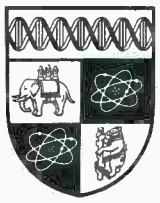
IMPERFECT COMPETITION AND MACROECONOMICS: A SURVEY

Huw Dixon* and Neil Rankin**

No. 387

WARWICK ECONOMIC RESEARCH PAPERS



DEPARTMENT OF ECONOMICS

UNIVERSITY OF WARWICK
COVENTRY

IMPERFECT COMPETITION AND MACROECONOMICS: A SURVEY

Huw Dixon* and Neil Rankin**

No. 387

November 1991

* Dept of Economics,
University of York,
York YO1 5DD

** Dept of Economics,
University of Warwick,
Coventry CV4 7AL

Contents

1. Introduction

The importance of imperfect competition has long been recognised in many areas of economics, perhaps most obviously in industrial economics and in the labour economics of trade unions. Despite the clear divergence of output and labour markets from the competitive paradigm in most countries, macroeconomics where it has used microfoundations has tended to stick to the Walrasian market-clearing approach. However, over the last decade a shift has begun away from a concentration on the Walrasian price-taker towards a world where firms, unions and governments may be strategic agents. This paper takes stock of this burgeoning literature, focusing on the macroeconomic policy and welfare implications of imperfect competition, and contrasting them with those of Walrasian models.

We seek to answer three fundamental questions. First, what is the nature of macroeconomic equilibrium with imperfect competition in output and labour markets? With monopoly power in the output market causing price to exceed marginal cost, and union power leading to the real wage exceeding the disutility of labour, we would expect imperfectly competitive macroeconomies to have lower levels of output and employment than Walrasian economies, a Pareto-inefficient allocation of resources, and the possibility of involuntary unemployment. Few would disagree that deviations from perfect competition will probably have undesirable consequences. Second, to what extent can macroeconomic policy be used to raise output and employment in an imperfectly competitive macroeconomy? Third, if policy can raise output and employment, what will be the effect on the welfare of agents?

Whilst there may be fairly general agreement over the answer to question one, we believe that there are no truly general answers to questions two and three. In Walrasian models there is only one basic equilibrium concept employed: prices adjust to equate demand and supply in each market. There are, however, many different types of imperfect competition, which can differ in fundamental respects, as has been seen in industrial organisation and the "new" international trade theory. Thus we would expect the theory of imperfectly competitive macroeconomies to embrace "classical" models, with monetary neutrality and a vertical aggregate supply curve, as well as "Keynesian" models. Friedman's concept of the Natural Rate (1968) allows for the fact that non-

Walrasian factors may lead to too little employment. Despite this, Friedman believes that (in the long run) both monetary and fiscal policy are ineffective. These features are shared by the empirical models of the Natural Rate developed in the 1980's for the U.K. by Layard and Nickell (1985, 1986).

Imperfect competition, however, opens the door to new channels of influence for both monetary and fiscal policy. Furthermore, there is more scope for an increase in output to have welfare-improving expansionary effects on the economy. The First Fundamental Theorem of welfare economics tells us that the Walrasian equilibrium is Pareto-optimal. With imperfectly competitive equilibria in output and labour markets, however, matters are different, since the market prices of output and labour may exceed their shadow prices. Hence policies that succeed in expanding output have the *possibility* of increasing welfare. The survey considers several cases where policy effects are very non-classical, and in stark contrast to Walrasian economies.

In Section 2 we present a general framework which nests much of the theoretical literature on imperfectly competitive macroeconomies, and enables us to explore the effects of imperfect competition on output and labour markets. In Sections 3 and 4 we explore monetary and fiscal policy respectively, concentrating on the mechanisms through which policy effects occur in an imperfectly competitive economy. In Section 5, we focus on the possibility of multiple Pareto-ranked equilibria and related coordination issues (for a more detailed survey of these, see Silvestre (1991)). We inevitably have been forced to omit several closely-related areas of potential interest, amongst which are the "mesoeconomic" approach developed by Ng (1980, 1982a, 1986); open-economy applications (these are surveyed in Dixon (1992b)); macroeconomic models of bargaining (MacDonald and Solow (1981), Jacobsen and Schultz (1990)); and the "insider-outsider" literature (Lindbeck and Snower (1989)).

2. A General Framework

The models constructed in much of the recent literature on imperfect competition have shared some common features. In this section we will outline a generic model of an imperfectly competitive economy that provides a baseline, and variants of which we will use in subsequent sections to derive particular results. The three main points we make in this section are (i) that imperfect competition in either output or labour markets will tend to reduce equilibrium output and employment, (ii) that the introduction of union wage-setting will tend to generate "involuntary" unemployment, and (iii) that the model will possess a (unique in this case) *Natural Rate*, with money being neutral. This section thus highlights the "classical" properties of imperfect competition, as a prelude to subsequent sections which will extend the framework to models with less classical effects for monetary and fiscal policy.

There are n produced outputs i = 1,...,n, the ith being X_i. Households derive utility from consuming output, from leisure, and from real money balances. In particular we assume that the utility function takes the form

$$[u(\mathbf{X})]^c[M/P]^{1-c} - \theta N^e \qquad 0 < c < 1, \quad e > 1 \qquad (2.1)$$

where u is a degree-one homogeneous subutility function, P is the cost-of-living index for u, M is nominal money holdings, and θN^e is the disutility of supplying N units of labour, $N \leq H$. Since preferences are homothetic over consumption and real balances we can aggregate and deal with one "representative" household. Most papers further simplify (2.1). Firstly, a specific functional form is assumed for $u(\mathbf{X})$ - notably Cobb-Douglas or CES. Secondly, the labour supply decision may be made a [0,1] decision - to work or not to work for each individual household. We can represent this for our aggregated household by setting e = 1, so that θ is the disutility of work. Most models of imperfect competition incorporate money using the standard temporary equilibrium framework (see Grandmont (1983) for an exposition) by including end-of-period balances in the household's utility function. Whether it should be deflated by the current price level as in (2.1) depends on the elasticity of price expectations, as we discuss in section 3.2 below.

Let us now consider the technology of firms in each sector. Let there be F firms in sector i, whose output X_{if} depends on employment N_{if} in that firm. The technology is log-linear:

$$X_{if} = B^{-1}N_{if}^{a} \quad a \leq 1 \tag{2.2}$$

The special case of constant returns with a = 1 is widely used. The main exception to (2.2) is in the menu cost literature where, following Blanchard and Kiyotaki (1987), each firm employs many differentiated labour types, of which output is a CES function.[1]

Given the basic assumptions about the household and firm, we have now to add the macroeconomic framework. Turning first to aggregate income-expenditure identities, income in each sector must equal expenditure Y_i on that sector, and national income must equal total expenditure Y. We will introduce fiscal policy in Section 4. In this section, let us suppose that the government merely chooses the total money supply M_0. In aggregate, the household's total budget consists of the flow component Y and the stock of money M_0. Given (2.1), households will choose to spend a proportion c of this on producer output (c is the marginal - and average - "propensity to consume") and to "save" a proportion 1-c to accumulate money balances M.[2] Hence the income-expenditure identities coupled with (2.1) imply that in aggregate:

$$Y = c[M_0 + Y]$$

$$Y = \frac{c}{1-c} M_0 \tag{2.3}$$

Given total expenditure, households allocate expenditure across the produced goods. Since preferences are homothetic, the budget share of output i, α_i, depends only on relative prices. Hence total expenditure on sector i, Y_i, is given by:

$$P_iX_i \equiv Y_i = \alpha_i(\mathbf{P})Y \tag{2.4}$$

---

[1] A quite common simplification of the above separate treatment of households and firms is to assume a single type of agent (the "farmer") who produces output using only his own labour as an input. This is used for example in Blanchard and Fischer (1989, Ch.8) and Ball and Romer (1989,1990,1991), and has the advantage that the model reduces to one in a single type of market - namely for goods, with the labour market being suppressed.

[2] Replacing the Cobb-Douglas form for sub-utility over aggregate consumption and money by a more general homothetic form makes no difference to the constancy of c, *unless* a different deflator for M is used. This becomes important in models with non-unit-elastic expectations: see section 3.2.

where α_i is homogeneous of degree zero in the vector of prices **P**. We will assume symmetric preferences, so that if all prices of outputs are the same then $\alpha_i = 1/n$.

Given the basic micro and macroeconomic framework of the economy, how are wages and prices determined? As a benchmark let us consider the Walrasian economy with price-taking households and firms. Furthermore, let us assume perfect mobility of labour across sectors, so that there is a single economy-wide labour market and wage W. The labour supply from (2.1) is then:

$$N^s(W/P) = [\theta e]^{1/[1-e]}[W/P]^{1/[e-1]} \qquad (2.5)$$

So 1/[e-1] is the elasticity of labour supply with respect to the real wage. The additive separability combined with degree-one homogeneity of (2.1) rules out any wealth effect on labour supply, so that only real wages matter.

Assume a single, representative, price-taking firm per sector[3]. Then sector i's labour demand takes the form:

$$N^d(W/P_i) = [a/B]^{1/[1-a]}[W/P_i]^{-1/[1-a]} \qquad (2.6)$$

where -1/[1-a] is the elasticity of labour demand with respect to the real wage. In a symmetric equilibrium where $P_i = P$, (2.5)-(2.6) determine equilibrium real wages, employment and output in the representative sector. Equilibrium sectoral output X* is given by $B^{-1}[N^*]^a$, and under symmetry $\alpha_i = 1/n$ in (2.4) so that the nominal price level is

$$P^* = \frac{c}{1-c}\frac{M_0}{nX^*} \qquad (2.7)$$

Nominal wages and prices adjust to equate aggregate demand with equilibrium output. This is an entirely "classical" model with full employment and neutral money.

What difference does the introduction of imperfect competition make to this basic model? Let us assume that each output is monopolised by a sole producer (F = 1) and that there are many sectors. The large "n" means that the monopolist treats the general price index P as exogenous

---

[3] So formally F=1 but perfect competition is imposed by the assumption of price-taking: this enables a comparison with the monopoly case below which is not distorted by different numbers of production units.

when it makes its decisions. Before we proceed, it should be noted that the elasticity of demand $\varepsilon_i(\mathbf{P}) \equiv [-\partial \ln X_i / \partial \ln P_i]_{P \text{ const.}}$ from (2.4) is homogeneous of degree zero in prices, due to homotheticity. In a symmetric equilibrium, $\varepsilon_i(\mathbf{P})$ will thus take the same value irrespective of the price level: $\varepsilon^* \equiv \varepsilon(\mathbf{1})$. We will assume gross substitutability in general, so that $\varepsilon^* > 1$. If the individual firm maximises its profits treating the general price level as given, then its labour demand is easily obtained as:

$$N^{dm}(W/P_i) = [1-1/\varepsilon^*]^{1/[1-a]}[a/B]^{1/[1-a]}[W/P_i]^{-1/[1-a]}$$

$$= [1-1/\varepsilon^*]^{1/[1-a]} N^d(W/P_i) \qquad (2.8)$$

Since $\varepsilon^* > 1$ and $a < 1$, labour demand is smaller for any given real wage, as we would expect . Equilibrium under symmetry is depicted in Figure 1:

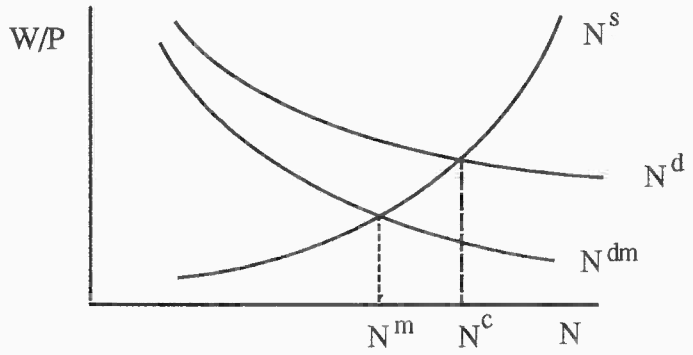


Figure 1

For a given labour supply curve, in a symmetric equilibrium the effect of monopolistic competition is simply to reduce sectoral employment (and hence output) from N^c to N^m. Note that money will still be neutral, since (2.5) and (2.8) are both homogeneous of degree zero in (W,P). The degree of monopoly μ is $\mu = 1/\varepsilon^*$. So the less elastic is demand when prices are all equal, the higher the marking-up of price over marginal cost and the lower equilibrium output. Imperfect competition in the output market has thus reduced total output and employment, although (since the labour market is competitive) households are on their labour supply curve N^s.

How will the introduction of unions alter matters? To take the simplest case, consider an economy-wide monopoly union that has the unilateral power to set the nominal wage. In effect, the union will be able to predict, given the wage it has set, what prices will be set by firms and the resultant level of employment.[4]. At the aggregate level, the trade-off between real wages and employment faced by unions in a symmetric equilibrium is given by (2.8) multiplied up by the number of sectors n. There are several assumptions made about possible union preferences in the literature (see, e.g., Oswald (1985)). Here we will simply assume that the union's objective function is to maximise the total surplus, or wage revenue less disutility, earned by employed workers.[5] If we let e = 1, then there is a constant marginal disutility of labour θ. Each employed worker earns W/P - θ as surplus. The union's problem can then be seen as that of solving

$$\max_{W/P} \quad [W/P - \theta]N \tag{2.9a}$$

$$\text{s.t.} \quad N = N^{dm}(W/P) \tag{2.9b}$$

Since the elasticity of labour demand with respect to W/P is constant in (2.8), the solution to (2.9) has the property that the union chooses the real wage as a constant mark-up over θ:

$$W/P = \theta/a \tag{2.10}$$

This is depicted in Figure 2, where we show the union's maximum utility indifference curve U*.

---

[4] When there is a centralised union, we assume that firms' profits are received by a separate rentier class of household which entirely consumes them. If the union receives them, it would effectively control the whole economy and so would obviously choose the first-best, competitive outcome.

[5] This is consistent with the maximisation of household's utility (2.1) if there is equal rationing of workers. With all-or-nothing rationing and random selection it is consistent with expected utility maximisation if e = 1, since (2.1) then exhibits risk-neutrality.

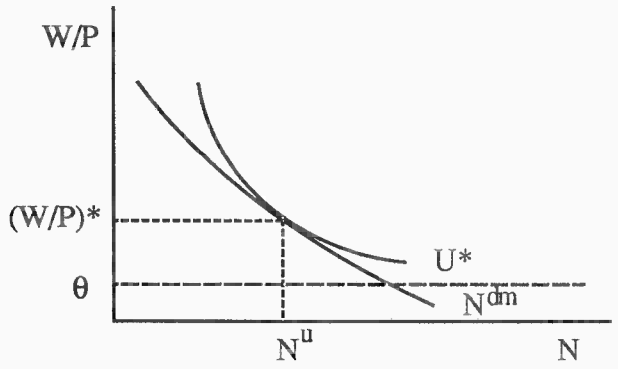


Figure 2

Note that the less elastic is the demand for labour (the lower is a) the higher is the wage set by the union. Since with this model the monopolistic and competitive firms have the *same* real-wage elasticity of labour demand, the real wage chosen by the union is the same, though employment is lower with monopolistic firms. Again, since (2.10) is homogeneous of degree zero in (W,P) money is neutral here: equilibrium in the labour market will determine output, employment and the real wage, whilst nominal wages and prices simply adjust so that given M_0 the demand equals the supply of output, as in (2.7). This model illustrates the point that the introduction of wage-setting unions leads to involuntary unemployment. Since the union marks up the wage over the disutility of labour (from (2.10)), the unemployed households are worse off than the employed, and furthermore the employed would be willing to work more for less. Since the union is often taken to represent all of the labour force (employed and unemployed), this has sometimes been dubbed "union-voluntary" unemployment.

Now let us turn to the case of *sectoral* unions. Sectoral unions provide one reason for different wages in each output sector. The union is assumed to be able to control entry into employment in that industry so that employed "insiders" are isolated from the potential competition of "outsiders" (see Lindbeck and Snower (1989) for a discussion). Taking the case of a large economy with many sectors, each individual union will take the general price level of goods consumed by its members as given (in contrast to the centralised union) and in a non-cooperative

Nash framework it will also treat other sectoral unions' wages as given. However, each union will take into account the effects of its wages on the own-sector price P_i and hence on output and demand for labour in its sector. The sectoral labour demand curve is thus essentially a relation between *nominal* wages W_i and employment, rather than real wages W_i/P. This is because the firm bases its employment on the own-product wage W_i/P_i, in contrast to the union's objective function which depends on the real consumption wage W_i/P.[6]

Consider the elasticity of the sectoral unions' demand for labour with respect to W_i. The labour-demand equation stems from the price-cost equation which equates the own-product wage to the marginal revenue product of labour:

$$\frac{W_i}{P_i} = \frac{\varepsilon}{\varepsilon-1} a N_i^{-[1-a]} \tag{2.11a}$$

If we take logs and differentiate with respect to W_i, taking into account that P_i depends upon X_i which depends upon N_i, we obtain the money-wage elasticity of labour demand as:

$$-\frac{d \log N_i}{d \log W_i} = \frac{1}{1 - a + a[1-\eta]/\varepsilon} \tag{2.11b}$$

where η is the elasticity of $[\varepsilon-1]/\varepsilon$ with respect to P_i, which captures the effect of a rise in W_i (and hence P_i) on the mark-up $[\varepsilon-1]/\varepsilon$. This can take either sign, although it is perhaps more reasonable to assume that $\partial\varepsilon/\partial P_i > 0$ (demand becomes more elastic as you raise price), so that $\eta > 0$ (the mark-up falls as W_i rises). If the sectoral union maximises its surplus (2.9a) with respect to W_i, subject to the labour demand implicitly defined by (2.11), the equilibrium real wage (given symmetry across sectors) is:

$$\frac{W}{P} = \frac{\theta}{a} \frac{\varepsilon^*}{\varepsilon^* - 1 + \eta} \tag{2.12}$$

---

[6] However, one of the best-known models with sectoral unions does not fit this pattern. In Hart (1982) consumers are able to buy output only in one sector, so one sector's output is neither a gross complement nor gross substitute for another's and the money-wage elasticity of labour demand is not affected by having sectoral rather than centralised unions.

This is a higher real wage than with the centralised union (cf. (2.10)) so long as $\eta < 1$. Note that, as is easily shown, if utility is CES then $\varepsilon(P)$ is equal to the constant elasticity of substitution itself, so $\eta = 0$ and the comparison of (2.12) with (2.10) is unambiguous.

Thus, the sectoral union tends to set a higher wage, with a consequent lower level of employment. This is despite the fact that the money wage elasticity of its labour demand is likely to be higher than for a centralised union.[7] The reason is that it sees no effect of its own behaviour on the general price level P at which its members consume. A centralised union takes the general rise in P which it causes into account, and so restrains its wage pressure. This can also be seen as an example of *externalities*: the price rise caused by a sectoral union is mostly borne by members of other unions. For a detailed discussion of the effect of different union structures on wage determination, see Calmfors and Driffill (1988).

An alternative to sectoral unions.- which are organised by industry.- are craft unions, which are organised by labour skills. Blanchard and Kiyotaki's (1987) model has a labour market of this type. Suppose each union sells a different kind of labour, some of which is required by every firm. Each firm's production function has the CES form:

$$X_i = [\Sigma_{h=1}^{H} N_{ih}^{[\sigma-1]/\sigma}]^{a\sigma/[\sigma-1]} \qquad \sigma > 1 \tag{2.13}$$

Since the number of labour types is large, each W_h is assumed to have a negligible effect on the general index of wages W. Thus no union sees itself as having an effect on any firm's output, and the firm's demand for N_{ih} is obtained by minimising the cost of producing a given output X_i:

$$N_{ih} = k_n[W_h/W]^{-\sigma}X_i^{1/a} \qquad k_n = \text{const.} \tag{2.14}$$

Blanchard and Kiyotaki further assume increasing marginal disutility of work, i.e. $e > 1$ in (2.1), so that the union's surplus is[8]:

$$[W_h/P]N_h - \theta N_h^e \tag{2.15}$$

---

[7] This is true if goods are gross substitutes: a rise in W_i and thus P_i will cause consumers to switch to other goods j, something which would not happen if all goods' prices rose together.

[8] Here, we need to think of each household as constituting a separate union

Maximising (2.15) subject to (2.14) (aggregated over all i) taking W and $X_1,...,X_n$ as given, union h's labour supply is:

$$N^{sm} = [1-1/\sigma]^{1/[e-1]}[\theta e]^{1/[1-e]}[W_h/P]^{1/[e-1]}$$

$$= [1-1/\sigma]^{1/[e-1]}N^s(W_h/P) \qquad (2.16)$$

Since $\sigma > 1$, labour supply is smaller for any given real wage than in the competitive case (2.5), as we would expect. Combining (2.16) with (2.8), equilibrium under symmetry amongst firms and unions is depicted in Figure 3:

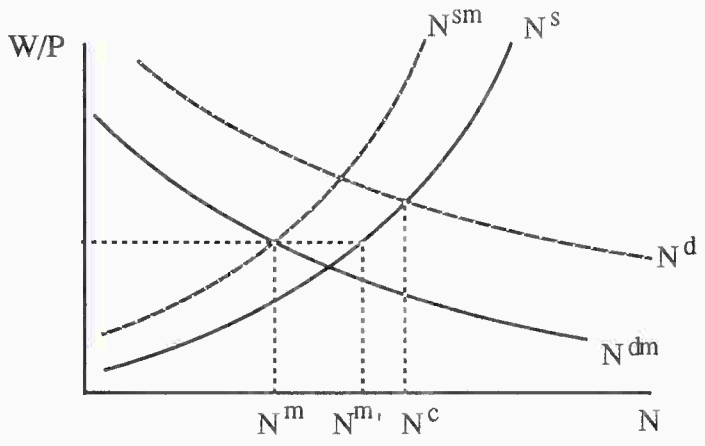


Figure 3

Whether the real wage is above or below the competitive level now depends on whether unions' or firms' monopoly power is the stronger. Money is clearly still neutral.

In this section we have presented a simple general framework that captures some common features of much of the recent work on imperfect competition and macroeconomics. We have illustrated the framework by outlining and contrasting three different models with nominal wage- and price-setting under centralised and sectoral unions. We will now proceed to see how extensions of this general framework will yield less orthodox results.

3. Monetary Policy

Imperfect competition by itself does not create monetary non-neutrality, as we have already seen in Section 2.[9] It is the *combination* of imperfect competition with some other distortion[10] which generates the potential for real effects of monetary policy. The nature of this other distortion provides us with a natural method for classifying models of monetary policy effectiveness. First, the largest part of the literature combines imperfect competition with small lump-sum costs of adjusting prices ("menu" costs), which are intended to represent the administrative costs of printing new price lists, etc. Examples of this approach are Mankiw (1985), Akerlof and Yellen (1985a), Blanchard and Kiyotaki (1987), Benassy (1987), Caplin and Spulber (1987), Ball and Romer (1989,1990,1991). A second group of papers may be interpreted as taking the same general framework of imperfect competition in a monetary temporary equilibrium, but as relaxing an implicit assumption often unconsciously made there: namely, that of unit-elastic expectations of future with respect to current prices. These include the seminal paper of Hart (1982) and applications and extensions by Dehez (1985), D'Aspremont *et al* (1989, 1990), Silvestre (1990), Rankin (1988) and Jacobsen and Schultz (1989). Thirdly, papers by Dixon (1990b, 1992a), Fender and Yip (1990) and Moutos (1991) look at the impact of imperfect competition combined with a small nominal rigidity in some sector of the economy. Common to all three approaches is that the same distortions in the presence of perfect competition would not cause monetary policy to affect output significantly. It is the *interaction* between minor, and perhaps intrinsically uninteresting, distortions and imperfect competition which generates major departures from neutrality. This can be viewed as an instance of the theory of the second best at work: monetary policy is not capable of causing Pareto improvements given either imperfect competition or the other distortion on its own, but given both together, it is.

---

[9] This point was not recognised in some early literature, which tended to regard any situation in which agents face downward-sloping demand curves as generating ipso facto demand management effectiveness. A simple fallacy is to argue that a money supply increase shifts outwards agents' demand curves causing them to raise output, forgetting that in a general equilibrium context cost curves will shift up too, exactly offsetting the output increase. In several papers, Ng (1980,1982a,1982b,1986) claims that imperfect competition breaks the classical dichotomy despite this, but his argument in fact rests on proving the existence of a local continuum of equilibria: see the interchange with Hillier, Lambert and Turner (1982). The clearest statement of the need for distortions in addition to imperfect competition is in Blanchard and Kiyotaki (1987)

[10] "Distortion" is not an ideal term because not all the extra factors we consider are necessarily sources of failure to achieve Pareto optimality in a competitive economy, although they could be.

(i) Menu costs

We take Blanchard and Kiyotaki's (1987) model for our illustration, though the central ideas appear first in Mankiw (1985) and Akerlof and Yellen (1985a), and very similar points were simultaneously made by Benassy (1987). An early version of the Blanchard-Kiyotaki model is acknowledged by Layard and Nickell as providing the framework for their influential empirical studies of U.K. unemployment (Layard and Nickell (1985,1986)). The model in the absence of menu costs has already been described in Section 2. Suppose now that the price- and wage-setting agents face administrative costs of changing prices and wages (e.g. for a restaurant, the cost of reprinting its menus). Such costs are lump-sum in nature: they do not depend on the size of the price or wage change. If they are sufficiently large to outweigh the foregone profits or utility of not adjusting a price or a wage when a shock such as an increase in the money supply hits, the firm or union still has to decide whether to meet the increase in demand, or whether to ration it. This is where monopoly is important: since price exceeds marginal cost and wage exceeds marginal disutility in the initial equilibrium, firms and unions will prefer to *satisfy* the extra demand (up to a point), since a profit or surplus is made on every extra unit sold. This is illustrated in Figure 4, where the shaded area indicates the increase in the firm's profits or the union's utility:

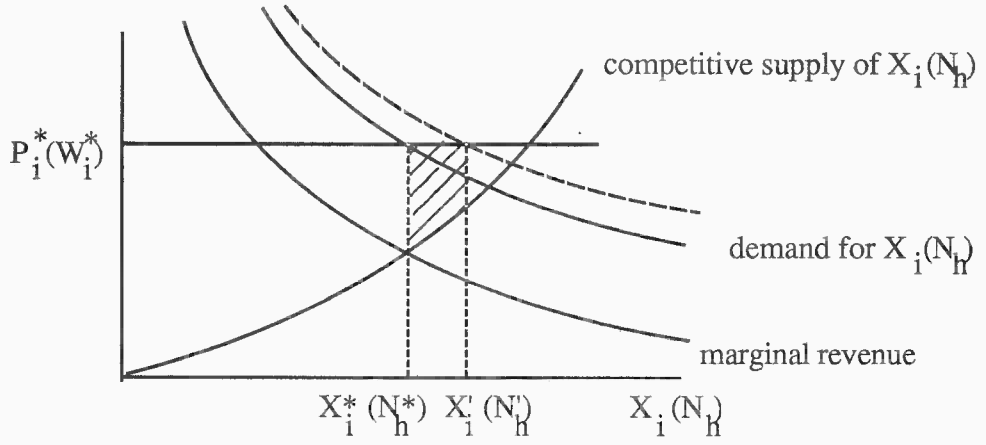


Figure 4

By contrast, under perfect competition, the price (wage) equals marginal cost (disutility) initially, and the firm (union) would lose profits (utility) if it satisfied an increase in demand, and so would choose to ration its customers.[11]

Once general equilibrium spillover effects have been taken into account, the size of the horizontal shift in the goods demand curves, and hence the size of the increase in output, will be in percentage terms equal to the increase in the money supply. This may be seen from the macroeconomic aggregate demand function (2.3), whence, together with the goods demand function (2.4) and the labour demand function (2.14), we may derive the multipliers:

$$\frac{d \log X}{d \log M_0} = 1 , \qquad \frac{d \log N}{d \log M_0} = 1/a \tag{3.1}$$

Although Figure 4 is a partial equilibrium diagram in which the position of the marginal cost (disutility) curve depends on the general wage (price) index, these two indices may validly be assumed unchanged provided menu costs are binding for all agents. Hence no shift in the curve is needed to depict the new general equilibrium.

The limit of the possible increase in employment and output (always given large enough menu costs) is reached when demand equals the competitive supply in either market. Beyond this, even monopolistic agents will choose to ration any further increase. Whether the limit is first hit in the goods or labour market depends whether the real wage is above or below its Walrasian level (respectively). In Figure 3, for example, the maximum employment level as M is increased occurs at $N^{m'}$, where the supply constraint in the labour market becomes binding. This brings out the formal similarity between the monopolistic menu cost equilibrium and the "disequilibrium" models of the 1970's (Barro and Grossman (1971), Benassy (1975), Malinvaud (1977), et al. - see Benassy (1990) for a recent survey). Within the class of equilibria for which menu costs bind, the economy behaves exactly as if it were in a quantity-constrained equilibrium.[12] In particular, within

---

[11] Jones and Stock (1987) claim that imperfect competition is not necessary for the result. They assume "near rationality", following Akerlof and Yellen (1985a,b). Behaviour is "near-rational" if the foregone utility or profits is less than some small fixed amount. If the failure of rationality is a failure to adjust prices optimally, then this is formally equivalent to menu costs. However, Jones and Stock assume it takes the form of a "rule of thumb" in which competitive firms increase output whenever demand increases, which is clearly different from the notion of menu costs.

[12] The formal similarities are explored in depth in Madden and Silvestre (1988).

the neighbourhood of the initial frictionless equilibrium, it behaves as if in a regime of generalised excess supply, or "Keynesian unemployment". Big increases in the money supply will shift it into a regime of "repressed inflation" (Figure 3) or "classical unemployment", depending on whether labour or goods supply constraints are reached first. This similarity between excess supply and monopoly was first exploited by Benassy (1976, 1978) and Negishi (1979) as a means to "endogenise" prices in disequilibrium models. Their models however use the concept of "subjective" demands, introduced by Negishi (1961), rather than the "objective" demands used here.

Note that the increase in output also constitutes a Pareto improvement. This is for three reasons: first, the shift in demand for labour brings a utility gain to the household equal to the shaded area in the diagram; second, households receive an increase in profits from firms; and third, real money balances increase, which increases households' utility directly. An interesting interpretation of the Pareto sub-optimality of the initial monopolistic equilibrium is to view it as resulting from a lack of cooperation amongst price-setting agents. Benassy (1987) and Blanchard and Kiyotaki (1987) both point out that an agreement by all firms and households simultaneously to lower their prices and wages by x% would produce the exact same real reallocation as is achieved by a money supply increase of x% in the presence of binding menu costs. In either case real balances, and thus real demand and output, rise by x%, with no relative price changes. Monetary policy can thus be seen as a substitute for a cooperative agreement to lower prices. The failure to lower prices when acting independently is explained by Blanchard and Kiyotaki as due to an "aggregate demand externality"[13] : a lowering of one agent's price benefits all others to the extent that it slightly reduces the general price index and so raises real money balances and aggregate demand[14] . However the private gain to the price cutter is outweighed by the private loss due to the too-low relative price which would result. The monopolistically competitive equilibrium is therefore a form of economy-wide "Prisoner's Dilemma". In the absence of menu costs, when

---

[13] Clearly a "pecuniary" rather than a "technological" externality. The term "externality" is misleading insofar as pecuniary externalities are not usually held to cause market failure: the underlying source of the market failure here is of course just the imperfect competition itself.

[14] The *total* effect of a fall in P_j (W_h) on firm j's (union k's) welfare is negative because he is undercut by a rival, but these relative price effects cancel out when *all* prices and wages are reduced.

to expand the money supply would have no beneficial effect, a welfare-enhancing measure would be to impose an all-round wage and price cut by a prices and incomes policy.

Before the menu cost model can be taken seriously, it must tackle the obvious objection that in practice administrative costs of price and wage adjustment are very small relative to total production and disutility costs. Note that once they are dominated by the foregone profits or utility of not re-optimising in the face of a money supply increase, then such costs will have no effect at all on the new equilibrium. An agent who has decided to adjust her price will want to adjust it to the same level as in the absence of any menu costs, since the cost depends on the fact of the adjustment and not on its size.[15] Consequently, a large part of the research into menu costs has been concerned with overcoming this objection. The key observation is provided by Akerlof and Yellen (1985a) and Mankiw (1985), who point out that the opportunity cost of non-adjustment is second-order in the size of the money supply shock. That is, if we take a Taylor approximation to firm i's foregone profits of not increasing P_i, or to union h's foregone utility of not increasing W_h, it will contain no term in ΔM_0, only in $(\Delta M_0)^2$ and higher powers of ΔM_0. (We explain this shortly.) By comparison, the increase in output is first-order, as is clear from (3.1). Thus, the ratio of the critical size of menu cost necessary for non-adjustment, to the change in output which it sustains, tends to zero as ΔM_0 tends to zero. For finite but small changes in the money supply, it follows that only a very small menu cost may be required in order to sustain non-adjustment. One of Blanchard and Kiyotaki's numerical examples shows, for instance, that with a 5% money supply increase and values of 5, 1.6, and 0.8, respectively, for the two elasticities of substitution (in preferences and technology), e and a, the minimum menu cost for firms to prefer non-adjustment is equal to only 0.018% of total revenue, and for households is equal to only 0.112% of total consumption.

The claim that the opportunity cost is second-order in the size of ΔM_0 may easily be demonstrated. Let firm i's maximised profits (the case of a union is exactly similar) in the absence of menu costs be:

---

[15] If the cost were assumed to be increasing in the size of the adjustment, as in Rotemberg (1982), this would not be true; but administrative costs cannot realistically be argued to take this form

$$\Pi^*_i(P,W,M_0) \equiv \max_{P_i} \Pi_i(P_i,P,W,M) \tag{3.2}$$

Then, assuming other firms and unions do not adjust their prices and wages, a first-order Taylor approximation to the change in Π^*_i due to a small finite change ΔM_0 is:

$$\Delta\Pi^*_i \approx \left[\frac{\partial\Pi_i}{\partial M_0} + \frac{\partial\Pi_i}{\partial P_i}\frac{\partial P_i}{\partial M_0}\right]\Delta M_0 = \frac{\partial\Pi_i}{\partial M_0}\Delta M_0 \tag{3.3}$$

where derivatives are evaluated at the pre-shock equilibrium. The second term in [.], which represents the opportunity cost of not adjusting P_i, is zero: $\partial\Pi_i/\partial P_i = 0$ at the old optimum since the firm is by definition maximising profits there. This demonstration is just an application of the "envelope theorem", which says that the derivative of a maximised function with respect to an exogenous parameter equals the derivative of the non-maximised function. Its intuitive explanation is simply the observation that "objective functions are flat on top".

Although small menu costs can support large non-neutralities, the same costs may also be consistent with a neutral outcome. The above calculations of opportunity cost assume other firms keep their prices fixed. If we instead assume they raise them, the opportunity cost to firm i is greater, since her demand curve will shift out still further as consumers try to substitute into good i. Suppose it now exceeds her menu cost and so she raises too. This makes it slightly more likely, by a symmetric argument, that the others' rise was the profit-maximising strategy. From this it can be shown that, for menu costs in a certain range, there are two possible equilibria: one with complete adjustment and one with none. The issue of multiple equilibria is taken up again in Section 5. Here we simply note that they make it possible to argue, as Ball and Romer (1991) do, that nominal rigidity is in part due to a coordination failure. If each firm believes that the others will do nothing when the money supply increases, then it will prefer to do nothing as well; but if it believes others will raise prices, then it will raise too.

Ball and Romer (1989) extend the analysis just described to consider whether the combination of imperfect competition and small menu costs can explain large welfare losses arising from a positive *variance* of the money stock, and thus of output. The money stock is assumed to

have a known probability distribution, and the welfare cost of price rigidity, measured as the fall in expected utility, is compared to the private cost. They find that the welfare cost, as well as the private cost, is now second-order (i.e. proportional to the variance of money supply shocks). Although this removes one major reason why small menu costs could explain large welfare losses due to risk aversion in the face of output fluctuations, they nevertheless show that parameter values exist which drive the ratio of second-order menu costs to second-order welfare losses to zero.[16]

A problem with the basic menu cost model is that, although theoretically plausible parameter values exist which will keep the menu costs necessary to support non-neutrality small, these values are nonetheless still unrealistic empirically. The lowest value of competitive labour supply elasticity used in Blanchard and Kiyotaki's illustrative calculations is 1.67 (1/[e-1]), which is still much higher than most econometric estimates. In a second paper, Ball and Romer (1990) suggest a solution by showing that rigidities in nominal prices are made more likely if there are also rigidities in real, or relative, prices. Their general argument is as follows. Suppose agent i has the indirect utility function:

$$U_i = W(M_0/P, P_i/P) \tag{3.4}$$

Agents in the model are "farmers".[17] i's optimum relative price is clearly determined from the first-order condition $W_2(M_0/P,P^*_i/P) = 0$ ("2" denoting a partial derivative), whence

$$\partial(P^*_i/P)/\partial(M_0/P) = \underset{(+)}{-} \frac{W_{12}}{\underset{(-)}{W_{22}}} \quad (\equiv \pi, \text{ say}) \tag{3.5}$$

If a change in aggregate demand causes only a small change in i's desired relative price, real rigidity is said to be "high", so π is an inverse measure of it. The second-order approximation to i's private utility cost of not adjusting P_i after a change ΔM_0, given that others do not adjust, is

$$PC \approx [-(W_{12})^2/2W_{22}][\Delta M_0]^2 = [1/2]\pi W_{12}[\Delta M_0]^2 \tag{3.6}$$

---

[16] It would seem to be a limitation of Ball and Romer's analysis that risk aversion is only present in their model incidentally. They use the utility function from Blanchard and Kiyotaki's deterministic model without any modification: there is no separate risk aversion parameter; risk aversion simply happens to be be present in the utility function due to the assumption of increasing marginal disutility of work (e > 1).

[17] See footnote 1

Thus the smaller is π, i.e. the greater the real rigidity, the smaller is the menu cost needed to ensure i does not adjust his price. Ball and Romer flesh out this simple framework with two explicit models of real rigidities: a "customer market" model in which firms face kinked demand curves due to ignorance by their customers of prices elsewhere; and a model with an "efficiency wage" in the labour market.[18] Hence by combining *three* "distortions" - imperfect competition, menu costs and real rigidities - an empirically plausible model of non-neutrality can be obtained.[19]

The menu cost models described so far are all static. It is natural to ask how the results would be modified in a dynamic setting, which would permit a sequence of monetary shocks to be considered, and in addition would permit agents to experience idiosyncratic shocks so that they would not start in identical positions relative to their optimum prices. Early dynamic models of imperfect competition with menu costs, but without a focus on monetary non-neutrality, were constructed by Barro (1972) and Shesinski and Weiss (1977, 1983). A feature of such models when compared with the orthodox staggered wage contract models of Fischer (1977) and Taylor (1979), and one which is discussed in depth by Blanchard and Fischer (1989, Ch.8), is that the rules for price- and wage-setting are "state-dependent" rather than "time-dependent". An agent changes his price when it has become too far distant from the optimum, rather than changes it at predetermined dates. In general the optimal rule will take an (Ss) form, in which an adjustment is made when the deviation of P_i from the optimum P_i^*, $P_i^*-P_i$, hits a ceiling S or a floor s. $P_i^*-P_i$ is restored to an upper or a lower return point, Z or z. Models of this type smooth the abrupt switch from non-neutral to neutral behaviour exhibited in the static models as the size of the money supply shock is increased. By allowing a distribution of initial deviations $P_i^*-P_i$ across otherwise identical agents, decisions as to whether or not to adjust are not all the same, and thus partial adjustment of the aggregate price level is observed.

The main results on non-neutrality so far derived in such a framework are by Caplin and Spulber (1987) and Caplin and Leahy (1991). When the stochastic money supply process

---

[18] This is almost identical to Akerlof and Yellen (1985a), who however do not comment on the help which efficiency wages give towards keeping opportunity costs small

[19] Again, "distortion" may be a misleading label for certain kinds of "real rigidities", since on Ball and Romer's definition they could consist of no more than, for example, highly elastic labour supply; yet it is clearly appropriate for those which derive from, for example, imperfect information.

involves only non-negative increments in the money stock, surprisingly, money turns out to be neutral in the aggregate (Caplin and Spulber, 1987). The intuitive explanation for this is that the cross-section distribution of price deviations, $P_i^*-P_i$, across agents at a point in time is uniform, and an increase in M, by causing those agents with high initial values of $P_i^*-P_i$ to adjust, pushes a number of them in exact proportion to the rise in M off the top of the distribution. They are brought in again at the bottom, preserving the shape of the distribution and raising the mean P_i in proportion to M. If the money supply process is instead symmetric, so that negative increments are just as likely as positive ones, then the distribution is non-uniform and shocks do affect aggregate output (Caplin and Leahy, 1991). The effects depend on the initial value of output within a band: towards the edges of the band, monetary shocks in the direction away from the centre become progressively less effective. These models employ a stylised version of the Blanchard-Kiyotaki microfoundations: imperfect competition is only present in the background, and household optimisation is not explicit. Still on the research agenda are the difficult tasks of employing more general money supply processes and incorporating the effects of expectations of future prices and incomes on current demands.

(ii) Non-unit-elastic price expectations

It has been well known since the work of Patinkin that in temporary equilibrium models a necessary condition for money to be neutral is that expectations of future prices should be unit-elastic in current prices (Grandmont (1983) provides an excellent modern discussion). This is what motivates the use of real rather than nominal balances (or any more general specification) in the utility function in the models considered so far, where the focus was on menu costs as the source of non-neutrality.[20] The models of the present sub-section, all of which derive from the seminal article by Hart (1982), instead generate policy effectiveness by combining imperfect

---

[20] To see the relationship between expectations elasticity and the way money enters utility in the simplest possible manner, suppose there is a single future period and no future income. Then expected future consumption is $X^e = M/\varphi(P)$, where M is the consumer's money balances at the end of the current period, and $\varphi(P)$ is his subjective expectation of the future price P^e as a function of the current price. If utility u is defined over (X,X^e), we then have an indirect utility function with the general form $u(X,M/\varphi(P))$. Two obvious benchmark cases are (i) unit-elastic expectations, where $\varphi(P) = \varphi_1 P$ (φ_1 = constant), which, subsuming the constant, yields u(X,M/P); (ii) zero-elastic expectations, where $\varphi(P) = \varphi_0$ = constant, which yields u(X,M).

competition with (implicitly or explicitly) non-unit-elastic expectations. Possible justifications for such an expectations assumption will be discussed in due course. We also take this opportunity to discuss the work of D'Aspremont et al. (1989) and others, showing how non-unit-elastic expectations can cause imperfect competition in *goods* markets to result in unemployment.

In a Walrasian setting, non-unit-elastic expectations produce only minor and relatively uninteresting non-neutralities. This is obvious if we consider models with an exogenous competitive labour supply: perfect competition in the labour market ensures full employment and thus exogenous output, so that the only effect of changing the money stock is on the distribution of output amongst consumers (and in a multi-sector framework, maybe also on its composition). In this sense non-unit-elastic expectations constitute a "small" distortion, as do menu costs. However, combined with imperfect competition they have a similar potential for producing large non-neutralities.

The first model to use, albeit implicitly, the non-unit-elastic expectations assumption was that of Hart (1982). Hart assumes that household utility is defined over consumption of a produced and of a non-produced good, where the latter is in fixed supply. A non-produced good can clearly be interpreted as "money" if it is also assumed that price expectations are zero-elastic[21] , though Hart himself hesitates to make this interpretation. Goods and labour markets are taken to be Cournot oligopolies, with households being grouped into trade unions whose objective is to maximise the utility of a representative member. Since leisure provides no utility, this yields the function (2.9a) with $\theta = 0$, i.e. wage revenue maximisation. Hart assumes there are many separated, but identical, local goods and labour markets. The total number of firms and households in the economy is fixed, but by grouping firms into more product markets, and households into fewer unions per labour market, monopoly power can be parameterised. Agents are exogenously assigned each to a single market such that firms in the same product market are also in the same labour market, while households in the same labour market are distributed evenly across product markets. These assumptions are made to avoid "feedback effects", so justifying firms in taking customers' incomes as given, and unions in taking members' consumption prices

---

[21] See the preceding footnote

as given, when making their strategic choices. . However they also imply, as we will see, that consumers' elasticity of price expectations is one of the factors determining the elasticity of demand faced by firms and thus, at one further remove, the elasticity of demand faced by unions. Without this money would be neutral. Hart shows, first, that there exists an imperfectly competitive equilibrium (symmetric across the local markets) in which employment is less than the exogenous labour supply, and, second, that in it the price level is fixed independently of the money stock. This surprising "Keynesian feature" implies that increases in money proportionally increase output.

To demonstrate the result, we consider a simplified case in which the goods market is perfectly competitive and there are constant returns to labour (a = B =1). We need to modify the household's decision problem somewhat relative to Section 2, such that it is now:

$$\text{maximise} \quad u(X, M/P^e) \quad \text{s.t.} \quad M_0 + Y = PX + M \tag{3.7}$$

with $P^e = \phi(P)$ as the subjective expectations function. The differences from (2.1), apart from dropping disutility of work, are that consumption is now a scalar, expectations are no longer implicitly imposed to be unit-elastic, and that utility over current consumption and real balances (proxying for future consumption) is no longer constrained to be Cobb-Douglas, though we continue to assume that it is homothetic. We thus obtain a demand for goods function of the form:

$$X = \alpha(P/P^e)\frac{M_0 + Y}{P} \tag{3.8}$$

In calculating the elasticity, the dependence of P^e on P via $P^e = \phi(P)$ is taken into account, yielding:

$$\varepsilon(P) \; (\equiv -\partial \ln X/\partial \ln P) = 1 - \varepsilon_\alpha(P/P^e) + \varepsilon_\alpha(P/P^e).\varepsilon_\phi(P) \tag{3.9}$$

where $\varepsilon_\alpha, \varepsilon_\phi$ are the elasticities of the functions α, ϕ, respectively.

With a competitive goods market, and constant returns to labour such that X = N, we have P = W and the demand for labour derived from (3.8) is:

$$N = \alpha(W/\phi(W))\frac{M_0 + Y}{W} \tag{3.10}$$

This is the demand faced by the r unions in a typical labour market. Unions take local consumers' income Y as exogenous, since it is earned at other locations. Under the Cournot assumption, the kth union treats the labour supply of the other r-1 unions, N', as given, and so solves:

$$\text{maximise} \quad WN_k \quad \text{s.t.} \quad N_k + N' = N, \quad N_k \leq H$$

At an interior (unemployment) solution where each union supplies (1/r)th of the market, we then have:

$$\varepsilon(W) = 1/r \tag{3.11}$$

Note that equation (3.11) defines W, and thus P, independently of M_0. This is Hart's price rigidity result: an increase in M_0 does not affect P. It therefore raises output and employment proportionally: this may be seen directly by imposing symmetry across local goods markets and so setting $Y = PX$ [22] in (3.8), enabling us to solve for X as:

$$X = \frac{\alpha(P/P^e)}{1 - \alpha(P/P^e)} \frac{M_0}{P} \tag{3.12}$$

(analogously to (2.3)).

Unlike in the menu cost model, price rigidity here comes as rather a surprise, so what underlies it? First, non-unit-elasticity of the expectations function $\phi(P)$ is essential. This can easily be seen from (3.9): if $\varepsilon_\phi = 1$, $\varepsilon(P) = 1$, and so the interior equilibrium condition (3.11) cannot in general be satisfied. The equilibrium in such a case would have to be a full-employment one, in which output would be determined by the exogenous labour supply and so unaffected by monetary policy. Second,we note that an intertemporal substitution effect on consumption implicitly plays an important role. The perceived relative intertemporal price of consumption (i.e. the inverse of the real interest rate) is P/P^e: if this does not affect current consumption (as occurs when, e.g., utility is Cobb-Douglas), then $\varepsilon_\alpha = 0$, whence, from (3), $\varepsilon(P) = 1$ and the preceding observations again apply. Since the signs of the intertemporal substitution effect and of the expectations elasticity

[22] Since households' income and firms' sales revenue at the typical location must be equal

minus one are theoretically and empirically ambiguous, these signs might well be expected to affect the direction of monetary policy's effect on output. However Rankin (1988) shows that this is not the case: under CES preferences and a constant expectations elasticity, the money supply has a positive effect whether current and future consumption are gross substitutes or gross complements, and whether the expectations elasticity is greater or less than unity.[23] This robustness property is critical for the generality of this approach to explaining monetary effectiveness.

To get the strong result of *complete* price rigidity, a constant returns production function is required (or a Cobb-Douglas one like (2.2), as Hart assumes), and also the absence of disutility of work. Rankin (1988) relaxes the former assumption, and Hart (1982), later in his article, relaxes the latter: both have the plausible effect of introducing a partial response of the price level to the money supply. It should also be noted that the assumption that each consumer buys goods in only one local goods market is important. Suppose instead that goods are differentiated across local goods markets, that there are a large number of such markets and therefore types of good, and that each consumer buys a small amount of each good, as in the baseline model. The price elasticity of demand for each good would then have the exogenous value ε^*, as we saw in Section 2. This would again make the condition for unemployment equilibrium, (3.11), impossible to satisfy. Hart's model works by making the demand elasticity endogenous, to do which Hart needs to assume that each consumer spends - at least - a non-negligible fraction of her budget on the output of a given local product market. This ensures that a rise in the good's price, by significantly increasing the cost of the consumer's current consumption basket, induces some intertemporal substitution (positive or negative), and so brings expectations of next period's price level into play.

Is non-neutrality here based simply on expectational errors? To answer this we need to construct a truly dynamic, perfect foresight, version of the model, so that there exists an objective "future" with which the expectations in the temporary equilibrium model can be compared. Extensions of Hart's model to overlapping-generations frameworks have been made by Jacobsen and Schultz (1988), Schultz (1989) and Rankin (1992). A permanent "step" increase in the level of the money stock is shown by Jacobsen and Schultz to be neutral. This is not surprising, since

---

23 Though an unemployment equilibrium may fail to *exist* depending on the signs. A sufficiently concave production function is needed if there is to be unemployment at and in the vicinity of $\varepsilon = 1$.

this type of monetary policy change is just like a currency reform: if, starting from one equilibrium, all initial money holdings and all current and future prices are doubled, then the same real equilibrium should be supportable. However, this conclusion should not cause us to dismiss the non-neutrality found in the temporary equilibrium model. First, unit- and non-unit-elastic expectations, being - in the spirit of temporary equilibrium - rules of thumb, will *both* in general involve errors in forecasts of the *level* of the future price. Therefore this type of error cannot be what distinguishes them, and cannot be what gives rise to the non-neutrality. Where they differ is in the forecasts which they imply of the *change*, due to the money supply increase, in the expected inflation rate. This is zero in the unit-elastic case. Is the forecast of a change in the expected inflation rate, which non-unit-elastic expectations implies, necessarily an irrational one? Not, for example, if the currently observed money supply increase is perceived to herald the start of a period of monetary growth; or if it is perceived as a temporary rise which will be reversed the following period. In an economy with agents who need to learn from past experience and with a varied monetary history, the unit-elasticity assumption deserves no special prominence.

Although under perfect foresight a once-and-for-all increase in the level of the money supply is neutral, an increase in the *rate of growth* of the money stock can be expected to have real effects, i.e. money is not likely to be *superneutral*. In a simple Walrasian overlapping-generations economy with an exogenous labour supply, for example, higher monetary growth and thus a higher inflation rate are known to redistribute the given output from the "old" to the "young" generation (e.g. Hahn (1982)). With imperfect competition and thus the possibility of unemployment, monetary growth could be expected to affect employment and output as well. Rankin (1992) shows that this is indeed the case. However, the most interesting aspect of this extension is that, when "backward-looking" rules for forecasting the next period's price are used, each such rule gives rise to a *different* steady state, with an associated different effect of higher monetary growth on output - sometimes positive, sometimes negative. This is despite considering only rules which yield correct steady state forecasts. Such a result contrasts with the Walrasian economy, where any forecasting rule which is such as to yield correct forecasts in a steady state leads to (in general) a unique steady state, with unique properties. The reason for the dependence on the forecasting rule is that the elasticity of expectations implicit in the rule permanently affects

the elasticity of demand faced by unions in the labour market. Under perfect competition, by contrast, the elasticity facing all agents is by assumption infinite, and so independent of the forecasting rule. This result suggests that unless the strong assumption of perfect foresight is accepted as always valid, and the need for any kind of learning is denied, then the process of expectations formation may assume much greater importance in imperfectly competitive macroeconomies: it can be relevant for long-run behaviour, and not merely for behaviour along the transition path to the long run.

For non-neutrality, as was shown by our example, it is imperfect competition in the *labour* market which matters. Suppose instead that the labour market is perfectly competitive, but there is Cournot oligopoly in the *goods* market. Firm f faces the problem:

$$\text{maximise} \quad PX_f - WX_f \quad \text{s.t.} \quad X_f + X' = X \tag{3.13}$$

where X is given by (3.8), and the output X' of the other F-1 firms is taken as given. The first-order condition for a solution is:

$$P\left[1 + \frac{\partial P}{\partial X_f}\frac{X_f}{P}\right] = W \tag{3.14}$$

i.e. MR = MC. In equilibrium, $X_f/X = 1/F$, so we may re-express MR as $P[1 - 1/F\varepsilon]$, and (3.14) becomes:

$$P[1 - 1/F\varepsilon(P)] = W \tag{3.15}$$

Firm f's profit maximum can be depicted as in Figure 5:

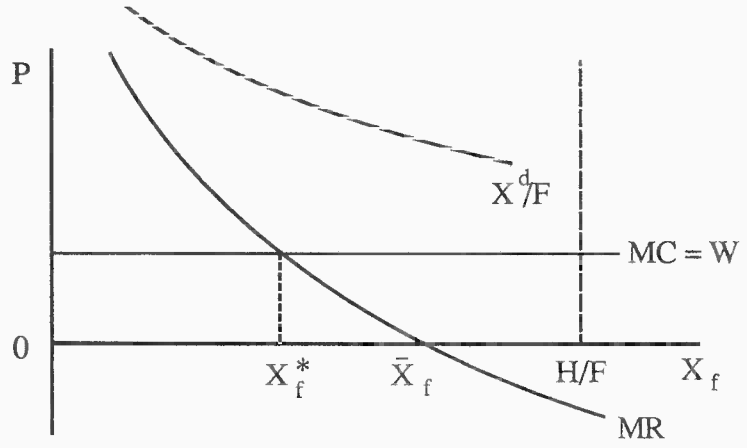


Figure 5

(In this diagram note that MR is drawn as a function of X_f, not P; the link from P to MR is via the demand curve.) As W and so MC falls, a maximum output and thus labour demand will be reached at $\overline{X}_f$, where MR = 0. With a competitive labour market and an exogenous labour supply H, the market-clearing wage will thus be zero, and there will be unemployment equal to $H - F\overline{X}_f$.

This possibility of unemployment even at a zero wage is pointed out and investigated by Dehez (1985), D'Aspremont et al. (1989, 1990), Schultz (1989) and Silvestre (1990), where it is referred to as "involuntary unemployment". Note that it arises from imperfect competition in the *goods* market, and that goods demand is unbounded as P tends to zero, so that under perfect competition full employment will always prevail. The label "involuntary unemployment" is potentially confusing, because the absence of disutility of work means that in a competitive labour market equilibrium households are indifferent between working and not working, despite the zero wage. The point is to demonstrate that, under goods market imperfect competition, an extreme degree of wage flexibility may be necessary in order to clear the labour market. In practice, therefore, even the smallest amount of wage rigidity would be enough to cause true involuntary unemployment.

The "involuntary unemployment" result cannot arise if expectations are unit-elastic. We can see this from the fact that $\varepsilon(P)$ then equals unity, from which it follows that (3.15) cannot be

satisfied at W = 0 except if P = 0; but if P = 0 goods demand would become infinite, so that a full employment solution would have to occur before P = 0 were reached. To satisfy (3.15) when W = 0 and so obtain unemployment, ε must instead be an increasing function of P, and must pass through 1/F in order to ensure that as P falls (i.e. as X_f rises) MR becomes negative at some strictly positive P (finite X_f). This will happen in our example, for instance (as Silvestre (1990) shows for Hart's model), in the case of a zero expectations elasticity and of a CES utility function with an elasticity of substitution less than 1/F. Extending the model to include overlapping generations and perfect foresight, however, has raised doubts about the robustness of the "involuntary unemployment" result: Schultz (1989) finds that in such a framework the condition for it to occur cannot be satisfied. Yet another paper to make use of Hart's basic framework to characterise the conditions for unemployment to occur is by Jacobsen and Schultz (1990). The distinctive feature here is the use of a Nash bargain in the labour market, coupled with perfect competition in the goods market.

(iii) Small nominal rigidities

There are in an economy many possible sources of nominal rigidity, which may occur in only a small sector of the economy, but which may in the presence of imperfect competition cause significant non-neutrality of money. The origin of the nominal rigidity may be outside the domestic private sector - for example, for a small country with a fixed exchange rate, in the nominal price of tradeables: Rivera-Campos (1991) studies this case. Prices, subsidies, welfare payments and taxes set by the government are also often "rigid" in the sense of being set in nominal terms for a given period. One of the most significant of such nominal rigidities is unemployment benefit. Dixon (1990b), Fender and Yip (1990) and Moutos (1991) focus on this. As we shall see, the presence of such nominal rigidities can have very different implications in a unionised economy from in a Walrasian economy. We will very briefly look at the example of unemployment benefits.

Unemployment benefits are set in nominal terms by governments, and revised at regular intervals (at the annual budget, in the U.K.). In between revisions they are fixed. The level of unemployment benefits is important in a unionised economy because it alters the marginal trade-off

between employment and unemployment for union members. If we take the baseline model and assume Cobb-Douglas preferences, constant returns to scale (a = B = 1) and a perfectly competitive output market, and assume that benefits are financed by a universal poll tax T, then, from (2.3) and (2.4), in each sector nominal demand is given by:

$$Y_i = \frac{c}{1-c}\frac{M_0 - T}{n} \tag{3.16}$$

Let us further assume that there is no disutility of labour, i.e. $\theta = 0$. In the absence of benefits, a perfectly competitive labour market will always lead to full employment (so T = 0), with the market-clearing wage being:

$$W^c = \Sigma_{i=1}^{n} Y_i/H = \frac{c}{1-c}\frac{M_0}{H} \tag{3.17}$$

The presence of unemployment benefits whose nominal level is fixed at b will not influence the level of wages so long as $b < W^c$, which means that it is worthwhile working (the replacement ratio is below unity). Except for the fact that benefits provide a floor for wages, money is neutral in the Walrasian case, since a doubling of the money supply M_0 will lead to a doubling of Y_i and hence of W^c.

With unions, however, things may be different. Suppose that households are grouped into r unions in each sector who behave as Cournot quantity-setters. In this case, we can see each union k in sector i as choosing its labour supply N_{ik}, with the wage that clears the labour market being:

$$W_i = Y_i/\Sigma_{k=1}^{n} N_{ik} \tag{3.18}$$

If the union seeks to maximise the "surplus" earned by its members, treating the general price level P as fixed, then as is shown in Dixon (1990b), in equilibrium the nominal wage becomes a mark-up over the benefit level:

$$[W_i - b]/W_i = 1/r, \tag{3.19}$$

so long as $W_i > W^c$. This is depicted in Figure 6:

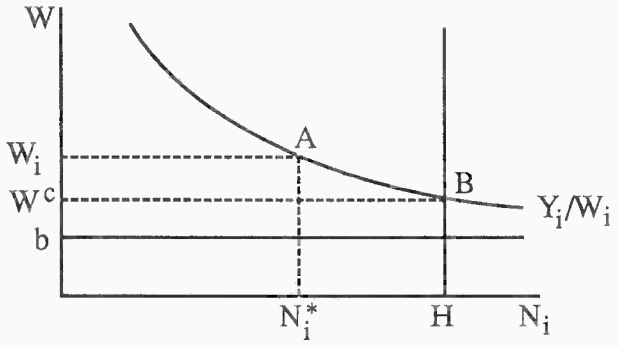


Figure 6

The important point to note here is that in a unionised economy the nominal wage becomes tied to the benefit level. Furthermore even levels of benefit below the competitive wage can lead to involuntary unemployment, depending on the level of the money supply. So $W_i > W^c \geq b$, and employed households earn more than the unemployed, as at point A. Otherwise employment is always at B. This contrasts with the Walrasian economy, in which benefits can only cause unemployment if they are above the market-clearing wage. As a result of the nominal rigidity introduced by unemployment benefits, with a unionised labour market there will be standard Keynesian multiplier effects. Again, this contrasts with the Walrasian economy in which there will be full employment and a zero multiplier so long as $b \leq W^c$.

4. Fiscal Policy

There are several reasons why the nature of competition in product and labour markets may make a big difference to how fiscal policy affects the economy, even in the presence of monetary neutrality. First, it is of the essence of price and wage determination in imperfectly competitive markets that elasticity of demand matters. Government policies which influence the elasticity of demand therefore have the potential to alter relative prices in a way that is absent in a price-taking economy. Second, imperfect competition influences the distribution of income between wages and profits. In circumstances where this distribution can affect equilibrium, such as when there are income effects on labour supply, the degree of competition can alter the impact of government

spending. A third reason why fiscal policy may be important in imperfectly competitive economies is that in practice it is not generally symmetric: governments tend to concentrate spending on particular areas. We will show that the exact microeconomic mix of expenditures can have a significant macroeconomic influence, which is much greater than in a Walrasian environment. Finally we show how fiscal policy affects activity by inducing entry and exit of firms to and from the economy. Imperfect competition here combines with increasing returns in production to determine the number of firms. These four mechanisms just described determine the sub-division of the section.

(i) Elasticity effects of the spending mix

When the demand for output has two components, private and public, its price elasticity is simply the weighted average of the individual elasticities. An increase in government spending, by increasing the share of public expenditure in the total, shifts the elasticity of demand towards that of public spending. If the latter is higher (lower) than the elasticity of private spending, overall demand elasticity rises (falls), and consequently the degree of monopoly tends to decrease (increase). Given the general finding that raising monopoly power lowers output, output could be expected to rise (fall).

This mechanism has been emphasised by numerous authors.[24] A simple illustration may be given by adapting the monopolistic competition model from section 2. If consumers have CES utility with elasticity of substitution ρ, then private demand for good i takes the constant-elasticity form:

$$C_i = [P_i/P]^{-\rho}\frac{1}{n} C \qquad (\rho > 1) \qquad (4.1)$$

where C is aggregate real consumption. We postulate a government demand function with a similar form:

$$G_i = [P_i/P]^{-\gamma}\frac{1}{n} \overline{G} \qquad (4.2)$$

24 Amongst whom are Thomas (1982), Wren-Lewis (1985), Solow (1986), Svensson (1986), Rankin (1988), Dixon (1989).

where $\overline{G}$ is a scale parameter. Total demand for i is:

$$X_i = C_i + G_i$$

and the price elasticity of demand is:

$$\varepsilon = \frac{C_i}{X_i}\rho + \frac{G_i}{X_i}\gamma \tag{4.3}$$

(4.3) makes it clear how variations in G_i/X_i shift ε between ρ and γ. We can now use (4.3) to endogenise ε in the labour demand function of the sector i firm, (2.11a). In a symmetric equilibrium we have:

$$\frac{W}{P} = \frac{\rho + [\gamma - \rho]B\overline{G}/N^a}{\rho - 1 + [\gamma - \rho]B\overline{G}/N^a} aB^{-1}N^{-[1-a]} \tag{4.4}$$

(where X has been substituted out using the production function (2.2)). This modified labour demand curve may be used to determine employment assuming either a competitive labour market, by superimposing it on a labour supply curve as in Figure 1; or alternatively assuming a Blanchard-Kiyotaki-type unionised labour market, by superimposing it on a monopolistic labour supply curve as in Figure 3. In either case it is clear that an increase in $\overline{G}$ has no effect if private- and public-sector demands have the same elasticity ($\gamma = \rho$). However if γ is greater (less) than ρ, the labour demand curve shifts down (up) when $\overline{G}$ increases, raising (lowering) total employment.

In practice it seems reasonable to argue that $\gamma < \rho$ for most economies. This is obvious if the government fixes its spending, and its allocation between sectors, in real terms ($\gamma = 0$)[25] , but it is also true if it fixes spending in nominal terms ($\gamma = 1 < \rho$). This would then imply a negative impact of an increase in spending on output. In general terms, governments often conceive of policies as affecting the trade-off faced by market participants, even though this has not often been recognised as an attempt to influence their degree of market power. For example, in 1957 the British Chancellor of the Exchequer Mr Thorneycroft argued that "if ... money national income was pegged ... wages could push up prices only at the expense of employment: the onus of choice

25 $\gamma = 0$ in our example would lead to non-existence, since firms would have an incentive to set $P_i = \infty$; however with more than one firm per sector this problem can be avoided.

was, as it were, placed on the unions" (Dow (1964), p.101). It is also possible to view one reason for the shift from volume planning to cash planning of U.K. public spending in the 1970's, and for the general reduction in the scale of public spending in the 1980's, as being the desire to weaken monopoly (particularly labour monopoly) power, with the aim of countering the trend rise in unemployment.

(ii) Income effects on labour supply

Even in a Walrasian economy, one way in which fiscal policy may affect output is through the labour supply. A balanced-budget increase in government spending will have a positive effect on output if leisure is a "normal" good in households' preferences, by virtue of the higher tax burden which causes a lower demand for leisure and thus stimulates labour supply. Up to now we have deliberately excluded income effects on labour supply by the use of the utility function (2.1). Now we relax this assumption and show how imperfect competition strengthens such an effect, since it leads to a higher proportion of income entering the household's budget constraint in the form of profits.

The following simple example is taken from Mankiw (1988); other models exhibiting an essentially similar transmission mechanism are constructed by Dixon (1987) and Startz (1989). The representative household has Cobb-Douglas utility over goods and leisure:

$$U = [\Pi_{i=1}^{n} C_i^{1/n}]^c [H-N]^{1-c} \qquad (4.5)$$

This implies that the price elasticity of private-sector demand for each good is unity. To abstract from the "elasticity" effects discussed above, government spending in each sector is taken to be fixed at G_i in nominal terms, so that real government spending, $g_i = G_i/P_i$, is also unit-elastic. On the production side we assume there are constant returns to scale with output equal to employment, $X_i = N_i$, and thus marginal cost equal to the wage, W. Given F firms per sector, the unit elasticity of demand implies that under Cournot-Nash equilibrium there will be a fixed mark-up of the price over the wage with:

$$\frac{P_i - W}{P_i} \equiv \mu = 1/F \quad \Rightarrow \quad W/P_i = 1-\mu \qquad (4.6)$$

Firms' nominal and real profits in sector i are:

$$\Pi_i = [P_i - W_i]N_i , \qquad \Pi_i/P_i = \mu N_i \tag{4.7}$$

Profits are immediately distributed and government spending is financed by lump-sum taxation, so the household's budget constraint is:

$$\Sigma_{i=1}^{n} P_i C_i + W[H - N] = WH + \Sigma_{i=1}^{n} \Pi_i - \Sigma_{i=1}^{n} G_i \tag{4.8}$$

Since Cobb-Douglas utility implies constant expenditure shares, we can immediately write down the household's spending on leisure as:

$$W[H - N] = [1-c][WH + \Sigma_{i=1}^{n} \Pi_i - \Sigma_{i=1}^{n} G_i] \tag{4.9}$$

The macroeconomic system is completed by assuming a symmetric goods market equilibrium with a competitive, clearing labour market. Using (4.6) and (4.7) in (4.9) yields:

$$N = cH - \frac{1-c}{1-\mu}[\mu N - g] \tag{4.10}$$

The balanced-budget spending multiplier is equal to:

$$\frac{dN}{dg} = \frac{1 - c}{1 - c\mu} \tag{4.11}$$

As the degree of monopoly, μ, increases from zero to one, the multiplier rises from 1-c to unity. Thus it approaches the macro textbook multiplier for a high degree of monopoly. The reason for this may be understood in either of two ways. First, a higher mark-up increases the profit feedback from firms to households per unit increase in output. This boosts consumption spending and so the multiplier. Alternatively viewed, a higher μ lowers the real wage. The income effect on labour supply of the increased taxation is thereby strengthened, as may be seen from the term $1-\mu$ in (4.10). This arises since the "propensity to spend on leisure" is a constant, 1-c: a lower real wage means more leisure is consumed per unit increase in exogenous income. The result is not specific to a barter economy: Dixon (1987) obtains essentially the same outcome in a monetary

economy with money-financed expenditure (see also Molana and Moutos (1992) for a discussion of taxation in this model)).

(iii) Effects of sectoral spending asymmetries

One of the most important ways that fiscal policy differs from monetary policy is its inherently microeconomic content. This is of course obvious in the case of taxation: most taxes levied by governments alter supply-side incentives. It is, however, also true in the case of government expenditure: the government needs to decide not just how much to spend, but also on what to spend it. The issue of how to allocate government expenditure is given much time and consideration by politicians, and quite rightly is seen by many as having important economic consequences. Some of these consequences stem from the intrinsic value of government expenditure - on health, education and so on. However, in this section we will rather consider the case where government expenditure is "waste". Furthermore, we will also assume that apart from possibly different levels of government expenditure the "fundamentals" of each market are the same - technology, the number of firms, union and consumer preferences. This rules out fairly obvious reasons for expenditure decisions based on differential employment effects due to capital intensity, import content and so on. By what mechanism can the allocation of government expenditure influence aggregate employment?

In an economy with perfect labour mobility and a competitive labour market, there can only be a single market-clearing wage in the economy. Whilst fiscal (or monetary) policy might influence this, it cannot influence the *relative* wages of those in employment. However, if there are *sectoral* unions, then these can in principle determine wages in their own sectors, and relative wages can then vary. In effect the union can be seen as an institution which limits labour mobility: the employed union "insiders" are protected from the competition of "outsiders" who may either be unemployed or employed in other industries. Since relative wages can then differ across sectors, the allocation of government expenditure amongst sectors has a foothold from which to influence aggregate output and employment.

In order to illustrate this, we will adopt the same approach as in Dixon (1988a,1991). In terms of the general framework we will assume that consumer preferences are Cobb-Douglas over

outputs, and furthermore that there is no disutility of labour ($\theta = 0$) and that there are constant returns to labour ($a = B = 1$). Whilst we will talk about a "large economy" where each sector is small, we will often formally deal with the case of a two-sector economy. Furthermore we will rule out the elasticity effects already discussed, by assuming cash-planning of government expenditures in each sector i, G_i, so that both household and government demand are unit-elastic. Total government expenditure G is financed by a lump-sum tax, T. The addition of fiscal policy to income-expenditure equation (2.4) results in:

$$Y_i = G_i + \frac{c}{n}\left[M_0 + \Sigma_{j=1}^{n} Y_j - \Sigma_{j=1}^{n} G_j\right] \qquad i = 1,...,n \tag{4.12}$$

Total expenditure on sector i is equal to government expenditure on sector i, G_i, plus household expenditure, which is a proportion $\alpha_i = c/n$ of household's income (initial money balances minus tax, plus total factor income ΣY_j). Solving the n equations (4.12) for the n unknowns Y_i yields:

$$Y_i = G_i + \frac{c}{1-c}\frac{M_0}{n} \tag{4.13}$$

Equation (4.13) is in effect the reduced-form equation for expenditure, taking account of the income-expenditure feedbacks. Demand for sector i is equal to the direct sectoral government expenditure plus household demand (total government expenditure nets out due to the balanced budget.) Total output and employment are then given by:

$$N_i = \frac{Y_i}{P_i} = \frac{[1-\mu]Y_i}{W_i} \tag{4.14}$$

(4.14) defines the demand curve facing the union: the trade-off between the nominal wage W_i and employment N_i, given that prices are a markup on wages, $P_i = W_i/[1-\mu]$.

For the purposes of this section we will assume that union preferences are Stone-Geary (this is commonly used in empirical work, e.g. Pencavel (1984), Dertouzos and Pencavel (1984)):

$$[W_i/P - \xi][N_i - \overline{N}], \qquad P = \Pi_{i=1}^{n} P_i^{1/n} \tag{4.15}$$

$(\xi,\overline{N})$ are parameters which represent minimum acceptable levels for real wages and employment, respectively. Each sectoral union chooses W_i to maximise union utility (4.15) given demand

(4.14), treating the general price level P as fixed, by the "large economy" argument. The union's optimum wage is then a function of the level of demand $[1-\mu]Y_i$ and of the price level P:

$$\ln W_i = [1/2] \ln (\xi/\overline{N}) + [1/2] \ln Y_i + [1/2] \ln P \qquad (4.16)$$

However, since prices are a mark-up over wages,

$$\ln P = - \ln (1-\mu) + \Sigma_{j=1}^{n} \ln W_j \qquad (4.17)$$

Substituting (4.17) into (4.16) and solving for equilibrium wages and employment yields for each i = 1,...,n:

$$W_i = N_B^{-1} Y_i^{1/2} \overline{Y}^{1/2} \qquad (4.18a)$$

$$N_i = N_B y_i^{1/2} \qquad (4.18b)$$

where $\overline{Y}$ is the geometric mean of the Y_i's, $y_i \equiv Y_i/\overline{Y}$, and $N_B \equiv [1-\mu]\overline{N}/\xi$. Turning to (4.18b), we can see that equilibrium employment depends on y_i, the strength of demand in sector i relative to mean demand. From this we get the fundamental *Natural Range* property of Dixon (1988a,1991):

$$\Pi_{i=1}^{n} N_i = N_B^n \Pi_{i=1}^{n} y_i^{1/2} = N_B^n \qquad (4.19)$$

That is, the *product* of sectoral employment levels is constant, defining a rectangular hyperbola in employment space. We can thus graph the combinations of possible equilibrium employment levels when n = 2 in Figure 7. Total iso-employment isoquants are represented by negatively-sloped 45° lines, $N_1 + N_2 = N$. The total employment constraint is set by the aggregate labour supply, H. There is then a range of feasible aggregate employment levels: with a symmetric fiscal policy, aggregate employment is minimised at A with $n = 2N_B$; as we move away from the positively-sloped 45° line total employment increases up to full employment at H.

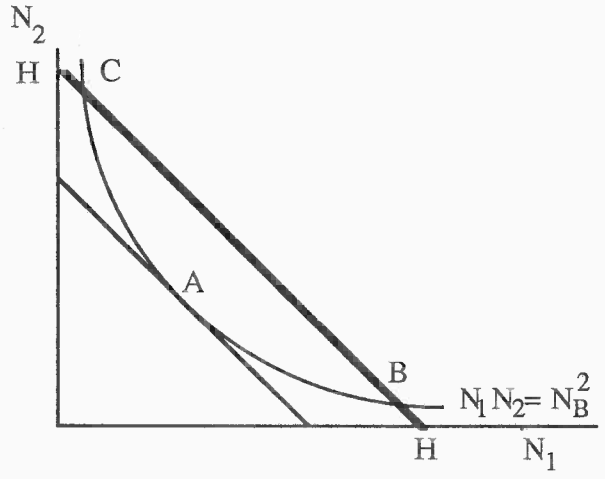


Figure 7

Government macroeconomic policy is represented by the vector of sectoral government expenditures, and money balances. For any given government policy (G_1,G_2,M_0) which determines the sectoral demands Y_i (4.13), there is a unique equilibrium on the rectangular hyperbola $N_1N_2 = N_B^2$. When $G_1 = G_2$, i.e. a symmetric policy, employment is minimised. As we move along the rectangular hyperbola away from A, total output increases. As G_1 increases relative to G_2, we move from A towards B: N_1 increases by more than the decrease in N_2. We move from A to C as G_2 increases relative to G_1. N_B is thus the *balanced rate* of sectoral employment, which is determined by the degree of monopoly μ, and union preferences $(\xi,\bar{N})$.

Thus, in the unionised multi-sector economy the government's allocation of expenditure across sectors determines aggregate employment. This stands in total contrast to the Walrasian economy. In this case, perfect mobility of labour ensures that there is a single wage W for all workers, and furthermore that so long as $W > 0$ there will be full employment at H. The market-clearing wage W^c is then $W^c = [1-\mu][Y_1+Y_2]/H$. Switching expenditure from one sector to another merely serves to cause exactly offsetting changes in employment to maintain full employment. The reason for the difference with imperfect competition is that the presence of unions means that wages may differ across sectors, and that as demand shifts across sectors relative wages alter, and thus changes in sectoral employment need not cancel out. The particular functional forms here of course give rise to the specific "natural range" result found in these

papers. From (4.18b), with n = 2, a 10% increase in y_1 will lead to a 5% increase in N_1 and a 5% fall in N_2: hence if initial N_1 is bigger (smaller) than initial N_2, total output and employment will rise (fall). Thus the government can increase total output and employment by concentrating its expenditure in one sector. However, the existence of a natural range does not depend upon the specific functional forms, and is quite general (see Dixon (1988a), Theorems 1 and 2).

Given that in an imperfectly competitive economy the government can increase total employment within the natural range, will it want to? Recall that we are treating government expenditure as waste. It can be shown that the real government expenditure multiplier in this model is less than unity. This is because a rise in nominal G leads to higher prices which crowd out private sector expenditure (see Dixon (1991, Proposition 6)). However, despite this, government policy that increases total employment will increase the total utility of households (op. cit., Theorem 2). This is an interesting and possibly counterintuitive result. The increase in total utility occurs through two mechanisms. First, in unionised labour markets the real wage will (usually) exceed the marginal disutility of labour. Each employed worker thus earns a "surplus": as total employment goes up, there is an increase in the total surplus as unemployed people become employed. This mechanism would not be present in Walrasian equilibrium since workers are indifferent, on the margin, between employment and unemployment. The second mechanism is due to the convexity of the indirect utility function in prices, which implies that consumers like divergent prices (so that they can substitute less expensive commodities for the more expensive). As the government concentrates expenditure and raises employment, prices in the high-output sectors rise and those in the low-output sectors fall. This raises the utility derived from consumption.

(iv) Fiscal effects on entry and exit

All the imperfectly competitive economies considered so far have treated the number of firms as fixed. In this sense they are all "short run" analyses. One strand of the literature, beginning with Weitzman (1982) and developed further by Snower (1983), Solow (1986), Pagano (1990), Green and Weale (1990), Christodoulakis and Weale (1990), focuses on entry and exit of firms as the explanation of unemployment and macroeconomic behaviour. In simple terms, policy which

induces entry will tend to increase competition in the market. Hence fluctuations in the number of firms can influence output, with more firms leading to higher output. Since a key feature of many of these models is multiple equilibria, we defer a more detailed treatment to section 5. However it is worth noting some of the results on fiscal policy here. Using an overlapping-generations version of the Weitzman model, Pagano (1990) obtains a negative multiplier for fiscal policy when it takes the form of a tax cut financed by bond issues. This raises the interest rate and cause capital decumulation, reducing long-run output. The basic mechanism is identical to that in Diamond's (1965) well-known growth model based on Walrasian equilibrium, since finitely-lived households imply that "Ricardian equivalence" fails to hold. However the negative impact is reinforced by imperfect competition, because as firms are driven out of the economy the degree of monopoly increases, tightening the monopolistic restriction on output.

5. Multiple Equilibria and Increasing Returns

In a Walrasian economy, if there were more than one equilibrium, then the different equilibria could not Pareto-dominate each other. This follows immediately from the First Fundamental Theorem of welfare economics, which states that any perfectly competitive equilibrium is Pareto optimal. From the macroeconomic perspective, even if one equilibrium possessed a higher level of economic activity (output, employment) than another, it would not imply that anyone or everyone is better off. However, imperfectly competitive equilibria are "inefficient": as we have seen, if all firms and unions lowered wages and prices together, output and welfare would increase (there would be a Pareto improvement). Non-cooperative Nash equilibria are in general not Pareto optimal, since each agent chooses her strategy purely with reference to her own payoff, ignoring the effects of her action on other agents (the "spillover" effect).

This distinction has led some authors (Cooper and John (1988), Chatterjee and Cooper (1989)) to argue that imperfect competition can generate multiple Pareto-ranked equilibria in the economy. This gives rise to the very Keynesian notion that "the economy can get stuck at an inefficient equilibrium with a low level of economic activity even though a better equilibrium

exists" (Cooper and John (1988), p.448). In order to understand the argument we need to define two terms. Suppose we have two agents (both firms or both unions) who each choose an action a_i.(e.g. a price, or a wage, or an employment level). Actions are said to have *positive (negative) spillover* effects if an increase in the action by one player increases (reduces) the payoff of the other player. *Strategic complementarity* occurs when the marginal payoff of one player is increasing in the action of the other player. This implies that the reaction function of one player (giving his best response) will be *increasing* in the actions of other players. If we consider symmetric equilibria in symmetric games, possible equilibria are represented by the intersections of the upward-sloping reaction function and the 45° line, as in Figure 8:

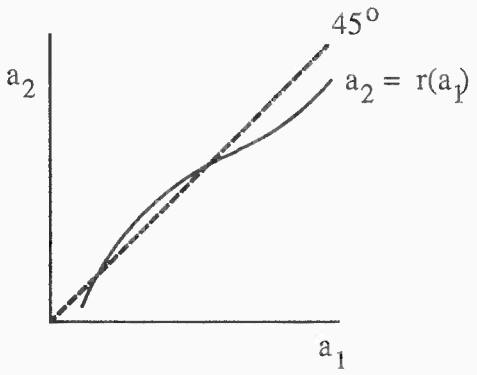


Figure 8

Strategic complementarity, which makes the reaction functions upward-sloping, is necessary for multiple equlibria (a downward-sloping reaction function can only cross the 45° line once). If *in addition* there are spillover effects (that is, each agent's payoff depends on what the other does), then the equilibria will be Pareto-ranked. With positive spillovers, the high-activity equilibrium Pareto dominates, and vice versa with negative spillovers.

Let us illustrate this with an example from the general framework - the case of sectoral monopoly unions. Furthermore let us adopt the simplifying assumptions of constant returns to labour ($a = B = 1$) and perfect competition in the product market so that $P_i = W_i$. In that case,

there are no profits so that welfare depends only on the expected/average utility of households in each sector. The union's objective is to maximise workers' surplus:

$$u_i(\mathbf{W}) = [W_i/P(\mathbf{W}) - \theta]N_i$$

where $N_i = \alpha_i(\mathbf{W})Y/W_i$ and $\mathbf{W}$ is the vector of sectoral wages. To examine spillovers and strategic complementarity, consider the effect of another union's wage W_j on u_i:

$$\frac{\partial u_i}{\partial W_j} = -\frac{W_i}{P^2}\frac{\partial P}{\partial W_j}N_i + \left[\frac{W_i}{P} - \theta\right]\frac{Y}{W_i}\frac{\partial \alpha_i}{\partial W_j} \qquad (5.1)$$

The first right-hand term is always negative, being the cost-of-living spillover: if unions in another sector j raise their wage, the price level rises which makes households in sector i worse off. The second term is variously called the demand linkage across sectors (Cooper and John (1988)), demand externality or spillover. A rise in W_j (and hence P_j) causes consumers to switch demand either towards or away from sector i. If goods are gross substitutes (budget shares increase with other prices) it is *positive* (so sector i's demand curve shifts to the right); if goods are gross complements (budget shares decrease with other prices), then it is negative. It seems more natural to think that the demand spillover is positive, and that goods are gross substitutes.[26]

To examine the issue of strategic complementarity, note that to find the effect of W_j on $\partial u_i/\partial W_i$, by Young's theorem we can differentiate (5.1) with respect to W_i. The resultant cross-partial derivative is rather messy: however, it is almost universally assumed that wage reaction functions are upward-sloping (at least in the context of sectoral unions), which implies strategic complementarity.[27] In this example then, if there were multiple symmetric equilibria, they would be Pareto-ranked. High nominal wage equilibria with low employment would be Pareto-inferior to low-wage equilibria with high employment. The economy can get locked into either equilibrium,

---

26 It is interesting to note that, despite their title, there is no demand linkage across sectors in Cooper and John's example (1988, pp.454-460), since they assume Cobb-Douglas preferences with fixed budget shares, so that the (nominal) income in each sector is fixed. In fact the "reaction functions" derived and depicted on pp.459-460 are incorrect, failing to reflect the equilibrium conditions in each market.

27 This can be ensured in the model by assuming that unions treat the general price level as exogenous ($\partial P/\partial W_i = 0$), and that the second derivatives of α_i are small.

and there is thus a coordination problem, in that unions (and their members) would prefer to be at the low wage/high employment equilibrium.

This multiple equilibrium contrasts with the natural range result of Dixon (1988a, 1991) considered in the previous section. In Dixon's natural range, there is a unique equilibrium for any given mix of monetary and fiscal policy. The equilibria are Pareto-incomparable, in that there are winners and losers as the economy moves within the natural range, despite the increase in total utility (Dixon (1991), Theorem 2). With Cooper and John's multiple equilibria, there is more than one equilibrium for any given macroeconomic policy. However, Cooper and John's model can also yield a natural range if the reaction function intersects the 45^{o} line for a range of values.

To what extent can the government's macroeconomic policy help unions to solve their coordination problem? On the formal game-theoretic level, an increase in, say, the nominal money supply will not alter the situation. The underlying homogeneity properties of the equilibrium equations imply that an X% increase in M_0 will merely result in an X% increase in the set of equilibrium wages, yielding the same equilibrium levels of employment. However, if one assumes that wages will only change from their initial value if it ceases to be an equilibrium value with the new money supply, then in effect the government can "select" the Pareto optimal equilibrium. For example, take the case of the two equilibria depicted in Figure 8. At the initial level of the money supply, we have the reaction function r_0, with two equilibria at W_L (high employment) and W_H (low employment). Suppose we start at the high-wage, low-employment equilibrium W_H. The government can increase the money supply so that the initial value of money wages W_H becomes the new low-wage/high-employment equilibrium defined by the new reaction function r_1, as depicted in Figure 9:

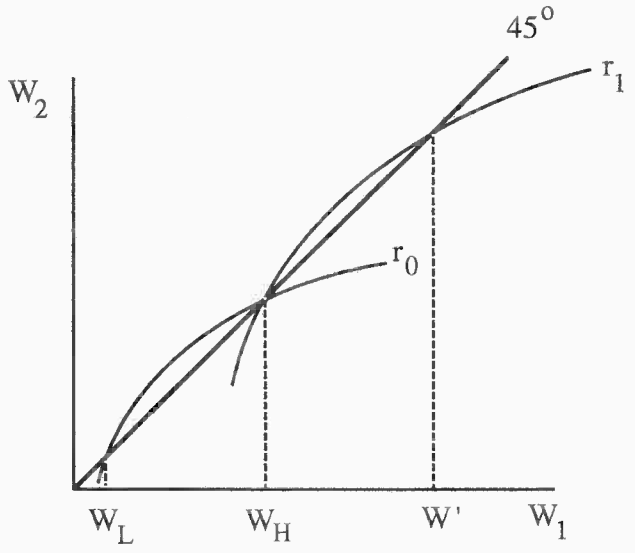


Figure 9

Although there is a new low-employment equilibrium with the wage W', wages may be reasonably assumed to stay at W_H, which is now the high-employment equilibrium.

In a seminal paper, Weitzman (1982) first suggested that multiple unemployment equilibria (in fact a continuum of equilibria) could result from the presence of increasing returns to scale in an economy's production technology. Imperfect competition is a necessary concomitant of increasing returns, since price-taking behaviour would involve firms making losses. Weitzman's intuitive argument was that increasing returns would prevent any automatic tendency to full employment, since whereas under decreasing returns any unemployed worker could set himself up as a one-man business, under increasing returns this is impossible. Unfortunately Weitzman's original formal analysis is weakened by the omission of any labour supply relationship from the model, and consequently of any labour market clearing condition (or of its counterpart, if an imperfectly competitive labour market is instead assumed). Nevertheless when this lacuna is made good, it still provides a basis for (a finite number of) multiple equilibria, as Pagano (1990) has shown. We can illustrate this using a simplified version of Pagano's model which, like his, draws on some extensions to Pagano made by Solow (1986).

Weitzman employs Salop's (1979) "spatial" model of imperfect competition. n firms are equally spaced on a circle of circumference H. Firm i has the production function:

$$X_i = B^{-1}[N_i - f] \tag{5.2}$$

where f is a "fixed cost" requirement in terms of labour which is the source of permanently decreasing average costs. Households are evenly distributed round the circle. Household j has the utility function:

$$U_j = X_j e^{-\beta d} - \theta_j N_j, \qquad N_j \leq 1 \tag{5.3}$$

where X_j is its consumption of the output of a firm from which it is d units distant along the circle. Thus households prefer "local" products, and moreover, since marginal utility is constant, they buy only from the nearest firm. The household chooses either to work or not to work according as the real wage exceeds or falls below its reservation wage, θ_j. The negative slope of the demand curve facing a firm derives from two sources: as price increases, remaining customers are able to buy less, but also the firm's "market area" shrinks as customers on the margins switch instead to neighbouring firms. An important feature of the spatial model of monopolistic competition which distinguishes it from the Dixit-Stiglitz (1977) version is that substitutability between firms' products increases, and thus the degree of monopoly falls, as the number of firms increases.

The conditions for a symmetric equilibrium in the model, determining (X,N,n,W/P), may be written as follows:

$$P = WB[1 + \beta H/n] \tag{5.4}$$

$$X = B^{-1}[N/n - f] \tag{5.5}$$

$$nPX = WN \tag{5.6}$$

$$N = N^s(W/P) \tag{5.7}$$

(5.4) is obtained from profit maximisation by the individual firm[28] : it shows that the mark-up of the price over marginal cost WB, is decreasing in the number of firms. (5.5) is just the production function (5.2), while (5.6) is the long-run zero-profit condition which determines the number of

[28] The derivation is simple but is omitted for brevity: see Solow (1986) or Pagano (1990)

firms n. (5.7) closes the model by equating aggregate employment N to aggregate labour supply, thus postulating a competitive, clearing labour market. The exact shape of the labour supply function will depend on the nature of the distribution of reservation wages θ_j across households. Combining (5.4)-(5.6) to eliminate (X,n), we may obtain a "labour demand" relation for the economy:

$$N = \beta H f B^{-1} \frac{W/P}{[B^{-1} - W/P]^2} \tag{5.8}$$

This is plotted as LL in Figure 10. The key feature of LL is that it is upward- not downward-sloping. To see why, note that an increase in aggregate employment increases households' goods demand. This raises the profits of existing firms and induces new firms to enter, which not only validates the original increase in employment but also reduces the degree of monopoly, lowering the mark-up, and so *raising* the real wage.

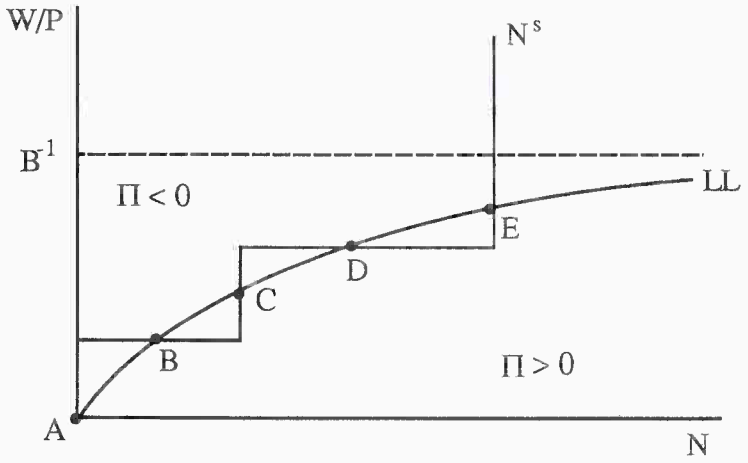


Figure 10

It is the positive slope of the "labour demand" curve which creates the possibility of multiple equilibria. With an upward-sloping labour supply curve, there may clearly be several intersections. This is shown in Figure 10 for the case of a stepwise labour supply: here it is supposed that workers fall into two groups, one with low and one with high reservation wages. For plausible

adjustment mechanisms, only equilibria where the labour supply curve cuts from below are "stable". This is because above LL firms make negative profits, and below it, positive ones. If the economy is always on N^s but may be off LL in the short run (because entry and exit take time), a positive rate of growth of the number of firms, and thus of employment, in response to positive profits implies that A,C and E are stable, B and D unstable. From this diagram we may also gain some insight into Pagano's (1990) result, mentioned in section 4, that fiscal expansion raises unemployment. If a tax cut raises the interest rate and so firms' costs, this may be pictured as expanding the region of negative profits in Figure 9. This would shift LL down, so that with an upward-sloping (rather than step-wise) labour supply, employment at stable equilibria falls.

Another interesting example of multiple Pareto-ranked equilibria is given in Frank (1990). In this paper, monopolistic competition is the feature that makes Pareto-ranked equilibria possible. The multiplicity is generated by uncertainty and firms' attitudes to risk. Frank assumes decreasing absolute risk aversion, which means that firms become more cautious and have a higher risk premium at lower levels of economic activity. There is then a positive spillover effect: higher levels of aggregate activity can stimulate the individual firm to increase output a lot because it becomes less risk-averse when expected profits are higher.

Kiyotaki (1988) also provides a model of imperfect competition with multiple equilibria that are Pareto-ranked. His is a two-period model with investment, the crucial ingredients being increasing-returns technology and monopolistic competition. If firms are optimistic (pessimistic) about the future, they invest more (less) now. This leads to a large (small) output and capital stock in the future which causes expectations to be self-fulfilling: "The current investment decisions of the firm are based on its expectations of future demand conditions. At the same time, the equilibrium output in the future is a function of the future capital stock, which depends upon current investment" (Kiyotaki (1988), p.696). Kiyotaki sees the model as capturing Keynes's notion of "animal spirits". Firms can either become trapped in an optimistic, high-investment equilibrium, or a pessimistic, low-investment equilibrium. The presence of monopolistic competition and increasing returns allows the multiple equilibria to be Pareto-ranked. This is because in the optimistic equilibrium with high output the presence of increasing returns to scale improves productive efficiency, and hence tends to compensate for the under-production inherent

in monopolistic competition. In the pessimistic equilibrium the reverse occurs, leading to large welfare losses. Kiyotaki argues that investment subsidies or an insurance programme can be utilised to ensure that the optimistic equilibrium is selected by the entrepreneurs.

Manning (1990) provides a simple model which adds increasing returns to Layard and Nickell's (1985) model (itself closely related to Blanchard and Kiyotaki's (1987) approach). In each sector a union bargains with a firm, the resultant real wage being a mark-up over $\overline{V}$, the "alternative" real wage. The alternative real wage is a weighted sum of unemployment benefit and of the actual real wage, the weights being given by the unemployment rate u (the probability of being unemployed) and 1-u (the probability of getting a job). The equilibrium real wage thus decreases with unemployment, since higher levels of aggregate unemployment lower the alternative real wage. This is depicted by the labour market equilibrium relationship WW in Figure 11:

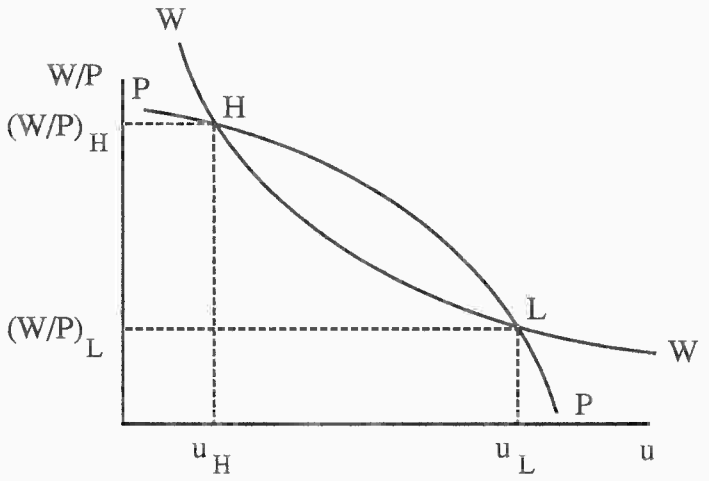


Figure 11

The firm's price-cost equation ("labour demand curve") equates the real wage to the marginal revenue product of labour. With diminishing (constant) returns to labour, this is upward-sloping (horizontal) in (W/P,u) space. With *increasing* returns to labour, it is downward-sloping, as depicted by the PP price equation line in Figure 11. Without increasing returns, there will be a unique equilibrium. Increasing returns can give rise to two equilibria as in Figure 11: one with high employment and a high real wage (H), the other with low employment and a low real wage (L). Although the model is not derived from an explicit model of an optimising consumer, it can easily be checked that the two equilibria are Pareto-ranked, in that households' consumption,

firms' profits and real unemployment benefits are higher in the equilibrium H. In a later paper (1991), Manning applies the model to the U.K. labour market. He finds support for the notion that there are two long-run equilibria in the U.K economy, and suggests that the severe recession of the early 1980's could be interpreted as a switch from a high-employment equilibrium to a low-employment one, induced by a severely contractionary government policy.

Another source of multiple Pareto-ranked equilibria are models with equilibrium price rigidity, where there is a continuum of price/wage levels which constitute an equilibrium. We have already explored the menu cost model in Section 3 which has this property. For any given level of the money supply, there is a range of price levels which constitute Nash equilibria. For a given money stock, the higher the price level, the lower the utility of all agents in the economy. There are other models of limited price rigidity of this sort, giving rise to a natural range of employment with Pareto-ranked equilibria - in particular the traditional kinked-demand curve literature (e.g. Baran and Sweezy (1966), Hahn (1978), Negishi (1979)). More recent literature has tried to provide a rigorous foundation for the kinked demand curve in terms of search theory or game theory. One strand (Okun (1981), Woglom (1982), MacDonald (1987,1990), Ball and Romer (1990)) focuses on "customer markets", by which is meant markets where the frequency of search is low relative to the frequency of purchase. Thus agents tend to patronise one shop for several periods, being well-informed of the price in their chosen shop but not of other prices. This gives rise to a kink in the firm's demand curve: if it raises its price, it will lose customers who will shop elsewhere; however if it lowers its price, it will (in the short run) attract relatively few customers, since those patronising other shops will not know of the price cut unless they engage in search. Another strand focusses on developing a formal game-theoretic model of the asymmetric price responses of competitors which underlies the traditional kinked demand curve (Bhaskar (1988, 1990)).

6. Conclusions

What has imperfect competition added to the macroeconomic interest of the Walrasian model? First, it generates a sub-optimally low level of output and employment, which is an apparently

pervasive feature of real economies. This is no great surprise, since it is suggested by any partial equilibrium model of imperfect competition, but the macromodels in addition enable us to see inefficiently low output as resulting from a coordination failure amongst imperfectly competitive agents. Whereas under partial equilibrium coordination increases market power and so the monopolistic distortion, under general equilibrium coordination can bring about a Pareto-improving move *towards* Walrasian equilibrium. Moreover *multiple* equilibria are more likely to arise when there is imperfect competition, to the extent that both features are likely to be the product of increasing returns. Unlike Walrasian equilibria, multiple imperfectly competitive equilibria are Pareto-rankable. This again creates scope for coordination, this time to raise expectations and so flip the economy from a low- to a high-welfare equilibrium.[29]. Second, closely associated with low output, imperfectly competitive economies typically generate unemployment. When there is imperfect competition in the labour market, such unemployment is involuntary in the sense that there are individuals who would prefer to work more at the prevailing wage. Even where it is voluntary, as occurs with a competitive labour market, it is above the Pareto-efficient level of unemployment.

The focus of our survey has been on policy effectiveness. As regards fiscal policy, imperfect competition adds several important new mechanisms whereby policy can affect output, and modifies others. It is notable that, so long as money remains neutral, there is no general presumption in favour of a positive rather than a negative effect of a fiscal expansion on output. The transmission mechanisms are different from those of the Keynesian multiplier, and the sign of the effect depends on features which in a Walrasian economy are of little importance, such as relative price elasticities of private- and public-sector demands, or the sectoral allocation of spending. We may be tempted to think of these mechanisms as "supply side" ones, but this would be incorrect, since they operate primarily via demand. Imperfect competitition tends to undermine the convenient textbook demand-side/supply-side dichotomy. However, the really crucial difference between fiscal policy in Walrasian and imperfectly competitive economies is on the *welfare* side. Since output and employment are inefficiently low, it is much more likely that a

29 Silvestre (1991) makes a very helpful distinction between this type of coordination and the previous type, and suggests referring to the former instead as "cooperation": the difference is that where there is a unique equilibrium modification of agents' decision rules is required, not just a "bootstraps" shift in expectations.

fiscal policy change which increases output will bring about an increase welfare (even if not necessarily a Pareto improvement). This is never true in Walrasian models, where if government expenditure is pure "waste", an increase will always reduce welfare, irrespective of the change in employment.

As regards monetary policy, it was acknowledged from the start that we require some second distortion in addition to imperfect competition to generate real effects. The importance of imperfect competition is that without it the distortion would cause no, or else only negligible, non-neutralities. Provided it is present, monetary policy, unlike fiscal policy, almost never has a negative effect on output, and the general behaviour of the economy is much closer to that of traditional macroeconomic theory. The essential reason for this is that there is then some form of endogenous nominal rigidity in the economy. The study of imperfectly competitive macroeconomies thus helps to reinforce the view.- which is still not especially widespread - that to generate some type of *nominal* rigidity is an essential part of any explanation of traditional macroeconomic policy effects.

In looking at promising avenues for future research, two relatively unexplored areas which we may note are extensions to the open economy and to dynamic models. Work on the former exists primarily in the shape of studies of exchange rate pass-through, by Dornbusch (1987), Giovannini (1988), Froot and Klemperer (1989) and others. This could be profitably merged with studies of policy effectiveness in the open economy such as those of Christodoulakis and Weale (1990) and Dixon (1990a).. An example of recent progress in this direction is the paper by Rivera-Campos (1991). Work on dynamic models of imperfectly competitive macroeconomies exists in the papers by, amongst others, Caplin and Spulber (1987), Caplin and Leahy (1991) Jacobsen and Schultz (1989) Pagano (1990), and Rankin (1992). This is still a fairly disparate set of contributions: in particular, the complex strategic issues which potentially arise in the intertemporal setting have yet to be incorporated into macroeconomics. Beyond these areas, much future work is likely to focus on models which generate nominal rigidities, in view of the importance of these to traditional channels of policy effectiveness. Of the three sources of monetary non-neutrality which we have reviewed, the dominant one has been menu costs. However serious questions remain for the menu cost approach, such as whether it is reasonable that for a sufficiently large monetary

shock neutrality will prevail. A difficult but potentially rewarding sequel to this work would be to model not the administrative costs of price adjustment faced by firms, but the costs imposed on imperfectly informed customers, and thus indirectly on firms. This suggests that we should introduce uncertainty and information problems as explicit new ingredients in imperfectly competitive models. Some macroeconomic implications of these have begun to be explored, for example by Andersen and Hviid (1989, 1990).

References

Akerlof, G.A. and Yellen, J.L. (1985a) "A Near-Rational Model of the Business Cycle with Wage and Price Inertia", *Quarterly Journal of Economics* 100 (Supp.), pp.823-838

———————— (1985b) "Can Small Deviations from Rationality Make Significant Differences to Economic Equilibria?", *American Economic Review* 75,pp.708-721

Andersen, T.M. and Hviid, M. (1989) "Imperfect Competition, Information Acquisition and Price Adjustment", Memo 1989-11, Institute of Economics, University of Aarhus

———————— (1990) "Asymmetric Information and Price Stickiness in Imperfectly Competitive Markets", Discussion Paper 90-10, Institute of Economics, University of Copenhagen

Ball, L. and Romer, D. (1989) "Are Prices Too Sticky?", *Quarterly Journal of Economics* 104, pp.507-524

———————— (1990) "Real Rigidities and the Non-Neutrality of Money", *Review of Economic Studies* 57, pp.183-203

———————— (1991) "Sticky Prices as Coordination Failure", *American Economic Review* 81, pp.539-552

Baran, P.A. and Sweezy, P.M. (1966) *Monopoly Capital* , New York: Monthly Review Press

Barro, R.J. (1972) "A Theory of Monopolistic Price Adjustment", *Review of Economic Studies* 34, pp.17-26

————————.and Grossman, H.I. (1971) "A General Disequilibrium Model of Income and Employment", *American Economic Review* 61, pp.82-93

Benassy, J.-P. (1975) "Neo-Keynesian Disequilibrium Theory in a Monetary Economy", *Review of Economic Studies* 42, pp.503-523

———————— (1976) "A Disequilibrium Approach to Monopolistic Price Setting and General Monopolistic Equilibrium", *Review of Economic Studies* 43, pp.69-81

———————— (1978) "A Neo-Keynesian Model of Price and Quantity Determination in Disequilibrium", in Schwodiauer, G. (ed.) *Equilibrium and Disequilibrium in Economic Theory* , Dordrecht: Reidel

———————— (1987) "Imperfect Competition, Unemployment and Policy", *European Economic Review* 31, pp.417-426

———————— (1990) "Non-Walrasian Equilibria, Money and Macroeconomics", in B. Friedman and F.H. Hahn (eds.) *Handbook of Monetary Economics*, Amsterdam: North-Holland

Bhaskar, V. (1988) "The Kinked Demand Curve: A Game-Theoretic Approach", *International Journal of Industrial Organisation* 6, pp. 373-384

———————— (1990) "Wage Relativities and the Natural Range of Unemployment", *Economic Journal* 100 (Supp.), pp. 60-66

Blanchard, O.J. and Fischer, S. (1989) *Lectures on Macroeconomics*, Cambridge MA: MIT Press

Blanchard, O.J. and Kiyotaki, N. (1987) "Monopolistic Competition and the Effects of Aggregate Demand", *American Economic Review* 77, pp.647-666

Calmfors, L. and Driffill, J. (1988) "Bargaining Structure, Corporatism and Macroeconomic Performance", *Economic Policy* 6, pp.13-61

Caplin, A. and Leahy, J. (1991) "State-Dependent Pricing and the Dynamics of Money and Output", *Quarterly Journal of Economics* , ?, pp.??

Caplin, A. and Spulber, D. (1987) "Menu Costs and the Neutrality of Money", *Quarterly Journal of Economics* 102, pp.703-726

Chatterjee, S. and Cooper, R. (1989) "Multiplicity of Equilibria and Fluctuations in Dynamic Imperfectly Competitive Economies", *American Economic Review* 79 (P&P), pp.353-357

Christodoulakis, N. and Weale, M. (1990) "Imperfect Competition in an Open Economy", Working Paper ECO 90/29, European University Institute, Florence

Cooper, R. and John, A. (1988) "Coordinating Coordination Failures in Keynesian Models", *Quarterly Journal of Economics* 83, pp.441-463

D'Aspremont, C., Dos Santos Ferreira, R. and Gerard-Valet, L.-A. (1989) "Unemployment in an Extended Cournot Oligopoly Model", *Oxford Economic Papers* 41, pp.490-505

———————————————————————— (1990) "On Monopolistic Competition and Involuntary Unemployment", *Quarterly Journal of Economics* 85, pp.895-919

Dehez, P. (1985) "Monopolistic Equilibrium and Involuntary Unemployment", *Journal of Economic Theory* 36, pp.160-165

Dertouzos, J. and Pencavel, J. (1984) "Wage-Unemployment Determination Under Trade Unionism: The International Typographical Union", *Journal of Political Economy* 89, pp. 1162-1181

Diamond, P. (1965) "National Debt in a Neoclassical Growth Model", *American Economic Review* 55, pp.503-511

Dixit, A. and Stiglitz, J. (1977) "Monopolistic Competition and Optimum Product Diversity", *American Economic Review* 67, pp.297-308

Dixon, H. (1987) "A Simple Model of Imperfect Competition with Walrasian Features", *Oxford Economic Papers* 39, pp.134-160

———— (1988) "Unions, Oligopoly and the Natural Range of Employment", *Economic Journal* 98, pp.1127-1147

———— (1990a) "Macroeconomic Policy with a Floating Exchange Rate and a Unionised Non-Traded Sector", *Economic Journal* 100 (Supp.), pp.78-90

———— (1990b) "Imperfect Competition, Unemployment Benefit and the Non-Neutrality of Money: An Example in the Spirit of Hart", *Oxford Economic Papers* 42, pp.402-413

———— (1991) "Macroeconomic Equilibrium and Policy in a Large Unionised Economy", *European Economic Review* 35, pp. 1427-1448

———— (1992a) "Nominal Wage Rigidity in a Unionised Economy", *The Manchester School*, forthcoming

———— (1992b) "Imperfect Competition and Open-Economy Macroeconomics", in F. van der Ploeg (ed.) *Handbook of International Macroeconomics*, Oxford: Blackwell, forthcoming

Dornbusch, R. (1987) "Exchange Rates and Prices", *American Economic Review* 77, pp.93-106

Dow, J.C.R. (1964).*The Management of The British Economy 1945-60*, Cambridge: Cambridge University Press

Fender, J. and Yip, C.Y. (1990) "Aggregate Demand Management Policies in an Intertemporal Macroeconomic Model with Imperfect Competition", mimeo., Dept of Economics, Pennsylvania State University

Fischer, S. (1977) "Long Term Contracts, Rational Expectations and the Optimal Money Supply Rule", *Journal of Political Economy* 85, pp.163-190

Frank, J. (1990) "Monopolistic Competition, Risk Aversion and Equilibrium Recessions", *Quarterly Journal of Economics* 85, pp.921-938

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

Froot, K.A. and Klemperer, P.D. (1989) "Exchange Rate Pass-Through When Market Share Matters", *American Economic Review* 79, pp.637-654

Giovannini, A. (1988) "Exchange Rates and Traded Goods Prices", *Journal of International Economics* 24, pp.45-68

Grandmont, J.M. (1983) *Money and Value*, Cambridge: Cambridge University Press

Green, R. and Weale, M.R. (1990) "Macroeconomic Policy with Increasing Returns to Scale", mimeo., Department of Applied Economics, University of Cambridge

Hahn, F.H. (1978) "On Non-Walrasian Equilibria", *Review of Economic Studies* 45, pp.1-17

———— (1982) *Money and Inflation*, Oxford: Blackwell

Haltiwanger, J. and Waldman, M. (1989) "Limited Rationality and Strategic Complements: The Implications for Macroeconomics", *Quarterly Journal of Economics* 104, pp.463-483

Hart, O.D. (1982) "A Model of Imperfect Competition with Keynesian Features", *Quarterly Journal of Economics* 97, pp.109-138

Hillier, B. Lambert, P. and Turner, R. (1982) "Macroeconomics with Non-Perfect Competition: A Comment", *Economic Journal* 92, pp.701-705

Jacobsen, H.J. and Schultz, C. (1988) "The Effectiveness of Economic Policy in a General Equilibrium Macromodel with Wage Bargaining and Rational Expectations", mimeo., Institute of Economics, University of Copenhagen

———————————— (1989) "Wage Bargaining and Unemployment in a General Equilibrium Model", Discussion Paper 89-01, Institute of Economics, University of Copenhagen

———————————— (1990) "A General Equilibrium Macromodel with Wage Bargaining", *Scandinavian Journal of Economics* 92, pp.379-398

Jones, S.R.G. and Stock, J.H. (1987) "Demand Disturbances and Aggregate Fluctuations: The Implications of Near-Rationality", *Economic Journal* 97, pp.49-64

Kiyotaki, N. (1988) "Multiple Expectational Equilibria under Monopolistic Competition", *Quarterly Journal of Economics* 103, pp.695-713

Layard, R. and Nickell, S. (1985) "The Causes of British Unemployment", *National Institute Economic Review* 111, pp.62-85

———————————— (1986) "Unemployment in the UK", *Economica* 53 (Supp.), pp.121-166

Lindbeck, A. and Snower, D.J. (1989) *The Insider-Outsider Theory of Employment and Unemployment*, Cambridge MA: MIT Press

MacDonald, I.M.(1987) "Customer Markets, Trade Unions and Stagflation", *Economica* 54, pp.139-153

———————— (1990) *Inflation and Unemployment,* Oxford: Blackwell

———————— and Solow, R.M. (1981) "Wage Bargaining and Employment", *American Economic Review* 71, pp.896-908

Madden, P. and Silvestre, J. (1988) "Imperfect Competition and Fixprice Equilibria", Discussion Paper ES195, Dept. of Econometrics, University of Manchester (forthcoming in *Scandinavian Journal of Economics*)

Malinvaud, E. (1977) *The Theory of Unemployment Reconsidered* , Oxford: Blackwell

Mankiw, N.G. (1985) "Small Menu Costs and Large Business Cycles: A Macroeconomic Model of Monopoly", *Quarterly Journal of Economics* 100, pp.529-537

———————— (1988) "Imperfect Competition and the Keynesian Cross", *Economics Letters* 26, pp.7-13

Manning, A. (1990) "Imperfect Competition, Multiple Equilibria and Unemployment Policy", *Economic Journal* 100 (Supp.) pp. 151-162

———————— (1991) "Multiple Equilibria in the British Labour Market: Some Empirical Evidence", CEPR Discussion Paper no. 540

Molana, H. and Moutos, T. (1992) "A Note on Taxation, Imperfect Competition and the Balanced-Budget Multiplier", *Oxford Economic Papers*, forthcoming

Moutos, T. (1991) "Turnover Costs, Unemployment and Macroeconomic Policies", *European Journal of Political Economy* 7, pp.1-16

Negishi, T. (1961) "Monopolistic Competition and General Equilibrium", *Review of Economic Studies* 28, pp.196-201

———————— (1979) *Microeconomic Foundations of Keynesian Macroeconomics*, New York: North Holland

Ng, Y.-K. (1980) "Macroeconomics with Non-Perfect Competition", *Economic Journal* 90, pp.598-610

———— (1982a) "A Micro-Macroeconomic Analysis Based on a Representative Firm", *Economica* 49, pp.121-139

———— (1982b) "Macroeconomics with Non-Perfect Competition: A Reply to Hillier, Lambert and Turner", *Economic Journal* 92, pp.706-707

———— (1986) *Mesoeconomics:A Micro-Macro Analysis*, Brighton:Wheatsheaf

Okun, A.M. (1981) *Prices and Quantities: A Macroeconomic Analysis*, Brookings Institution, Washington DC

Oswald, A.J. (1985) "The Economic Theory of Trade Unions: An Introductory Survey", *Scandinavian Journal of Economics* 87, pp.160-193

Pagano, M. (1990) "Imperfect Competition, Underemployment Equilibria and Fiscal Policy", *Economic Journal* 100, pp.440-463

Pencavel (1984) "The Trade-Off Between Wages and Employment in Union Objectives", *Quarterly Journal of Economics* 99, pp.215-232

Rankin, N.(1988) "Monetary and Fiscal Policy in a 'Hartian' Model of Imperfect Competition", Discussion Paper No.182, Economics Dept., Queen Mary College, London; forthcoming in Bacharach, M., Dempster, M. and Enos. J. (eds.), *Mathematical Models in Economics*, Oxford: Oxford University Press

———— (1992) "Imperfect Competition, Expectations and the Multiple Effects of Monetary Growth", *Economic Journal* 102, pp.., forthcoming

Rivera-Campos, R. (1991) "Short-Run and Long-Run Effects of Devaluation in a Macromodel of Imperfect Competition", mimeo., Dept. of Economics, University of Warwick

Rotemberg, J.J. (1982) "Monopolistic Price Adjustment and Aggregate Output", *Review of Economic Studies* 49, pp.517-531

Salop, S.C. (1979) "Monopolistic Competition with Outside Goods", *Bell Journal of Economics* 10, pp.141-156

Schultz, C. (1989) "The Impossibility of 'Involuntary Unemployment' in an Overlapping Generations Model with Rational Expectations", mimeo, Institutre of Economics, University of Copenhagen

Shesinski, E. and Weiss, Y. (1977) "Inflation and Costs of Price Adjustment", *Review of Economic Studies* 44, pp.287-304

———————————— (1983) "Optimal Pricing Policy Under Stochastic Inflation", *Review of Economic Studies* 50, pp.513-529

Silvestre, J. (1990) "There May be Unemployment When the Labour Market is Competitive and the Output Market is Not", *Economic Journal* 100,pp.899-913

———— (1991) "The Market-Power Foundations of Macroeconomic Policy", Working Paper No.374, Economics Dept., University of California at Davis

Solow, R.M. (1986) "Monopolistic Competition and the Multiplier", in Heller, W., Starr, R. and Starrett, D. (eds.) *Equilibrium Analysis: Essays in Honour of K.J. Arrow*, Vol.2, Cambridge: Cambridge University Press

Snower, D.J. (1983) "Imperfect Competition, Underemployment and Crowding Out", *Oxford Economic Papers* 35 (Supp.), pp.245-270

Startz, R. (1989) "Monopolistic Competition as a Foundation for Keynesian Macroeconomic Models", *Quarterly Journal of Economics* 104, pp.737-752

Svensson, L. (1986) "Sticky Goods Prices, Flexible Asset Prices, Monopolistic Competition and Monetary Policy", *Review of Economic Studies* 53, pp.385-405

Taylor, J.(1979) "Staggered Price Setting in a Macro Model", *American Economic Review* 69, pp.108-113

Thomas, J.P. (1982) "Fiscal and Monetary Policy under Monopolistic Competition", mimeo., St. Catherine's College, Oxford

Weitzman, M.L. (1982) "Increasing Returns and the Foundations of Unemployment Theory", *Economic Journal* 92, pp.787-804

Woglom, G. (1982) "Underemployment Equilibrium with Rational Expectations", *Quarterly Journal of Economics* 97, pp. 89-107

Wren-Lewis, S. (1985) "Imperfect Competition and Effective Demand in the Long Run", Discussion Paper No. 98, NIESR