2 Imperfect Competition and Open Economy Macroeconomics

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1 Introduction

There is now a large and established literature on imperfect competition in closed economies, surveyed by Dixon and Rankin (1994) and Silvestre (1993). The origins of this literature stemmed from the desire to make prices endogenous in the fix-price models of the 1970s (see, for example, Benassy, 1976, 1978; Negishi, 1979). The literature took off, however, with Hart's (1982) paper, which provided a simple and tractable model with a clear macroeconomic content. Since then, on both sides of the Atlantic there has been the development of the New Keynesian school of macroeconomics which seeks to put imperfect competition at the center of macroeconomic models (see *inter alia* Akerlof and Yellen, 1985; Mankiw, 1985; Blanchard and Kiyotaki, 1987; Benassy, 1987; Dixon, 1987, 1988). This approach provides the most coherent challenge to the Walrasian view of the New Classical macroeconomics.

It is worthwhile to state the case for imperfect competition in macroeconomic models. First, in a Walrasian framework (of whatever vintage) there is little or no scope in principle for macroeconomic policy to be effective or useful. From the two fundamental theorems of welfare economics, we know that Walrasian equilibria are Pareto optimal as long as there is a complete system of (spot and forward) contingent markets. If we start from a position of Pareto optimality, then typically there will be little or no role for government intervention of any kind, and in particular no role for macroeconomic intervention. With imperfect competition, in contrast, the equilibrium itself is not typically Pareto optimal – as in the prisoner's dilemma, agents acting strategically in their own interest will give rise to a socially suboptimal

(Pareto-inefficient) outcome. Imperfect competition provides a more satisfactory framework in which to evaluate the need for and effects of macroeconomic policy. Second, imperfect competition provides a more satisfactory model of wage and price determination than does the competitive "supply-and-demand" framework. There is a central paradox in competitive markets, where all agents are assumed to be price-takers, yet prices need to adjust to clear markets. No such paradox is present in imperfectly competitive models, where optimizing agents set wages and prices. Furthermore, imperfectly competitive models often *generalize* the competitive model in the sense that perfect competition is often a special or limiting case of imperfect competition. Last, but not least, there is the empirical observation that in many markets in many countries market power is exercised, whether we are talking about highly concentrated product markets or unionized labor markets.

The main theme to emerge from the literature in imperfect competition and macroeconomics is that the welfare properties of equilibrium and policy are radically different from the Walrasian case. First, imperfect competition in either the output or the labor market typically gives rise to a Pareto-inefficient equilibrium in which there is too little output and employment (one need only consider the standard models of the monopolist or monopoly union). Second, if we start from a situation where the market prices of output and/or labor exceed their social shadow price, any policy (monetary or fiscal) that raises output is more likely to have a welfare-improving effect than in Walrasian models. See, for example, the beneficial effects of monetary policy with menu costs (Akerlof and Yellen, 1985; Mankiw, 1985; Blanchard and Kiyotaki, 1987), and of fiscal policy (Benassy, 1991; Dixon, 1990b, 1991).

There has, as yet, been little literature developing the theme of imperfect competition in open economy models. This literature divides into three groups. First, there is the issue of exchange rate pass-through concerned with how prices respond to a devaluation of the exchange rate. Most of these models have been of a partial equilibrium nature, exploring an oligopolistic output market with home and foreign firms competing. A devaluation then alters the relative costs of home and foreign firms, leading also to changes in prices (see, for example, Aizenman, 1989; Dornbusch, 1987; Froot and Klemperer, 1989; Giovannini, 1988). By focusing on the product market, treating costs (such as wages) as unaffected by devaluation, these papers ignore any long-run general equilibrium effects of a devaluation. The only paper to evaluate pass-through in a general equilibrium imperfectly competitive framework is that of Campos (1991). Second, there is the issue of real-wage resistance. This has been explored in an open economy wage-bargaining model by Ellis and Fender (1987). Third, there is the issue of standard monetary and fiscal policy effectiveness under different nominal exchange rate regimes. This has been explored for a unionized economy under floating exchange rates by Dixon (1990a). Helpman (1988) also considers the effect of price controls on the macroeconomic impact of demand changes in a small open economy.

In this chapter we shall develop a simple general equilibrium macromodel of an open economy. We have chosen to focus on imperfect competition in the output market, leaving the labor market perfectly competitive. This is not because we believe that labor markets are actually competitive. Far from it. Rather, we want to show that, even with labor-market clearing, imperfect competition in the output market is on its own enough to generate substantially different welfare effects for policy. Indeed, throughout the chapter we shall focus on the welfare analysis of policy (and its contrast with the Walrasian case).

2 A two-sector model of a small open economy

We shall be considering a two-sector model of a small open economy. The precise interpretation of the two sectors will vary slightly. However, we can specify them broadly as follows.

1 The *domestic sector* consists of oligopolistic industries meeting domestic consumer demand. In the absence of any foreign competition, this will be a *nontraded* sector. Firms in this sector have market power, and an increasing returns to scale technology.
2 The *export sector* consists of perfectly competitive price-taking firms who supply a traded good to foreign and domestic consumers at exogenous world prices. Following Neary (1980), we abstract from the distinction between goods which are net exports and net imports. These firms are assumed to have diminishing returns to scale.

It should be immediately apparent that the presence of increasing returns to scale in the domestic sector marks a decisive shift away from the competitive paradigm, as has been seen in the new international trade theory. The government is assumed to spend money purchasing the output of the domestic sector. This expenditure is regarded as "waste." Whilst we recognize that this is not a very realistic assumption (most government expenditure goes on health and education), it serves to focus on the purely *macroeconomic* implications of fiscal policy. For similar reasons, the government raises a lump-sum tax (for the alternative treatments of taxation in imperfectly competitive models, see Molana and Moutos (1992)).

Clearly, the choice of model structure for this chapter is one of many possible ways of modeling an imperfectly competitive open economy. For example, we could have allowed unions in the labor market. We could have allowed for imperfect competition in the export sector. Perfect competition in the export sector is mainly for parsimony, since it means that we need not model the rest of the world in any detail. This chapter focuses on imperfect competition in the *output* market, in contrast with the existing papers in the open economy literature (Ellis and Fender, 1987; Dixon, 1990a). Clearly, the exercise of market power by unions can lead to real wages above the market clearing level, and hence to some form of involuntary unemployment. However, as we shall see, the presence of imperfect competition in the domestic sector output market is *in itself* a cause of distortion leading to Pareto suboptimality, and also it is enough to make possible welfare-improving monetary and fiscal policy. The implications of firm–union bargaining in the framework developed in this chapter are explored in Dixon and Santoni (1992).

2.1 Households

There is a continuum of measure H (or just plain H households) who each supply up to one unit of labor. Since we shall be assuming that households have suitable preferences for aggregation, we shall save notation by dealing with a single leviathan (or representative) household with H units of labor. This household consumes domestic sector output c^{D}, traded sector output c^{T}, and real money balances (where the latter can be derived as a mixed indirect utility function or proxy for an overlapping generations model (see Campos, 1991). Initial money balances are denoted M^0, and end-of-period balances M. Household preferences take the form

$$c^{-c}(1-c)^{-(1-c)}[u(c^{\mathrm{D}}, c^{\mathrm{T}})]^{c}\left[\frac{M}{P(p^{\mathrm{D}}, p^{\mathrm{T}})}\right]^{1-c} - \theta N \qquad (2.1)$$

where N is employment, θ is the disutility of work, u is a homothetic subutility function, and $P(\mathrm{p}^{\mathrm{D}}, p^{\mathrm{T}})$ stands for the corresponding cost-of-living function. Although much of the analysis of this chapter could be carried through for the general case of homothetic preferences (see, for example, Dixon, 1990a, 1992), we shall assume that u is Cobb–Douglas:

$$u(c^{D}, c^{T}) = (c^{D})^{1-m}(c^{T})^{m}[m^{m}(1-m)^{1-m}]^{-1} \tag{2.2a}$$

$$P(p^{D}, p^{T}) = (p^{D})^{1-m}(p^{T})^{m} \tag{2.2b}$$

The household's budget constraint is

$$p^{D}c^{D} + p^{T}c^{T} + M \leq wN + \Pi + M^{0} - T$$

where w is the nominal wage rate, Π denotes nominal profits, and T stands for the lump-sum tax levied by the government. We can aggregate over total wage and profit income to denote the total (flow component) of household income as

$$Y = wN + \Pi \tag{2.3}$$

where Y is of course to be determined. However, we can note that, *given* Y, the household follows a two-stage budgeting decision. In the first stage it allocates a proportion c of total funds $Y + M^{0} - T$ to consumption and a proportion $1 - c$ to money balances ("saving"). For obvious reasons c is interpreted as the marginal propensity to consume. In the second stage, the household uses subutility function (2.2a) to allocate its total expenditure between the domestic sector and export sector outputs. Since u is itself Cobb–Douglas, the consumer budget shares of the goods produced by the domestic and export sectors are constant:

$$p^{D}c^{D} = (1-m)c(Y + M^{0} - T) \tag{2.4a}$$

$$p^{T}c^{T} = mc(Y + M^{0} - T) \tag{2.4b}$$

For obvious reasons we can identify the preference parameter m as the marginal propensity to import.

From (2.1) the labor supply decision is very simple. If the real wage exceeds θ, the household wishes to supply H units of labor; if it equals θ it is indifferent between work and leisure; if it is less than θ the household will not work. Throughout this chapter, we shall be assuming that the real wage equals θ, so that the labor market clears at a level of employment below H:

$$\frac{w}{P(p^{D}, p^{T})} = \theta \qquad N < H \tag{2.5}$$

The actual level of employment will be demand determined. We are assuming a single economy-wide labor market, with perfect labor mobility between sectors.

2.2 The export sector

In the export sector, perfectly competitive firms produce a traded good whose foreign currency price p^* in world markets is fixed. Hence the domestic currency price is

$$p^{\mathrm{T}} = ep^*$$

where e is the exchange rate, the quantity of domestic currency necessary to buy one unit of foreign currency. Aggregating over firms, employment in this sector is N^{T}, and output is given by

$$x^{\mathrm{T}} = (N^{\mathrm{T}})^{\alpha}$$

Given the domestic wage w, the profit-maximizing levels of output and employment of the firm are

$$x^{\mathrm{T}} = \left(\frac{ep^*}{w}\alpha\right)^{\alpha/(1-\alpha)} \tag{2.6a}$$

$$N^{\mathrm{T}} = \left(\frac{ep^*}{w}\alpha\right)^{1/(1-\alpha)} \tag{2.6b}$$

2.3 The domestic sector

We shall assume initially that the goods produced by the domestic sector are not traded, although in section 7 we allow for foreign competition. We conceive of the domestic sector as consisting of a large number of identical industries, but formally we shall deal with one "representative" industry. In this industry there are a fixed number n of home firms who act as Cournot–Nash competitors (we allow for free entry and exit in section 6). Each firm i has an increasing returns technology:

$$x_i = N_i - \bar{N}$$

Industry demand is given by the sum of household and government demand. Household demand is given by (2.4a) and is unit elastic (given Y, to be determined below). We shall also assume that government expenditure G is fixed in *nominal* terms. This is realistic in the UK, and convenient, since this simplification rules out any "elasticity effect" of government expenditure (see Dixon and Rankin, 1994). Each firm acts as a Cournot competitor, choosing its output given the outputs of other firms in its industry. The firm's objective demand curve is thus

$$p^{\mathrm{D}} = \frac{G + (1-m)c(Y + M^0 - T)}{\sum_{j=i}^{n} x_j} \tag{2.7a}$$

The firm's nominal profits are

$$(p^{\mathrm{D}} - w)x_i - w\bar{N} \qquad (2.7\mathrm{b})$$

The firm is assumed to maximize nominal profits, equation (2.7b), subject to the objective demand curve (2.7a). Nominal profit maximization is reasonable if there are many industries in the domestic sector, so that any one has little effect on the general price level.

Given unit-elastic industry demand, with n firms there is a unique symmetric Cournot–Nash equilibrium in which price is a mark-up on marginal cost w:

$$p^{\mathrm{D}} = \frac{n}{n-1} w \qquad (2.8\mathrm{a})$$

Demand in the domestic sector is given by

$$x^{\mathrm{D}} = g + c^{\mathrm{D}}$$

where c^{D} is derived from (2.8a) and (2.4a), whilst *real* government expenditure g is

$$g = G/p^{\mathrm{D}}$$

Employment in the domestic sector is

$$N^{\mathrm{D}} = x^{\mathrm{D}} + n\bar{N}$$

A more useful way of writing the oligopolistic price equation is to express it in terms of the disutility of labor, using (2.5):

$$\frac{p^{\mathrm{D}}}{P(p^{\mathrm{D}}, p^{\mathrm{T}})} = \frac{n}{n-1}\theta \qquad (2.8\mathrm{b})$$

This equation states that the real price of domestic output is a mark-up over the disutility of labor. Clearly, as n becomes larger, the mark-up tends to unity (the competitive price). This mark-up in the domestic sector, equation (2.8), represents the only distortion introduced in this model. The real price of output exceeds the marginal social cost θ of its production.

2.4 Balance of payments and nominal national income

The balance of trade surplus S in terms of domestic currency is simply the difference between the value of the total expenditure on the traded good and its output (often called net exports):

$$S \equiv ep^* x^{\mathrm{T}} - mc(Y + M^0 - T) \qquad (2.9)$$

The national income is equal to the sum of the total home consumption of outputs C, plus government expenditure G plus net exports S. From (2.9) and (2.4)

$$\begin{aligned} Y &= C + G + S \\ &= c(Y + M^0 - T) + G + [ep^*x^{\mathrm{T}} - cm(Y + M^0 - T)] \end{aligned}$$

Hence the equilibrium level of nominal national income is given by

$$Y = \frac{c(1-m)}{1-c(1-m)}(M^0 - T) + \frac{ep^*x^{\mathrm{T}} + G}{1-c(1-m)} \tag{2.10a}$$

This equation gives the income–expenditure equilibrium, since Y can be seen either as income (wages and profits of the home households in the domestic and export sectors) or as the flow of expenditure on home-produced outputs by home and foreign households. As we shall see in section 3, x^{T} is in fact constant in equilibrium. If we have balanced trade, so that $S = 0$, then (2.10a) simplifies to

$$Y = \frac{1}{1-c}[c(M^0 - T) + G] \tag{2.10b}$$

These equations can be used to substitute for equilibrium national income Y in the previous equations (2.4) and (2.7).

Lastly, we have the equation for the expansion in the domestic money supply from the various agents' budget constraints:

$$M - M^0 = S - T + G \tag{2.11}$$

This equation says simply that the three deficits (public, private, foreign) must all sum to zero. Monetary expansion (the gap between income and consumption) equals the budget deficit plus the balance of trade surplus.

3 Macroeconomic equilibrium

In this section we shall solve for equilibrium in the private sector *given* the exchange rate e and government policy (G, M^0, T). This is not a long-run equilibrium since we are not imposing balanced trade. We shall explore the long-run equilibrium in subsequent sections: section 5 achieves balanced trade through a floating exchange rate given the money supply; section 7 achieves balanced trade through changes in the domestic money supply given e. Because trade need not be balanced, we can consider the equilibrium in this section to be temporary or short run.

The model presented in section 2 is easily solved because it is recursive. It should be recalled throughout that we are treating e, M^0, G, and T as exogenous. Let us first take the wage and price equations ((2.2b), (2.5), (2.8b)):

$$p^{\mathrm{T}} = ep^*$$

$$P(p^{\mathrm{D}}, p^{\mathrm{T}}) = (p^{\mathrm{D}})^{1-m}(p^{\mathrm{T}})^m \tag{2.2b}$$

$$\frac{w}{P(p^{\mathrm{D}}, p^{\mathrm{T}})} = \theta \tag{2.5}$$

$$\frac{p^{\mathrm{D}}}{P(p^{\mathrm{D}}, p^{\mathrm{T}})} = \frac{n}{n-1}\theta \tag{2.8b}$$

We can solve these for (p^{D}, w) which yields

$$p^{\mathrm{D}} = ep^*\left(\frac{n\theta}{n-1}\right)^{1/m} \tag{2.12a}$$

$$w = ep^*\theta^{1/m}\left(\frac{n}{n-1}\right)^{(1-m)/m} \tag{2.12b}$$

What equations (2.12) tell us is that both the domestic wage and price become *pegged* to the price of tradeables ep^*. This happens because from (2.5) and (2.8b) both p^{D} and w are fixed relative to the cost-of-living index $P(p^{\mathrm{D}}, p^{\mathrm{T}})$. But since the price of tradeables is fixed at ep^*, this ties down both p^{D} and w (see for a similar result Dixon, 1990a, proposition 1). Another way of expressing this is to note that both equations (2.5) and (2.8b) are homogeneous of degree zero in $(p^{\mathrm{D}}, p^{\mathrm{T}}, w)$, so that both w and p^{D} are determined relative to p^{T}.

Having solved for nominal wages and prices, we can now solve for the output of the export sector, combining (2.6) with (2.12b):

$$X^{\mathrm{T}} = \left(\frac{ep^*}{w}\alpha\right)^{\alpha/(1-\alpha)} = \left[\alpha\left(\frac{n}{n-1}\right)^{(m-1)/m}\theta^{-1/m}\right]^{\alpha/(1-\alpha)} \tag{2.13}$$

Output in the traded sector is determined solely by the technology (α), preferences (m, θ), and the degree of competition in the *domestic* sector (n). Note that as n increases (the domestic sector is more competitive), the equilibrium output X^{T} increases. This is an interesting spillover (or "externality") from the imperfectly competitive sector to the competitive export sector which we shall explore in more detail in section 6. It is important to note for future policy analysis that equilibrium X^{T} is independent of both the exchange rate and government policy parameters (G, M^0, T). This is because the competitive firms' output depends only upon the own-product real wage w/ep^*. Since w is itself pegged to ep^* from (2.12b) it follows that the own-product real wage in the export sector is constant. Having determined X^T, it can be plugged into (2.10) to yield equilibrium Y.

Output and employment in the domestic sector follow straightforwardly. We know the level of demand and employment given Y and the nominal price level:

$$X^D = \frac{G + c(1 - m)(Y + M^0 - T)}{p^D} \tag{2.14a}$$

$$N^D = X^D + n\bar{N} \tag{2.14b}$$

Total employment N is simply the sum of employment in the two sectors:

$$N = N^T + N^D \tag{2.15}$$

where N^T is derived directly from (2.13) using the production function. For the model to be consistent with labor market equilibrium, we need the total labor demand (2.15) to be less than total labor supply H. This implies that the right-hand side determinants of X^D should not be too large (these are G, M^0, e, p^*).

How does the equilibrium in this section contrast with the Walrasian equilibrium? We shall explore this issue further in section 5 when we examine the equilibrium with a floating exchange rate. However, to compare the imperfectly competitive equilibrium with the Walrasian equilibrium, we can take the limit as the number of firms tends to infinity. If we do this, the following are easily verified.

1 p^D and w are lower in the Walrasian limit. From (2.12) they are both lower relative to ep^*.
2 X^T is larger in the Walrasian limit. As a result of (1), the own-product wage w/ep^* declines, thus stimulating output X^T.
3 Y is higher in the Walrasian limit. Since from (2) tradeables exports increase, this increases nominal national income from (2.10a).
4 X^D, N^D are higher in the Walrasian limit as a result of lower nominal w, p^D from (1) and higher nominal demand from (3).

None of these four comparisons is surprising. In a general equilibrium system the imperfections in one market can spill over to affect other markets. Most importantly, here the market imperfection in the domestic sector spills over and lowers output in the export sector, which has repercussions on equilibrium nominal national income.

4 Macroeconomic policy under a fixed exchange rate

In this section we shall examine the effect of macroeconomic demand management, in terms of its impact both on output and employment and on welfare. The analysis is concerned with the short run, in the sense that we shall not be imposing the condition of balanced trade on the economy, nor following through the effects of any trade surplus or deficit on the domestic money supply using (2.11). We shall examine the long-run equilibrium with a floating exchange rate in section 5 and with an endogenous money supply in section 7.

The economy we are considering is Walrasian in all of its aspects except that the domestic sector is a Cournot oligopoly. This means that the equilibrium does not satisfy the first fundamental theorem of welfare economics. Indeed, the equilibrium is Pareto suboptimal, since the consumers' marginal rate of substitution between domestic sector and export sector output does not equal the marginal rate of transformation (the latter being 1:1). Hence the most significant difference between the Walrasian equilibrium and imperfectly competitive equilibrium will be in welfare analysis.

4.1 Monetary policy

Let us first consider the short-run impact of monetary policy. Since money is the only asset in the model, monetary policy should be conceived of as a "helicopter drop" exercise. From section 3, we know that, given the exchange rate *e*, domestic nominal wages and prices become fixed in nominal terms. The effects of monetary policy are therefore very easy to follow through. An increase in the nominal money supply will increase initial real balances, leading to an increased demand for both the domestic and traded outputs. The increased demand for domestic sector output will lead to a direct increase in output and employment. Increased output comes at the cost of leisure forgone as employment increases. However, since the price of output is "too high," there is a surplus gained in the form of profits. It is best to explore this more formally. The welfare of the representative household is given by the indirect utility function corresponding to (2.1), given the level of employment (2.15):

$$V(p^{D}, p^{T}, Y + M^{0} - T, N) = \frac{Y + M^{0} - T}{P(p^{D}, p^{T})} - \theta N \qquad (2.16)$$

PROPOSITION 1 Under a fixed nominal exchange rate, an increase in M^0 leads to a Pareto-improving increase in output and employment.
PROOF Since $P(p^D, p^T)$ is constant, we have

$$\frac{dV}{dM^0} = \frac{1}{P}\left(1 + \frac{dY}{dM^0}\right) - \theta \frac{dN}{dM^0}$$

Turning first to dN/dM^0, note that, since N^T is fixed, only N^D can vary with M^0 from (2.14):

$$\frac{dN^D}{dM^0} = \frac{c(1-m)}{p^D}\left(\frac{dY}{dM^0} + 1\right)$$

From the mark-up equation

$$\frac{\theta}{p^D} = \frac{1}{P(p^D, p^T)} \frac{n-1}{n}$$

so that

$$\frac{dV}{dM^0} = \left(1 + \frac{dY}{dM^0}\right)\left[\frac{n - c(1-m)(n-1)}{n}\right]P^{-1} > 0 \qquad (2.17)$$

where of course from (2.10a)

$$\frac{dY}{dM^0} = \frac{(1-m)c}{1 - c(1-m)}$$

Note that we use the term "Pareto improvement," since the nominal income of no agent (wage-earner, shareholder) goes down and prices are constant.

If we consider (2.17) it is clear that, as n increases, the welfare improvement decreases. The reason for this is that the "surplus" earned in the domestic sector declines as it becomes more competitive. This surplus stems from the fact that the disutility of labor (the marginal social cost of output) is less than the real price of output. This is depicted in figure 2.1. As the monetary expansion shifts demand from DD to DD′, the shaded rectangle ABCD represents the difference between the value of the additional output and its cost. This is not the only source of welfare gain. The additional consumption of the traded output is bought (in the short run) with no cost in terms of increased employment since N^T is fixed. In the Walrasian limit only this factor is present, and the second term on the right-hand side reduces to $1 - c(1-m)$. The presence of imperfect competition clearly boosts the welfare gain from monetary expansion.

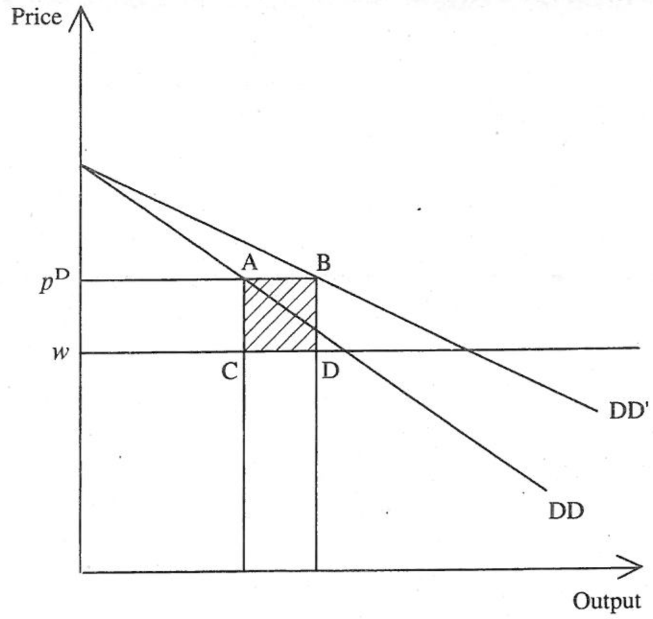

Figure 2.1 Imperfect competition and Pareto-improving monetary policy.

4.2 Fiscal policy

Let us turn to the consideration of fiscal policy. First, we shall deal with a *money-financed* increase in expenditure. As with monetary policy, since nominal prices are pegged to ep^*, the effects are fairly straightforward and Keynesian.

PROPOSITION 2 For a given nominal exchange rate and lump-sum tax T, the government expenditure multipliers are

$$\left.\frac{\mathrm{d}c^D}{\mathrm{d}g}\right|_T = \frac{c(1-m)}{1-c(1-m)}$$

$$\left.\frac{\mathrm{d}N}{\mathrm{d}g}\right|_T = \left.\frac{\mathrm{d}x^D}{\mathrm{d}g}\right|_T = \frac{1}{1-c(1-m)}$$

PROOF The proof follows directly from (2.14). Note that since p^{D} is fixed the derivative of *real* government expenditure with respect to nominal expenditure is

$$\frac{\mathrm{d}g}{\mathrm{d}G} = \frac{1}{p^{\mathrm{D}}}$$ □

Under a fixed exchange rate, there is a "crowding-in" effect in that the increase in government expenditure on the domestic sector output causes private sector expenditure ($c^{\mathrm{D}}, c^{\mathrm{T}}$) to increase. The welfare effects of a money-financed increase in G are very similar to the effects of a pure monetary policy:

$$\frac{dV}{dG} = \frac{dY}{dG}\left[\frac{1}{P(p^D, p^T)} - \theta \frac{dN}{dY}\right]$$

$$= \frac{1}{1 - c(1 - m)} \frac{1}{P(p^D, p^T)} \left[\frac{n - c(1 - m)(n - 1)}{n}\right]$$

Again the presence of the "surplus" in the domestic sector means that the welfare gain is enhanced by the monopoly power in the output market.

Lastly, we can consider the effects of a balanced-budget multiplier, with a government spending increase financed by lump-sum taxes ($G = T$).

PROPOSITION 3 Given a nominal exchange rate e, a tax-financed increase in government expenditure has a multiplier of unity and reduces welfare.

PROOF From (2.10a)

$$\left.\frac{dY}{dG}\right|_{BB} = 1$$

(BB, balanced budget). That is, the increase in nominal national income equals the increase in government expenditure. Private disposable income is constant, and hence so is (c^D, c^T), so that welfare is decreased:

$$\left.\frac{dV}{dG}\right|_{BB} = -\theta \frac{dN}{dG} \qquad \square$$

This proposition shows that a tax-financed increase in government expenditure will leave private disposable income (and hence consumption) unchanged. However, the increased output demanded by the government is produced by more work and thus less leisure, which reduces welfare. In terms of national income accounts, there is an increase in tax revenue which is offset by the increase in wages and profits received in the domestic sector.

Under a fixed nominal exchange rate, then, the fact that nominal wages and prices are fixed in equilibrium gives the model a textbook Keynesian flavor as only output responds to changes in nominal aggregate demand brought about by monetary and fiscal policy. The presence of an imperfectly competitive output market in the domestic sector, however, is sufficient to make the welfare effects of policy different from the Walrasian case.

5 Macroeconomic policy under a floating exchange rate

In the previous section we analyzed the short-run effects of macroeconomic policy under a fixed exchange rate without any condition for balanced trade. There are two mechanisms in this simple framework which can bring about balanced trade: (a) an adjustment in the nominal exchange rate; (b) an endogenous change in the domestic money supply. In this section we consider the mechanism of a floating nominal exchange rate and in section 7 the latter mechanism.

Recalling (2.9), the balance of payments surplus S is

$$S = ep^{*}X^{\mathrm{T}} - cm(Y + M^{0} - T) \tag{2.18}$$

Recall that from (2.13) the output of tradeables X^{T} is determined in equilibrium independently of e. From (2.10a) we have

$$Y + M^{0} - T = \frac{1}{1 - c(1 - m)}(ep^{*}X^{\mathrm{T}} + M^{0} + G - T)$$

Hence, solving (2.18) for $S = 0$ yields an expression for the nominal exchange rate:

$$e = \frac{cm}{1 - c}\,\frac{M^{0} + G - T}{p^{*}X^{\mathrm{T}}} \tag{2.19}$$

This equation is very intuitive. The exchange rate will be higher when the marginal propensities to consume and import (c, m) are higher, when domestic nominal demand is higher (as indicated by $M^{0} + G - T$), and when the output or foreign currency price of the export sector is larger.

We can now substitute the long-run equilibrium nominal exchange rate (2.19) into the equilibrium equations in section 3. From (2.12) we obtain

$$p^{\mathrm{D}} = \frac{cm}{1 - c}\,\frac{M^{0} - T + G}{X^{\mathrm{T}}}\left(\frac{n\theta}{n - 1}\right)^{1/m} \tag{2.20a}$$

and likewise for w. The price of tradeables in domestic currency is

$$p^{\mathrm{T}} = \frac{cm}{1 - c}\,\frac{M^{0} + (G - T)}{X^{\mathrm{T}}} \tag{2.20b}$$

The equilibrium cost-of-living index is given by

$$P(p^{\mathrm{D}}, p^{\mathrm{T}}) = \frac{cm}{1 - c}\,\frac{M^{0} + (G - T)}{X^{\mathrm{T}}}\left(\frac{n\theta}{n - 1}\right)^{(1 - m)/m} \tag{2.20c}$$

Equations (2.20) simply reflect the fact that domestic prices (and wages) are pegged to the domestic currency price of tradeables ep^*, which itself is determined by (2.19). If we combine equations (2.20) with the equation for nominal national income when there is balanced trade (equation (2.10b)), these price equations imply fixed domestic consumption of the domestic and traded good. The condition for balanced trade immediately implies that $c^{\mathrm{T}} = X^{\mathrm{T}}$. Turning to domestic sector output, this is obtained by combining (2.20c) with (2.4a) to yield (noting that Y is given by (2.10a)) an expression for consumption of home goods:

$$c^{\mathrm{D}} = \frac{1-m}{m} X^{\mathrm{T}} \left(\frac{n-1}{n\theta} \right)^{1/m} \tag{2.21}$$

where X^{T} is of course given by (2.13). c^{D} is in the long run independent of government policy (G, M^0, T) and is determined by household preferences, the export sector technology, and the degree of oligopoly.

The reasons behind the determination of c^{D} under balanced trade are simple enough. In equilibrium, nominal wages and prices are pegged to the nominal exchange rate e, which in effect fixes *relative* prices $p^{\mathrm{D}}/p^{\mathrm{T}}$. Furthermore, the output of tradeables in the export sector is determined by (2.13). Under balanced trade, domestic consumption of the traded good must equal its output, $c^{\mathrm{T}} = X^{\mathrm{T}}$. Given both relative prices and the quantity of the traded good to be consumed, the first-order tangency condition for utility maximization ties down the quantity of domestic output that must be consumed in any equilibrium, as depicted in figure 2.2. The ray through the origin IC is the income-expansion path depicting the allocation of expenditure between the domestic and traded goods as expenditure increases, given relative prices $p^{\mathrm{D}}/p^{\mathrm{T}}$. (It is linear because the subutility over consumption is homothetic.) On the horizontal axis is the quantity of the traded good X^{T}. The corresponding equilibrium consumption c^{D} of domestic output is obtained where the vertical broken line meets the income-expansion path at A. At this point, as depicted, the budget line bb is tangential to maximum utility u^*.

At this stage it is perhaps useful to compare the imperfectly competitive equilibrium with the Walrasian equilibrium. To do this, note that from (2.13) X^{T} is *increasing* in n. The Walrasian value for X^{T} is obtained by letting n approach infinity, which limit we denote by $X^{\mathrm{T}}(w)$. Furthermore, note that imperfect competition alters *relative* prices, and hence the slope of budget constraints and the income-expansion path. From (2.20) we obtain

$$\frac{p^{\mathrm{D}}}{p^{\mathrm{T}}} = \left(\frac{n\theta}{n-1} \right)^{1/m}$$

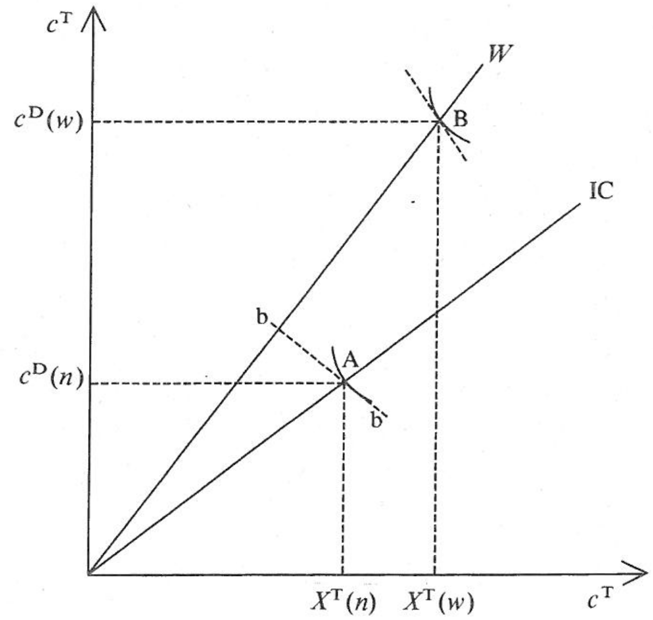

Figure 2.2 Equilibrium consumption with balanced trade.

Hence, as n increases, p^D falls relative to p^T, as we would expect. In figure 2.2, we have depicted the Walrasian income–expenditure path W, which lies "above" the imperfectly competitive income–expenditure path (IC), reflecting the fact that the optimal consumption of domestic output will be higher when its relative price is lower. Putting together the fact that X^T is larger and p^D/p^T is smaller in the Walrasian case, we can compare the consumption of domestic output in the Walrasian case ($c^D(w)$) with consumption of domestic output under imperfect competition ($c^D(n)$). The Walrasian equilibrium occurs at B and the imperfectly competitive equilibrium at A in figure 2.2. We have drawn in the corresponding budget line and indifference curves. As should be clear from figure 2.2 and the above arguments, c^D increases with n, i.e. decreases with the monopoly power of firms. This is easily verified directly from (2.21).

Under balanced trade, the welfare of the representative household is given by a simple expression. Using (2.20c) we obtain

$$V = \frac{Y + M^0 - T}{P(p^D, p^T)} - \theta N$$

$$= \frac{1}{cm}\left(\frac{n\theta}{n-1}\right)^{1-1/m} X^T - \theta N \qquad (2.22)$$

The first term on the right-hand side gives indirect utility from consumption and real balances. Since c^D, c^T and real balances are all tied down by the condition for balanced trade, this is *increasing* in the number of firms n, as we would expect from figure 2.2: imperfect competition reduces welfare. The second term on the right-hand side gives the disutility from work. This will tend to be increasing in n, since c^{D} and X^{T} and hence N increase with n.

Having analyzed the nature of long-run equilibrium with balanced trade under a floating exchange rate, we can now go on to analyze the effects of macroeconomic policy. In contrast with the case of a short-run fixed nominal exchange rate in section 4 which was rather Keynesian in its flavor, the long-run equilibrium is more classical. This mirrors the approach of the American New Keynesians in their closed economy analysis (Mankiw, 1992; Startz, 1989). From (2.22), in so far as policy does succeed in raising output and employment N, it must inevitably *reduce* welfare. Total employment is given by

$$N = N^{\mathrm{D}} + N^{\mathrm{T}} = c^{\mathrm{D}} + g + N^{\mathrm{T}} \tag{2.23}$$

where c^{D} is given by (2.21), N^{T} follows from (2.13), and *real* government expenditure g is given by

$$g = \frac{G}{p^{\mathrm{D}}} = \frac{1-c}{cm} \frac{X^{\mathrm{T}}G}{G + M^0 - T} \left(\frac{n\theta}{n-1} \right)^{-1/m} \tag{2.24}$$

Let us turn first to monetary policy. Since we are looking at long-run equilibrium with balanced trade we shall restrict ourselves to a balanced budget for the government (i.e. no monetary growth from (2.11)), so that $G = T$.

PROPOSITION 4 Monetary policy under a floating rate: assuming a balanced budget for the government

(a) if $G = 0$, $\mathrm{d}N/\mathrm{d}M^0 = 0$;
(b) if $G > 0$, $\mathrm{d}N/\mathrm{d}M^0 < 0$ and welfare is increasing in M^0.

PROOF The proof follows directly from (2.23) and (2.24) given $G = T$. Since c^{D} and c^{T} are constant (as trade balances)

$$\frac{\mathrm{d}N}{\mathrm{d}M^0} = \frac{\mathrm{d}g}{\mathrm{d}M^0} = -\frac{g}{M^0} \leq 0$$

Hence, if G (and hence g) is strictly positive, employment decreases and welfare increases with M^0.

In the absence of any fiscal policy ($G = T = 0$), money is neutral. This is because the equilibrium nominal exchange rate is proportional to M^0 (see (2.19)). In effect, *real money balances* are endogenously determined under balanced trade from (2.20c):

$$\frac{M^0}{P(p^{\mathrm{T}}, p^{\mathrm{D}})} = \frac{1-c}{cm} X^{\mathrm{T}} \left(\frac{n\theta}{n-1} \right)^{1-1/m} \tag{2.25}$$

A change in the domestic money supply simply leads to an equiproportionate rise in the nominal exchange rate, and thus also in p^{D} and p^{T}. In the presence of government expenditure/taxation, the rise in nominal prices engendered by the rise in M^0 reduces *real* government expenditure and hence employment.

Turning to fiscal policy, we find that the multiplier for *real* government expenditure is unity, which follows from the fact that c^{D} and X^{T} are fixed in equilibrium. This holds irrespective of how government expenditure is financed (see Dixon, 1990a, p. 84, proposition 2), although in proposition 5 below we shall conduct the analysis with a balanced budget.

PROPOSITION 5 Under a floating nominal exchange rate with a balanced government budget

(a) $\mathrm{d}N/\mathrm{d}g = 1$;
(b) welfare is decreasing in g.

PROOF The proof follows directly from (2.23). Note that from (2.24) we have

$$\frac{\mathrm{d}N}{\mathrm{d}G} = \frac{\mathrm{d}N}{\mathrm{d}g}\frac{\mathrm{d}g}{\mathrm{d}G}$$
$$= \frac{1-c}{cm}\frac{X^{\mathrm{T}}}{M^0}\frac{n-1}{n\theta} > 0 \qquad \square$$

Thus whilst fiscal policy can increase output and employment, it must reduce welfare. If we compare the Keynesian results of section 4 with the more classical results of this section, we can see that whilst there is a short-run role for welfare-improving monetary and fiscal policy, in the long run the condition for balanced trade makes policy either neutral or effective and welfare reducing. Even though the long-run equilibrium is Pareto inefficient (due to imperfect competition), output-increasing fiscal policy tends to *reduce* welfare.

6 Balanced trade with free entry and exit of firms

So far, we have treated the number of firms n as exogenous. However, at least since Weitzman (1982), many have argued that the combination of increasing returns with free entry and exit may play a special role in models with imperfect competition (for closed economy models with imperfect competition and free entry and exit see Snower (1983), Startz (1989), and Dixon and Lawler (1992)). In this brief section we outline the effects of introducing free entry and exit into the long-run balanced-trade equilibrium of section 5. The classical results of the previous section were obtained for the case of a fixed number of firms n. However, if government expenditure leads to more firms, then under Cournot competition this will make the economy more competitive. This will have important consequences for both the domestic and export sectors.

If we recall the analysis of section 2, each domestic sector firm i has the increasing (constant) returns technology $X_i = N_i - \bar{N}$, where $\bar{N} > 0$ ($\bar{N} = 0$) is a fixed cost of producing output. Nominal profits of firm i are then

$$\Pi_i = (p^{\mathrm{D}} - w)X_i - w\bar{N} \tag{2.26}$$

The mark-up in the typical domestic sector industry is given by

$$p^{\mathrm{D}} = \frac{n}{n-1}w \tag{2.8a}$$

Hence the free entry and exit condition of zero profits is that n satisfies

$$\frac{1}{n-1}X_i - \bar{N} = 0 \tag{2.27a}$$

If we aggregate over firms i and ignore the fact that n is an integer, this simplifies to

$$n(n-1) = X^{\mathrm{D}}/\bar{N} \tag{2.27b}$$

From (2.27b) it is clear that, as total employment (output) in the domestic sector increases, more firms will want to enter the market and n will increase. As more firms enter the domestic sector, this will have knock-on general equilibrium effects in the whole economy.

Consider the long-run equilibrium conditions for X^{T}, $p^{\mathrm{D}}/p^{\mathrm{T}}$, and c^{D} in section 5. As n increases, X^{T} and c^{D} rise and $p^{\mathrm{D}}/p^{\mathrm{T}}$ falls. If an increase in government expenditures induces entry, it will thus move the whole economy towards the Walrasian point W in figure 2.2. Whilst entry tends to bring the domestic price nearer to its competitive level relative to (w, p^{T}), it also induces an inefficiency since production becomes less efficient (the domestic sector has a subadditive cost function). If we focus on the domestic sector (where n is determined), we have two equations with two endogenous variables (X^{D}, n):

$$X^{\mathrm{D}} \equiv c^{\mathrm{D}}(n) + g$$

$$X^{\mathrm{D}} = \bar{N}n(n-1) \tag{2.27b}$$

where c^{D} is expressed as a function of n. Total differentiation yields

$$\frac{\mathrm{d}X^{\mathrm{D}}}{\mathrm{d}g} = \frac{\bar{N}(2n-1)}{\bar{N}(2n-1) - \partial c^{\mathrm{D}}/\partial n} > 1 \tag{2.28a}$$

$$\frac{\mathrm{d}n}{\mathrm{d}g} = \frac{1}{\bar{N}(2n-1) - \partial c^{\mathrm{D}}/\partial n} > 0 \tag{2.28b}$$

Together, the two equations (2.28) tell us that the real government expenditure multiplier on output is greater than unity, since additional expenditure induces entry. The multiplier for domestic sector employment will also be greater than unity:

$$N^{\mathrm{D}} = X^{\mathrm{D}} + n\bar{N}$$

$$\frac{\mathrm{d}N^{\mathrm{D}}}{\mathrm{d}g} = \frac{\mathrm{d}X^{\mathrm{D}}}{\mathrm{d}g} + \bar{N}\frac{\mathrm{d}n}{\mathrm{d}g}$$

$$= \frac{\bar{N}2n}{\bar{N}(2n-1) - \partial c^{\mathrm{D}}/\partial n} > 1$$

In addition to the marginal workers needed to produce the extra output, $\mathrm{d}X^{\mathrm{D}}/\mathrm{d}g$, there are also more workers needed to cover the fixed-cost element of the new firms. The output and employment multipliers for the export sector follow directly from (2.28b) and (2.13).

What of the welfare analysis of fiscal policy under balanced trade induced by a floating nominal exchange rate? The results here are rather complicated and in general ambiguous. We shall merely show that it is *possible* for an increase in government expenditure to increase social welfare by providing a numerical example. Under balanced trade, we are in fact able to express all the endogenous variables as functions of exogenous variables (α, m, c, θ, $\bar{N}$, g). However, although n is an endogenous variable under free entry and exit, as our analysis in section 5 showed, we can express the endogenous variables c^{D}, X^{T}, and N^{T} in terms of n and the exogenous variables. In fact, we can express social welfare as a function of (n, g) and then find the overall effect of g on welfare directly and via n. From (2.22) and (2.13), we obtain an expression for welfare:

$$V = \left[a_0\left(\frac{n-1}{n}\right)^{a_1} - \theta^{1+a_2}N\right]\theta^{-a_2} \tag{2.29}$$

where

$$a_0 = (cm)^{-1}\alpha^{\alpha/(1-\alpha)}$$

$$a_1 = \frac{1-m}{m(1-\alpha)}$$

$$a_2 = \frac{1-m(1-\alpha)}{m(1-\alpha)}$$

Now, again from (2.13) we obtain an expression for employment in the traded sector

$$N^{\mathrm{T}} = cma_0\left(\frac{n-1}{n}\right)^{a_1}\theta^{-1/m(1-\alpha)} \tag{2.30}$$

and from (2.27b) and the definition of N^{D} we obtain

$$N^{\mathrm{D}} = n^2\bar{N} \tag{2.31}$$

Substituting (2.31) and (2.30) into (2.29) and using the monotonic transform of indirect utility (welfare) $\bar{V} = \theta^{a_2}V$, we have (after some considerable manipulation)

$$\bar{V} = a_0\left(\frac{n-1}{n}\right)^{a_1}(1 - cma_0) - \theta^{1+a_2}n^2\bar{N} \tag{2.32}$$

In effect, we have eliminated g from any direct effect on $\bar{V}$. This is because the only direct effect of g on $\bar{V}$ is via N^{D}, and from (2.31) we have expressed this in terms of n. Hence, from (2.32) we need only consider the size of $\mathrm{d}\bar{V}/\mathrm{d}n$ to determine the sign of $\mathrm{d}\bar{V}/\mathrm{d}g$:

$$\mathrm{sign}\left(\frac{\mathrm{d}\bar{V}}{\mathrm{d}g}\right) = \mathrm{sign}\left(\frac{\mathrm{d}\bar{V}}{\mathrm{d}n}\frac{\mathrm{d}n}{\mathrm{d}g}\right) = \mathrm{sign}\left(\frac{\mathrm{d}\bar{V}}{\mathrm{d}n}\right)$$

A general analysis of this is left to the reader. However, we consider a numerical example for which an increase in real government expenditure g can increase welfare.

EXAMPLE Let $\alpha = c = m = 0.5$. Then $a_1 = a_0 = 2$, and $a_2 = 3$. Hence

$$\bar{V} = \left(\frac{n-1}{n}\right)^2 - \theta^4\bar{N}n^2$$

and

$$\frac{\mathrm{d}\bar{V}}{\mathrm{d}n} = 2\left(\frac{n-1}{n^3}\right) - 2\theta^4\bar{N}n \tag{2.33}$$

The difficulty in evaluating (2.33) is that n is endogenous, and so we cannot independently choose n, $\bar{N}$, and θ. However, it is easy to solve for n when $g = 0$. Under our parameter values, equations (2.13) and (2.21) yield

$$X^{\mathrm{T}} = \frac{1}{2}\left(\frac{n-1}{n}\right)\theta^{-2} \qquad c^{\mathrm{D}} = \frac{n-1}{n}\frac{1}{2\theta} \tag{2.34}$$

With $X^{\mathrm{D}} = c^{\mathrm{D}}$ when $g = 0$, it follows from the free entry and exit condition (2.27b) that

$$n = (2\bar{N}\theta)^{-1/2} \tag{2.35}$$

We can therefore examine the impact of an increase in n in the neighborhood of $g = 0$. First, consider the parameter values $\theta = 1/8$ and $\bar{N} = 1/4$. It is easily verified from (2.35) that the equilibrium number of firms is $n = 4$, and from that $\mathrm{d}\bar{V}/\mathrm{d}n > 0$. Again, for $\theta = 1/2$, $\bar{N} = 1/25$. In this case $n = 5$, and from (2.33) $\mathrm{d}\bar{V}/\mathrm{d}n > 0$. These two examples show that, if the government expenditure is entry inducing, then it can increase welfare even though we are in a long-run balanced-trade equilibrium and government expenditure is pure "waste."

7 Intra-industry trade and exchange rate pass-through

In this section we extend the model of the previous section to allow for intra-industry trade. We open up the domestic sector to allow for a foreign competitor. There will be two firms supplying the domestic sector, one "home" firm and one foreign firm which produces abroad. The foreign firm has an identical technology and pays wages w^* (in foreign currency) with no transport costs. For simplicity, we also assume that home consumers do not consume any of the export sector output (in terms of (2.1), $m = 0$), and since there is no entry we set $\bar{N} = 0$. The structure of this model is similar to that of Campos (1991).

The main goal of this section is to explore the effect of a devaluation in an imperfectly competitive trade environment. Much of the existing literature has focused on this in a purely *partial equilibrium* setting (e.g. Dornbusch, 1987; Froot and Klemperer, 1989). We shall explore this in a general equilibrium model. This, of course, also relates to the issue of real wage resistance which we shall briefly discuss. Lastly, in this section we shall assume a regime of fixed exchange rates for the long run, so that the domestic money supply will adjust to achieve balanced trade. This is in contrast with the assumption of a floating exchange rate assumed in the previous two sections.

7.1 Domestic sector equilibrium

The main difference in modeling the domestic sector from previous sections is that the duopolists will have *different* marginal costs. Hence, the symmetric equilibrium conditions in section 2 will not be generally applicable. The wages paid by foreign firms are given by ew^* in domestic currency. Furthermore, the level of imports will depend upon the market share of the foreign firm and is endogenously determined by the duopoly equilibrium. Throughout this section, we shall ignore the government sector, setting $G = T = 0$ (we are focusing on the policy instrument of devaluation). Total domestic consumption will be the sum of home firm output x and imports x^* from the foreign firm:

$$c^{\mathrm{D}} = x + x^*$$

Since $m = 0$ in (2.1), all consumer expenditure is used for goods produced by the domestic sector. Let us define this total nominal expenditure Y^{D}, which will be a proportion c of total income (wages, profits, initial money balances). Y^{D} is of course endogenous and will be determined by the income–expenditure relations below. The "industry" demand curve for the domestic sector is

$$p^{\mathrm{D}} = Y^{\mathrm{D}}/c^{\mathrm{D}} \tag{2.36}$$

Hence (nominal) profits for the home and foreign firm are given by

$$\Pi^{\mathrm{h}} = \frac{x}{x + x^*} Y^{\mathrm{D}} - wx \tag{2.37a}$$

$$\Pi^* = \frac{x^*}{x + x^*} Y^{\mathrm{D}} - ew^*x \tag{2.37b}$$

Each firm chooses its own output to maximize nominal profits (in domestic currency), treating Y^{D}, e, w, and w^* as given. To justify this we need to appeal to the notion that we are looking at a *representative* industry in the domestic sector which is one of many, so that firm's actions have no effect on aggregate variables. The first-order conditions are

$$\frac{\mathrm{d}\Pi^{\mathrm{h}}}{\mathrm{d}x} = \frac{x^*}{(x + x^*)^2} Y^{\mathrm{D}} - w = 0 \tag{2.38a}$$

$$\frac{\mathrm{d}\Pi^{\mathrm{h}}}{\mathrm{d}x^*} = \frac{x}{(x + x^*)^2} Y^{\mathrm{D}} - ew^* = 0 \tag{2.38b}$$

From (2.38) we can directly obtain the relative outputs and market shares as functions of relative wages:

$$\frac{x^*}{x} = \frac{w}{ew^*} \tag{2.39a}$$

$$\frac{x^*}{x + x^*} = \frac{w}{w + ew^*} \tag{2.39b}$$

$$\frac{x}{x + x^*} = \frac{ew^*}{w + ew^*} \tag{2.39c}$$

Substituting (2.39) back into (2.38) yields the solutions for equilibrium outputs and price as functions of Y^D, w, and ew^*:

$$x = \frac{ew^*}{(w + ew^*)^2} Y^D \tag{2.40a}$$

$$x^* = \frac{w}{(w + ew^*)^2} Y^D \tag{2.40b}$$

$$p^D = w + ew^* \tag{2.40c}$$

These equations make intuitive sense, and when $w = ew^*$ yield the standard symmetric duopoly results.

The real wage for domestic households depends only upon p^D when $m = 0$; $P(p^D, p^T) = p^D$. Hence, from (2.40c) the labor market equilibrium (2.5) becomes

$$\frac{w}{p^D} = \frac{w}{w + ew^*} = \theta$$

which yields the equilibrium nominal wage

$$w = ew^* \frac{\theta}{1 - \theta} \tag{2.41}$$

Although the mechanism is different, the domestic nominal wage again is pegged to the nominal exchange rate e. The reason is that the domestic sector price is itself pegged to the domestic value of foreign wages, from (2.41) and (2.40c):

$$p^D = \frac{ew^*}{1 - \theta} \tag{2.42}$$

7.2 National income

We now solve the national income system for total nominal expenditure Y^D on the domestic sector and national income Y. The marginal/average propensity to import $\bar{m}$ comes directly from (2.39b), the foreign firms' market share, combined with (2.41):

$$\bar{m} = \frac{w}{ew^* + w} = \theta \tag{2.43}$$

As in previous sections, the fact that domestic wages are pegged to the nominal exchange rate ties down the output of the export sector:

$$X^{\mathrm{T}} = \alpha^{\alpha/(1-\alpha)} \left(\frac{p^*}{w^*} \frac{1-\theta}{\theta} \right)^{\alpha/(1-\alpha)} \tag{2.44}$$

The flow component of home income Y in the form of wages and profits from the domestic and export sector is

$$Y = (1 - \bar{m})Y^{\mathrm{D}} + ep^*x^{\mathrm{T}} \tag{2.45}$$

Imports are of course $\bar{m}Y^{\mathrm{D}}$. We can now solve for Y^{D} using the consumption function (2.4a) with $m = 0$ (recall that $G = T = 0$):

$$\begin{aligned} Y^{\mathrm{D}} &= c(Y + M^0) \\ &= c((1 - \bar{m}))Y^{\mathrm{D}} + (ep^*x^{\mathrm{T}}) + cM^0 \\ &= \frac{c}{1 - c(1 - \bar{m})}(M^0 + ep^*x^{\mathrm{T}}) \end{aligned} \tag{2.46}$$

Hence, from (2.45) and (2.46), we obtain an expression for the national income of the home country

$$Y = \frac{c(1 - \bar{m})}{1 - c(1 - \bar{m})} M^0 + \frac{1}{1 - c(1 - \bar{m})} ep^*x^{\mathrm{T}} \tag{2.47}$$

and the trade surplus is given by

$$S = ep^*x^{\mathrm{T}} - \bar{m}Y^{\mathrm{D}} \tag{2.48}$$

Solutions (2.46)–(2.48) are valid whether or not trade is balanced. In the long run with balanced trade, so that $S = 0$, Y is again given by (2.10b). Since we are holding e constant (at least after each devaluation), the new long-run equilibrium nominal money supply is given by

$$M^0 = \frac{1 - c}{c\bar{m}} ep^*x^{\mathrm{T}} \tag{2.49}$$

7.3 Devaluation and pass-through

We shall break up the analysis of devaluation into three Marshallian time "periods":

1 *very short run (VSR)* – domestic wages are fixed;
2 *short run (SR)* – domestic nominal wages and prices adjust to equilibrium, but trade need not be balanced;

3 *long-run (LR)* – trade balances through adjustment of the domestic money supply.

Most of the recent literature on imperfect competition and pass-through is partial equilibrium in outlook and has really dealt only with the VSR. Literature on real-wage resistance (e.g. Ellis and Fender, 1987) has examined the SR issues in the context of a bargaining model. With the exception of Campos (1991, 1992), this is the first attempt to examine the long run.

In the VSR, the domestic wages w are treated as fixed, so that the effects are straightforward. A devaluation raises the (domestic currency) wages and marginal cost of the foreign firm. If we depict the two firms' reaction functions in (x, x^*) space, the foreign firm's reaction function r^* moves leftwards in figure 2.3 to r^{**}, and equilibrium moves from A to B. As can be seen from (2.40), devaluation of the exchange rate boosts x and reduces x^*, with the domestic price p^D rising since the slope of r is less than unity. The extent of pass-through in the VSR is

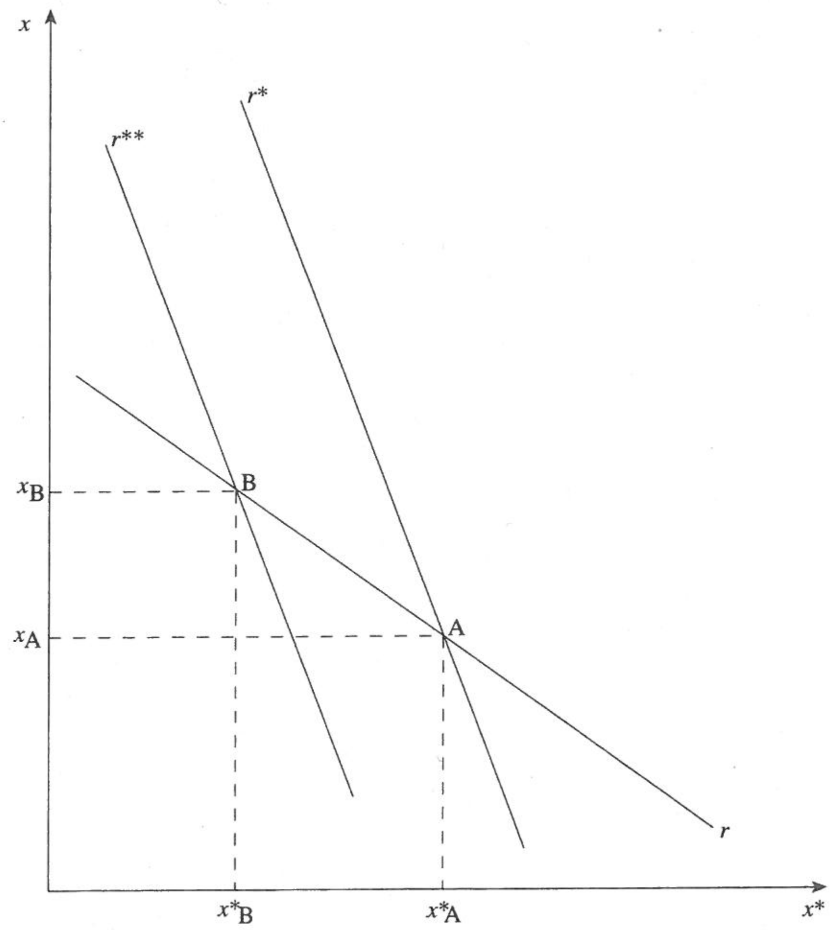

Figure 2.3 Pass-through in the very short run.

captured by the elasticity of p^D with respect to e:

$$\left.\frac{d \log p^D}{d \log e}\right|_w = \frac{ew^*}{w + ew^*} < 1$$

Hence, from (2.39c) the extent of pass-through is inversely related to the foreign firm's market share. This is perhaps counter-intuitive, and illustrates that the introduction of imperfect competition raises many possibilities, as was pointed out by Dornbusch (1987). If we contrast this with the competitive export sector, pass-through is 100 percent even in the VSR, since $p^T = ep^*$. Hence the relative price p^D/p^T falls.

In addition to the effects of a devaluation on prices (p^D, p^T) in the VSR, there are secondary knock-on effects to national income. These stem from two sources: the reduced import penetration of the domestic sector means that $\bar{m}$ falls in (2.46) and (2.47), thus boosting (Y^D, Y); second, the (domestic currency) earnings from the export sector (price and output are up) are increased. In the VSR, then, devaluation has a clear expansionary effect on the economy as output and employment expand both in the export sector and the domestic sector. Nominal prices (p^D, p^T), however, have risen relative to wages and money balances. This sets counteracting contractionary tendencies in train.

In the short run we allow wages to respond, employing equation (2.46) and (2.42). From (2.41), domestic nominal wages are pegged to the domestic currency value of foreign wages ew^* and will rise directly in proportion to the devaluation in order to restore the real wage θ. This *real-wage resistance* (Dornbusch, 1980, pp. 71–4; Sachs, 1980; Eichengreen, 1980; Ellis and Fender, 1987) leads to a *contractionary* effect from the devaluation. In essence, there has been 100 percent pass-through (via the labor market), and with fixed nominal domestic money balances this will lead to a decline in output. From (2.46) and (2.47), although export earning ep^*x^T will have risen in line with the devaluation and domestic prices, the "monetary" part M^0 will not. The output of the export sector will return to its initial value as w rises. The domestic sector, however, will find its output declining to below its initial value. Whilst the market share adjusts, the price p^D will have risen by a greater proportion than Y^D. Hence, total domestic sector output declines. If we started from a situation of balanced trade before devaluation, the situation after the short-run adjustments will be one of a trade surplus. Whilst the export earnings have been boosted in proportion to the devaluation, the impact of the contraction brought about by the devaluation means that imports have risen (in nominal terms) by a smaller proportion. Hence a specie-flow mechanism will lead to an increase in the domestic money supply until the long-run equilibrium is reached. From (2.49) we can see that the balanced-trade equilibrium level of the nominal domestic money stock is proportional to e. Hence the long-run increase in the domestic money supply will fully restore c^{D}, x, and x^* to their initial equilibrium values.

The effects of a devaluation of the exchange rate thus differ over time. In the long run, it can have no effect as the balanced-trade condition will ultimately tie down all of the real variables, as we saw in a slightly different model in section 5. We have not, of course, considered fiscal policy in this section, but the analysis would be much the same as in section 5. In the VSR, before the domestic labor market has time to respond, the effect of a devaluation on domestic output and employment is unambiguously positive. In the domestic sector, the output of the home firm rises, whilst output of the export sector also rises. However,.real-wage resistance leads to a return of output of the export sector to its initial value, and the domestic sector output of home and foreign firms contracts due to a "real-balance" effect since prices have risen relative to the nominal money supply. To what extent is there a distinctive role in this story for imperfect competition? Not much, it seems to me, except in the VSR. In the VSR, the exact type of output market configuration will indeed influence the immediate rate of exchange rate pass-through. However, beyond that initial impact, the issue becomes dominated by the perennial factors to do with the labor market and real balances. To put all these factors together, as we have done, requires a coherent general equilibrium framework.

8 Conclusion

Whilst the theme of imperfect competition has been well developed during the last two decades in the context of a closed economy, its implications for open economies have received relatively little attention. In this chapter we have focused on the implications of imperfect competition in the domestic/nontraded output market of an open economy. The basic framework can easily be extended to embrace alternative configurations. I hope to have convinced the reader that both the positive and the welfare analysis of government policy under imperfect competition differ significantly from those under Walrasian equilibrium. In order to capture these differences fully it is necessary to model the components of the macroeconomy and their interrelationships carefully in a coherent general equilibrium setting. An alternative approach is developed by Abayasiri-silva (1992), who develops Ng's mesoeconomic approach (Ng, 1982) in an open economy setting.

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