Journal of Economic Literature
Vol. XXXI (June 1993), pp. 732–761

Nonclearing Markets: Microeconomic Concepts and Macroeconomic Applications

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I want to thank the anonymous referees for the numerous improvements they brought to this article. All remaining deficiencies are my sole responsibility.

I. *Introduction*

THE LAST TWENTY YEARS have witnessed the development of a new body of theory, in both micro and macroeconomics, aimed at generalizing traditional Walrasian theory to cases where not all markets clear. This generalization was achieved through a synthesis of three important paradigms: Walrasian, Keynesian, and imperfect competition. The purpose of this article is to give a simple and self-contained account of these developments for both micro and macroeconomists.

A. *Early Motivations and Scope*

An early and continuing motivation for this theory was the desire to give serious microeconomic foundations to macroeconomics. When this research program started there was indeed a profound split between the two.

The microeconomics of perfect competition was built from rigorous principles in a general equilibrium framework, and culminated in the notion of Walrasian equilibrium in its modern reformulation (Léon Walras 1874; Kenneth Arrow and Gérard Debreu 1954; Debreu 1959). Imperfect competition, on the other hand, was dealt with in a "Marshallian" partial equilibrium framework,[1] in line with the pioneering works of Augustin Cournot (1838) and Edward Chamberlin (1933).

As for macroeconomics, it had been for many years dominated by the Keynesian paradigm, particularly in its IS-LM version (John Maynard Keynes 1936; John Hicks 1937). It was then clear to most economists that the Keynesian model had no microfoundations and that its long existence was due to the fact that, unlike the Walrasian model, it could deal explicitly with such important problems as involuntary employment and the associated policy problems.

A number of authors tried to bridge the gap between microeconomics and Keynesian macroeconomics: The stimu-

[1] With of course one important exception, Takashi Negishi's (1961) formalization of imperfect competition with subjective demand curves in a general equilibrium framework.

lating contributions by Don Patinkin (1956), Robert Clower (1965), and Axel Leijonhufvud (1968) made clear that the Keynesian paradigm could make sense only in a world where agents were quantity constrained (for example the involuntarily unemployed in labor markets) and where quantity adjustments would partly replace price adjustments (as in the various versions of the Keynesian multiplier). In a well-known article, Robert Barro and Herschel Grossman (1971) constructed an aggregated fixprice model giving some choice theoretic foundations to the basic Keynesian model, and pointing out the existence of other regimes as well. At that stage, however, both a full general equilibrium formulation of the Arrow-Debreu type, and a description of rational price formation in various markets were obviously missing.

The goal of the research program described in this article was to fill these gaps and produce a framework of analysis which would encompass simultaneously the three lines of work described above by using their most interesting insights. From the Walrasian paradigm it retained the full general equilibrium setting; from the Keynesian one the possibility of nonclearing markets, quantity signals, and partial quantity adjustments; and from the imperfect competition paradigm the explicit formalization of price making by agents internal to the system.[2] More specifically the synthesis between these three lines of thought was achieved through a generalization of Walrasian theory, first by allowing agents to react to quantity signals as well as to price signals, and secondly by endogenizing prices in a way that resulted from explicit maximization by private agents. The resulting concepts enable us to treat price formation schemes ranging from full rigidity to full flexibility, including a thorough treatment of imperfect competition. Moreover each market may have its own specific price determination scheme, which allows the model builder great flexibility, as we shall see especially in the macroeconomic applications of Part IV.

Generalizing the Walrasian model to cases where markets do not clear was not the only avenue to reconcile micro and macroeconomics. In the early 1970s a new macroeconomic school, the "new classical" school, took the opposite route by rejecting both Keynesianism and imperfect competition, and constructing macroeconomic models based on the assumption of full market clearing at all times. This school met with quite a large success, due to the fact that it combined the market clearing hypothesis with a very popular assumption, the "rational expectations hypothesis" (John Muth 1961). It has become clear, however, that the distinguishing feature of new classical macroeconomics is not so much the rational expectations hypothesis as the Walrasian market clearing one. As this will be the main focus of this article, we are now naturally led to examine why we want to have a general theory of nonclearing markets.

B. *Why Study Nonclearing Markets*

We begin our argument with the simple observation that on only a fraction of real world markets, such as the stock market which inspired Walras, is the equality between demand and supply ensured institutionally by an actual auctioneer. For all other markets where no

[2] Though this endogenous price setting aspect will be obvious in what follows, it may be useful to dispel at this early stage a widespread misconception of the domain, in which this reduces solely to the treatment of completely fixed prices. Although the first models endogenizing prices in such a framework appeared in the mid-seventies (Bénassy 1976, 1978), this misrepresentation persists in some circles. Two recent examples are Olivier Blanchard and Stanley Fischer (1989) and Gregory Mankiw (1990).

auctioneer is present, there is, as Arrow (1959) himself perceptively noted

> a logical gap in the usual formulations of the theory of the perfectly competitive economy, namely that there is no place for a rational decision with respect to prices as there is with respect to quantities. (p. 41)

Although quantity actions by all agents result from rational maximizing behavior, market clearing is assumed axiomatically.

As we demonstrate below, our method allows us to build a consistent theory of price (and quantity) determination on markets without an auctioneer, mainly because it enables us to derive the potential quantity consequences of any price choices, whereas Walrasian theory allows such a description of quantity consequences for the Walrasian equilibrium prices only. Furthermore, the explicit use of quantity signals in the determination of demands, supplies, and prices by private agents makes our representation of the functioning of markets much closer to what is observed in real world decentralized markets.

From a more macroeconomic and empirical point of view it is clear to most people that a number of historical episodes, such as the massive unemployment or idleness of productive capacities observed during the Great Depression or the recent crisis, seem extremely difficult to reconcile with a general market clearing view of the world.

Finally on the theoretical side, recent developments in industrial economics, labor economics, or financial markets (in particular credit markets) all point to the possibility of non-market clearing situations, due to informational imperfections or to the game theoretic nature of the price formation process. Thus a theory is needed that can accommodate in a general equilibrium setting the possibility of these non-market clearing situations.

C. *The Necessity of a General Equilibrium Approach*

One might agree with the preceding arguments, but still be satisfied with a partial equilibrium approach to nonclearing markets. In this case market imbalances would be studied at the level of each single market, while the Walrasian structure would be kept for general equilibrium and macroeconomics, the basic idea being that, as far as policy is concerned, demand-supply imbalances can be dealt with on a market by market basis. We shall show here that, at least from a general equilibrium and macroeconomic point of view, this is not a sound position. Indeed one of the main insights of the models we shall study is the importance of "spillover effects" through which disequilibrium in one market can actually be provoked by causes originating in another market. We shall illustrate this by a simple example where, in spite of a fully flexible wage, unemployment in the labor market is caused entirely by the malfunction of the goods market.

The Example

Consider an economy with two agents: One firm whose production function is $y = F(\ell)$, and one household supplying inelastically ℓ_0 units of labor and with a utility function:

$$U = \alpha \log c + (1 - \alpha) \log(m/p^e) \quad (1)$$

where c is current good consumption, m the quantity of money saved and p^e future expected price.[3] We assume the household has a quantity of money m_o to start with and receives from the firm all profits $\pi = py - w\ell$. Its budget constraint is thus:

$$pc + m = w\ell + \pi + m_o = py + m_o. \quad (2)$$

[3] The quantity m/p^e should be thought of as expected future consumption, the implicit assumption being that the household expects no future income.

Maximization of the firm's profits subject to the production function $F(\ell)$ yields the Walrasian demand for labor $\ell^d = F'^{-1}(w/p)$. Equating this with the inelastic supply ℓ_o gives us the Walrasian real wage:

$$\frac{w^*}{p^*} = F'(\ell_o).$$

Employment is thus equal to ℓ_o, and production to $y_o = F(\ell_o)$. Maximization of the household's utility function (1) under budget constraint (2) yields a consumption demand:

$$c^d = \alpha\left(\frac{m_o}{p} + y\right). \tag{3}$$

With total real income equal to y_o, the equality of demand (c^d) and supply (y_o) on the goods market yields the Walrasian price:

$$p^* = \frac{\alpha m_o}{(1-\alpha)y_o}. \tag{4}$$

The traditional view on unemployment is that it is due to too high real wages, i.e., $w/p > F'(\ell_o)$. This in turn may come from a "real wage rigidity" $w/p > F'(\ell_o)$, or a "nominal wage rigidity" $w > w^*$. We shall see that this need not be the case by experimenting with a totally different cause.

Assume indeed that w is perfectly flexible, but that for some reason p is rigidly fixed at a level above p^*. Let us now consider a wage level w such that $w/p \leq F'(\ell_o)$ (if this were not the case the excess supply of labor would make w go down until the inequality holds) so that unemployment cannot come from a too high real wage. With $p > p^*$ we see that, even if a real income y_o is distributed to the household, consumption demand will be below y_o (equations 3 and 4). Faced with a consumption demand $c^d < y_o \leq F[F'^{-1}(w/p)]$, it is clearly not profit maximizing for the firm to continue demanding a quantity of labor $F'^{-1}(w/p)$. Rather it will curtail production to the level demanded ($y = c^d$) and demand the quantity of labor needed to produce it, i.e., $\ell = F^{-1}(y)$. Using the consumption function (3), these two equations yield:

$$y = \frac{\alpha m_o}{(1-\alpha)p} \qquad \ell = F^{-1}\left[\frac{\alpha m_o}{(1-\alpha)p}\right]. \tag{5}$$

We see that with $p > p^*$ we shall always have $\ell < \ell_o$. If the labor market is competitive, the wage would go down to zero, and unemployment would remain at the value $\ell_o - \ell$, where ℓ is given by formula (5). We see that unemployment in the labor market is due entirely to the malfunctioning of the goods market! Of course this is only an example but we must keep in mind the extreme importance of the interactions across markets, which is a major reason why a full general equilibrium analysis is needed.

D. *The Structure of the Article*

The article will be organized as follows: Part II will describe in a simple manner the basic concepts of the theory. Part III will give a number of non-Walrasian equilibrium concepts, which generalize Walrasian equilibrium to nonclearing markets. Part IV will derive macroeconomic applications using a unified model under various assumptions about the price mechanism, and Part V will conclude.

Because the field under review aims at synthesizing different currents of microeconomic and macroeconomic theory, the structure of this article has been chosen such that people with specific interests can take shortcuts in their first reading of the paper. For example the micro-oriented reader will find the sequence of Parts II and III of most interest, whereas the macro-oriented reader can go through Part II and move directly to the macroeconomic applications of Part IV. However, as the purpose of the article is to synthesize these different currents, the article should be read in full so as to exploit fully the positive externalities between the various parts.

II. *Microeconomic Concepts*

We are now ready to study the basic microeconomic elements of the theory. We shall show successively how transactions and quantity signals are formed in a decentralized fashion on a nonclearing market, how quantity signals affect demand and supply, and finally how we can build a consistent theory of price making by agents internal to the system.

A. *Nonclearing Markets and Quantity Signals*

A Monetary Economy

An often neglected issue in Walrasian general equilibrium models is the problem of the actual institutions of exchange. In his initial model Walras himself (1874) referred to a barter economy, with a market for each pair of goods. Other authors assume that all exchanges are monetary. Barter exchange is almost never observed nowadays, and thus for evident reasons of realism we shall from here on work in the framework of a monetary economy.[4] Money is the medium of exchange. It is also the numéraire and a reserve of value.

There are ℓ markets in the period considered where nonmonetary goods, indexed by $h = 1, \ldots, \ell$, are exchanged against money. The money price of good h is p_h. An agent i may make a purchase d_{ih} on market h, for which he will pay $p_h d_{ih}$ units of money, or a sale s_{ih}, for which he will receive $p_h s_{ih}$ units. Let us note in passing that it is only in a monetary economy that the notion of a "market for good h" unambiguously exists, as the counterpart is always money. In a barter economy there would be $\ell - 1$ markets where good h would be traded, against $\ell - 1$ different counterparts.

Demands and Transactions

We must make an important distinction, which by nature is not made in market clearing models, that between demands and supplies on the one hand, and the resulting transactions on the other. They will be distinguished by different notations. Demands and supplies, denoted $\tilde{d}_{ih}$ and $\tilde{s}_{ih}$, are signals sent by each agent to the market (i.e., to the other agents) before exchange actually takes place. They represent as a first approximation the exchanges agents wish to carry, and thus do not necessarily match on a market. Transactions, i.e., purchases and sales of goods, are denoted d^*_{ih} and s^*_{ih}. They are exchanges actually carried on markets, and as such are subject to all traditional accounting identities, such as budget constraints. In particular in each market h aggregate purchases must be equal to aggregate sales. If there are n agents in the economy this will be written

$$D^*_h = \sum_{i=1}^{n} d^*_{ih} = \sum_{i=1}^{n} s^*_{ih} = S^*_h. \qquad (6)$$

As we indicated no such equality holds a priori for demands and supplies.

Rationing Schemes

We shall now study the functioning of a market for a particular good h, where a price p_h has *already* been quoted by some price setter. This price being given, we shall, until Section II.C where price making is explicitly studied, treat price makers and price takers symmetrically.

[4] Non-Walrasian theory has been developed in nonmonetary exchange structures as well; see notably Bénassy (1975b, 1982).

Because the price p_h is not necessarily a market clearing one, we may have:

$$\tilde{D}_h = \sum_{i=1}^{n} \tilde{d}_{ih} \neq \sum_{i=1}^{n} \tilde{s}_{ih} = \tilde{S}_h.$$

From any such set of possibly inconsistent demands and supplies the exchange process must generate consistent transactions satisfying equation (6) above. Evidently, as soon as $\tilde{D}_h \neq \tilde{S}_h$ some demands and supplies cannot be satisfied in the exchange process and some agents must be rationed. In real life this may be done through a variety of procedures, such as uniform rationing, queueing, proportional rationing, priority systems, etc., depending on the particular organization of each market. We shall call *rationing scheme* the mathematical representation of the exchange process on market h. This rationing scheme gives the transactions level of good h for each agent as a function of the demands and supplies of all agents present in that market (this will be formalized more rigorously in Section III.A). We shall now study successively a number of properties of rationing schemes in general, which will lead us naturally to the notion of quantity signals.

Voluntary Exchange and Market Efficiency

The first property we shall require from rationing schemes is a very natural one in a free market economy, namely that of *voluntary exchange,* according to which no agent can be forced to purchase more than he demands, or to sell more than he supplies. This will be expressed by:

$$d^*_{ih} \leq \tilde{d}_{ih} \qquad s^*_{ih} \leq \tilde{s}_{ih}.$$

This condition is quite natural and actually verified on most markets (except maybe for some labor markets which are regulated by more complex contractual arrangements). Under voluntary exchange agents are naturally classified in two categories: Rationed ones (for which $d^*_{ih} < \tilde{d}_{ih}$ or $s^*_{ih} < \tilde{s}_{ih}$) and nonrationed ones (for which $d^*_{ih} = \tilde{d}_{ih}$ or $s^*_{ih} = \tilde{s}_{ih}$).

We shall now say that a rationing scheme on a market h is *efficient* or *frictionless* if there are not both rationed demanders and rationed suppliers on market h. The intuitive idea behind it is that in an efficiently organized market a rationed buyer and a rationed seller should be able to meet, and would exchange until one of the two is not rationed. Together with the voluntary exchange assumption, this implies that agents on the "short side" of the market (i.e., demanders in case of excess supply, suppliers in case of excess demand) can realize their desired transactions:

$$\tilde{D}_h \geq \tilde{S}_h \Rightarrow s^*_{ih} = \tilde{s}_{ih} \qquad \text{for all } i$$

$$\tilde{S}_h \geq \tilde{D}_h \Rightarrow d^*_{ih} = \tilde{d}_{ih} \qquad \text{for all } i.$$

This also yields the "rule of the minimum," implicit in many macroeconomic models, which says that the aggregate level of transactions is equal to the minimum of aggregate demand and supply:

$$D^*_h = S^*_h = \min(\tilde{D}_h, \tilde{S}_h).$$

We should note that the market efficiency assumption may be somewhat unrealistic if we consider a fairly wide and decentralized market. We shall use this property for its convenience in the macroeconomic examples of Part IV, but we should keep in mind that most of the concepts that follow do not depend on it.

We may finally note that, though these properties are never explicitly discussed in the Walrasian literature, the "rationing schemes" implicit in Walrasian theory satisfy both voluntary exchange and market efficiency, so that our theory of markets appears as a natural generalization of the Walrasian one to cases where markets do not clear.

Quantity Signals

Now it is quite obvious that at least rationed agents must perceive a binding quantity constraint in addition to the price signal. To get a first intuitive approach on these quantity signals, we shall begin with a simple example, where there are only two agents in market h. Agent 1 demands $\tilde{d}_{1h}$, agent 2 supplies $\tilde{s}_{2h}$. In this case the rule of the minimum applies, and the rationing scheme is:

$$d^*_{1h} = s^*_{2h} = \min(\tilde{d}_{ih}, \tilde{s}_{2h}).$$

At the same time as transactions take place, quantity signals are sent across the market: Faced with supply $\tilde{s}_{2h}$ and under voluntary exchange, demander 1 knows that he will not be able to purchase more than $\tilde{s}_{2h}$. Symmetrically supplier 2 knows that he cannot sell more than $\tilde{d}_{1h}$. Each agent thus receives from the other one a "quantity signal," respectively denoted $\bar{d}_{1h}$ and $\bar{s}_{2h}$, which tells him the maximum quantity which he can respectively buy and sell. In this example:

$$\bar{d}_{1h} = \tilde{s}_{2h} \qquad \bar{s}_{2h} = \tilde{d}_{1h}$$

so that the rationing scheme can be alternatively expressed as

$$d^*_{1h} = \min(\tilde{d}_{1h}, \bar{d}_{1h}) \tag{7}$$

$$s^*_{2h} = \min(\tilde{s}_{2h}, \bar{s}_{2h}). \tag{8}$$

It turns out that many rationing schemes, and actually all those we will study in what follows, share the simple representation given by equations (7) and (8). Each agent i receives in market h a quantity signal, respectively $\bar{d}_{ih}$ or $\bar{s}_{ih}$ on the demand or supply side, which tells him the maximum quantity he can buy or sell, so that the rationing scheme can be written simply:

$$d^*_{ih} = \min(\tilde{d}_{ih}, \bar{d}_{ih}) \tag{9}$$

$$s^*_{ih} = \min(\tilde{s}_{ih}, \bar{s}_{ih}) \tag{10}$$

where the quantity signals $\bar{d}_{ih}$ and $\bar{s}_{ih}$ are functions of the demands and supplies

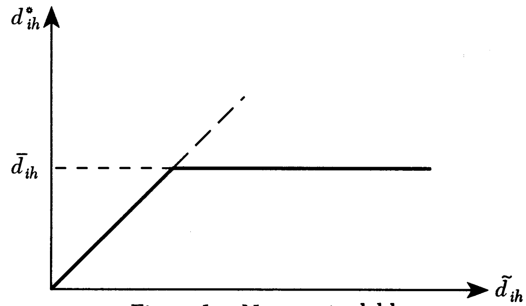

Figure 1a. Nonmanipulable

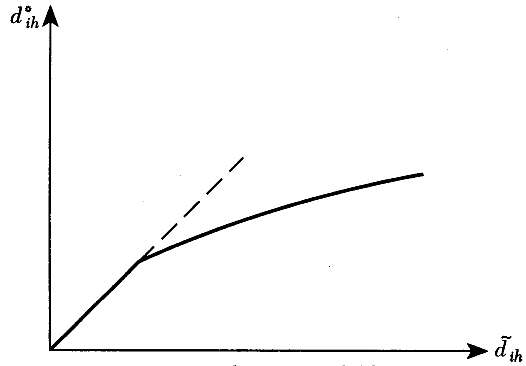

Figure 1b. Manipulable

of the *other* agents on the market. The relation between demand $\tilde{d}_{ih}$ and purchase d^*_{ih} looks thus as in Figure 1.

We may note that under the representation given by (9) and (10), the rationing scheme displays obviously voluntary exchange, but also another important property, that of nonmanipulability. A scheme will be called *nonmanipulable* if, once rationed, an agent cannot increase his transaction by increasing the size of his demand. This assumption will be maintained in what follows.[5] Of course, even though the trader cannot "manipulate" through the size of his demand (or supply), he can modify his quantity constraints in his favor by other (costly)

[5] We thus exclude manipulable schemes (Figure 1b), like the proportional rationing scheme. Typically, unless exogenous constraints are imposed, manipulable schemes lead, in case of non-market clearing, to divergent demands or supplies and no equilibrium (see Bénassy 1977, 1982).

means, such as for example arriving earlier in a queue. As we shall see in Sections II.C and III.C, price setting is a particularly important way to "manipulate" the quantity constraints an agent is faced with.

Now it is clear that the quantity signals perceived by the agents should have an effect on demand, supply, and price formation. This is what we shall explore next.

B. *Effective Demand and Supply*

A Definition

We must now discuss how demands and supplies are formed when markets do not clear, and for that develop a theory of *effective demand and supply,* which will be functions of *both* price and quantity signals. When formulating these effective demands and supplies, agent i knows that his transactions will be related to them by equalities (9) and (10) above.

Maximizing the expected utility of these resulting transactions may lead to complex calculations, especially if constraints are stochastic (see for example Bénassy 1977, 1982). In the case of deterministic constraints, which is what we shall consider throughout, there exists a simple and workable definition which generalizes Clower's (1965) original "dual-decision" method: Effective demand (or supply) on one particular market is the trade which maximizes the agent's criterion subject to the usual constraints *and* to the quantity constraints on the *other* markets. This definition thus naturally includes the well-known spillover effects: We say indeed there is a *spillover effect* when an agent who is constrained to exchange less than he wants in a market because of rationing modifies his demands or supplies in other markets. These spillover effects, which underlie the surprising result of Section I.C, will be present throughout the theory via our definition of effective demand. This we shall further see by studying a well-known example.

The Employment Function

The first illustrative example of our definition is the employment function due to Patinkin (1956) and Barro and Grossman (1971): Consider a firm with a diminishing returns to scale production function $y = F(\ell)$ faced with a price p and wage w. The Walrasian labor demand is equal to $F'^{-1}(w/p)$. Assume now that the firm faces a constraint $\bar{y}$ on its sales of output ($\bar{y}$ is of course equal to the total demand coming from the other agents). According to the above definition the effective demand for labor, $\tilde{\ell}^d$, is the solution in ℓ of the program:

$$\text{Max } py - w\ell \text{ such that}$$

$$\begin{cases} y = F(\ell) \\ y \leq \bar{y} \end{cases}$$

the solution of which is:

$$\tilde{\ell}^d = \min \{F'^{-1}(w/p),\ F^{-1}(\bar{y})\}. \quad (11)$$

We see that the effective demand for labor may have two forms: The Walrasian one if the sales constraint is not binding, or, if this constraint is binding, a more "Keynesian" form equal to the quantity of labor just necessary to produce the output demand (this last form was actually the one operative in Section I.C). We see immediately in this example that effective demand may have various functional forms, which explains intuitively why non-Walrasian models often have multiple regimes, as we shall see indeed in Part IV devoted to macroeconomic applications.

C. *The Formation of Prices*

We are now ready to address the problem of price making by agents internal to the system, and we shall see that, as in demand and supply theory, quantity signals must play a fundamental role. The general idea relating the concepts of this section to those of the previous ones is thus that price makers change their prices so as to "manipulate" the quantity constraints they face (that is, to increase or decrease their possible sales or purchases). As a result of this introduction of quantity signals into the price-making process, the theory will bear some resemblance to the traditional theories of imperfect competition (see notably Chamberlin 1933; Negishi 1961).

Various modes of price making integrating the above ideas can be envisioned. We shall deal here with a particular (and realistic for many markets) organization of the pricing process where agents on one side of the market (usually the sellers) quote prices and agents on the other side are price takers.[6]

We shall moreover, as in the traditional theories of monopolistic competition, characterize a good not only by its physical and temporal characteristics, but also by the agent who sets its price. Each price maker is thus alone on his side of the market, and appears formally as a monopolist (or a monopsonist). This does not imply, however, anything as to his degree of monopoly power, as there may be competitors' markets where other agents sell or buy goods that are extremely close substitutes.

Perceived Demand and Supply Curves

Consider thus the seller i who sets the price p_h on a market h (the exposition for a demander would be symmetrical). As we saw above, once he has posted his price, demands are expressed, and this seller faces a constraint $\bar{s}_{ih}$ which is equal to the sum of all other agents' demands on the market h:

$$\bar{s}_{ih} = \sum_{j \neq i} \tilde{d}_{jh} = \tilde{D}_h. \qquad (12)$$

But if we consider the market h *before* agent i has set price p_h, we see that he will not, contrary to a price taker, consider $\bar{s}_{ih}$ as parametric. Rather, and this is how the price making theory developed here links with what we saw previously, he will use the price p_h to "manipulate" the quantity constraint $\bar{s}_{ih}$ he faces, i.e., to increase or decrease the demand addressed to him. The relation between the maximum quantity seller i expects to sell and the price he sets on the market is called the perceived demand curve. If expectations are deterministic (which we shall assume in all that follows) it will be denoted $\bar{S}_{ih}(p_h, \theta_i)$ where θ_i is a vector of parameters which integrates all information available to the price maker. In view of equation (12), this perceived demand curve can also be written:

$$\bar{S}_{ih}(p_h, \theta_i) = \tilde{D}_h(p_h, \theta_i)$$

where $\tilde{D}_h(p_h, \theta_i)$ is what the price maker expects the aggregate effective demand of the rest of the agents to be, conditional on the price he sets p_h and on all information contained in the vector θ_i. We see that, depending on what the price maker knows about the rest of the economy, several forms of perceived demand curves can be considered:

- In the objective demand curve approach it is assumed that θ_i contains all relevant information *and* that the price maker knows the exact form of the function $\tilde{D}_h$. This assumption is the one usually made in partial equilibrium analysis and in industrial organization. We shall see in Section III.C how to use the concepts developed here to construct rigorously the objective demand

[6] Other modes of pricing could be studied with our tools but have not yet been integrated in this line of work at a general equilibrium level. Interesting alternative concepts have been studied directly at the macroeconomic level by Joaquim Silvestre (1988, 1989), Hans-Jörgen Jacobsen and Christian Schultz (1990).

curve in a full general equilibrium system.

- In the subjective demand curve approach, the price maker is assumed to make a subjective evaluation of the demand curve addressed to him. Note however that subjective demand curves are not fully arbitrary, as each realization $(p_h, \bar{s}_{ih})$ is a point on the "true" demand curve, and the subjective demand curve must "go through" this point (Donald Bushaw and Clower 1957). The functional form and the elasticity may be wrong, but at least the position must be right.

The important point to keep in mind is that the perceived demand curves represent the *effective* demands (and not, for example, the Walrasian ones) of the agents. For applications of this point, see for example, Bénassy (1988, 1989, 1991b), Huw Dixon (1987b), and the references therein.

Price Making

Once the parameters of the perceived demand curve, objective or subjective, are known, price making proceeds along lines that are traditional in the theories of imperfect competition: The price maker will maximize his objective function, subject to the constraint that demand be smaller than the amount given by the perceived demand curve on the markets he controls (in addition to the usual constraints). Consider as an example a firm with a cost function $C_i(y_i)$ and assume it faces an isoelastic perceived demand curve of the form $\tilde{S}_i(p_i, \theta_i) = \theta_i p_i^{-\eta}$, where the elasticity parameter η is given. The program giving the optimal price of the firm is thus written:

$$\text{Max } p_i y_i - C_i(y_i) \qquad \text{such that}$$

$$y_i \leq \theta_i p_i^{-\eta}.$$

This well-known program yields as a first order condition the traditional "marginal cost equals marginal revenue" condition, which is written here:

$$C_i'(y_i) = p_i\left(1 - \frac{1}{\eta}\right)$$

in which we see that the firm will choose a price high enough, so that it will want not only to serve the demand forthcoming, but would be willing even to serve more at the price it has chosen: in fact, the firm would be happy to serve demand up to $C_i'^{-1}(p_i)$. There is thus in our sense "excess supply" of the good, even though this excess supply is fully voluntary on the part of the price maker. Of course which level of output and price will be chosen will depend on the exact value of the estimated θ_i. This will be determined, as we already indicated above, by the effective demands of the other agents. An example of this will be seen in the fully closed model of Section IV.C below.

III. *Non-Walrasian Equilibria*

We shall now describe in a more formal way than in Section II a number of non-Walrasian equilibrium concepts that embody all the notions seen above in a full general equilibrium framework. In order not to burden the exposition, we shall describe these concepts in a pure exchange economy. The concepts described extend naturally to economies with production, though at the cost of a heavier notation.

A. *The Economy*

Markets and Agents

We shall thus consider a monetary exchange economy. There are in the period considered ℓ markets where nonmonetary goods indexed by $h = 1, \ldots, \ell$ are exchanged against money at a price

p_h. We call p the ℓ-dimensional vector of these prices.

Agents are indexed by $i = 1, \ldots, n$. Agent i has initial endowments ω_{ih} of good h and $\bar{m}_i$ of money. He may purchase a quantity $d_{ih} \geq 0$, or sell a quantity $s_{ih} \geq 0$ of good h. In what follows it will often be more convenient for notations to work with the net transaction of agent i on market h, z_{ih}, defined by:

$$z_{ih} = d_{ih} - s_{ih}.$$

Call z_i the ℓ-dimensional vector of net transactions of agent i, ω_i his vector of initial endowments. His final holdings of nonmonetary goods $x_i \in R_+^\ell$ and of money $m_i \geq 0$ are given respectively by:

$$x_i = \omega_i + z_i \qquad m_i = \bar{m}_i - pz_i.$$

We shall assume that the agent has a utility function on these final holdings:

$$U_i(x_i, m_i) = U_i(\omega_i + z_i, m_i)$$

which we shall assume throughout continuous and strictly concave in its arguments. Note that, at least because of the presence of m_i as a store of value in the utility functions, everything we shall say is conditional on the prevailing expectations scheme. Because expectations are not the subject of the article, and our approach allows us to deal with rational and nonrational expectations as well, we shall leave this expectations issue totally implicit in this section (for explicit treatments see Bénassy 1975a, 1982, 1986, 1990, 1991a).

Walrasian Equilibrium

For every price vector p, agent i determines his Walrasian net demands by maximizing his utility subject to the budget constraint:

$$\text{Maximize } U_i(\omega_i + z_i, m_i) \qquad \text{such that}$$
$$pz_i + m_i = \bar{m}_i.$$

This yields a vector of Walrasian net demand functions $z_i(p)$ with components $z_{ih}(p)$, $h = 1, \ldots, \ell$. A Walrasian equilibrium price vector p^* is defined by the condition that all markets clear, i.e.:

$$\sum_{i=1}^{n} z_{ih}(p^*) = 0 \qquad h = 1, \ldots, \ell$$

The net transaction of good h realized by agent i is $z_{ih}(p^*)$.

Demands, Transactions, and Rationing Schemes

As we indicated in Section II.A, one must make a clear-cut distinction between demands and supplies, $\tilde{d}_{ih}$ and $\tilde{s}_{ih}$, on the one hand, and transactions, d_{ih}^* and s_{ih}^* on the other hand. Let us define net demand $\tilde{z}_{ih}$ and net transaction z_{ih}^* by:

$$\tilde{z}_{ih} = \tilde{d}_{ih} - \tilde{s}_{ih} \qquad z_{ih}^* = d_{ih}^* - s_{ih}^*.$$

A rationing scheme converts possibly inconsistent demands and supplies into consistent transactions. The rationing scheme in market h is described by a set of n functions

$$z_{ih}^* = F_{ih}(\tilde{z}_{1h}, \ldots, \tilde{z}_{nh})$$

such that:

$$\sum_{i=1}^{n} F_{ih}(\tilde{z}_{1h}, \ldots, \tilde{z}_{nh}) \equiv 0 \qquad \text{for all } \tilde{z}_{ih}, \ldots, \tilde{z}_{nh}.$$

We shall generally assume that F_{ih} is continuous, nondecreasing in $\tilde{z}_{ih}$, nonincreasing in the other arguments. The property of *voluntary exchange* on market h translates here into:

$$|z_{ih}^*| \leq |\tilde{z}_{ih}| \quad \text{and} \quad z_{ih}^* \cdot \tilde{z}_{ih} \geq 0 \quad \text{for all } i.$$

The assumption that a market h is *efficient* or *frictionless* is written here:

$$\left(\sum_{j=1}^{n} \tilde{z}_{jh}\right) \cdot \tilde{z}_{ih} \leq 0 \Rightarrow z_{ih}^* = \tilde{z}_{ih} \qquad \text{for all } i.$$

As we indicated in Section II.A, we will always assume voluntary exchange, whereas frictionless markets will not be assumed unless explicitly specified.

Quantity Signals

To express the way quantity signals are formed in an easier way, let us rewrite the rationing scheme on market h as:

$$z_{ih}^* = F_{ih}(\tilde{z}_{ih}, \tilde{z}_{-ih}) \qquad (13)$$

where $\tilde{z}_{-ih}$ is the set of all net demands on market h, except that of agent i, i.e.:

$$\tilde{z}_{-ih} = \{\tilde{z}_{jh} | j \neq i\}.$$

As we indicated in Section II.A we shall work with nonmanipulable rationing schemes which can be written under the form seen above:

$$d_{ih}^* = \min(\tilde{d}_{ih}, \bar{d}_{ih}) \qquad (9)$$
$$s_{ih}^* = \min(\tilde{s}_{ih}, \bar{s}_{ih}) \qquad (10)$$

where the quantities $\bar{d}_{ih}$ and $\bar{s}_{ih}$ are functions of all demands on the market, except that of agent i himself, which is written:

$$\bar{d}_{ih} = G_{ih}^d(\tilde{z}_{-ih}) \geq 0 \qquad (14)$$
$$\bar{s}_{ih} = G_{ih}^s(\tilde{z}_{-ih}) \geq 0. \qquad (15)$$

For compactness of notation, equations (13), (14), (15) will be rewritten in vector form as:

$$z_i^* = F_i(\tilde{z}_i, \tilde{z}_{-i}) \qquad (16)$$
$$\bar{d}_i = G_i^d(\tilde{z}_{-i}) \qquad (17)$$
$$\bar{s}_i = G_i^s(\tilde{z}_{-i}) \qquad (18)$$

where:

$$\tilde{z}_{-i} = \{\tilde{z}_j | j \neq i\}$$

Effective Demand

As we indicated in Section II.B the effective demand $\tilde{z}_{ih}$ is obtained by maximizing the utility function U_i subject to the budget constraint and to the quantity constraints on the *other* markets, i.e., it will be the solution in z_{ih} (unique because of strict concavity) of the following program:

$$\text{Maximize } U_i(\omega_i + z_i, m_i) \qquad \text{such that}$$
$$\begin{cases} pz_i + m_i = \bar{m}_i \\ -\bar{s}_{ik} \leq z_{ik} \leq \bar{d}_{ik} \qquad \text{for all } k \neq h \end{cases}$$

which yields an effective demand function $\xi_{ih}(p, \bar{d}_i, \bar{s}_i)$. Call $\xi_i(p, \bar{d}_i, \bar{s}_i)$ the vector of all these demands, ξ_{ih}, $h = 1, \ldots, \ell$ for agent i. It has two good properties: The first is that, as it is easy to check (or see Bénassy 1977, 1982), it leads to the best transaction vector taking account of all constraints $\bar{d}_i$ and $\bar{s}_i$. Secondly, whenever a constraint is binding on a market h, the effective demand or supply on this market is greater than the corresponding quantity constraint, which thus "signals" to the market that the agent trades less than he wants. Such a signal is actually useful to avoid trivial equilibria where nobody would trade because nobody else signals that he wants to trade.

B. *Fixprice Equilibria*

We shall now begin with a first concept of equilibrium, somehow polar to the Walrasian one, that of fixprice equilibrium associated to a given price vector p. This concept is interesting for several reasons: First it will give us a very wide class of logically consistent market allocations, as we shall find out that under very standard conditions a fixprice equilibrium exists for all strictly positive price vectors and every rationing scheme (we may note also that Walrasian allocations are part of these allocations, as they are simply those corresponding to a Walrasian price vector). Secondly, as we shall see in Section III.C below, fixprice equilibria are a very useful building block for constructing other non-Walrasian equilibrium concepts with flexible prices. We shall now study two different fixprice equilibrium concepts.

The first concept we shall describe was developed in Bénassy (1975a, 1977, 1982). It derives straightforwardly from the definition of effective demand functions and the equations describing transactions and quantity signals (equations 16, 17, 18).

DEFINITION 1: *A fixprice equilibrium is characterized by a set of vectors of effective demands* $\tilde{z}_i$, *transactions* z_i^* *and quantity signals* $\bar{d}_i$ *and* $\bar{s}_i$ *such that:*

$$\begin{aligned}
&(a)\ \tilde{z}_i = \tilde{\xi}_i(p,\bar{d}_i,\bar{s}_i) && \text{for all } i\\
&(b)\ z_i^* = F_i(\tilde{z}_i,\tilde{z}_{-i}) && \text{for all } i\\
&(c)\ \bar{d}_i = G_i^d(\tilde{z}_{-i}) && \text{for all } i\\
&\bar{s}_i = G_i^s(\tilde{z}_{-i}) && \text{for all } i.
\end{aligned}$$

Equilibria defined in this way exist for all positive price systems, and for all rationing schemes satisfying voluntary exchange and nonmanipulability (Bénassy 1975a, 1982). The "exogenous data" are the price system and the rationing schemes F_{ih}. It was shown by Norbert Schulz (1983) that for a given price system and rationing scheme the equilibrium is unique provided that the "spillover effects" from one market to the other are less than one hundred percent in value terms. For example in the simplest Keynesian model this would assume a propensity to consume strictly smaller than one, a fairly intuitive condition.

In what follows, we shall assume that the Schulz conditions hold, and we shall denote by $\tilde{Z}_i(p)$, $Z_i^*(p)$, $\bar{D}_i(p)$, $\bar{S}_i(p)$ the functions giving the values of $\tilde{z}_i$, z_i^*, $\bar{d}_i$, $\bar{s}_i$ at a fixprice equilibrium corresponding to p (the market organization, and thus the rationing schemes being assumed invariant).

A Simple Example

As a simple example of fixprice equilibrium, consider the traditional Edgeworth box example (Figure 2), which represents a single market where agents A and B exchange a good (measured horizontally) against money (measured vertically).

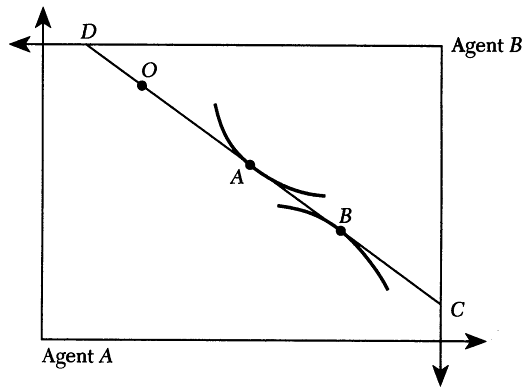

Figure 2.

Point O corresponds to initial endowments, DC is the budget line of the two agents at price p, points A and B are the tangency points of the indifference curves with this budget line. Of course, because there are only two agents, we assume that the market is frictionless.

Measuring the level of exchanges along the line OC, we see that A demands a quantity OA, B supplies a quantity OB. They exchange the minimum of these two quantities, i.e., OA, and agent B is rationed. Perceived constraints are, respectively, OA for agent B and OB for agent A. Agent B is constrained on his supply, while A is not.

An Alternative Concept

The concept we shall now describe is from Jacques Drèze (1975, 1991).[7] This concept does not differentiate between demands and transactions, and thus deals directly with quantity signals and transactions. The quantity signal structure is very simple, with uniform rationing on all markets. Each agent i receives on every market h signals $\bar{d}_h$ and $\bar{s}_h$ representing the maximum quantity he can re-

[7] The original paper dealt with the more general case of prices variable between preset bounds, or indexed on each other, an issue pursued in Gérard van der Laan (1980), Pierre Dehez and Drèze (1984).

spectively purchase and sell, so that his transactions on market h are limited to the interval:

$$-\bar{s}_h \leq z_{ih} \leq \bar{d}_h.$$

We are now ready to give the definition of a fixprice equilibrium in the sense of Drèze:

DEFINITION 2: *A fixprice equilibrium for a given set of prices p is characterized by transactions z^*_{ih}, $i = 1, \ldots, n$, $h = 1, \ldots, \ell$, and quantity constraints $\bar{d}_h$ and $\bar{s}_h$, $h = 1, \ldots, \ell$, such that:*

(a) $\sum_{i=1}^{n} z^*_{ih} = 0$ *for all h*

(b) *The vector z^*_i is solution in z_i of the following program:*

Maximize $U_i(\omega_i + z_i, m_i)$ such that

$$\begin{cases} pz_i + m_i = \bar{m}_i \\ -\bar{s}_h \leq z_{ih} \leq \bar{d}_h \qquad h = 1, \ldots, \ell \end{cases}$$

(c) *If $z^*_{ih} = \bar{d}_h$ for some agent i, then $z^*_{jh} > -\bar{s}_h$ for all agents j.*
If $z^*_{ih} = -\bar{s}_h$ for some agent i, then $z^*_{jh} < \bar{d}_h$ for all agents j.

Let us now interpret these conditions. Condition (a) simply says that transactions should balance on each market. Condition (b) says that transactions maximize utility subject to the budget constraint and the quantity constraints on all markets, a natural individual rationality condition. We may note that the uniform rationing procedure used here displays the two properties of voluntary exchange and nonmanipulability that we discussed earlier. Condition (c) says basically that rationing may affect either supply or demand, but not both simultaneously. We recognize here the assumption of efficient or frictionless markets, which is thus "built in" to this definition.

The existence of such an equilibrium was proved in Drèze (1975) under the traditional concavity assumptions for the utility functions. The concept can be easily extended to nonuniform bounds $\bar{d}_{ih}$ and $\bar{s}_{ih}$ (Jean-Michel Grandmont and Guy Laroque 1976), but in this last case it is not specified in the concept how shortages are allocated among rationed demanders and rationed suppliers, so that there are usually a large number of equilibria for a given price vector.

At this stage the reader may wonder if there are connections between the two concepts we described. It was proved by Silvestre (1982, 1983; see also Antoine D'Autume 1985) that one obtains the same set of equilibrium allocations for definition 1 (assuming all rationing schemes to be frictionless) and definition 2 (extended for nonuniform bounds), in both exchange and production economies. These allocations have a number of suboptimality properties which we shall not study here, but which are developed in Bénassy (1975a, 1982, 1990), Drèze and Heinz Müller (1980), and Silvestre (1985).

C. *Equilibria with Price Makers*

We shall now construct a non-Walrasian general equilibrium model where prices are explicitly set by agents internal to the system. This will show that, as a "by-product," our theory provides a simple and natural solution to the (heretofore unsolved) problem of defining an objective demand curve for price makers in a general equilibrium situation.

The Framework

As we indicated in Section II.C, we shall consider the case where agents on one side of the market (demanders or suppliers) set prices and agents on the other side act as price takers. Call H_i the (possibly empty) subset of goods whose prices are set by agent i. As said above goods are distinguished not only by their physical characteristics, but also by the agent who sets their price. As a result, the sets H_i are disjoint:

$$H_i \cap H_j = \{\varnothing\} \qquad j \neq i$$

and each price maker is alone on his side of the market. Subdivide further H_i into H_i^s (goods supplied by i) and H_i^d (goods demanded by i). Agent i appears formally as a monopolist on markets $h \in H_i^s$, as a monopsonist on markets $h \in H_i^d$. Consequently the constraints he perceives have the simple form:

$$\bar{s}_{ih} = \sum_{j \neq i} \tilde{d}_{jh} \qquad h \in H_i^s \tag{19}$$

$$\bar{d}_{ih} = \sum_{j \neq i} \tilde{s}_{jh} \qquad h \in H_i^d. \tag{20}$$

Now the basic idea of the concept we shall present is that the agent i uses the prices he controls to "manipulate" his constraints. Call p_i the set of prices controlled by i:

$$p_i = \{p_h | h \in H_i\}.$$

In order to pose the problem of the optimal price choice by the firm, all we need to know is how he perceives the quantity constraints in equations (19) and (20) to vary with p_i. We shall now describe here the objective demand curve approach, as developed in Bénassy (1988).[8] The subjective demand curve approach will be treated by way of example in Section IV.C.[9]

The Objective Demand Curve

The equilibrium structure we shall consider is that of a Nash equilibrium in prices, which corresponds implicitly to the idea that there are many price setting agents, as in monopolistic competition. Each agent chooses his price vector p_i, taking as given the prices decided by others, which we shall denote by p_{-i}:

$$p_{-i} = \{p_j | j \neq i\}.$$

The idea behind the objective demand curve approach is that the agent knows the economy well enough to be able to compute the quantity constraints he will face under all circumstances. In particular he must be able to compute the $\bar{d}_{ih}$ or $\bar{s}_{ih}$ of equations (19, 20) for *any* value of the prices p_{-i} and p_i that others and himself may set. This is actually quite easy to do given the results of Section III.B where we saw that, for any given market organization, we could notably compute demands, supplies, and quantity constraints as functions of the price vector $p = (p_i, p_{-i})$. These were denoted $\tilde{D}_i(p)$, $\tilde{S}_i(p)$, $\bar{D}_i(p)$, $\bar{S}_i(p)$. The objective demand curve for a good $h \in H_i^s$ is thus:

$$\sum_{j \neq i} \tilde{D}_{jh}(p) = \bar{S}_{ih}(p)$$

and symmetrically the objective supply curve for a good $h \in H_i^d$:

$$\sum_{j \neq i} \tilde{S}_{jh}(p) = \bar{D}_{ih}(p).$$

Price Making and Equilibrium

Once it is assumed that agent i knows the exact functions $\bar{D}_i(p)$ and $\bar{S}_i(p)$, the program yielding his optimal price p_i is very naturally written

$$\text{Maximize } U_i(\omega_i + z_i, m_i) \qquad \text{such that}$$
$$\begin{cases} pz_i + m_i = \bar{m}_i \\ -\bar{S}_{ih}(p) \leq z_{ih}(p) \leq \bar{D}_{ih}(p) \quad h = 1, \ldots \ell \end{cases}$$

which gives the optimum price decision of agent i as a function of the prices chosen by the other agents:

$$p_i = \psi_i(p_{-i}).$$

[8] Earlier works on the objective demand curve approach are found in Jean Gabszewicz and Jean-Philippe Vial (1972), Thomas Marschak and Reinhard Selten (1974), Hukukane Nikaido (1975), Frank Hahn (1978).

[9] For an application of this methodology to subjective demand curves in general equilibrium, see Bénassy (1976, 1978, 1982, 1990), which link the approach described here with Negishi's (1961) seminal work on general equilibrium with subjective demand curves.

We can now describe the equilibrium as a Nash equilibrium in prices as follows:

DEFINITION 3: *An equilibrium with price makers is characterized by a set of prices p_i^*, net demands $\tilde{z}_i$, transactions z_i^*, and quantity constraints $\bar{d}_i$, $\bar{s}_i$ such that:*

(a) $p_i^* = \psi_i(p_{-i}^*)$ *for all* i

(b) $\tilde{z}_i$, z_i^*, $\bar{d}_i$, $\bar{s}_i$ $(i = 1, \ldots, n)$ *form a fixprice equilibrium for the price vector* p^*, *i.e., they are equal respectively to* $\tilde{Z}_i(p^*)$, $Z_i^*(p^*)$, $\bar{D}_i(p^*)$, $\bar{S}_i(p^*)$.

Further discussion, conditions for existence, and inefficiency properties can be found in Bénassy (1987, 1988, 1990, 1991b). For an explicit modeling of rational expectations in that framework, see for example Bénassy (1991a).

At this stage we clearly see that the method we described, far from being confined to fixed prices, allows us on the contrary to treat the endogenization of prices in a rigorous manner, because it allows us to derive the quantity consequences (i.e., demands, supplies, transactions, and quantity constraints) of any price choice.

An Example

For a simple example of an equilibrium with price makers, consider again the Edgeworth box seen above. Assume now that agent B (the seller) sets the price. The "objective demand curve" is then agent A's demand, and corresponds thus to the locus of tangency points between various budget lines and A's indifference curves. This is depicted as the curved line OMW in Figure 3, where W is the Walrasian point. The equilibrium point is then simply point M, the tangency point of this curve with B's indifference curve, which yields agent B the highest possible utility, given A's objective demand behavior.

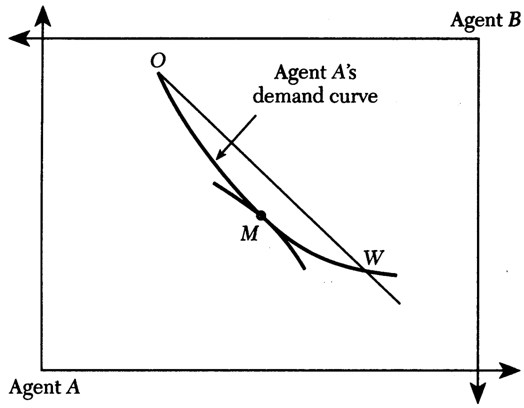

Figure 3.

IV. *Macroeconomic Applications*

In this part we shall show how the concepts studied above allow the construction of a wide variety of macroeconomic models. We shall thus study successively a Walrasian equilibrium model, a fixprice-fixwage model, a model with imperfect competition on the goods and labor markets, a model with real and nominal rigidities, and an extension of that model to rational expectations. All these models will be studied in the framework of the same economy, which we shall now quickly describe.[10]

A. *The Economy and Walrasian Equilibrium*

Markets and Agents

We shall consider here a very simple monetary economy with three goods (money, output, and labor) and three

[10] We shall concentrate in this part on the standard three goods model and the problems of employment and policy. Other problems have been treated with this methodology, including foreign trade (Avinash Dixit 1978; Peter Neary 1980; John Cuddington, Per-Olov Johansson, and Karl-Gustav Löfgren 1984), growth (Takatoshi Ito 1980; Pierre-Yves Hénin and Philippe Michel 1982; Pierre Picard 1983; D'Autume 1985), business cycles (Bénassy 1984, 1986), as well as the specific problems of planned socialist economies (Richard Portes 1981).

agents: An aggregate firm, an aggregate household, and the government.

There are two markets where output and labor are exchanged against money at the price p and wage w respectively. We assume that these markets are frictionless, so that transactions on each one are equal to the minimum of supply and demand. We shall denote by y and ℓ respectively the transactions on output and labor.

The aggregate firm has a production function $F(\ell)$ which we shall assume strictly concave. The firm maximizes profits $\pi = py - w\ell$, which are fully redistributed to the household.

The household has an initial endowment of labor ℓ_o and of money m_o. It consumes a quantity c of output, works an amount ℓ, saves an amount of money m, and its budget constraint is:

$$pc + m = w\ell + \pi + m_o - p\tau \quad (21)$$

where τ is the real value of taxes levied by the government. The household will be assumed to have the simple utility function

$$U = \alpha \log c + \beta \log(\ell_o - \ell) + \gamma \log(m/p^e). \quad (22)$$

Finally the government taxes an amount τ in real terms from the household. He also has a demand for output g.

Walrasian Equilibrium

Let us first compute the Walrasian demands and supplies on the output and labor markets. Maximization of the firm's profits under the production function $F(\ell)$ yields:

$$\ell^d = F'^{-1}(w/p) \qquad y^s = F[F'^{-1}(w/p)].$$

Maximization of the household's utility function (22) subject to the budget constraint (21) yields:

$$c^d = \frac{\alpha}{\alpha + \beta + \gamma}\left[\frac{w\ell_o + \pi + m_o - p\tau}{p}\right] \quad (23)$$

$$\ell^s = \ell_o - \frac{\beta}{\alpha + \beta + \gamma}\left[\frac{w\ell_o + \pi + m_o - p\tau}{w}\right]. \quad (24)$$

The equations giving the Walrasian price and wage are:

$$y^s = y = c^d + g$$
$$\ell^s = \ell = \ell^d.$$

Simple manipulations of the above equations yield the following equations for the values of ℓ, y, p, w in Walrasian equilibrium (if it exists):

$$F'(\ell)(\ell_o - \ell) = \frac{\beta}{\alpha}[F(\ell) - g] \quad (25)$$

$$y = F(\ell) \quad (26)$$

$$\frac{w}{p} = F'(\ell) \quad (27)$$

$$p = \frac{\alpha m_o}{\gamma(y - g) - \alpha(g - \tau)}. \quad (28)$$

From (25) and (28) we see that the conditions for the existence of a Walrasian equilibrium are:

$$g < F(\ell_o)$$
$$\alpha(g - \tau) < \gamma(y - g) \quad (29)$$

where y is that given by equations (25, 26). The first condition is obvious. The second says that the real deficit of the government should not be too high. From these equations we see a few things; first money is neutral (i.e., price and wage are proportional to m_o, y and ℓ do not depend on it). Further:

$$0 < \frac{\partial y}{\partial g} < 1 \qquad -1 < \frac{\partial c}{\partial g} < 0$$

on which we see that there is crowding out of private consumption by government expenditures, though less than one hundred percent.

B. *Fixprice-Fixwage Equilibria*

We shall now study the above model under the assumption, somehow polar to the Walrasian one, that the price p and wage w are completely rigid in the period considered. We shall obtain the famous "fixprice" model originally developed by Barro and Grossman (1971, 1976).[11] As is well known, this model has three possible regimes.[12]

- Keynesian unemployment with excess supply for both output and labor,
- Classical unemployment with excess supply of labor and excess demand for goods,
- Repressed inflation with excess demand for both labor and output.

We shall study these three regimes in turn.

Keynesian Unemployment

This regime displays excess supply in both markets. In particular the household faces a binding constraint $\bar{\ell}^s$ in the labor market, so that its effective consumption demand $\tilde{c}^d$ is the value of c that solves the following program (cf., Clower 1965):

$$\text{Maximize } \alpha \log c + \beta \log(\ell_o - \ell) + \gamma \log(m/p^e) \quad \text{such that}$$
$$\begin{cases} pc + m = m_o + w\ell + \pi - p\tau \\ \ell \leq \bar{\ell}^s \end{cases}$$

yielding, as the second constraint is binding:

$$\tilde{c}^d = \frac{\alpha}{\alpha + \gamma} \left[\frac{m_o + w\bar{\ell}^s + \pi - p\tau}{p} \right]$$

which can be rewritten, using the definition of π and the fact that $\bar{\ell}^s$ is equal to the actual sale of labor:

$$\tilde{c}^d = \frac{\alpha}{\alpha + \gamma} \left[\frac{m_o}{p} + y - \tau \right]$$

in which we recognize a very traditional Keynesian consumption function. Because of excess supply in the goods market, transactions y are equal to total output demand:

$$y = \tilde{c}^d + g = \frac{\alpha}{\alpha + \gamma} \left[\frac{m_o}{p} + y - \tau \right] + g$$

yielding:

$$y^* = \frac{\alpha}{\gamma} \left(\frac{m_o}{p} + g - \tau \right) + g = y_k \quad (30)$$

a most traditional Keynesian multiplier formula where $(\alpha + \gamma)/\gamma$ is the multiplier. Labor transactions are equal to the firm's demand, which, as the firm is constrained in its output sales to y_k, is (as we saw in Section II.B) equal to the quantity of labor just necessary to produce y_k, i.e.:

$$\ell^* = F^{-1}(y_k) = \ell_k. \quad (31)$$

We may also compute private consumption $c^* = y^* - g$:

$$c^* = \frac{\alpha}{\gamma} \left(\frac{m_o}{p} + g - \tau \right).$$

[11] The fixprice macromodel was further developed in Bénassy (1978, 1982), Edmond Malinvaud (1977), Werner Hildenbrand and Kurt Hildenbrand (1978), John Muellbauer and Portes (1978), Seppo Honkapohja (1979), Neary and Joseph Stiglitz (1983), Torsten Persson and Lars Svensson (1983). The adaptation presented here is that of Bénassy (1978, 1990).

[12] Note that this terminology of the regimes, which is Malinvaud's (1977) contribution to the field, is not fully satisfactory as it tends to associate the idea of classical unemployment to an excess demand for goods. This clearly need not be the case, as we shall see in Section IV.D. However, we still keep this terminology here, as most people aware of the field are accustomed to it.

Let us make a few observations: The first is that money is not any more neutral, but that increases in m_o will increase production, employment, and private consumption. These will also be increased by decreases in taxes or increases in government spending. The traditional results of "Keynesian" analysis are thus valid in this regime.

Maybe the most striking fact is that an increase in government spending will increase not only production and employment, but *also* private consumption. There is thus no crowding out, quite the contrary, as even though the government collects real output from the private sector, more of it is available for private consumption, a remarkable by-product of the inefficiency of the Keynesian multiplier state.[13]

Classical Unemployment

In this case there is excess supply of labor and excess demand for goods. The firm, being on the "short" side in both markets, is able to carry out its Walrasian plan, so that:

$$\ell^* = F'^{-1}(w/p) = \ell_c \tag{32}$$

$$y^* = F[F'^{-1}(w/p)] = y_c. \tag{33}$$

We see immediately that "Keynesian" policies have no impact on employment and production. In fact it is easy to check that their main effect is to aggravate excess demand on the goods market. If we further assume that government has priority in the goods market, then the actual consumption is equal to:

$$c^* = y^* - g = y_c - g.$$

There is a one hundred percent crowding out effect of government expenditures, which thus appears as an undesirable policy instrument. Note that this time crowding out does not occur through prices, but by a direct rationing mechanism. The only variable which affects the level of employment and production is the level of real wages, thus validating the "classical" presumption that there is unemployment because "real wages are too high."

Repressed Inflation

In this regime there is excess demand in both markets. In particular the household is faced with a binding constraint $\bar{c}$ (actually equal to its purchases c^* in the goods market). Its supply of labor $\tilde{\ell}^s$ is thus given by the solution in ℓ to the following program:

$$\text{Maximize } \alpha \log c + \beta \log(\ell_o - \ell) + \gamma \log(m/p^e) \quad \text{such that}$$

$$\begin{cases} pc + m = m_o + w\ell + \pi - p\tau \\ c \le \bar{c} \end{cases}$$

where the last constraint is binding. The solution to this program (assuming labor supply is strictly positive) is:

$$\tilde{\ell}^s = \ell_o - \frac{\beta}{\beta + \gamma} \left[\frac{m_o + w\ell_o + \pi - p\tau - p\bar{c}}{w}\right].$$

In this formula we see a new spillover effect: Rationing on the goods market leads the household to reduce its supply of labor. Now assume again that government has priority on the goods market, and production is high enough to satisfy g (the reader can easily work out the case where it is not). Then:

$$\bar{c} = c^* = y^* - g.$$

Because there is excess demand for labor, the transaction ℓ^* is equal to $\tilde{\ell}^s$. Combining this with the definition of profits and the two above equations, we obtain:

[13] For further developments on these inefficiency properties, see for example Bénassy (1975a, 1978, 1982, 1990).

$$\ell^* = \ell_o - \frac{\beta}{\gamma}\left(\frac{m_o + pg - p\tau}{w}\right) = \ell_r. \quad (34)$$

Output transactions are equal to the supply, which is equal (as the firm is constrained in its labor purchases) to the maximum quantity producible with available labor supply, i.e.:

$$y^* = F(\ell_r) = y_r.$$

We may now note that the economic policy variables have effects completely opposite to those in the Keynesian regime. In particular, increases in the quantity of money or in government spending diminish employment and production! Furthermore, under the above assumptions, private consumption is equal to:

$$c^* = y^* - g = y_r - g.$$

Because an increase in g reduces y_r, it reduces c^* by a quantity even greater than g. There is thus a more than one hundred percent crowding out effect! The mechanism at work in this regime is some kind of "supply multiplier" (Barro and Grossman 1974), by which a reduction in the amount of goods available for consumption reduces the supply of labor, which itself reduces further the amount of goods produced, and so on . . .

The Complete Picture

As we have seen above, the three regimes of our model display strikingly different properties concerning the determination of employment and activity and the response to policy variables. It is therefore important to know for which values of the "exogenous" parameters m_o, p, w, g, and τ, each of the three regimes obtains. As the reader may easily check, both the employment level and the nature of the regime are determined by finding out the lowest of the three possible employment levels computed above (equations 30 to 35), i.e.:

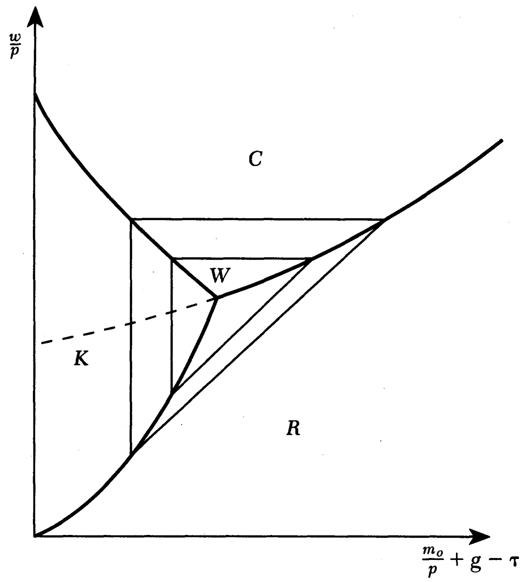

Figure 4.

$$\ell^* = \min(\ell_k, \ell_c, \ell_r)$$
$$y^* = \min(y_k, y_c, y_r).$$

We can depict the three regimes, denoted K, C, and R in the space $(m_o/p + g - \tau, w/p)$, with g being parametric. Figure 4 has been drawn for g equal to zero. The triangles are iso-employment or iso-output lines. For a given g, the highest level of employment and production occurs at W, the Walrasian equilibrium point. As g increases, point W slides down the dashed line, and the frontier between regime K and the two other regimes moves accordingly.

On this diagram we see particularly well that the spillover effects from the goods market to the labor market do matter a lot: Even if the real wage is "right" (i.e., equal to its Walrasian equilibrium level, which corresponds to the horizontal line going through W), we may have inefficiently low values of employment due to insufficient (or excessive) demand in the output market.

C. *An Imperfectly Competitive Model*[14]

We shall now endogenize the price and wage in a framework of imperfect competition similar to those of Sections II.C and III.C. It will be assumed that the firm sets the price, and the household sets the wage. In order to make exposition more compact, and because we have a model with aggregate representative agents, we shall use the subjective demand curve approach. It turns out that the same results are obtained with objective demand curves (Bénassy 1987, 1990) and with both objective demand curves *and* rational expectations (Bénassy 1991a).

The Equilibrium

In order to characterize the equilibrium, we shall successively consider the optimal actions of the firm and household. Consider first the firm, and assume that it perceives demand curves for goods of the form $\theta p^{-\eta}$, where $\eta > 1$ is given and θ is a variable "position" parameter; the optimal actions of the firm are given by the program:

$$\text{Maximize } py - w\ell \qquad \text{such that}$$

$$\begin{cases} y \leq F(\ell) \\ y \leq \theta p^{-\eta}. \end{cases} \tag{A$_1$}$$

Note that in all rigor we should add a quantity constraint on ℓ since the firm is a wage taker on the labor market. But we know that the household will always choose a wage high enough for the firm not to be rationed on the labor market, so we shall simply ignore this nonbinding constraint. The first order conditions for this program yield, after elimination of θ:

$$F'(\ell) = \frac{\eta}{\eta - 1}\frac{w}{p} \tag{36}$$

and of course the production relation always holds:

$$y = F(\ell). \tag{37}$$

Assume now that the household similarly perceives demand curves for labor of the form $\theta w^{-\epsilon}$ where $\epsilon > 1$ is given, and θ is again a position parameter. The program yielding the household's optimal actions is:

$$\text{Maximize } \alpha \log c + \beta \log(\ell_o - \ell) + \gamma \log(m/p^e) \qquad \text{such that}$$

$$\begin{cases} pc + m = m_o + w\ell + \pi - p\tau \\ \ell \leq \theta w^{-\epsilon}. \end{cases} \tag{A$_2$}$$

The first order conditions yield, calling λ the "marginal utility of income," and after elimination of θ:

$$\frac{\partial U}{\partial m} = \lambda \qquad \frac{\partial U}{\partial c} = \lambda p \tag{38}$$

$$\frac{\partial U}{\partial(\ell_o - \ell)} = \lambda w\left(1 - \frac{1}{\epsilon}\right)\cdot \tag{39}$$

With our particular Cobb-Douglas utility function, these yield, defining $\beta' = \epsilon\beta/(\epsilon - 1)$:

$$pc = \frac{\alpha}{\alpha + \beta' + \gamma}(w\ell_o + \pi + m_o - p\tau) \tag{40}$$

$$w(\ell_o - \ell) = \frac{\beta'}{\alpha + \beta' + \gamma}(w\ell_o + \pi + m_o - p\tau). \tag{41}$$

We may note that these equations resemble the competitive ones (equations 23 and 24 in Section IV.A), with β replaced by β'. Of course we must add the budget constraint of the household:

[14] Macroeconomic models with imperfect competition were developed notably in Bénassy (1978, 1982, 1987, 1990, 1991), Negishi (1978, 1979), Yew-Kwang Ng (1980, 1986), Oliver Hart (1982), Martin Weitzman (1982, 1985), Dennis Snower (1983), Torben Andersen (1985a, 1985b), Kiyohiko Nishimura (1986, 1992), Svensson (1986), Blanchard and Nobuhiro Kiyotaki (1987), Huw Dixon (1987a, 1991), Henri Sneessens (1987), Silvestre (1988, 1989), Jacobsen and Schultz (1990), Marco Pagano (1990). This section is adapted from Bénassy (1978).

$$pc + m = m_o + w\ell + \pi - p\tau. \quad (42)$$

Finally we still have the equality between production and total demand

$$y = c + g. \quad (43)$$

Solving the system of equations (36, 37, 40–43) we find that the values of y, ℓ, p, w in equilibrium (if it exists) are given by:

$$F'(\ell)(\ell_o - \ell) = \frac{\epsilon}{\epsilon - 1} \cdot \frac{\eta}{\eta - 1} \frac{\beta}{\alpha} \; [F(\ell) - g] \quad (44)$$

$$y = F(\ell) \quad (45)$$

$$\frac{w}{p} = \frac{\eta - 1}{\eta} F'(\ell) \quad (46)$$

$$p = \frac{\alpha m_o}{\gamma(y - g) - \alpha(g - \tau)}. \quad (47)$$

We may first note that the Walrasian equilibrium is a limiting case of our equilibrium when both η and ϵ go to infinity (compare equations 44 to 47 with equations 25 to 28). Secondly the conditions for the existence of the equilibrium are again

$$g < F(\ell_o)$$
$$\alpha(g - \tau) < \gamma(y - g) \quad (48)$$

where y is given by (44) and (45). Though they look the same, condition (48) is a bit more stringent than condition (29) in the competitive case, as the level of employment given by equation (44) is smaller than the one given by (25).

Properties of the Equilibrium

We shall now show that the allocation at our imperfectly competitive equilibrium has properties similar to those of a "Keynesian" allocation, as described in Section IV.B above. Let us note first that equation (47), inverted to give y as a function of p, yields exactly formula (30) giving y_k in the Keynesian regime when p is exogenously given.

Secondly, we may remark that we are somehow in a "general excess supply" regime. Indeed program A_1 and equation (36) show that the firm would be willing, at the equilibrium price and wage, to sell more goods (and hire more workers), if the demand was forthcoming. Similarly program A_2 and equation (39) show that the household would like to sell more labor at the going price and wage, if there was more demand for it. In the diagram of Figure 4, the equilibrium w and p would yield a point within region K. There is underemployment and underproduction, even though both are voluntary and individually rational.

Now let us come back to equation (44) which gives the level of employment at equilibrium. We see that it is smaller than Walrasian employment, and actually a decreasing function of the "market power" of both firms and households (the "Lerner indices" of market power are equal respectively to $1/\eta$ on the output market and $1/\epsilon$ on the labor market). Further, and though it is arrived at by fully rational behavior, this level of employment is inefficiently low in the following sense: Assume that some "benevolent dictator" makes the household work more (say by $d\ell > 0$) and gives the extra production $dy = F'(\ell)\ d\ell > 0$ to the household. Considering first the firm, we see, using equation (36), that the variation in its real profits would be:

$$d(\pi/p) = \frac{dy}{\eta} > 0. \quad (49)$$

Considering now the household, we can compute the variation in its utility as:

$$dU = \frac{\partial U}{\partial c} \cdot dc + \frac{\partial U}{\partial \ell} \cdot d\ell$$

which, using equations (36), (38), and (39) yields:

$$dU = \left[1 - \left(\frac{\eta - 1}{\eta}\right)\left(\frac{\epsilon - 1}{\epsilon}\right)\right] \frac{\partial U}{\partial c} dy > 0. \quad (50)$$

We see that both the firm (equation 49) and the household (equation 50) would gain from the move. It can further be shown (Bénassy 1987, 1990) that the household gains both as a wage earner (if $1/\epsilon \neq 0$) and as a profit earner (if $1/\eta \neq 0$). Of course, and even though it is Pareto improving, it is very difficult to envision such a "benevolent dictator" solution in a free market economy. Moreover the complexity of actual exchanges, and notably the lack of "double coincidence of wants," would make these additional Pareto improving trades almost impossible to realize in a real world decentralized economv (Bénassy 1990). We shall thus examine whether more traditional policies can bring about this increase in employment and production.

Government Policy

We shall now try to find out whether government policies which were successful in the regime of Keynesian unemployment are still so in this imperfectly competitive framework. Studying first monetary policy, we see that it is fully neutral: An increase in m_o will bring about an equiproportionate rise in p and w, and y and ℓ will not move.

Considering now a tax decrease, we see that it does not have any impact on y and ℓ, but increases prices (equation 47) and thus wages (equation 46). In view of condition (48), a too large tax decrease might actually be inflationary to the point of jeopardizing the existence of an equilibrium. If we finally consider an increase in government spending g, we see that it will increase employment and production, but actually crowd out private consumption. In order to see whether this would be desirable or not from a welfare point of view, one should include explicitly government spending as an argument of the household's utility function. For such a normative analysis, see Bénassy (1991a).

All in all, we see that this model yields an allocation which has very "Keynesian" inefficiency properties, but reacts to government policy in a way which is somewhat similar to that of a Walrasian model.

D. *Real and Nominal Rigidities*[15]

We shall now study briefly another version of our macroeconomic model, which will allow us to throw some light on the issue of "real" versus "nominal" rigidites. If we consider the fixprice-fixwage model of Section IV.B above, it is indeed not clear what kind of rigidities are actually at work: It might be that both p and w are nominally rigid, *or* p nominally rigid and the real wage (w/p) rigid, *or* w nominally rigid and the "real markup" (p/w) rigid (we may remark that, from this point of view, the imperfectly competitive model of the preceding section displays two "real" rigidities). We shall thus make things a little more explicit, and study a simple model with one real and one nominal rigidity. We shall assume that both the *nominal* price level and the *real* wage are rigid downwards, but flexible upwards, which we will represent by the conditions:

$$p \geq p_o \qquad w/p \geq \omega.$$

We may note that the first inequality implies that the household will never be rationed on the goods market. Consumption rationing clearly made the fixprice-fixwage model a bit unrealistic for free market economies, as rationing on goods markets is seldom observed in such economies. As a result we shall always be "on the demand curve" (in a sense that will

[15] The model in this section is adapted from Bénassy (1986).

become clearer below). In spite of this we shall still observe three regimes with markedly different properties in this model (if an equilibrium exists):

- Excess supply of labor and goods (Regime A),
- Excess supply of labor with the goods market cleared (Regime B),
- Both markets cleared (Regime C)

Regime A ("Keynesian")

With excess supply on both markets, the price will be blocked at p_o and the real wage at ω.

$$p = p_o \qquad w/p = \omega.$$

Output level will be determined by demand in exactly the same way as in the "Keynesian" case of Section IV.B, yielding:

$$y^* = \frac{\alpha}{\gamma}\left(\frac{m_o}{p} + g - \tau\right) + g$$

and

$$\ell^* = F^{-1}(y^*).$$

These are exactly the values found in the Keynesian unemployment regime of the fixprice-fixwage model, and employment will be increased through the same policy measures: An increase in m_o, g, or a decrease in τ. For what follows it will be convenient to define a "demand curve" $K(p,m_o,g,\tau)$, similar in spirit to the "aggregate demand curve" of macroeconomic textbooks, by:

$$K(p,m_o,g,\tau) = \frac{\alpha}{\gamma}\left(\frac{m_o}{p} + g - \tau\right) + g.$$

With this definition y^* in this regime is simply equal to $K(p_o,m_o,g,\tau)$.

Regime B ("Classical")

Here the real wage is blocked at ω, but the price is now determined by the equality of supply and demand. As in the previous regime, y is equal to demand, so that we have on the demand side of the goods market:

$$y = K(p,m_o,g,\tau).$$

The firm is unconstrained on the goods market (which clears) and on the labor market (where it is on the short side). It carries thus its Walrasian plan, which yields, taking into account that $w/p = \omega$:

$$y^* = F[F'^{-1}(\omega)]$$
$$\ell^* = F'^{-1}(\omega).$$

We see here that only a reduction in the real wage ω can cure unemployment, as in the "classical" regime of Section IV.B. As we already emphasized, this occurs without any rationing on the goods market.

Regime C ("Walrasian")

Because both markets clear, we are in the Walrasian case, described in Section IV.A (see equations 25–28). We shall not comment on policies, which were discussed there, but simply note for the sequel that equation (28), inverted to give y as a function of p, yields:

$$y = K(p,m_o,g,\tau).$$

The General Picture

If we look at the systems of equations giving the equilibrium values of y and p in each of the three regimes (as well as the inequalities they must satisfy, which are left to the reader), we see that they can be determined as the intersection in (p,y) space of a "demand curve" and a "supply curve" (Figure 5), The "demand curve" has for equation:

$$y = K(p,m_o,g,\tau).$$

The "supply curve" consists of two parts: A vertical part with equation $p = p_o$. A horizontal part with equation:

$$y = \min\{F[F'^{-1}(\omega)],\ y_w\} = \min(y_c,y_w)$$

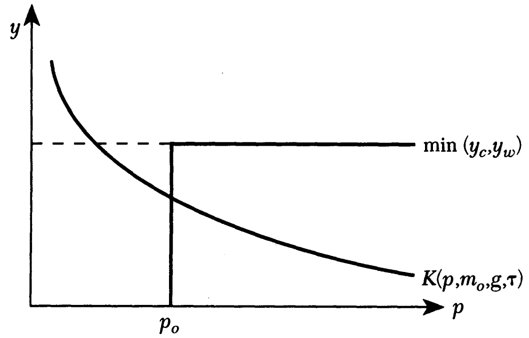

Figure 5.

where y_w is the Walrasian value of y, given by equations (25) and (26) above. In Figure 5 (as well as from the above formulas) we see immediately that the equilibrium (if it exists) will yield values of y^* and ℓ^*:

$$y^* = \min\{K(p_o,m_o,g,\tau),\ F[F'^{-1}(\omega)],\ y_w\}$$
$$\ell^* = F^{-1}(y^*).$$

Figure 5 also gives us the condition for the existence of an equilibrium, which is simply that the "demand" and "supply" curves intersect, i.e.:

$$\lim_{p\to\infty} K(p,m_o,g,\tau) < \min(y_w,\ y_c)$$

Or:

$$\alpha(g - \tau)/\gamma + g < \min[y_w(g),\ y_c(\omega)]$$

a condition which is more stringent than the one for the existence of a Walrasian equilibrium (equation 29) if $\omega > F'(\ell_w)$.

To summarize, this model with real and nominal rigidities, although extremely simple, has taught us a few things: The first is that one could obtain both Keynesian type (Regime A) and classical type (Regime B) unemployment with the demand for consumer goods always satisfied. The usual association of "classical unemployment" with an excess demand for goods is thus clearly invalid.

Secondly, even though *both* real and nominal rigidities are present in all cases, we have seen that the economy can still have several regimes where it behaves as if mainly nominal rigidities were present (Regime A), mainly real rigidities were present (Regime B), or none was (Regime C). From that we deduce that interesting insights can be gained by an adequate combination of the two types of rigidities; and secondly that the same system may react in a totally different manner to different shocks, so that apparent "discontinuities" in observed behavior of economic series may come from a "change of regime" within the same economic system as well as from changes in the system itself.

E. *Rational Expectations and the Multiplier*[16]

We shall finally describe an intertemporal extension of the model of the previous section with explicitly rational expectations. This will be useful in several respects:

- It will demonstrate in the most simple manner that our approach is fully consistent with rational expectations.
- It will show that spillover effects work not only through current quantity constraints, but through expected ones as well. If these intertemporal spillovers are correctly taken into account, the multiplier in Keynesian regimes will be higher than what we would expect from the value of the propensity to consume out of current income (which may be fairly low if one has a "permanent income" view of consumption).

Our model will be a direct extension of that in Section IV.D, but this time taking explicitly into account a sequence of periods indexed by $t = 1, \ldots, k$. In each period the price p_t and the real

[16] The model in this section derives from Neary and Stiglitz (1983), Bénassy (1986).

wage w_t/p_t are flexible upwards but rigid downwards. The aggregate household has a utility function

$$U = \Sigma\, \alpha_t \log c_t + \Sigma\, \beta_t \log(\ell_o - \ell_t) + \gamma \log m/p^e$$

where m is the quantity of money saved and p^e the price expected after the last period (which may be thought of as the retirement time). Assuming the household does not have any binding "liquidity constraint," its budget constraints for periods $t = 1, \ldots, k$ can be merged into the single following one:

$$\Sigma\, p_t c_t + m = \Sigma\, p_t y_t + m_o - \Sigma T_t$$

where T_t is the nominal value of taxes in period t. We assume that the government spends G_t in nominal terms in period t,[17] so that we will have

$$p_t y_t = p_t c_t + G_t \quad \text{for all } t. \qquad (51)$$

Because prices are flexible upwards, demand for goods will always be satisfied. It is then easy to check that, whatever the regime in each period t, the following equations always hold:

$$p_t c_t = \frac{\alpha_t}{\Sigma\, \alpha_t + \gamma}\,[m_o + \Sigma\, p_t y_t - \Sigma\, T_t] \quad \text{for all } t. \qquad (52)$$

Putting together equations (51) and (52) for all t and solving the corresponding system we find:

$$p_t y_t = \frac{\alpha_t}{\gamma}\,[m_o + \Sigma\, G_t - \Sigma\, T_t] + G_t \quad \text{for all } t. \qquad (53)$$

These equations are the multiperiod generalization of the "demand curve" in Section IV.D. Note that these equations hold whatever the regime (A,B,C) the economy is in during period t. Assume now that the economy is in a state of Keynesian unemployment in period 1 (regime A), and thus that p_1 is blocked at its floor value. Equation (53) immediately yields a multiplier on current government expenditures equal to $(\alpha_1 + \gamma)/\gamma$. We see that, with expectations correctly taken into account, the multiplier is the same as it would be in a one period model where the propensity to consume would be $\alpha_1/(\alpha_1 + \gamma)$, whereas the propensity to consume out of current income is actually equal to (cf. equation 52):

$$\frac{\alpha_1}{\Sigma\, \alpha_t + \gamma}$$

which may be much lower than $\alpha_1/(\alpha_1 + \gamma)$ if there are many periods. We thus see that not taking expectations into account and considering only the propensity to consume out of current income might lead us to seriously underestimate the multiplier effects in a Keynesian regime.

[17] Taking both taxes and government spending in nominal terms is made only to simplify calculations.

V. *Conclusions*

As compared with the Walrasian approach, we have described in this article a more general and realistic view of the market process, where the exchange of information consists not only of price signals, but also of quantity signals generated in a decentralized fashion in each market by the agents' demands and supplies. All agents, including some explicitly modeled price makers, take these signals into account for their price-quantity decisions. The result is a more general formulation of demand and supply theory, as well as of price making, that takes full account of the intermarket "spillovers" generated by the quantity signals. In particular we endogenized prices in a framework with fully rational price markers.

We saw that the Walrasian general equilibrium concept may be generalized to non-market clearing situations, generating consistent allocations for any positive price system. This permits to build an equilibrium concept with fully flexible (though non-Walrasian) prices by deriving rigorously an "objective demand curve" in a general equilibrium situation with price makers. The concepts so obtained link the Walrasian, Keynesian, and imperfect competition theories in a manner that allows us to treat the corresponding issues in a unified way, as demonstrated in the macroeconomic applications of Part IV. Although the role of expectations is not at all the focus of this article we indicated, and emphasize again, that our framework is consistent with both rational and nonrational expectations. This leaves maximal flexibility to the model builder.

Some readers may be curious about the relation between the approach developed in this article and the currently popular "New Keynesian economics." Rather than a school of thought, New Keynesianism, recently described in the insightful survey by Robert Gordon (1990), is a collection of contributions designed to describe non-market clearing price making derived from rational microfoundations, the ultimate aim being to rationalize Keynesian-type situations. This literature covers a wide range of topics: Labor contracts, unions, insider-outsider theory, efficiency wages, and menu costs, to name only a few. While many of these ideas are worth pursuing, a problem with this literature (noted by Gordon 1990) is that for the most part these insights are of a partial equilibrium nature.[18] But, as we have seen in this article, many interesting results (and certainly most of the "true Keynesian" insights) come from the "spillover" effects between several non-clearing markets in a full general equilibrium framework, such as the one we provided. Thus it would certainly be worthwhile to integrate the most relevant "New Keynesian" insights into the general equilibrium approach developed here.

There are several prospective future developments for research in the field we have surveyed. On the theoretical side, various theories of price formation without an auctioneer can be developed and integrated within the general equilibrium framework presented here. (So far only imperfect competition under complete information has been fully integrated.) Insights should come not only from macroeconomics, but also from microeconomic studies, particularly in the fields of industrial organization, labor, and financial markets. The methodology and framework we outlined will permit the derivation of the micro and macroeconomic consequences of these new developments, as well as the potential consequences of economic policy prescriptions.

Though we did not discuss the empirical literature, important work remains to be done on the empirical side. Our concepts apply to various sorts of market economies, whether of the U.S. type or of the planned socialist type. But clearly the type of market imbalances observed will differ widely across countries, depending on the underlying economic and institutional organization of markets. Further development of econometric methods should allow us to choose the most relevant hypotheses for each country and to characterize specific historical episodes.[19]

All this shows that this article, and the

[18] There are of course exceptions to this qualification, for example Russell Cooper and Andrew John (1988). Gordon himself, though more empirical than the current article, is distinctly general equilibrium oriented in his approach.

[19] Econometric work in this area is actually a lively research domain. A bibliography circulated by Richard Quandt of Princeton University contained around 400 empirical studies in June 1990. For recent contributions see, for example, Drèze and Charles Bean (1991), Jean-Paul Lambert (1988), Quandt (1988), Sneessens and Drèze (1986).

work described therein, should certainly not be seen as a completed research program. Its purpose is rather to sketch a few aspects and potential developments of this very large field of research, and to encourage researchers to explore it further.

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