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IN DEVELOPMENT POLICY ANALYSIS

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ABSTRACT

From the early use in the nineteen 'fifties of fixed coefficient Input-Output (I-O) models in analysing the consistency and technical feasibility of development plans, economy-wide models have become indispensable tools of analysis in the armory of economists interested in development planning. The I-O models were succeeded by their lineal descendents, the linear programming (LP) or more generally, the activity analysis models, and still later by the so-called computable general equilibrium (CGE) models. While this increase in size, scope and sophistication in modelling was no doubt a reflection in large part of the advances in economic theory and computational algorithms and techniques that took place during the post-war period, it is also in part influenced by changing perception of the relative importance of growth and equity in the distribution of fruits of growth in designing development strategies in mixed economies.

It is argued in the paper that while CGE models have a number of advantages over the I-O and LP models in their providing a more satisfactory picture of the economy in terms of an equilibrium in which prices are flexible (albeit tempered by government interventions), markets clear and agents optimize given prices and relevant constraints. However, beyond analysing resource pulls generated by alternative policy interventions, they have proved to be of limited value in illuminating the development process largely because they are restricted in important ways by the nature of their theoretical foundation. What they can say about income distribution is limited, and their treatment of factor employment, based as it is on crude specification of the functions of labour markets, is not altogether convincing. More importantly, they are particularly ill-suited to analyse processes involving real time, such as accumulation and inflation. Their fruitful application for this purpose may have to await further theoretical development.

On The Uses and Abuses of Economy-Wide Models
in Development Policy Analysis

1. INTRODUCTION

Find an economist with a keen interest in development planning and almost certainly there will be an economy-wide model in the offing. In drawing up a consistent and feasible Plan, for example, it is essential to take into account industries' requirements for intermediate and capital goods and the circular flow of production, incomes and demand, treating them in such detail as their importance seems to warrant -- or the data permit. Not so long ago, the only formal and practicable model available for this task was the fixed-coefficients Leontief model. Cleverly used and ingeniously extended, the Leontief model and its close, linear programming (LP) cousins gave intellectual support to, and perhaps greater confidence in, the economist's assessment of how much investment should be made and to which industries it should go. From its origins in the 1950s, this work has grown into an established and distinguished tradition, to which Chenery has made such notable contributions.

Now, the assumption of fixed coefficients was in keeping with the tenor of the times; for it implies a homogeneous linear relationship between inputs and outputs in production, between income and the commodity composition of private consumption, and among imports, exports and national income in foreign trade. Such a relationship was basic to formal models in the Keynesian tradition, and also reflected a strong residue of 'elasticity pessimism' about foreign trade from the inter-war period. In principle, of course, one could approximate (to any desired degree of accuracy) a 'smooth'

neo-classical production function or indifference surface by a set of production or consumption activities, each of which involves a homogeneous linear relationship; indeed, many LP models allowed substitution in this way. It was nevertheless the case that the choice among activities in these models did not reflect cost minimization (or utility maximization) given endogenously determined market prices for inputs, outputs and factors.

This appeal to fixed coefficients could be justified on grounds that, so to speak, span the spectrum of possibilities. First, it may be argued that the relevant elasticities of substitution are low enough to make fixed-coefficients a satisfactory approximation in that even substantial changes in the relevant prices will not result in significant changes in coefficients under competitive conditions. In short, changes in prices will not matter, except for any income effects they may have. Secondly, if there are constant returns to scale and highly elastic supplies of factors, the relative prices of commodities will not change, and so it does not matter whether commodities (and factors) are good substitutes in consumption (production). In short, one can contrive a story in which prices do not change anyway! The third defense was a practical one: neither proven algorithms nor the computational power were available to solve systems in which both quantities and prices are mutually and simultaneously determined. Early on, however, Chenery and Uzawa [1958] had introduced non-linearities into a planning model. Subsequently, Chenery and Raduchel [1971] developed a compact, but quite generally specified model with "representative" data from cross-section studies to address the question: Is substitution likely to matter in practice?

While the first and second defenses of the use of fixed coefficients were already under some pressure, the third was beginning to crumble by the

early 'seventies. In particular, it had become possible to compute competitive (more generally, flex-price) equilibria for economies with numerous factors and goods. This achievement held out the promise of more refined calculations of the effects of public policy on patterns of resource allocation than those permitted by fix-price frameworks. Yet there was a more alluring prospect still; for if the relative prices of factors and goods are endogenously determined, one can derive the distribution of factor incomes under fairly general conditions and thence, under appropriate assumptions about the distribution of factor endowments among households, proceed to the distribution of real household incomes. Such an approach to income distribution was far more appealing from a theoretical standpoint than earlier attempts to assess the impact of exogenously specified changes in the distribution of household consumption within the framework of an input-output planning model, as was done in India in the mid-'sixties, for example. Given the urgency of understanding better how growth and income distribution are related in the development process, this opportunity was eagerly seized.

Yet another reason for the move away from the planning models of the 'fifties and 'sixties was the growing dissatisfaction with development planning in mixed economies with dominant private sectors. It was argued that the development plans of many developing countries had little or no relation to the feasible set of policy instruments available to planners of these countries. From the optimistic assertion attributed to a highly placed Indian planner that "to any physically feasible plan there corresponds a feasible financing scheme (in terms of taxes, transfers, domestic and foreign savings, and investment)," the mood shifted to pessimism about successfully implementing any plan unless it was compatible with private incentives.

Moreover, these incentives were initially affected by a myriad of other policies, such as import quotas and capacity licensing, let alone taxes and subsidies. Thus, if the early development planning models (particularly those of the optimizing genre) could be described somewhat, but not entirely, inaccurately as assuming that the "first best" policy instruments were available for implementing the plan, the search was on for models that had a "second best", if not an Nth best, character about them. Given the dominance of the private sector in many of these economies, it was natural that the search would focus on models influenced by the spirit of Walrasian general competitive equilibrium, albeit tempered by "second best" considerations.

At about that time, many of the ideas, problems and techniques in development planning had been discussed in general terms in Blitzer, et al [1975]. There, Taylor emphasized that "there is no single best model for use by all planning offices. Rather, there is a wide range of possible specifications -- an appropriate one in a given country depending on factors ranging from data availability, to the institutional framework for planning, to the specific policy problems under discussion." (p. 33) While agnostic about the additional light shed by optimizing models compared to consistency models of the input-output type, and properly skeptical about the relevance of the implicit assumption, shared by most of the models, of perfect competition, Taylor nevertheless concluded that: "If we had a better theory of prices and economic power than the Walrasian one, model builders would clearly use it. At the moment, however, all that can be said is that an LP model is likely to be a poor facsimile for a Walrasian economy, while a nonlinear constant returns model will be a better one. If competition is basically the only game in town, you might as well play it with elegance". (p. 100) There followed

the pioneering work of Adelman and Robinson [1978] on Korea and Taylor et al. [1980] on Brazil, and then a growing stream of what Adelman and Robinson christened as "computable general equilibrium models" (hereafter, CGEs). ^{1/} Like the fall fashions of the couturiers of Paris, however, these approaches to elegance, i.e., the specification of the model and the algorithm to solve it, were not always the same. We shall examine these variations in style and substance in Sections 2 and 3.

Independently of the work on CGEs for developing countries, other researchers, following the methodological breakthrough of Scarf [1973], built CGEs to analyze the effects of fiscal and foreign trade policies pursued in developed countries, a body of research which is surveyed in Shoven and Whalley [1983]. Not all analysts use Scarf's algorithm to compute equilibria, however, a recent advance being the development of a global version of the classical Newton-Raphson algorithm.

To limit the scope of this assessment, we shall confine our attention to only some of the topics that have been the subject of formal modelling. Our interest here lies mainly in the flex-price descendants of the disaggregated, fixed-coefficient models traditionally used in drawing up consistent plans and examining related issues of resource allocation. These flex-price models, the so-called CGEs, have been used to tackle a wider range of problems than their forebearers were. Thus, while we are not concerned with the whole class of economy-wide models or flex-price models for a specific sector, some of what we have to say does apply to "stylized" macro-models featuring nominal magnitudes and considerable aggregation, with or without flexible prices. In particular, we explore the insights CGEs afford into the principal questions that were addressed and whether they can be

fruitfully employed in tackling other questions. We shall argue that while the CGEs are particularly strong in modelling input substitution in production, commodity substitution in consumption, and the optimizing decisions of individual agents in response to changes in prices, they are rather weak in modelling long run processes of development and change. The relevant question, then, is whether their strength in the former is sufficient to make them superior overall to other models which provide a more convincing treatment of processes.

Another important practical policy issue in mixed economies in which there are widespread market distortions and the private sector's investment decisions often are subject to governmental approval or rejection is how to appraise the social profitability of projects. This requires the derivation of a set of shadow prices for goods and factors, taking full account of income distributional objectives as well as market distortions. In proposing simple and workable rules for such derivation, the celebrated manuals on project evaluation [Little and Mirrlees, 1974; UNIDO, 1972] attempt to approximate the much more complex procedure of obtaining them from an explicit economy-wide, inter-temporal general equilibrium model with distortions. It is useful to examine whether CGEs could be used to derive better approximations than those resulting from applying the rules of these manuals.

To complete this preamble, it should be mentioned that the relation between development policy and model building was very much on the minds of all when this departure into the realm of flex-price models took place. Indeed, a concern with income distribution and alternative patterns of development provided an important impulse for this departure. These themes were pursued at length in Chenery et al. [1974], who emphasized the need to

analyse the distributional aspects of development. They concluded that even though "there are no established models which have been constructed directly for [this] purpose ... useful results are obtainable by the imaginative adaptation and extension of existing models." (p. 246).

2. CGEs AS STATIC MODELS

To assess the strengths and weakness of CGEs as analytical tools, it is necessary to be clear about the problems to be tackled. There are two reasons for examining their salient features as static models before proceeding to establish why they are ill-suited to analyse development processes, which, by definition, involve movements through time. First, CGEs can be used to examine the effects of policy reforms -- for example, trade liberalisation and changes in the structure of taxes -- by means of straightforward comparative statics. Second, time appears in so-called dynamic formulations of CGEs in the guise of a string of static equilibria, each member of which inherits the factor endowments passed on by its predecessor.

The salient features of interest may be classified under two principal headings. First, there is the structure of markets, including those for traded goods and foreign capital. Second, and especially relevant to the case in which a sequence of static equilibria is strung together to yield a story of the economy's movement through time, there is the manner in which investment and savings are brought into equality, which is commonly referred to as the 'closing rule' for the economy.

It will be helpful to begin with a brief description of the mechanics of these models. Each agent (or group of identical agents) chooses his set of

demands (supplies) given the prices of goods and factors applicable to him, subject to the relevant budget (technological) constraints. The condition that the markets for goods and factors clear then determines the set of relative prices ruling in equilibrium. In a 'mixed' model, some prices are fixed exogenously, so that corresponding to them there will be a set of 'slacks'. For instance, if the wage rate (in terms of some numeraire good or bundle of goods) for some category of labor is fixed exogenously, then the level of unemployment among this group of workers will be endogenous. Similarly, if the support price of an agricultural commodity is fixed exogenously, there will be corresponding endogenous variations in stocks and/or net exports. The supply and demand functions may be derived in more or less detail. For instance, final demands are represented either as a single demand function relating disposable income and prices in terms of a numeraire, or as an aggregate of the demands of several categories of institutions, the weight of each category in the aggregate being endogenous. Supply functions may be specified in varying degrees of detail regarding technology and industrial organization.

It is fair to assert that most extant multisectoral CGEs are Walrasian, in the sense that they describe the equilibria of barter economies in which only relative prices matter. In certain cases, however, it is claimed that 'absolute' prices do indeed matter, so it is important to establish the possible basis for this claim. Suppose that the values of certain variables are fixed not in terms of some numeraire good or bundle of goods, but in 'money' units, which may be thought of as either rupees or cowrie shells, depending on how one views the parable. The choice of such variables must obey certain requirements if the consistency of the system is

to be maintained, but this need not detain us here. For the purposes of illustration, let the wage rate be fixed in rupees, so that there is just one nominal exogenous variable. If, now, there is a change in some other exogenous condition which leads to a rise in the price of goods denominated in rupees, then the real wage will fall. In general, therefore, some or all of output, employment, consumption and savings will be affected. This, then, is the sense in which 'absolute' prices matter.

We shall have more to say about the introduction of money and the role played by the monetary authority in ratifying the decision to fix certain so-called nominal variables at particular values in Section 3. Suffice it to say for the present that the discussion in the remainder of this section will not deal at all with nominal magnitudes. Not only are they best avoided, but the main points can be made in settings in which only relative prices matter. It must be emphasised also that the choice of a numeraire good or bundle of goods is an entirely separate matter from the determination of an 'absolute' price level, and can proceed quite independently of the latter.

2.1 Market Structure

Our use of the term 'Walrasian' to characterise CGEs may have left the impression that price-taking behaviour by agents and the determination of prices through the clearing of markets are intrinsic parts of their specification. In fact, no such restriction is necessary, or even desirable, although the theoretical and practical difficulties confronting attempts to incorporate other types of behaviour may be formidable.

Quite frequently, it will happen that the price of a good or factor is fixed exogenously, whether by government fiat, or a parametrically given

world price and tariff, or just convention. In the case of a fully traded good, net exports can adjust endogenously, while both suppliers and purchasers are able to transact as much as they please at that price. In the case of a non-traded good or factor, however, someone is going to be disappointed. Either suppliers are on their supply schedules, while purchasers are off their demand schedules, and there will be excess demand; or purchasers will be on their demand schedules, while suppliers are off their supply schedules, and there will be excess supply. The next step is to specify how the quantity transacted is going to be rationed, and with what effect on suppliers' and purchasers' decisions. To clarify what is involved, consider the case when labour is in excess supply. Current practice in CGE modelling is to derive the level of employment and the wage bill for each type of labour on the assumption that each class of household will receive a share of such jobs and wage income equal to its share of the total endowment of that sort of labour. In general, there is no compelling analytical justification for the assumption that each agent will be given a ration in proportion to his or her notional demand at the going prices. Yet this is what the above procedure implicitly rests on. Moreover, no account is taken of the fact that households' demands for commodities will be affected by their failure to sell as much labour as they would like at the going wage rate, except insofar as their disposable incomes reflect such rationing.

Turning to imperfect competition among producers, the simplest case to deal with probably is pure monopoly or monopsony. To exploit his strategic opportunities to the full, a profit-seeking monopolist needs to know the entire demand schedule facing him. Oligopoly is still more intractable, for in this case, the aggregate supply of a commodity will be the outcome of a

non-cooperative game among producers. When CGE modellers do not assume perfect competition, their usual practice, which is supported by rather simple empirical analysis, is to appeal to mark-up theories of pricing, but with the mark-up exogenously given. Nevertheless, market structure is likely to exert an important influence on the strength and direction of resource pulls in the economy, and further work on incorporating various forms of imperfect competition is warranted.

Concerning foreign trade, as is well known, if (i) world prices are parametrically given, (ii) there are constant returns to scale with no sector-specific factors and (iii) the number of traded goods far exceeds the number of primary factors, then there will be a tendency towards specialization in equilibrium. This tendency has been curbed in CGEs by the introduction of both imperfect mobility of productive factors and the so-called 'Armington assumption', which postulates a less-than-perfect substitutability of nominally identical domestic and foreign goods. While the former may be defended in specific instances, the latter practice is a less blatant way of avoiding excessive specialisation than imposing bounds on export and import activities, as was done in LP models of yore to get them to behave 'sensibly', but it is not much less arbitrary for that. If the country does have some market power in international trade, then there is certainly a case for treating this as an opportunity to impose an optimal tariff if domestic firms behave as atomistic price takers and foreigners are too poorly organised to retaliate. Implicitly, this is what was done in some of the LP planning models. In CGEs, of course, such market power needs to be treated appropriately, depending on whether or not it is perceived by firms.

2.2 Closing Rules

As much has been written on closing rules in recent years ^{2/}, we can be fairly brief. Consider, to start with, an economy closed to international capital flows, so that, in equilibrium, domestic investment must be equal to domestic savings. Since no institution -- government, firm or household -- is constrained to invest what it saves, how are savings and investment decisions coordinated?

The Arrow-Debreu version of the Walrasian model brings about this coordination by assuming the existence, at the beginning of time, of a complete set of active markets for all commodities, where each commodity (good, factor, or service) is distinguished by its physical characteristics, the date of the transaction and the description of the uncertain state of nature in which it is exchanged. At the prices ruling in such markets, each agent (whether a producer or a consumer, currently alive as well as yet unborn) determines his demand or supply subject to a life-time budget or "technological constraint". The simultaneous clearance of all of these so-called contingent commodity markets automatically coordinates savings and investment decisions. To wit, a decision to save part of one's income (i.e. to choose a consumption bundle whose value is less than the value of current claims) in any period implies a simultaneous decision to consume more than one's income (to dissave) in some other periods in amounts adding up to the present value of what is saved. A decision to invest in the current period (i.e., to purchase commodities now to augment the flow of production in the future) is simultaneous with a decision to sell in this period the resulting future output in the relevant contingent commodity market. In equilibrium,

the excess of savers' endowments over their consumption of each contingent commodity is equal in the aggregate to the net purchases of investors.

Although one could define a set of interest rates applicable to intertemporal transactions in such an equilibrium, it is not necessary to do so.

In the stock market version of the Walrasian model, instead of a full set of contingent markets, there exist a set of spot markets and a set of stock or securities markets in which claims to streams of future outputs are traded. Under a set of standard assumptions, the equivalence of the two versions can be established.

Walrasian though they are in spirit, extant CGEs cannot claim such a pure lineage, and in the absence of an apparatus for bringing about equality between savings and investment such as those described above, there is a limited menu of options to choose from. The first may be called neoclassical inasmuch as all relative prices are assumed to be perfectly flexible, and in equilibrium, all markets clear with full employment of all factors. Aggregate savings depend, in general, on the level and distribution of income and prices, while aggregate investment is simply taken to be equal to aggregate savings. That is to say, there is no independent investment demand function. Nothing is said about the mechanisms that are at work in bringing about just this amount of investment. In barter economies, no appeal can be made to the swift and intelligent intervention of the monetary authorities to accomplish it; but the right fiscal policies might just do so.

The second so-called 'closing rule' may be called classical in that the wage rate is fixed in terms of some good or a bundle of goods and the assumption of full employment is dropped. Once again, aggregate savings are endogenous, and whatever is saved is invested. This case lends itself to an

evaluation of the rewards to 'getting the prices right', in the form of the movements towards full employment induced by parametric variations in the wage rate. In their zeal to assail this doctrine, Taylor and Lysy [1979] call this specification, misleadingly, neoclassical.

In contrast to the above cases, there are 'closing rules' which introduce an independent investment function. Capitalists' "animal spirits", which are motivated primarily by expectations of future profits based on considerations other than current conditions, and the government's plans are assumed to result in an exogenously fixed demand for a bundle of investment goods or a total outlay in terms of the numeraire (an outlay which is sometimes confusingly referred to as a "nominal" demand for investment). There are two ways of accomodating this fixed demand. First, the assumption of full employment may be dropped, so that savings may be brought into equality with investment through shifts in the level of output, employment and the distribution of income. Hence, despite the absence of money, this closure is invariably referred to as 'Keynesian', albeit a vulgar form of the same. Secondly, full employment can be reinstated by throwing out the condition that the marginal product of labour be equal to the wage, in which case, shifts in the distribution of income will have a pre-eminent role. This variant, which Kaldar [1955] formulated in his renowned paper on distribution, is usually dubbed 'neo-Keynesian'.

Turning to the case of an open economy, each of the above accounts is unaltered in its essentials if the balance of trade is fixed exogenously -- again, in terms of the numeraire -- and there are no unrequitted transfers. If, however, this balance is endogenous, then an independent investment function is always admissible; for any excess of domestic investment over

domestic savings will be financed by an accommodating inflow of foreign savings. ^{3/} It should be noted, however, that if both the volume and the world price of exports are fixed, then fixing the balance of trade will also determine output and employment immediately in the case where there is no substitutability between domestic and imported inputs into production. In essence, this is the regime of trade-limited growth in Chenery and Strout's [1966] model.

To see 'closing rules' at work, consider a two-sector economy in which one sector produces investment (I) goods and the other consumption (C) goods, both sectors using capital and labour in their production activities under constant returns to scale. With the given aggregate endowment of capital and labour, the production possibility curve (with full and efficient utilization of both factors) is shown as AB in Figure 1. Any point on AB determines the price p_I of I good and the factor prices w and r (of labour and capital, respectively), all in terms of C. In moving from A to B, p_I and w increase (decrease) and r decreases (increases) if I is labour (capital) intensive relative to C in production. Hence, given the distribution of capital and labour endowments among agents in the economy, the factor prices will determine the distribution of income. Furthermore, given p_I , their savings behaviour will determine the demand for C (and supply of savings). For instance, if workers neither own capital nor save while capitalists neither work nor consume, the demand for C equals wage income. With full employment of labour, in such a case, the demand for C rises (falls) as one moves from A to B as long as I is labour (capital) intensive.

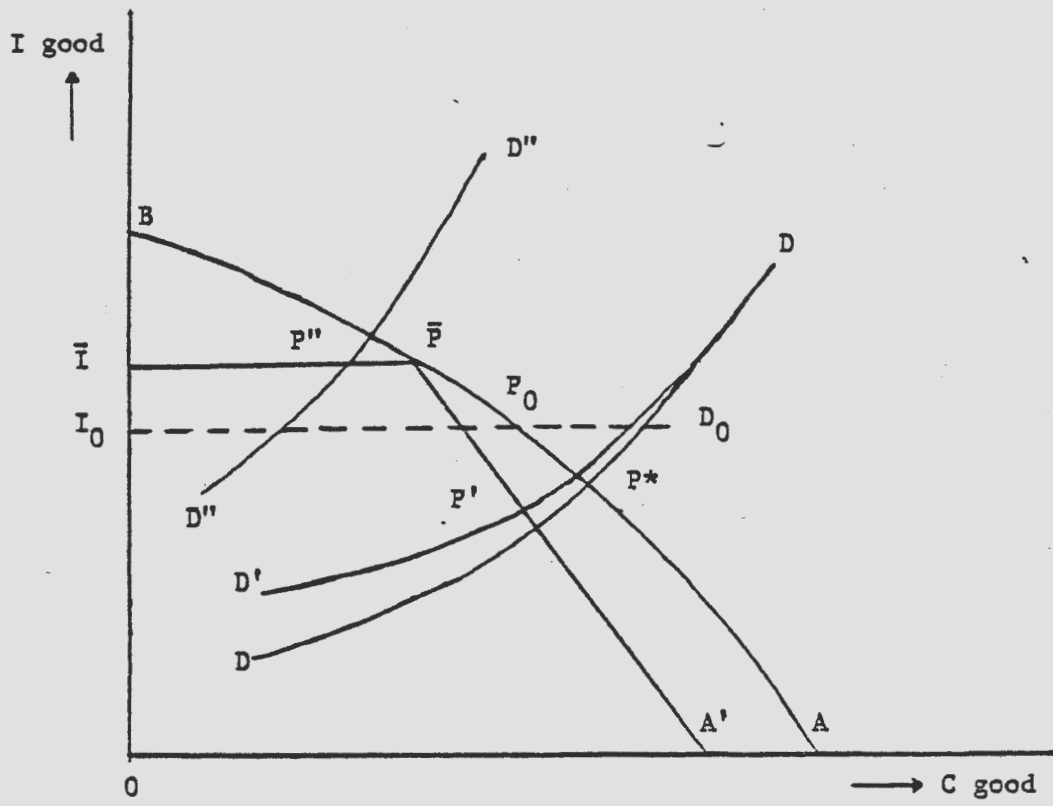


Figure 1

More generally, one can depict the demand for C good as determined by the income distribution associated with the prices p_I , w and r at a point P on AB as a curve such as DD .^{4/} For any level of I-good output, say I_0 , the supply of C is determined by the point P_0 on AB with I_0 as its I coordinate and the demand is indicated by the point D_0 on DD with I_0 as coordinate. If DD intersects AB once and only once at P^* as depicted in Figure 1, a unique laissez-faire equilibrium is determined. This, in a nutshell, is the story of the first closing rule.

The second closing rule deals with the case where a minimum wage rate \bar{w} (in terms of C) higher than that (w^*) obtaining at P^* is specified. Without loss of generality, we assume that I good is labour intensive. Then at any point on AB from B up to \bar{P} , at which the wage rate equals \bar{w} , the minimum wage constraint is met. But as is seen from Figure 1, there is an excess demand for C at all such points. Now the output of C can be increased beyond its level at \bar{P} at the cost of full employment level by choosing production points along the so-called labour Rybczynski line $\bar{P}A'$. At any point other than \bar{P} on $\bar{P}A'$, the prices p_I , w and r remain the same as at \bar{P} ; but because of unemployment and its impact on agents' incomes, the demand curve for C shifts to DD' , as depicted, with a new unemployment equilibrium established at P' .

The third closing rule can be illustrated by viewing the output of I at \bar{P} as the fiscal investment 'demand' as determined by "animal spirits". With full employment this cannot be met, since the supply of savings is inadequate (or equivalently, the demand for C is too much), as can be seen from the corresponding point on DD . By creating unemployment while maintaining the output of I as at \bar{P} , the production point moves

towards \bar{I} from \bar{P} . As long as the resulting change in the level and distribution of income shifts the demand curve to, say, $D''D''$ to intersect $\bar{I}\bar{P}$ once at P'' , again an unemployment equilibrium is established.

The upshot of all this is that the qualitative behaviour of the economy (as a statical system) stems not as much from the extent of disaggregation or the possibilities of substitution, as from the manner in which investment and savings (more generally, supplies and demands) are brought into equality. No doubt the specific magnitudes of the economy's responses to changes in the exogenous variables depend on how many goods and households there are and whether there is easy substitution in production and consumption. Yet, while the detail afforded should be valuable in examining resource pulls, it is the choice of closing rule which seems to matter for aggregate output and the factoral distribution of income.

2.3 Empirical Underpinnings of CGEs

In any model, one has to make choices about the appropriate functional forms for the various behavioural and technological relationships and assign values to the parameters that occur in such relationships. If the model is an econometric one, then in principle at least, one can estimate the parameters from data given the functional forms, or even choose among alternative forms through some method of model selection. But in working with a CGE, one has to choose functional forms that are at once consistent with theory (for instance, demand functions have to satisfy Walras' law) and analytically tractable. Since available econometric estimates are often not consistent with one or both requirements, they can rarely be used in a CGE. Further, in some of the CGEs, the Armington assumption is made. Yet hardly

any empirical estimate of the relevant elasticity of substitution exists for any country. In view of these difficulties, the most commonly used procedure for parametrizing the CGE is "calibration", a procedure which involves assuming some parameter values rather than estimating them econometrically ^{5/}, and hence the strong assumption that the initial position of the economy is one of equilibrium. Although the latter is hardly a tenable assumption, the data from which many of the parameters are derived are often assembled to satisfy the accounting identities of a SAM and can therefore lay some claim to internal consistency. Suffice it to say here that given the strong and often untestable assumptions required to set up a CGE model empirically, the resulting policy simulations it yields must be used with great care.

3. TIME AND MONEY

As development is a process, both a clearly defined real time frame and an account of how the economy shifts forward in time are needed. In Section 2, there were no explicit references to the former, and the discussion of savings and investment was confined to the unit time period without considering how expectations about the future are formed and how they influence decisions to accumulate wealth. Likewise, when examining the claim that absolute prices matter, nothing was said about inflation, which is a process involving time.

In choosing a time frame, it is traditional (and useful) to distinguish between the short, medium and long run. In the short run, many variables which are endogenous in the medium and long runs are fixed exogenously, for example, the capital stock in each sector and, particularly

in Keynesian formulations, some prices as well. In the medium run, the installed capacities to produce many goods can be augmented or reduced by net investment or disinvestment, the growth of the labour force can be predicted with fair confidence and there is less rigidity in prices. Similarly, it is assumed that the technology is known and that preferences change little, if at all. In the long run, almost everything, including technology, can change significantly and in uncertain ways. While these distinctions are drawn for analytical purposes, it is understood that the various changes are taking place continuously and at different speeds, except that some changes are ignored to show the effects of others in bolder colours.

As noted above, CGEs are often used to generate a string of results which purport to show the movement of the economy through time. This form of pseudo-dynamic analysis is accomplished by linking the changes in the exogenous variables over time to the values of the endogenous variables in equilibrium at a point in time. Even in those variants in which investment is endogenously determined within the unit time period, its level depends only on current prices and endowments. In effect, agents expect the future to be just like the present. Hence, when model builders label a sequence of results, "1976, 1977, 1978, 1979, 1980, ...", they are presenting the movement of the economy through time as a chain of short period equilibria, each of which is based on myopic expectations. It is hard to defend the notion that this sort of comparative statics involves meaningful dynamics. ^{6/}

While this comparative statical approach to the movement of the economy through time is unsatisfactory, it is not clear that there are more appealing alternatives. The answer cannot be sought in the virtual dynamics of Walrasian tatonnement. Nor is there much promise that the so-called price

and stock adjustment models can be employed to give the system credible dynamic behaviour. For how is one to make sense of the juxtaposition of the refined optimisations by agents which underlie the static equilibrium at a point in time and the crude 'adjustments' of the so-called dynamic behaviour which shifts the system through time?

The central difficulty in dealing with time is that there is uncertainty about the future, and hence unavoidable risk in a world that lacks a complete set of contingent markets. If uncertainty is incorporated in a way that eliminates the possibility of what could be loosely termed as "regret", or perhaps "time inconsistency", neither of which should be confused with irrationality, this will again reduce a dynamic problem to an essentially static one. In any event, the escape from crude adjustment rules which shift the system from one period to the next to the refined calculus of intertemporal optimisation leads either to inconsistencies or to the reduction of the problem into an expanded static one. Thus, while it is both possible and desirable to introduce other forms of investment behaviour than those considered here, it remains the case that constructing a sequence of equilibria in the manner described above is unlikely to yield a plausible account of an economy's dynamic behaviour.

Turning to money, economic development is invariably accompanied by increasing monetization in very poor countries and a progressively more elaborate system of financial intermediation, markets and institutions in more affluent ones. In the short to medium run, these features of the economy may be taken as given. But any account of inflation must include the role of money and other financial assets, as well as the behaviour of financial institutions. Is there a home for these elements in a CGE?

Now, to all intents and purposes, most of the CGEs under discussion here are barter economies, in which, in equilibrium, only relative prices are determined. Some hold the view that it is impossible to introduce fiat money into a Walrasian framework in a meaningful way, if only because exchange involving money is a process, and hence cannot be described by a system in which there is no real time. One attempt to do so postulates that real cash balances enter utility or production functions as arguments on the grounds that there are costs of transacting without the use of money. Alternatively, there are dynamic models, such as the overlapping generations variety, in which fiat money makes possible some trades across generations that otherwise would be infeasible, thereby moving the economy to an intertemporally efficient path. But neither of these attempts is very satisfactory, and both are essentially ad hoc. Some theorists -- for instance, Wallace [1983] -- appeal to legal restrictions on private intermediation to explain why money is held in a world where other equally safe, interest-bearing placements for wealth are available.

What of those CGEs for which changes in absolute prices can have real effects? One approach is to assume that a certain set of variables -- wage rates, investment and transfer payments -- can be maintained at exogenously given nominal values. Indeed, it is sometimes argued that this is a realistic, rather than merely simplifying, assumption. Although the role played by the monetary authority is left implicit in this story, it seems that the authority must accommodate all wage contracts struck in rupees, as well as any exogenous nominal flows. For its part, the public must make all current decisions without reference to what the authority has done in the past, or what it is up to now. A second approach involves making a polar opposite

assumption about the monetary authority's behaviour, namely, that it fixes the stock of money without any reference to what is happening in the economy. All institutions are given a demand function for money (the basis for which is not quite consistent with utility or profit maximisation), so that when the money supply is fixed by the authority, a set of prices denominated in rupees will result. Once again, however, the authority's past behaviour does not enter into the public's current decisions. Whatever else may be said about it, this second approach does have the merit of specifying explicitly the mechanism at work.

These two approaches to the determination of absolute prices employ, in effect, very simple versions of the quantity theory of money, and neither, as currently formulated, can deal satisfactorily with inflation, which is a process in real time. The criticisms we have levelled at the practice of stringing together a set of static equilibria will apply even more forcefully here. For example, if the monetary authority strives to validate any nominal wage contract, then private agents are going to discover as much at some point along the way. One need not adopt an extreme 'rational expectations' position to see that only a very gullible public would fail to adjust their behaviour accordingly once they found out. The other version, in which the authority fixes the initial supply of money and its subsequent course at the beginning of time and does not intervene subsequently, whatever may happen afterwards, also strains credulity. What can be said is that if agents are unable to distinguish between real and monetary shocks, then changes in absolute prices may have real effects.

All in all, it appears that the chances of introducing inflationary processes into these models in a credible way are problematical at best.

4. INCOME DISTRIBUTION

As indicated in the Introduction, it was hoped that CGEs would yield useful insights into the evolution of the distribution of income. With the advantage of hindsight this now seems unduly optimistic, especially in view of the difficulties of dealing with processes. Nevertheless, it is instructive to look at the influences on the distribution of income in a static setting, before turning to the processes at work over the long run.

In CGEs, the central dimension of the distribution of income is that among factors. This is not to say that a distribution of incomes by size cannot be generated endogenously. For if the distribution of factors among institutions and/or the parameters of the distributions for the various household categories are known and assumed stable, then it is possible to construct a mapping from factor to household incomes. These mappings are rather ad hoc, however, and serve mainly to complete the circular flow of production, incomes and demand, although it should be noted that they do permit the introduction of variations in tastes across households, which may matter under certain circumstances.

The substance of the main results has already been set out in the section on 'closing rules', which is itself a summary of work that attempted to understand why the large numerical systems behave as they do. Indeed, one of the principal findings from such CGEs is that the distribution of income is not very responsive to incremental changes in policy. "Only when a sufficient number of different interventions are applied simultaneously, so that there is, in effect, a change in development strategy, are more sizable or lasting

effects possible" [Adelman and Robinson, 1978, p. 17]. As Taylor and Lysy [1979] have demonstrated, this behaviour can be explained quite adequately by simple one or two-sector macro models. If the choice of closing rule is changed, the system dances to a different (and predictable) tune, however intricate and impenetrable the background music of its structure may appear at first glance!

In our view, none of these variations will give a convincing account of how the size distribution of income is determined over the long run. As Bruno [1977] put it: "There are some basic forces operating in the development process which affect functional and sectoral shares for which manageable models should continue to be developed ... [Multi-sectoral CGEs] remain background production and allocation models and are quite removed from being able to explain wealth transition matrices for families of different sizes and social background". (p. 8). Thus, if one accepts that the size distribution of income is generated by such cumulative processes, one is led to look for approaches which emphasize economic forces other than the determination of relative prices in a static setting.

5. SOME POSSIBLE USES OF CGEs

In concentrating thus far on the weaknesses of CGEs, we have attempted to show that, as currently formulated at least, they have limited usefulness in addressing many topics. What, when, are they good for? Among the potentially valuable uses already mentioned are the analysis of the effects of measures to liberalise trade and reform taxes, and other examples of changes in policy or the exogenous variables characterizing the economy's environment come readily to mind. As this literature has been extensively

reviewed elsewhere [Shoven and Whalley, 1983], however, we will discuss two other uses in some detail: drawing up a consistent plan; and deriving shadow prices for project evaluation, a subject which is obviously closely related to that of policy reforms.

5.1 Consistent Plans

In the past, the formulation of a consistent, medium-term development plan was often accomplished with the help of some variant of fixed-price, input-output analysis. Although we have expressed strong reservations about the usefulness of generating a sequence of short period equilibria as an account of how the economy grows and changes, the formulation of such plans might be improved with the aid of a CGE. In this time frame, the appropriate prices are Marshallian normal prices, whether endogenous or otherwise.

One way of proceeding is as follows: Using the standard methods described in Blitzer et al [1975], or otherwise, a consistent plan is drawn up for 5, 7 or 10 years. The associated path of investments will yield a set of capital stocks, sector-by-sector, for the terminal year. Similarly, available labour supplies will be known from independent projections of the labour force, which the consistent plan has been derived to respect. With factor endowments thus given in the terminal year, the set of prices consistent with them can be computed from the static CGE of the planner's choice. Concerning the closing rule, if investment is determined endogenously, the only requirement is that its level and composition be compatible with that in the plan, which is implied by the post-terminal conditions specified in drawing up the plan. If, on the other hand, total investment is set exogenously in the CGE, its level is simply taken from that in the plan.

Now, if the rate of profit (or equivalently the rate of quasi-rent on the same sort of capital good) differs greatly across sectors or from the pattern of rates of profit that the planner believes to be 'normal', then the consistent plan will need some revision. In making these revisions, the departures of the rates of profit from their normal pattern (or straight uniformity) will be useful guides, and after a few iterations, it should be possible to contrive the requisite result. The consistent plan that results may be regarded as good. Moreover, in this setting, it is appropriate to call the associated set of prices 'normal' prices, that is, prices which reflect the set of long run profit rates appropriate to the rate and composition of the growth of output. In effect, this procedure envisages a very powerful planning authority, which creates supplies of factors in the terminal year of a plan, whereupon prices get determined in what amounts to a pure exchange economy, in high Walrasian tradition.

In the approach sketched above, arriving at a consistent set of outputs, incomes and other activities, together with the associated set of market prices, is not simply a matter of mechanical computation. Rather, the analyst draws a picture of the economy at a moment in time when it has attained (approximate) steady state growth by making informal reconciliations between the projections from a consistency framework and the results from the static CGE. Whether the story is credible will depend as much on the quality of the analyst's judgment and insight as on the finer details of either model. Nevertheless, used in this way, a CGE may permit a significant improvement over what would be derived from a traditional consistency framework by itself, principally by making possible a more efficient pattern of investment. Whether the additional time and resources which went into the

building of the CGE would be warranted by such putative improvements is, of course, open to question. As yet, there is insufficient evidence to arrive at a definite judgement.

5.2 Shadow Prices

The derivation and use of shadow prices based on the principles in Little and Mirrlees [1974] and UNIDO [1972] have flourished in the past decade. The most illuminating way of understanding these principles is to view them as simple rules that yield estimates of the shadow prices derived from a more complicated model of the relevant economy.

Suppose, to begin with, that there are no distortions in the economy and the government's only objective is an "appropriate" income distribution. Then the second welfare theorem of neo-classical welfare economics assures us that under specified assumptions about technology and tastes; any desired income distribution (within the feasible set) can be achieved through lump sum transfers of income (or equivalently, redistribution of initial endowments) among agents. No other intervention in the economy is needed. Clearly, in such a world the equilibrium market-clearing prices are also the shadow prices for goods and factors. In particular, if the economy is a price-taker in world markets, the shadow prices for traded goods will be their border or world prices.

The resulting shadow prices could be used for project evaluation, but there is no need to use the acceptance (or rejection) of projects to influence allocation and distribution! For the government has unrestricted scope to achieve any desired and feasible distribution of income (and welfare) both at

a point in time and intertemporally through lump sum taxes and transfers, and there are no discrepancies between shadow and market prices.

Even if optimal lump sum taxes cannot be levied, there are other circumstances in which a full social optimum can be attained. In a Diamond-Mirrlees economy [1971], for example, optimal commodity taxation ensures that public and private sector production decisions will be based on the same set of producer prices. That is to say, shadow prices at the optimum are also decentralizing prices, and once again all decisions concerning the acceptance of projects can be left to the managers of firms, whether public or private. ^{6/} Thus, the computation of shadow prices for the use of government agencies in evaluating projects is only interesting and relevant when the government does not have the power to impose optimal taxes. However, the computation of the optimal set of taxes may, in effect, involve the solution of a CGE.

In practice, it is fair to say that most governments in LDCs have virtually no power to effect lump sum transfers and scarcely more to redistribute ownership of factor endowments. Their ability to impose distortionary commodity taxes in an optimal way is also limited. Moreover, in any initial equilibrium associated with such restrictions on the power to tax, savings are likely to be lower than the socially optimal level, so that there will be a premium on both (uncommitted) revenue and private savings relative to private consumption. In such a world, undertaking a project -- or prohibiting the private sector from doing so -- provides an instrument to influence production and the distribution of income in a socially desirable direction.

The point of departure, therefore, is some equilibrium in which the whole panoply of taxes and quotas is not only non-optimal, but also cannot be changed, and various prices are sticky, so that there will be rationing in some markets. Defining a project as an activity which produces a vector of outputs from a vector of inputs, and viewing any project as a small disturbance to an arbitrary equilibrium, we are interested in deriving a set of shadow prices which will reveal whether a project will improve social welfare starting from that equilibrium. Such prices may be called "welfare-detecting" shadow prices, to distinguish them from the "decentralizing prices" associated with a social optimum, a distinction that forms the main theme of Dreze's [1982] insightful paper. Now, relative to any equilibrium, the (welfare-detecting) shadow price of a good or factor is simply the change in the level of social welfare that would result if an extra unit of the same were produced in the public sector. These shadow prices will, except under certain circumstances that need not concern us here, serve as well in evaluating projects in the private as in the public sector.

A CGE looks like a promising tool with which to calculate welfare-detecting shadow prices. Appropriately specified, it can encompass all manner of distortions, including quotas affecting traded goods and other forms of rationing, and the equilibrium corresponding to them can be computed to yield the reference point for the derivation of shadow prices. The shadow price of a good or a factor can be computed in two steps: in the first step, the initial reference equilibrium is perturbed by adding to (or subtracting from) the availability of that good or factor by a unit, and the new equilibrium is computed. At the second step, the change in social welfare relative to the reference equilibrium is computed, thus yielding the desired shadow price.

For small changes, the change in social welfare will be approximately equal to a suitably weighted sum of the changes in the utilities of individual agents.

Once the choice of social weights has been settled, therefore, the calculation of shadow prices is thus routine. It turns out that under diverse circumstances, the relative shadow prices of fully traded goods are still their respective relative border prices, even in a distortion-ridden world of the sort considered here. This is indeed the theoretical basis for the principles laid down in Little and Mirrlees [1974], and it obviates the need for to use CGEs to compute the shadow prices of fully traded goods. Moreover, the shadow prices of non-traded goods can be derived from those of traded goods in certain situations (see Srinivasan [1982] on this matter). Implicit in this analysis is the assumption that the economy has access to perfect international capital markets, in which case the foreign trade deficit is endogenous. Even in the polar case of an exogenously specified (and binding) limit on the size of the foreign trade deficit, the shadow prices of fully traded goods will, in general, be proportional to their respective border prices [Bell and Devarajan, 1983].

If the simple rules do this well, what can a CGE contribute? First, the simple rules for estimating the shadow prices of traded goods that are subject to quantitative restrictions and non-traded goods subject to various forms of rationing are approximate ones, and may yield substantial errors. Moreover, the shadow prices of non-traded goods for which markets clear will depend, in general, on those for all other goods and factors, so any errors in the latter will be propagated in the former. Such errors are avoided when shadow prices are derived from a CGE formulated so as to capture all the relevant distortions; for such shadow prices reflect all the effects of the

distortions and are mutually and simultaneously determined. Second, when the shadow prices of fully traded goods are proportional to their respective border prices, the (common) factor of proportionality will, in general, depend on production and consumption decisions everywhere in the economy.

Furthermore, this factor of proportionality affects the shadow prices of all non-traded goods and factors. Once again, shadow prices derived from a CGE will reflect this interdependence in full, which is a notable advantage when there is more than one non-traded good. Hence, we conclude that CGEs will be valuable in deriving shadow prices when quantitative restrictions appear to affect domestic and foreign markets in an important way.

This is a natural point to introduce the use of LP models into the discussion. When LP models were first introduced into the tool kit of development economics, it was primarily in the context of development planning with the implicit assumption that the planner has enough policy instruments at his disposal to implement the optimal solution churned out by the model, be it in respect of private and public consumption, private and public investment, or exports and imports. That the shadow prices associated with the constraints of the LP model reflected resource scarcities was well understood; but apart from any implications they may have for the set of optimal taxes or subsidies needed to make market prices mirror resource scarcities, there was little room for them to play much of a role, given the considerable scope of the government's policy instruments.

Moreover, the informational economies arising out of solving several smaller LP models iteratively rather than one giant LP model were also appreciated. Indeed, two-level and multi-level planning procedures and decomposition algorithms were designed precisely to exploit such economies.

In some versions, an aggregated LP model of low dimensionality was used to generate key shadow prices (e.g., for capital, forcing trade balance, etc.) which were then used in more detailed sectoral models. It is fair to say, however, that the fact that different agents may have different objectives and may not reveal their true preferences and constraints in this iterative dialogue did not play any role in the early literature, at least in a development planning context. In this respect, they were not too different from extant CGEs, in that the latter incorporate neither strategic behaviour by agents nor asymmetric as well as incomplete information among them.

The LP models do, however, have some advantages over CGEs. By keeping the number of goods sufficiently small, it is possible to solve LP models which are specified so as to span many years. This has the great advantage of permitting the introduction of foreign borrowing (under the control of the government) in such a way as to yield a simultaneous determination of optimal production, investment and foreign indebtedness, a simultaneity which lies beyond the foreseeable reach of non-linear CGEs featuring comparable degrees of disaggregation. The objective function for this purpose is the discounted present value of the stream of consumption over the planning horizon, plus the discounted value of the capital stock net of foreign indebtedness in the terminal year. For a sufficiently distant horizon, it is reasonable to expect a longish stretch of steady state growth free of the adjustments attending the initial and terminal conditions. The shadow prices ruling in this stretch of time are perhaps more appropriate for use in project evaluation. To the extent that the activities of the LP model (i.e. the columns of the LP tableau) reflect the choices made by agents in response to fixed, but possibly non-optimal, tax and other interventions, and

the objective function is social welfare, these shadow prices will be the true welfare-detecting, second best shadow prices.

The practical question in all this, then, is whether the comparative simplicity and cheapness of solving LP models and the simultaneous derivation of an optimal foreign borrowing path outweigh the somewhat unsatisfactory assumptions of fixed coefficients in production, consumption and investment, which, in effect, reflect a fixed and unchanging set of taxes and subsidies. As is so often the case, the answer does not lie so much in theory as in empirical analysis, and may vary with the circumstances of each case. One possibility that is worth exploring is to start by deriving the key intertemporal parameters, such as the accounting rate of interest and the premia on private savings and public income, from an LP model of the sort sketched above. As a second step, these parameters can be incorporated into the specification of a static CGE from which welfare-detecting shadow prices can be obtained in the manner we have described.

6. CONCLUDING DISCUSSION

In the light of the above assessment of extant CGEs, which owes much to the extensive work on such models over the past decade, we conclude by taking up the question of what problems now seem most worth tackling and what improvements in such models are most pressingly needed. We content ourselves with sketching out a few ideas, organising our discussion around two groups of topics: consistency planning and policy reform; and income distribution and the long run.

6.1 Consistency Planning and Policy Reform

We have already discussed, in Section 5, how traditional consistency models and CGEs can be teamed to formulate a consistent development plan and how welfare-detecting shadow prices appropriate to that setting may be derived from the same economy-wide models. Similarly, CGEs may be used to examine the resource pulls exerted by changes in taxes and other public policies. As currently specified, however, CGEs are not particularly satisfactory for these purposes.

First, while agriculture and certain service sectors are competitive, other sectors of the economy are manifestly not so. How, and in what form, imperfect competition is to be introduced will depend not only on the actual market structures in question, but also on the computational difficulties they pose. In economies with very extensive public ownership of industry and utilities, it will also be necessary to specify the behaviour of public enterprises, in the likely event that their managers have considerable de facto autonomy. Secondly -- and this is an old refrain -- more attention must be paid to how the labour market works, especially in the organised sectors of the economy, where clearing of the labour market through flexible wages seems to be a poor description of what actually happens.

Thirdly, there is the pervasiveness of rationing, which affects both firms and households. While quotas, licenses and other bureaucratic allocations may be undesirable forms of intervention, their presence must be recognised and dealt with, even if the experiment in question is their abolition (in part or in whole). In some cases, of course, such allocations may result in little more than lump sum transfers, as when, for example, the

beneficiaries can resell the allocations they purchased at the regulated price in a thriving black market. In others, resales may not be possible -- electric power supplies are an obvious example -- or transactions costs may be so large, perhaps because of moral scruple, as to make them unprofitable. In yet another case, real resources may be wasted on lobbying for, or seeking, quota rents or tariff revenues (Krueger [1974]; Bhagwati and Srinivasan [1980]). Whenever quantity rationing does intrude, it becomes necessary to specify what firms and households will do when they are so constrained. It should be added, however, that while, in principle, the derivation of all demands and supplies under quantity rationing is well understood, it may prove to be a formidably difficult task in practice unless the number of goods rationed is very small. To sum up, here is a rich agenda of issues to tax economy-wide model builders with a taste for applying relevant theory.

6.2 The Long Run and Income Distribution

In approaching the long run, it may be necessary to deal with just a few issues at a time. For example, the optimal paths of accumulation, foreign borrowing and the depletion of exhaustible resources (if any) are naturally linked, and associated with them will be some key 'national parameters' for project evaluation, such as the accounting rate of interest and the premium on saving. Then again, it is plausible that the distribution of income, the structure of the economy and the working of markets are closely related, which suggests another nexus to be studied.

To examine the basic forces at work in development viewed as a long run process, a fairly aggregated framework is virtually inescapable. Perhaps the best way of starting the analysis is to distil a fairly descriptive

account from the historical experience of a particular country of interest, paying attention to the effects of changing institutions and gradual but vital processes, such as demographic changes, resource exhaustion, innovations, urbanization and so on. A 'model' which is at once simple, elegant and broad in sweep, even if it does not encompass all of the above, is Lewis' [1954] celebrated model of development with unlimited supplies of labour. Unfortunately, the wooden formalism that the subsequent work of others brought to this model has added little to our understanding of development beyond what was learned from Lewis' original contribution. Be that as it may, a study of a country's economic history which concentrates on structural changes may suggest one or two key issues or phenomena which will provide the focus for a formal model. It may also provide some clues as to what 'closing rule' best characterises the working of the economy, which would be a key element in any such model.

Another good reason for approaching these issues through case studies of particular countries is that it forces the analyst to concentrate on how each economy in question is actually organised and how its people behave, both as individuals and as social groups. To quote Joan Robinson [1977]:

"Micro questions--concerning the relative prices of commodities and the behavior of individuals, firms, and households--cannot be discussed in the air without any reference to the structure of the economy in which they exist, and to the processes of cyclical and secular change. Equally, macro theories of accumulation and effective demand are generalizations about micro behavior. [...] If there is no micro theory, there cannot be any macro theory either. [...]"

The macro setting of the analysis of "scarce means with alternative uses" is very vaguely sketched. [...] Nothing much is usually said about the inhabitants of the model. The ancestry of Adam Smith is often claimed for it, but his world was inhabited by workers, employers, and gentlemen. Here there are only

"transactors" or "economic subjects." To borrow Michio Morishima's trope, the people in this model are like the conventionally invisible property men of the Kabuki theatre, and only the commodities have speaking parts."

As for the distribution of productive assets over the long run, we need answers to the questions: who saves, where do the savings go, what forms of investment do they finance and what rates of return do they earn? Once again, it is no solution to engage in the mechanical manipulation of parameters. What is needed is the development of some relevant theory, drawing inductively upon empirical investigations of what has happened in a particular country or countries.

Moreover, there are two distinct dimensions of income distribution over the long run that ought to concern us. The first is a straightforward comparison of the present and future patterns of income distribution in terms that reflect economic and social organisation: How will the share of profits move over the next 20 years? Will the gap between a landlord's and a peasant's income be wider a generation hence than it is now? The second, as Bruno emphasises, is more subtle and difficult, involving as it does the life cycle of a cohort of individuals drawn from particular social groups. For example, of every 100 peasants in their twenties today, how many will be peasants, proletarians, artisans, or even businessmen and landlords, 20 years on? And what will be the occupations taken up by their respective children? As for the resulting changes in individual welfare, even if the "average peasant" is destined to become an urban proletarian, he may be better off as a result. More importantly, his metamorphosis entails a shift in the balance of social forces and perhaps a change in the way in which the economy functions.

Finally, although we have argued trenchantly against the use of a sequence of short period equilibria to tell a story about the movement of the economy over time, the relation between the short run and the long run is an important one and will not simply go away. Of especial interest is how the process of output and income determination in the short run is reflected in the evolution of the economy in the long run.

To sum up, in our view the questions which can be profitably addressed by extant CGEs are restricted in important ways by the nature of their theoretical foundations, though there are prospective improvements through the introduction of non-competitive behaviour and various forms of rationing. What they can say about income distribution is limited, and their treatment of factor employment is not wholly convincing, resting as it does on crude specifications of how the labour market works. More importantly, they are particularly ill-suited to analyse processes involving real time, such as accumulation and inflation. Skillfully used, they may improve resource allocation in the context of the formulation of a medium term development plan, they can assess the resource pulls exerted by policy reforms, and they will yield shadow prices appropriate to distortion-ridden economies. Their fruitful application to the analysis of processes may, however, have to await the arrival of more satisfactory theoretical foundations than those available to applied model builders in the past.

Footnotes

- 1/ See, for example, Adelman and Robinson [1978]; Dervis and Robinson [1982]; Dervis, de Melo and Robinson [1982]; J. de Melo [1980]; Robinson and Tyson [1983]; Taylor et al [1980].
- 2/ See, for example, the symposium in the Journal of Development Economics, March, 1979, and Lysy [1982].
- 3/ This is the closing rule adopted by Ahluwalia and Lysy in their work on Malaysia [Lysy, 1982].
- 4/ We have not established that DD has the particular shape depicted in Figure 1, but the following argument is unaffected provided DD, whatever its shape, intersects the frontier AB just once.
- 5/ Shoven and Whalley [1983] describe "calibration" in some detail.
- 6/ There is some evidence from the CGEs used to analyze tax policy, such as those of Fullerton et al [1983], that replacing myopic expectations with perfect foresight does not greatly change the welfare effects of replacing income taxes with a progressive consumption tax. In any event, perfect foresight is not evidently a more attractive assumption than myopia.
- 7/ For extensive discussions of this point, see Dreze [1982] and Srinivasan [1982].

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