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RURAL WORKS PROGRAMS IN INDIA: COSTS AND BENEFITS

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A sequential applied general equilibrium model of the Indian economy is used for analyzing the costs and benefits of a rural works program designed to provide employment during slack agricultural seasons through the creation of productive assets such as roads, irrigation works, schools etc. It is shown that such a program, if carried out efficiently, targeted effectively and financed in a way that does not jeopardize long-term growth, can be a very effective instrument for alleviating rural poverty in India.

1. Introduction

Nearly three-fourths of India's 800 million people live in rural areas and two-thirds of her labor force is still dependent on agriculture for gainful employment. At least a third of India's population in 1983–84 (245 million) is considered poor, with a consumption expenditure below a modest poverty line of about $15 per month. The majority of the rural poor are either landless agricultural workers or farmers with a landholding too small to provide them farm incomes above the poverty line. Incidence of unemployment, particularly in the slack agricultural seasons, is substantial among rural poor [Parthasarathy (1978), Vyas and Mathai (1978), Visaria (1981)]. With the rural labor force growing at about the same rate or faster than agricultural output, the prospects of employing it fully in agriculture at a real wage adequate to eliminate poverty appear dim. It is in this context that

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rural works programs (RWP) have evolved with the objectives of providing gainful employment to rural workers, particularly during slack seasons, in creating productive assets such as roads, irrigation works, schools etc.

The efficacy of RWP in alleviating unemployment and poverty has been disputed for the reason that the incidence of unemployment among the poor is not significant and, in any case, rapid growth of output is the surest remedy for unemployment and poverty. The association between the two in the available data is non-existent according to Dantwala (1979) and Sinha (1981). A contrary claim is made by Parthasarathy (1978), and Visaria (1981). Part of the contradiction is resolved by Sundaram and Tendulkar (1982) by noting that the indicator of *current* unemployment, namely, proportion of unemployed man days in total man days available for work, is significantly related to poverty, while the indicator of *chronic* unemployment, namely, the proportion of individuals classified as unemployed most of the year, is not. They claim that since the poor can least afford to be chronically unemployed, the latter indicator cannot be expected to have any association with poverty.

The existence of a link between output growth and employment generation has been tested with inconclusive results by estimating a relationship between some measures of total labor input and cultivated area and between labor input and output, both per hectare of land. Vaidyanathan (1978) found a positive association between the latter pair across districts though not within districts. Bardhan (1984, ch. 3) found a positive relationship between the former pair in Hooghly district. Mehra (1976) did not find any such relationship with respect to areas devoted to individual crops. Vyas and Mathai (1978) also found no relation between gross output and number of agricultural workers using state-wise data. However, Bhalla, Alagh and Bhaduri (1978) found that in 100 high output growth districts out of 281, agriculture was absorbing workers at a rapid rate, though there was no exodus from agriculture in low or negative growth districts.

The fact that in the hundred years since the first population census in 1881 the proportion of the labor force in agriculture has hardly changed shows that employment opportunities outside agriculture has not grown rapidly enough, before or after independence. Rural industrialization, such as was experienced by countries like Taiwan, has not made much headway. Unless the inward-oriented and capital-intensive industrialization strategy of post-independence era is drastically altered, the prospects of rapid employment generation outside agriculture will continue to be dim. On the other hand, agricultural growth by itself is unlikely to eliminate unemployment in a context of a rapidly growing labor force, in part because many regions of the country lag behind others both in agricultural and non-agricultural development, reflecting constraints (largely institutional) that preclude rapid development at least in the short run. RWP, by providing additional employment

opportunities outside of agriculture and rural industry, particularly in the slack seasons, can augment incomes and alleviate poverty. To the extent the size of the program can be varied at low cost, such variations can be used to offset fluctuations in employment opportunities caused by weather. Thus, RWP can augment as well as stabilize the incomes of the poor.

From a poverty alleviation point of view, RWP offer additional benefits compared to purely redistributive programs. With voluntary participation of the poor in them, it enables the identification and targeting of the poor for other poverty alleviation programs. And by creating productive assets, such as irrigation works, schools, roads etc., such programs contribute to the growth of the economy. Of course, this assumes that the resources needed for RWP are not drawn out of resources that would have been otherwise invested in similar productive investment elsewhere in the economy.

2. The experience with RWP in India

Rural works programs in India are a part of a larger set of rural development programs executed through a plethora of agencies such as (1) *The Small Farmers Development Agency* (SFDA) initiated in 1969–70 to meet the credit needs of small farmers, (2) *Agency for Development of Marginal Farmers and Agricultural Laborers* (MFAL) initiated in 1969–70 but later merged with SFDA – devoted to raising land productivity and creating income earning opportunities in activities allied to agriculture, such as animal husbandry, (3) *Drought Prone Areas Program* (DPAP) initiated in 1969–70 and aimed at 'optimum utilization of land, water and livestock resources, restoration of ecological balance and stabilization of the incomes of people ... ' in areas prone to frequent drought, (4) *Crash Scheme for Rural Employment*, launched in the early 1970s with a view to generating employment and creating durable assets, (5) *Employment Guarantee Scheme* initiated by the Maharashtra State Government in 1972–73 and devoted to assuring employment for a specified period and wage to anyone who wished to avail of it, and (6) *Food for Work Program* started in 1977 to provide employment and create durable assets with the added thrust that part of the wages were to be paid in kind in terms of foodgrains.

Many of these programs were reorganized and combined later. At the time of the formulation of the Seventh Five Year Plan (1985–90) the major rural development programs were: (i) *Integrated Rural Development Program* (IRDP) designed to develop self-employment opportunities in a variety of activities, such as sericulture, animal husbandry, land improvement, handicrafts and small business enterprises, (ii) *Training of Rural Youth and Self Employment* (TRYSEM) with the objective of providing technical skills to rural youth, (iii) *National Rural Employment* (NREP) which is essentially the same as the earlier Food for Work Program, and (iv) *Rural Landless*

Employment Guarantee Program which is an extension to the whole country of the Maharashtra State Program mentioned above, and (v) *DPAP*.

Briefly the achievements of these programs were as follows [for details see Planning Commission (1985)]. The IRDP benefited 1.65 million persons during 1980–85 of which 40% belonged to the economically and socially weak scheduled castes and tribes. Nearly a million rural youth were trained under TRYSEM during the same period. Around 350 million *man days* of employment were generated under NREP in 1984–85 in creating assets such as roads, irrigation works, schools, etc. RLEGP created another 260 million *man days* of employment in 1983–84 and 1984–85. The DPAP generated 177 million *man days* of employment in 1980–85. To put these figures in perspective, *total* employment in the country was estimated at 186 million standard *person years*. Thus, the additional employment generated by these programs is modest.

A number of problems have been encountered in the implementation of these programs. For example, with respect to NREP, the Planning Commission (1985) identified the problems as relating to (a) supply and distribution of foodgrains, (b) time taken in the preparation of a shelf of projects for implementation, (c) non-availability of technical manuals/guidebooks in local languages, (d) difficulties in mobilizing local resources, and (e) in maintenance of assets created and their durability. Corruption and leakages of benefits to non-target groups were also prevalent. These problems have led some [e.g. Guhan (1980)] to question the likely quantitative impact of the program on rural unemployment and others [e.g. Dantwala (1978)] to view these only as transitional in the development process. However, not all assessments have been negative; MHJ (1980), Reynolds and Sundar (1977), Bagchee (1984) and Dandekar and Sathe (180) all suggest that the objectives of some of the programs have been achieved in a significant measure.

Unfortunately, most of the evaluations of RWP are largely descriptive. Few pose the issues in an analytical framework that will permit the evaluation of macro and micro economic consequences of large scale RWP. In contrast, we evaluate the benefits and costs of RWP taking full account of their direct and indirect effects using an applied general equilibrium model.

3. The issues

The fundamental question is not whether development (or growth) and redistributive objectives can be attained through RWP but simply: how effective are they in meeting these objectives?

Clearly, those who are willing to work more at the wages offered by RWP but do not otherwise get such work for reasons to be explored below get additional employment and do benefit in the long run. Yet depending on the way the programs are financed, the long-term consequences could be

different. If the government is able to raise the resources[1] needed for the RWP through additional taxation so that the level of investment in the country, excluding the investment under RWP, is maintained, then total current consumption would be reduced, but the long-term growth of the economy would not be affected. Part of the fall in total current consumption may come from a fall in public consumption and the rest from a tax-induced reduction in private consumption. If part of RWP wages are saved then the total consumption would not have to be reduced to that extent. The productivity of the assets created by the RWP adds to the future income stream of the economy. Indeed, if the government finances the RWP through reduction in investment then the effect on future growth of the economy would depend upon the productivity of the assets created by the RWP relative to the assets that would have been created by these resources otherwise.

The productivity of the assets created by the RWP significantly influences the social cost–benefit ratio of RWP as poverty alleviating instruments. The productivity would depend, among other things, on how well the projects are prepared, selected and executed. A poorly prepared project will increase its ultimate cost. A poorly selected project in the sense of having a lower return than the social marginal rate of return in the economy will drain resources from elsewhere in the economy. A badly executed work will unduly reduce the working life of the assets created. Thus, poor preparation, selection and execution of an RWP project inflate its cost compared to other public and private investments. These apart, leakages through inefficiency and corruption (in addition to the leakages customary in any public investment program) in executing such widely distributed investment programs as RWP would affect the cost of the assets created as well as the wages that accrue to the poor rural target groups. Of course, the materials stolen from the RWP, such as cement, do not leak away from the economy to the extent that such stolen goods are used effectively by the thieves, but they nevertheless defeat the purpose of the RWP by reducing their scale and efficiency. Since in some studies substantial leakages of wages away from the target groups have been reported, the presumably effective targeting possibilities of RWP have to be balanced against other less easily targeted redistributive measures that are not prone to leakages.

The net benefits of RWP are influenced by how well the rural labor market functions in the peak and off-peak agricultural seasons. To begin with, if the market functions in the ideal textbook fashion, with labor demand arising from producers and supply from labor force participants who take wages (or wage structure, if more than one type of labor is involved)

[1]The argument that resources could be raised by reducing waste or improving the efficiency of the public sector does not apply since waste and inefficiency ought to be eliminated whether or not the saved resources are used in RWP.

and all other relevant prices as given *and the market clears*, then RWP will attract no labor if it offers a real wage below the prevailing market clearing wage prior to its introduction. Put another way, the equilibrium wage in this model is endogenous, and RWP, by adding to the demand for labor, will raise it. Since at the new equilibrium wage the labor for RWP will come in part from the release of labor from other uses and in part from additional labor supply, whether or not RWP should be undertaken has to be determined by comparing the social value of the output of RWP with the value of the output loss in the rest of the economy due to diversion of labor.

The rationale for RWP is that it employs part of the labor force at periods in which there is no alternative employment for it. The competitive full employment (market clearance) model is therefore inappropriate for analyzing RWP. On the other hand, non-clearance of the labor market, i.e. why wages do not adjust to clear the market, has to be explained if unemployment exists at the going wage. A number of explanations are available. A popular one is to assert that an effectively enforced minimum wage above the market clearing wage results in unemployment. But in the Indian context there is no evidence that the legislated minimum wage has been effectively enforced. Another explanation is based on the efficiency wage theory, it being assumed that the labor in efficiency units the employer obtains per unit of labor he hires (measured in man days) is a function of the wage rate per man day. The function has the property that the cost per efficiency unit attains its minimum at a unique wage rate. This would mean that no employer will offer a wage rate below this cost minimizing wage rate. If the demand for labor at this wage is below the supply of labor, then the equilibrium wage will be above the critical minimum wage and we will be back in the market clearance world. However, if it exceeds the supply, clearly there will be unemployment. Since by assumption the wage rate cannot fall, market clearance through wage adjustment is impossible. A number of economists have analyzed this model and attempted to provide a foundation for the wage productivity relationship, such as through an alleged nutrition–work effort relationship or through trade-off between the loss of ouput from shirking of work by the employee and the cost of monitoring him so as to prevent it. [Leibenstein (1957), Stiglitz (1976), Bliss and Stern (1978), Dasgupta and Ray (1986).] Rosenzweig (1988) summarizes the theoretical issues and empirical analysis of labor markets in developing countries.

The Indian rural labor market has been studied by a number of scholars [Bardhan (1984), Rudra (1981), Rajaraman (1984)]. There is ample evidence in these studies that the labor market (if it could be termed a market at all) is highly segmented, with wage rates differing even for labor involved in narrowly defined agricultural operations across villages that are close to each other geographically, the differences being too large to be accounted for by transportation costs or barriers to rapid dissemination of market infor-

mation. One explanation offered for this phenomenon is that each individual village (for reasons that are left unstated or unconvincing) is a closed economy and further, the distribution of assets, particularly land, is such that a non-competitive framework is needed to analyze the interaction of demand for labor from oligopsonistic large landlords and the supply of labor from an essentially price taking mass of landless workers and small land holders. In addition, circumstances in some areas may provide incentives for the interlinking of labor, land and credit transactions. How powerful such incentives are may vary from village to village with the result that intervillage differences in wage rates (or for that matter, in crop shares or interest rates) by themselves do not convey much information about the labor markets.

RWP can clearly play a useful role in favor of workers in situations of oligopsonistic labor markets by reducing, if not eliminating, the oligopsony power and rents of the employers. Even if oligopsony was absent, RWP executed at the same time over a large area may integrate otherwise segmented markets and improve efficiency. In situations of interlinked markets, it is not necessarily the case that intervention in one market, namely, the labor market through RWP, will benefit the workers, for the reason that employers may be able to alter the other terms of an interlinked contract to offset the effect of labor market intervention. Yet if the program is of sufficient size and is also a part of a well-defined set of policy interventions in credit and land markets, their joint effect may be to eliminate incentives for interlinking and to improve workers' welfare. Of course, RWP are clearly beneficial in situations where unemployment exists in equilibrium.

The impact of RWP on rural employment and wages can be seen from a simple characterization of the rural labor market that may correspond roughly to the Indian conditions. In fig. 1, two labor demand curves, PP' and QQ' correspond to peak and off-peak seasons, respectively. The labor supply curves for peak and off-peak seasons may be interdependent and different. Also, participation in the labor force may itself depend on prospects for employment and the supply curve may be affected by the introduction of RWP. Yet for simplicity of exposition, the same supply curve is assumed for both seasons. The off-peak wage level is OA below which wages cannot fall for any one of the reasons discussed earlier. AU is the total labor supply forthcoming at the wage OA. Employment level is AB and excess supply of labor at wage OA is BU. Wage earnings are given by $OABC$. If the RWP offers limited employment at the same wage as the off-peak, as shown in fig. 2a, the labor demand curve becomes now $QBDR'$. As long as the additional employment generated does not exceed the available excess labor supply BU, there is no change in agricultural wages and employment. The wage earners earn an additional income corresponding to $BDEC$. On the other hand, if the

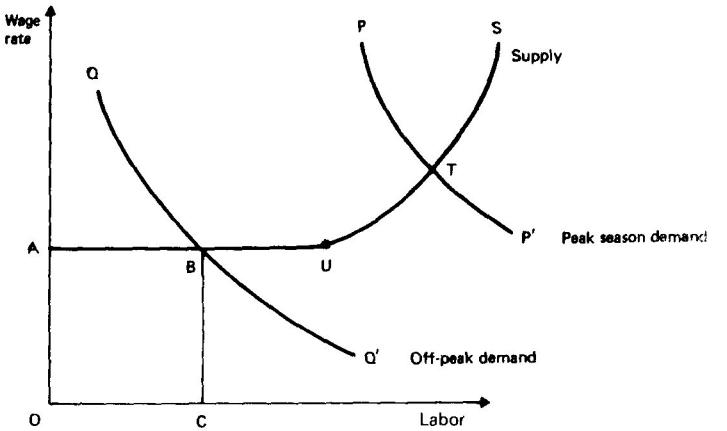

Fig. 1. The rural labor market.

wage rate offered by the RWP exceeds the prevailing wage OA, there may be a reduction in agricultural labor employed depending on the additional employment offered by the RWP relative to the initial excess supply.

In fig. 2b, RWP wage rate is higher than the prevailing wage rate but the amount of employment offered by RWP is limited. The labor demand curve after the RWP is initiated is $QSRR'$. The additional employment offered by the RWP is not sufficient to absorb all those who offer themselves for employment at the higher wages, and jobs will have to be allocated among applicants in some way, for example, on a first-come, first-served basis. The total employment is AD and the employment in agriculture will be unaffected at AB with the agricultural wage continuing and the institutional minimum level OA.

On the other hand, if the RWP is initiated as an employment guarantee scheme, then it will set the rural wage rate. As seen in fig. 2c, the labor demand curve is now $QSDR'$. Equilibrium wage is OQW offered by the RWP. Agricultural employment is reduced from AB to WS. However, agricultural wage income $OWSF$ may increase rather than fall if the labor demand curve is sufficiently inelastic. Agricultural output is reduced as a consequence of the reduction in agricultural employment.

Since the RWP are primarily meant to reduce off-peak season unemployment we can assume for analytical simplicity that cases 2a and 2b are the relevant ones. RWP then do not affect agricultural employment and output.

To summarize, the following specific questions arise regarding RWP:

(1) What are the impacts of different levels of RWP on poverty reduction

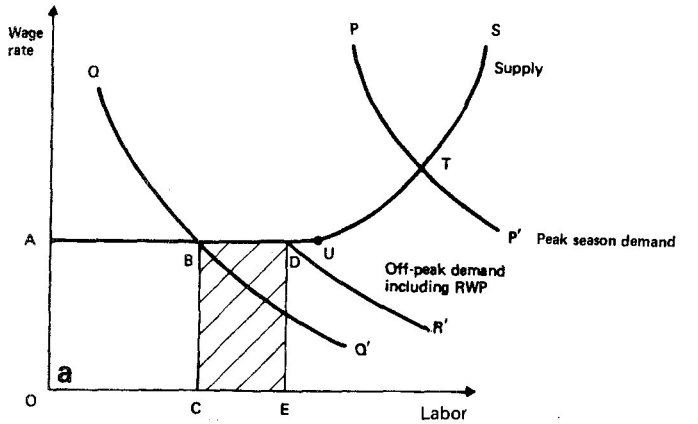

Fig. 2a. RWP – Offers limited employment at institutional minimum wage.

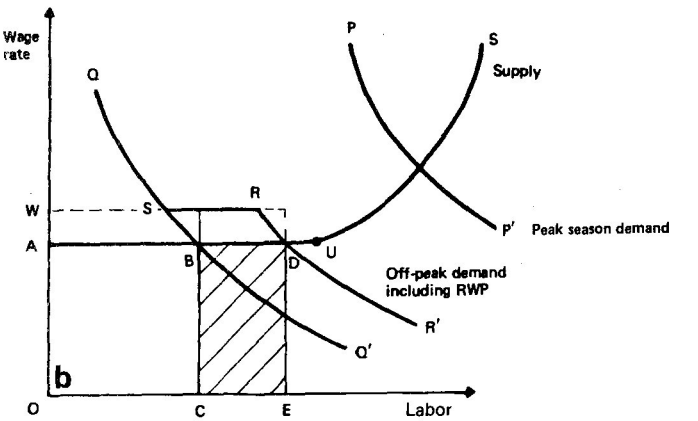

Fig. 2b. RWP – Offers limited employment at a higher than institutional minimum wage.

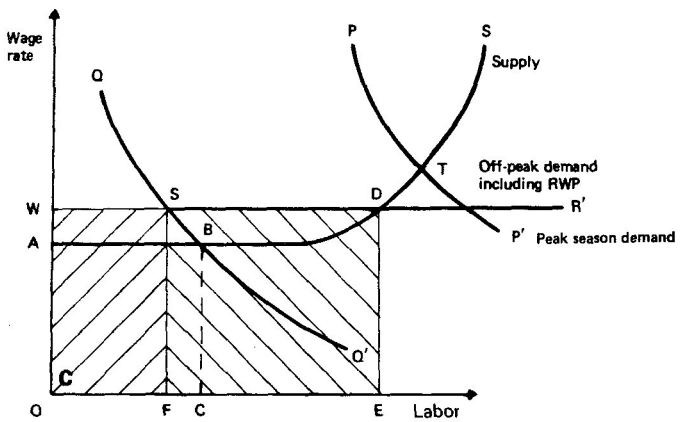

Fig. 2c. RWP – Assured employment at above market, i.e., an employment guarantee scheme.

and on economic growth in the short run and the long run? How do they depend on the government's ability to mobilize needed resources?

(2) How are these benefits and costs affected by poor selection, preparation and execution of RWP?

(3) As a purely targeting scheme for redistribution, are RWP cost effective?

We address these questions with the help of the Indian Agricultural Model.

4. The model in outline

The model is a sequential applied general equilibrium (AGE) model in which an equilibrium price vector is computed for each year in succession. Unlike other such models, a number of behavioral functions relating to demand and supply have been econometrically estimated with data mostly from the period 1950–51 to 1973–75. In the running of the model, for the period up to 1980 outputs, imports and exports were set equal to their actual values and the actually observed prices were generated as equilibrium prices by ensuring market clearance at these prices through stock accumulation or decumulation. Indeed, the fact that such a procedure did not lead to implausible values of change in stocks was viewed as a validation of the model. The period after 1980 was the simulation period. Great simplification was achieved by imposing a one-year lag between production and market sale. Thus, in effect the economy became an exchange economy for the purposes of computing equilibrium prices.

The economy is divided into ten sectors, of which the first nine produce agricultural commodities and the tenth produces the only non-agricultural good. There are three sets of agents: producers, consumers and government. Consumers are classified by their residence as rural or urban. Rural as well as urban consumers are divided into five expenditure classes, each according to their monthly per capita household consumption expenditure. Means of production (capital), natural resources [land, human resources (labor)] and livestock (draft and milk animals, poultry, etc.) generate income through production activities that is distributed to consumers. Thus, behavior of producers (i.e., their production activities) determines commodity supplies and incomes. Consumer behavior generates commodity demands (and implicitly resource supplies). The government sets policies (e.g., investment targets, taxes, tariffs, quotas, rations, price supports and ceilings, etc.). Finally, equilibrium is achieved through exchange in which domestic demand, together with export demand by the rest of the world for each sector's output, is equated in the sum of domestic supply (emerging from previous year's production net of changes in stocks) and (foreign) import supply. We now describe in some detail each of these components: demand, supply, policy and exchange.

4.1. Consumer behavior

To begin with, per capita consumer expenditure of each class of consumers on the output of each sector is a linear function of sectoral prices and per capita total consumer expenditure, the functional specification being that of the Stone–Geary linear expenditure system. Thus, once the distribution of the population in any year into the ten expenditure classes is determined, total consumer expenditure on each of the ten sectoral outputs is also determined as a function of prices.

4.2. Distribution of households in expenditure classes

The joint distribution of households according to their per capita income and consumption expenditure (at the prices of each year) is assumed to be a bivariate log normal distribution (a different one for rural and urban households). The parameters of these distributions were estimated using data from a household income and savings survey conducted in 1976 by the National Council of Applied Economic Research (NCAER, 1980).

To be specific, let c and y denote respectively the logarithms of per capita household consumption expenditure and per capita income. The log normality assumption ensures that the conditional distribution of c given y is normal so we can write $c=\alpha+\beta y+v$, where v is normally distributed with mean zero and variance $\sigma_v^2=(1-\rho^2)\sigma_c^2$, $\alpha=\mu_c-\beta\mu_y$ and $\beta=\sigma_c/\sigma_y$, the parameters μ_y, μ_c, σ_y^2, σ_c^2, and ρ respectively denoting the mean of y, mean of c, variance of y, variance of c and the correlation between c and y. In the simulation exercise the mean of the marginal distribution of y was allowed to vary from year to year, but its variance was kept unchanged as its estimated value from the 1976 data, thereby keeping the Gini coefficient of the distribution of per capita household income (nominal) constant. Also, the parameters α, β and σ_v^2 were kept constant at their estimated values as well. This meant that the mean of conditional distribution of c varied from year to year (depending linearly on the mean of y) but its variance remained unchanged. The marginal distribution of y and the conditional distribution of c given y together determined their joint distribution. Using it one can determine the proportion of the relevant population of households falling within any specified interval of c, in particular, any interval corresponding to a specified per capita expenditure at 1970 prices as well as the average value of c and y for those households. Each year the boundaries of expenditure classes were revised to give the same utility at expected prices as was provided by the class boundaries in 1970–71 at 1970–71 prices. These proportions, together with an exogenously projected total number of households (rural and urban) in each year and their average size, enables the determination of aggregate consumer demand using the linear expenditure

system. The value of aggregate household savings is obtained as the difference between aggregate income and consumption expenditure. We now turn to the determination of the mean of the distribution of y for each of the simulation periods on which the rest depends as described above.

4.3. Non-agricultural production

Non-agricultural production in any year equals non-agricultural income (since the non-agricultural good is the numeraire of the model). Non-agricultural capital stock, which is determined by past capital accumulation determines potential production behavior given uncertain demand and a cost function which is quadratic around the capacity level of output. Actual production of non-agriculture depends on the demand for non-agriculture which in turn depends on GDP investment, public consumption and demand for intermediate products by agriculture. The proportion of non-agricultural income accruing to rural households is exogenously specified.

4.4. Agricultural production responses

All agricultural income consisting of income from crop production and animal husbandry accrues to rural households. Supply of livestock products is a function of time and the relevant price, the elasticity of price response being exogenously specified. Output of each crop (16 major and 9 minor) is by definition the product of land allocated to it and the yield per unit of land. Land allocation is based on a Nerlovian adaptive response model, the driving variable being the expected revenue from devoting a unit of land to one crop relative to that of two of its main competing crops. Revenue expectations are based on past prices and yields. In general, crop yield per unit of land depends on whether the land is irrigated, the amount of fertilizers used, which depend on price of output relative to that of fertilizers, and the variety (high yielding, or local) of seeds sown. Only for five major cereal crops the adoption of high yielding varieties is significant and plans a role in determining their yields. Narayana and Parikh (1981) describe in detail the estimation of farm supply responses.

Not all cultivable land is in fact cultivated in any year. The amount of land on which at least one crop is sown in a given year, known as net sown area (NSA), is assumed to approach its potential asymptotically with some year to year variation depending on rainfall. By counting each hectare of land as many times as the number of crops grown on it in a given year one obtains the gross sown area (GSA). Whether more than one crop is grown in a year on a particular parcel of land (i.e., its cropping intensity), depends on moisture availability from (natural) rainfall and (artificial) irrigation. But irrigation can be used intensively or extensively, that is, to irrigate more than

one crop on a limited area or irrigate just one crop over a wider area. This leads to the analogous distinction between net (NIA) and gross (GIA) irrigated area. Briefly, GIA is linearly related to investment in agriculture, a time trend and rainfall. NIA is assumed to be a constant proportion of GIA. Average cropping intensity (i.e., ratio of GSA to NSA) is linearly related to the ratio of NIA to NSA and quadratically to rainfall. GIA was first allocated to six groups of crops formed out of the 25 crops and then allocated to crops within each group.

4.5. Government policy: Public consumption, targeted investment

Thus far we have described the derivation of household consumption demand and supplies emerging from domestic production. Expenditure on public consumption is assumed to increase as a proportion of GDP over time from about 12% in 1980 to over 20% in 2000. It is spent entirely on non-agricultural goods. The non-agricultural sector is the only domestic source of supply of investment goods. Household savings are one source of finance for investment, the other source being public savings. In fact, we postulated that the government achieves a specified target of total investment in the economy as a proportion of GDP, by saving and investing the difference between target investment and household savings. The two sectors of destination for investment are agriculture as a whole and non-agriculture. The share of agriculture in total investment is specified as a function of time and the terms of trade between agriculture and non-agriculture.

4.6. Government policy: Trade and price

For simplicity, foreign trade and inventory operations are assumed to be in the hands of government. Thus the difference in the value of exports (imports) at domestic purchase (sale) price and their value at foreign sale (purchase) price, called Tariff Revenue for simplicity, enters the government budget. So does any change in the value of inventories.

Behind any domestic price policy is an implicit trade policy. These two therefore have to be consistently specified. We have stipulated a price policy in which the government tries to steer the prices over time to the world market prices, subject to (implicitly) specified trade quotas on certain commodities. This policy is articulated in terms of target domestic prices for the coming period that are in general functions of world prices and the realized domestic prices in the current period. Quotas on imports reflect objectives of attaining certain levels of self-sufficiency. Quotas on exports reflect perceived constraints on external demand. These trade quotas are given a priority over the objective of bringing domestic prices closer to world prices.

Thus price targets are realized as long as trade quotas are not binding. Once a quota becomes binding, the price of that commodity adjusts away from its targeted value. In the simulations, weather is taken as normal and thus, except for maintaining normal inventories as a function of production levels, no buffer stock operations are carried out.

4.7. Government policy: Public food distribution

The system of public distribution of foodgrains enters the model as follows. The discrepancy between the set price at which the government buys foodgrains (the so-called procurement price) and the open market or equilibrium price is treated as a tax on producers. Thus, producers' disposable income is the difference between the value of their total output at market prices and the amount they lose by selling to the government at the procurement price instead of the market price. Analogously the difference between the set price (the so-called issue price) at which the rations are sold and the open market price is treated as an income subsidy to consumers. The procurement price and issue price are set relative to target open market prices at their historical values. The quantity of grains (rice, wheat, and coarse grains) bought by government and the quantity distributed are endogenously determined based on estimated equations. The fraction of production the government would like to distribute in ration shops depends on the per capita availability of foodgrains over the past two years, whether the current year is a bad year or a good one, and on the normal consumption level of the urban population. This sets its procurement targets, but its actual procurement depends on the difference between the procurement price and target market price and per capita availability.

4.8. Income distribution at 'target' prices

Income calculated at 'target' prices entered in the determination of aggregate consumption expenditure, and its distribution among the five rural expenditure classes. Consumer demand within each class then becomes a function of market equilibrium prices to be determined and income at target prices. Since target prices need not be realized as equilibrium prices, any discrepancy between the two sets of prices implied a discrepancy between the income at target prices, which determined distribution of households in different expenditure classes and hence determined demands and the incomes at equilibrium prices. We did not attempt to remove this inconsistency as it turned out to be relatively insignificant. However, as mentioned earlier, for the period up to 1980 sectoral supplies were set equal to their observed values and target prices were set equal to their observed values.

4.9. *Exchange equilibrium: Market clearance*

With the assumed lag of one year between production and sale in the exchange process, domestic supplies are given. Equilibrium is achieved if a price vector (as well as a net import vector and an inventory change vector) can be found that match the sum of consumption demanded at those prices and other non-price sensitive demands with the sum of predetermined domestic supplies from production and stock and imports. The only constraints on the search for equilibrium are an overall trade balance constraint and sector-specific constraints on exports, imports and inventory changes. Keyzer (1981) describes the algorithm used for computing such an equilibrium.

5. Specification of rural works programs scenarios

It will be recalled that there are ten (five rural and five urban) per capita consumer expenditure classes and ten commodity/sectors in the model. We assume that only the poorest two expenditure classes (consisting of agricultural and non-agricultural households) in rural areas are the target groups to be covered under RWP. An average quantity of 'r' kilograms of foodgrains per year per person in these two expenditure classes are distributed to the participants as wages under RWP.

In most of our analysis, 'r' is exogenously fixed at a level of 100. However, the per capita quantity 'r_1' of foodgrains distributed to the poorer of the two classes, class 1, is fixed at 125 kg. In a few runs r_1 is fixed at 50, in which case r is set at 62.5.

The amount r_2 distributed per capita to class 2, given r and r_1, is given by

$$r_2=(rp-r_1p_1)/p_2$$

where p, p_1, p_2 are respectively the population of the two classes together and class 1 and class 2. Though r and r_1 remain constant at 100 and 125, r_2 varies over time depending on p_1 and p_2.

The constancy of r_1, given the wage rate of the RWP, implies that a constant proportion of the population of the poorest class 1 would be employed under the RWP, but the proportion employed from class 2 would change depending on the population of the class, p_2.

Though the composition of the basket of foodgrains in terms of rice, wheat and coarse grains to be used for wage payments is in principle a policy decision, we have assumed that the basket consists only of wheat. This simplifies comparisons of different scenarios and would not change the nature of the results. Obviously the wage cost of the RWP is the value of the

total foodgrains thus distributed. We compute the wage bill at the target (or open market) prices.

This wage bill is, however, only a part of the cost of investment activity under RWP. Additionally, some complementary non-agricultural tools and implements etc., construction materials, such as cement, lime or bitumen, as well as transportation services, are needed for digging irrigation channels or building earth works for road construction and so on. We assumed that the cost of complementary non-agricultural goods is one-half of the wage bill in value terms. This was indeed the norm for the sixth plan employment programs. In other words, in physical units:

$$\text{the complementary demand for non-agriculture} = 0.5\ (\text{wage bill})/P(10)$$

where $P(10)$ is the price of the tenth sector (non-agriculture)

The amount of 125 kg of wheat distributed per person per year for the poorest class is selected as wage on the following considerations. For a family of five provision of 125 kg of wheat per person at Rs 2.0 per kg would cost Rs 1,250 per year. At an annual employment of 200 person days per year per family, this implies a wage rate of Rs 6.25 per person per day. This is marginally higher than the implied wage rate in the RWP of the sixth plan. It is proposed to generate 2,000 million person days of employment over the plan with a total outlay of Rs 16,000 million, of which a third was for the non-wage component of RWP, thereby implying as average wage rate of Rs 5.33 per person per day.

The total investment taking place in the economy under RWP in our scenarios is thus equal to one and a half times its wage bill. This investment may be put in place either in agriculture, the non-agriculture sector or shared by both. We assume that these two sectors share such investment equally.

Various inefficiencies and leakages can and do in fact occur in the RWP. For analytical purposes these can be grouped into two types with distinctly different consequences. The first one relates to the effectiveness of the investment generated under the RWP. Additional output from the RWP investment may be less than what can be obtained from investing the same expenditure in other activities. This kind of inefficiency affects the growth of the economy. The second one relates to a failure of targeting: the actual beneficiaries of the RWP are not the target groups (i.e., the population in the two poorest rural classes) but middle-men belonging to other richer classes. Such unintended diversion of benefits to non-target groups affects the degree to which the primary objective of removal of poverty is realized. Of course, such leakages would also have their own secondary implications on total consumption, savings and investment in the economy by the non-target groups.

The inefficiencies of the first kind are reflected in three alternative levels of

Table 1

Description of policy scenarios.

Issue addressed	Run designation	Per person quantity of wheat distributed as wages	Targeting effectiveness t	Investment effectiveness e	Tax rates free or fixed
Impact of the size of RWP and mode of financing	RW50-1-1	50 kg	1.0	1.0	free
	RW100-1-1	100 kg	1.0	1.0	free
	RW50-1-1X	50 kg	1.0	1.0	fixed
	RW100-1-1X	100 kg	1.0	1.0	fixed
Impact of targeting failures and investment inefficiencies	RW100-1-1X	100 kg	1.0	1.0	fixed
	RW100-0.5-1X	100 kg	0.5	1.0	fixed
	RW100-1-0.5X	100 kg	1.0	0.5	fixed
	RW100-0.5-0.5X	100 kg	0.5	0.5	fixed
	RW100-1-0X	100 kg	1.0	0.0	fixed
	RW100-0.5-0X	100 kg	0.5	0.0	fixed

1, 0.5 and 0 of effectiveness of RWP investment relative to the economy-wide average. At one extreme a level of 1 corresponds to well-planned and well-executed programs. At the other extreme, a level of 0 corresponds to totally infructuous investment. A level of 0.5 is between the two extremes. Thus, an investment expenditure of $1.5W$, where W is the wage bill, leads to an effective investment of $e1.5W$, where e could take one of the three alternative values 1, 0.5 and 0.

We incorporated two alternative characterizations of targeting failure. One is the case of no failure, and the second is the case of 50 percent failure in the sense that only 50 percent of the wage bill reaches the targeted two poorest rural classes and the remaining 50 percent of W accrues to all other three richer rural classes in proportion to their population.

Thus, the following set scenarios are generated:

(A) Reference scenarios — Contains no specific redistributive policies except the continuation of public distribution of foodgrains only to urban groups.

(B) Rural works scenarios — The policy of rural works programs (denoted by RW) is made operative from the year 1980 onwards. With the combination of two targeting failure denoted by t) levels and three investment effectiveness (e) levels, six alternative scenarios designated RW$-t-e$ arise.

To make the RW runs comparable and somewhat easy to interpret, prices are maintained at the same levels in all these runs as in the reference run in corresponding years by removing all export and import quotas and imposing

a tariff equal to the difference between the domestic price in the reference run and the world market price.

Moreover, in most of the variants it is assumed that the government is unable to raise the average tax rate above its level in the reference scenario and that the RWP are financed by reducing other public investments. A few runs, however, were also made where investment rates were maintained and tax rates increased to finance the RWP. The fixed rate runs are identified with a letter 'X' in their designation.

The scenarios are listed in table 1, grouped according to the issue addressed by them.

(C) Free food scenario In order to compare RWP with a generalized food subsidy program which does not attempt to distinguish between various income groups in this scenario, 40 kg of wheat per person was given free to the entire population. The figure of 40 kg was chosen as it involved roughly the same level of government expenditure as the RWP in which 100 kg of wheat is distributed so that the long-term impact on growth would be comparable. This run is designated FF40X.

6. The results

The impact on the growth of the economy and on the welfare of the rural poor can be seen from table 2. Growth indicator is the growth in gross domestic product at 1970 prices (GDP 70). The welfare indicators include GDP 70 per capita, energy intake in kilocalories per capita per day (Cal/Cap) and average equivalent income per capita (EQY/Cap). Equivalent income of a person is the minimum expenditure needed at 1970 prices to achieve the utility he enjoys in year 2000. In the table results for the year 2000 are given as percentage changes in values of various variables in different scenarios from their reference run values.

7. Impact on growth and hunger

It is obvious from the results for RW100-1-1 that if rural works programs can be financed through additional taxation and if they could be carried out without investment inefficiencies and targeting failures, then not only the rural poor improve their welfare substantially but the economy grows faster also. The GDP in 2000 is 3.5 percent higher, amounting to an increase of 0.22 percent per year in the GDP growth rate over 1980–2000. The poorest

Table 2

Impact on growth and rural poor of rural works programs.

	GDP 70 per capita	Difference in GDP 70 growth rate 1980–2000	Rural poor					
			Avr *EQY* Cap	Cal Cap	Poorest class		Two poorest classes	
					EQY Cap	Cal Cap	*EQY* Cap	Cal Cap
With additional taxation								
RW100-1-1	+3.5	+0.22	+2.2	5.7	67	70	39	40
RW50-1-1	+1.8	+0.13	+1.1	2.9	34	35	19	20
With fixed tax rates								
RW50-1-1X	2.3		0.1	2.4	33	35	19	20
RW100-1-1X	4.6	0.28	0.2	4.7	67	70	39	40
RW100-1-0.5X	8.5	0.47	2.6	2.8	67	70	39	40
RW100-1-0X	13.2	0.73	5.4	2.6	67	70	39	40
RW100-0.5-1X	3.7	0.20	0	3.0	33	40	19	20
RW100-0.5-0.5X	7.3	0.40	2.0	2.1	33	40	19	20
RW100-0.5-0X	11.8	0.66	4.7	1.0	33	40	19	20
1-1-40X	4.2	0.23	0.8	1.3	11	11	10	10

rural class improves its energy intake by 70 percent to a level which virtually eliminates hunger.

8. Impact of the size of the program

These effects are roughly halved when the size of the rural works program is halved in RW50-1-1 compared to RW100-1-1. The impact of the size of the program for the year 2000 is plotted in fig. 3. The gain in GDP, as well as the gain in average equivalent income are approximately linearly related to the size of the program.

The additional tax effort needed can be seen from table 3 which gives the tax rate on non-agricultural incomes of the two richest classes. The bottom three classes, starting from the poorest class 1, face respectively 0.1, 0.4 and 0.9 times the tax rates of the richest two classes. The tax rate in table 3 can be interpreted as a combination of direct and indirect taxes. It excludes corporate taxes and tariffs on foreign trade.

The additional tax effort in 1980 with the introduction of RWP is substantial. In the reference run in 1980, taxes on non-agricultural income generate revenue of less than two percent of the GDP, and to finance an RWP at the level of 100 kg of wheat per person this revenue has to be raised to around eight percent of GDP. This is no small effort and its political

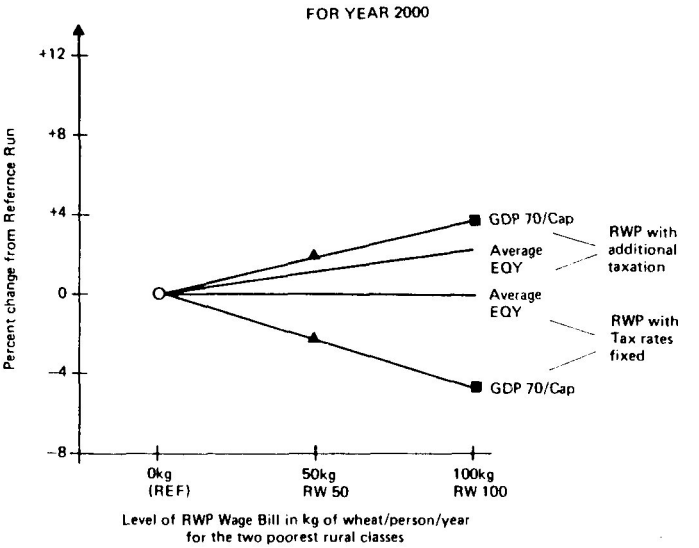

Fig. 3. Size of RWP and growth.

Table 3

Tax rates on non-agricultural income.

Scenario	1980	1985	1990	1995	2000
Reference	0.04	0.04	0.06	0.08	0.12
RW100-1-1	0.17	0.11	0.10	0.11	0.14
RW50-1-1	0.10	0.07	0.08	0.10	0.13

feasibility, let alone its administrative feasibility, is doubtful. Nonetheless, such an RWP would be effective in drastically reducing poverty and hunger.

An RWP at a lower level of 50 kg per person still has a substantial impact (nearly half as much as that of RW100-1-1), while reducing the tax effort in 1980 from eight percent of GDP to about five.

Though the tax efforts needed in 1980 for financing the RWP are substantially higher than in the reference run, as the economy grows over the years the difference in tax rates reduces by 2000 to around one percent of the GDP. This means that a serious financing problem arises only in the initial years. As such, if foreign grants are available for a limited period, RWP can be initiated without straining the tax effort. If foreign grants are not forthcoming and tax effort is not feasible, RWP may be introduced at a modest level and gradually stepped up, thereby keeping the needed tax effort within modest limits.

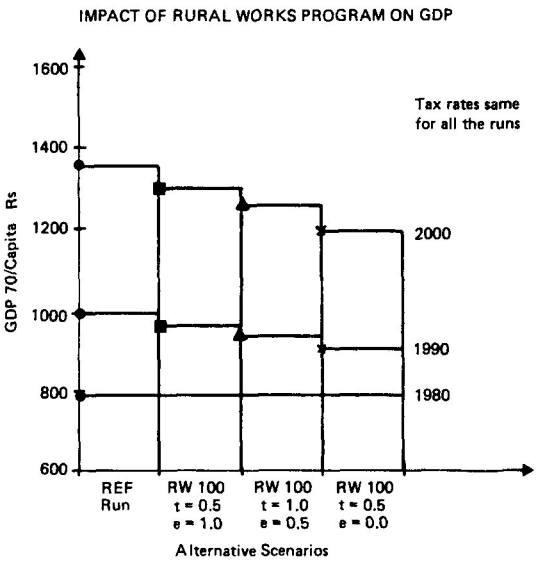

Fig. 4. RWP leakages, investment and effectiveness and GDP/cap.

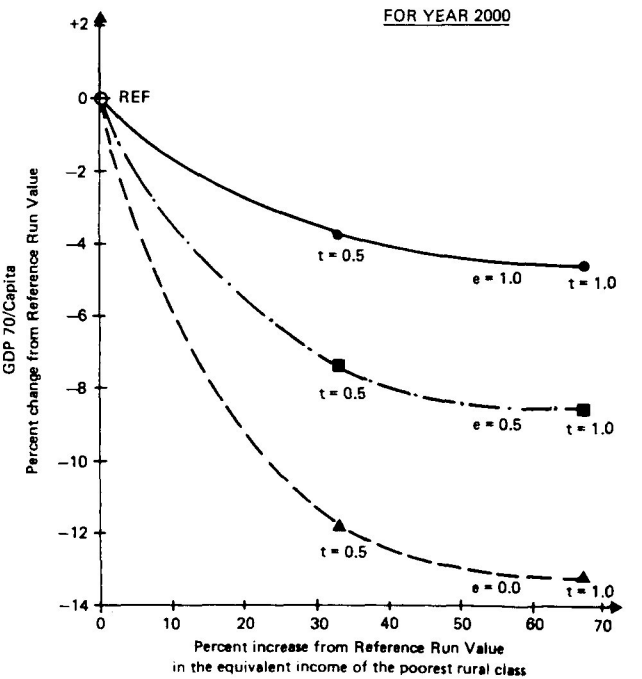

Fig. 5. Growth, welfare and RWP leakages and effectiveness.

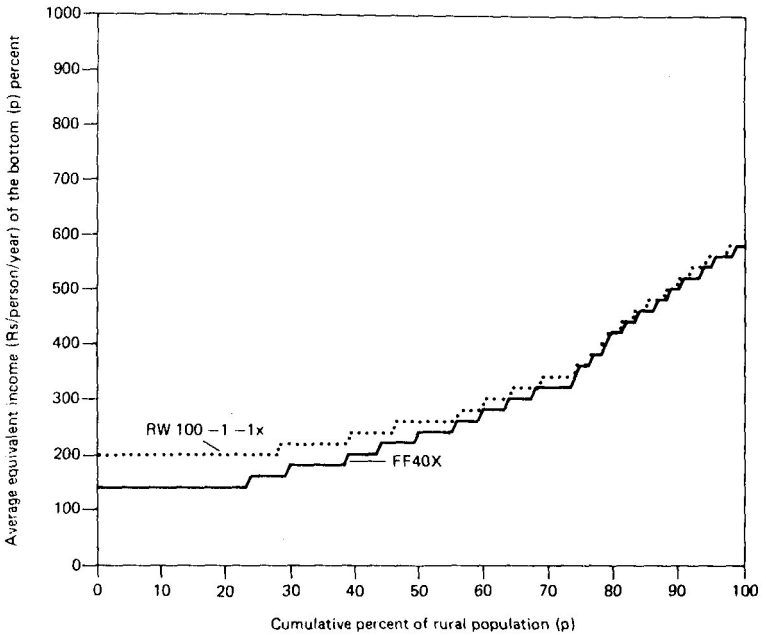

Fig. 6. Social welfare comparisons.

whatever, the impact on growth is similar to RW100-1-1X; as is to be expected, distributional impacts on the rural poor are much worse. This is seen in table 2 and fig. 5.

In fig. 6, the average per capita equivalent income of the bottom p percent of the rural population is plotted against p. The fact that the curve corresponding to RW100-1-X is above that of FF-40-X means that social welfare as per the criterion developed by Willig and Bailey (1981) is higher in the former. This criterion ranks income distributions according to any social welfare function that satisfies the Pareto principle, anonymity and aversion to regressive transfers.

12. Conclusions

Rural works programs are an effective instrument for virtually eliminating hunger at modest cost in terms of growth if they can be well planned and executed.

RWP create a demand for perhaps the only endowment the rural poor have, namely, unskilled labor. They increase their earnings. In the absence of any radical redistribution of rural assets (particularly agricultural land) and

without creating additional demand for unskilled labor, the possibilities of improving incomes of the rural poor in India's mixed economy are very limited.

By making rural unskilled labor less dependent on the rural land-owning rich, RWP may loosen the social and economic power of the latter. An anticipation of this happening may lead the rural rich to oppose them. However, RWP also improve rural infrastructure, thereby increasing productivity of land, which may be sufficiently attractive to the rural rich to blunt their opposition.

The effectiveness of planning and execution determine the success of RWP. The fact that RWP were not effectively executed in the past is not an argument against RWP per se, but only an argument for creating a design and implementation mechanism with less incentives for diversion of resources to other uses. For instance, the participation of the rural poor in formulating RWP may help. In any case, it is likely that the efforts and the resources needed to plan and execute RWP effectively will be modest compared to designing and implementing alternative policies with similar impact on the rural poor.

A few remarks on the limitations of AGM as a tool of policy analysis are in order. The results of the analysis depend crucially on the algebraic specification of the model and the values assigned to its parameters. Although many parameters of our model have been econometrically estimated, albeit with varying degrees of precision, several of them have been exogenously specified. Also, some of the behavioral relationships (e.g., the determination of public consumption) are specified in an ad hoc fashion. Given the complexity and cost of computation, it is virtually impossible to do any serious sensitivity analysis with respect to functional forms and parameter values. The treatment of investment is crude in most AGMs, including ours. Technical progress is again crudely modeled and treats it as exogenous. Although one can add many more caveats, it would be hasty to conclude that AGM is not a powerful analytical tool. Any model is an abstraction of reality to a considerable extent and a policy focused model is even more so, given the complexities and nuances that policy making inevitably involves. As such, AGM should be evaluated relative to the next best alternative, perhaps a partial equilibrium detailed model of individual markets with only an informal accounting of general equilibrium effects. In such a comparison, AGM comes out on top by providing a set of tools for tracing through the *full* effects of a *set* of policy changes in a logically consistent framework. Neither a local analysis of 'small' changes in policy, as is often done with algebraic models, nor a partial analysis of one policy at a time can hope to approximate these full effects. Even in an economy which is only moderately complex, the feed back effects are likely to be sufficiently strong that even the qualitative (let alone quantitative) effects of a simultaneous change in several policies cannot be assumed through a priori

reasoning or the use of highly simplified and aggregated models of small dimensionality.

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