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Population growth, inequality and poverty

Gerry RODGERS *

I. The issues

The extent to which population growth is a hindrance to economic development has been frequently debated in recent years. Rapidly increasing populations are widely thought to restrict the spread of social infrastructure, to reduce the growth of income per person, to increase pressure on limited natural resources, and to lead to excess labour supply and unemployment.

In particular, rapid population growth is seen as a factor leading to greater inequality in the distribution of income.[1] Why would this be so? Many reasons have been suggested. For instance:

(i) Population growth increases the supply of labour relative to land, which is fixed, and capital, whose growth is usually thought to be independent of, or negatively related with, population growth. This will tend to reduce the average remuneration of labour relative to land and capital, and indeed the aggregate remuneration of labour as well, if labour cannot be readily substituted for other factors of production.

(ii) Population growth tends to promote inequality in landownership; the division of holdings leads to unviable farms in the smallest size groups, where land would eventually be lost through usufruct mortgage or distress sales, leading to an increase in the proportion of the population which is landless.

(iii) Population growth is often found to be more rapid among lower-income groups. If the share of these groups in national income is fixed, and there is little upward mobility, the relative incomes of the poor will decline.

(iv) The welfare of the poor is often held to be more dependent on government interventions than that of the rich. But the cost of schooling and medical facilities, nutrition programmes, employment-generating

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schemes and so on rises almost in proportion to the population covered. Thus if the total cost of these programmes is not to be raised, population growth tends to reduce the fraction of the population they can reach.

(v) High fertility and a high ratio of dependants to earners limit the capacity of parents to save, or to invest in the education or health of their children. This constraint is felt much more severely among the poor, leading to inequality in "human capital"–and hence in income–in the next generation.

Other such relationships can also be suggested. They make a strong *prima facie* case for the adverse effects of population growth on equality. But these are for the most part expectations and hypotheses and empirical support for them is limited. One reason for this is that the testing of propositions about the effects of population growth on inequality runs into several problems:

(i) All the relationships noted above are subject to considerable time lags. Although an annual population growth of 2-3 per cent may, in theory, have significant effects within a year or two, in practice only the cumulation of five to ten years' growth is likely to give rise to statistically observable outcomes. What is more, one of the suggested effects is esentially intergenerational, one depends on the growth of the labour force (which lags roughly 15 years behind population growth), and a third depends on household formation, which responds even more slowly. We therefore need a very long time horizon. But in most countries, especially developing countries, the last 20 or 30 years have been periods of substantial political and economic change, the effects of which are not easy to separate from those of population growth.

(ii) The relationship between population growth and income distribution is complicated by the likelihood that each affects the other; a stylised model might see current inequality affecting current population growth, which in turn affects future inequality. The problem here is that current and future inequality will be closely related–if only because inequality is partly the result of additional, structural factors, the effects of which are not always easy to isolate.

(iii) Measures of inequality are essentially aggregative. We cannot easily test our propositions using household data, and inequality at the community level is rarely measured. This makes empirical work primarily dependent on measures of national inequality, which have to be analysed either in time series or in cross-section. In both cases there are serious problems. Usable time series of inequality are rare, and their analysis is plagued by the variety of lags in the relationship with population growth. International cross-section analysis faces problems of non-comparability, especially in measures of inequality, while structural and cultural differences between countries make firm conclusions difficult to reach.

This article takes up some of these issues. First we explore the type of relationships that can be observed in inter-country comparisons, discussing the findings of several other authors, and presenting (in summary form) some new estimates using an ILO data bank. Second, we consider some basic conceptual problems which work in this field must face. And finally, we return to some of the theoretical and empirical issues that call for investigation at the national level.

II. Inter-country analysis

Despite their weaknesses, inter-country comparisons appear to be the easiest starting-point for empirical analysis. The approach adopted by most researchers has been to select one or more population indicators and a measure of national income inequality, and to explain inter-country differences in one or both of these variables in terms of each other and of other indicators of economic and social development. Underlying this methodology is the assumption that there are aspects of demographic and economic change that are common to all countries included in the study, so that differences between countries give some guide to the likely evolution over time within any one country. This can be accepted at best with reservations; but given the paucity of data on the evolution of inequality over time, a working hypothesis of this type seems to be unavoidable.

Authors who have analysed fertility differences in this framework include Repetto (1978, 1979), Morawetz, Ogawa, Flegg (1979), Moreland and Winegarden (1978, and in press). All except Winegarden find a strong positive effect of inequality on fertility (i.e. the greater the degree of inequality, the higher is fertility). Winegarden finds a strong negative relation, a result which can be mainly traced to the fact that he controls for family planning efforts. But it turns out that where family planning is endogenous, as in Ogawa's model, it is strongly negatively associated with inequality, so that the positive relationship between fertility and inequality would probably re-emerge if family planning were also endogenous in Winegarden's model. Other relationships fluctuate to some extent with the sample and the specification (especially relationships with income), but high child mortality is consistently associated with higher fertility and high literacy with lower fertility.

Those who have investigated the effects of inequality on mortality (e.g. Rodgers, 1979; Flegg, 1982; Moreland) find a strong positive relation. Flegg, Moreland and Repetto (1978) also find strong positive relationships between illiteracy and mortality.

Attempts to explain variations in inequality across countries have a long history; the "U-shaped" relationship between inequality and income was researched by a number of authors in the 1960s and early 1970s after Kuznets' pioneering work. A non-linear relationship between inequality and incomes, of the Kuznets U-shaped variety, survives the introduction of population growth or fertility in the function (Ogawa; Ahluwalia); the effect of fertility or population growth on inequality is consistently positive and usually strong.

These results have their critics. Boulier, for instance, considers that the international data base is inadequate for statistical analysis: "it is doubtful whether the income distribution data are sufficiently comparable among countries to support the econometric analysis for which they are used" (p. 169); he also argues that the models are inadequately specified: it is most unclear whether the statistical association between the distribution of income and fertility among nations is a causal association or merely a spurious correlation due to underlying (unmeasured) social and economic factors jointly determining fertility and the distribution of income" (p. 170). Of course, it is a time-honoured practice to attack the data if one is unhappy with the results, or to postulate additional unobservable relations which would undermine those estimated. While there is merit in Boulier's remarks, pending the development of better data and improved models we must accept the use of international cross-section results as one element in the array of evidence.

Most of the authors cited above were mainly interested in establishing current interactions between fertility or mortality and inequality (Winegarden, in press, also considers certain lagged relationships). But, as noted in the introductory section, many of the factors likely to cause population growth and inequality to be related operate over extended periods of time; a dynamic model is indicated. It is possible to build fairly complex models of the Bachue type on an international cross-section base, and this has in fact been done (Moreland). However, a simpler model, which pays particular attention to lags and variations over time, may well generate new insights. The remainder of this section presents a summary of the results of a new international cross-section analysis set up on these lines.[2] The data used came mainly from a file established at the ILO by Hopkins for the analysis of basic-needs satisfaction. Details of this file were reported in Rietschin. Results from another analysis using this file were reported in Sheehan and Hopkins. Some information was also added to the file from World Bank sources (1980, 1982) and from United Nations national accounts statistics.

The negative relationship between equality of income distribution and population growth, reported by other authors, was also found in these data: using different measures and different time periods, the simple correlation varied from –.24 to –.44.

The next stage was to build a model in which both population growth and inequality were endogenous. The dynamics of population growth and inequality are clearly inter-related with the overall process of economic growth; it was inferred that the growth of aggregate output should also be endogenous in such a model. The first key issue, then, was to specify the interactions over time between inequality, output growth and population growth. Current levels of inequality are likely to be partly the consequence of past population growth and past income growth; in both cases the usual expectation is that a higher rate of growth will generate a more unequal distribution of income. The reasons why this might be so in the case of

population growth have been outlined in the introductory section above; in the case of income, rapid growth might increase the possibilities for small groups to make spectacular gains (the "Brazilian" model), but it could also provide greater possibilities for redistribution. It has been argued that this depends on the distribution of physical and human capital prior to the period of rapid growth (Adelman). The lags in these relationships arise because the effects of growth cumulate, concentrating the population in particular age groups, or income in particular classes. The ideal way to incorporate these features in a model is with a distributed lag function, but our data would not support this; we assumed that current inequality was affected by the previous decade's growth of income and of population. Thus

$$D(t) = f_1[GP(t\text{-}1,t),\ GX(t\text{-}1,t)] \qquad (1)$$

where D = income inequality, GP = population growth rate, GX = output or income per capita growth rate, and t = time (in decades).

The measure of inequality used was the income share of the poorest 40 per cent; this appeared best adapted to a broad focus on poverty.

Population growth seems more likely to be affected by income *levels* than by income *growth*. The components of population growth, i.e. fertility, mortality and migration, are all commonly thought to be associated with income levels (cf. Simon and the practitioners of "household economics"), though for fertility at least the sign of the relationship is ambiguous. We also postulated a relationship with income distribution, either current or with fairly short lags; there are several reasons why this might be present, either because of non-linearities in the relationship with income, or because of more structural factors (for a review of these issues, see Kocher; also Farooq and Simmons). The general expectation is that greater equality is associated with both lower mortality and lower fertility, so that the effect on population growth is ambiguous. We modelled the time pattern by assuming that population growth during a given period depends on income levels and income distribution at the start of the period. This gave:

$$GP(t+1,t) = f_2[X(t),\ D(t)] \qquad (2)$$

where GP = population growth rate, X = output or income per capita, and D = income inequality.

Income growth, during a given period, may be associated with inequality at the start of the period for many reasons, e.g. because inequality may affect the pattern and growth of demand. It may also be (negatively) associated with income levels at the start of the period, if the diffusion of existing technology facilitates output growth at low incomes. The link with population growth involves both current and lagged components. Current population growth, consisting essentially of children, will increase the number of consumers and thus reduce income per capita directly (although there may be offsetting effects, e.g. through changes in the work of adults). Past population growth, however, will be associated with increases in the current labour force, and thus with higher output growth. There may also be adaptive

Estimated relationships (*t*-statistics in parentheses)

Independent variables	Dependent variables		
	% of income received by bottom 40%, around 1970	Population growth, 1970-77 (% p.a.)	Growth in GNP/capita, 1970-77 (% p.a.)
Log GNP/capita, 1970 ($)	–20.7 (5.43)	2.44 (2.43)	–
Log GNP/capita squared, 1970 ($)	1.49 (4.92)	–0.193 (2.51)	–
GNP/capita, 1970 ($)	–	–	–0.000125 (2.62)
% of income to bottom 40%, 1970	–	–0.048 (1.67)	0.00125 (0.02)
Growth in GNP/ capita, 1960-70	0.539 (2.97)	–	–
Population growth 1970-77 (% p.a.)	–	–	–0.850 (1.91)
Population growth 1960-70 (% p.a.)	–0.790 (1.35)	–	–
Population growth 1950-60 (% p.a.)	–	–	0.716 (1.84)
Literacy, 1970 (%)	0.059 (3.19)	–0.011 (2.19)	0.0119 (0.86)
% of workers in agriculture, 1970	–	0.018 (2.52)	–
"Socialist", 1970 (E. Europe)	7.81 (4.95)	–0.722 (1.68)	–
Military expenditure as % of GNP, 1970	–	–	0.281 (3.13)
Log investment as % of GNP	–	–	4.01 (4.94)
Intercept	78.6 (7.06)	–4.71 (1.41)	–10.5 (3.97)
R^2	0.62	0.72	0.53
N	72	67	63

technological changes which affect ouput growth, if growing population pressure induces shifts in agricultural technology (Boserup) or generates economies of scale, in both cases with fairly long lags. These relations were expressed by the following equation:

$$GX(t+1,t) = f_3[X(t), D(t), GP(t+1,t), GP(t,t\text{-}1), GP(t\text{-}1,t\text{-}2), \ldots] \quad (3)$$

where GX = output or income per capita growth rate, X = output or income per capita, D = income inequality, and GP = population growth rate.

These three equations formed the core of the model. Each equation was then extended to encompass a number of important, additional explanatory variables which we do not discuss in detail here. The complete functions used in the model, with the estimated coefficients, are reported in the accompany-

ing table. It can be seen that the level of explanation of these functions is fairly high (R^2 = 0.53 to 0.72). Interactions between population growth and income distribution, however, are not strong. Even using one-tail tests the effect of population growth on inequality is significant only at the 10 per cent level, the effect of inequality on population growth at the 5 per cent level. Both population growth and inequality, however, are strongly related to the level and, in the case of inequality, the growth of income, with the latter relationship contradicting those who see high growth as leading to greater inequality. In the function for GNP growth, no independent effect of inequality can be discerned, but the effect of population growth, and its pattern over time, are as expected.

Several of the independent variables of these functions were also incorporated endogenously in the model; these included investment, literacy, the proportion of workers in agriculture, and the fraction of the population under 15 years old. For a detailed discussion of the logic and estimation of all these functions, see Rodgers (1983). However, some general comments about results of the type reported in the table are in order. Firstly, the data base is of uneven quality and often not strictly comparable across countries. Secondly, statistical problems, notably multicollinearity, make the models very vulnerable to changes in specification. Thirdly, the variables for which data are available are limited in number, and often not those which are theoretically most desirable. But certain conclusions, albeit modest, may be drawn from these results. To assess the overall picture which these equations provide, they were built into a consistent model and the evolution of key variables was simulated over time. The model was run for ten-year intervals from 1970-2050.

It was necessary to select a starting-point for 1970; we have taken as an example a country with GNP per adult equivalent[3] around $120 in 1970 and literacy at just over 20 per cent; GNP is growing initially at just under 5 per cent a year. These figures would broadly correspond to a relatively poor Asian country, or to a middle-income African country, in 1970.

Three different simulations are reported in plots 1 to 4: first, a "reference" simulation, which represents an "average" development pattern; second, a "population" simulation, in which the annual population growth rate is reduced by 1 percentage point; and third, an "equality" simulation, in which the share in income of the bottom 40 per cent of households is raised by 5 percentage points. These are substantial changes, implying major shifts in policy or in behaviour.

Each plot reports the evolution of one variable over time under the three different model assumptions. Plot 1 reports GNP per adult equivalent, an approximate indicator of mean income, on a log scale (equal distances between points on this scale imply equal percentages, not absolute differences). The first, most obvious comment is that the outcomes are suprisingly insensitive to the quite substantial experimental changes involved; in 2050, after 80 years, the highest simulation (population) is only 21 per cent ahead

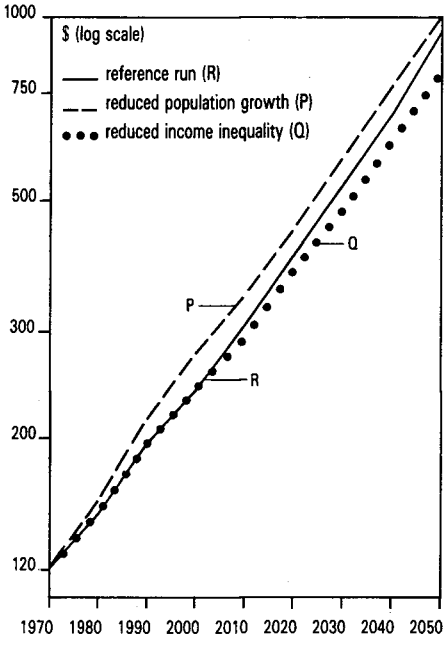
of the lowest (equality). The pattern over time is also contrary to conventional expectations. Where population growth is reduced, significant income gains are built up at first (compared with the reference run), peaking at a 16 per cent gain in 1990; but thereafter the gain is steadily whittled away, and by the end of the simulation period it is down to 7 per cent. This is quite contrary to the conventional view of gains from reduced population growth, which are thought to build up slowly but eventually to become substantial. Our result is due to the longer-term positive feedbacks from population growth to GDP growth, and (to a lesser extent) changes in investment and literacy. The simulation with reduced inequality differs little from the reference for the first 40 years. Thereafter, it starts to fall behind the reference run. This relative decline can be largely traced to a negative effect of the income share of the poor on investment (which, however, was statistically weak, and so should be interpreted with caution).

Plot 2 gives the percentage share in income received by the poorest 40 per cent of households. In all three runs there is a decline in the share, concentrated in the period 1980 to 2030, after which date the bottom of the Kuznets U-curve seems to be reached. The relatively more equal results with the reduced inequality run merely reflect the 5 per cent experimental change, but the pattern with the population run is interesting. At first, reducing population growth reduces inequality (raises the share of the poorest 40 per cent), because of the direct effect of population growth in the inequality function. But the longer-term indirect relationships have the opposite effect, operating through the effects on GNP per capita (plot 1) and literacy. Eventually the population run stabilises with the income share of the poorest 40 per cent about half a percentage point below the reference run–not much, but opposite in sign to the expectations of those who see high population growth as a major cause of inequality.

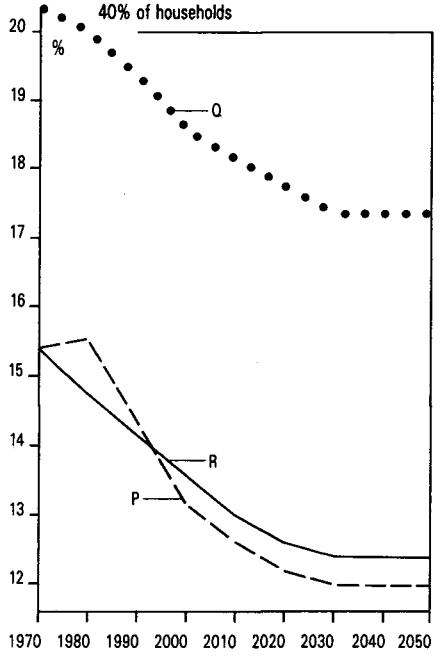
If plot 2 suggests that reducing population growth is unlikely to reduce inequality, plot 3 gives some indication that reducing inequality may reduce population growth. In all three runs shown in plot 3, population growth declines–quite sharply after the year 2000. The reduction in inequality generates a decline in population growth of about 0.2 percentage point, relative to the reference run.

Plot 4 combines the information from plots 1 and 2 to give an indicator of incomes among the poor. Despite worsening income distribution, the incomes of the poor rise steadily in all three runs. The impact of reduced population growth parallels that found in plot 1, but is somewhat more extreme; the maximum gain due to reduced population growth is about 18 per cent in 1990, but drops away more rapidly than in plot 1, and is down to 3 per cent at the end of the simulation. The run where inequality is reduced generates gains for the poor throughout the simulation period, peaking at 36 per cent in 1990, then declining to 23 per cent in 2050. Thus in plot 4 the reduced inequality run does consistently and substantially better than the reduced population growth run.

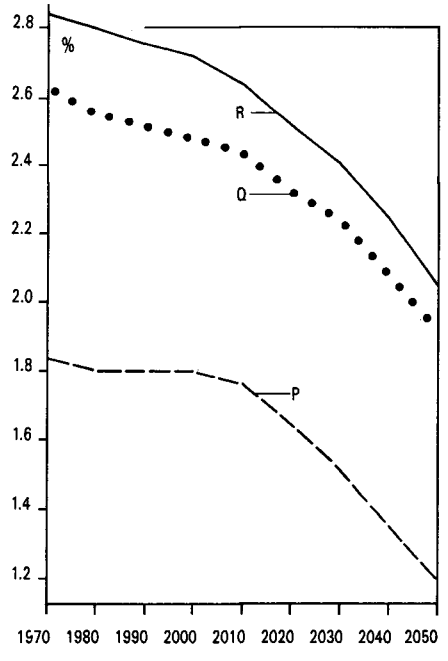
Plot 1. GNP per adult equivalent



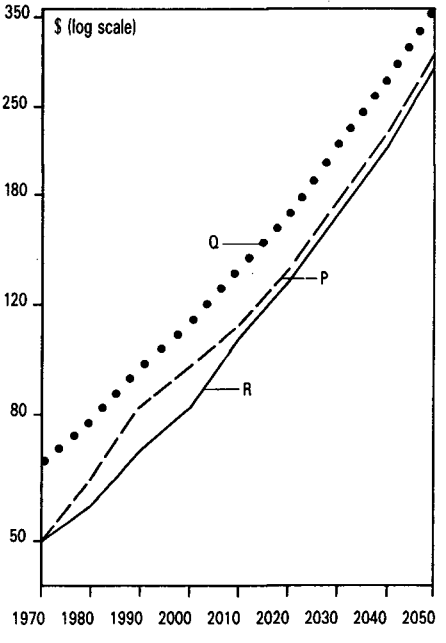
Plot 2. Percentage of income received by poorest 40% of households



Plot 3. Population growth (% per annum)



Plot 4. Income per adult equivalent among poorest 40% of households



These results suggest that, contrary to expectations, reducing population growth does not seem to generate long-term benefits for the poor in this model, though some short-term gains are found. Increasing equality does appear to generate some decline in population growth, as well as persistent gains in incomes among the poor, but the reductions in population growth look small when set against the substantial reduction in inequality assumed.

To sum up, the specification of this model, and especially the data base on which it is estimated, can no doubt be improved upon. But the expectation that population growth will increase inequality and poverty is so dominant in the literature that one would expect this result nevertheless to come through strongly; after all, many of the other results conform to expectations. The fact that this one does not gives cause to ponder.

III. Some conceptual problems

Before pursuing the empirical issues further, it will be helpful to address some conceptual and methodological questions which we have side-stepped so far. The central problem is that inequality and poverty are not the simple variables which the previous section assumes; they are complex both conceptually and empirically. Three major sets of issues are particularly relevant: (i) the nature of the unit of analysis, (ii) the reference period, and (iii) the conceptualisation and measurement of welfare in relation to inequality and demographic change.

(i) The majority of official statistics on income, consumption and related measures use the household as the unit of analysis, although definitions vary considerably. Much analysis of fertility also uses models of "household" decision-making. But the number, size and composition of households are systematically associated both with income and with fertility (Kuznets, 1976). Schultz, for instance, decomposes household income per capita in Colombia by the numbers of adults and children. He identifies a positive relation between the number of adults and household income per capita, and a negative relation between the number of children and household income per capita. Households where fertility is high will thus in general report lower incomes per capita, so that the distribution of fertility across the population is directly reflected in income inequality per capita. Note that Schultz uses *per capita* household income. Most official statistics, however, use *per household* incomes, especially for income distribution purposes, and this is what was used in the international cross-section analysis. Larger households tend to report higher total incomes, so again the measured distribution of (household) income will reflect demographic structure. How this affects the relationships between population growth and inequality will depend on how fertility and mortality changes are distributed across the population, and also on the time lags between

changes in population growth and changes in age composition. But there will in general be an effect.

(ii) A second issue, in some ways related to the first, concerns the period over which income is measured. The shorter the period, in general, the more unequal the measured distribution of income. The distribution of income over a period of years, or over a lifetime, will usually be less unequal than the distribution of, say, last year's income. So a part of measured inequality can be traced to income changes over the life cycle, because in many (but not all) occupations, there is a rise in income with age and experience. Population growth affects this aspect of inequality because it affects the age distribution of populations; a rapidly growing population will have a larger fraction of its members concentrated in the younger, lower-paid age groups. Schultz shows that age composition alone can account for a substantial fraction of measured inequality, although he finds that age is distinctly less important for inequality in Colombia than in the United States or the Netherlands. Paglin and Wada show that such factors contribute significantly to explaining changes over time in measured inequality in the United States and Japan, respectively.

Another, often overlooked, point about the time horizon is that in most societies average incomes are rising; thus future generations can expect to have higher incomes, on average, than the present generation. If a reduction in population growth eventually increases income (not an obvious outcome, as we have seen above), it may increase intergenerational inequality. Whether this point is important will depend on whether there are significant costs to be borne by current generations--but the issue cannot be ignored, given the long-term nature of demographic processes.

(iii) This concern with poverty and inequality implies a concern with welfare, not just with income. This has several consequences. One is that we need to widen the definition of income to encompass measures of "non-market income", including measures of access to education, health and other public goods. Growing populations put exceptionally heavy demands on educational and some parts of health infrastructure, and it is quite possible that inequality in access to these services rises as a result. There may in particular be differential access to goods and services by birth order, with a family's younger children being relatively disadvantaged.

Secondly, we have to consider the direct implication for welfare of mortality decline; Kuznets (1977) brings this out clearly. A fall in mortality without a corresponding fall in fertility *reduces* per capita income if nothing else changes, although it is unambiguously an *increase* in welfare. How this affects measured inequality depends on the distribution of mortality declines. If mortality declines are concentrated in the lower-income ranges, they will increase per capita income inequality while reducing welfare inequality.

A third, and equally fundamental, consideration is the value to parents of children themselves (Blandy). Measured welfare should somehow take this into account; wanted children therefore enter into the numerator of the measure of welfare, as well as into the denominator. "Unwanted" children, if somehow their numbers could be measured, might plausibly be regarded as only belonging in the denominator. On the other hand, it is not obvious that high fertility is in the interests of the children themselves, at least beyond a certain, difficult to identify, family size. The complications for analysis of inequality in the face of changing mortality and fertility are apparent.

The main conclusion to draw from these conceptual and methodological issues is that the problem is distinctly more complex than might appear at first sight. Indeed, many of the more important points–e.g. the last one–are not amenable to empirical treatment. In interpreting empirical findings, it is necessary to be aware of these different aspects of inequality and the correspondingly varied links with demographic change.

IV. Back to the drawing-board?

If international comparisons give us largely negative results, and if we wish to face up to the methodological issues outlined above, then we must return to the structures and processes at work within countries to see whether they permit us to advance further. The issues raised by the effects of inequality on population growth are quite distinct from those of population growth on the generation of inequality, and we separate them below.

A. The effects of inequality on population growth

There is a rapidly growing literature on this topic. We may note, with Repetto (1982), that most researchers who have looked for non-linearities in the effects of income on fertility have found them; whence it follows that the pattern of inequality will also affect fertility and hence population growth.[4] Indeed, many of the variables commonly found to be related to fertility at the micro-level–education, female labour force participation, land ownership, child work, and so on–are closely bound up with patterns of social inequality, so that in consequence the pattern of inequality indisputably affects fertility. But apart from the societal patterns which result from the aggregation of micro-level relationships, is there any reason to suppose that inequality *per se* affects fertility and thus population growth? Evidence on this is hard to come by, although there must be some expectation that the answer will be yes. The distribution of access to jobs and to productive assets will presumably modify perceptions of the benefits of high fertility. Exactly how will depend on the fertility model appropriate to a given social environment. In some circumstances those with more assets, and easier job access for their children, will tend to have higher fertility–this is a plausible model if fertility behaviour depends on the need for and use of family labour, and one widely reported in

the literature; see for example Djurfeldt and Lindberg. In such cases a more equal distribution of assets and job access may well raise fertility. In contrast, high fertility may be a response to the insecurity of families in an economic system where job access is uncertain. A large number of sons may be needed to ensure that one or more will obtain some source of income, or will survive to provide some insurance against catastrophe. Where this model is valid, more equal access to jobs and assets may be expected to lower fertility. But more empirical work is required on these issues.

B. The effects of population growth on inequality and poverty

Although some writers give the impression that the reduction of population growth is a major objective in itself, the final objective must clearly be couched in terms of personal and social welfare. It is therefore ultimately more interesting to assess the effects of population growth on inequality and poverty, rather than the reverse. At the same time, it is considerably more difficult.

The analytical and empirical problems faced can be well illustrated by reference to Penny and Singarimbun, who examined relations between population and poverty in Java. These authors are convinced that the growth of population is the key constraint on poverty alleviation in Java; landholdings are small, employment is inadequate, output is insufficient, in some cases incomes have fallen. The authors assert that population growth is responsible; but there is no empirical evidence for this other than the coexistence of population growth and acute problems of poverty. At the same time, we learn from their data that the technological possibilities in agriculture are far from exhausted, and that labour intensities are much higher than average on the smallest plots, so that there appears to be scope for further intensification; that compared with another study carried out 40 years before, land productivity is over twice as high and rice production per head appears to be rather similar to the district average 40 years before, despite population growth; and that peasants refuse opportunities to migrate to new areas where incomes are said to be several times higher.

Another author who studied population growth in Java, Geertz, developed a more thoughtful model of involution, a historical process of absorption of population increase into traditional production systems by steady increase of intensification without reducing per worker output. For Geertz, the system is "treading water" as population increases. As long as such a process continues, the impact of population increase on inequality is likely to be marginal; incomes remain low, but static. Geertz thought that the limits of involution in Java were being approached, and that rural production relations would increasingly be based on wage labour, unless rapid industrialisation could absorb the growth in the labour force. In either case the pressure of population might eventually facilitate the evolution of more

polarised, capitalist production relations in the place of a decreasingly viable peasantry. But the empirical support for this last point is weak. Observers of Java have been forecasting for 50 years or more that the agricultural system cannot absorb more population growth–and yet it still has not broken down.

Penny and Singarimbun, and Geertz obviously operate with quite different theoretical frameworks, and these condition their interpretation of the effects of population growth. This point is worth developing: the impact of population growth on inequality is surely mainly indirect, making itself felt through the pattern of social relationships responsible for inequality.

In hunting and gathering communities, or in egalitarian peasant societies, the impact of population growth operates primarily through production for subsistence within a family unit. The evolution of such societies in the face of population growth, whether by increasing their output through technological change, by out-migration of excess labour, or by involution, is built around the maintenance of the subsistence level. Subsistence may also be the key to understanding exploitative feudal or capitalist systems. In the classical Ricardian model production levels are determined by the equality of marginal product with the subsistence wage, this in turn determining profits and rent because of diminishing returns to land. Wages are maintained at subsistence level by demographic forces. A basic Marxist model of capitalist development uses similar notions, except that in this view a relative surplus population which provides the "reserve army" is actively promoted by employers, whether by labour-saving innovation or by promoting the growth of the wage labour force.

Population growth is relatively unimportant in such models; paradoxically, at the same time it is crucial as a source of surplus labour. But the degree of inequality is a property of the social relations of production, and population increase is a mechanism whereby these social relations are maintained, rather than their fundamental cause. This is the basis for much of the Marxist critique of conventional demography; "overpopulation is not a matter of too many people, but of unequal distribution of resources" (Michaelson, 1981).

A subsistence model, by treating wages as exogenous, predetermines a major aspect of inequality. Neo-classical models, by contrast, incorporate wage levels and factor shares into a simultaneous determination of all major economic variables. Income distribution thus becomes a consequence of demands for outputs and supplies of inputs, and of the technological characteristics of production processes. It is models of this sort which most clearly predict adverse effects of population growth on equality, for several reasons: the labour force grows relative to the stock of capital and land, and is therefore remunerated less, especially if the elasticity of substitution is low; there is a substitution of children for other forms of investment, leading to slower production growth, and relatively higher returns to capital; and there is a substitution of quantity (of children) for quality, which increases the

returns to quality and thus promotes wage differentials (for "quality" read "education" in most empirical applications).

The obvious deficiencies of neo-classical models lead many authors to build in institutional features such as fixed wage or price differentials (for example between "modern" and "traditional" sectors), constraints on behaviour, and other exogenous social institutions. The expected effects of population growth in such models are partly diluted versions of those in the pure neo-classical model; additional relationships with population growth depend on the precise institutions invoked. In the case of dualistic labour market models, for instance, population growth might drive down wages in the informal sector while leaving modern-sector wages unchanged, thus increasing inequality; but if the wage differential is fixed, effects on inequality would arise only through changes in the overall wage share, via the usual neo-classical mechanisms.

A number of models of labour use, production and distribution do not rely primarily on the market. This is characteristic of segmentation and related models, in which the allocation of individuals to jobs, and of incomes to those jobs, is part of a process of social control and not a question of optimal resource allocation. In such models rigidity rather than fluidity is the rule. The labour market is segmented on the basis of sex, race, education, migrant status or other characteristics. The outcome is a hierarchised and differentiated employment structure, with considerable wage differentials across sectors and groups of workers. Different underlying models of production and distribution can lead to a labour market theory of this type. For some, labour market segmentation derives mainly from the inner logic of production technology; for others, it is a manifestation of a particular set of social relations of production (Carnoy et al.).

Population growth is of importance in these models mainly in so far as it facilitates control of the labour force. A rapid influx to labour markets of inexperienced and ill-trained youths, for instance, due to high rates of population growth, might facilitate the lowering of wage levels overall; or lower wages might be paid to this group, using age as a basis for segmentation. In the latter case higher population growth will be associated with greater wage inequality, in the former case with lower remuneration for labour relative to other factors. On the other hand, declining fertility might lead to a rapid growth in an unorganised and relatively exploitable female labour force. But, as in the case of the subsistence models, population growth is a secondary, facilitating phenomenon; the basic pattern of inequality is shaped by economic forces.

A key element in all these models is the relative rates of growth of different sections of the population. The usual expectation is that the group which grows fastest is likely to be disadvantaged; if this group is relatively poor, inequality will increase. In practice, however, neither estimated fertility nor mortality relationships entirely support this position. It is true that white-collar and other upper classes tend generally to have low fertility; but the

assetless are also often found to have lower than average fertility (e.g. in Indonesia–Penny and Singarimbun; in Kenya–Anker and Knowles; in India–Djurfeldt and Lindberg; and elsewhere), and a positive relation between land-holding and fertility is often reported. In addition, mortality tends to be higher among the poor, so that population growth may be distinctly lower than average among the poorest groups. In such a situation population growth may be concentrated among groups who own sufficient land to ensure that subdivision of their holdings is not in itself a primary cause of landlessness (although landlessness may at the same time be increasing for other reasons). The effects of differential population growth on inequality are then far from obvious.

Starting from one or other of the models outlined above it is possible to develop general propositions about the impact of population growth on inequality in specific economic and cultural settings. But empirical analysis of such relationships is, as we have seen, difficult, and debate tends to centre on the merits of the assumptions of the model rather than on directly testing its predictions. Perhaps as a result, there does not seem to be much empirical support, other than from international cross-section analysis, for the position that higher population growth leads to greater inequality; and our international cross-section results do not support this view in the long term. Clearly there are reasons for expecting such relationships to be present in certain situations. In particular, some of the conceptual and methodological issues raised in section III identify aspects of inequality which are directly related to demographic change, and which should if possible be separated out for analytical purposes. Age distribution, the distribution of access to population-related public services, the satisfaction to parents from child-bearing, unequal risks of mortality, and the other factors there discussed will often be relevant for analysis of interactions between population growth and inequality. But apart from these specific topics, interesting though they may be, there does not emerge from the literature, national or international, a convincing demonstration that the effects of population growth on inequality are *important*. Future research in this area will perhaps be most productive if it concentrates not on direct relationships between population growth and inequality, but on the multiple roles of population growth in the transformation of systems of production. It is surely these transformations which are the key to understanding changes in inequality. These changes can then be traced in part, and indirectly, to population growth. Whether these links are strong, and whether they are positive or negative, are questions that can only be answered in specific economic, social and historical contexts.

Notes

[1] For a statement of this view, see for example World Bank (1974), p. 35.

[2] Full results will be published in another paper; in the meantime, details are available in working paper form (Rodgers, 1983).

[3] "Adult equivalents" are estimated as adults + 0.5 (children).

[4] A similar comment may be made about mortality.

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