Poverty and the Demographic Transition

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Introduction

The "demographic transition", the secular decline in mortality followed more or less rapidly by a decline in fertility, has two main demographic effects. The first is an acceleration in the population growth rate due mainly to higher infant survival rates followed by a deceleration in population growth as fertility adjusts to the higher survival. The second effect is the changing age structure. The acceleration in the population growth makes the population younger with larger new cohorts. When population growth tapers off, new cohorts become smaller, causing a bulge of large population cohorts to move up through the age distribution.

Of all the regions of the world, the demographic transition has been the fastest and most dramatic in Asia. Mortality declined much more rapidly after World War Two throughout Asia than it had earlier in Western Europe. The fertility decline in East Asia, once it got under way, was also among the fastest ever seen (Kelley, 1988).

The consequences of the accelerating population growth rates in the first phase of the demographic transition have been the cause of great alarm to many demographers and others. Many believed that population growth would outstrip the available resources, both renewable and non-renewable, as Thomas Malthus (1798) had feared. Population would then be a drag on economic growth, trapping the developing world in poverty.

As evidence on the relationship of population growth and economic development has accumulated in recent decades, the fears about the effects of rapid population growth on economic development have dissipated. Clear evidence that population growth is drag on economic growth in the post-World War Two period has been hard to find. This "revisionist" reinterpretation of the evidence was expressed most influentially in the 1986 National Academy of Sciences study (NRC 1986, Johnson and Lee, 1987).

In response to the ambiguous evidence of the effects of population growth on economic growth, researcher's and advocate's attention has shifted to the potential effects of population growth on poverty, the environment, and maternal and child health. The main obstacle to studying the effect of population growth on the poor in developing countries has been the lack of cross-country poverty data (and the lack of long panel datasets in developing countries). The experience of poor countries is addressed by the huge literature about the effects of population growth on economic growth. But whether these results reflect the experience of the poor *within* countries cannot be ascertained without comparable cross-country data on income distribution over time.

The empirical literature on the effects of population growth and age structure on the poor is very limited. Much of the writing on population growth and poverty is made up of hypotheses rather than empirical examinations. Statements are often couched in terms of generally accepted beliefs: "it is largely unquestioned that, the more rapid the growth of population in developing countries, the higher the cost and the longer the time required to eliminate poverty."[1] Or "[t]here is widespread belief that population growth worsens the distribution of income."[2]

Most of the assertions about the differential effect of population growth on the poor follow from the association between poverty and large families. Children in large families are often disadvantaged. Controlling for income and other variables, children in large families are usually found to receive less education, have lower birthweight and worse nutrition than children in small families, but the magnitude of these effects is small.[3]

The theoretical links between population growth and the poor is better grounded than the empirical discussion. In recent times, family size is usually within the conscious choice of parents. People tend to have as many children as they say they want (Pritchett, 1994). Why then would couples have large families if it made them or their children poor? If asset and insurance markets are missing, families have a motive to have children for old age support. If labor markets are missing or distorted, families may have children to provide needed labor on the farm. The family is better off with more children in these cases, but there may not be enough money to send the children to school, and they may be too busy working in the fields to attend school anyway. With low education, the next generation is likely to remain poor.

Population growth may cause poverty for a second reason even though couples have the number of children they want. If having children imposes externalities on other members of society, especially the poor, then population growth could exacerbate poverty. The externalities may be true externalities like lost shares of common property resources or environmental degradation, or they may be pecuniary externalities which impose a cost on some people but benefit others. Population growth is likely to cause an increase in labor supply a generation later, and the wages of the poor may be most susceptible to being driven down.

The first task of this paper will be to look at the cross-country effects of population growth and age distributions on the growth of incomes of the poor using new income distribution data. Aggregate studies are essential for looking at economy-wide effects that take into account externalities.

Survey data is essential for studying the consequences of the demographic transition on the poor from the vantage point of the household and the individual. In the second part of the paper, I will use household survey data from one East Asian country, Taiwan, to address two questions. The first question is whether there is a clear relationship between poverty and large family size. The second question is whether poor are more adversely affected by increases in labor supply.

[1] Birdsall and Griffin (1988, p.50).
[2] Ahlburg (1994, p.137).
[3] Ahlburg (1994).

Does population growth or child dependency reduce the income growth of the poor?

The availability of new income distribution data makes it possible to measure the income growth of different segments of society. Here, I focus on the income growth of the poorest quintile, the poorest 20% of the population. The growth of the average income of the poor, g_p, can be decomposed into the growth of the average income, *g*, plus the growth in the share of income going to the poor, g_δ.[4] That is,

$$g_p \equiv g + g_\delta \qquad (1)$$

This provides a natural framework to look for causes of the income growth of the poor. The recent effort that has gone into estimating the factors responsible for cross-country variations in average growth rates (*g*) provides a specification and a set of correlates of this component of income growth of the poor. The other component, g_δ, the growth of the share of income going to the poor, measures the change in (part of) the income distribution. Income distribution is much less studied than economic growth, empirically and theoretically, but it is not difficult to find a plausible set of correlates for changes in the poor's income share. Indeed, most of the candidates for correlates of overall growth are likely to affect income distribution, and vice versa.

If the same set of factors, *X*, potentially affect both *g* and g_δ in a linear way, then (1) can be written as a system of three equations with cross-equation restrictions:

$$\begin{aligned} g_p &= X\beta_1 + \varepsilon_1 \\ g &= X\beta_2 + \varepsilon_2 \\ g_\delta &= X\beta_3 + \varepsilon_3 \end{aligned} \qquad (2)$$

where $\beta_1 = \beta_2 + \beta_3$.

It would appear at first that (2) would be best estimated by seemingly unrelated regression (SUR) with cross-equation constraints. However, since the regressors are the same in each equation, SUR estimates are identical to ordinary least squares (OLS) estimates. In addition, the constraints are implicitly met by OLS estimates of each equation separately.[5] Note that the test that $\beta_3 = 0$ is also the test of $\beta_1 = \beta_2$, that is, if a variable has a significant effect on the growth of the income share of the poor, this variable has a statistically different impact on the growth of the income of the poor than it has on average income growth.

The covariates, *X*, of growth in income per person, *g*, are taken from the empirical growth literature using the error correction model of Barro (1991). Barro's framework can be derived from the Solow (1956) growth model, where growth depends on factors that influence the long-run growth of the economy as well as factors which affect the short-

[4] See Gallup, Radelet, and Warner (1998) for a derivation.

[5] The OLS estimates of $\beta_1, \beta_2, \text{and}\, \beta_3$ are $b_1 = (X'X)^{-1}X'g_p$, $b_2 = (X'X)^{-1}X'g$, and $b_3 = (X'X)^{-1}X'g_\delta$, respectively, and $b_1 - b_2 - b_3 = (X'X)^{-1}X'(g_p - g - g_\delta) = 0$ by (1).

run transition to long-run growth. Long-run growth is affected by variables like geography and policy. The most important transitional variable is initial income which captures how far the economy is from its long-run equilibrium path. Other variables like population growth and initial human capital affect growth off the equilibrium path in a Solow-type model.

Economic theory provides little guidance in the specification of growth of the share of the poor's income, g_δ, since the modeling of income distribution is poorly developed. However, most of the factors that affect overall growth could plausibly affect the share of the income going to the poor. For instance, some would hypothesize that trade openness may be good for economic growth, but bad for the poor. Besides factors affecting overall growth, initial income distribution may affect the growth in the share of income of the poor. Countries where the poor already receive a higher share of income may be more or less likely to see an improvement in the poor's share. Initial income distribution has likewise been recently linked to overall growth (Alesina and Rodrik, 1994, and Persson and Tabelini, 1994), so it is also included as a regressor for *g*.

The data

The income growth of the poor is derived from two data sources. Purchasing power parity GDP per capita from the Penn World Tables 5.6 (Summers and Heston, 1991) provides average income levels by country from the 1950s to the early 1990s. Deininger and Squire (1996) provide data on the share of income earned by the poorest 20% of the population for countries and years for which household surveys are available. Deininger and Squire select "high quality" survey data that has national coverage and measures total household income or expenditure (instead of just wages, for instance). This study selects the 51 countries with quintile data spanning at least ten years in the period from 1965 to 1992. The mean span is 19 years with a standard deviation of 5. For countries with only two observations, the growth rate of income of the poor is calculated from the two endpoints. For the countries with more than two observations over the 1965-92 period, the growth rate is calculated from the least squares trend to reduce the impact of any measurement error in the quintile shares on the growth rate.

Initial GDP per capita from the Penn World Tables and initial income share of the poorest quintile are among the correlates of income growth of the poor. Population growth, density, and dependency ratios are from the United Nations (1994). The dependency ratio is the number of people under age 15 or 65 and over divided by the working age population aged 15 to 64. Openness to international trade is measured by Sachs and Warner's (1995) index, which classifies a country as open if (i) import duties average less than 40%, (ii) less than 40% of imports are covered by quotas, (iii) the black market exchange rate premium is under 20%, and (iv) export taxes are moderate. The openness variable is the fraction of years that a country was classified as open. Government savings is the difference between central government current revenues and current expenditures divided by GDP and averaged over the period of growth from the World Bank (1994). Political instability is equal to one half the number of assinations per million population plus one half the number of revolutions per year averaged over the period 1960 to 1984, all rescaled to range from 0 to 5, from Barro and Lee (1994). Tropical area is the percent of each country's land area in the geographical tropics from Gallup, Sachs, and Mellinger (forthcoming). Year of secondary schooling in the initial year and total years of female schooling are from Barro and Lee (1993). Missing data on the correlates of growth for some of the 51 countries with income data reduces the sample size to 44.

Table 1 presents the OLS regressions of income growth of the poor, g_p, overall income per capita growth, g, and growth of the income share of the poor, g_δ. Population has a significant negative correlation with the income growth of the poor and an insignificant correlation with overall growth. This suggests that population may be bad for the poor, worse than it is for the average person, but the simple OLS regressions do not account for the likely endogeneity of population growth. The negative correlation between population and income growth may be due to rising income levels causing a reduction in fertility. The issue of causation is addressed below.

The regressions in Table 1 include the initial dependency ratio to capture the effects of age structure. Since production in the economy depends (largely) on the labor of working age adults, a high dependency ratio reduces the productive labor per person and also may increase the share of resources devoted to consumption reducing savings and investment. Both these effects will reduce the growth rate of income per capita. The dependency rate may impact the incomes of the poor more than the rest of the population if dependent consumption is a larger share of family income for the poor. The poor may also have less recourse to savings and credit markets to smooth consumption over the life cycle (the poor household may behave more like the self-sufficient households of Chayanov, 1966).

Despite these hypotheses, the dependency ratio has no significant relationship in Table 1 with income growth of the poor or overall income growth.

The other regressors in Table 1 are common across the subsequent tables as are, for the most part, their size and statistical significance, so I will discuss their role as control variables just once. The log of initial income shows the traditional "conditional convergency" result (Barro and Sala-i-Martin, 1995) that, other things being equal, poorer countries grow faster. This effect holds for the growth of the income of the poor as well as overall growth, and, perhaps surprisingly, it is stronger for the poor than for the rest of the population. That is, the poorer the country, the more likely the income distribution to the poor will improve.

Another surprising result is that the lower the initial income share of the poor, the higher the growth rate of the poor's income, so unequal countries tend to see an improvement in the income distribution to the poor. Some of this effect may be due to errors in measurement of the poor's income share, since errors will induce a negative correlation between the initial income share and growth of the income share. The relationship remains strong, though, when controls are made for measurement error (see Gallup, Radelet, and Warner).

Policy has dramatic and similar impacts on overall growth and income growth of the poor. Countries open to international trade and with high government savings have higher growth for the poor and for the rest of the population. Political instability is estimated to be four times worse for income growth of the poor than for overall growth. Being in the tropics is a disadvantage for growth (though not quite significant at the 5% level in Table 1) that is estimated to be worse for the poor, though not significantly so. Finally, it is difficult to find a significant correlation between initial education and economic growth of the whole population and of the poor (this is explored more thoroughly in Pritchett, 1996). The percentage of variance explained (R^2=0.75) in the income growth equations is quite high.

Interpretation of the negative correlation between population growth and income growth of the poor is difficult because the economic growth of the poor may be *causing* a reduction in population. It is not clear which of the variables is responsible for causing the change in the other. Instrumental variables estimation can address this problem if a convincing set of instruments can be found. Two variables provide good instruments for population growth. Population growth from 1950 to the start of the growth period (usually 1965) and average female years of education in 1960 are both correlated with population growth during the period of interest, but are not likely to be correlated with the unobserved components of economic growth in the latter period. The first stage regression for the instrumental variables estimation is

$$\underset{(2.86)}{g_{pop} = 0.66} + \underset{(9.18)}{0.67 g_{pop(-1)}} - \underset{(4.05)}{0.11 femed_{(-1)}}; \quad \text{Adjusted } R^2 = 0.79$$

. If income growth as well as population growth was correlated over time, past population growth would not be a good instrument. Past population growth may be caused by past economic growth, and if past economic growth is correlated with current economic growth, past population growth would be correlated with the error in the current period which was the original problem with current population growth. However, economic growth is not correlated over time in most countries (Easterly, Kremer, Pritchett, and Summers, 1993, and Pritchett, 1998). Regressing income growth from 1950 to the start of the period under study on income growth during the approximately 1965-90 period studied shows no correlation:

$$g = \underset{(2.06)}{1.35} + \underset{(1.31)}{0.22 g_{(-1)}}; \quad \text{Adjusted } R^2 = 0.01$$

.

When population growth is instrumented by past population growth and past female education, the significant correlation between population growth and income growth of the poor disappears (Table 2). The cross-country regressions show no evidence that population growth is detrimental to the poor.

Population growth is most likely to be a problem for the poor where their livelihood depends on the natural resource base, especially agricultural land. If there is imperfect fertility limitation, capital and credit market imperfections or poorly defined property rights, the poor could follow an unsustainable path of high fertility leading to diminished resources per household and immiseration (Dasgupta, 1995). It is much less clear why the poor would suffer economically from population growth in, say, an urban setting with access to the coast and international trade. In a coastal city, population growth may lead to positive economies of agglomeration.

Geographical endowments have a major impact on economic growth and on the location of population concentrations (Gallup, Sachs, and Mellinger, 1998). The most geographically disadvantaged countries, which are isolated from the coast, in tropical climates, and in malarial regions, are among the poorest countries in the world. Most of them are excluded from the cross-country sample used here because they don't have income distribution data for the 1960s or early 1970s. A cruder measure of the richness of the agricultural resource base, initial population density, does have considerable variation within the sample. In Table 3, population growth is interacted with (the log of) initial population density. As before, population growth is instrumented with past population growth and female education. Population growth is negatively correlated with income growth of the poor and overall growth, but population growth becomes more positively associated with growth as land density rises, statistically significantly in the case of overall growth. Perhaps contrary to expectations, the least densely populated lands seems the most susceptible to deleterious impact of population growth on overall growth. This is really just a suggestion, though, because if we take one of the lowest values of log land density in the sample of about 6 for Zambia, the net impact of population growth in economic growth is not significantly less than zero neither for the poor nor for overall growth. Further investigation with a larger sample of countries including more geographically-challenged ones would seem fruitful, though it would be possible at this point to look for relationships with within-country poverty.

There is a hint that geography may mediate the impact of population growth on economic growth, but there is no indication that population growth effects the poor any differently than the rest of the population in Table 3. This does not provide evidence of a relationship between within-country poverty and population growth.

Finally, Table 4 shows the same regression as in Table 3, but for less developed countries along, in case the impact of population is different in poor countries. We are asking a lot of the data to identify the effects of 10 variables with only 24 observations on growth in developing countries. The regressions show remarkably similar estimated effects and statistical significance to the larger sample.

The results show that the effects of population growth on the poor can not be clearly distinguished from their effects the rest of the population in cross-country data. Moreover, that is, it is difficult to find any robust effect of population on the economic growth of the poor or everyone else. This is in sharp contrast to other included policy and geographic variables which do show a strong consistent correlation with economic growth of the poor and the general population even in these very small samples. These results do not disprove a more subtle effect of population growth on the poor that cannot be picked up in these simple regressions, but population does not appear to have the first order effects that other variables do, and many observers have feared. It is perhaps surprising that central government current budget deficits and political instability show up more clearly as a problem for the poor than high population growth.

For many of the potential links between the demographic transition and poverty, cross-country growth regressions are a blunt instrument. We now turn to more micro questions relating population growth and poverty survey data from one country, Taiwan.

Do the poor have more children in Taiwan?

One of the stylized "facts" of population growth and poverty is that the poor have more children. This suggests that if large families are a burden on households, they are more of a burden on poor households.

Household survey data generally show that family size decreases with household income (or expenditure) per capita. But this takes no account of the difference in the cost of meeting the needs of children and adults. It is usually less expensive to feed and cloth children than adults. If children require, say, half the income that an adult requires to be "rich", then comparing income per undifferentiated person in households with many children and households with no children will give a distorted picture of their relative wealth. If it is less expensive to provide the same standard of living for children as for adults, income per capita measures will make households with many children appear poorer than they really are. Some plausible "equivalence scale" between needs of children and adults should be used when comparing the family size of poor and richer families.

Public goods within the household is a second issue. If all goods in the household were public goods, then the appropriate measure of material welfare for the individual should be total household income. In general, when households are ranked by household income, the wealthiest households have the *least* children. If some, but not most, household goods are public (the consumption of these goods by some household members does not reduce the consumption of the goods by others), then some adjustment for economies of scale are needed.

The importance of different income concepts can be explored using Taiwanese household sample survey data. The government's Family Income and Expenditure Survey (previously called the Survey of Personal Income for Taiwan) is a random stratified survey started in 1964, but individual household data are only available from 1976 onwards. The number of households surveyed has increased from 9,500 in 1976 to 15,000 since 1980, but the survey methodology seems to have been consistently applied over this period (Fei, Ranis, and Kuo, 1979).

When households are sorted into income quintiles based on household income per capita, the data shows the typical pattern of poor households having more children. The survey identifies the family relationships with respect to the household head, so children are counted if they are own children of the household head aged 15 or under, for household heads aged 30 to 50, in order to eliminate gross age composition effects. In 1976, households in the poorest quintile (according to income per capita) had 3.3 children by this method, while the non-poor households had on 2.1 children on average. The average number of children for all households declined from 2.3 in 1976 to 1.2 in 1996, but the ratio of number of children in poor households to number of children in non-poor households remained essentially constant, from 1.56 in 1976 to 1.58 in 1996 (see Table 5, column 1).

Income per adult is the appropriate measure of material well-being if children are assigned the lower bound adult-equivalency weight of zero: children cost nothing extra. T. Paul Schultz (1997) argues that income per adult is the appropriate measure of household resources prior to any fertility decisions. It treats couples with the same income as equally well off regardless of how many children they choose to have. Ranking households by income per adult automatically gives a higher income ranking for families with many children compared to ranking by income per capita because income per adult has a smaller denominator than income per capita for these families. Poor households ranked by income per adult now have much lower average number of children than the non-poor households. Poor households have only 57% of the children of non-poor households by this ranking (Table 5, column 2).

There are many practical and conceptual difficulties in obtaining the right adult equivalency weights. Clever methods have been developed to infer intra-household distribution (e.g. Deaton and Muellbauer, 1980), but they rest on shaky assumptions, and give inconsistent results across similar surveys. Elements of household member consumption can be measured directly, typically food consumption, but this measures only a part of consumption, and is not necessarily a good measure of needs. Due to these difficulties, I arbitrarily choose an adult equivalency value of one-half for all children 15 and under. Ranking households by income per adult equivalent in column 3 shows that the poor have somewhat more children than the non-poor, about 1.2 poor children for every 1 non-poor child. The adult equivalency weight for children that equates the average number of children of the poor and non-poor over this period is 0.35.
The final column of Table 5 adjusts for economies of scale within the household using the formula

$$y = \frac{Y}{N^{\alpha}}$$

where y is scale-adjusted income per capita, Y is total household income, N is the number of adult household members plus the adult-equivalency weights for children, and α is the scale parameter. A modest scale parameter of 0.9 slightly reduces the ratio of children of the poor to non-poor compared to the income per adult equivalent ranking. Taiwanese families are small enough by 1976 that adjusting for economies of scale within the household does not dramatically affect the income ranking.

The association of poverty and large family sizes has been an important reason for presuming that population growth is a cause and a consequence of poverty. These results show that the relationship between family size and poverty depends crucially on what measure of income is used to gauge poverty. Making quite reasonable adjustments for the lower material needs of children, and to a lesser degree, economies of scale in the household, weakens or entirely reverses the common finding that poor households have more children. Anand and Morduch (1996) likewise find that, in the context of much larger families in Bangladesh, allowing for an economy of scale parameter of 0.9 even without adult equivalency adjustments is sufficient to reverse the association of poverty and large families.

Are the wages of the poor affected by increasing numbers of workers in Taiwan?

David Lam (1987, pp.609-10) writes that "[t]he most standard argument for negative distributional consequences of higher population growth rates is the depressing effect of increased labor supply on wages...[W]e may in fact be more interested in relative wages directly than in potentially confusing income shares." In the case of Taiwan, have increases in the supply of workers depressed the wages of poor workers?

Fertility in Taiwan peaked in the mid-1950s (United Nations, 1994). The increase in population growth before then and the rapid decrease in population growth since have resulted in large cohorts moving into the labor market in the 1970s. Have these large cohorts depressed the wages of the poor, or the non-poor, over this period?

In order to avoid complex issues about the determinants of women's labor force participation, comparison of poor to non-poor wages only includes the wages of Taiwanese men from 1976 to 1996. Adult Taiwanese men in the household sample have a labor force participation of almost 100%. The effect of cohort size is conveniently estimated with the methodology of Welch (1979) using repeated cross-sectional surveys over time. For each experience cohort, cohort size in the labor market is approximated by the number of workers with that experience in the household survey. Average wages for the cohort are regressed on experience level, time trend, and sample cohort size to estimate the effect of cohort size on wages.

To distinguish the effect of cohort size on the wages of the poor versus the non-poor, one needs to separate wage-earners into groups according to their earnings. If current wages are used to identify the poor, though, the poor will include many young workers who are at the low initial stages of their age-earnings profile but will have much higher incomes when they get older. By construction, then, the poor will have large young cohorts while the wealthier groups will have larger middle aged and older cohorts. Instead one should use earnings controlling for the worker's stage in his or her earnings profile to identify the poor. The fifty-year-old is poor precisely because he has the same income as a twenty-year-old job market entrant; the two should not be considered equally poor.

The poor are classified using an experience-adjusted estimated wage. Wages for all workers are estimated as a function of experience level in four education groups. Predicted wages at zero years of experience are then used to divide workers into quintiles. The actual wages and experience levels of workers in each quintile are used to estimate the effect of own cohort size on wages for the poor and the non-poor.

The first stage wage regressions by education category are presented in Table 6. Education is divided into no education, primary, secondary, and tertiary education.

Nominal wages are converted to real wages using the CPI for Taiwan in DGBAS (various years). Experience is defined as age minus education minus six. For each year of survey data and each number of years of experience, the sample average wage and sample number of workers is calculated. These sample averages are the observations used in the wage regression. Experience levels over forty-five have small cell sizes, so these observations are dropped. Cohort size is defined as a weighted moving average of the number of workers of each experience level to smooth out anomalous cells with especially high or low numbers of workers sampled in the survey.[6] The estimated equation regresses the log of wages on the log of cohort size, experience and experience squared, and a linear time trend equal to zero in 1976 using a seemingly unrelated regression to control for contemporaneous correlation in the errors across education groups.

The estimation of wages by education categories reveals no significant cohort size effects, but the expected experience-earnings profile and a dramatic growth rate of wages over time. To check specifically whether *poor* workers are subject to lower wages when population growth produces large cohorts, the coefficients in Table 6 are used to estimate wages for each worker at zero years of experience. Workers are ranked by their estimated initial wages and divided into quintiles. Table 7 shows the results of regressing log average wages on the log of cohort size, experience and experience squared, average education levels in years, and a time trend. Once again, there is no significant cohort size effects, neither for poor workers nor for rich workers. Poor workers entering the labor market at the same time as large cohorts of other poor workers do not seem to have had lower wages in Taiwan.

The lack of cohort size effects on wages in Taiwan may reflect the labor market flexibility and rapid growth and structural transformation of the Taiwanese economy over this period. Researchers have usually found negative cohort size effects on wages in the U.S. and other industrialized countries, though often larger for highly educated workers than for the less educated.[7]

Conclusion

Looking for effects of the demographic transition on poverty mostly produced negative results. There is no clear evidence that population growth and age structure changes have a differential impact on the poor using both cross-country data and household data for Taiwan. Population growth does not have a clear negative impact on the income growth of the poor. Even the suggestion that population may be harmful in poorly

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[6] Cohort size for workers with *x* year of experience, *c(x)*, is $c(x) = [n(x-2) + 2n(x-1) + 3n(x) + 2n(x+1) + n(x+2)]/9$, where *n(x)* is the number of workers in the survey with experience *x*. The weights for *c(x)* at the lowest and highest experience levels are scaled to sum to one.

[7] See Welch (1979), Freeman (1979), Berger (1985), and Murphy et al. (1988) for the U.S., Martin and Ogawa (1988) for Japan, and Ben-Porath (1988) for Israel. Ermisch (1988) finds little sign of cohort effects in Great Britain. Behrman and Birdsall find a negative cohort size effect in Brazil using the 1970 census, but Gallup (1992) finds a large positive cohort size effect in Brazil using survey data from 1976-85, presumably due to simultaneous shifts in labor market demand.

geographically-endowed regions did not show a stronger impact on the poor than the rest of the population.

Likewise there is no evidence that in Taiwan over the past twenty years influxes of large cohorts into the labor market reduced relative wages of workers in large cohorts, for the poor or the non-poor. Even the positive association of poverty and family size is not clear when reasonable adjustments are made for the smaller needs of children.

These results are not meant to prove there is no effect of demographic change on poverty. They do show that several of simple direct effects of demography on poverty cannot be easily detected.

Table 1: The correlation of population growth and age structure with income growth of the poor

	g_p (1)	g (2)	g_δ (3)
Population growth rate (%)	-1.1	-0.7	-0.4
	(2.49)*	(1.49)	(0.83)
Dependency ratio (0-1)	-3.4	3.5	-6.8
	(0.40)	(0.45)	(0.82)
Log of initial GDP p.c.	-3.3	-2.1	-1.2
	(6.17)**	(6.28)**	(2.37)*
Poorest quintile income share (0-1)	-0.8	-0.1	-0.7
	(4.15)**	(1.03)	(4.32)**
Openness (0-1)	3.0	3.2	-0.2
	(5.15)**	(6.61)**	(0.27)
Government savings (% GDP)	0.3	0.2	0.1
	(4.42)**	(5.20)**	(1.49)
Political instability (0-5)	-1.7	-0.4	-1.3
	(2.75)**	(2.16)*	(2.32)*
Tropical area (0-1)	-1.8	-1.0	-0.8
	(1.89)	(1.99)	(1.04)
Initial secondary school (years)	0.3	0.5	-0.2
	(0.80)	(1.98)	(0.66)
Constant	36.4	17.3	19.1
	(4.87)**	(3.36)**	(2.80)**
Number of observations	44	44	44
R-squared	0.75	0.75	0.61

Robust *t*-statistics in parentheses

* significant at 5% level; ** significant at 1% level

Table 2: Instrumental variables estimates of the effect of population growth and age structure on the income growth of the poor

	g_p (1)	g (2)	g_δ (3)
Population growth rate (%)	-0.7	0.2	-0.9
	(1.03)	(0.47)	(1.53)
Dependency ratio (0-1)	-6.2	-3.1	-3.1
	(0.65)	(0.57)	(0.36)
Log of initial GDP p.c.	-3.2	-1.8	-1.4
	(5.99)**	(3.99)**	(2.42)*
Poorest quintile income share (0-1)	-0.8	-0.1	-0.7
	(4.24)**	(0.70)	(4.29)**
Openness (0-1)	3.1	3.4	-0.3
	(4.99)**	(6.36)**	(0.46)
Government savings (% of GDP)	0.3	0.3	0.1
	(4.26)**	(4.39)**	(1.53)
Political instability (0-5)	-1.7	-0.4	-1.3
	(2.73)*	(2.58)*	(2.24)*
Tropical area (%)	-1.9	-1.2	-0.6
	(1.98)	(2.27)*	(0.83)
Initial secondary school (years)	0.2	0.4	-0.1
	(0.66)	(1.35)	(0.40)
Constant	36.0	16.4	19.6
	(4.96)**	(3.01)**	(2.76)**
Number of observations	44	44	44
R-squared	0.75	0.71	0.60

Robust *t*-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 3: Instrumental variables estimates of the effect of population growth at different population densities

	g_p (1)	g (2)	g_δ (3)
Population growth rate (%)	-2.3	-2.0	-0.4
	(2.34)*	(2.29)*	(0.39)
Population growth * Density	0.2	0.3	-0.1
	(1.65)	(2.50)*	(0.43)
Dependency ratio (0-1)	-4.5	-0.2	-4.3
	(0.49)	(0.03)	(0.49)
Log of initial GDP p.c.	-2.8	-1.3	-1.5
	(4.58)**	(2.94)**	(2.36)*
Poorest quintile income share (0-1)	-0.8	-0.1	-0.7
	(4.53)**	(1.14)	(4.07)**
Openness (0-1)	3.0	3.2	-0.2
	(5.16)**	(6.54)**	(0.37)
Government savings (% of GDP)	0.3	0.2	0.1
	(4.00)**	(5.68)**	(1.54)
Political instability (0-5)	-1.8	-0.6	-1.2
	(2.88)**	(4.30)**	(2.16)*
Tropical area (%)	-2.0	-1.4	-0.6
	(2.28)*	(2.98)**	(0.79)
Initial secondary school (years)	0.2	0.3	-0.1
	(0.43)	(1.19)	(0.40)
Constant	32.0	11.6	20.4
	(4.46)**	(1.91)	(2.73)*
Number of observations	44	44	44
R-squared	0.77	0.78	0.61

Robust *t*-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 4: Developing country instrumental variables estimates of the effect of population growth at different population densities

	g_p (1)	g (2)	g_δ (3)
Population growth rate (%)	-3.7	-2.4	-1.3
	(2.39)*	(1.35)	(0.64)
Population growth * Density	0.5	0.4	0.1
	(2.09)	(1.43)	(0.61)
Dependency ratio (0-1)	-6.1	-1.0	-5.0
	(0.48)	(0.09)	(0.38)
Log of initial GDP p.c.	-3.3	-1.4	-1.9
	(4.26)**	(2.51)*	(2.23)*
Poorest quintile income share (%)	-1.0	-0.2	-0.8
	(4.30)**	(1.43)	(3.13)**
Openness (0-1)	2.3	3.3	-1.0
	(4.05)**	(5.19)**	(1.40)
Government savings (% GDP)	0.4	0.2	0.2
	(5.11)**	(5.35)**	(2.02)
Political instability (0-5)	-2.3	-0.7	-1.6
	(4.13)**	(3.50)**	(2.90)*
Tropical area (%)	-1.7	-1.5	-0.2
	(1.58)	(2.59)*	(0.19)
Years of secondary school (years)	0.6	0.6	0.0
	(0.56)	(0.91)	(0.00)
Constant	36.0	12.8	23.2
	(3.56)**	(1.39)	(1.91)
Number of observations	24	24	24
R-squared	0.90	0.86	0.77

Robust *t*-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 5: Ratio of number of children in poor to non-poor households using different income measures

Year	Income per capita	Income per adult	Income per adult equivalent (0.5)	Income per adult equivalent (0.5) with scale (0.9)
1976	1.56	0.66	1.22	1.20
1977	1.60	0.65	1.25	1.23
1978	1.59	0.68	1.24	1.24
1979	1.59	0.65	1.23	1.22
1980	1.60	0.60	1.17	1.17
1981	1.62	0.59	1.17	1.16
1982	1.64	0.59	1.19	1.17
1983	1.63	0.58	1.17	1.17
1984	1.62	0.58	1.19	1.18
1985	1.67	0.59	1.23	1.22
1986	1.65	0.58	1.20	1.19
1987	1.67	0.56	1.18	1.17
1988	1.65	0.54	1.15	1.13
1989	1.67	0.57	1.19	1.16
1990	1.63	0.54	1.16	1.13
1991	1.63	0.54	1.13	1.12
1992	1.60	0.54	1.12	1.11
1993	1.63	0.50	1.09	1.07
1994	1.66	0.48	1.11	1.08
1995	1.71	0.46	1.07	1.04
1996	1.58	0.42	0.97	0.96
Average	1.63	0.57	1.16	1.15

Table 6: Cohort size wage regression by education category

	No education	Primary	Secondary	Tertiary
Log of cohort size	-0.021	0.005	-0.024	0.032
	(0.56)	(0.28)	(1.22)	(1.15)
Experience	0.078	0.057	0.087	0.105
	(10.06)**	(23.51)**	(19.51)**	(16.56)**
$Experience^2$	-0.001	-0.001	-0.002	-0.002
	(10.40)**	(24.33)**	(21.69)**	(19.87)**
Trend	0.066	0.062	0.048	0.049
	(25.39)**	(78.07)**	(31.92)**	(22.53)**
Constant	10.405	11.076	11.154	11.527
	(51.81)**	(127.53)**	(126.32)**	(89.09)**
Number of observations	580	580	580	580
R-squared	0.59	0.93	0.74	0.65

Absolute value of *t*-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 7: Cohort size wage regression by experience-adjusted wage quintile

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Log of cohort size	0.004	0.003	-0.002	0.008	0.010
	(0.14)	(0.71)	(0.40)	(1.67)	(1.18)
Experience	0.081	0.081	0.082	0.079	0.070
	(27.66)**	(91.64)**	(105.99)**	(103.37)**	(77.84)**
Experience^2	-0.002	-0.002	-0.002	-0.002	-0.001
	(35.71)**	(86.21)**	(95.46)**	(84.65)**	(61.71)**
Trend	0.077	0.064	0.061	0.061	0.062
	(46.06)**	(131.02)**	(135.87)**	(133.30)**	(108.23)**
Years of education	-0.009	0.004	0.013	0.021	0.031
	(0.66)	(2.03)*	(8.72)**	(12.98)**	(15.42)**
Constant	11.085	10.854	11.015	11.195	11.435
	(79.89)**	(364.41)**	(407.83)**	(400.11)**	(262.79)**
Number of observations	965	965	965	965	965
R^2	0.81	0.97	0.97	0.97	0.97

Absolute value of *t*-statistics in parentheses
* significant at 5% level; ** significant at 1% level

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