Millennium Development Goals, Agricultural Growth and Openness

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Abstract

Millennium Development Goal (MDG) of poverty reduction aims for halving of the head-count ratio over the period 1990-2015. The present study examines the feasibility of halving poverty at the global, regional and country levels drawing upon two-stage cross-sectional and panel estimations which take into account agricultural growth and inequality. The gaps between required and observed growth rates of aggregate and agricultural income, and the trade-offs between growth and redistribution of income are assessed. While doubts persist about the feasibility of halving poverty in some regions, the results bring into sharper relief the potential of redistribution in achieving this goal.

Keywords: poverty, goals, growth, redistribution, openness, feasibility.

JEL Codes: I32, O 57, R11.

Millennium Development Goals, Agricultural Growth and Openness [1]

1. Introduction

Millennium development goals (MDGs) embody a broad-based view of economic development. These goals were endorsed in the United Nations Millennium Declaration in September, 2002. This Declaration represents a historic global commitment to reduce substantially extreme poverty and other forms of deprivation in the developing world by 2015. Among others, specific targets include: (a) reducing the proportion of people living in extreme poverty (i.e. those living below US $ 1 per day) by half during 1990-2015; (b) ensuring that all children are enrolled in primary schools by 2015; (c) reducing gender inequality through eliminating the gender gap in both primary and secondary education by 2005, and in all levels of education no later than 2015; (d) reducing infant and child mortality by two-thirds during 1990-2015; (e) reducing maternal mortality ratios by three-quarters during 1990-2015; and (f) ensuring that all women have access to reproductive health services by 2015.[2]

Although the MDGs have been successful in raising awareness of pervasive deprivation in the developing world, doubts persist about their appropriateness and feasibility (e.g. Demery and Walton, 1999, Collier and Dollar, 2000, Besley and Burgess, 2003, Sahn and Stifel, 2002, McArthur and Sachs, 2002, Gaiha, 2003). The objective of the present study is to focus on the feasibility of the poverty target. In an earlier contribution (Demery and Walton, 1999), for

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example, the feasibility of this target was assessed in terms of overall economic growth rates, taking into account inequality in income distribution and policy stance[3]. At a regional level, the growth rates required to reduce the US $ 1 per day head-count ratio by half seems feasible, relative to actual growth during the early 1990s (except in Sub-Saharan Africa). If the focus shifts to the number of countries, a different pattern emerges. More than half of the countries (in a sample of 36) fall short of achieving this goal. If account is taken of initial conditions and policy choices in determining their growth prospects, 18 (or exactly half of the sample) countries are predicted to achieve the growth rates required to reduce the head-count ratio by half. On the more optimistic assumption that the policy stance changes from 'bad' to 'good' in all countries, 28 of the 36 countries are predicted to meet this goal.[4] They also explore the growth-equity trade-offs in this context. To illustrate, if inequality in income distribution in Brazil and South Africa is reduced to that in Colombia and Thailand, respectively, the required growth rates are significantly reduced. So two important conclusions emerge from the simulations in Demery and Walton (1999). One is that the feasibility of the MDG of poverty reduction is conditional upon sustainability of the growth rates achieved during the early 1990s. The second conclusion is that if inequality rises the required growth rates may be higher. Another study (Collier and Dollar, 2000) constructs several different scenarios for 2015, focusing on the effects of policy reforms, aid reallocation, and increased volumes of aid. Regions with good per capita income growth register large reductions in poverty (e.g. South and East Asia). But there is very little poverty

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[2] The MDGs originated from a series of UN resolutions and agreements made at world conferences held over the past decade. For an earlier version, see the DAC (Development Assistance Committee of OECD) targets (Gaiha, 2003).

[3] Sachs and Warner (1995) classify the sample of countries in terms of a good and bad policy stance, and political conditions to explain variations in growth rates.

[4] Generalising from the sample, Demery and Walton (1999) conclude that the goal of poverty reduction will be achieved in countries representing 86 per cent of the world's population without policy reforms, and in over 90 per cent of the population if policies improve.

reduction in Africa, and an increase in poverty in the transition economies of Eastern Europe and Central Asia. However, given that the better performing economies have large populations, the head-count ratio for the developing economies as a whole is halved. This leads to the optimistic conclusion that "….if the objective is to reduce the poverty rate by about half in the developing world, then based on current trends there is a pretty good chance that this goal will be met "Collier and Dollar, 2000, p. 12). A third study (Besley and Burgess, 2003), based on a panel data set, points to the large gap between the required and actual growth rates. Specifically, while the historical per capita income growth rate during 1960 to 1990 was 1.7 per cent, the required growth rate is 3.6 per cent per annum. The feasibility of the MDG of poverty reduction is thus far from resolved.

The present study builds on earlier work in several respects. First, it uses a richer data base, drawing upon some recent sources. Secondly, it employs a more rigorous methodology. Attention may be drawn to the following features. All the studies cited earlier treat income as exogenously determined. We relax this assumption by taking into account the primacy of agriculture in the development process[5]. An important implication is that agricultural growth impacts on poverty in two ways: directly through its effect on rural poverty, and indirectly through its stimulation of the rest of the economy[6]. So a two-stage estimation procedure is employed. Income is posited to depend on agricultural income, a measure of openness of the economy and regional characteristics in the first stage. Two alternative measures of poverty- the head-count and the poverty gap ratios- are then posited to depend on the (estimated) income, the Gini coefficient of income distribution, some regional and/or structural characteristics in the

[5] Kuznets (1965), for example, argued that a rise in agricultural productivity is a precondition for growth, while Mellor (1976) drew attention to the backward and forward linkages between agriculture and the rest of the economy. For a more recent reaffirmation, see Singh and Tabatabai (1993).

second stage. Alternative econometric techniques are employed to check the robustness of the results. Finally, in the context of the MDG of poverty reduction, more detailed explorations of growth-equity trade-offs are carried out.

The rest of the present study is organised as follows. In Section 2, the econometric specifications are discussed; this is followed by a brief and selective description of the data sources in Section 3; Section 4 is devoted to a discussion of the results, and Section 5 focuses on the simulations; and concluding observations are made in Section 6.

2. Methodology

2.1. Specification

As noted earlier, there are two equations in our specification: the first equation posits that income per capita, Y_{it}, depends on lagged per capita agricultural income, Y_{ait-1}, a measure of openness, O_i, agricultural income interacted with regional dummies (the latter denoted by a vector D_i), and a measure of biophysical constraints, constructed as a composite of proportion of population living in the tropical climate and the proportion of population at the risk of malaria, R_i. The second equation posits a relationship between national poverty as the dependent variable, and estimated per capita GDP, the Gini coefficient of income/consumption expenditure distribution, regional dummies interacted with estimated per capita GDP, and a measure of biophysical constraints as the right-hand side variables. Algebraically, the equations take the following form:

$$Y_{it} = \alpha + \beta_1 Y_{ait-1} + \beta_2 O_{it} + (D_i' \cdot Y_{ait-1})\beta_3 + \beta_4 R_i + \eta_i + u_{it} \qquad (1)$$

[6] For an assessment of the former, see Gaiha (1989, 1995).

η_i is an individual country effect and u_{it} is an error term. i and t subscripts denote country and time, respectively. Note that the individual country effect can only be captured in a panel data set.

A lagged measure of agricultural income is designed to capture the primacy of agricultural growth, as also to overcome the complications arising from endogeneity of agricultural income. Openness of an economy, on the other hand, may improve growth prospects *independently* through increases in total factor productivity (Edwards, 1998).[7] Total factor productivity growth (TFPG) varies (negatively) with initial per capita income, and (positively) with stock of educated manpower/workforce, and a measure of openness.[8] Since the index of biophysical constraints overlaps with regional dummies, one of them is used at a time. Note also that the dependent variable in equation (1), per capita income, and a right side variable, lagged agricultural income per capita, appear in logs.

$$P_{it} = \delta + \gamma_1 \hat{Y}_{it} + \gamma_2 G_{it} + (D_i' \cdot \hat{Y}_{it})\gamma_3 + \gamma_4 R_i + \mu_i + v_{it} \qquad (2)$$

[7] As argued in Edwards (1998), there are two issues. One is that existing measures of openness are incomplete in so far as each focuses on an aspect of trade policy restriction or policy induced distortion. A solution that is not entirely satisfactory is to use a few alternative measures of openness and check whether the results are robust to them. In the present study, we use three different kinds of the openness measure. The first is the Sachs and Warner measure which is a binary variable based on a series of trade related indicators- tariffs, quotas, black market premium, social organisation and the existence of export marketing boards (Sachs and Warner, 1995, cited by Edwards, 1998). The second is a physical isolation index which measures the proportion of a country's population that lives less than 100km from the coast (McArthur and Sachs, 2002). The third measure is the Frankel-Romer index, based on values of trade share estimated using geographical variables (e.g., area, population). For details, see (Frankel and Romer, 1999).

[8] Edwards (1998) posits two sources of TFPG: a domestic source associated with innovation, and an international one linked to the rate of absorption of technical progress elsewhere. While domestic innovation depends on the stock of educated workforce, imitation or absorption of technical progress elsewhere depends on a "catch up" term. In other words, countries with a lower initial stock of knowledge will tend to imitate faster than those with a higher initial stock of knowledge (or, equivalently, TFP). In the spirit of new models of growth, it is assumed that more open countries tend to absorb new ideas at a faster rate. Thus, TFP growth will be positively affected by human capital and openness, and negatively by the initial stock of knowledge.

where P_{it} refers to log of the poverty index (*i.e.*, the headcount ratio, $P_{0\,it}$, or the poverty gap ratio, $P_{1\,it}$)[9], $\hat{Y}_{it}$ is log of per capita income estimated in the first stage, and G_{it} is the log of the Gini coefficient of income distribution. All other variables have the same notation as in equation (1). μ_i is the individual country effect and v_{it} is an error term. As mentioned earlier, this corresponds to the panel data case. As before, either the index of biophysical constraints or a vector of regional dummies is used at a time.

2.2. Estimation

The estimation of this system of equations (1) and (2) is straightforward, given that it is *recursive*. After obtaining estimates of per capita income, these are combined with data on the other variables to estimate the second equation using 2SLS.[10] The Huber-White sandwich estimator of variance is used to correct for heteroscedasticity. For panel data estimation, we have used GLS random effects method (Baltagi, 2001).

3. Data

We have constructed two data sets, relying mostly on World Bank estimates of poverty. The first is the cross-sectional data on the headcount index or poverty gap in 1998, and the second is the panel data for the period 1980 to 1998.[11] While some countries have a long time series,

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[9] We use the international poverty data based on the population living below $1.08 a day at purchasing power parity in 1993.

[10] Note that under certain conditions IV and 2SLS are equivalent estimation procedures (Pindyck and Rubenfeld, 1991).

[11] These are taken from WDI (2002). The panel data were supplied by T. Besley.

others have few observations with gaps on a comparable basis.[12, 13] Thus use of an unbalanced panel data set is unavoidable. Other relevant data (e.g. income per capita, the Gini coefficient) were also obtained from the World Bank data base (WDI, World Bank, 2002b). The estimates of agricultural income were obtained from FAOSTAT (FAO). The indices of openness were taken from Sachs and Warner (1995) and Frankel and Romer (1999), and of physical isolation and biophysical constraints from McArthur and Sachs (2002).

Recent assessments of World Bank estimates of poverty (i.e. those living below US $ 1 per day) have drawn attention to distortions arising from various sources (e.g. purchasing power parity conversions, divergence between household survey data and national income estimates, price deflators).[14] With the change of the PPP base year from 1985 to 1993, for example, the poverty estimates for Latin American and African countries change considerably. Given the volatility of prices of primary commodities, this is hardly surprising. No less serious are the problems arising from a widening gap between household survey based estimates of consumption and those obtained from National Accounts Statistics rendering comparisons of changes in poverty over time difficult. A case in point is the absence of a consistent reduction in poverty in India *despite* a rapid post-reform growth in the 1990s.[15] Finally, the poverty estimates

[12] The panel data include 78 countries, with both the number of poverty estimates and periods covered varying. Details will be furnished on request.

[13] When the panel data are incomplete or unbalanced, it is appropriate to use the general version of error components model proposed by Wansbeek and Kapteyn (1989). On this issue, see also Baltagi (2001). We have used the GLS random-effects model for unbalanced data. Wansbeek and Kapteyn's (1989) simulations show that the GLS and the computationally more demanding ML estimates are almost identical in the presence of 20 % attrition. However, our results must be interpreted with caution, given the higher degree of attrition.

[14] See, for example, Deaton (2000, Srinivasan (2000) , and Gaiha (2003).

[15] The problems are compounded by changes in the National Sample Survey design – in particular, the change from a monthly recall to a weekly recall. For details, see Deaton and Dreze (2002).

are also highly sensitive to the use of different price deflators.[16] For all these reasons, the regression results given below must be viewed with caution.

4. Results

The results based on cross-sectional data are given in Table 1, and those based on panel data in Table 2. We shall comment on them in turn.

4.1. Cross-Sectional Data

All variables in the first column in Table 1 have expected signs (Case 1-A). Agricultural income in 1993 has a positive and significant effect on per capita income. The coefficient of the share of population living within 100 km from the coast (as a measure of openness) is positive and significant. In other words, the higher the value of this index, the higher is the income per capita.[17, 18] The coefficients of the regional dummies interacted with agricultural income for Sub

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[16] For illustrative evidence, see Deaton (2003).

[17] An issue here is whether openness in the sense of low barriers to trade produces growth or whether sound macroeconomic policies, and institutions of conflict management matter more. For different perspectives, see World Bank (2002a), and Rodrik (1999).

[18] A related issue is openness and physical isolation. It is arguable that isolation may not just restrict foreign trade but also constrain development in other ways (e.g. fragmented markets, absence of property rights, limited exposure to economic and other changes taking place elsewhere). So it is a more comprehensive measure. Other merits are its continuity and exogeneity (relative to the Sachs-Warner dichotomous classification of openness of developing countries, and its endogeneity to policy choice). Some of the problems of the Sachs-Warner index are also avoided by the Frankel-Romer index.

Saharan Africa and South Asia are negative and significant.[19] The overall specification is validated by an F-test.

In the second stage regression, the head-count ratio is inversely related to the (IV estimate) of per capita income. The Gini coefficient is positively linked to the head-count index, implying that the greater the income inequality the higher would be the incidence of poverty at a given level of income. Interactions of estimated log of per capita income and regional dummies have positive and significant coefficients for East Asia, Sub-Sahara Africa, Latin America, and South Asia. The overall specification is validated by an F-test.

When the head-count index is replaced with the poverty gap ratio in the second stage regression, similar results are obtained. While per capita income reduces the poverty gap, the Gini coefficient increases it. In absolute terms, however, these coefficients are larger than the corresponding ones for the head-count index. All regional dummies interacted with estimated per capita income except that for South Asia have significant coefficients. The coefficient for East Asia is negative, while the remaining two are positive. The overall specification is validated by an F-test.

In Case 1-B in Table 1, we dispense with the regional dummies and replace them with an index of biophysical constraints.[20] While both agricultural income and openness indicator have positive effects on per capita income, biophysical constraints dampen it. The overall specification is validated by an F-test.

[19] No comment is offered on the effect of the Gini coefficient since efficiency of IV (2SLS) estimation requires that all exogenous variables are included in the first stage regression. The Gini coefficient is hypothesised to have an explanatory role only in the second stage.

[20] This was necessary as the measure of biophysical constraints overlaps with the regional classification.

In the second stage regression, the head-count ratio and per capita income are inversely related. Both the Gini coefficient as a measure of income inequality and biophysical constraints have positive effects on the poverty index. The overall specification is validated by an F-test.

In Case 2-A, we report the results based on an alternative measure of openness, referred to as the Sachs-Warner index. Similar results are obtained. In the first stage regression, agriculture has a positive effect on income per capita, as also the Sachs-Warner index. In the second stage, income per capita reduces the head-count index while the Gini coefficient has a positive effect. When the head-count index is replaced with the poverty gap, there are minor differences in the results. In both cases, the overall specification is validated by an F-test.

The results under Case 3-A are based on a specification similar to Case 2-A except that the measure of openness is different. Here the Frankel-Romer index is used. This index, however, does not have a significant coefficient. Under Case 3-B, both this and the biophysical constraint index have significant coefficients. The overall specifications are validated by the F-test. The second stage regressions in both cases are similar to Case 2-A and Case 2-B, respectively. An important conclusion that emerges from these regressions is that openness has an important role in stimulating growth which in turn reduces poverty.[21]

4.2. Panel Data

Panel data techniques have the specific advantage that unobservable country–specific effects can be captured. The results are shown in Table 2. Given the unbalanced panel data set, the results are likely to be sensitive to the data and specification used. The overall pattern of the

[21] Note that the correlation between the isolation and the Sachs-Warner indices is 0.37, between the Sachs-Warner and the Frankel-Romer is 0.21, and between the Frankel-Romer and the isolation indices is 0.14. The weak correlations are not surprising as these indices measure different dimensions of openness.

results in Table 2 is, however, largely similar to that in Table 1. To avoid repetition, we shall confine our remarks mainly to the differences in the results.

We begin with a comparison of the results under Case 2-A in Tables 1 and 2. The only difference in the specification is that the latter takes into account random country-specific effects using a panel data set. There are some differences in the values of the coefficients. In the panel data case, in the first stage, the (absolute) contributions of both agriculture and the Sachs-Warner index to per capita income are much smaller. More striking differences are observed at the second stage, with considerably larger elasticities of the head-count and poverty gap indices with respect to (estimated) per capita income and the Gini coefficient in panel data estimates.[22] This pattern is observed in all other regressions in the second stage (i.e. in Cases 1A- 3B). In most cases, the elasticities of the head-count and poverty gap ratios to biophysical constraints are also higher in Table 2. In all the regressions, the overall specification is validated by the Wald test.

An issue therefore is the reliability of cross-sectional results vis-à-vis panel data results. Two advantages of panel data estimation are: use of data over time, and incorporation of unobservable country-specific effects. These advantages are, however, often partly offset by the sensitiveness of the results to the data and method of estimation used. Thus the reliability of panel data results is not obvious. So, if a more optimistic assessment of the feasibility of the MDG emerges from panel data results, this caveat must be borne in mind.

5. Simulations

[22] Note that the comparison relates to absolute values of γ_1 here. In Case 2-A in Table 2, for the head-count index, γ_1 = -1.647 as against –0.692 in Table 1. When the regional dummy coefficients are taken into account, the differences in income elasticities of head-count and poverty gap ratios are not so large.

Two different sets of simulations are carried out. In the first set, we focus on required rates of growth of overall income and agricultural income per capita, relative to observed rates of growth over the period 1985-2000.[23] Such comparisons are carried out separately for halving the head-count and poverty gap indices at the regional level. In the second, we first examine the feasibility of achieving the MDG at the regional level using panel data projections on different distributional assumptions. In order to supplement this analysis, more detailed results are presented for selected countries on the trade-offs between growth (or openness) and redistribution in the context of the MDG of poverty reduction.

5.1. MDGs and Growth Rates

As noted earlier, elasticities of the head-count and poverty gap ratios with respect to income are higher in panel data estimates.[24] Also, elasticities of the poverty gap ratio to income are higher than those of the head-count ratio in both cross-section and panel data estimates. Corresponding elasticities of agricultural income exhibit a similar pattern in Table 3: the elasticities of the poverty gap are higher, as also those obtained from the panel data. The latter may reflect that poverty reduction achieved by income growth over time is not fully captured by the cross-sectional variation.[25]

Openness of an economy also helps reduce poverty through its contribution to economic growth. We get a range of elasticities depending on the measure of openness and poverty index used. Since the Sachs-Warner index uses a dichotomous classification, the head-count index reduces by 24 per cent in Case 2-A in Table 1, and by 32 per cent in Case 2-B in Table 1. The

[23] Different combinations of poverty reduction *within* a region as well as *between* regions may be consistent with halving of global poverty. MDGs, however, steer clear of these difficulties by assuming halving of poverty indices in each region over the period 1990-2015 (Gaiha, 2003).
[24] Usually, comparisons of elasticities are based on their absolute values unless stated otherwise.
[25] As noted earlier, this could also be due to the unbalanced panel data set.

reduction in the poverty gap ratio is slightly greater- 26 and 34 per cent, respectively. Finally, the elasticities of the poverty indices with respect to the Gini coefficient are large. For the head-count index, these range from 0.92 to 1.72, and, for the poverty gap ratio, from 1.31 to 2.39, in Cases 1-A and 1-B in Table 1. The corresponding elasticities based on panel data range from 5.25 to 6.28. Even if we go by the considerably smaller cross-sectional elasticities, high trade-offs are implied between growth and redistribution in meeting the MDG of halving poverty.

These elasticities (η) are inserted in the formula given below, used by Besley and Burgess (2003), to compute the growth rates of overall income and agricultural income per capita required to halve a poverty index (g_{half}) in 25 years (i.e. over the period 1990-2015). In the Besley-Burgess simulations, based on η = -0.76, the overall growth rate required to halve the head-count index works out to be 3.6 per cent, as against the historical growth rate of 1.7 per cent (over the period 1960-90).

$$g_{half} = \frac{\log\left(\frac{1}{2}\right)}{25\eta} \tag{3}$$

As our specification is different, we get different results. The results are shown in Table 4. If we use the cross-sectional estimates under Case 1-A, for the head-count index, the required GDP growth rate is 4.30 per cent per annum, as against an observed growth rate of 0.62 per cent in the aggregate sample over the period 1985-2000. Also, the observed growth rates fall short of the required rates in all regions - especially in Sub Saharan Africa, Latin America and the Caribbean, and Eastern Europe and Central Asia. Panel data estimates lead to a more optimistic assessment. The required GDP growth rate for the aggregate sample is much lower (1.87 per cent per annum) but still considerably higher than the observed growth rate. At the regional level, however, the required rates are lower than the actual in East and South Asia regions. As the results are similar for the poverty gap ratio, further elaboration is unnecessary.

Comparison of required and actual growth rates of agricultural income leads to a more pessimistic assessment of the feasibility of halving the head-count index. The growth rate required at the aggregate level in the cross-sectional case is much higher than the historical growth rate, with the former exceeding the latter in all the regions regardless of whether the required growth rate is obtained from panel or cross-sectional elasticities. In fact, in most regions, the gaps between required and actual growth rates are large. With the panel data estimates, these gaps reduce. Nevertheless, both at the aggregate and regional levels, the scale of effort required in accelerating agricultural growth rates is likely to be high.[26] With the poverty gap ratio, the overall assessment is pessimistic too, except that the gaps between required and actual growth rates are slightly smaller.

Particularly worrying is the performance of Sub Saharan Africa, Latin America and the Caribbean and Eastern Europe and Central Asia, with nearly stagnant or negative agricultural growth rates and consequently large gaps between actual and required growth rates. In at least two of these regions (Sub Saharan Africa and Latin America and the Caribbean), low growth rates are also characterised by high variability of agricultural growth rates.[27]

5.2. Growth-Redistribution Trade-Offs

[26] The actual growth rate has been barely 0.30 per cent per annum over the period 1985-2000.

[27] Coefficient of variation of annual agricultural growth at regional level ranges from 199% in East Asia to 1391% in Sub Saharan Africa (Table 4).

Here we summarise first simulation results at the regional level, based on different income distributional assumptions- specifically, different values of the Gini coefficients. To do so, we utilise the relevant elasticities from Case 2-A in Table 2, computed from panel data. Combining them with extrapolation of growth rates of GDP, changes in poverty indices, observed over the period 1985-1999, and different distributional assumptions, we get additional insights into the feasibility of the MDG. [28] To investigate the trade-offs between agricultural growth and redistribution as well as what different combinations of openness and redistribution imply in terms of feasibility of the MDG, we review the experience of a few developing countries from three regions – India, China and the Philippines and in Asia, Zambia in Africa and Brazil in Latin America.

Let us first consider the results at the regional level in Table 5. A somewhat optimistic scenario emerges. Without any change in the distribution, and the observed GDP growth continuing until 2015, all regions other than Sub Saharan Africa, Latin America and the Caribbean, and South Asia will achieve desired reductions in the head-count ratio. With a 10 per cent reduction in the Gini coefficicient, only Sub Saharan Africa will fail to meet this target. With a 20 per cent reduction in the Gini coefficient, even this region will achieve the desired reduction in the head-count ratio.

As similar results are obtained with the poverty gap ratio, further elaboration is unnecessary. Thus, to the extent that there are limits to accelerating GDP growth, a mix of growth accelerating and income redistributional strategies is imperative in achieving the MDG in a large part of the developing world.

[28] Since these simulations could not be carried out with cross-sectional data, the caveat against panel data elasticities being high- especially that of the Gini coefficient- must be borne in mind. We use here the Sachs-

In Table 6, we examine the trade-offs between accelerated agricultural growth and redistribution of income as well as the implications of different combinations of openness and redistribution for selected developing countries. Little, however, can be said on the question of whether a given (percentage) reduction in the Gini coefficient is easier to accomplish than the same (percentage) acceleration in agricultural growth rates. Broadly, there are two difficulties. One is that this requires a careful contextual analysis of specific policies that have implications for growth (e.g trade policy liberalisation) and for income distribution (e.g. progressive income tax). And the second relates to growth promoting policies altering income distribution, and income distribution policies impinging on growth prospects. So a clear cut separation of growth and income distributional effects of specific policies is far from straightforward. Subject to this qualification, we review the results in Table 6.

India's is an important case as it accounts for roughly one–third of the total poor in the developing world. Going by the results in Table 6, India is unlikely to halve the head-count ratio by 2015 on the assumption that the observed growth rate of agricultural income (0.7%) continues. While a 20% higher agricultural growth will reduce the head-count ratio substantially, it will still be above the desired ratio. On the other hand, a 10% reduction in the Gini coefficient is sufficient to achieve this target. Interestingly, if the openness index takes the value 1, its effect is similar to that of a 20 per cent higher agricultural growth. By contrast, the poverty gap will be halved by 2015 even without any redistribution.

China witnessed a rapid reduction in poverty during 1985-1998. During this period, both GDP and agriculture- especially the former- grew rapidly. On the assumptions of an unchanging Gini and continuation of actual agricultural growth rate (3.2%), the halving of poverty will occur well

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Warner index of openness as it is amenable to change over time (0 to 1), and has a closer link to trade policy before 2015. The contribution of a small reduction in inequality (i.e. a 10 per cent reduction in the Gini coefficient) to a reduction in the head-count index is equivalent to that of accelerated growth (i.e. a 20 per cent faster GDP growth). The poverty gap is slightly less responsive to the reduction in the Gini coefficient than is the head-count ratio. As in the case of India, openness of the economy would have a potentially important role in reducing poverty, given that its effect is equivalent to that of a 20 per cent faster growth.

Although the head-count and poverty gap ratios were low in 1988, they remained unchanged over the period 1988-97 in the Philippines. The GDP growth was negligible while agriculture recorded a low negative growth. Because of the latter, simulations are carried out with alternative assumptions about GDP growth rates and second stage regression results. In all the cases with various growth rates and an unchanging Gini, the target of halving the head-count ratio will not be achieved. A 10 per cent reduction in the Gini coefficient combined with continuation of sluggish GDP growth will, however, do so before 2015. For halving the poverty gap, a larger reduction in the Gini (20 per cent) is required. What is indeed significant is low responsiveness of poverty indices to GDP growth rates. Thus the trade-offs between growth and redistribution in the context of poverty reduction are non-negligible.

In Zambia the head-count ratio rose sharply from 58% in 1990 to 72.6% in 1996, and, as a result, the prospect of reducing it to about 29 per cent by 2015 is grimmer. Given the negative growth rates of GDP and agriculture (or, their near stagnation), their extrapolation will result in a slightly higher poverty. So the reference growth rate is the Sub Saharan agricultural growth rate of 0.47 per cent. With a 20 per cent higher growth rate, the desired reduction will occur. A 10 per cent reduction in the Gini coefficient with the reference growth rate continuing will lead to a

liberalisation than the isolation index.

substantial reduction in the head-count index but will not enough to achieve the MDG. A similar result is obtained for the poverty gap ratio. Growth promotion through an open economy also yields a substantial reduction in poverty. In the context of stagnating economies such as Zambia's, it is arguable that growth promoting policies have a potentially more significant role in reducing poverty.

As the GDP and agricultural growth rates were modest, Brazil is unlikely to achieve the desired reduction in the head-count index even with a 30 per cent higher agricultural growth rate but an unchanging income distribution. But continuation of modest growth combined with a 10 per cent reduction in the Gini coefficient will. By contrast, the desired reduction in the poverty gap is not an issue since it was below half the 1990 estimate in 1998. So, as far as the head-count index is concerned, the results in Table 6 confirm the substantial potential of reduction in income inequality in achieving the MDG.

To sum up, these country case studies are useful in two respects. One is that they bring out the diversity within a region. The second is that they illustrate the potential of redistribution of income in reducing poverty at a given GDP growth rate. The important point is that, if acceleration of agricultural growth rate is difficult outside a certain range, the desired reduction in poverty could be accomplished with a modest reduction in inequality. This is of course not to suggest that redistribution is easier to accomplish, but to point out that the trade-offs between growth and redistribution are non-negligible. The results for Zambia are, however, significant in pointing to the imperative of growth promotion in various ways- including opening up of the economy- in a poverty reduction strategy. A generalisation to other stagnant African economies needs further investigation.

6. Concluding Observations

Some observations are made on the main findings from a broad policy perspective. That agricultural growth is central to overall growth is corroborated. In addition, openness of the economy has a significant effect on the growth of an economy. While to some extent overlapping with the regional classification of the sample countries, biophysical constraints dampen growth. Focusing on the determinants of poverty in the next stage, per capita income reduces poverty. Controlling for all other effects, inequality in income distribution (measured by the Gini coefficient) is associated with higher poverty. In other words, the greater the inequality, the higher is the poverty, other things being equal. Biophysical constraints also directly aggravate poverty.

At the global level, the goal of halving poverty seems unlikely to be met in 2015, because of the gap between the GDP growth rate required and the observed rate. A more pessimistic assessment follows from a comparison of actual and required growth rates of agricultural income. The global growth rate required exceeds the actual by a wider margin. Thus the scale of effort required in accelerating agricultural growth rate is likely to be high. However, if we use an alternative approach that combines panel estimation with observed performance of various regions, a more optimistic assessment is obtained. A few regions will achieve the stipulated reduction in poverty while in the aggregate sample the likely reduction will fall short of it.

The country case studies confirm the key role of reduction of income inequality in attaining this target. Even if a modest agricultural growth rate is combined with a small reduction in income inequality (e.g. India), it is likely to result in a substantial reduction in poverty. On the other hand, in some stagnant economies (e.g. Zambia), growth promoting policies deserve higher priority. What an appropriate mix of growth and equity promoting policies would be and how the conflicts might be resolved are of course largely contextual and require a more detailed investigation than was feasible in the present study.

Two specific concerns need elaboration. One relates to the primacy of agricultural growth in developing countries and the underlying constraints, and the second to trade-linked expansion of these opportunities, and the ability of rural populations to benefit from them. Table A-1 in Annex contains regional data on a few variables of interest. Shares of agricultural value added are relatively high in East Asia, South Asia and Sub Saharan Africa. What is also significant is that, while in East Asia and South Asia the share of agriculture fell during the 1980s and 1990s, in other regions the share changed little. However, the share of agricultural employment was considerably higher than the corresponding share of value added, confirming agriculture's vastly greater employment potential. Despite the reduction in this potential during the 1990s, in a few regions (e.g. South Asia, Sub Saharan Africa, and East Asia) agriculture is likely to remain a major source of employment. For employment in this sector to be remunerative, land productivity must rise. Table A-2 provides some illustrative regional evidence. Two points emerge. One is the virtual stagnation in land productivity in all regions. The second is the large range, with the lowest productivity in Sub Saharan Africa and the highest in East Asia. The prospects of raising land productivity in Sub Saharan Africa are constrained by the depletion of soil fertility and concomitant problems of weeds, pests and diseases.

While trade liberalization promises new opportunities for growth and poverty reduction, the barriers that many developing countries and smallholders in rural areas face in availing of such opportunities must not be overlooked. Without easy market access in remote areas, the potential benefits of higher product prices and lower input prices are not transmitted to poor rural households. Remoteness also restricts access to information about new technologies and changing prices, leaving the poor unable to respond to changes in incentives. Other factors inhibiting supply response are lack of assets, skills and credit. As a result, the outcomes of trade liberalization are mixed- especially in the short-term. Also, and more generally, smallholders find it particularly hard to comply with supermarket requirements of quality, reliability of supply, and health, safety and ethical assurances. But there are possibilities of integrating them into global markets through niche markets, such as environment friendly products and, to a limited extent, organic products. However, significant improvements in information, knowledge and farm management are a prerequisite.

More generally, a serious concern is that globalization – in the sense of international economic integration and, in particular, openness to foreign trade and investment- has aggravated income inequality. Although there is some evidence that inequality increased during the late 1980s and early 1990s- a period marked by a wave of domestic and external liberalization in developing countries- the causal role of the latter is not conclusively established. A link between globalisation and inequality cannot, however, be ruled out. In that case, the poverty reducing potential of accelerated growth through openness to foreign trade and investment is likely to diminish.

In conclusion, while doubts persist about the feasibility of halving poverty by 2015, a challenge is to combine accelerated growth with reduction of income inequality.

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Table 1 2SLS Estimation Results for Poverty Head Count Ratio and Poverty Gap in 1998 ($1 a day at 1993 PPP) for Cross-Country Data

	Case 1: Openness: *Isolation Index*				Case 2: Openness: *Sachs & Warner Index*				Case 3: Openness: *Frankel-Romer Index*			
	Case 1-A With $D_i \cdot Y_{ait-1}$		Case 1-B Without $D_i \cdot Y_{ait-1}$		Case 2-A With $D_i \cdot Y_{ait-1}$		Case 2-B Without $D_i \cdot Y_{ait-1}$		Case 3-A With $D_i \cdot Y_{ait-1}$		Case 3-B Without $D_i \cdot Y_{ait-1}$	
First Stage: Dep. Variable: log (Per Capita GDP) t	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]
β_1 **(log of Per Capita Agricultural Production Value Added in 1993)**	**0.912**	**(5.64)****	**0.911**	**(3.90)****	**0.889**	**(5.25)****	**0.985**	**(6.49)****	**1.078**	**(6.18)****	**1.241**	**(8.42)****
β_2 **(Openness Indicator)**	**0.688**	**(2.56)***	**1.100**	**(4.93)****	**0.349**	**(1.81)†**	**0.511**	**(3.00)****	**0.005**	**(0.70)**	**0.012**	**(1.70)†**
β_3 **(log of Gini Coefficient of Income)**	**-0.648**	**(-1.59)**	**-0.12**	**(-0.42)**	**-0.863**	**(-2.08)***	**-0.312**	**(-0.95)**	**-0.718**	**(-1.58)**	**-0.072**	**(-0.22)**
β_4 (Whether East Asia)* Y_{ait-1}	-0.068	(-1.19)	-	-	-0.056	(-0.96)	-	-	-0.058	(-1.01)	-	-
β_4 (Middle East & North Africa) * Y_{ait-1}	-0.036	(-0.55)	-	-	-0.021	(-0.31)	-	-	-0.012	(-0.17)	-	-
β_4 (Sub Saharan Africa) * Y_{ait-1}	-0.135	(-2.20)*	-	-	-0.123	(-1.97)*	-	-	-0.128	(-1.86)	-	-
β_4 (Latin America & Caribbean) * Y_{ait-1}	0.045	(0.83)	-	-	0.075	(1.39)	-	-	0.075	(1.41)	-	-
β_4 (South Asia)* Y_{ait-1}	-0.168	(-2.22)*	-	-	-0.164	(-2.10)*	-	-	-0.140	(-1.82) †	-	-
β_5 (An Index of Biophysical Constraints)	-	-	-1.12	(-4.65)**	-	-	-0.893	(-3.50)**	-	-	-0.894	(-3.34)**
α (Constant)	4.664	(2.79)	2.802	(2.24)	5.612	(3.23)	3.221	(2.24)	4.201	(2.26)	1.084	(0.77)
Number of Observations	77		77		77		77		73		73	
Joint Significant Test	F(8,68)=20.28**		F(4,72)=46.99**		F(8,68)=19.02**		F(4,72)=36.66**		F(8,64)=19.51**		F(4,68)=37.58**	
R^2	0.7047		0.7076		0.6912		0.6707		0.6728		0.6885	
Variant 1: Dep. Variable: log(Head Count Ratio)												
Second Stage ($P_{0\,it}$ **)**												
γ_1 **log (per capita GDP) t**	**-0.729**	**(-4.68)****	**-0.680**	**(-5.95)****	**-0.692**	**(-3.92)****	**-0.634**	**(-5.28)****	**-0.704**	**(-4.14)****	**-0.654**	**(-5.50)****
γ_2 **(log of Gini Coefficient of Income)**	**0.918**	**(2.32)***	**1.719**	**(5.66)****	**0.984**	**(2.34)***	**1.713**	**(5.72)****	**0.899**	**(2.12)***	**1.697**	**(5.20)****
γ_3 (Whether East Asia) * $\hat{Y}_{it}$	0.083	(1.76)†	-	-	0.089	(1.84)†	-	-	0.093	(1.82)†	-	-
γ_3 (Middle East & North Africa) * $\hat{Y}_{it}$	-0.056	(-1.51)	-	-	-0.055	(-1.45)	-	-	-0.053	(-1.56)	-	-
γ_3 (Sub Saharan Africa) * $\hat{Y}_{it}$	0.178	(3.28)**	-	-	0.184	(3.08)**	-	-	0.194	(3.05)**	-	-
γ_3 (Latin America & Caribbean) * $\hat{Y}_{it}$	0.134	(3.30)**	-	-	0.130	(3.03)**	-	-	0.136	(3.29)**	-	-
γ_3 (South Asia)* $\hat{Y}_{it}$	0.162	(2.59)*	-	-	0.173	(2.48)*	-	-	0.174	(2.39)*	-	-
γ_4 (An Index of Biophysical Constraints)	-	-	0.911	(2.69)**	-	-	0.995	(2.86)**	-	-	0.993	(2.60)*
δ (Constant)	3.356	(1.57)	0.355	(0.26)*	2.845	(1.19)	0.018	(0.01)	3.212	(1.38)	0.227	(0.17)

Number of observations	77		77		77		77		73		73	
Joint Significant Test	F(7,69)=82.61**		F(3,73)=109.83**		F(7,69)=73.37**		F(3,73)= 106.78**		F(7,65)=84.79**		F(3,69)= 99.44**	
R^2	0.7806		0.7337		0.7683		0.7417		0.7814		0.7338	
Variant 2 : Dep. Variable: log (Poverty Gap) [3]												
Second Stage ($P_{1\ it}$)												
γ_1 **log (per capita GDP) t**	**-0.813**	**(-4.09)****	**-0.735**	**(-4.77)****	**-0.747**	**(-3.22)****	**-0.663**	**(-4.20)****	**-0.730**	**(-3.31)****	**-0.652**	**(-4.24)****
γ_2 **(log of Gini Coefficient of Income)**	**1.310**	**(2.56)***	**2.392**	**(5.76)****	**1.397**	**(2.56)***	**2.38**	**(5.80)****	**1.304**	**(2.39)***	**2.383**	**(5.41)****
γ_3 (Whether East Asia) * $\hat{Y}_{it}$	0.061	(1.35)	-	-	0.069	(1.46)	-	-	0.076	(1.48)	-	-
γ_3 (Middle East & North Africa) * $\hat{Y}_{it}$	-0.067	(-1.71)†	-	-	-0.064	(-1.59)	-	-	-0.060	(-1.70)†	-	-
γ_3 (Sub Saharan Africa) * $\hat{Y}_{it}$	0.199	(2.77)**	-	-	0.211	(2.66)**	-	-	0.236	(3.00)**	-	-
γ_3 (Latin America & Caribbean) * $\hat{Y}_{it}$	0.161	(3.27)**	-	-	0.156	(3.00)**	-	-	0.162	(3.26)**	-	-
γ_3 (South Asia)* $\hat{Y}_{it}$	0.117	(1.47)	-	-	0.135	(1.50)	-	-	0.145	(1.56)	-	-
γ_4 (An Index of Biophysical Constraints)	-	-	0.997	(2.21)*	-	-	1.127	(2.45)*	-	-	1.219	(2.51)*
δ (Constant)	1.185	(0.43)	-3.043	(-1.67)	0.384	(0.12)	-3.564	(-2.04)	0.559	(0.18)	-3.667	(-2.05)
Number of observations	77		77		77		77		73		73	
Joint Significant Test	F(7,69)=61.82**		F(3,73)=93.75**		F(7,69)=57.08**		F(3,73)=93.15**		F(7,65)=61.92**		F(3,69)=89.84**	
R^2	0.7406		0.7032		0.7319		0.8151		0.7451		0.7147	

Note: 1 ** denote significance at 1 % level, * denotes at 5 % level and † at 10 % level.
2. The Huber/White/sandwich estimator of variance is used to adjust for heteroscedasticity.
3. As the first-stage results for Variant 2 are identical to those for Variant 1, these are omitted.

Table 2 2SLS Estimation Results (based on GLS Random-Effects Model) for Poverty Head Count Ratio and Poverty Gap ($1 a day at 1993 PPP) for Panel Data

	Case 1: Openness: *Isolation Index*				Case 2: Openness: *Sachs & Warner Index*				Case 3: Openness: *Frankel & Romer Index*			
	Case 1-A With $D_i \cdot Y_{ait-1}$		Case 1-B Without $D_i \cdot Y_{ait-1}$		Case 2-A With $D_i \cdot Y_{ait-1}$		Case 2-B Without $D_i \cdot Y_{ait-1}$		Case 3-A With $D_i \cdot Y_{ait-1}$		Case 3-B Without $D_i \cdot Y_{ait-1}$	
First Stage: Dep. Variable: log (Per Capita GDP) t	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]	Coef.	(t value) [1, 2]
β_1 **log (Per Capita Agricultural Production Value Added) t-1**	**0.675**	**(8.02)****	**0.759**	**(9.85)****	**0.634**	**(7.40)****	**0.785**	**(9.58)****	**0.706**	**(7.96)****	**0.915**	**(10.91)****
β_2 **(Openness Indicator)**	**0.229**	**(1.58)**	**0.843**	**(6.49)****	**0.171**	**(1.71)†**	**0.409**	**(4.36)****	**0.008**	**(1.96)***	**0.010**	**(2.39)***
β_3 **(log of Gini Coefficient of Income)**	**0.301**	**(1.66)†**	**0.359**	**(2.62)***	**0.232**	**(1.27)**	**0.336**	**(2.30)***	**0.421**	**(2.33)***	**0.442**	**(2.95)***
β_4 (Whether East Asia)* Y_{ait-1}	-0.146	(-4.37)**	-	-	-0.137	(-4.14)**	-	-	-0.139	(-4.12)**	-	-
β_4 (Middle East & North Africa) * Y_{ait-1}	-0.055	(-1.51)	-	-	-0.050	(-1.37)	-	-	-0.080	(-2.12)*	-	-
β_4 (Sub Saharan Africa) * Y_{ait-1}	-0.254	(-8.45)**	-	-	-0.250	(-8.20)**	-	-	-0.293	(-8.86)**	-	-
β_4 (Latin America & Caribbean) * Y_{ait-1}	-0.022	(-0.74)	-	-	-0.012	(-0.40)	-	-	-0.035	(-1.23)	-	-
β_4 (South Asia)* Y_{ait-1}	-0.258	(-6.98)**	-	-	-0.254	(-6.81)**	-	-	-0.256	(-6.51)**	-	-
β_5 (An Index of Biophysical Constraints)	-	-	-1.406	(-10.43)**	-	-	-1.260	(-9.17)**	-	-	-1.245	(-8.35)**
α (Constant)	2.831	(3.52)	2.00	(3.16)	3.269	(4.06)	2.015	(2.95)	2.268	(2.79)	0.997	(1.45)
Number of observations	217		217		217		217		203		203	
Joint Significant Test Wald Chi^2(8 (or 4))	479.00**		385.00		411.00**		332.00*		398.48**		292.57**	

Variant 1 : Dep. Variable: log (Head Count Ratio) Second Stage ($P_{0\,it}$)	Coef.	(t value)	Coef.	(t value)	Coef.	(t value)	Coef.	(t value)	Coef.	(t value)	Coef.	(t value)
γ_1 **log (per capita GDP) t**	**-1.719**	**(-2.23)***	**-1.133**	**(-3.16)**	**-1.647**	**(-2.33)***	**-1.287**	**(-3.42)****	**-3.115**	**(-4.56)****	**-1.870**	**(-4.72)****
γ_2 **(log of Gini Coefficient of Income)**	**5.255**	**(6.24)****	**6.284**	**(9.12)****	**5.426**	**(6.42)****	**6.368**	**(9.26)****	**5.208**	**(6.66)****	**6.528**	**(9.51)****
γ_3 (Whether East Asia) * $\hat{Y}_{it}$	0.423	(3.74)**	-	-	0.418	(3.76)**	-	-	0.311	(2.81)**	-	-
γ_3 (Middle East & North Africa) * $\hat{Y}_{it}$	0.068	(0.51)	-	-	0.067	(0.52)	-	-	-0.053	(-0.44)	-	-
γ_3 (Sub Saharan Africa) * $\hat{Y}_{it}$	0.155	(0.66)	-	-	0.159	(0.74)	-	-	-0.241	(-1.04)	-	-
γ_3 (Latin America & Caribbean) * $\hat{Y}_{it}$	0.309	(3.45)**	-	-	0.295	(3.28)**	-	-	0.300	(3.58)**	-	-
γ_3 (South Asia)* $\hat{Y}_{it}$	0.479	(2.03)*	-	-	0.488	(2.23)*	-	-	0.089	(0.40)	-	-
γ_4 (An Index of Biophysical Constraints)	-	-	1.82	(2.16)*	-	-	1.571	(1.82)†	-	-	0.638	(0.68)
δ (Constant)	-7.453	(-1.15)	-14.666	(-4.67)	-8.553	(-1.42)	-13.804	(-4.33)**	3.399	(0.60)	-9.937	(-3.06)
Number of observations	217		217		217		217		203		203	

Joint Significant Test Wald Chi^2(7 (or 3))	211.68**		168.60**		201.81**		173.21**		256.20**		178.78**	
Overall R^2	0.6037		0.5838		0.5996		0.5873		0.6642		0.6006	
Variant 2 : Dep. Variable: log (Poverty Gap) [3]												
Second Stage ($P_{1\ it}$)												
γ_1 **log (per capita GDP) t**	**-1.892**	**(-2.70)****	**-1.220**	**(-3.82)****	**-1.759**	**(-2.74)****	**-1.319**	**(-3.91)****	**-2.682**	**(-4.24)****	**-1.719**	**(-4.93)****
γ_2 **(log of Gini Coefficient of Income)**	**4.881**	**(6.48)****	**5.992**	**(9.93)****	**5.001**	**(6.66)****	**6.045**	**(10.00)****	**4.725**	**(6.62)****	**6.094**	**(10.11)****
γ_3 (Whether East Asia) * $\hat{Y}_{it}$	0.331	(3.13)**	-	-	0.337	(3.27)**	-	-	0.262	(2.50)*	-	-
γ_3 (Middle East & North Africa) * $\hat{Y}_{it}$	-0.022	(-0.18)	-	-	-0.013	(-0.11)	-	-	-0.089	(-0.78)	-	-
γ_3 (Sub Saharan Africa) * $\hat{Y}_{it}$	0.093	(0.43)	-	-	0.123	(0.63)	-	-	-0.114	(-0.53)	-	-
γ_3 (Latin America & Caribbean) * $\hat{Y}_{it}$	0.288	(3.52)**	-	-	0.281	(3.46)**	-	-	0.288	(3.68)**	-	-
γ_3 (South Asia)* $\hat{Y}_{it}$	0.330	(1.53)	-	-	0.363	(1.82)†	-	-	0.106	(0.52)	-	-
γ_4 (An Index of Biophysical Constraints)	-	-	1.553	(2.06)*	-	-	1.385	(1.79)†	-	-	0.846	(1.02)
δ (Constant)	-5.686	(-0.97)	-14.012	(-5.01)	-7.119	(-1.31)	-13.451	(-4.71)	0.916	(0.18)	-10.593	(-3.71)
Number of observations	217		217		217		217		203		203	
Joint Significant Test Wald Chi^2(7 (or 3))	223.16**		199.62**		217.68**		202.01**		256.44**		209.29**	
Overall R^2	0.6227		0.6241		0.6206		0.6256		0.6716		0.6420	

Note: 1 ** denote significance at 1 % level, * denotes at 5 % level and † at 10 % level.
2. The Huber/White/sandwich estimator of variance is used to adjust for heteroscedasticity.
3. As the first-stage results for Variant 2 are identical to those for Variant 1, these are omitted.

Table 3 Elasticity of Poverty Head Count Ratio/ Poverty Gap ($1 a day at 1993 PPP) with respect to Per Capita Agricultural Production [*1]

	Poverty Head Count Ratio		Poverty Gap	
Estimation Method:	**Cross-Section**	**Panel**	**Cross-Section**	**Panel**
East Asia	**-0.545**	**-0.686**	**-0.635**	**-0.826**
Middle East and North Africa	**-0.688**	**-1.024**	**-0.771**	**-1.187**
Sub-Saharan Africa	**-0.428**	**-0.658**	**-0.477**	**-0.757**
Latin America and Caribbean	**-0.569**	**-0.921**	**-0.624**	**-1.047**
South Asia	**-0.422**	**-0.517**	**-0.518**	**-0.651**
Eastern Europe and Central Asia	**-0.665**	**-1.160**	**-0.741**	**-1.277**
Whole Sample	**-0.553**	**-0.828**	**-0.628**	**-0.958**

[1] Elasticities of poverty indices with respect to per capita agricultural income are based on the results of both first and second stage regressions in Case 1-A in Table 1 and Table 2. Regional differences are taken into account by the coefficients of interaction terms.

Table 4 Simulation Results on the Feasibility of Millennium Development Goal - Disaggregation by Area

AREA	Head -count* Ratio (%) 1990	Pov-erty Gap* (%) 1990	Actual Annual Growth Rate of GDP per capita 1985-2000 (%)	Actual Annual Growth Rate of Agricultural Income per capita1985-2000 (%)				Required Rate of Agricultural Production Growth for Halving Poverty*1 *2 (%)				Required Rate of GDP Growth for Halving Poverty*1 *2 (%)			
								(Headcount Ratio)		(Poverty Gap)		(Headcount Ratio)		(Poverty Gap)	
								Cross-Section	Panel	Cross-Section	Panel	Cross-Section	Panel	Cross-Section	Panel
								Required Growth Rate of Agricultural Production per capita		Required Growth Rate of Agricultural Production per capita		Required Growth Rate of GDP per capita		Required Growth Rate of GDP per capita	
				Aver-age	Max	Min.	CV*3 (%)								
East Asia	27.58	7.64	**3.79**	**0.90**	2.57	-1.01	198	**5.09**	**4.04**	***4.37***	***3.36***	***4.29***	2.14	3.69	1.78
Middle East and North Africa	2.39	0.46	**0.98**	**2.14**	4.66	0.79	226	**4.03**	**2.71**	***3.60***	***2.34***	***3.53***	***1.68***	***3.15***	***1.45***
Sub-Saharan Africa	47.67	20.36	**0.41**	**0.47**	3.01	-2.65	1390	**6.48**	**4.21**	***5.81***	***3.66***	***5.03***	***1.77***	***4.52***	***1.54***
Latin America and Caribbean	16.80	5.95	**1.26**	**0.74**	3.92	-0.94	749	**4.87**	**3.01**	***4.44***	***2.65***	***4.66***	***1.97***	***4.25***	***1.73***
South Asia	44.01	12.00	**2.83**	**1.08**	2.28	0.6	389	**6.57**	**5.36**	***5.35***	***4.26***	***4.89***	2.24	***3.98***	1.78
Eastern Europe and Central Asia	1.56	0.99	**-1.36**	**-1.07**	6.78	-8.93	296	**4.17**	**2.39**	***3.74***	***2.17***	***3.80***	***1.61***	***3.41***	***1.47***
Total	28.95	8.97	**0.62**	**0.30**	6.78	-8.93	–	***5.02***	***3.35***	***4.42***	***2.90***	***4.30***	***1.87***	***3.77***	***1.61***

Notes: *1 Simulations are based on the Besley- Burgess formula.
*2 Required growth rates *exceeding* actual growth rates are italicized in bold.
*3 CV denotes coefficient of variation of annual agricultural growth rates over the period 1985-2000.

Table 5 Simulation Results on the Feasibility of Millennium Development Goal for Different Distributional Assumptions *1 *2

AREA	Poverty Headcount ratio (%)					Poverty Gap (%)				
	MDG	Distri-bution un-changed	Gini Coef 10% de-creased	Gini Coef 20% de-creased	Gini Coef 30% de-creased	MDG	Distri-bution un-changed	Gini Coef 10% de-creased	Gini Coef 20% de-creased	Gini Coef 30% de-creased
East Asia	**13.8**	*7.9*	4.4	2.2	1.0	**3.8**	2.2	1.7	1.3	0.9
Middle East and North Africa	**1.2**	0.5	0.3	0.1	0.1	**0.2**	0.2	0.1	0.1	0.1
Sub-Saharan Africa	**23.8**	***37.0***	***24.2***	17.1	8.0	**10.2**	***14.3***	11.1	8.3	6.0
Latin America and Caribbean	**8.4**	***12.4***	6.9	3.5	1.6	**3.0**	***3.6***	2.8	2.1	1.5
South Asia	**22.0**	***25.2***	14.1	7.2	3.3	**6.0**	5.3	4.2	3.1	2.2
Eastern Europe and Central Asia	**0.8**	0.8	0.6	0.5	0.3	**0.5**	0.3	0.2	0.1	0.04
Total	**14.5**	***15.2***	9.7	6.6	3.0	**4.5**	***5.8***	4.5	3.4	2.4

Notes: *1 Simulations are based on panel data estimates of relevant elasticities and extrapolation of growth rates observed over the period 1985-99. Further details will be furnished on request.
*2 Head count and poverty gap ratios that are above the MDG are italicized in bold.

Table 6 Simulations on the Feasibility of Millennium Development Goal for Selected Countries–Growth and Distribution [*1 *2]

India	Sachs-Warner	=0 (1 open, 0, closed)	Isolation Index	=0.22 open, closed)	(1 0	Frankel-Romer Index	=3.29 (min 2.3, max, 68.18, average, 14.61)	Biophysical Constraints	=0.7 (1 constrained, 0, unconstrained)

	Per capita GDP average growth rate (1985-1998) (%)				3.7		
	Per capita agricultural production average growth rate (1985-1998) (%)				0.7		
	Head Count Ratio (1990)	46.6		Poverty Gap (1990)		12.8	
	Head Count Ratio (1998)	44.2		Poverty Gap (1998)		12.0	
	MDG of Head Count Ratio	23.3		MDG of Poverty Gap		6.4	

Prediction for 2015	Head Count Ratio Distribution Unchanged	Gini Coef. 10% Decreased	Gini Coef. 20% Decreased	Gini Coef. 30% Decreased	Poverty Gap Distribution Unchanged	Gini Coef. 10% Decreased	Gini Coef. 20% Decreased	Gini Coef. 30% Decreased
Actual Growth Rates	***33.7***	18.4	9.4	4.4	6.3	4.9	3.6	2.6
20 % higher	***25.9***	14.3	7.28	3.39	5.2	4.0	3.0	2.1
30% higher	22.93	12.7	6.5	3.0	4.7	3.6	2.7	1.9
Open Policy (If Sachs-Warner becomes 1)	***26.1***	14.4	7.3	3.4	5.2	4.0	3.0	2.2

China

	per capita GDP average growth rate (1985-1998) (%)				8.1		
	per capita agricultural production average growth rate (1985-1998) (%)				3.2		
	Head Count Ratio (1990)	33.9		Poverty Gap (1990)		10.5	
	Head Count Ratio (1998)	16.9		Poverty Gap (1998)		4.9	
	MDG of Head Count Ratio	17.0		MDG of Poverty Gap		5.2	

Prediction for 2015	Head Count Ratio Distribution Unchanged	Gini Coef. 10% Decreased	Gini Coef. 20% Decreased	Gini Coef. 30% Decreased	Poverty Gap Distribution Unchanged	Gini Coef. 10% Decreased	Gini Coef. 20% Decreased	Gini Coef. 30% Decreased
Actual Growth Rate	8.6	4.9	2.5	1.2	2.6	2.0	1.5	1.1
20 % higher	4.6	2.6	1.3	0.6	1.5	1.2	0.9	0.6
30% higher	3.4	1.9	1.0	0.5	1.2	0.9	0.7	0.5
Open Policy (If Sachs-Warner becomes 1)	4.8	2.7	1.4	0.6	1.6	1.3	0.9	0.7

The Philippines	Sachs-Warner	=1 (1 open, 0, closed)	Isolation Index	=1 (1 open, 0 closed)	Frankel-Romer Index	=8.84 (min 2.3, max, 68.18, average, 14.61)	Biophysical Constraints	=1 (1 constrained, 0, unconstrained)
	Per capita GDP average growth rate (1985-1998) (%)					0.33		

Per capita agricultural production average growth rate (1985-1998) (%)	-0.01
Head Count Ratio (1988)	18.3
Head Count Ratio (1997)	18.4
MDG of Head Count Ratio	9.1
Poverty Gap (1988)	3.6
Poverty Gap (1997)	3.8
MDG of Poverty Gap	1.8

Prediction for 2015	Head Count Ratio				Poverty Gap			
	Distribution	Gini Coef.	Gini Coef.	Gini Coef.	Distribution	Gini Coef.	Gini Coef.	Gini Coef.
	Unchanged	10% Decreased	20% Decreased	30% Decreased	Unchanged	10% Decreased	20% Decreased	30% Decreased
Actual Growth Rate	***14.4***	7.9	4.0	1.9	***3.1***	***2.4***	1.8	1.3
20 % higher	***14.1***	7.8	4.0	1.8	***3.0***	***2.4***	1.8	1.3
30% higher	***14.0***	7.7	3.9	1.8	***3.0***	***2.3***	1.7	1.3

Zambia	Sachs-Warner	=0 (1 open, 0, closed)	Isolation Index	=0 (1 open, 0 closed)	Frankel-Romer Index	=13.81 min 2.3, max, 68.18, average, 14.61)	Biophysical Constraints	=0.86(1 constrained, 0, unconstrained)

Per capita GDP average growth rate (1985-1998) (%)	-0.02
Per capita agricultural production average growth rate (1985-1998) (%)	-0.0007
Head Count Ratio (1990)	58.6
Head Count Ratio (1996)	72.6
MDG of Head Count Ratio	29.3
Poverty Gap (1990)	31.0
Poverty Gap (1996)	37.7
MDG of Poverty Gap	15.5

Prediction for 2015	Head Count Ratio				Poverty Gap			
	Distribution	Gini Coef.	Gini Coef.	Gini Coef.	Distribution	Gini Coef.	Gini Coef.	Gini Coef.
	Unchanged	10% Decreased	20% Decreased	30% Decreased	Unchanged	10% Decreased	20% Decreased	30% Decreased
Actual Growth Rate	***62.0***	***34.1***	17.4	8.1	***19.6***	15.1	11.3	8.1
20 % higher	***27.4***	15.0	7.7	3.6	10.0	7.7	5.8	4.2
30% higher	***26.9***	14.7	7.5	3.5	9.9	7.6	5.7	4.1
Open Policy (If Sachs-Warner becomes 1)	***31.4***	17.2	8.7	4.1	11.2	87	6.5	4.2

Brazil	Sachs-Warner	=1 (1 open, 0, closed)	Isolation Index	=0.34 (1 open, 0 closed)	Frankel-Romer Index	=3.03 (min 2.3, max, 68.18, average, 14.61)	Biophysical Constraints	=0.45 (1 constrained, 0, unconstrained)

Per capita GDP average growth rate (1985-1998) (%)	1.2

	Per capita agricultural production average growth rate (1985-1998) (%)					1.2		
	Head Count Ratio (1990)		20.8			Poverty Gap (1990)	7.3	
	Head Count Ratio (1996)		14.9			Poverty Gap (1998)	1.3	
	MDG of Head Count Ratio		10.4			MDG of Poverty Gap	3.7	

Prediction for 2015	Head Count Ratio Distribution Unchanged	Gini Coef. 10% Decreased	Gini Coef. 20% Decreased	Gini Coef. 30% Decreased	Poverty Gap Distribution Unchanged	Gini Coef. 10% Decreased	Gini Coef. 20% Decreased	Gini Coef. 30% Decreased
Actual Growth Rate	***16.0***	8.8	4.5	2.1	3.1	2.4	1.8	1.3
20 % higher	***14.5***	8.0	4.1	1.9	2.8	2.2	1.6	1.2
30% higher	***13.8***	7.6	3.9	1.8	2.7	2.1	1.6	1.1

Notes: *1 Simulation results are based on panel data estimates of relevant elasticities and extrapolation of growth rates. Details will be furnished on request.
*2 Values of poverty indices above the MDG are italicized in bold.

Annex: Role of Agriculture in Developing Countries

(a) Share of Agriculture

Even though agriculture accounts for a (relatively) low share of GDP in some regions (e.g. Middle East and North Africa, and Latin America and the Caribbean), it accounts for a higher share of total employment. In South Asia, for example, it contributed more than 60 per cent of total employment in the 1990s. Moreover, it is also a major source of foreign exchange earnings (e.g. in South Asia, Middle East and North Africa, and Sub-Saharan Africa). In most regions, except Middle East and North Africa, the share of agricultural exports has changed little or stagnated.

Table A-1 Shares of Agriculture in Output, Employment and Trade (Averages in 1980s and 1990s) (%)

	Share of Agricultural Value Added In Total GDP		Share of Employment in Agriculture Sector In total Employment		Share of Agricultural Import in Total Export		Share of Agricultural Export in Total Export	
	1980s	1990s	1980s	1990s	1980s	1990s	1980s	1990s
East Asia	30.30	23.82	49.28	43.95	13.16	12.37	7.60	7.35
South Asia	32.93	27.68	62.57	60.34	20.63	19.88	12.90	12.82
Middle East and North Africa	12.67	13.90	31.44	25.64	6.14	7.39	13.39	27.45
Sub-Saharan Africa	29.47	29.55	60.53	61.11	32.15	32.29	12.19	12.01
Latin America & Caribbean	13.86	13.78	17.29	17.95	24.54	23.72	8.77	8.55
East Europe & Central Asia	14.32	14.99	25.90	25.72	9.61	9.61	4.49	6.02
Total Average	21.88	20.12	39.32	36.99	23.23	22.67	10.27	11.53

Source: Constructed from World Development Indicator and FAO data (FAO STAT in 2002).

(b) Land Productivity

Table A-2 draws attention to wide divergence in land productivity at the regional level, with the highest output per hectare in East Asia and lowest in Sub-Saharan Africa. What is worse, land productivity has changed little or stagnated in almost all regions.

Table A-2 Change of Agricultural Output per hectare（US$ in 1995)

AREA	1981-89 Average	1990-99 Average
East Asia	2044.55	2079.34
South Asia	552.80	569.12
Middle East & North Africa	692.20	710.48
Sub-Saharan Africa	93.43	92.67
Latin America & Caribbean	378.14	367.16
East Europe & Central Asia	545.13	536.60
Average	537.31	530.79

Source: Constructed from World Development Indicator and FAO data (FAO STAT in 2002).