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Could a Global Marshall Plan be Successful? An Investigation Using The WEEP Simulation Model

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Summary. — Using the WEEP simulation model ("World Economic Equalization Program"), this research examines the potential impact of a very large-scale foreign development assistance program (a "global Marshall Plan") on the future development of the world economy. The benchmark simulations of the model indicate a dramatic reduction in world economic inequality, at the cost of a very minor retardation in the economic growth of the rich countries. Sensitivity analysis demonstrates that with certain key exceptions, these optimistic results are reasonably robust against parametric variation.

Key words — international investment, long-term capital movements, foreign aid, international finance forecasting and simulation, planning models, planning policy

1. INTRODUCTION

The remarkable developments of the early 1990s in the ex-Soviet Union and the Eastern European countries have fundamentally transformed international relations. The monopoly on political power and social authority held by the various communist parties of these countries was broken, and democratic multiparty systems have been established, featuring contested elections for high state positions, and meaningful observance of rights of free speech and free press. The abolition of socialism and the restoration of capitalism, so much feared by the communist leadership during the Cold War, has in fact taken place—not through outside intervention—but through the voluntary choice of the citizens of these countries. While it is by no means completely inconceivable that the Russian Federation, along with other components of the old Soviet bloc, will at some point in the future revert to the aggressive communism of the Cold War decades, and/or that the People's Republic of China will do the same, the currently dominant consensus is that the Cold War is definitely finished and that ideological conflict between communism and non-communism will never again become a major contributor to international tension.

In historical context, ideological conflict has been a relatively recent contributor to international tension. Several other contributors long predated ideology and promise to long postdate it as well. Among these are religious differences, cultural differences, racial differences, linguistic differences, and disparities in economic welfare. Now that the Cold War is finished, arguably economic welfare disparities have taken over as the single most important potentially rectifiable impediment to the peaceful and harmonious advance of global human civilization. The reason for this is the inherent attractiveness to the large majority of the world's population of a potential program of drastic income redistribution from the rich countries to the poor countries. The attractiveness of this potential program does not depend entirely on its direct material benefit to the huge number of poor people throughout the world. It also depends on the fact (as unpalatable as it may be to people in the rich countries) that a fairly strong case could be made for global redistribution in terms of moral philosophy.

A truly disinterested moral philosopher (brought in, say, from a hypothetical intelligent species resident on another planet) might find it

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not merely troubling but fully unacceptable that at the same time that much of the world's human population lives in desperate poverty, a relatively small minority enjoys living standards that would be regarded as extravagantly luxurious by the poor. An obvious solution to the problem would be a global minimum income standard, that would benefit mostly people in the poor countries, to be financed by a progressive income tax that would fall most heavily on people in the rich countries. [1] A moral philosopher from one of the rich countries could and would uncover a number of objections to global income redistribution—but, of course, a moral philosopher from a rich country is not a disinterested party. Not that the attitude of the poor people of the world would be any different, were they to magically change places with the rich people of the world. It is simply asking too much of human benevolence to propose that the rich people of the world subject themselves voluntarily to heavy taxation the purpose of which would be to benefit poor people in other countries. So long as the rich countries possess the military means to deter and forestall global income redistribution, they will do so. Of course, the maintenance of military forces of adequate strength to deter the poor countries from entertaining notions of forcible redistribution of world income is not a cost-free proposition to the rich countries, either financially or psychologically.

If the global economic gap were smaller, presumably less reliance would be needed on military power. Among visionaries, the notion of a massive, coordinated, worldwide effort to ameliorate the economic gap—along the lines of the post-WW II Marshall Plan but far more ambitious both financially and geographically—has a long history (see, for example: Barr, 1953; Church, 1978; Melman, 1961). By means of large-scale capital transfers from the rich countries to the poor countries, the living standards of the latter countries would (over a period of time probably in the order of several decades) be raised to levels comparable to those in the rich countries. Ideally the economic transfers would involve little or nothing in the way of consumption commodities—the idea is rather to endow the poorer countries with sufficient capital and other resources that they themselves could produce quantities of consumption goods comparable to those being produced in the rich countries. Were such a program of large-scale transfers to be successful, this would greatly reduce the importance of economic disparities among countries as a source of international tension, instability and conflict.

For as long as the basic idea of a global Marshall Plan has been advanced, however, the idea has been routinely disparaged and rejected as clearly impractical. For example, in his 1978 essay in *Time Magazine* entitled "The Case for a Global Marshall Plan," George J. Church quotes West German Economics Minister Count Otto Lambsdorff as follows: "I do not believe that a kind of Marshall Plan for the Third World—which today would have to be shouldered jointly by the US, Europe and Japan—is a feasible solution." It could be argued, in support of the infeasibility of a global Marshall Plan, that there has never been any significant economic evidence presented that suggests that even a very greatly expanded program of foreign development assistance could make significant inroads against the problem of world economic inequality within a reasonable period of historical time.

The purpose of this article is to present just such evidence. The evidence is derived from computer simulations of a model designed to examine the potential effect of very large investment capital transfers from the rich countries to the poor countries. Transfers of this magnitude would clearly amount to a global Marshall Plan: such a program is dubbed herein the World Economic Equalization Program (WEEP). Evidence from the WEEP model simulations is definitely optimistic—it suggests that a sufficiently ambitious program of transfers could be a spectacular success that within a 50-year planning period would reduce the world poverty problem to a small fraction of its present dimensions.

Conventional opinion among professional economists, especially those resident in the more prosperous countries, holds that a massive world economic development program would almost certainly result in massive waste. Although some minor progress might be made by some of the less developed countries (LDCs), a heavy price would be paid by the taxpayers of the wealthy countries, the principal beneficiaries of the effort would surely be an army of corrupt bureaucrats and dishonest businessmen, and the overall net impact of a tremendous resource flow on the world poverty problem would be minimal. Of course, the possibility exists that the conventional pessimistic judgment on this matter is merely a superficial rationalization of short-sighted self-

ishness. What is especially unfortunate about this particular rationalization is not so much that it manifests a fundamental human vice—but rather that it is very possibly based on two seriously mistaken premises: (a) that such a program would impose heavy costs on the rich countries; (b) that such a program would have little beneficial impact on the poor countries.

The evidence presented here disputes both of these premises. This evidence suggests: (i) that a World Economic Equalization Program would not seriously impinge on the continued economic progress of the wealthy countries, (ii) at the same time such a program would indeed dramatically accelerate the economic progress of the poor countries. The research reported here builds upon my earlier work on the subject contained in *Common Progress: The Case for a World Economic Equalization Program* (Yunker, 2000). Although the same basic model and data are utilized, there are some significant enhancements. Five years of additional data have become available: in the earlier contribution the validation period is 1970–95, whereas here the validation period is 1970–2000. The policy simulation period has been changed: 1970–2020 in the earlier contribution to 2000–50 in the present contribution. Needless to emphasize, there have been major changes in the relative economic positions of the countries during 1970–2000, so that a policy simulation from 2000 to 2050 provides better illumination on a potential WEEP commenced in the relatively near future. In addition, results are obtained based on purchasing power parity (PPP) measures of national income, in addition to conventional exchange rate measures. As is well known, the relative economic status of countries is quite different as between conventional national income measures and PPP national income measures. Since data on PPP national income are available only from 1975, the validation period is shorter than with conventional national income: 1975–2000 rather than 1970–2000. But policy simulations for 2000–50 are done using both measures. This report compares PPP measure results with conventional measure results.

Obviously no evidence based on computer simulations of economic models is ever conclusive: too often there are large gaps between model specifications and reality. Moreover, it is shown via sensitivity analysis that the positive results obtained from benchmark computer simulations of the WEEP model are heavily dependent on the numerical value of two critical parameters of the model. If these parameters depart substantially from their benchmark values, the results achieved from the WEEP simulations become drastically degraded, to the point where the conventional pessimistic prognostications are largely supported. Nevertheless, what these simulations do clearly demonstrate is that a World Economic Equalization Program *might* be successful in achieving its purposes. The implication is that the only way to determine more or less conclusively whether a real-world WEEP would in fact be successful would be to apply the same experimental method that has been so instrumental to the advance of knowledge in the physical sciences. The program could be initiated and pursued for a reasonable period of time sufficient to derive strong empirical inferences concerning its long-run success probability. If the indications from a 10–15 year experiment are unpromising, then the program could be drastically curtailed or even abandoned altogether. If the experiment were to fail, to be sure it would be an expensive failure. But failure would lay to final rest any residual suspicions that it is primarily the selfishness of the rich countries that forestalls worldwide economic equalization.

The remainder of the article is organized as follows. Section 2 briefly reviews a selection of relevant economic literature. Section 3 informally describes the economic theory underlying the WEEP model used to evaluate the potential performance of a global Marshall Plan. Section 4 discusses numerical implementation of the model using World Bank data, and setting model parameters so as to produce a reasonable fit of the model output to the empirical data over the validation interval 1970–2000. Section 5 presents the benchmark policy simulations for the planning interval 2000–50. These results suggest that the impact of such a program on the world economic inequality situation could be extremely beneficial. Section 6 considers the sensitivity of the results to parametric variation. For most parameters the favorable results are fairly robust against parametric variation. For at least two critical parameters, however, unfavorable values could have a seriously adverse effect. Section 7 briefly summarizes and evaluates the results.

2. RELEVANT ECONOMIC LITERATURE

While it is almost universally acknowledged by knowledgeable people that economic

inequality among the countries of the contemporary world is pronounced, and that this inequality constitutes an impediment to stable and cooperative international relations, opinions differ as to the nature and seriousness of the problem. [2] To begin with, per capita income figures based on the newer purchasing power parity (PPP) measurement indicate a much lower level of inequality among countries than do those based on conventional exchange rate measurement. Also on the optimistic side is the fact that according to reputable national income estimates of the World Bank, most countries of the world—with the dramatic exception of the countries of sub-Saharan Africa—are exhibiting respectable growth in terms of per capita income and other measures of economic well-being. Therefore if a certain level of per capita income is specified as the "poverty level," a steadily decreasing proportion of the world's population is living on less than that level of per capita income. In this sense, it can be argued that the "world poverty" problem is diminishing over time. Moreover, according to certain more sophisticated measures of economic inequality, the worldwide level of inequality has been declining over the recent past. [3]

On the other hand, even using PPP per capita income, the absolute gap between the richest countries and the poorest countries has been steadily increasing over the last few decades. And several other plausible indicators of economic inequality are also on the rise. Even if per capita income growth rates were generally higher among the poor countries than among the rich countries (a proposition for which there is no strong evidence at the present time), given the substantial disparities currently existing, it could take a very long period of time before convergence became noticeable. It is a peculiarity of geometric growth that even if a poorer country is growing at a substantially higher growth rate than a richer country, if the initial differential is large, a substantial number of periods will elapse during which the absolute differential will actually increase, even though eventually convergence will occur. For example, if initially a rich country has a per capita income 10 times greater than that of a poor country, then if per capita income in the rich country grows at a constant 1% per annum while per capita income in the poor country grows at a constant 2% per annum, it will require 234 years for convergence to occur, and the absolute gap in per capita income will continue to increase for 164 years (Yunker, 2000, Table 2.11). Such results suggest that if there is no major change in international policies toward global economic inequality, then a high level of inequality is likely to persist for a very long time, perhaps indefinitely.

The question is whether anything can be done about the situation. Specifically, could a very substantial increase in the foreign development assistance expenditures of the rich contributor countries (albeit a politically acceptable increase) generate a very substantial increase in the economic growth rates of the poor countries? The evidence adduced below from simulations of the WEEP model suggests that the answer to this question could well be in the affirmative. But obviously what would be a "politically acceptable" increase in foreign aid contributions by the rich countries would depend on prevalent expectations regarding the effect of the increase on the economic growth rate of the poor countries. The dominant consensus at the moment is that foreign aid has, if anything, a rather weak effect on the economic growth of the poor countries. Therefore there is little political pressure toward expanding foreign aid, and the likelihood that a global Marshall Plan will be undertaken in the foreseeable future is very small. This present-day political reality may change, however, if the consensus on which it is based were to change. In turn, this consensus could conceivably change—if substantive evidence that challenges it were to become widely known. Such substantive evidence, however, admittedly cannot be found in the existing economic literature on the effects of foreign aid.

A substantial economic literature has accumulated on the effects of foreign aid. [4] Evidence on the subject ranges from anecdotal narratives to comprehensive statistical investigations. Some case studies are horror stories in apparent mismanagement and waste, while others point to a high level of success. Some statistical studies have found significant positive effects of aid on growth, while others have not. Recent research by Burnside and Dollar (2000) aroused considerable interest because it seemed to confirm the plausible hypothesis that if a recipient country is practicing "good policy" (trade liberalization, fiscal conservatism, limited regulatory distortions, and so on), there will be a substantial positive effect of foreign aid on its growth, whereas if it not doing so, foreign aid will be of little economic benefit. But, the influence of this research may prove highly

ephemeral. An even more recent study by Easterly (2003) challenges the Burnside-Dollar results, among other things on the basis that they break down if just a few more years of data are added to the sample. Once again the fragility of statistical evidence supporting healthy effects of foreign aid has been demonstrated.

Of course it need not be surprising that it is difficult to find robust statistical evidence consistent with a positive impact of foreign aid on growth. A weak to nonexistent effect of foreign aid on economic growth would be expected by those on both ends of the opinion spectrum on this policy issue. Opponents of foreign aid attribute the situation to the inherent ineffectiveness of foreign aid: the political processes involved in its appropriation and application inevitably result in its misallocation, diversion and waste. Proponents of foreign aid, on the other hand, attribute the situation partly to misallocation (e.g., distributing aid on political grounds rather than economic grounds), but mostly to the numerical inadequacy of foreign aid. Neither of these viewpoints can be conclusively confirmed or confuted by econometric evidence because the data on which the econometric estimations are based have been generated by complex real-world processes that are far removed from the well-ordered and thoroughly controlled laboratory experiments of the natural sciences. What is important for present purposes, however, is simply the proposition that the fragility of econometric evidence supportive of the beneficial effects of foreign aid does not constitute compelling evidence against the potential effectiveness of a very large-scale global economic development effort—assuming that it were guided by sound economic analysis and a reasonable amount of common sense.

The WEEP model described and implemented in the following is a medium-scale model of the international economy in which the units are countries: 140 countries in the empirical implementation using conventional national income measures, and 142 countries in the empirical implementation using PPP national income measures. It is in the general tradition of several other international models such as the Link Project (Dutta, 1995; Hickman, 1983, 1991; Waelbroeck, 1976), the Globus model (Bremer, 1987), the Duchin–Lange model (Duchin & Lange, 1994), the WorldScan model (Nahuis, 1999), the Mercosur model (Diao & Somwaru, 2000), and the Ingenue model (Aglietta *et al.*, 2001). To the author's knowledge, however, none of these models has been designed specifically to examine foreign development assistance, nor have they ever been applied to this issue. For example, the Globus model focuses on political institutions and international trade, the Duchin–Lange model focuses on environmental issues, the Ingenue model examines the effect of differentials in demographic aging among countries, the Mercosur model analyzes the effects of the Southern Common Market on the member countries and nonmember countries. And so on. None of these models has considered the concept of a global Marshall Plan.

The WEEP model applied in this research differs from all prior world models in that both the foreign aid contributions of the donor countries and the foreign aid receipts of the recipient countries are endogenous variables. Possibly some of the prior world models could be modified in such a way as to be plausibly applied to the possibility of a global Marshall Plan: a massive international economic development effort aimed at achieving a high level of economic convergence within a foreseeable period of historical time. It would certainly be interesting to see how results obtained with other world models compare to those of the WEEP world model. Of course it would also be possible to expand the WEEP model itself to incorporate numerous additional variables. In its present stage, the WEEP model is obviously a preliminary effort. If it arouses sufficient interest, the model could and would be further developed and elaborated.

It is perhaps worthwhile to emphasize that although the World Economic Equalization Program (WEEP) under consideration in this paper is described as a "global Marshall Plan," neither this author, nor presumably others who have invoked this term, are under any illusions that the success of the real-world Marshall Plan of 1948–51, in and of itself, provides strong evidence that a global Marshall Plan would be similarly successful. [5] The differences are obvious and striking. The original Marshall Plan was completed within a period of only four years, and it accounted, over those four years, for only 1.18% of United States national income (Yunker, 2000, Table 2.1). The simulations of the WEEP model cover a 50-year period, and during that period US contributions into the transfer fund would probably fall into the range from 3.5% to 4.5% of national income (Table 3). A global Marshall Plan

would obviously call for a much greater commitment from the United States (and the other rich countries) because the problem is much greater. Just prior to the start of WW II, living standards in the Western European countries were only slightly lower than those in the United States, whereas today the gap in living standards between the richest and the poorest countries is many times as great as the gap between US–Western European living standards in the immediate prewar period. The purpose of the original Marshall Plan was simply to repair war damage, not to fundamentally re-constitute the economies of the recipient countries. Moreover, there was a critical political incentive to the original Marshall Plan: the US desire to build up strong military allies in Western Europe against the threat of communist expansion. Today, in the aftermath of the collapse of the Soviet Union, fears of communist expansion are a rapidly fading memory.

In the final analysis, all that can be said of the original Marshall Plan is that it constitutes a very vague and problematic adumbration of a potential future global Marshall Plan. Nevertheless, this vague and problematic adumbration—as a symbol of the potentialities that may reside in human intelligence and rationality—might eventually become a strong inspiration to action. But this would only happen if a sufficiently plausible case can be made that a global Marshall Plan could achieve its objectives without imposing excessive economic stress and strain on the populations of the rich contributor countries. This research is intended as a first step toward building that plausible case.

3. THE WEEP MODEL

The WEEP model (so designated because it pertains to the potential performance of a World Economic Equalization Program—WEEP) is a model of the world economy with countries as economic units and years as time periods. Intended for computer simulation, the model's purpose is to develop formal evidence on the potential performance of a very large-scale worldwide economic development assistance program. The model represents an effort to achieve a reasonable compromise between the diverse objectives of realistic economic content, tight focus on the main questions of interest, analytical simplicity, and computational convenience. Key elements of the model are the production function, the consumption function, the transfer allocation function determining each country's foreign aid contribution, and the share function determining each country's foreign aid receipts. Owing to the model's tight focus on foreign aid, the single model link between the national economies consists of transfers of generalized capital investment resources through the WEEP. The model does not encompass various other links between national economies such as foreign trade, private foreign investment, and private voluntary transfers.

Appendix A to this paper contains a list of parameters, initial conditions, endogenous variables and structural form equations of the WEEP model. In the interest of brevity, however, I will not provide here an explanation of the various mathematical details concerning the structure of the model and its setup for the simulations. These details are available to interested readers in *Common Progress*, cited earlier. For purposes of the present exposition, I will utilize symbolic notation for variables and parameters, but relationships involving these variables and parameters will be described in informal terms only.

The WEEP model production function is a Cobb-Douglas form in generalized capital and labor. Raw labor is proxied in the model by population P. It is an abstraction from reality, of course, to utilize population for productive labor, because the ratio of productive labor to total population is not the same over all countries. But, usage of labor force participation rates to infer productive labor from total population would be problematical, even if such rates were reliably available for all countries. Generalized capital (symbolized by K)—for which no empirical measures are currently available—is the value of all physical capital (plant and equipment) utilized in production, plus the value of all education and training inputs into the population, plus the value of all social infrastructure physical capital such as roads and schools. For each country at each point in time, output Y is a Cobb-Douglas function of population P (a proxy for productive labor), generalized capital K, the total factor productivity coefficient A, and the parameters α and β, representing respectively the output elasticity of generalized capital K and the output elasticity of population (labor) P.

Statistical data are utilized for Y and P in the numerical implementation of the model, but K,

generalized capital, represents a hypothetical construct for which existing statistical proxies such as "plant and equipment," even if they were reliably available for all countries, would not be appropriate. The most common economic understanding of the term "capital" is in terms of business physical capital: plant and equipment. Sometimes "capital" is broadened to include the value of socially owned capital. Of course there is much economic discussion and analysis of "human capital," albeit this discussion and analysis is rarely accompanied by empirical estimates of the monetary value of human capital. The term "generalized capital" encompasses direct productive capital such as business-owned plant and machinery, *plus* all types of social capital, *plus* all types of human capital. It represents the equivalent financial value of anything and everything (i.e., all reproducible inputs) that go into the aggregate productive process with the single exception of raw physical labor power. In addition to the usual "plant and equipment," to reiterate, it would definitely include the value of educational and training inputs into the labor force (human capital components) as well as the value of various publicly provided productive resources such as roads, bridges, dams, and schools (social capital components). At this point in time, there are no available empirical estimates of generalized capital. Despite this, it is a clearly defined concept, and could potentially be estimated by direct or indirect means. In fact the starting point of a WEEP model simulation lies in an estimate of the generalized capital stocks of the countries.

Generalized capital plays a pivotal role in the WEEP model. It is presumed: (a) that the extreme differentials in per capita output between countries in the contemporary world may be all or mostly attributed to extreme differentials in current endowments of generalized capital between countries; and (b) that generalized capital is transferable between countries, in the sense that a given investment in generalized capital may be installed in any country and it will have the same impact on production. The proposed WEEP is based on the hypothesis that most of the observed differences in output per capita ($y = Y/P$) across countries are the result of K differentials rather than A differentials. The program aims at influencing the future development of national K stocks: the K stocks of rich countries would grow at a slower rate in order that the K stocks of poor countries may grow at a faster rate.

Needless to emphasize, both of the above assumptions are highly controversial. As to the first, it has long been argued by many economists that the bulk of the productivity differentials in the world today may be attributed to imbedded political, cultural and institutional factors that are virtually impervious to human control. In other words, the main reason for observed differences in per capita output are total factor productivity differentials: these tend to be low for poor countries because of imbedded political, cultural and institutional conditions. To the extent that this hypothesis is valid, and per capita income differentials are in fact principally a result of A differentials rather than K differentials, it is intuitively evident that a WEEP would have limited impact on the world inequality problem. If the observed productivity differentials in the world today are the result of A differentials rather than K differentials, then a program such as the WEEP proposed herein—that would alter the future allocation of world investment in K as between countries—would have a very small impact on the distribution of production over countries. Quite simply, the program would be ineffective.

This possibility is encompassed in the WEEP model by a parameter designated ξ (the "productivity differential source coefficient"), which represents the proportion of the initial per capita income differentials that may be attributed to differentials in total initial factor productivity coefficients, as opposed to differentials in initial generalized capital stocks. The numerical range of ξ is between 0 (zero) and 1 (one). If $\xi = 0$, then all the A are equal and all differentials in per capita income are owing to differentials in generalized capital K. If $\xi = 1$, then every country has the same amount of initial K in proportion to initial output Y as every other country, and all differentials in initial per capita income are owing to differentials in the total factor productivity coefficient A. If ξ is between 0 and 1, then differentials in initial per capita income are partially owing to differentials in initial generalized capital stock and partially owing to differentials in initial total factor productivity coefficients. Simulation experimentation verifies that if the ξ parameter becomes too high, a WEEP would not be effective.

As to the second assumption (that generalized capital is transferable between countries), according to critics of foreign aid, only a small proportion of foreign aid is actually put to productive use, owing to high administrative

costs and/or to the diversion of significant resources to private uses through the machinations of dishonest businessmen and corrupt bureaucrats. Graft, corruption, dishonesty and malfeasance consumes the bulk of foreign aid (according to the critics), leaving very little left over for the intended purposes. This possibility is encompassed in the WEEP model by a parameter designated χ (the "conversion effectiveness coefficient"), which represents the proportion of each country's net share of the total transfer fund that is actually transformed effectively into generalized capital. The numerical range of χ is also between 0 (zero) and 1 (one). If $\chi = 1$, then all transfer shares are converted into generalized capital. If $\chi = 0$, then no transfer shares are converted into generalized capital. If χ is between 0 and 1, then the proportion χ of a recipient's transfer shares is converted into generalized capital, while the remainder $(1 - \chi)$ goes to waste—at least as far as the general population is concerned, albeit in practice it would probably be used to improve the current living standards of elite politicians, bureaucrats and businessmen. Once again, simulation experimentation verifies that if the χ parameter becomes sufficiently adverse (this time taking on too low a value rather than too high a value), a WEEP would not be effective.

An informal description of the basic workings of the WEEP model is as follows. At the start of each time period (i.e., year), there is determined for each country (via the Cobb-Douglas production function) a certain output level Y on the basis of population P, generalized capital K, and total factor productivity A. Once output Y in a certain country at a certain time period is produced, it is then allocated among four uses: military expenditure M, consumption C, gross transfer T, and domestic investment I. Military expenditure is assumed to be a fixed proportion of total output. Consumption is derived from a linear function of "disposable income," defined as total output less military expenditure. The gross transfer T is a proportion λ of the country's "residual," defined as total output less military expenditure and consumption. The remainder $(1 - \lambda)$ of the country's residual goes to domestic generalized capital investment I. The proportion λ for a particular country is determined by the country's "ratio," defined as the ratio of that country's per capita income to maximum per capita income (i.e., per capita income of the richest country in the world). [6] The "transfer allocation function" is designed so that richer countries have larger proportions of their residuals going into the total transfer fund. Another formula is derived to determine the share of each country in the total transfer fund. The share of each particular country is determined by two factors: its population and its "difference," the latter defined as the difference between the per capita consumption of the richest country in the world and the per capita consumption of that particular country. Transfer amounts and share amounts of each country are computed separately. The net transfer is the difference between the transfer amount and the share amount. This amount will be positive for rich countries and negative for poor ones. Positive net transfers are foreign aid donations; negative net transfers are foreign aid receipts. The model is completed by a set of equations representing transition from period t to period $t + 1$. These latter equations introduce a number of additional parameters, one of which is χ (the "conversion effectiveness coefficient"), discussed above.

4. NUMERICAL IMPLEMENTATION AND VALIDATION

The empirical basis for the WEEP model consists of two "World Bank datasets." The dataset for conventional national income measures consists of the 140 countries that had populations over one million people as of 1970. The dataset for purchasing power parity (PPP) national income measures consists of the 142 countries that had populations over one million people as of 1975 (the year in which PPP national income measures become available in the data source). Even with this restriction to larger countries, these sets of countries account for somewhat over 98% of the world population. The principal motivation for eliminating the smaller countries is to reduce the amount of random error introduced by making various *ad hoc* estimations of missing data (missing data in the World Bank statistical source are more frequent for smaller countries). The two variables in each dataset include population and real per capita income of the component countries annually for 1970–2000 for conventional measures and 1975–2000 for PPP measures. Data from the 31-year period 1970–2000 are used to calibrate the model: that is, to set the structural parameters of the model to values that create a reasonably close fit between the observed data and results from the WEEP

model validation simulation. This was done initially using the conventional national income measure dataset. It was found, however, that virtually the same parameter values also generate a reasonably close fit using PPP data. Thus the same structural parameter values were used for both sets of simulations. The WEEP model policy simulations, as opposed to the validation simulations, cover the 51-year period 2000–50. Since the initial year of this interval has already passed into history, the policy simulation results should be thought of as "what if" results. That is to say, these are potential results if a WEEP had (or had not—in the case of without-WEEP simulations) been initiated in 2000.

Although the structure of the WEEP model used to obtain the results reported in this article is the same as that of the WEEP model used to obtain the results reported in *Common Progress*, there are a few numerical differences. The empirical data underlying the *Common Progress* results were obtained from the World Bank 1997 *World Development Indicators* CD-ROM, while the empirical data underlying the present results were obtained from the 2002 *World Development Indicators* CD-ROM. Even though only five years separate the issuance dates of these two sources, there are some fairly substantial differences. Owing to these differences, it was found that a considerably better fit to the actual per capita income data over the validation interval was obtained with a slightly different set of benchmark parameter values from those utilized for the *Common Progress* simulations.

Owing to various data and estimation problems, it would be unrealistic to aspire to a high level of numerical precision and accuracy in specifying model parameters. But, the benchmark parameter values utilized to produce the tables and figures below do in fact satisfy the following criteria: (a) they are consistent with basic *a priori* economic theory; (b) they lie within the wide boundaries of plausibility established by an impressionistic appreciation of related empirical literature; (c) they produce a reasonably satisfactory fit between the empirical data and the model results over the validation interval extending 1970–2000. The benchmark values of the structural form parameters are shown in the technical Appendix A.

Of course, it goes without saying that the uncertainty that inevitably exists with respect to model parameter values means that an important part of the research is sensitivity analysis, the determination of how various model simulations are affected by changes in numerical parameter values. Qualitative model results are more weighty to the extent that they are robust, i.e., to the extent that they continue to hold true under alternative parameter values. An especially important example of this pertains to the two controversial parameters, ξ and χ. In the benchmark case, both of these are set to the most "optimistic" values: respectively $\xi = 0$ (indicating that all initial per capita income differentials are owing to differences in generalized capital endowments and none to total factor productivity differentials), and $\chi = 1$ (indicating that all net transfer fund shares of recipient countries are successfully translated into increases in generalized capital). Later on, we examine the consequences of setting these parameters to less optimistic values.

The validation simulation uses the WEEP model to generate estimated values of conventional per capita income for each country over the 1970–2000 interval under the assumption that there is no World Economic Equalization Program in effect, using as initial values the actual population and conventional per capita income figures for each country in 1970, and also using the average annual rate of population growth in each country during 1970–2000 to generate population increase for that country during the interval. The same methodology is used for the validation simulation using PPP per capita income, except that the start of the validation period is 1975 rather than 1970. To eliminate WEEP transfers from the model simulation, the parameters of the transfer allocation function are set to values such that no country pays any proportion of its residual into the foreign development assistance transfer fund. There was in fact over the 1970–2000 interval a certain amount of foreign development assistance resources transferred from rich donor countries to poor recipient countries. It perhaps tells us something about the inadequacy of these transfers that a model which completely ignores them (as well as ignoring foreign trade and foreign investment) still manages to produce a reasonable fit to the actual data.

The validation simulation of the WEEP model estimates the 2000 per capita income of most countries with a reasonable degree of accuracy, whether we use conventional per capita income or PPP per capita income. Using conventional per capita income, a regression of

actual PCY (per capita income) for 2000 on model estimate PCY for 2000 has an *R*-square (coefficient of determination) of 0.9025. Using PPP per capita income, a regression of actual PCY (per capita income) for 2000 on model estimate PCY for 2000 has an *R*-square of 0.8268. Further insight into the goodness-of-fit issue is provided by Figures 1 and 2, which show actual PPP PCY growth (solid lines) and model estimate PPP PCY growth (dashed lines) for a group of eight representative countries ranging from rich to poor. The eight representative countries, in order of 1970 per capita income (according to the 2002 *World Development Indicators* CD-ROM), are the United States, France, Italy, Spain, Algeria, Ecuador, Ghana and India. The first four are representative of high-income countries, and the latter four are representative of low-income countries. From visual inspection of Figure 1 (for the high-income countries) and Figure 2 (for the low-income countries), it is apparent that while the WEEP model does not provide perfect tracking of real-world per capita income growth of countries, it does a reasonably good job of tracking long-term trends, taking due account of the relative simplicity of the model. The growth estimated by the WEEP model is ''smoothed out''—that is, it does not track the short-term fluctuations in actual growth. A model of such a high level of abstraction and simplicity as that embodied in the WEEP model obviously cannot encompass the myriad factors affecting short-term growth patterns. But this is not a matter of consequence, because the WEEP model is not designed for short-term forecasting and policy analysis. Rather, it is designed for long-term forecasting and policy

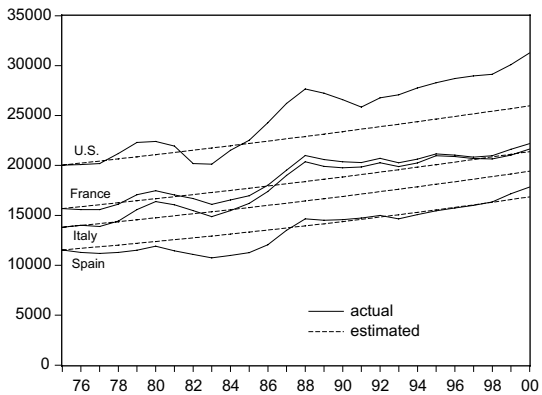

Figure 1. *Actual and estimated PPP per capita income growth, 1975–2000, four representative high-income countries.*

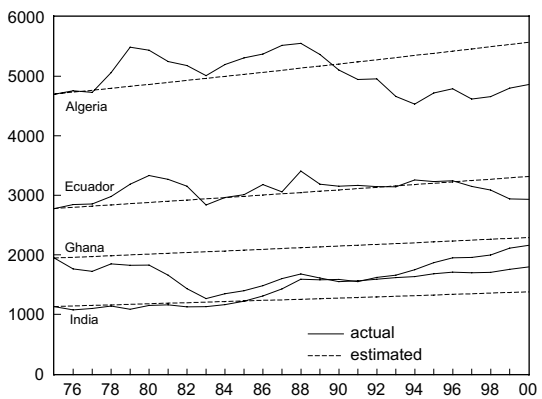

Figure 2. *Actual and estimated PPP per capita income growth, 1975–2000, four representative low-income countries.*

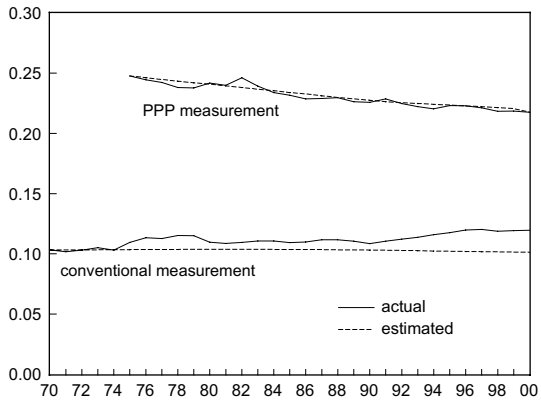

Figure 3. *Weighted mean ratio (WMRatio) over validation interval (1970–2000).*

analysis, i.e., to evaluate the potential performance of a WEEP.

Figure 3 shows validation interval results on overall inequality as measured by WMRatio, defined as the weighted mean ratio over all countries in the sample. The "ratio" referred to is the ratio of each country's per capita income to per capita income in the richest country. According to conventional per capita income, the richest country in the world over the entire 1970–2000 interval was Switzerland. According to PPP per capita income, the richest country in the world over the entire 1975–2000 interval was the United States. A convenient aggregate measure of inequality is the weighted mean ratio, where the weights are provided by each country's population as a proportion of total population. The lower the value of this indicator, the greater the degree of inequality among countries in terms of per capita income; the higher the value, the lesser the degree of inequality. In Figure 3, actual movements in WMRatio are shown by solid lines, estimated movements using the WEEP simulation model are shown by dashed lines. The figure shows that using PPP measures of per capita income, inequality as measured by WMRatio is substantially less than inequality using conventional measures. On the other hand, the actual movement in WMRatio for PPP measurement shows a distinct trend toward greater inequality, a trend which is closely tracked by the model result. Meanwhile, there is apparently a weaker trend toward lesser inequality using conventional measurement, a trend which is not tracked by the WEEP model, which shows virtually unchanging inequality over the validation interval. Although the WEEP model does not track this latter trend, the trend itself is weak, and it seems safe to conclude that there is a close fit between actual and estimated WMRatio even using conventional per capita income measures.

5. WEEP MODEL POLICY SIMULATIONS

The WEEP model policy simulations reported in *Common Progress* cover the 51-year period commencing in 1970 and concluding in 2020. They represent "what-if" experiments: they estimate what would have happened had a real-world WEEP (World Economic Equalization Program) been started (or not started) in 1970. The WEEP model policy simulations reported here cover the 51-year period commencing in 2000 and concluding in 2050. Once again these results represent "what-if" experiments: they estimate would have happened if a real-world WEEP had been started (or not started) in 2000. There have been some fairly important changes in the economic status of countries during 1970–2000, among both the rich countries and the poor countries. These changes affect both the relative size of the rich country donations and the relative size of the poor country receipts. Relative donations and receipts are also strongly affected by whether we utilize conventional per capita income measurement or PPP per capita income measurement. The simulations reported in *Common Progress* are based only on conventional per capita income measurement. For each per capita income measure (conventional and PPP),

there are two benchmark WEEP model simulations: the without-WEEP simulation and the with-WEEP simulation. In the without-WEEP simulation, the parameters of the transfer allocation function are set so that no country pays any part of its GNP into the transfer fund.

Table 1 shows results for three measures of aggregate world inequality at five-year intervals over the 2000–50 planning period. The first measure is WMRatio, defined above. The second measure is MinRatio: the ratio of per capita income of the poorest country in the sample to that of the richest country in the sample. The third is RangePCY: the range between the per capita income of the richest country in the sample and the per capita income of the poorest country in the sample. PCY is measured in real terms, so RangePCY is not augmented by inflation. Inequality is negatively related to MinRatio and positively related to RangePCY. The upper part A of Table 1 is based on conventional per capita income measures, while the lower part B is based on PPP per capita income measures. With one exception, all the inequality measures show increasing inequality over 2000–50 in the absence of a WEEP. The single exception is WMRatio under PPP measurement: the results indicate a weak movement toward reduced inequality following 2030. The with-WEEP results are dramatically improved. On the basis of all three inequality measures, and on the basis of both conventional PCY measures and PPP PCY measures, there occurs a dramatic swing toward greater equality over this 51-year period.

Figure 4 shows plots of projected with-WEEP and without-WEEP weighted mean ratio (WMRatio) using yearly data over the 2000–50 planning interval. The without-WEEP results are plotted using solid lines; the with-WEEP results are plotted using dashed lines. Without a WEEP, the model results indicate basic continuation of the current inequality situation over the next 50 years. As would be expected, PPP inequality is considerably less than conventional inequality, but even PPP inequality would have to be described as severe. With neither conventional measures nor PPP measures do the without-WEEP simulation

Table 1. *Projected aggregate inequality measures 2000–50, with and without a World Economic Equalization Program*

Year	WMRatio		MinRatio		RangePCY	
	With	Without	With	Without	With	Without
(A) Conventional measurement						
2000	0.1195	0.1195	0.0025	0.0025	46,621	46,621
2005	0.3030	0.1169	0.2150	0.0024	38,894	49,511
2010	0.3891	0.1140	0.2744	0.0024	38,120	52,600
2015	0.4465	0.1115	0.3454	0.0023	36,478	55,902
2020	0.4894	0.1086	0.4024	0.0022	35,330	59,433
2025	0.5242	0.1055	0.4484	0.0022	34,608	63,213
2030	0.5538	0.1021	0.4856	0.0021	34,259	67,260
2035	0.5796	0.0987	0.5121	0.0020	34,511	71,596
2040	0.6027	0.0953	0.5352	0.0020	34,924	76,244
2045	0.6233	0.0921	0.5558	0.0019	35,467	81,228
2050	0.6416	0.0887	0.5745	0.0019	36,122	86,575
(B) PPP measurement						
2000	0.2175	0.2175	0.0144	0.0144	30,815	30,815
2005	0.3264	0.2126	0.2348	0.0141	25,199	32,513
2010	0.3605	0.2084	0.2689	0.0139	25,365	34,321
2015	0.4109	0.2053	0.3200	0.0137	24,866	36,247
2020	0.4603	0.2031	0.3776	0.0135	23,998	38,303
2025	0.5034	0.2014	0.4280	0.0132	23,262	40,499
2030	0.5411	0.2010	0.4710	0.0130	22,702	42,846
2035	0.5747	0.2022	0.5083	0.0127	22,280	45,359
2040	0.6051	0.2025	0.5412	0.0125	21,960	48,054
2045	0.6330	0.2033	0.5708	0.0121	21,712	50,947
2050	0.6588	0.2051	0.5978	0.0118	21,517	54,053

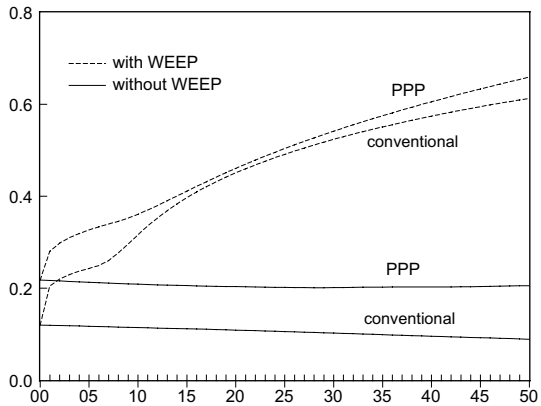

Figure 4. *Weighted mean ratio (WMRatio) over planning interval (2000–50).*

results provide any grounds for hope of significant economic convergence within the foreseeable future. With a WEEP in operation, on the other hand, the model simulations indicate a dramatic reduction in inequality whether we utilize conventional accounting or PPP accounting.

Many economists believe that purchasing power parity (PPP) national income accounting presents a more accurate impression of relative living standards among countries than does conventional national income accounting. But PPP measures are not available over as long a period of time, and are subject to more measurement error. [7] Moreover, it is not universally agreed that PPP data are actually conceptually preferable to conventional exchange rate data. Still another reason for showing conventional data results as well as PPP data results has to do with the purpose of the research, which is to demonstrate the possibility that a sufficiently large-scale global Marshall Plan might achieve success. If the possibility of economic convergence were shown using only PPP data, it could be objected that PPP data quite possibly underestimate the current level of inequality, and that the results would be less optimistic were conventional data utilized. Figure 4 makes it clear that the benchmark with-WEEP simulations show the possibility of a high level of convergence even if we utilize conventional per capita income measures, under which current inequality is substantially higher.

Figures 5 and 6 show projected per capita income growth results for the eight

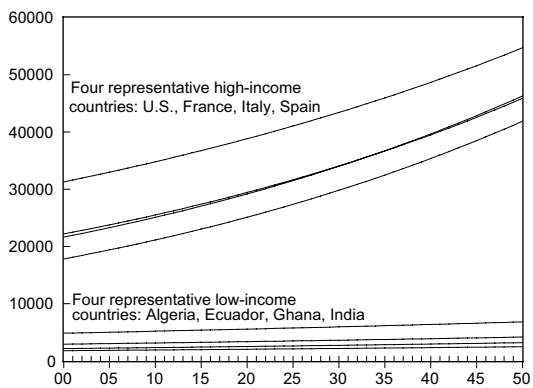

Figure 5. *Estimated PPP per capita income growth without a WEEP, 2000–50, for eight representative countries.*

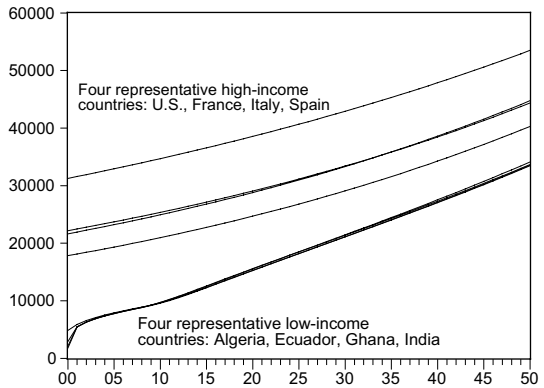

Figure 6. *Estimated PPP per capita income growth with a WEEP, 2000–50, for eight representative countries.*

representative countries previously utilized: United States, France, Italy and Spain (the high-income countries), and Algeria, Ecuador, Ghana and India (the low-income countries). Both of these figures are based on PPP results. Figure 5 pertains to the without-WEEP case: it shows a projection of the likely evolution of per capita income in the absence of a World Economic Equalization Program. It would appear that we may expect "more of the same." The economic gap continues to widen: the rich countries get richer, while the low-income countries continue the same slow-growth pattern they have exhibited over the last few decades. There is no evidence of any sort of economic convergence of the relatively poor countries on the relatively rich countries. On the other hand, if a World Economic Equalization Program were set into motion, there could, according to the with-WEEP simulation illustrated by Figure 6, occur a very significant amount of progress toward overcoming the economic gap within a 51-year time span. Indeed, the contrast between the without-WEEP simulation (illustrated by Figure 5) and the with-WEEP simulation (illustrated by Figure 6) can only be described as remarkable. True, we do not see absolute convergence in the sense that the poorest countries, at the end of the 51-year period, would have living standards as high as those in the richest countries at that time. These results suggest however, that the living standards of what are the poorest countries of today would have improved sufficiently, by the end of the period, to be comparable to those of the richest countries today. They also suggest that all countries, from the relatively rich to the relatively poor, would be growing at comparable rates.

Clearly the WEEP model does not encompass short-term factors affecting growth. If humanity were to undertake a real-world WEEP, the actual growth patterns of various countries would be highly variable: growth would not be according to the smooth, neat curves shown in Figure 6. In addition to that, there are several long-term factors that influence the long-term rates of economic growth of the various countries. It seems unlikely, for example, that Japan will continue the high-growth pattern it has exhibited over the last 50 years through the next 50 years. As for the poor countries of today, under a WEEP some would no doubt benefit more than others. As a result, there could well be some substantial alterations in the relative economic positions of countries. The possibility exists, even, that some of the poorest countries of today may end up overtaking some of the richest countries of today. For example, it is conceivable that India could overtake the United States within a 51-year period. If that were to happen, however, India would change from a recipient country to a donor country within the WEEP. Recall that a country's receipts from the foreign aid transfer fund depend on its relative economic prosperity. The more prosperous a country becomes, the less it would receive in foreign aid. As a country becomes steadily richer, at some point it would shift from being a recipient country to being a donor country.

The strongest indication from the with-WEEP simulation is not what it projects for individual countries, but rather what it suggests

about the entire family of countries. What it suggests is a leveling of the "global economic playing field," as it were: that is to say, the development of a global economy in which there are not two qualitatively different types of countries: those that have been very rich for a long period of time and those that have been relatively poor for a long period of time. Instead, we would see a world in which all countries are characterized by living standards that are high by our present standards, but in which the finer degrees of prosperity would fluctuate over time. The relative economic status of the countries would vary, so that at one point in time country A would be richer (in terms of PCY) than country B, while at a later time their relative positions would be reversed. But the differentials in PCY would not be so large and so persistent for these differentials to be a source of hostility and conflict among countries. For example, in 2000 Switzerland had a PCY (in conventional terms) in 1995 US dollars of $46,737 while the United States had a PCY of $31,996. This is a substantial differential, but it is not enough to cause the people of the United States to feel relatively poor, and to experience unhealthy impulses toward envious resentment against the people of Switzerland. (Any such impulses would be further reduced by the fact that according to PPP measures, in 2000 the United States had a per capita income of $31,264, while Switzerland had a smaller per capita income of $26,344.) What we should actually be pursuing—and what a real-world WEEP would give us a fair and reasonable opportunity of achieving—is not a world of perfect equality, but rather a world in which all per capita income differentials between pairs of countries would be in the general order of magnitude of that between Switzerland and the United States at the present time. Unlike perfect equality, this would be a feasible objective.

The results illustrated in Figure 6 are representative of the entire range of countries in the dataset. That is to say, over all countries the losses in terms of a slightly lower growth rate for the small number of rich countries would be minuscule relative to the tremendous gains of the large number of poor countries. This, of course, raises the question of believability. Are not these results simply too good to be true? Would not the actual situation under a hypothetical future gigantic real-world economic development assistance program have little or nothing in common with the benchmark WEEP model simulations under consideration here? Obviously, the only way to answer questions such as these definitively would be to initiate a very large-scale real-world economic development assistance program and observe the outcome. Short of that, discussion of these questions must necessarily remain highly speculative and inconclusive. But, the chances that a real-world WEEP will actually be initiated (on a provisional and experimental basis to determine its likelihood of long-term success) will be enhanced to the extent to which a case may be made—even though a highly speculative and inconclusive case—that these benchmark WEEP model results are *not*, despite understandable initial impressions to the contrary, wholly implausible.

A first step toward the development of this case is simply to point out that the results shown above in Figure 6 are a consequence of one of the oldest and most universally accepted economic principles: the law of diminishing returns to a factor of production. The factor of production in this case is generalized capital, comprising not only the value of physical plant and machinery, but also the value of human capital resources (knowledge and skills achieved via education and training) and the value of social capital resources (roads, bridges, dams, schools, and so on). According to the law of diminishing returns, as the absolute amount of a particular input to the productive process increases, the marginal product of that input decreases. That is to say, fixed increases in the amount of the input utilized will generate steadily decreasing amounts of additional output as the total amount of the input utilized increases.

The rich countries are utilizing large amounts of generalized capital, therefore the marginal product of generalized capital in these countries is low. The poor countries are utilizing small amounts of generalized capital, therefore the marginal product of generalized capital in these countries is high. Consequently, if a certain increment of generalized capital that would have been installed in a rich country, is instead installed in a poor country, the reduction in potential output of the rich country will be small, while the increase in actual output of the poor country will be large. This proposition, in and of itself, is hardly a matter for debate. But according to the benchmark WEEP model simulations with and without a World Economic Equalization Program in operation, the numerical implications of this proposition, in the context of the world economic inequality

problem, are far more dramatic than have ever been imagined by the great majority of contemporary mainstream economists.

From the standpoint of professional economic logic, the most sensible and meaningful cost imposed on the rich countries by their contributions into the transfer fund of a World Economic Equalization Program would be in terms of foregone growth: the difference between their per capita incomes at the end of the 51-year period 2000–50 if no WEEP takes place and no contributions are made into the transfer fund, and their per capita incomes at the end of this period if a WEEP does take place and they do make contributions into the transfer fund. The estimated differences between the benchmark without-WEEP simulation and with-WEEP simulation, in percentage terms, are shown in Table 2 for the 10 richest countries in per capita income (PCY) in the year 2000. The upper part A of the table pertains to conventional PCY measures while the lower part B of the table pertains to PPP measures. The five columns of the table show respectively the name of the country, its actual PCY in 2000, its projected PCY in 2050 without a WEEP, its projected PCY in 2050 with a WEEP, and the percentage difference between the two. For all countries the percentage differences are well under 4%. The foregone growth of the rich countries, according to the benchmark WEEP model simulations, could reasonably be described as inconsequential.

The information shown in Table 2 suggests that the costs to the rich countries, in terms of slower economic growth, would be quite modest. But there is an alternative way to look at the cost of the program, an alternative with a long tradition in the real-world history of foreign development assistance programs over the last half-century. This alternative would look at the proportion of a country's total current output that would go to the global transfer fund. It should be noted that from the structure of the WEEP model, the actual amount of the transfer fund contribution would be a *net* amount: it would be the difference between a certain country's gross transfer fund contribution and that same country's share of the transfer fund. Both the contribution and the share are determined by the country's position relative to the richest country in the world. Every country in the world, with the exception of the richest country, would—for accounting

Table 2. *Burden of the WEEP foregone growth for the 10 richest countries*

Country	PCY 2000	PCY 2050 without WEEP	PCY 2050 with WEEP	Percentage difference
(A) Conventional measurement				
Switzerland	46,737	86,736	84,883	−2.136
Japan	44,830	82,658	80,715	−2.350
Denmark	38,521	76,866	74,685	−2.838
Norway	37,954	74,774	72,589	−2.922
Austria	32,763	70,173	67,794	−3.391
Germany	32,623	70,482	68,108	−3.368
Finland	32,024	68,871	66,499	−3.443
United States	31,996	65,591	63,308	−3.481
Sweden	31,206	68,301	65,922	−3.483
Netherlands	30,966	66,593	64,231	−3.547
(B) PPP measurement				
United States	31,264	54,697	53,499	−2.191
Norway	27,396	52,276	50,922	−2.591
Ireland	27,348	51,199	49,824	−2.684
Switzerland	26,344	50,937	49,530	−2.762
Canada	25,493	47,306	45,879	−3.017
Denmark	25,298	50,561	49,118	−2.852
Belgium	24,887	50,163	48,703	−2.911
Austria	24,509	49,333	47,851	−3.004
Japan	24,500	48,484	47,008	−3.045
Australia	23,527	44,581	43,116	−3.287

purposes—receive a share of the global transfer fund. This would be true even of quite rich countries. But if the share amount is less than the gross transfer fund contribution (as it would be for rich countries), then the country would pay the difference into the fund. In this case, the country would be a donor country. On the other hand, if the share amount is greater than the gross transfer fund contribution, then the country would receive the difference as a disbursement from the fund. In this case, the country would be a recipient country. The net transfer ratio is the ratio of the net transfer (contribution less share) to total national output.

Table 3 presents data on the net transfer ratio, derived from the benchmark with-WEEP simulation, for the 10 richest countries in per capita income as of 2000, at 10-year intervals over 2000–50. The upper part A of the table pertains to conventional PCY measures while the lower part B of the table pertains to PPP measures. Using conventional measurement, the highest proportion of GNP contributed into the global transfer fund for 2000 would have been from Switzerland: 4.241%. The second highest would have been from Japan: 3.981%. These high contributions reflect the high 2000 PCY of Switzerland and Japan: respectively $46,737 and $44,830. The United States, with a 2000 PCY of $31,996, would have contributed 2.033% of its GNP. Because of its relatively large population and high GNP, the United States would have made the largest single contribution in terms of percentage of the total transfer fund. Using PPP measurement, the highest proportion of GNP contributed into the global transfer fund for 2000 would have been from the United States: 3.675%. The second highest would have been from Norway: 2.893%. These high contributions reflect the high 2000 PPP PCY of the United States and Norway: respectively $31,264 and $27,396. Once again it is true, using PPP measures, that the United States, because of its relatively large population and high GNP, would have made the largest single contribution in terms of percentage of the total transfer fund. The substantial differences in WEEP transfer fund contributions under the two types of national income measurement, conventional and PPP, suggest the possibility

Table 3. *WEEP contributions as percentages of national income for the 10 richest countries*

Country	Net transfer ratio (%)					
	2000	2010	2020	2030	2040	2050
(A) Conventional measurement						
Switzerland	4.241	4.345	4.438	4.521	4.595	4.662
Japan	3.981	4.054	4.098	4.125	4.139	4.141
Denmark	3.028	3.139	3.179	3.210	3.244	3.288
Norway	2.924	3.007	3.008	2.994	2.977	2.967
Austria	2.220	2.327	2.311	2.291	2.288	2.313
Germany	2.176	2.292	2.285	2.278	2.289	2.332
Finland	2.089	2.185	2.148	2.105	2.079	2.084
United States	2.033	2.060	1.934	1.787	1.641	1.516
Sweden	1.953	2.055	2.017	1.977	1.957	1.972
Netherlands	1.931	2.003	1.924	1.835	1.762	1.718
(B) PPP measurement						
United States	3.675	3.814	3.940	3.999	4.161	4.257
Norway	2.893	3.111	3.297	3.378	3.616	3.785
Ireland	2.935	3.124	3.277	3.339	3.505	3.612
Switzerland	2.702	2.921	3.100	3.174	3.384	3.533
Canada	2.514	2.658	2.745	2.761	2.755	2.722
Denmark	2.461	2.708	2.910	2.994	3.243	3.430
Belgium	2.379	2.630	2.833	2.916	3.163	3.349
Austria	2.321	2.563	2.751	2.825	3.035	3.191
Japan	2.314	2.531	2.692	2.749	2.895	2.997
Australia	2.063	2.198	2.255	2.247	2.149	2.048

of wrangling among the countries as to which basis to use. If conventional measurement is used, this would benefit the United States (in terms of a lower contribution percentage), while if PPP measurement is used, this would benefit Japan. It is to be hoped that if a sufficient amount of determination is mustered among the rich contributor countries to undertake a WEEP, it will not be dissipated in endless circular disputes over relative burdens. A common sense solution to this particular problem would be to simply utilize the mean of the conventional contribution percentage and the PPP contribution percentage.

The important indication from Table 3 is certainly not the precise numerical information on prospective contribution percentages of specific richer countries. For one thing, these numbers pertain to 2000. A WEEP was not initiated in 2000. If a real-world WEEP is initiated, it will be in some future year, and the relative economic positions of the countries will obviously be somewhat different, in some cases quite a bit different, from what they were in 2000. In addition, it must be emphasized that the specific "transfer allocation function" utilized in the WEEP model is merely a suggestion. Upon future deliberation by authoritative agencies, another formula might be adopted. The important thing is not what specific formula is utilized to determine contributions by the rich countries, but merely that the formula be such that the richer the country is, the larger its contribution as a percentage of national output.

Again the important indication from Table 3 is not the specific numbers shown therein—it is rather the fact that the indicated net transfer ratios are not excessively high. For the richest countries the ratios are *high*, to be sure, but they are not *excessively* high. During the Cold War era, many of the rich countries allocated more than these percentages to military expenditure. If the benchmark with-WEEP model simulation were to tell us that the richest countries would have to allocate 10%, 15% or 20% of their GNPs in order for a World Economic Equalization Program to be a success, then we could more legitimately conclude that the entire concept was wholly impractical. But the actual percentages are mostly in the order of 2%, 3% or 4%. Obviously these percentages are far beyond current contributions, which for most of the rich countries including the United States, are far below the longstanding United Nations goal of 0.7% (seven-tenths of 1%). [8] Certainly a major transformation in attitudes would be required to make a WEEP politically feasible. But such a transformation is not inconceivable—if sufficient economic evidence could be amassed that a real-world WEEP might be successful.

Lest it be too readily concluded that the contribution percentages shown in Table 3 are politically impossible, it should be recalled that according to the logic of the WEEP model, these percentages would not be drawn out of current consumption, which implicitly embraces public good consumption as well as private good consumption. Rather WEEP transfer fund contributions would be drawn out of the "residual," defined as national income less military expenditures and (public and private) consumption expenditures. One "painless" way to meet the transfer fund contribution expectation would be to redirect military expenditure. Realistically, however, most of it would have to come out of domestic investment. Resources that would ordinarily have been directed into domestic generalized capital investment in the donor countries, would instead be directed into foreign generalized capital investment in the recipient countries. Current consumption—in principle—would not be affected. Of course, it is difficult to see how this could be accomplished without some kind of direct economic controls, i.e., some form of planning. No doubt political conservatives in the rich countries would object to this inevitable departure from the laissez faire ideal, and moreover they would most likely endeavor to persuade the general public that national government appropriations into the WEEP transfer fund were being painfully extracted from current living standards. There can be little doubt that initiation of a real-world WEEP would be accompanied by intense, acrimonious political controversy. Only if the program achieves quick and dramatic success would it be continued for very long.

6. SENSITIVITY ANALYSIS

Up to this point we have looked the benchmark WEEP model simulations: the benchmark simulations without a World Economic Equalization Program in operation, and the benchmark simulations with such a program in operation. The without-WEEP simulations indicate continuation of the present situation: an increasing economic gap owing to the fact

that the living standards (as measured by per capita income PCY) of the rich countries are growing faster than those of the poor countries. The with-WEEP simulation suggests that a very large-scale economic development assistance program might generate a large amount of economic equalization across all countries of the world without imposing a serious cost on the rich countries. The cost to the rich countries would be in the form of a slightly lower *rate of growth* in living standards, but by no means in terms of a *decline* in living standards. Presuming that the benchmark simulation results represent a reasonable approximation to potential reality, the desirability of a real-world World Economic Equalization Program would be manifest to most if not all.

Of course, the conventional belief in the contemporary world, particularly within the richer countries, is that a very large-scale economic development assistance program along the lines of the envisioned WEEP would almost certainly be a very expensive failure. Such a program would substantially reduce economic growth in the rich countries. At the same time, improvement in the poor countries would be at best modest and at worst negligible. The natural reaction to the benchmark WEEP model results described above stemming from this conventional viewpoint is therefore that these results are simply too good to be true. Either the WEEP model itself is in error (does not represent an adequate approximation to real-world variables and relationships), or the benchmark parameter values are in error (do not represent adequate approximations to the real-world numerical parameter values). At this point the model itself will not be defended other than to say that it is based on conventional and widely accepted economic principles (a Cobb-Douglas production function, a linear consumption function, and so on). But the numerical values of the model's parameters are another story—it cannot be reasonably maintained that these values are "very conventional and widely accepted." The actual parameter values utilized for purposes of policy simulations of economic models are normally subject to a considerable amount of uncertainty and error.

Therefore, in assessing the policy implications of any particular economic model, considerable weight is normally placed on sensitivity analysis: on the investigation of how changes in the numerical input into the model simulation affect the numerical output. The question to be addressed is how robust are particular qualitative policy indications against changes in parameter values. Do these qualitative policy indications change dramatically if the parameter values are changed slightly? If so, we deem the initial policy indications to be nonrobust. On the other hand, do these qualitative policy indications remain basically intact despite substantial variation in the numerical values of the parameters? If so, we deem the initial policy indications to be robust. In the case of the present research, the initial policy indication is that a World Economic Equalization Program would be highly beneficial. To what extent is this indication robust?

In the section entitled "Selected Sensitivity Analyses" of Chapter 4 of *Common Progress*, I presented results from a large number of WEEP model simulations with parameters set to different values from the benchmark values. Something over 10 pages of tabular data were provided. Replicating this information here, using both conventional and PPP measures of national income, would obviously constitute overkill. Suffice it to say that the initial policy indication that a World Economic Equalization Program would be highly beneficial is indeed highly robust over a considerable range of numerical variation in *most* of the parameters of the WEEP model. These include the parameters of the production function, the parameters of the consumption function, and various other parameters governing technological progress, population growth and military spending.

It must be conceded however, that there are indeed two very important exceptions to this rule. Our attention in the remainder of this section will be focused on these two exceptions. The exceptions pertain, respectively, to the "productivity differential source coefficient" (ξ) and to the "conversion effectiveness coefficient" (χ). It must be frankly acknowledged that with sufficiently adverse numerical values for either of these two parameters, the WEEP model simulation results are fully consistent with pessimistic preconceptions regarding the futility of very large-scale economic development assistance efforts. The fact that WEEP simulations run using adverse values for these parameters show little or no progress at overcoming the economic gap was not unanticipated, because these parameters were incorporated into the model precisely in order to encompass the pessimistic beliefs of foreign aid skeptics.

Let us consider first the ξ parameter, the productivity differential source coefficient. This is the parameter that determines the extent to which observed differentials in initial-period per capita income y among the 140 countries of the World Bank dataset may be attributed to differentials in generalized capital stock endowments K, as opposed to differentials in total factor productivity coefficients A. An alternative descriptive designation of this parameter would be the "K differential vs. A differential coefficient." The benchmark value of this parameter is 0 (zero), which indicates that *all* differentials in per capita income are the result of differentials in generalized capital stocks (i.e., the total factor productivity coefficients A are the same over all countries). At the other end of the spectrum would be $\xi = 1$, according to which *all* differentials in per capita income are the result of differentials in total factor productivity coefficients (i.e., the ratios of initial generalized capital K to initial total output Y are the same over all countries). If the value of $\xi = 0.5$, this would indicate that one-half of the differentials in per capita income y could be attributed to differentials in generalized capital K, and the other one half of the differentials could be attributed to differentials in the total factor productivity coefficients A.

Table 4 shows the consequences for the benchmark with-WEEP simulation of different values of the ξ parameter: ξ is varied from its minimum possible value of 0 (the most optimistic value) to its maximum possible value of 1 (the most pessimistic value) by increments of 0.05. This table uses results from PPP-based simulations. For each value of ξ the table reports the period-50 WMRatio, MinRatio and RangePCY. It is observed that the equalizing effect of a WEEP is steadily degraded as the value of ξ increases. It should also be noted, however, that unless the ξ value becomes quite large, a substantial amount of economic equalization still takes place. For example, if ξ is at its midpoint value of 0.50, the terminal-period WMRatio is 0.3129, which is a considerable improvement over the expected without-WEEP WMRatio in 2050 of 0.2051.

Far more important, however, is the indication in the final four columns of Table 4, which report respectively the period-50 per capita income (PCY) of Japan, the percentage growth in Japanese PCY during 2000–50, the period-50 per capita income of India, and the percentage growth in Indian PCY over 2000–50. Japan is representative of the rich donor countries while India is representative of the poor recipient countries. We observe that while terminal-

Table 4. *Comparative statics analysis (PPP) effect of parameter ξ on economic equalization*

ξ	WMRatio ($t = 50$)	MinRatio ($t = 50$)	RangePCY ($t = 50$)	Japan PCY ($t = 50$)	Japan % growth	India PCY ($t = 50$)	India % growth
0.00	0.6588	0.5978	21,517	47,008	89.49	34,109	525.62
0.05	0.6223	0.5600	23,540	46,833	88.80	31,886	511.53
0.10	0.5861	0.5177	25,801	46,663	88.13	29,673	496.21
0.15	0.5502	0.4756	28,055	46,497	87.47	27,473	479.56
0.20	0.5145	0.4336	30,303	46,334	86.83	25,287	461.33
0.25	0.4792	0.3917	32,545	46,176	86.20	23,118	441.32
0.30	0.4444	0.3500	34,776	46,022	85.59	20,969	419.24
0.35	0.4100	0.3085	36,992	45,872	84.99	18,848	394.87
0.40	0.3763	0.2679	39,164	45,725	84.41	16,767	368.05
0.45	0.3437	0.2295	41,222	45,583	83.85	14,746	338.71
0.50	0.3129	0.1962	43,002	45,445	83.30	12,829	307.59
0.55	0.2851	0.1714	44,329	45,311	82.77	11,100	277.00
0.60	0.2616	0.1534	45,291	45,181	82.25	9,664	250.64
0.65	0.2427	0.1357	46,240	45,054	81.75	8,597	232.11
0.70	0.2267	0.1181	47,183	44,932	81.26	7,710	214.98
0.75	0.2123	0.1005	48,123	44,813	80.79	6,832	192.11
0.80	0.1988	0.0830	49,061	44,698	80.33	5,967	163.67
0.85	0.1863	0.0655	49,998	44,587	79.89	5,127	131.32
0.90	0.1751	0.0480	50,934	44,479	79.46	4,347	98.32
0.95	0.1658	0.0305	51,868	44,376	79.05	3,709	70.03
1.00	0.1596	0.0143	52,734	44,275	78.65	3,334	53.11

period Japanese PCY and Indian PCY are both adversely affected by increasing ξ (as are the prospective percentage growth rates over 2000–50), the effect is far stronger for India than it is for Japan. This suggests that if a real-world WEEP were unsuccessful, it would be unsuccessful in terms of not achieving much acceleration in the economic growth of the recipient countries. But it would not be unsuccessful in terms of having a substantial adverse effect on the economic growth of the rich countries. That is to say, if the rich countries are investing heavily in a real-world WEEP and the program is not having the desired effect, this would be bad news far more to the populations of the recipient countries than to the populations of the donor countries. According to the simulation results, the rich countries would continue to grow at a brisk rate even if the WEEP is a near-total failure as far as the poor countries are concerned. If the program is inevitably destined for failure, whether because the real-world ξ is close to 1 or some other reason, then soon enough the rich countries would give up on the effort.

The very significant indication of the last four columns of Table 4 is that such an experiment would not be especially costly to the rich countries. Clearly this indication—if valid—supports the sensibility of inaugurating a real-world WEEP on a tentative and experimental basis in the hope that it will succeed. There are two conceptually distinct issues in deciding whether to undertake a real-world WEEP: (a) benefits; (b) costs. What the results shown in Table 4 suggest is that while the benefits to the poor countries of such a program are uncertain, the costs to the rich countries are likely to be modest in any case. It would of course be terribly unfortunate if the benefits to the poor countries of a real-world WEEP turned out to be minor. Such an outcome would bode ill for the future destiny of human civilization. But at least this outcome would not entail a direct, immediate and substantial material penalty on the rich countries.

The other highly sensitive WEEP model parameter is χ, the conversion effectiveness coefficient. A familiar and quite fundamental objection to the notion of a World Economic Equalization Program is that the "resources would not get through." Owing partly to legitimate administrative expenses, and partly to illegitimate graft, a large part of the transferred resources would be diverted away from productive uses. Those of a particularly pessimistic and cynical nature would no doubt be tempted to assert that the "vast majority" of large-scale economic development assistance resources would end up in the pockets of corrupt bureaucrats and/or dishonest businessmen. But even if considerably less than the "vast majority" of these resources were wasted, it could seriously debilitate the effectiveness of a potential future World Economic Equalization Program. This possibility is encompassed in the WEEP model by means of the χ parameter, representing the proportion of the poor countries' shares in the global transfer fund that are successfully converted into productive generalized capital resources.

Results for the χ parameter exactly parallel those for the ξ parameter, so I will very briefly summarize them. The benchmark value for the χ parameter is 1, indicating that the entire amount of the shares of the poorer countries in the global transfer fund are successfully converted into generalized capital. From simulation results for χ values less than the benchmark value, it would appear that the losses from administrative costs and theft would have to be extremely large for the effectiveness of a WEEP to be seriously impaired. Even if χ is as low as 0.1, indicating that only 10% of transfer fund resources "get through," the impact on world poverty remains very high while the same time the costs of the program to the rich countries remain very low. Only if the value of χ is actually 0, indicating that nothing gets through, does the WEEP become totally ineffective. Even then, the cost of the WEEP to the rich countries continues to be minor. The results for the conversion effectiveness coefficient are thus fully analogous to those already described for the productivity source differential coefficient. In both cases, these results are basically supportive of the desirability of a real-world WEEP.

7. SUMMARY AND EVALUATION

This article has reported results from a simulation model designed to provide formal evidence on the potential performance of a very large-scale economic development assistance effort—a "global Marshall Plan" of the sort long proposed by visionaries—termed herein the World Economic Equalization Program (WEEP). The empirical basis of the WEEP model consists of two World Bank datasets. The first of these contains per capita income y

(in conventional exchange rate terms) and population P from 1970 through 2000 for the 140 countries in the world that had populations of 1,000,000 or more in 1970. The second contains per capita income y (in purchasing power parity terms) and population P for 1975–2000 for the 142 countries in the world that had populations of 1,000,000 or more in 1975.These datasets are used to validate the WEEP model. The benchmark numerical parameter values of the model are consistent with *a priori* economic theory, lie within the boundaries of plausibility established by relevant empirical literature, and produce model results in per capita income over the 1970–2000 interval that match the observed values to a reasonable degree of accuracy.

Following validation, two benchmark simulations of the WEEP model are run for the 51-year interval 2000–50: the "without-WEEP" simulation and the "with-WEEP" simulation. These simulations are first done using conventional per capita income, and then using PPP per capita income. According to the without-WEEP simulations, the observed trends during the 1970–2000 interval may be expected to continue through the 2000–50 interval: the richer countries will grow faster than the poorer countries, the absolute gap between the richest and poorest countries in the world will get larger, and aggregate measures of world economic inequality will continue to rise. The with-WEEP simulations show a far more attractive possibility: a pattern of tremendous acceleration of the economic growth of the poor countries, at the cost of only a very slight retardation of the economic growth of the rich countries. The remarkable results of the benchmark without-WEEP and with-WEEP model simulations provide hard evidence that humanity has within its grasp an effective antidote to the greatest single hazard (now that the Cold War has dissipated and the near-term threat of nuclear holocaust has greatly receded) to continued human progress in the contemporary age.

Deep pessimism regarding the economic prospects of the poorer countries of the world has become quite prevalent among the populations of the wealthy countries. Given this reigning pessimism, the immediate reaction of most people (economists and noneconomists) to the WEEP model policy simulation results described in the foregoing will be that they are "too good to be true," that they fall beyond the remotest bounds of plausibility, that they are simply not believable. Let us briefly consider, therefore, some of the more important objections that might be raised against the fundamental conclusions of the WEEP model research reported herein.

(a) *Deficiencies of the WEEP model*

The argument here is that the WEEP model is too simplistic and unrealistic for the results derived from it to be taken seriously. For example, it ignores international trade and investment, it utilizes very simple mathematical forms for the production and consumption functions, and it takes no account of complicating factors within the national economies, such as different levels of domestic income inequality within different countries. But in fact the simplicity of the WEEP model does not in itself constitute a fundamental criticism of the methodology. Simplicity is relative. While the WEEP model does not attain the scale and complexity of some of the largest general equilibrium models and macroeconometric models in usage today, with 140 countries in its dataset, comprising 98% of the world's population, it is certainly not below the average scale and complexity of economic models routinely utilized in the analysis of economic policy issues. Recall also that the WEEP model in its current form is intended only for preliminary exploration. Should results from this version of the model arouse any interest, the model will certainly be expanded and elaborated.

Another important point is that model simplicity, in and of itself, does not necessarily bias the results in one direction or the other. In our case specifically, the simplicity of the WEEP model does not necessarily predispose it to showing that a real-world WEEP would be highly successful. Or if it does in fact do this, it is not apparent how. One obvious example might be cited to the effect that the simplicity of the current version of the WEEP model might bias it *against* showing successful results from the proposed World Economic Equalization Program. The WEEP model does not incorporate trade among countries, and a strong consensus exists among contemporary economists that international trade is highly beneficial to all participants, and moreover, that increased participation in international trade is the chief remaining hope to those LDCs wishing to initiate rapid economic progress. Presumably, therefore, a model that incorporated the various "expansionary feedback effects" of

international trade might display an even higher level of success for a massive, worldwide economic development assistance effort.

(b) *Adverse consequences of rapid economic growth*

By the well-known "law of unintended consequences," a real-world WEEP, even if it were to generate very rapid increases in average material living standards within the recipient countries, would also most likely entail certain downsides of such magnitude and severity that they could easily outweigh the positive effects on human welfare. Rapid industrialization would cause severe environmental degradation. Rapid economic growth is unlikely to benefit all sections of the population equally, leading to greater inequality in income and wealth. Intense competition to gain control over the inflow of foreign resources is likely to exacerbate political and social conflict within the recipient countries. If the program were going poorly so that the rich countries began withdrawing support, the disappointed hopes of the populations of the poor countries would greatly intensify North–South tensions.

That there would be disadvantages of rapid economic growth is undeniable, because progress always comes at a price. But these disadvantages should not be exaggerated. Many of them would be temporary. According to the original "Kuznets curve" hypothesis, as a country moves from low-income to mid-income status, income and wealth inequality increases—but as it then progresses from mid-income to high-income status, inequality decreases. According to the more recent "environmental Kuznets curve" hypothesis, as a country moves from low-income to mid-income status, environmental degradation increases—but as it then progresses from mid-income to high-income status, it decreases. As for political competition and social unrest, it seems plausible that the long-term effect of increasing living standards would be to decrease them. As for North–South tensions, these are currently quite severe, among other things because the immigration services of the rich countries are constantly obliged to beat back a potential tidal wave of immigration from the poor countries. The fact that the current edgy and distrustful international relations between poor countries and rich countries are not continually boiling over into armed conflict, is principally attributable to the military power of the rich countries. Maintaining this military power entails a significant economic burden on the populations of the rich countries. Over the long-term this burden might greatly exceed the burden of a temporary World Economic Equalization Program that would close the North–South economic gap once and for all, and thereby eliminate the extra pressures injected into international relations by wide differences among the countries in material living standards.

(c) *Results inconsistent with past experience*

The argument here is that if it were true that extreme differentials in per capita income were the result of extreme differentials in generalized capital stocks, then the foreign aid programs of the past would have achieved a much higher level of success. After all, according to the underlying hypothesis being put forward in support of the proposed World Economic Equalization Program, the generalized capital stocks of the poor countries are tiny and virtually microscopic relative to the generalized capital stocks of the rich countries. This explains the tremendously accelerated growth of the poor countries at the same time that the rich countries experience only a minor retardation of growth: the marginal products of the extremely small generalized capital stocks of the poor countries are huge in relation to the marginal products of the extremely large generalized capital stocks of the rich countries. But if this were actually the case, would we not have witnessed a much greater payoff to the foreign aid receipts of the poor countries during the last half-century?

The most plausible answer to this objection is that the foreign aid flows of the past, while they have been large in an absolute sense, were small in relation to the need, and for most of the LDCs did not constitute the necessary "critical mass" to initiate rapid economic progress. In nuclear physics, as everyone has learned since the appearance of operational nuclear weapons in 1945, the critical mass is that quantity of uranium that when compacted will initiate a nuclear explosion. If one were to compact a quantity of uranium even slightly below the critical mass, nothing would happen. This basic concept has applications outside of nuclear physics. For example, in behavioral psychology, the "threshold of perception" refers to that minimum level of sensory stimulation required for the individual to become

consciously aware of the stimulation. "Threshold of perception" could equally be termed the "critical mass" of sensory stimulation that will initiate conscious awareness of the stimulation. Quite possibly the notion of a "critical mass" is fully relevant to the real-world success or failure of economic development assistance programs, and that the principal reason for the poor performance of the recipient countries in the past has been the fact that the resources provided fell short of the necessary critical mass.

(d) *Overoptimistic parameter values*

The argument here is that the encouraging results shown by the benchmark with-WEEP simulation are an invalid artifact stemming from overoptimistic parameter values. This argument would stipulate that the theoretical structure of the WEEP model is reasonable, but maintains that the numerical parameter values used in the benchmark simulation are unrealistic. Of all the objections to the results, this is the only one capable of being explored within the context of the WEEP model itself. This was done by means of the "selected sensitivity analyses" reported in the concluding section of Chapter 4 of my book *Common Progress*. Results are shown there for variations in the numerical values of some 14 model parameters. Of the 14 parameters, variation in 12 of them within reasonable numerical ranges does not affect the qualitative conclusion that a very large amount of progress in the living standards of the poor countries may be achieved at the cost of a very minor retardation in the growth rates of living standards in the rich countries.

It must be conceded however, that the impact of the two parameters representing the two objections described above, ξ and χ, is just as predicted by skeptics. If either of these parameters departs sufficiently from its benchmark value, then the WEEP model simulations demonstrate that the World Economic Equalization Program would indeed be a complete failure. On the other hand, the model simulations run with less optimistic values of these parameters do bring to light two very important offsetting indications: (1) the departures from the benchmark value would have to be very large for the program to be fully ineffective; (2) even with these parameters at their extreme pessimistic values, showing little economic progress among the poor countries despite the WEEP, the retarding effect on the rates of growth of per capita income in the rich countries would not be significantly increased. In other words, the worst-case scenario is that a WEEP would simply not benefit the poor countries—not that a WEEP would not benefit the poor countries *and* impose heavy costs on the rich countries.

(e) *Primacy of total factor productivity*

A specialized variant of the "overoptimistic parameter values" argument focuses on ξ (the productivity differential source coefficient). According to this variant, there is much evidence that the key to economic performance is total factor productivity and not stocks of factors of production. This evidence suggests that to the extent that the WEEP model can be taken seriously as a representation of economic reality, the actual value of the ξ parameter is close to or equal to 1, indicating that all or most of the current differences in per capita income among countries are attributable to differences in the total factor productivity coefficients rather than to differences in stocks of generalized capital. For example, Robert Solow's classic work on the sources of US economic growth (1957) estimated that less than half of the total increase in national output could be attributed to increases in capital and labor. Another example is the classic work of Bergson (1978) comparing United States with Soviet Union economic performance, which indicated that the ratio of SU total factor productivity to US total factor productivity was much less than the ratio of SU capital stock to US capital stock.

The crucial problem with this argument is that previous economic research demonstrating the greater dependence of economic performance on total factor productivity than on capital stock has used a narrow definition of capital stock based mostly on business physical capital. The value of social physical capital is rarely included, and the value of human capital (in terms of its cost of production, i.e., educational and training expenditures) is never included. Solow himself has pointed out that "total factor productivity" in sources of growth research is in effect simply a terminological proxy for all factors affecting economic growth other than narrowly measured capital and labor (Solow, 2000). In the case of sources of growth over time, one of these factors is technological progress. In the case of crossnational

comparisons at a given point in time, technological progress is not relevant, but there are several other factors affecting economic performance, and many if not most of them are affected by past investments in costly commodities. The clearest example of this consists of expenditures on the commodities "education and training," these commodities in turn determining how much productive power is represented by a certain numerical population of laborers. In a word, what economists currently think of as "total factor productivity" is to a large extent dependent on prior investments in costly commodities other than what is currently thought of as "capital." These investments are included in the generalized capital concept. Since generalized capital has never been measured, there is no evidence against differences in generalized capital stocks being the primary determinant of differences in per capita income.

(f) *Ignores implementation questions*

The argument here is that the research presented has nothing at all to say on the numerous applied policy questions in the area of foreign aid, questions that have intrigued and puzzled a generation of economists. But unless clear and cogent answers are provided to these questions, and these answers are duly incorporated into the actual operation of the World Economic Equalization Program, the program would just be "throwing money at the problem" on a massive scale—the overwhelmingly probable consequence of which would be profligacy and waste on an equally massive scale. These questions include, but are not confined to, the following: What would be the appropriate proportions, of the total amount of foreign aid provided to each recipient country under the WEEP, to be allocated to plant and equipment, education and training, and social infrastructure? How should specific projects be chosen? What proportion of assistance should be provided in the form of grants, and what proportion in the form of interest-bearing loans? To what extent should assistance be tied, that is, required to be spent by the specific recipient country in the specific donor country? What should be the role of the OPEC countries, most of which are oil-rich but otherwise poor? What, if any, requirements should be placed on the recipient countries as a precondition for receiving aid?

It is quite true that the WEEP model, in and of itself, has nothing to add to the discussion of these kinds of questions. But it is necessary to proceed one step at a time. The purpose of the research described above is simply to *demonstrate the possibility*—as opposed to establish the fact—that a sufficiently massive economic development assistance program might be dramatically successful, raising the living standards of poorer countries by a tremendous amount while at the same time only slightly reducing the growth rate of living standards in the richer countries. Once this possibility has been established and accepted, then would be the time to get into the details of program functioning. It is not necessary to resolve all the myriad implementation issues in advance of deciding whether to undertake the proposed World Economic Equalization Program. Indeed, if resolution of all these issues were made a precondition for deciding the basic question of whether to initiate a WEEP, then this latter decision would probably never be made. The ephemeral prominence of the Washington Consensus is instructive in this regard. No sooner had the "consensus" achieved widespread recognition when the various economic setbacks of the latter 1990s cast grave doubt on the sensibility of some of its prescriptions, and such major players as the World Bank began to distance themselves from it. (See, for example: Broad & Cavanaugh, 1999; Naim, 2000; Williamson, 2000). The Washington consensus episode suggests that if we wait for permanent agreement to be reached on a specific set of economic development policy prescriptions prior to considering a WEEP, we may wait forever.

In conclusion, it must be acknowledged that the WEEP model simulation results described above most certainly do not constitute "proof" that a World Economic Equalization Program would be successful in achieving a substantial degree of economic equalization across the world within a reasonably abbreviated period of historical time, and without imposing an excessive burden on the rich contributor countries. They do, however, constitute "proof" that a World Economic Equalization Program *could* be successful in accomplishing this. In a legal sense, these results are mere "circumstantial evidence," and of its nature circumstantial evidence cannot be conclusive, but merely probative. The probative value of this particular evidence, in relation to

other evidence, must be evaluated by each individual.

Because the potential stakes are so great, however, perhaps this particular evidence should be evaluated from a larger perspective than is typical in economic analysis and inquiry. If a World Economic Equalization Program were undertaken by humanity, the best-case scenario is that it would be a complete success that would drastically diminish the problem of global economic inequality and dramatically improve the material living standards of a large majority of the entire human race, thereby achieving a significant moral victory and permanently eliminating this serious irritant in North–South international relations. The worst-case scenario is that the program would be a total failure that would have no perceptible positive impact on the living standards of the general population of the poorer countries, while having a serious negative impact on the living standards of the smaller population of the richer countries. If this latter were to occur, there is little doubt that the rich countries would quickly abandon their support of the program. Thus the inconvenience to their populations would be fleeting. On the one hand, therefore, there is the possibility of a large and perpetual benefit to the whole human race. On the other hand, there is the possibility of a small and temporary loss to a part of the human race. It is perhaps not too much to suggest that this would not be a difficult choice for a truly disinterested moral philosopher—or to any ordinary citizen of good will.

NOTES

1. It is generally assumed that the world economic inequality situation is sufficiently extreme that any effort to rectify it by means of international programs analogous to the redistributional programs utilized within countries would require a rate of taxation that would be politically unacceptable to the populations of the rich countries. Although not common, careful numerical explorations of the implications of worldwide current income redistribution have been undertaken by a few economists. See Tinbergen (1990, Chapter 5), Horowitz and Bohanon (1996), and Yunker (2000, Chapter 2). These explorations tend to confirm the general assumption.

2. See Thorbecke and Charumilind (2002) for a survey of the literature on the socioeconomic impact of economic inequality. This literature is almost entirely devoted to the domestic impact of economic inequality within countries, and it suggests various adverse internal effects of inequality in terms of political instability and so on. If within-country economic inequality has adverse effects within countries, it seems plausible that between-countries economic inequality would have adverse effects on international relations.

3. Although still unpublished in the journal literature as of the time of writing, the two working papers of Xavier Sala-i-Martin issued by the National Bureau of Economic Research in 2002 have caused something of a stir because they directly challenge the common presumption of "rising world inequality." In a 2003 working paper, Branko Milanovic criticizes Sala-i-Martin's results, describing them as "very dubious." Following Milanovic (2003), the "world Gini coefficient" might be computed in any of three ways: (a) using unweighted per capita income across countries; (b) using per capita income across countries weighted by their respective populations; (c) using individual households across countries. According to (a), the world Gini coefficient is increasing. According to (b), it is decreasing (Milanovic points out that this is owing to the influence of one very populous country: China). Data limitations preclude a highly accurate Gini estimate based on (c), but Milanovic's, 2002 article in the *Economic Journal* presents reasonably plausible Gini estimates for 1988 and 1993, which show an increase from 62.8 to 66.0. According to Milanovic (2003), Sala-i-Martin's results showing a decrease not only in concept (b) inequality, but in concept (c) inequality as well, are not to be trusted.

4. The most negative view of foreign aid is based on the premise that the recipient countries are so dysfunctional in terms of institutions, politics and culture that any foreign aid receipts are inevitably misdirected or simply squandered. Illustrative expressions of this view may be found in Bovard (1986); Dorn (1987); Bauer (1991); Bandow (1995), and Bandow and Vasquez (1994). More balanced examinations of foreign aid are to be found in an extensive professional literature, examples of which include Mosley, Hudson, and Horrell (1987); Michalopoulos and Sukhatme (1989); Lipton and Toye (1990); Mosley, Harrigan, and Toye (1991); Browne (1990); Cassen (1994); Kemp (1995); Boone (1996), Brewster and Dickson (1996) and Yunker (2000).

5. A few representative references on the history, politics and economics of the original Marshall Plan

include Wexler (1983); Mee (1984); Hoffmann and Maier (1984); Hogan (1987); Clesse and Epps (1990); Orme (1995); Reichlin (1995); Bager and Pelsoczi (1998); Schain (2001). General discussions of possible policy directions for ameliorating global economic inequality sometimes invoke the term "Marshall Plan," as in Angelopoulos (1983) and Cerami (1989). The policy directions under consideration tend to focus on alternatives to direct foreign aid such as debt relief. There is little or no effort to quantify what would be necessary to make significant inroads into global economic inequality.

6. In the WEEP model utilized in *Common Progress*, this "ratio" is defined in terms of per capita consumption rather than per capita income. Qualitatively there is very little difference between simulations done using per capita income ratios and simulations done using per capita consumption ratios. This is the only substantive difference in the structural model used to obtain the results presented here, relative to that used to obtain the results presented in *Common Progress*.

7. As one example of this, according to the *World Development Indicators, 2002* CD-ROM, in 1975 the per capita income of Columbia, in PPP terms, was higher than the per capita income of the United States. Until this was discovered, the WEEP model simulations were producing incomprehensible results. But once the given per capita income figures for Columbia were replaced by those of a roughly comparable country (Brazil), the results returned to comprehensibility. There were a few other anomalies in the PPP data that were handled similarly. No such anomalies were encountered with the conventional data.

8. According to the 2001 edition of *OECD in Figures* (available at http://www.oecd.org), in 1999 overseas development assistance (ODA) as a percentage of GNP was 0.10 for the United States, 0.21 for the G7 countries, 0.32 for the EU-15 countries, and 0.24 for all DAC countries (Development Assistance Committee).

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APPENDIX A. WEEP MODEL TECHNICAL SPECIFICATION

Endogenous variables		Corresponding equations
Current period structural form		
$Y_{i,t}$	Total output/income	$Y_{i,t} = A_{i,t}K_{i,t}^{\alpha}P_{i,t}^{\beta}$
$M_{i,t}$	Military output	$M_{i,t} = m_{i,t}Y_{i,t}$
$y_{i,t}^{d}$	Per capita disposable income	$y_{i,t}^{d} = (Y_{i,t} - M_{i,t})/P_{i,t}$
$c_{i,t}'$	Per capita potential consumption	$c_{i,t}' = a + by_{i,t}^{d}$
$C_{i,t}'$	Potential consumption	$C_{i,t}' = c_{i,t}'P_{i,t}$
$C_{i,t}$	Consumption	$C_{i,t} = \min(C_{i,t}', Y_{i,t} - M_{i,t})$
$R_{i,t}$	Residual	$R_{i,t} = Y_{i,t} - M_{i,t} - C_{i,t}$
$y_{i,t}$	Per capita income	$y_{i,t} = Y_{i,t}/P_{i,t}$
$y_t^{\max}$	Maximum per capita income	$y_t^{\max} = \max(y_{i,t}, i = 1, \ldots, n)$
$r_{i,t}$	Ratio	$r_{i,t} = y_{i,t}/y_t^{\max}$

APPENDIX A—*continued*

Endogenous variables		Corresponding equations
$\lambda_{i,t}$	Transfer coefficient	$\lambda_{i,t} = 0$ if $r_{i,t} < r^{\min}$ $\lambda_{i,t} = \lambda^{\max} \frac{r_{i,t} - r^{\min}}{1 - r^{\min}}$ if $r_{i,t} \geqslant r^{\min}$
$T_{i,t}$	Generalized capital transfer	$T_{i,t} = \lambda_{i,t} R_{i,t}$
TT_t	WEEP total transfer fund	$TT_t = \sum T_{i,t}$
$d_{i,t}$	Difference	$d_{i,t} = y_t^{\max} - y_{i,t}$
$s_{i,t}$	Share ratio	$s_{i,t} = d_{i,t} P_{i,t} / \sum d_{i,t} P_{i,t}$
$S_{i,t}$	Share amount	$S_{i,t} = s_{i,t} TT_t$
$T_{i,t}$	Net transfer	$T_{i,t}^n = T_{i,t} - S_{i,t}$
$t_{i,t}^n$	Net transfer ratio	$t_{i,t}^n = T_{i,t}^n / Y_{i,t}$
$I_{i,t}$	Domestic investment	$I_{i,t} = R_{i,t} - T_{i,t}$
Current-period to next-period transition		
$m_{i,t+1}$	Military spending	$m_{i,t+1} = (1 + \mu) m_{i,t}$
τ_{t+1}	Technological change	$\tau_{t+1} = (1 + \phi) \tau_t$
$A_{i,t+1}$	Total factor productivity	$A_{i,t+1} = (1 + \tau_{t+1}) A_{i,t}$
$g_{i,t+1}$	Population growth rate	$g_{i,t+1} = (1 + \gamma) g_{i,t}$
$P_{i,t+1}$	Population	$P_{i,t+1} = (1 + g_{i,t+1}) P_{i,t}$
$K_{i,t+1}$	Generalized capital stock	$K_{i,t+1} = (1 - \delta) K_{i,t} + I_{i,t} + \chi S_{i,t}$

Benchmark case parameter values		Values
Structural form parameters		
α	Elasticity of output wrt generalized capital	0.8
β	Elasticity of output wrt population (labor)	0.2
a	Potential per capita consumption function intercept	1250
b	Potential per capita consumption function slope	0.85
$r^{\min}$	Minimum ratio: if a country's ratio less than this value, it makes no contribution into the WEEP transfer fund	0.25
$\lambda^{\max}$	Maximum transfer coefficient: WEEP transfer fund contribution proportion for the richest country	0.35
μ	Change in military output proportion	0
ϕ	Change in rate of technological progress	0
γ	Change in population growth rate	0
δ	Physical depreciation factor	0
χ	Conversion effectiveness coefficient	1
Initial period parameters		
$y_{i,1}$	Period-1 per capita income	Empirical
k_1	Period-1 generalized capital-output ratio in richest country	25
ξ	Productivity differential source coefficient	0
$K_{i,1}$	Period-1 generalized capital, computed using $y_{i,1}$, k_1 and ξ	Computed
$P_{i,1}$	Period-1 population	Empirical
$g_{i,1}$	Period-1 population growth rate	Empirical
$m_{i,1}$	Period-1 military output proportion	Empirical
τ_1	Period-1 rate of technological progress	0.012