DOES INCOME INEQUALITY RAISE AGGREGATE SAVING?

Klaus Schmidt-Hebbel
Luis Servén

DOCUMENTOS DE TRABAJO DEL BANCO CENTRAL

DOES INCOME INEQUALITY RAISE AGGREGATE SAVING?

Klaus Schmidt-Hebbel
Manager of Economic Research
Central Bank of Chile

Luis Servén
The World Bank

Resumen

Este trabajo presenta una revisión analítica y empírica de las relaciones entre la distribución del ingreso y el ahorro agregado. La teoría del consumo destaca varios canales directos -- la mayoría de ellos de signo positivo -- a través de los cuales la desigualdad de ingresos puede afectar el ahorro total de los hogares. Sin embargo, la teoría más reciente de economía política señala varios efectos indirectos y negativos de la desigualdad sobre el ahorro, a través de la inversión, el crecimiento y el ahorro público. Este estudio presenta nueva evidencia empírica acerca de la relación entre desigualdad del ingreso y ahorro agregado, basada en información reciente y de mejor calidad para países industrializados y en desarrollo. Los resultados empíricos, para medidas alternativas de desigualdad y ahorro y distintas especificaciones econométricas empleadas usando datos de corte transversal y de panel para países, no provee sustento estadístico para la noción que la desigualdad de ingresos tenga algún efecto sistemático sobre el ahorro agregado. Este resuiltado es consistente con la ambiguedad teórica destacada arriba pero contradice la literatura empírica existente, que señala una relación positiva entre desigualdad de ingresos y ahorro agregado usando datos de corte transversal de países.

Abstract

This paper reviews analytically and empirically the links between income distribution and aggregate saving. Consumption theory brings out a number of direct channels through which income inequality can affect overall household saving -- positively in most cases. However, recent political-economy theory points toward indirect, negative effects of inequality -- through investment, growth, and public saving -- on aggregate saving. On theoretical grounds the sign of the saving-inequality link is therefore ambiguous. This paper presents new empirical evidence on the relationship between income distribution and aggregate saving, based on a new and improved income distribution database for both industrial and developing countries. The empirical results, using alternative inequality and saving measures and various econometric specifications on both cross-section and panel data, provide no support for the notion that income inequality has any systematic effect on aggregate saving. These findings are consistent with the theoretical ambiguity but contrast with previous empirical literature that found a positive cross-country association between income inequality and aggregate saving.

We are grateful to Klaus Deininger and Lyn Squire for kindly making available to us their database on income distribution. We thank Aart Kraay, Steve Marglin, Branko Milanovic and Vito Tanzi for useful comments and suggestions on an earlier version. Excellent research assistance by Wanhong Hu and Faruk Khan is gratefully acknowledged.

1. Introduction

If all individuals were identical in all dimensions related to saving decisions (behavior, endowment, and restrictions they face), then aggregate saving would be trivially related to individual saving -- it would just equal the saving of a representative agent multiplied by the population. To determine society's total saving, it would suffice to know the values of the representative agent's income, wealth and so on. In other words, given the total population, aggregate saving would depend only on the *aggregate* values of variables such as income and wealth.

If individuals are instead heterogeneous, however, this simple relationship ceases to hold. To be more precise, only under very particular (and restrictive) forms of heterogeneity do aggregate consumption and saving depend exclusively on aggregate quantities.[1] In the more general, and realistic, case in which individual heterogeneity can take arbitrary forms, aggregate consumption and saving patterns inevitably reflect the dissimilar behavior of heterogeneous agents that differ in their preferences, resources and/or institutional constraints. This, of course, has long been recognized by consumption theory; indeed, consumption and saving are among the few areas in macroeconomics where theoretical developments have occasionally left the safe haven of representative-agent models to venture into the wilderness of agent heterogeneity, collecting along the way valuable analytical and empirical insights -- such as those derived, for example, from the life-cycle consumption model.

One particular dimension of heterogeneity that has received increased attention from the macroeconomic viewpoint in recent years is that of income distribution. Recent analytical and empirical work has focused on the relationship between income inequality, growth and investment.[2] Less attention has been paid, however, to the links between income distribution and saving.

It is important to clarify what distribution of income one is talking about, because different concepts have been considered in the literature. Early research focused on functional income distribution, which can behave very differently from personal income distribution. Further, among the class of personal distributions of income, household and individual income distribution typically differ significantly. Finally, the precise income definition also matters. For example, in a world of otherwise identical individuals that

[1] For a formal discussion of the circumstances under which the economy can be summarized by a "representative consumer", see Mas-Colell, Whinston and Green (1996). See also Kirman (1992) for a recent sharp criticism of the representative-agent paradigm.

[2] See for example Galor and Zeira (1993), Alesina and Rodrik (1994), Persson and Tabellini (1994), Perotti (1995), and Alesina and Perotti (1996).

differ only by age (but have the same lifetime income), inequality in current income would merely reflect the different stage of the life cycle in which different individuals find themselves.

Much of the historical literature on distribution and aggregate saving -- comprising both neo-classical and Keynesian growth models -- has focused on functional income distribution. Yet neoclassical consumption theory brings out a number of channels through which inequality in the personal distribution of income affects directly the total volume of personal (i.e. individual or household) saving. Most of these mechanisms (but not all) result in a positive relationship between income inequality and personal saving. However, recent political-economy theory underscores indirect links from inequality -- through investment, growth, and public saving -- to aggregate (household plus corporate plus public) saving, that should result in a negative relationship. Therefore, the sign of the overall impact of inequality on aggregate saving is ambiguous on theoretical grounds, and becomes largely an empirical matter.

Most of the empirical literature on the links between personal income distribution and personal saving based on cross-section micro data suggests a positive relation between personal income inequality and overall personal saving. In turn, the evidence from aggregate (typically, cross-country) data is more mixed. Some studies also find positive effects of personal income inequality on *aggregate* saving, but others do not. Reconciling these conflicting results is difficult because empirical studies based on macro data use widely different samples and specifications, different measures of saving and inequality and, in most cases, income distribution information of questionable quality.

This paper reexamines the empirical evidence from macro data on the links between the distribution of personal income and aggregate saving, controlling for relevant saving determinants. It provides an encompassing framework and a robustness check for previous empirical studies, and extends them in five dimensions: (i) testing alternative saving specifications, (ii) using alternative inequality and saving measures, (iii) making use of newer, better, and larger databases, (iv) conducting estimations jointly and separately for industrialized and developing countries, and (v) applying various estimation techniques on both cross-country and panel data. On the whole, we do not find any consistent effect of income inequality on aggregate saving -- a result that accords with the theoretical ambiguity.

The paper is organized as follows. Section 2 presents the stylized facts on saving, income, growth, and income distribution using data for a large number of industrial and developing countries. Section 3 provides a brief survey of alternative views of saving determination, with emphasis on the saving consequences of different income distribution profiles. Section 4 reviews previous empirical studies of the impact of income distribution on saving, and Section 5 presents new econometric evidence using our data set. Finally, Section 6 concludes.

2. Saving and Distribution: the Stylized Facts

The Data

We begin with a brief summary of our data. Individual variable definitions and sources are reported in the Data Appendix. Our basic information are cross-country time-series data for the 1965-1994 period from the World Bank macroeconomic and social databases, and income distribution data from a new World Bank database recently assembled by Deininger and Squire (1996). The cross-country data presented in this section was constructed by computing the 1965-94 country averages of the raw data. For some countries some of the variables of interest (notably those related to income distribution) are not available every year of the 1965-94 period; country averages were computed using the available observations. Finally, in some empirical experiments below the cross-country data was complemented with information from Barro and Lee's (1993) database. Thus, apart from the income distribution data, our sources are standard and well-known. Hence we describe briefly the main features of the income distribution database, and in particular the selection of the subsample used in this paper.

Deininger and Squire's (1996) new cross-country time-series database on income inequality measures represents a major improvement in rigor, quality, and coverage over preceding data sets -- including in particular those used in the previous literature on saving and income distribution. Unlike in other existing databases, a clear distinction is made between income-based and expenditure-based inequality measures, as well as between household-based and individual-based, and the underlying primary data are checked for three important quality criteria: they have to be based on household or individual surveys (not on national accounts), their coverage has to be comprehensive (i.e., based on nation-wide samples), and measurement of income (or expenditure) has to be comprehensive as well (including all income or expenditure categories).

While the total number of country-year observations in Deininger-Squire is 2621, applying the three latter quality criteria reduces the number to 682 high-quality country-year observations, corresponding to 108 countries and years within the period 1890-1995. For these observations, both Gini coefficients and income shares by population quintiles are available.

Of the latter 682 observations we include in our subsample only those 468 country-year observations (corresponding to 82 countries) that fall into the 1965-94 period (the one for which we have complete macroeconomic data). However, this set includes observations based on income data along with others based on expenditure data. In order to make the Gini coefficients from income- and expenditure-based data comparable (income is typically more concentrated than expenditure) we follow the simple procedure suggested by Deininger and Squire by adding a constant equal to 6.7 to the expenditure-based coefficients. The latter figure is the average difference between income and expenditure-based Gini coefficients reported by Deininger and Squire, for those country-year observations for which both data are available. However, it is methodologically much less clear what type of correction should be applied to the expenditure-based income shares by quintiles. Hence, we opt for dropping them and restrict our database of income shares only to income-based data.

For our cross-country dataset based on 1965-94 averages for each country we impose an additional requirement to achieve a minimum of time representation: countries are included only if they have at least one observation in each of the following two 15-year periods: 1965-79 and 1980-94. This leaves us with 52 country observations. Table 1 presents a summary of the total number of observations in terms of country-years (for our panel dataset) and country averages (for our cross-country dataset), for Gini coefficients and share ratios and by country groups:

Unless otherwise noted, here and in the rest of the paper we use the terms 'income inequality' and 'income distribution' for all samples and statistical results, even when they refer to Gini coefficients based on both income and expenditure-based information.[3] Likewise, we use the term 'saving' ('saving ratio') to refer to gross national saving (respectively, its ratio to GNP). We choose national saving and national product data as the relevant variables because they are closer to the relevant units (households or individuals) for which income distribution data is available than the domestic saving and domestic product measures. In this respect we differ from most previous empirical studies, that are based on the less adequate domestic measures.

A final caution relates to measurement error. As is well known, this is a central problem in empirical studies of saving, due not only to the inadequacy of the very saving concept used by the National Accounts (which, for example, exclude capital gains from the definition of income, and treat human capital expenditures as consumption) but also to the unreliability of measured saving, which stems largely from the fact that saving is often computed as the residual from another residual (consumption). The upshot is that

[3] The empirical results based on the smaller sub-sample of income-based Gini coefficients were very similar to those reported below, which are based on the larger sample comprising both income-based and adjusted expenditure-based Ginis. To save space, we only report the latter.

saving measures may contain large errors, particularly in developing countries where the statistical apparatus involved in the collection of household data is likely to be weaker.[4] Measurement error is likely to be an even more serious problem in the case of income distribution statistics. The latter are primarily derived from household survey data, which typically understate the income of the richer households. As a result, income inequality is likely to be underestimated -- and probably more so in poorer countries.

The stylized facts

Keeping in mind the features and limitations of the available data discussed above, we turn next to the review of the stylized facts present in the data. To save space and keep comparability with the previous literature, the discussion focuses only on the cross-country dimension of the data.

We first provide summary statistics for our income distribution data (a detailed description of the full dataset is in Deininger and Squire 1996). Table 2 presents means and standard deviations of three conventional indicators of inequality: the Gini coefficient, the ratio between the income shares of the richest 20 percent and poorest 40 percent of the population, and the income share of the 'middle class', defined as the middle 60 percent of the population (often used as an indicator of equality). The statistics are computed for the world, industrial countries, and developing countries. As the table shows, developing countries are more unequal than industrial countries by any of the three indicators presented, and show also a larger dispersion in their levels of inequality.

Let us examine now the empirical association between the saving ratio and some important saving determinants. We start with the relationship between saving and the level of development -- as measured by real per capita GNP. Figure 1 presents the scatter plot of the 1965-1994 averages of these two variables for the sample countries.[5] In the figure, countries appear clustered in rough correspondence to their development level. On average, saving rates are lower for developing countries than for industrial countries. Saving rates tend to rise with per capita income: the correlation coefficient between the two variables is .36 (Table 3), significantly different from zero at the 5 percent level, and is even higher (.48)

[4] Biases may arise in saving regressions as a result of measurement errors in saving, because the errors are likely to be correlated with saving determinants in general and income in particular. Recent discussions of measurement problems in saving data and analyses include Deaton (1989), Lipsey and Tice (1989), Srinivasan (1994), and Schmidt-Hebbel, Servén and Solimano (1996).

[5] Using per capita income at the initial year of the sample instead of its average value yields a very similar picture.

among developing countries. A similar association has been found in a number of empirical studies of saving (e.g., Collins 1991; Schmidt-Hebbel, Webb and Corsetti 1992; Carroll and Weil 1994; Masson, Bayoumi and Samiel 1995; Edwards 1995).

The figure also suggests that at high levels of per capita income saving ratios appear to level off -- i.e., the relationship is not linear, and possibly not even monotonic. As a more formal check on this, the solid line in Figure 1 plots the fitted values from regressing the saving rate on a quadratic polynomial in per capita income; the estimated coefficients are significant at conventional levels. The fitted curve shows that the positive association between saving and development appears indeed to be confined to the early stages of development, ceases to hold at about $10,000 per capita GNP (in 1987 US$), and turns into a negative association at higher income levels.

A second stylized fact is the strong positive association between saving ratios and real per capita growth, which has been amply documented in cross-country empirical studies.[6] However, its structural interpretation remains controversial, as it has been viewed both as proof that growth drives saving (e.g., Modigliani 1970, among many other studies) and that saving drives growth through the saving-investment link (e.g., Levine and Renelt 1992; Mankiw, Romer and Weil 1992).[7] As Figure 2 and Table 2 show, our data conform to these findings. Aggregate saving ratios and real per capita GNP growth are positively associated, and as Table 3 shows their correlation coefficient equals .50, significantly different from zero at the 5 percent level.

Is the association between saving and income distribution as clear-cut as that between saving and income (or its growth rate) ? Figure 3, which plots saving ratios against Gini coefficients of income distribution, shows no clear pattern. The full-sample correlation between both variables is in fact *negative* (-0.32, significant at the 5 percent level), suggesting a negative effect of income concentration on aggregate saving. As the picture also suggests, however, the correlation pattern is rather different in the industrial (.10) and developing-country (-.20) subsamples; in neither is it significantly different from zero.

The above facts lead to the much-discussed relationship between income inequality and level of development -- with the latter measured as before by real per capita GNP. According to the well-known finding by Kuznets (1955), the relationship between these variables follows an inverted-U shape: inequality

[6] See for example Modigliani (1970), Maddison (1992), Bosworth (1993) and Carroll and Weil (1994).

[7] On the saving-growth causality see the recent overviews by Carroll and Weil (1994), Deaton (1995), and Schmidt-Hebbel, Serven and Solimano (1996).

rises in the early stages of development, and then decreases as per capita income continues to rise. This stylized fact has been replicated to varying extent in a number of cross-country studies (for recent examples see Bourguignon and Morrison 1990, and Clarke 1992), but its interpretation is far from clear (see Adelman and Robinson 1989, for a discussion).[8] Time-series data provide much less support for a Kuznets-type relation.[9]

Figure 4 shows that our cross-country sample fits the Kuznets curve. Keeping with convention, the figure plots Gini coefficients against the log of per capita income (with both variables measured by their 1965-94 averages). The curved line in the graph depicts the fitted values from regressing the Gini coefficient on the log of per capita income and its square; the estimated regression coefficients are highly significant. As can be seen from the figure, developing countries account for the upward-sloping portion of the empirical curve, and industrial countries cluster along the declining portion.

One methodological issue that arises is whether the above findings are sensitive to our choice of the Gini coefficient as the relevant inequality statistic. A number of alternative indicators are found in the literature -- e.g., Theil's index, the coefficient of variation of income across households, the income share of the poorest 20 or 40 percent of the population, the ratio of the latter to the income share of the richest 20 percent, or the income share of the middle class.[10] Among all them, the Gini coefficient, Theil's index or the coefficient of variation are generally preferable because they use more information than the commonly-encountered quintile-based indicators. At the same time, the Gini index has the well-known drawback that it is not uniquely related to the shape of the underlying distribution, so that very different redistribution schemes can be reflected in the same change in the Gini coefficient. Finally, income shares (in levels) and Gini coefficients may pose cross-country comparability problems more severe than those derived from the use of share ratios (Deininger and Squire, 1996).

In practice, however, the informational content of all these indicators is usually very similar, as shown by the fact that they typically are very highly correlated -- even though they may yield different

[8] As is well known, Kuznets' explanation of his empirical finding was based on the shift of population from traditional to modern activities. See Anand and Kanbur (1993) for an analytical reassessment of this view.

[9] For instance Fields (1991), using time-series data for low and middle-income countries, concludes that inequality increases as often as it decreases in low-income countries -- and the same holds for middle-income countries.

[10] For a discussion of the properties of these indices see for example Cowell (1977).

orderings for a few sample observations (see e.g. Clarke 1992). This applies also in our case. By way of example, Figure 5 plots the Gini coefficient against the ratio of the income share of the richest 20 percent of the population to that of the poorest 40 percent, for those countries in our sample for which both kinds of data are available. The plot reveals a strong positive association between both distribution measures; indeed, their correlation coefficient equals .94.

To summarize this section, our data conform to three stylized facts found in cross-country studies. First, saving rates appear to rise with development (as measured by per capita GNP) -- at least at its early stages. Second, saving rates and growth rates are positively correlated across countries. Third, income inequality seems to rise at early stages of development, and decline beyond certain levels of per capita income, as predicted by the 'Kuznets curve'.

For the overall sample, we also find a negative association between aggregate saving rates and standard measures of income inequality, although the relationship is not robust across subsamples. More importantly, this refers only to the simple correlation between saving and income distribution. The more substantive question is whether the negative association between both variables continues to hold -- or whether it is reversed in sign -- once other standard saving determinants are taken into consideration. To answer this question, we need to examine the analytical underpinnings of the saving-inequality link, and place the latter in a broader empirical framework encompassing other relevant determinants of saving. This task is undertaken in the next section.

3. Saving and Income Distribution: A Brief Survey

Aggregate saving is the outcome of individual saving efforts by heterogeneous members of different classes of savers. Heterogeneity may be due to the fact that different individuals determine their consumption/saving plans according to different objectives (i.e., their preferences are not identical). Alternatively, even if all individuals possess identical preferences, their behavior may differ because they face different institutional constraints (e.g., in their access to borrowing).

Heterogeneity is of course important because when agents are dissimilar the aggregate levels of those variables relevant for *individual* saving decisions are not sufficient to determine *aggregate* saving -- the latter also depends on the distribution of such variables across individual savers. There are some exceptions to this rule, that apply when the class of admissible individual preferences and/or admissible endowment distributions across individuals are suitably restricted (see Caselli and Ventura 1996 for some recent examples). However, the practical relevance of those exceptions is rather limited. Even if all agents share the same preferences and face identical constraints, distribution still matters as long as agents' (common) decision rule for saving is not linear in the relevant variables.

Heterogeneity among savers is a key feature that helps understand how aggregate saving is affected by changes in saving determinants, including policies. A given change in the aggregate value of a saving determinant (such as disposable income or wealth) can have very different consequences for aggregate saving depending on how it impacts different types of savers. Likewise, purely redistributive policies can have an impact on aggregate saving -- e.g., public transfers to the poor financed by taxes on the rich will reduce total saving if the former have a higher propensity to spend than the latter.

Below we review briefly the literature on consumption and saving determination, with a focus on income (or wealth) distribution in particular. We adopt an aggregate perspective, although where relevant some reference is made to the distinction between private and public saving, or firm and household saving. Our approach is selective rather than exhaustive. We first examine the relationship between saving and three basic determinants: income, the rate of return, and uncertainty.[11] Then we review the channels through which different forms of income distribution affect aggregate saving.

3.1 Basic saving determinants

Income

Income or wealth is the main driving force behind consumption (and hence saving) and therefore has attracted the largest attention among all potential saving determinants. But beyond this very general statement there is very little in common among different saving theories. The differences start with the appropriate measure of income: current income (in the conventional Keynesian hypothesis, henceforth KH), permanent income net of taxes over the life-cycle (the life-cycle hypothesis, LCH), permanent income net of taxes over an infinite horizon (the permanent-income hypothesis, PIH) or, as a variant of the latter, permanent income net of government spending over an infinite horizon (REH, the Ricardian-equivalence hypothesis).

As a starting benchmark consider either the PIH or its REH variant for a representative consumer.[12] A rise in net permanent income leads to a proportional increase in consumption levels without any effect on

[11] Uncertainty refers basically to the variability of income and the rate of return, and therefore is really not a separate variable. However, because the literature emphasizes the distinction between the effects on saving of income (or rate of return) variability and those of their respective levels, we treat them separately.

[12] See Friedman (1957), Hall (1978) and Flavin (1981).

saving. Temporary income changes are smoothed out through appropriate changes in saving. If both current and permanent income rise by the same amount, consumption and saving ratios to current income remain unaltered; in turn, purely temporary income changes result in movements of the saving (consumption) ratio in the same (opposite) direction.

According to the PIH, income growth -- i.e., the increase in future income relative to current income levels -- must reduce saving rates, as consumers raise current consumption in anticipation of higher future income. This, however, is at odds with the positive saving-growth correlation observed in the data and reviewed in the previous section, and has prompted several lines of research attempting to explain why rational consumers may fail to adjust their consumption levels in the face of rising income.[13] The explanations are mostly based on non-standard preferences incorporating consumption habits (which prevent rapid changes in consumption levels), subsistence consumption levels (below which no saving whatsoever takes place, so that the saving propensity is effectively zero) or wealth as an argument of the utility function (the classical "capitalist spirit" model). Under each of these formulations, higher income can generate increases in saving, at least transitorily.

At the other end of the theoretical spectrum is the LCH of Modigliani and Brumberg (1954, 1979) -- the main competitor of the PIH-REH theories. As opposed to the representative-agent framework of the latter, agent heterogeneity is the cornerstone of the LCH. Aggregate saving results from the addition of saving by different age-specific cohorts. Each cohort smooths consumption over a finite horizon, given lifetime resources that -- in the simple LCH hypothesis -- are not transferred across generations. Over the life cycle, saving and consumption follow hump-shaped patterns, with dissaving at young age, the peak of saving at working age, and dissaving during retirement as households run down their accumulated assets. Hence saving propensities depend on age and differ systematically across cohorts.

The impact of growth on saving in the LCH framework is ambiguous. On the one hand, the earnings and saving of the working-age population will rise relative to retirees' dissaving, thus pushing up aggregate saving. On the other hand, however, workers will anticipate higher earnings during their working age, and this will depress their saving just like in the PIH framework. The overall effect is therefore indeterminate. Empirically, recent work by Paxson (1996) using household data shows that life-cycle factors can account only for a small part of the strong observed association between growth and aggregate saving.

---

[13] See Carroll and Weil (1994) and Deaton (1995).

As mentioned earlier, there is of course an alternative interpretation of why standard models of saving have such a hard time generating the positive growth-saving association that is observed empirically. Rather than saving behavior, the latter could just reflect the combination of two well-established empirical facts: the positive association between investment and growth (Levine and Renelt 1992) and the equally positive saving-investment correlation (Feldstein and Horioka 1980, Feldstein and Bachetta 1990), often interpreted as evidence of international capital immobility (see Schmidt-Hebbel, Servén and Solimano 1996 for an overview of these stylized facts and their explanations).

The rate of return

The second key factor governing the intertemporal allocation of consumption, and hence saving, is the rate of return. However, its impact on saving in the representative-agent framework of the PIH is ambiguous, because changes in the rate of return have both income and substitution effects, which run in opposite directions (except in particular cases, like when the consumer is a net debtor). The situation is similarly ambiguous in the LCH framework. Here changes in interest rates entail transfers among cohorts, and the net impact on aggregate consumption and saving depends on the different cohorts' saving propensities as well as on their relative size (see Deaton 1992). In practice, empirical studies support these theoretical ambiguities, and typically fail to find significant effects of interest rate changes on saving.

Recent work by Ogaki, Ostry and Reinhart (1994) adds a new dimension to the effect of the rate of return on saving. They present a model in which the elasticity of intertemporal substitution (and hence the interest rate sensitivity of saving) rises with the level of income. Empirical estimation of the model on a cross-country data set provides some support for this view.

Uncertainty

Recent work on saving has moved away from the simple versions of the PIH and LCH models toward broader frameworks incorporating uncertainty about future income, the rate of return to savings, the length of life, etc. One line of work has relaxed the certainty-equivalent utility function of Hall's (1978) PIH, allowing the marginal utility of consumption to be nonlinear, typically convex. This convexity creates precautionary motives for saving whenever uncertainty about future consumption is introduced: it is prudent for individuals to limit borrowing and not consume too much until they know more about their future -- an effect that is stronger the greater the uncertainty about lifetime income.[14]

The existence of the precautionary motive for savings is less in doubt than its actual magnitude. Some recent empirical tests suggest that it could account for a substantial fraction of households' wealth (Samwick 1995). Lacking firmer evidence, precautionary saving seems likely to represent well the short-term consumption-smoothing behavior of the average consumer, but not explain the bulk of saving, which in most societies appears to be carried out by a relatively small number of wealthier households (see Carroll and Summers 1991 and Deaton 1995).

3.2 Income distribution and saving

Let us now focus in more detail on the impact of changes in the distribution of income (or wealth) on aggregate saving. We examine four topics: (i) links between saving and the *functional* distribution of income; (ii) links between saving and the *personal* distribution of income; (iii) borrowing constraints, distribution, and saving; and (iv) indirect effects of distribution on saving. Then we briefly sum up the different mechanisms at work.

Functional distribution and saving

The link between the functional distribution of income and saving (and growth) is at the heart of the neoclassical growth model (Solow 1956), as well as the neo-Keynesian growth models of Lewis (1954), Kaldor (1957) and Pasinetti (1962). These models are general-equilibrium in nature, with both saving and income distribution as endogenous variables.

In the neoclassical framework workers and capitalists do not necessarily differ in their saving patterns. Aggregate saving behavior in conjunction with production characteristics determines income distribution. The reason is that saving influences investment and thus the capital stock. An increase in the propensity to save will increase the long-run capital-labor ratio, and capital's income share will rise or fall depending on whether the elasticity of factor substitution is greater or smaller than one, respectively.

[14] Unlike in the simple PIH, in this framework intertemporal transfers of resources that leave the present value of lifetime income unaffected can still affect saving behavior. Higher present taxes with lower future taxes lead to a decline in consumption if individuals have to rebuild their precautionary balances (and cannot borrow against the future tax break).

By contrast, the neo-Keynesian growth models of Lewis and Kaldor assume from the outset that workers and capitalists have different saving behavior. Lewis (1954) argues that most saving comes from the profits of the entrepreneurs in the modern, industrial sector of the economy, who save a high fraction of their incomes, while other groups in the economy save less. The more fervent are the activities of the capitalists, the faster does the distribution of income tilt toward profits, increasing the aggregate saving ratio. Income redistribution from the low-saving group to the entrepreneurs raises aggregate saving.

Likewise, in the simplest form of Kaldor's (1957) model, workers spend what they earn (their propensity to save is zero) and the share of profits in national income depends positively on the investment-output ratio and inversely on the propensity to save of the capitalists. Thus, like in Lewis' model, an increase in investment raises the income share of profits at the expense of the wage share, and the more the capitalists spend, the more they earn -- the "widow's cruse" is never empty.

Pasinetti (1962) assumes that saving propensities differ among classes of individuals, rather than classes of income. Workers' saving is not zero; indeed, they are assumed to own shares on the capital stock and receive part of the profits. Nevertheless, the implications for the share of profits in income are the same obtained by Kaldor. The fact that workers save does influence the distribution of income between capitalists and workers, but does not influence the distribution of income between profits and wages.

While these neo-Keynesian models establish a clear relation between the functional distribution of income and saving, it is worth noting that their implications in terms of the inequality-saving link are less automatic. The reason is that in many societies wage earners do not necessarily represent the poorer segments of the population, which are likely to include instead small rural landowners and self-employed individuals in the informal sector. As a result, the association between the functional and personal distributions of income is empirically rather weak (Atkinson 1994).

Personal Distribution and Saving

With consumer heterogeneity, standard consumption theories also generate links between personal income distribution and aggregate saving that, unlike the classical theories just referred to, do not depend on the exogenous distinction between savers and non-savers. These links result from a non-linear relationship between individual saving and income, which can have different sources, but in most cases -- although not invariably -- leads to a positive relationship between inequality and aggregate saving.

A starting point is again the LCH, amended to include bequests. The latter were absent from the early formulations of the LCH because they were thought insignificant, a notion that has later been reversed

(Kotlikoff and Summers 1981, 1988). The view that bequests as a saving motive are perhaps more important than life-cycle considerations, and that the elasticity of bequests with respect to lifetime resources exceeds unity, helps explain a number of empirical puzzles on the LCH model (see Deaton 1992 and 1995 for further discussion and references). First, there is little evidence that the old dissave, as implied by the simple LCH; on the contrary, their saving rates appear to be as high or even higher than those of young households. Second, if bequests are a luxury (at least over a relevant wealth range), saving rates should be higher among wealthier consumers and richer countries than in the rest, which empirically seems to be the case. Then income redistribution from rich to poor will unambiguously reduce aggregate saving.

Third, the fact that saving appears to be concentrated among relatively few richer households, who may be accumulating mostly for dynastic motives, is also in agreement with a central role of bequests in driving saving. This is consistent with the "capitalist spirit" model mentioned earlier, in which wealth is accumulated for its own sake (see, for example, Zou 1993), and higher wealth prompts further accumulation -- because consumption and wealth are gross substitutes in the agent's utility function. More generally, the apparent concentration of saving in a small group of richer individuals suggests that a better understanding of their saving behavior is essential to understand aggregate saving patterns.

An alternative route through which income distribution may matter for aggregate saving was suggested by Becker (1975). If there are decreasing returns to human capital, the poor will invest relatively more in human capital than the rich. Since human capital expenditures are considered as consumption in standard national accounting, the measured saving rates of the poor will appear lower than those of the rich, even if their "overall" saving rates (including human capital accumulation) are identical.

In turn, precautionary saving also implies a link between distribution and saving. Consumers with low assets tend to compress consumption to avoid running down their precautionary balances, so that their marginal propensity to consume out of income is higher than that of those consumers holding large asset stocks -- they would devote most of any extra income to consumption. Thus redistribution from the wealthy to the poor would depress overall saving. The opposite could happen, however, if the poor face greater uncertainty, are more risk-averse, or have more limited access to risk diversification than the rich; in such circumstances (which seem quite realistic), a transfer from the latter to the former would lead to higher aggregate saving. A related view, advanced by Friedman (1957), holds that, if the cross-sectional distribution of income reflects future income uncertainty, then greater income inequality should raise precautionary saving.

Borrowing constraints, distribution, and saving

The inability of some consumers to borrow forges a powerful link between income distribution and saving. Consumption models with borrowing constraints divide consumers into savers and non-savers. Unlike in the classical models of functional income distribution, however, this does not arise from the exogenous distinction of two classes of people or preferences, but from the distribution of preferences among the population, interest rates, the variability of earnings, and their rate of growth.

Borrowing constraints act in a way similar in many respects to the precautionary saving motive. Given the inability to borrow, consumers use assets to buffer consumption, accumulating when times are good and running them down to protect consumption when earnings are low. In theoretical models, borrowing constraints mostly affect impatient consumers who face high earnings growth (Deaton 1991).

The empirical relevance of borrowing constraints is well established. However, they help explain mostly short-term saving for consumption buffering, not long-term saving for old-age or for bequests. For example, Hayashi (1985) finds that for a significant fraction of the Japanese population the behavior of consumption over time is consistent with the existence of credit rationing and differential borrowing and lending rates. Borrowing constraints appear particularly important with regard to saving for housing purchases. Jappelli and Pagano (1994) show that credit constraints reflected in housing mortgage regulations are an important explanatory factor behind cross-country differences in saving.

In practice, borrowing constraints affect mostly poorer households, and not the rich who hold large asset stocks. Thus, like the precautionary saving motive, borrowing constraints likely are a chief force behind the saving behavior of lower- and middle-income groups, but not richer households. Income redistribution away from the latter makes the borrowing constraints less likely to bind and reduces the importance of buffer-stock saving, thus lowering aggregate saving rates.

Indirect links

Other recent literature brings out some indirect links between distribution and saving operating through third variables that affect saving. One particularly active line of research is the "political economy" literature, which has underscored the positive association between income equality and economic growth in a framework of endogenous growth and endogenous economic policy. In this approach, causality runs from distribution to growth via investment. In addition, these models include a political mechanism which provides a link between income inequality and economic policy.

The main line of argument is that a highly unequal distribution of income and wealth causes social tension and political instability (violent protests, coups, etc.); the result is a discouragement of investment through increased uncertainty, along with adverse consequences for productivity and thus growth (Persson and Tabellini 1994, Alesina and Rodrik 1994, Perotti 1995, Alesina and Perotti 1996). In addition, income distribution may affect growth also through taxation and government expenditure: in a more unequal society there is greater demand for redistribution and therefore higher taxation, lower returns to investments in physical and human capital, and less investment and growth.

These arguments have received some empirical support. From the point of view of saving, the implication is that if saving is positively dependent on growth then higher inequality will, through the above channels, depress aggregate saving -- in contrast with the positive impact of inequality on saving implied by most of the theories examined so far. Additionally, distributive inequality may also tend to lower *public* saving, as governments engage more actively in redistributive expenditures -- as in the populist experiences examined by Dornbusch and Edwards (1991); in the absence of strict Ricardian equivalence, this would in turn reduce aggregate saving.

The existence of an inverse relationship between inequality and investment, as suggested by the above literature, could also imply a negative association between inequality and saving through firms' earnings retention. The latter is typically the primary source of financing for private investment, so that if higher inequality lowers investment it should also reduce firm saving. What happens with *aggregate* saving, however, depends on whether firm owners (i.e., households) can pierce the "corporate veil" that separates household and firm decisions. If this were the case, a fall in firm saving could be fully offset by a rise in household saving, leaving aggregate saving unaffected.

Summing up

Chart 1 summarizes the different mechanisms through which a change in the distribution of personal income affects aggregate saving. The chart lists six ways in which income concentration affects household (and hence aggregate) saving *directly* -- positively in five cases and by negatively in one. It also lists two *indirect* links from income concentration to aggregate saving -- both negative -- that occur through lower corporate and lower public saving. We conclude that, in view of the opposing signs of the different mechanisms at work, the overall impact of changes in income distribution on household and aggregate saving is ambiguous on theoretical grounds, and is largely an empirical matter.

Chart 1

Summary of Mechanisms through which Income Concentration affects Household and Aggregate Saving

Income Concentration Affects Household Saving Directly and	
Positively	***Negatively***
If:	
• Marginal saving propensities increase with income levels. • Bequests are luxury goods. • The poor invest relatively more in education, the rich in financial assets. • The poor engage in buffer-stock saving in response to uncertainty. • Borrowing constraints affect more strongly the poor.	• The poor face larger uncertainty, are more risk averse or have limited access to risk diversification.
Income Concentration Affects Aggregate Saving Indirectly and	
Positively	***Negatively***
If:	
	• It raises instability that depresses corporate investment and corporate saving (and hence aggregate saving if households do not pierce the corporate veil), and reduces growth (and saving again). • It triggers larger distributional public spending programs, and thus reduces public saving (and hence aggregate saving if Ricardian equivalence is not satisfied).

4. Empirical Studies

Empirical tests of the impact of income distribution on saving are rather scarce. Some early studies followed the Kaldor-Lewis approach and focused on the functional distribution of income. Along these lines, Houthakker (1961), Williamson (1968), Kelley and Williamson (1968) and Gupta (1970) found some evidence that the propensity to save from non-labor income exceeds that from labor income.

More recent empirical studies have shifted their focus from functional to personal income inequality and its effects on saving. Blinder (1975) uses US time-series data for 1949-1970 to estimate an equation for aggregate consumption including income distribution indicators. He finds that higher inequality appears to raise aggregate consumption (and thus lower saving), although the estimated effect is in general statistically insignificant. He proposes as a preferable empirical test the estimation of separate consumption equations by income class, a suggestion taken up by Menchik and David (1983), who use disaggregated US data to test directly whether the elasticity of bequests to lifetime resources is larger or smaller for the rich than for other income groups. They find that the marginal propensity to bequeath is unambiguously higher for the wealthy, so that higher inequality leads to higher lifetime aggregate saving.

Data from cross-sectional household surveys typically show that high-income households save on average more than low-income households. Bunting (1991), who uses consumer expenditure survey data for the US, finds strong evidence that household spending depends on both the level and distribution of income: his estimates of the marginal propensity to save uniformly increase as the quintile share of income rises. Hugget and Ventura (1995) calibrate an overlapping-generations model to US household income and saving data and conclude that age differences across households and social security transfers from young to old are important in explaining the cross-section pattern of US saving rates.

Several cross-country studies have used aggregate saving data from national-accounts sources. Early contributions by Della Valle and Oguchi (1976) and Musgrove (1980) investigate the relationship between saving and income distribution using cross-country data on both industrial and developing countries. In both cases the results show no statistically significant effect of income distribution on saving. The exception are the OECD countries included in the study by Della Valle and Oguchi, for which they find some evidence that increased inequality may increase saving. In turn, Lim (1980) finds that inequality tends to raise aggregate saving rates in a cross-section sample of developing countries, but his coefficient estimates are significant at conventional levels only in some subsamples.

Venieris and Gupta (1986) use aggregate data for 49 countries to draw inferences about the average saving propensities of different income groups, using an econometric specification that includes also political instability as a saving determinant. Their results suggest that poorer households have the lowest saving propensities, while -- somewhat surprisingly -- the highest one corresponds to the middle-income group. Hence, redistribution against the rich may raise or lower the aggregate saving ratio depending on whether the favored group is the middle class or the poor, respectively. However, the interpretation of their results is somewhat unclear due to their use of constant-price saving as the dependent variable, which has no clear analytical justification.

Sahota (1993) tests a reduced-form relationship between saving and income distribution. Using data on 65 industrial and developing countries for the year 1975, he regresses the ratio of gross domestic saving to GDP (GDS/GDP) on the Gini coefficient and a quadratic polynomial in per capita income; he also includes regional dummy variables as a crude attempt to control for cultural and habit effects. The parameter estimate on the Gini coefficient is found to be positive, but the estimate is somewhat imprecise and significantly different from zero only at the 10% level.

More recently, Cook (1995) presents estimates of the impact of various inequality measures on the GDS/GDP ratio in 49 LDCs, using a conventional saving equation including also the level and growth rate of real income, dependency ratios, and a measure of capital inflows; the exogeneity of the latter variable is clearly questionable. A dummy for Latin American countries is also added to the regressions, although its justification is unclear since no other regional dummies are included. Using decade averages for the 1970s, he finds a positive and significant effect of inequality on saving, which appears robust to some changes in specification and to the choice of alternative indicators of income inequality.

Hong (1995) reports econometric results on the effect of the share of the top 20% income group on GDS/GDP ratios in cross-country samples of 56 to 64 developing and industrial countries, using 1960-85 averages for each country. He finds that the income share of the top 20% of the population has a positive effect on saving rates, controlling for population dependency, the level and growth of income, and education level.

Lastly, Edwards (1995) estimates private saving equations using panel data for developing and OECD countries for the years 1970-92. While the main focus of the study is not on the relation between income distribution and saving, he reports two regressions for mostly OECD countries that control for income inequality, finding that the latter has a significant positive effect on private saving if combined with one set of regressors, but negative and insignificant when combined with a different set.

In summary, most empirical studies based on micro household data show evidence for a positive effect of income concentration on household saving. Regarding the studies based on cross-country aggregate data, the results are more mixed, although some do find a positive impact of income inequality on total saving. Independently of their results, however, most of the cross-country studies utilize inadequate saving measures and use income-distribution data of highly heterogeneous quality, mixing both income- and expenditure-based measures. Their robustness to alternative specifications and data samples is also unclear. These drawbacks justify a more systematic empirical search of the effect of income inequality on aggregate saving across different specifications, saving and income distribution measures, data samples, and estimation techniques. This is our next task.

5. Econometric Results

In this section we present new empirical results on the relationship between aggregate saving and income distribution. Our aim is to examine this relationship making use of the world database introduced in section 2 and described in more detail in the Appendix, applying a large variety of specifications and econometric techniques, and conducting various robustness tests. We proceed in three stages. First, we investigate if the results of some recent studies that find a positive impact of income concentration on aggregate saving still hold when using our improved data set and alternative saving definitions. Next we introduce a simple saving specification (that includes measures of income distribution, among other variables), estimate it on cross-country data, and test the robustness of our empirical results to alternative specifications, income distribution measures, country groupings, and econometric techniques. Finally we apply our saving specification to a panel of annual time-series cross-country data.

Replicating Previous Results

For our replication we select the three most recent studies focused on the effect of income inequality on aggregate saving. We maintain the specifications used by the respective authors and described above: Sahota (1993), Cook (1995), and Hong (1995). The first two make use of regional dummy variables (only for Latin America in the case of Cook), while Hong does not. Our data samples are somewhat smaller in country observations than the corresponding samples of the three authors because we limit ourselves to the high-quality income and expenditure distribution data subset of Deininger and Squire's database, as discussed above. However, our data set is much larger in the time dimension and includes more recent years.

We start by using the saving rate measures (GDS/GDP) adopted by the three authors and the time periods used in computing individual country observations (time averages) that come closest to those considered by them.[15] Columns 1-3 in Table 4 present our attempt at replicating their results. Our results for a full sample of 45 OECD and developing countries in column 1 are very similar to Sahota's: the parameter estimate on the Gini coefficient is positive and close to that reported by Sahota (.19), but well below conventional levels of significance. Regarding Cook's specification, applied to a sample of 28 LDCs, the effect of the Gini is also positive but barely reaches a 10% confidence level (column 2). Finally, in Hong's specification, applied to 50 OECD and developing countries, the relevant distributive variable is the income share of the top 20%, for which our results do replicate a positive effect significant at a 5% level.

However, domestic saving and domestic product are not good saving and income measures for open economies. As argued in section 2, national saving and national product data are closer to the relevant units for which income distribution figures are available. Therefore, we next attempt to replicate the three authors' estimations by making use of the preferable gross national saving (GNS) and gross national product (GNP) measures, as reported in columns 4-6 in Table 4. The common finding across the three specifications is a

[15] For the replication of Sahota's work we use country averages for 1972-78 (our interpretation for observations "close to 1975"). In the case of Cook we use averages for the decade of the 1970s, and to reproduce Hong's estimation we use 1965-94 averages (which come close to his 1960-85 data).

general loss of precision regarding the coefficient estimates for income inequality. The point estimates are still positive but do not reach conventional levels of significance. The decline in precision is particularly strong in the case of Hong's specification, which is based on our complete sample period (1965-94).

As a final check, we expand the time dimension of the country averages by applying Sahota's and Cook's specifications to our longer 1965-94 sample period, which also allows us to add more countries to the sample, while still using GNS and GNP measures. The results show that under Sahota's specification (column 7) the Gini coefficient remains statistically insignificant, while it just reaches 10% significance under Cook's specification (column 8). Interestingly, however, both specifications rely on the inclusion of regional dummy variables whose justification, particularly in Cook's case, is unclear. Other empirical experiments (not reported to save space) show that dropping from the specification in column 8 the Latin America dummy or the current account surplus -- which, being the difference between saving and investment ratios, is clearly an endogenous variable -- would make the parameter estimate on the Gini coefficient statistically insignificant at any reasonable level.

We conclude that the results of these three empirical studies -- that found a positive effect of income concentration on aggregate saving -- are not robust to alternative and better saving and income distribution measures. In two cases (Hong's and Sahota's specifications) the results vanish altogether, while in the third one they do not reach conventional significance levels and, furthermore, are dependent on a questionable empirical specification. The question that arises now is if stronger evidence on the effect of income inequality on saving could be found using more standard specifications than those used by the previous authors. This is our next topic.

Testing Alternative Specifications Using Cross-Country Data

We limit our model search to variants of simple specifications found in comparable cross-country studies of saving (see e.g. Schmidt-Hebbel, Webb and Corsetti 1992, Edwards 1995, and Masson, Bayoumi and Samiel 1995) and the saving-distribution models tested above. Our basic specification encompasses the income, demographic, and inequality variables included by Sahota (1993) and Cook (1995) but, for the reasons already noted, excludes their more controversial variables (the current-account balance and regional dummies). The basic equation to be estimated is the following:

$$(1) \qquad GNS/GNP = \alpha_0 + \alpha_1\, gnp + \alpha_2\, (gnp)^2 + \alpha_3\, growth + \alpha_4\, old + \alpha_5\, young + \alpha_6\, distrib$$

where *GNS/GNP* is the ratio of current-price gross national saving to current-price gross national product, *gnp* is real per capita gross national product, *growth* is the (geometric) average annual rate of growth of real per capita gross national product, *old* is the old-age dependency ratio (ratio of population of age 65 and above to total population), *young* is the young-age dependency ratio (ratio of population of ages 0 to 15 to total population), and *distrib* is an income distribution variable.

The basic specification in (1) embeds both a linear and a quadratic term in real per capita income to encompass the non-linear relation between the saving rate and income described in section 2; accordingly, we should expect $\alpha_1 > 0$, $\alpha_2 < 0$. All other variables enter linearly in our basic equation. The majority of empirical studies suggests that the coefficient on *growth* should be positive, while those on the dependency ratios should be negative, according to standard life-cycle arguments.[16]

As income distribution indicators we broaden our empirical search by using both the Gini coefficient and the ratio of the income share of the richest 20 percent of households to that of the poorest 40 percent; we also perform some experiments using the income share of the middle 60 percent of the population. The latter variables, however, are available only for the smaller income-based sample.

We first examine the evidence from cross-country data, using country averages for the period 1965-94. The correlation matrix of our basic set of regressors was presented in Table 3 and shows four striking features. First, as already mentioned, all three income distribution indicators are very highly correlated with each other, with correlation coefficients exceeding in all cases .90 in absolute value. Second, the (negative) correlation between young-age and old-age dependency ratios is also very large (-.94). Third, dependency ratios are closely correlated with real per capita income (the corresponding correlation coefficients exceed .86 in absolute value). Finally, the correlations between income distribution measures and dependency ratios are also high; this is to be expected since such measures reflect differences in both intragenerational and inter-generational income distribution, and the latter are also captured in part by the dependency ratios. It will be important to keep in mind these features of the data for the discussion of the empirical results below.

Table 5 shows estimation results using the basic specification for a variety of samples. As a benchmark, the first column reports parameter estimates for the full sample of OECD and developing countries using a specification that excludes income distribution indicators. As expected, the second and third rows show that saving ratios rise with income levels (a result also found by Carroll and Weil 1994 and Edwards 1995) but taper off at high income, as indicated by the negative coefficient on squared GNP.

[16] See Leff (1969) and Modigliani (1970). Gersovitz (1988) includes an analytical discussion of the effects of these and other demographic variables on saving.

In turn, the fourth row in the table indicates that saving ratios are positively associated across countries with per capita GNP growth rates. A 1-percent increase in real growth raises the national saving ratio by about 0.9 percentage points. Finally, it can be seen from the fifth and sixth rows in column 1 that both old and young-age dependency ratios have the expected negative effect on national saving rates although only the former reaches a high level of significance.

The simple specification in column 1 accounts for nearly 50 percent of the observed cross-country variation in national saving rates. However, the estimated coefficients on per capita income and its square, as well as on the young-age dependency ratio, exhibit large standard errors. The obvious reason for this lack of precision is the just-described cross-correlation between age-dependency ratios, real income and its square.[17] Indeed, a joint F-test of the null hypothesis that real income and its square have no impact on saving rates can be rejected with a p-value of 0.04; adding the restriction that young-age dependency also has no effect further reduces the p-value to 0.009, overwhelmingly rejecting the null.

Columns 2-4 in Table 5 augment the specification in the first column using the Gini coefficient as income distribution indicator, both for the full country sample and separately for the 19 OECD and 33 developing countries. The sign pattern of the parameter estimates in the first six rows remains unchanged, and the full-sample estimates in column 2 are virtually identical to those in column 1. However, the saving-income and saving-growth relationships do not appear robust across country groups. The saving-per capita GNP relationship is weak among industrial countries (column 3) but very strong among developing countries (column 4). The opposite is true for the saving-growth relationship which appears strong among OECD countries but weak among LDCs -- the same cross-country pattern found by Carroll and Weil (1994). Controlling for other factors, a 1 percent increase in the growth rate raises national saving ratios by 3.1 percentage points among OECD countries, and by only 0.6 percentage point among LDCs (and the latter effect is not significantly different from zero). In both country groups the influence of demographic dependency on saving is negative although the size and statistical significance differs among country groups.

The seventh row reports the parameter estimates for the Gini coefficient. They are positive for the full sample and the OECD subsample, and negative for LDCs -- the same sign pattern described in section 2 above. In all three cases, however, the estimates are insignificantly different from zero.

Columns 5 through 7 use as an alternative income distribution indicator the ratio of the income shares of the top 20 and bottom 40 percent of the population. This results in a loss of twelve observations

[17] Note from Table 3 that the correlation between real per capita GNP and its square equals .98.

(two industrial countries and ten developing countries) due to unavailability of the income-based data for those countries. Despite the smaller sample size, however, the estimation results are very similar to those obtained using the Gini coefficient, an unsurprising result in view of the very high correlation between the two income distribution indicators. The inequality variable remains statistically insignificant, and its estimated coefficient has opposite signs for developing and industrial countries.

One potential source of bias in these regresssions is the possible endogeneity of right-hand side variables. For example, it is possible that income levels and growth rates are affected by saving ratios through the conventional saving-investment-output link discussed in preceding sections. In order to address this possible simultaneous-equation bias, columns 8 and 9 of Table 5 report results of two-stage least squares estimations on the full country sample, using the Gini coefficient and the income share ratio, respectively. The instruments used for the level, square, and growth rate of real per capita GNP were chosen among the variables found to be most significant in empirical cross-country growth regressions.[18] Due to instrument data unavailability for some countries, this results in a loss of 6 and 2 observations, respectively.

As the table shows, the results from instrumental-variable estimation are qualitatively similar to those obtained from OLS, particularly in regard to the sign pattern of individual regressors. Note, however, that the coefficients of the three instrumented GNP measures roughly double relative to their OLS counterparts (in columns 2 and 5), and their individual significance levels are now very high. This contrasts with the loss in precision of the coefficients of the (non-instrumented) dependency ratios. Finally, and most important, these results confirm the previous lack of significance of both income distribution measures. As a more formal check on the validity of the OLS estimates, we performed Hausman tests for the endogeneity of the three GNP-related variables. The computed test statistics were 6.098 (with an associated p-value of 0.107) and 5.792 (p-value of 0.122) for the specifications in columns 8 and 9, respectively. Thus, we do not find strong evidence against the OLS estimates, although this may be partly due to the low power of the test.

Overall, the above results are consistent in suggesting that income inequality does *not* significantly affect aggregate saving. To investigate their robustness, we explore a number of alternative specifications and income inequality measures found in previous studies. Table 6 presents some results using the full country sample.

---

[18] The instrument list included initial conditions, and demographic and institutional variables (see the Appendix for details). This choice was based on the results of standard cross-country growth regressions. See for example Barro and Sala-i-Martin (1995) and Barro (1996).

The first two columns investigate alternative inequality indicators: column 1 uses the income share of the middle class (to verify Venieris and Gupta's 1986 finding that the middle class is the highest-saving group) while column 2 uses the income share of the top 20 percent of population (which is Hong's 1995 income concentration measure). In neither case do we find any significant effects of income inequality on saving. Next we explore possible non-linear effects of income distribution, adding to the Gini coefficient an interaction term between the Gini and real per capita GNP (column 3), and the square of the Gini (in column 4). Neither specification proved successful.[19]

Finally, we test the role of income inequality by considering two alternative specifications based on the inclusion of additional saving regressors. While these regressors seem popular in the empirical saving literature, we excluded them from our basic specification because of their severe endogeneity problems and/or their ad-hoc nature. Column 5 of Table 6 reports the results when the ratio of the current account balance to GNP is included. As in other saving studies (i.e. Edwards 1995, Masson, Bayoumi, and Samiei 1995, Hong 1995) the corresponding coefficient is large and highly significant -- a hardly surprising result because by definition the current account balance equals national saving minus investment, and hence a coefficient equal to unity should be expected (in fact, the 95 percent confidence region for our point estimate does include 1). Further, in an open economy with access to international lending (as is the case for most OECD countries throughout 1965-94, and for many developing countries during much of that time), the current account simply reflects national saving and investment decisions and is therefore endogenous, so that the OLS estimator is inconsistent. Whatever the interpretation of this equation, however, the Gini coefficient estimate remains far below conventional levels of significance.

Finally, in column 6 we follow some of the previous literature by introducing regional dummy variables, with OECD countries as the omitted category. The parameter estimate on the Gini coefficient now reaches 10 percent significance. However, quite apart from the (obscure) interpretation of the dummies, this weak result seems suspect, because the dummies are not significant individually nor jointly (an F-test of their joint significance yields a p-value of .273, so they could be safely removed from the equation).

To summarize, our extensive[20] empirical tests on cross-section data find little evidence of income

[19] F-tests of the joint significance of the Gini coefficient and its product with GNP per capita (for column 3), and the Gini coefficient and its square (for column 4) yield marginal significance levels of .887 and .680 respectively, so that both variables can be safely dropped from the respective specifications.

[20] We tried a number of additional experiments not reported here. In one case we added income variability to the basic set of regressors (with variability measured by the standard deviation of real per capita GNP around trend relative to the average GNP level). According to the precautionary saving motive, it should have a positive impact on

inequality affecting aggregate saving. Arguably, however, our results are based only on part of the available information, because we have ignored the time-series dimension of the data. Further, ad-hoc regional dummies seem to affect the significance of the inequality indicators, which suggests that, like in other cross-country empirical work, country heterogeneity could be potential problem in the regressions. The best way to address these two concerns is by exploiting the full panel dimension of our data.

Panel data results

As we noted earlier, not all variables (especially the income distribution indicators) are available for each country every year within our sample period, and therefore our panel data set is unbalanced. Table 7 reports the results of 8 unbalanced-panel regressions for OECD and developing countries, jointly and separately, and applying alternative estimation techniques.[21]

The first two columns report simple OLS estimates on the pooled data for the full sample (468 observations), using our basic specification. Unlike in the cross-section regressions above, now all the parameters are strongly significant, with the notable exception of the Gini coefficient. In column 1, its point estimate is negative and, more importantly, small and insignificantly different from zero. The basic specification accounts for a respectable 48 percent of the observed variation in saving ratios.

Column 2 adds regional dummies to the regression, thus reproducing the specification in the last column of Table 6; while the dummies are individually insignificant, they are strongly significant when taken together (the corresponding F-test yields a p-value of .014). The estimated parameter on the Gini coefficient turns positive, but remains small and insignificant.

Do the regional dummies capture satisfactorily whatever country heterogeneity may exist in the sample ? To answer this question, column 3 in Table 7 reports fixed-effects estimates on the full sample. The addition of country-specific effects raises dramatically the explanatory power of the regression, which now accounts for over 88 percent of the variation in the dependent variable. All the coefficients remain strongly significant, again with the exception of the inequality variable, whose point estimate is now very close to

---

saving. In fact, the estimated coefficient was negative and insignificant, possibly because aggregate income variability is very different from -- actually much lower than -- individual income variability, as shown by Pischke (1995). We also experimented with the ratio of domestic credit to GNP as a measure of the extent of borrowing constraints. Its coefficient had the expected positive sign but it was insignificantly different from zero. Finally, we re-estimated our basic specifications using the least absolute deviation estimator (see e.g., Koenker and Basset 1978), to control for the possible influence of extreme observations. Our results were materially unaffected.

[21] Initially, all the specifications included also a set of year dummies. However, they were never significant either individually or jointly, and therfore were dropped from the estimations.

zero. Further, some of the estimates change substantially relative to the OLS results: the coefficient on real income growth falls, while that on its level more than doubles. The country effects are extremely significant, as shown by the F-test reported at the bottom of the table. Finally, we can test if the heterogeneity captured by the country effects can be adequately summarized by regional dummies. This amounts to testing a set of linear restrictions (specifically, 78 of them) on the estimated country dummies. The computed F statistic was 17.18, with a marginal significance level below .001, rejecting overwhelmingly the regional-dummy in favor of the fixed-effect specification.

In view of this result, columns 4 and 5 report fixed effect estimates using the industrial and developing country subsamples, respectively. In both cases the explanatory power of the regressions is very high, and the adjusted R-squared exceeds 0.86. Also in both cases the estimated parameter on the Gini coefficient is very small and altogether insignificant. There are also some differences across the two subsamples. In the OECD sample (209 observations) we find that neither the level nor the square of per capita income are significant, a result that we also encountered in the cross-section regressions in Table 5. Further, the young-age dependency ratio carries a surprising positive sign, and is close to 5 percent significance. By contrast, in the developing country subsample (259 observations) all the regressors except the Gini coefficient are strongly significant and carry the expected signs.

Finally, columns 6-8 are analogous to columns 3-5 but use the ratio of the income share of the top 20% to the bottom 40% of the population as the relevant income inequality measure. With exception of the latter variable, the results remain basically unchanged for all other saving determinants. Interestingly, the income inequality variable carries a negative (albeit again very small) coefficient across the three samples, and even reaches 10% significance in the full sample.

We have come to the end of a wide empirical search for evidence on the influence of income inequality on aggregate saving, controlling for other saving determinants. Only exceptionally have we found a (barely) significant effect: a positive one in cross-country data when using ad-hoc regional dummies (alone or in combination with another highly suspect variable, the current account deficit), and a negative one in panel data when controlling for country-specific effects and using the ratio of income shares as the relevant inequality measure. In every other specification, income concentration does not affect aggregate saving at a statistically significant level. This conclusion is consistent with the theoretical ambiguity on the saving effects of income inequality.

6. Concluding Remarks

Both the historical literature on distribution and aggregate saving based on functional income distribution and neoclassical consumption theory based on the personal distribution of income bring out a number of channels through which inequality affects personal saving. Most of these mechanisms (but not all) suggest positive direct effects of income inequality on overall personal saving. However, recent political-economy research brings out negative indirect links from inequality (through investment, growth, and public saving) to aggregate saving. Taken together, these two strands of the literature imply that the overall impact of inequality on aggregate saving is ambiguous and can only be assessed empirically.

The empirical literature on the links between personal income distribution on personal saving based on household data typically finds a positive relation between personal income inequality and overall personal saving. In turn, some empirical studies based on macro (national-accounts) saving data, typically conducted on cross-country samples, also report positive effects of personal income inequality on *aggregate* saving. Other studies, however, find the opposite result or no effect whatsoever. Reconciling these conflicting results is difficult because macro-based empirical studies use widely different samples and specifications, different measures of saving and inequality and, in most cases, income distribution information of questionable quality.

This paper has reexamined the empirical evidence from macro data on the links between the distribution of personal income and aggregate saving, controlling for relevant saving determinants, providing an encompassing framework and a robustness check for previous empirical studies, and extending them in five dimensions: (i) testing alternative saving specifications, (ii) using alternative inequality and saving measures, (iii) making use of newer, better, and larger databases, (iv) conducting estimations jointly and separately for industrialized and developing countries, and (v) applying various estimation techniques on both cross-country and panel data. On the whole, we do not find any consistent effect of income inequality on aggregate saving -- a result that agrees with the theoretical ambiguity.

One caveat that makes our results tentative is the fact that our findings are based on a reduced-form model of aggregate saving. Further research should address theoretically and empirically both the direct links between inequality and household saving, and the indirect links between inequality, private investment, public saving, and aggregate saving. Ideally, this would involve the specification of a complete theoretical model describing, at a minimum, the determination not only of saving, but also of the distribution of income and its growth rate. This, however, is likely to be a formidable task, well beyond the scope of this paper.

Data Appendix

The basic variables used in the estimations are listed below along with their definitions and sources.

Variable	*Source*
Gross National Saving Ratio	GNS/GNP ratio, each series in current prices and local currency. GNS Accounts (WBNA)
Gross Domestic Saving Ratio	GDS/GDP ratio, each series in current prices and local currency. Source: WBNA
Real GNP per capita	In constant 1987 U.S. dollars. Source WBNA
Real GDP per capita	In constant 1987 U.S. dollars. Source: WBNA
Growth rate of real GNP per capita	Annual growth rate computed from real GNP per capita
Growth rate of real GDP per capita	Annual growth rate computed from real GDP per capita
Gini Coefficient	The income-based Gini coefficients were taken directly from the source. The expenditure-based Ginis were adjusted by adding the mean difference between income- and expenditure-based Gini coefficients reported in the source. Source: Deininger and Squire
Ratio of Income Share of Top 20% to Bottom 40% of Population and Income Share of Middle 60%	Source: Deininger and Squire
Old Age (Young Age) Dependency Ratio	Population aged 65 and over (14 and below) as a share of the total population. Data available every 5 years only. Data interpolated for panel estimates. Source: World Bank Social Indicators.
Current-Account Balance Ratio	Ratio to GNP. Both series in current US dollars. Source (for Current-Account Balance): International Financial Statistics

The variables used as instruments for the level of GNP per capita, its square, and the growth rate of GNP per capita in the two-stage least squares estimates of Table 4 are the following:

Variable	*Source*
Initial level of GNP per capita (in 1965)	Source: WBNA
Square of initial (1965) GNP per capita. Average years of Schooling in the total population over the age of 25	Average of 1960 and 1965 figures. Source: Barro and Lee
Secondary School Enrollment Rate	Average of 1960 and 1965 figures. Source: Barro and Lee
Initial Trade Share	Sum of Exports/GDP and Imports/GDP ratios. Average over the 1960-64 period. Source: Barro and Lee
Black Market Premium	Black Market Exchange Rate/Official Exchange Rate-1 Averaged over 1960-89. Source: Barro and Lee
Terms of Trade Shocks	Averaged over 1960-85. Source: Barro and Lee
Life Expectancy (initial)	Average for the 1960-64 period. Source: Barro and Lee
Average Population growth rate	Average for 1965-94 period. Source: World Bank Social Indicators
Measure of Political Instability	Average over 1960-85. Source: Barro and Lee
Index of Civil Liberties	Average over 1972-89. Source: Barro and Lee

Cross-Country Sample

Averages over 1960-94 were used for the following variables: GDS/GDP ratio, real GDP per capita, and growth rate of real GDP per capita. For all other variables, averages over 1965-94 were used, except where indicated otherwise.

Countries are included in each of the cross-sectional samples only if they have at least one observation in each of the following two 15-year periods: 1965-79 and 1980-94. In the full cross-sectional sample, the distribution of countries according to the number of annual Gini observations is the following 37 countries with less than 10 observations, 12 countries with 10 to 20 observations, and 3 countries with more than 20 observations.

The following 52 countries are included in the full cross-country sample. **LDCs**: Bahamas, Bangladesh, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Egypt, Guatemala, Honduras, Hong Kong, India, Indonesia, Iran, Jamaica, Korea, Malaysia, Mexico, Pakistan, Panama, Peru, Philippines, Seychelles, Singapore, Sri Lanka, Taiwan, Tanzania, Thailand, Trinidad, Tunisia, Turkey, Venezuela, Zambia. **OECD countries**: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, UK, USA.

The following 40 countries are included in the "income-based only" cross-country sample. **LDCs**: Bahamas, Bangladesh, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Guatemala, Honduras, Hong Kong, Korea, Malaysia, Mexico, Panama, Peru, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Trinidad, Turkey, Venezuela. **OECD Countries**: Australia, Belgium. Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Sweden, UK, USA.

Panel Data Sample

The panel data sample comprises annual time series of variable length and coverage during the 1965-94 period for different countries.

The following 82 countries are included in the full panel sample. **LDCs**: Algeria, Bahamas, Bangladesh, Bolivia, Botswana, Brazil, Central African Republic, Cameroon, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Fiji, Ghana, Guatemala, Guinea Bissau, Guyana, Honduras, Hong Kong, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Lesotho, Madagascar, Malaysia, Mauritania, Mauritius, Mexico, Morocco, Nepal, Niger, Nigeria, Pakistan, Panama, Peru, Philippines, Puerto Rico, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Sri Lanka, Sudan, Taiwan, Tanzania, Thailand, Trinidad, Tunisia, Turkey, Uganda, Venezuela, Zambia, Zimbabwe. **OECD Countries**: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, UK, USA.

Not all countries have Gini coefficients available for each year. In the 82-country sample the distribution of countries according to the number of annual Gini observations is as follows: 47 countries with less than 5 observations, 21 countries with 5 to 9 observations, 11 countries with 10 to 20 observations, and 3 countries with more than 20 observations.

References

Adelman, I. and S. Robinson (1989): "Income Distribution and Development." in H. Chenery and T.N. Srinivasan (eds.): Handbook of Development Economics. New York: North-Holland.

Alesina, A. and R. Perotti (1996): "Income Distribution, Political Instability, and Investment", European Economic Review, forthcoming.

Alesina, A. and D. Rodrik (1994): "Distributive Politics and Economic Growth." Quarterly Journal of Economics 109, 465-90.

Anand and Kanbur (1993) in JDE: "The Kuznets Process and the Inequality-Development Relationship", Journal of Development Economics 40, p.25-52.

Atkinson, A. (1994): "Seeking to Explain the Distribution of Income", Discussion Paper WSP 106, London School of Economics.

Barro, R. (1996): "Democracy and Growth", Journal of Economic Growth 1, p. 1-27.

Barro, R. and L.Lee (1993): Winners and Losers in Economic Growth", World Bank Economic Review: Proceedings of the World Bank Annual Conference on Development Economics.

Barro, R. and X. Sala-i-Martin (1995): Economic Growth. McGraw Hill.

Becker, G. (1975): Human Capital. Cambridge: NBER.

Blinder, A. (1975): "Distribution Effects and the Aggregate Consumption Function", Journal of Political Economy 87, p. 608-26.

Bosworth, B.P. (1993): Saving and Investment in a Global Economy. Brookings: Washington, D.C.

Bourguignon, F. and C. Morrison (1990): "Income Distribution, Development, and Foreign Trade: A Cross Sectional Analysis." European Economic Review 34.

Bunting, D. (1991): "Savings and the Distribution of Income." Journal of Post Keynesian Economics 14, 3-22.

Carroll, C. and D. Weil (1994): "Saving and Growth: A Reinterpretation." Carnegie-Rochester Conference Series on Public Policy 40, p.133-192.

Carroll, C. and L. Summers (1991): "Consumption Growth Parallels Income Growth: Some New Evidence." in B. D. Bernheim and J. B. Shoven (eds.): National Saving and Economic Performance. Chicago: University of Chicago Press, 305-43.

Caselli, F. and J. Ventura (1996): "A Representative Consumer Theory of Distribution", mimeo, MIT.

Clarke, G. (1992): "More Evidence on Income Distribution and Growth." The World Bank, Policy Research Working Paper 1064.

Collins, S. (1991): "Saving Behavior in Ten Developing Countries." in B. D. Bernheim and J. B. Shoven (eds.): National Saving and Economic Performance. Chicago: University of Chicago Press, 349-72.

Cook, C. (1995): "Savings Rates and Income Distribution: Further Evidence from LDCs", Applied Economics 27, p. 71-82.

Cowell, F. (1977): Measuring Inequality: Techniques for the Social Sciences. New York: John Wiley and Sons.

Deaton, A. (1989): "Saving in Developing Countries: Theory and Review," *Proceedings of the World Bank Annual Conference on Development Economics*, The World Bank, Washington, D.C.

Deaton, A. (1991): "Saving and Liquidity Constraints." Econometrica 59, 1121-42.

Deaton, A. (1992): Understanding Consumption. Oxford: Clarendon Press.

Deaton, A. (1995): "Growth and Saving: What do we know, what do we need to know, and what might we learn?" manuscript, Princeton University, Research Program in Development Studies.

Deininger, K. and L. Squire (1996): "Measuring Income Inequality: a New Data Base", unpublished manuscript, Policy Research Department, The World Bank.

Della Valle, P. and N. Oguchi (1976): "Distribution, the Aggregate Consumption Function, and the Level of Economic Development: Some Cross-Country Results", Journal of Political Economy 84, 1325-34.

Dornbusch, R. and S. Edwards (1991): "The Macroeconomics of Populism." in R. Dornbusch and S. Edwards (eds.): The Macroeconomics of Populism in Latin America. Chicago: University of Chicago Press.

Edwards, S. (1995): "Why Are Saving Rates so Different Across Countries?: An International Comparative Analysis." NBER Working Paper 5097.

Feldstein, M. and C. Horioka (1980): "Domestic Saving and International Capital Flows." Economic Journal 90, 314-29.

Feldstein, M. and P. Bacchetta (1990): "National Saving and International Investment." in B. D. Bernheim and J. Shoven (eds.): National Saving and Economic Performance. Chicago: University of Chicago Press.

Fields, G. (1991): "Growth and Income Distribution", in G. Psacharopoulos (ed.): Essays on Poverty, Equity and Growth. Oxford: Pergamon Press.

Flavin, M. (1981): "The Adjustment of Consumption to Changing Expectations about Future Income." Journal of Political Economy 89, 974-1009.

Friedman, M. (1957): A Theory of the Consumption Function. Princeton: Princeton University Press.

Galor, O. and J. Zeira (1993): "Income Distribution and Macroeconomics." Review of Economic Studies 60, 35-52.

Gersovitz, M. (1988): "Saving and Development." in H. Chenery and T.N. Srinivasan (eds.): Handbook of Development Economics. Amsterdam: North Holland, 381-424.

Gupta, K. (1970): "Personal Saving in Developing Nations: Further Evidence", Economic Record 46, 0. 243-249.

Hall, R. (1978): "Stochastic Implications of the Life-Cycle Permanent Income Hypothesis: Theory and Evidence." Journal of Political Economy 86, 75-96.

Hayashi, F. (1985): "Tests for Liquidity Constraints: A Critical Survey." NBER Working Paper 1720.

Hong, K. (1995): "Income Distribution and Aggregate Saving", manuscript, Harvard University, Cambridge, Mass., November.

Houthakker, H. (1961): "An International Comparison of Personal Saving", Bulletin of the International Statistical Institute 38, p. 55-69.

Hugget, M. and G. Ventura (1995): "Understanding why High Income Households Save more than Low Income Households", manuscript Department of Economics, University of Illinois, Champaign, IL, October.

Jappelli, T. and M. Pagano (1994): "Saving, Growth, and Liquidity Constraints." Quarterly Journal of Economics 109, 83-109.

Kaldor, N. (1957): "A Model of Economic Growth." Economic Journal 57.

Kelley, A.C. and J.G. Williamson (1968): "Household Savings Behavior in Developing Countries: the Indonesian Case", Economic Development and Cultural Change, 16 (3): 385-403.

Kirman, A. (1992): "Whom or What Does the Representative Individual Represent?" Journal of Economic Perspectives 2, 117-36.

Koenker, R. and G. Bassett (1978): "Regression Quantiles", Econometrica 46, p. 33-50.

Kotlikoff, L. and L. Summers (1981): "The Role of Intergenerational Transfers in Aggregate Capital Accumulation." Journal of Political Economy 90, 706-32.

Kotlikoff, L. and L. Summers (1988): "The Contribution of Intergenerational Transfers to Total Wealth: A Reply." in D. Kessler and A. Masson (eds.): Modeling the Accumulation and Distribution of Wealth. Oxford: Clarendon Press.

Kuznets, S. (1955): "Economic Growth and Income Inequality." American Economic Review 89, 1-28.

Leff, N.H. (1969): "Dependency Rates and Savings Rates." American Economic Review 59, 886-96.

Levine, R. and D. Renelt (1992): "A Sensitivity Analysis of Cross-Country Growth Regressions." American Economic Review 82, 942-63.

Lewis, W.A. (1954): "Economic Development with Unlimited Supplies of Labor." The Manchester School 22, 139-91.

Lim, D. (1980): "Income Distribution, Export Instability and Savings Behavior", Economic Development and Cultural Change 26, 359-64.

Lipsey, R.E. and H.S. Tice (eds.) (1989): *The Measurement of Saving, Investment, and Wealth,* NBER Studies in Income and Wealth, vol. 52. NBER, Washington, D.C.

Maddison, A. (1992): "A Long-Run Perspective on Saving." Scandinavian Journal of Economics 94, 181-96.

Mankiw, N., D. Romer, and D. Weil (1992): "A Contribution to the Empirics of Economic Growth", Quarterly Journal of Economics 107, 407-38.

Mas-Colell, A., M. Whinston and J. Green (1995): Microeconomic Theory. Oxford University Press.

Masson, P., T. Bayoumi and H. Samiel (1995): "Saving Behavior in Industrial and Developing Countries." manuscript, International Monetary Fund.

Menchik, P. and M. David (1983): "Income Distribution, Lifetime Savings, and Bequests", American Economic Review 73, p.672-690.

Modigliani, F. (1970): "The Life Cycle Hypothesis of Savings and Intercountry Differences in the Savings Ratio", in W.A. Eltis, M.F.G. Scott and J.N. Wolfe (eds.): Induction, Growth and Trade. Oxford University Press.

Modigliani, F. and R. Brumberg (1954): "Utility Analysis and the Consumption Function: an Interpretation of Cross-Section Data." in K.K. Kurihara (ed.): Post-Keynesian Economics. New Brunswick, N.J.: Rutgers University Press.

Modigliani, F. and R. Brumberg (1979): "Utility Analysis and the Consumption Function: an Attempt at Integration". in A. Abel (ed.): The Collected Papers of Franco Modigliani. Vol. 2, Cambridge, M.A.: MIT Press.

Musgrove, P. (1980): "Income Distribution and the Aggregate Consumption Function." Journal of Political Economy 88, 504-25.

Ogaki, M., J. Ostry and C.M. Reinhart (1994): "Saving Behavior in Low- and Middle-Income Developing Countries: A Comparison." manuscript, International Monetary Fund.

Pasinetti, L. (1962): "Rate of Profit and Income Distribution in Relation to the Rate of Economic Growth." Review of Economic Studies 29, 267-79.

Paxson, C. (1996): "Saving and Growth: Evidence from Micro Data", European Economic Review 40, p. 255-288.

Perotti, R. (1995): "Growth, Income Distribution, and Democracy: What the Data Say", unpublished manuscript, Columbia University, New York, September.

Persson, T. and G. Tabellini (1994): "Is Inequality Harmful for Growth? Theory and Evidence." American Economic Review 84, 600-21.

Pischke, J-S. (1995): "Individual Income, Incomplete Information, and Aggregate Consumption", Econometrica 63 (4), 805-40.

Sahota, G. (1993): "Saving and Distribution." in J.H. Gapinski (ed.): The Economics of Saving. Boston: Kluwer Academic Publishers, 193-231.

Samwick, A. (1995): "How Important is Precautionary Saving ?", NBER Working Paper 5194.

Schmidt-Hebbel, K., L. Serven, and A. Solimano (1996): "Saving and Investment: Paradigms, Puzzles, Policies", World Bank Research Observer (forthcoming).

Schmidt-Hebbel, K., S. Webb, and G. Corsetti (1992): "Household Saving in Developing Countries: First Cross-Country Evidence." World Bank Economic Review 6, 529-47.

Solow, R. (1956): "A Contribution to the Theory of Economic Growth." Quarterly Journal of Economics 70, 65-94.

Srinivasan, T.N. (1994): "Data Base for Development Analysis: An Overview," *Journal of Development Analysis*, 44(1): 3-27.

Venieris, Y., and D. Gupta (1986): "Income Distribution and Sociopolitical Instability as Determinants of Savings: a Cross-Sectional Model", Journal of Political Economy 94, p.873-883.

Williamson, J. (1968): "Personal Saving in Developing Nations: an Intertemporal Cross-Section from Asia", Economic Record 44, p. 194-202.

Zou, Heng-Fu (1993): "The Spirit of Capitalism and Long-Run Growth", manuscript, forthcoming in European Journal of Political Economy.

Table 1

	Country-year observations during 1965-1994	*Country observations, 1965-1994 averages*
Income and expenditure-based data		
(for Gini coefficients)	468	52
OECD Countries	209	19
Developing Countries	259	33
Income-based data		
(for income shares)	339	40
OECD Countries	187	17
Developing Countries	152	23

Table 2

Income Distribution Indicators:
Descriptive Statistics

	Number of Observations	*Gini Coefficient*		*Income Share Ratio of Top 20% to Bottom 40%*		*Income Share of Middle 60%*	
		Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
World	52	0.417	0.085	3.33	1.56	0.48	0.07
OECD Countries	19	0.336	0.042	2.12	0.37	0.53	0.02
Developing Countries	33	0.464	0.066	4.22	1.50	0.43	0.05

Note: The summary statistics for the income shares have been computed using the income-based data only. The corresponding number of observations are: World (40), OECD (17), and Developing Countries (23).

Table 3

Correlation Matrix of Basic Saving Determinants

	GNS/GNP	GNP per capita	GNP per cap. Squared	Growth Rate GNP per cap.	Gini coefficient	Inc. share top20/bot40	Inc. share middle 60	Old Age Dep. Ratio
GNS/GNP								
Real GNP per capita	0.360							
Real GNP per capita Squared	0.287	0.972						
Growth rate of per capita GNP	0.496	0.016	-0.023					
Gini coefficient	-0.316	-0.698	-0.653	-0.289				
Income share: top20%/bottom40%	-0.361	-0.661	-0.606	-0.246	0.940			
Income share of middle 60%	0.331	0.792	0.723	0.153	-0.956	-0.914		
Old age dependency ratio	0.229	0.862	0.813	0.031	-0.715	-0.676	0.771	
Young age dependency ratio	-0.420	-0.885	-0.814	-0.238	0.775	0.763	-0.839	-0.940

Table 4. Replication of Previous Results

(t-statistics in parentheses)

	Dep. Variable: GDS/GDP			Dependent Variable: GNS/GNP				
	1	2	3	4	5	6	7	8
Sample	Sahota (1972-78) Full	Cook (1970s) LDCs	Hong (1965-94) Full	Sahota (1972-78) Full	Cook (1970s) LDCs	Hong (1965-94) Full	Sahota (1965-94) Full	Cook (1965-94) LDCs
Constant	-0.037	0.208	-0.153	0.025	0.020	0.157	0.048	0.197
	(-0.417)	(1.035)	(-0.735)	(0.249)	(0.120)	(0.767)	(0.681)	(1.128)
Real GDP or GNP per capita	4.47E-05	4.24E-05		3.68E-05	4.45E-05		2.27E-05	8.91E-06
(1987 constant dollar)	(5.206)	(4.757)		(3.035)	(6.058)		(3.122)	(1.207)
Real GDP or GNP per capita	-2.05E-09			-1.79E-09			-9.28E-10	
squared	(-4.537)			(-2.947)			(-2.578)	
Real GDP or GNP growth rate		0.077	0.818		0.589	1.421		0.626
		(0.136)	(1.584)		(1.592)	(4.187)		(1.749)
ln(GDP or GNP per capita)			0.030			0.011		
			(2.728)			(0.978)		
Old age dependency ratio		-3.365			-1.789			-0.624
		(-2.594)			(-1.966)			(-0.689)
Young age dependency ratio		-0.211			0.213			-0.318
		(-0.470)			(0.589)			(-0.806)
Total dependency ratio			0.020			0.088		
			(0.060)			(0.895)		
Gini coefficient	0.182	0.384		0.158	0.244		0.161	0.363
	(0.938)	(1.736)		(0.815)	(1.378)		(1.149)	(1.772)
Income share of top 20%			0.221			0.088		
			(2.199)			(0.895)		
Current Acct. Bal./(GNP or GDP)		0.601			0.695			0.667
		(2.838)			(4.995)			(2.866)
Latin America regional dummy	0.088	-0.035		0.031	-0.045		0.007	-0.050
	(2.044)	(-1.516)		(0.577)	(-2.876)		(0.181)	(-3.110)
Africa regional dummy	0.153			0.081			0.021	
	(3.391)			(1.873)			(0.559)	
Asia regional dummy	0.131			0.088			0.081	
	(4.771)			(2.363)			(2.509)	
Adjusted R2	0.369	0.556	0.401	0.233	0.638	0.511	0.355	0.374
Standard Error	0.059	0.057	0.047	0.062	0.046	0.040	0.046	0.046
Number of Observations	45	28	50	44	28	50	52	31

Note: The above t-statistics were computed using heteroskedasticity-corrected standard errors.

Table 5. Cross-Section Estimates of Saving Equations

Dependent Variable: GNS/GNP

(t-statistics in parentheses)

	1	2	3	4	5	6	7	8	9
	OLS							2SLS	
Sample	Full	Full	OECD	LDC	Full	OECD	LDC	Full	Full
Constant	0.397 (2.636)	0.367 (2.375)	0.394 (2.214)	0.392 (2.410)	0.488 (2.620)	0.526 (2.762)	0.669 (1.994)	0.079 (0.346)	-0.032 (-0.108)
Real GNP per capita (1987 constant dollar)	1.19E-05 (1.356)	1.20E-05 (1.356)	1.01E-05 (1.306)	6.05E-05 (4.527)	6.70E-06 (0.791)	5.80E-06 (0.792)	6.43E-05 (5.305)	2.43E-05 (2.837)	3.26E-05 (2.860)
Real GNP per capita squared	-4.51E-10 (-1.134)	-4.41E-10 (-1.112)	-3.34E-10 (-0.947)	-6.46E-09 (-4.778)	-2.33E-10 (-0.656)	-2.25E-10 (-0.668)	-7.02E-09 (-5.648)	-9.10E-10 (-2.272)	-1.20E-09 (-2.420)
Real GNP growth rate	0.878 (2.132)	0.947 (2.195)	3.085 (3.251)	0.575 (1.247)	1.106 (2.061)	2.754 (2.937)	0.435 (0.781)	2.020 (2.934)	2.317 (2.763)
Old age dependency ratio	-1.264 (-2.469)	-1.244 (-2.487)	-1.181 (-2.547)	-2.167 (-3.510)	-1.382 (-2.539)	-1.343 (-2.896)	-4.59 (-1.958)	-0.778 (-1.185)	-0.654 (-0.836)
Young age dependency ratio	-0.468 (-1.542)	-0.511 (-1.666)	-0.819 (-1.919)	-0.387 (-1.200)	-0.753 (-1.883)	-1.157 (-2.549)	-0.950 (-1.548)	-0.025 (-0.059)	0.286 (0.477)
Gini coefficient		0.095 (0.864)	0.066 (0.708)	-0.067 (-0.471)				0.154 (1.268)	
Income share ratio of top 20%/bottom 40%					0.005 (0.654)	0.016 (0.955)	-0.005 (-0.094)		0.006 (0.719)
Adjusted R2	0.423	0.4186	0.555	0.569	0.491	0.56	0.663	0.453	0.356
Standard Error	0.043	0.043	0.027	0.041	0.042	0.028	0.039	0.041	0.047
Number of Observations	52	52	19	33	40	17	23	46	38

Note: (i) The above t-statistics were computed using heteroskedasticity-corrected standard errors.

(ii) The equations using the top 20% to bottom 40% ratio (columns 5-7 & 9) as the relevant distribution measure were estimated using only observations with income-based distribution data

Table 6. Alternative Specifications
Dependent Variable: GNS/GNP
(t-statistics in parentheses)

	1	2	3	4	5	6
Sample	Full	Full	Full	Full	Full	Full
Constant	0.6037	0.394	0.361	0.189	0.266	0.302
	(2.933)	(2.009)	(2.236)	(0.954)	(1.784)	(1.874)
Real GNP per capita	9.59E-06	8.90E-06	1.39E-05	1.26E-05	1.10E-05	1.48E-05
(1987 constant dollar)	(1.161)	(1.075)	(1.301)	(1.364)	(1.379)	(1.838)
Real GNP per capita squared	-3.39E-10	-3.22E-10	-4.64E-10	-4.61E-10	-4.50E-10	-5.66E-10
	(-0.996)	(-0.935)	(-1.252)	(-1.118)	(-1.216)	(-1.539)
Real GNP growth rate	1.154	1.171	0.958	0.963	0.941	0.572
	(2.154)	(2.182)	(2.109)	(2.283)	(2.409)	(1.224)
Old age dependency ratio	-1.328	-1.316	-1.258	-1.154	-0.787	-1.107
	(-2.463)	(-2.430)	(-2.593)	(-2.340)	(-1.476)	(-2.070)
Young age dependency ratio	-0.741	-0.770	-0.512	-0.474	-0.315	-0.551
	(-1.968)	(-2.025)	(-1.662)	(-1.530)	(-0.999)	(-1.771)
Gini coefficient			0.112	0.863	0.154	0.249
			(0.667)	(1.610)	(1.213)	(1.792)
Income share of middle 60%	-0.250					
	(-1.257)					
Income share of top 20%		0.2193				
		(1.312)				
GNP * Gini coefficient			-4.37E-06			
			(-0.193)			
Gini coefficient squared				-0.902		
				(-1.400)		
Current Acct. Bal. / GNP					0.561	
					(2.443)	
Latin America regional dummy						-0.016
						(-0.428)
Africa regional dummy						0.005
						(0.143)
Asia regional dummy						0.038
						(1.090)
Adjusted R^2	0.5083	0.5116	0.4057	0.4173	0.4114	0.463
Standard Error	0.0414	0.0413	0.0437	0.0433	0.0422	0.042
Number of Observations	40	40	52	52	48	52

Note: The above t-statistics were computed using heteroskedasticity-corrected standard errors.

Table 7. Panel Estimates of Saving Equations
Dependent Variable: GNS/GNP
(t-statistics in parentheses)

	1	2	3	4	5	6	7	8
Estimation Procedure	Simple Pooled Estimates		Panel Estimates with Fixed Effects					
Sample	Full	Full	Full	OECD	LDCs	Full	OECD	LDCs
Constant	0.644 (15.442)	0.550 (10.151)	NA	NA	NA	NA	NA	NA
Real GNP per capita (1987 constant dollar)	6.38E-06 (2.633)	9.72E-06 (3.172)	2.15E-05 (4.820)	-2.79E-06 (-0.631)	5.87E-05 (5.202)	2.04E-05 (4.770)	2.37E-06 (0.492)	4.51E-05 (4.285)
Real GNP per capita squared	-2.45E-10 (-2.301)	-3.61E-10 (-2.924)	-5.69E-10 (-4.331)	1.28E-10 (0.991)	-3.02E-09 (-3.299)	-5.99E-10 (-4.495)	-5.77E-11 (-0.376)	-1.19E-09 (-1.230)
Real GNP growth rate	0.542 (7.402)	0.502 (6.789)	0.368 (7.641)	0.362 (6.375)	0.357 (5.416)	0.335 (6.666)	0.409 (6.940)	0.250 (3.502)
Old age dependency ratio	-1.947 (-11.341)	-1.746 (-8.758)	-2.903 (-6.340)	-0.725 (-2.016)	-4.578 (-4.137)	-3.144 (-7.034)	-0.883 (-2.350)	-7.489 (-5.80)
Young age dependency ratio	-0.953 (-11.235)	-0.863 (-9.676)	-0.525 (-6.147)	0.221 (1.917)	-0.575 (-4.290)	-0.670 (-7.722)	0.149 (1.279)	-1.067 (-6.658)
Gini coefficient	-0.048 (-1.157)	0.037 (0.697)	0.014 (0.217)	0.020 (0.299)	0.047 (0.489)			
Income share ratio of top 20%/bottom 40%						-0.0046 (-1.723)	-0.0084 (-1.268)	-0.0015 (-0.471)
Latin America regional dummy		-0.002 (-0.128)						
Africa regional dummy		-0.009 (-0.441)						
Asia regional dummy		0.028 (1.515)						
F test for joint significance of Fixed Country Effects (p-value)			.000	.000	.000	.000	.000	.000
Adjusted R2	0.470	0.478	0.861	0.876	0.868	0.881	0.887	0.906
Standard Error	0.062	0.062	0.032	0.020	0.037	0.027	0.019	0.030
Number of Observations	468	468	468	209	259	339	187	152

Note: The equations using the top 20% to bottom 40% ratio (columns 6-8) as the relevant distribution measure were estimated using only. observations with income-based distribution data

Figure 1

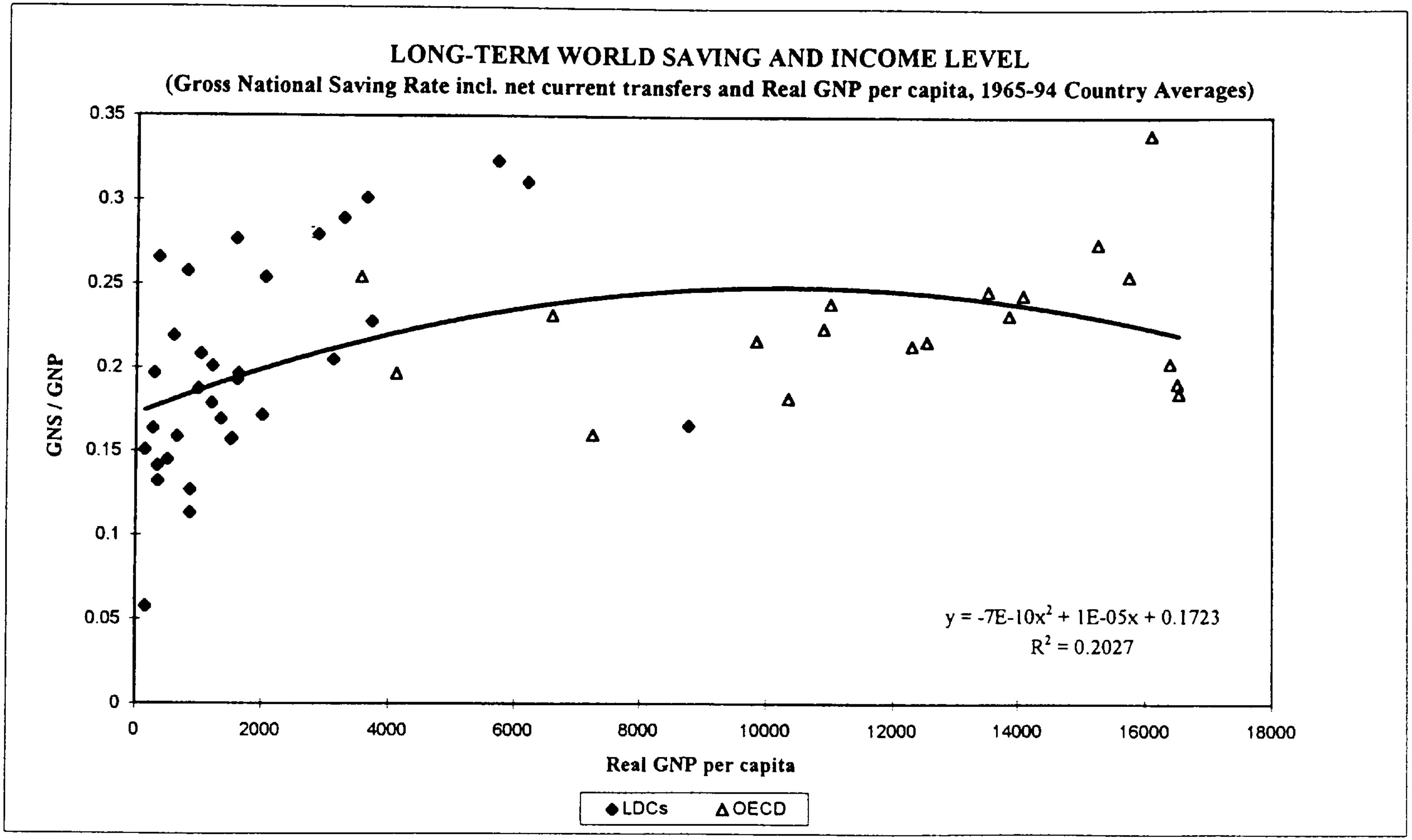

LONG-TERM WORLD SAVING AND INCOME LEVEL
(Gross National Saving Rate incl. net current transfers and Real GNP per capita, 1965-94 Country Averages)
GNS / GNP
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Real GNP per capita
y = -7E-10x² + 1E-05x + 0.1723
R² = 0.2027
LDCs
OECD

Figure 2

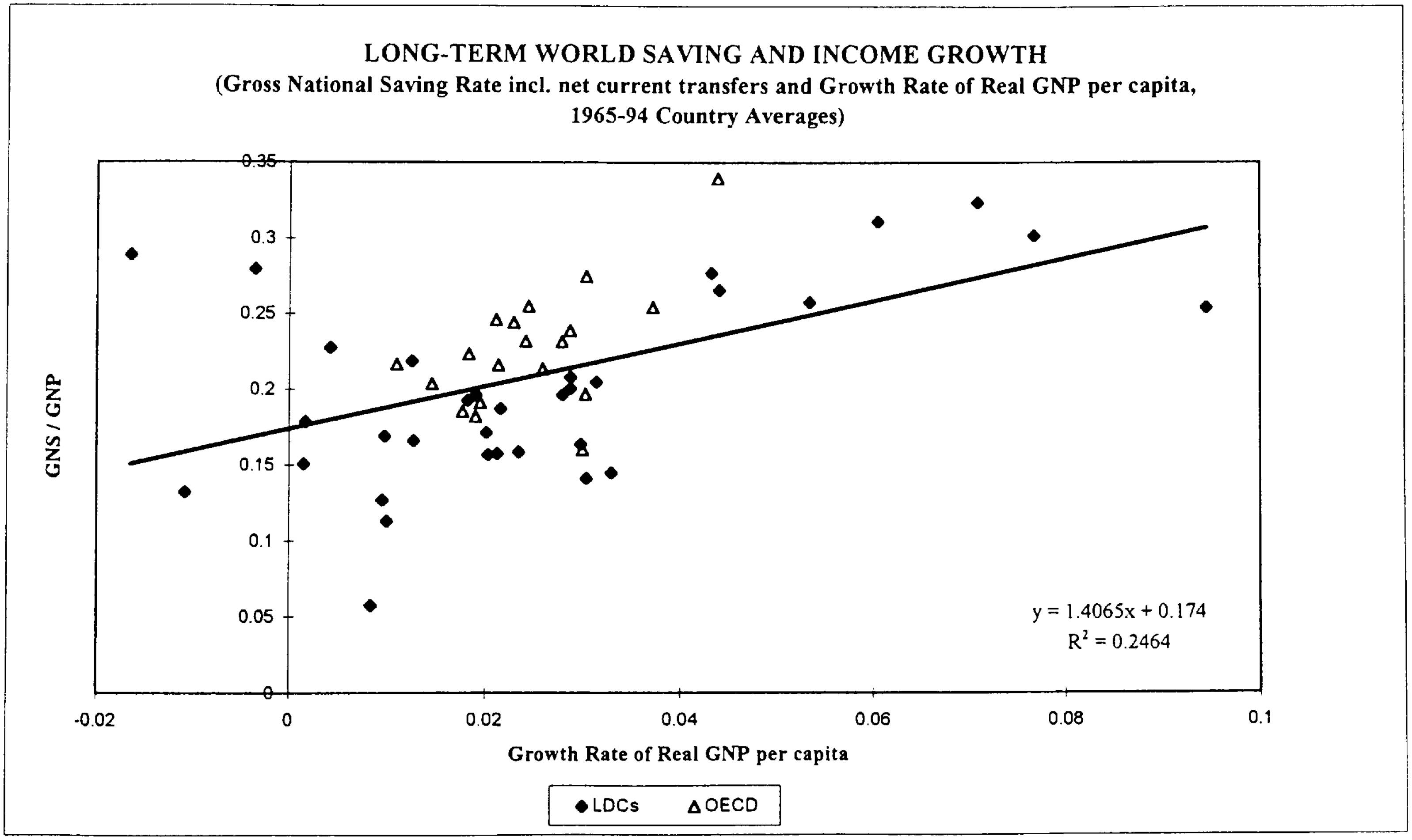
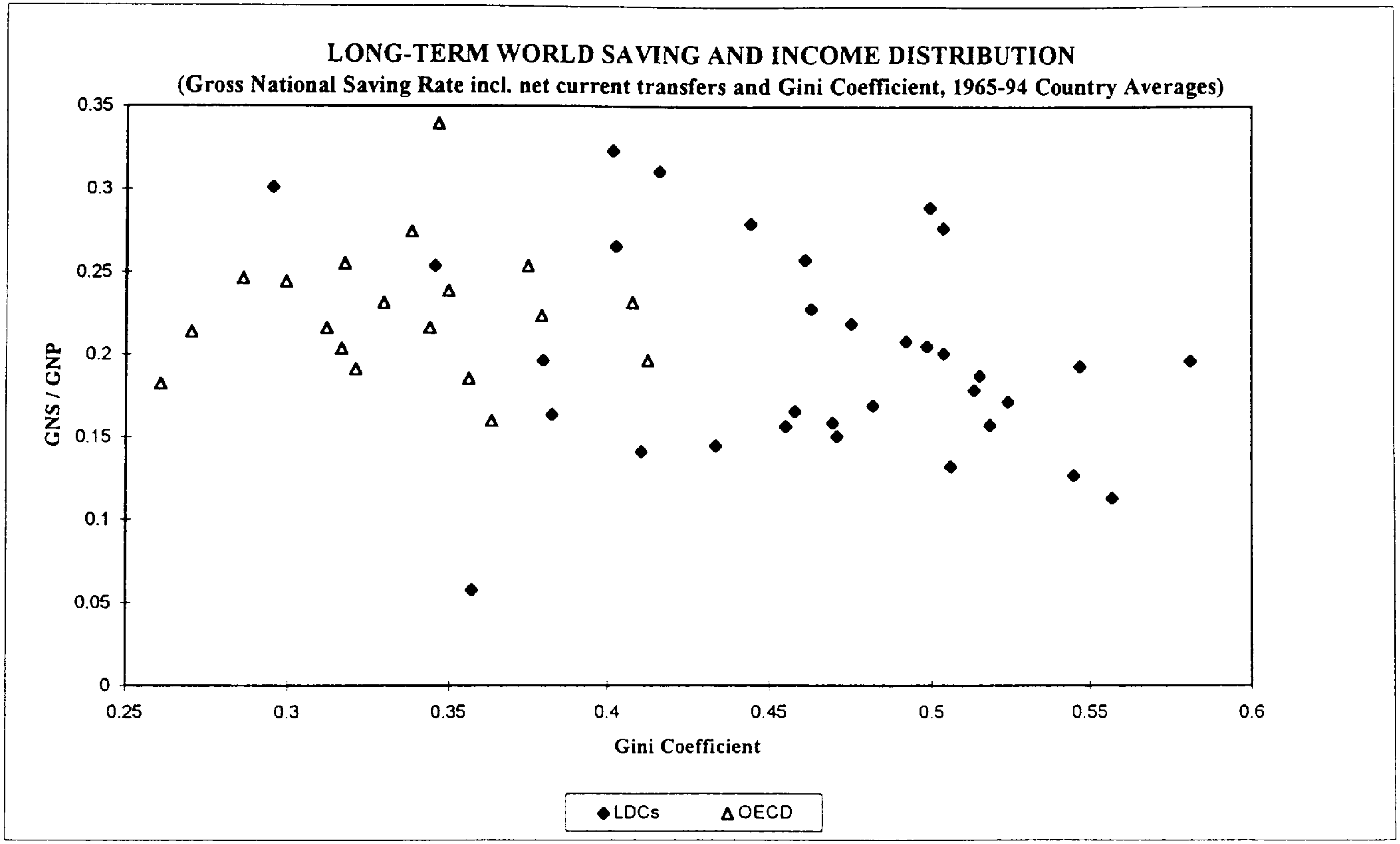

LONG-TERM WORLD SAVING AND INCOME GROWTH
(Gross National Saving Rate incl. net current transfers and Growth Rate of Real GNP per capita, 1965-94 Country Averages)
GNS / GNP
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.02
0
0.02
0.04
0.06
0.08
0.1
Growth Rate of Real GNP per capita
y = 1.4065x + 0.174
R^2 = 0.2464
LDCs
OECD

Figure 3



LONG-TERM WORLD SAVING AND INCOME DISTRIBUTION
(Gross National Saving Rate incl. net current transfers and Gini Coefficient, 1965-94 Country Averages)
GNS / GNP
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
Gini Coefficient
LDCs
OECD

Figure 4

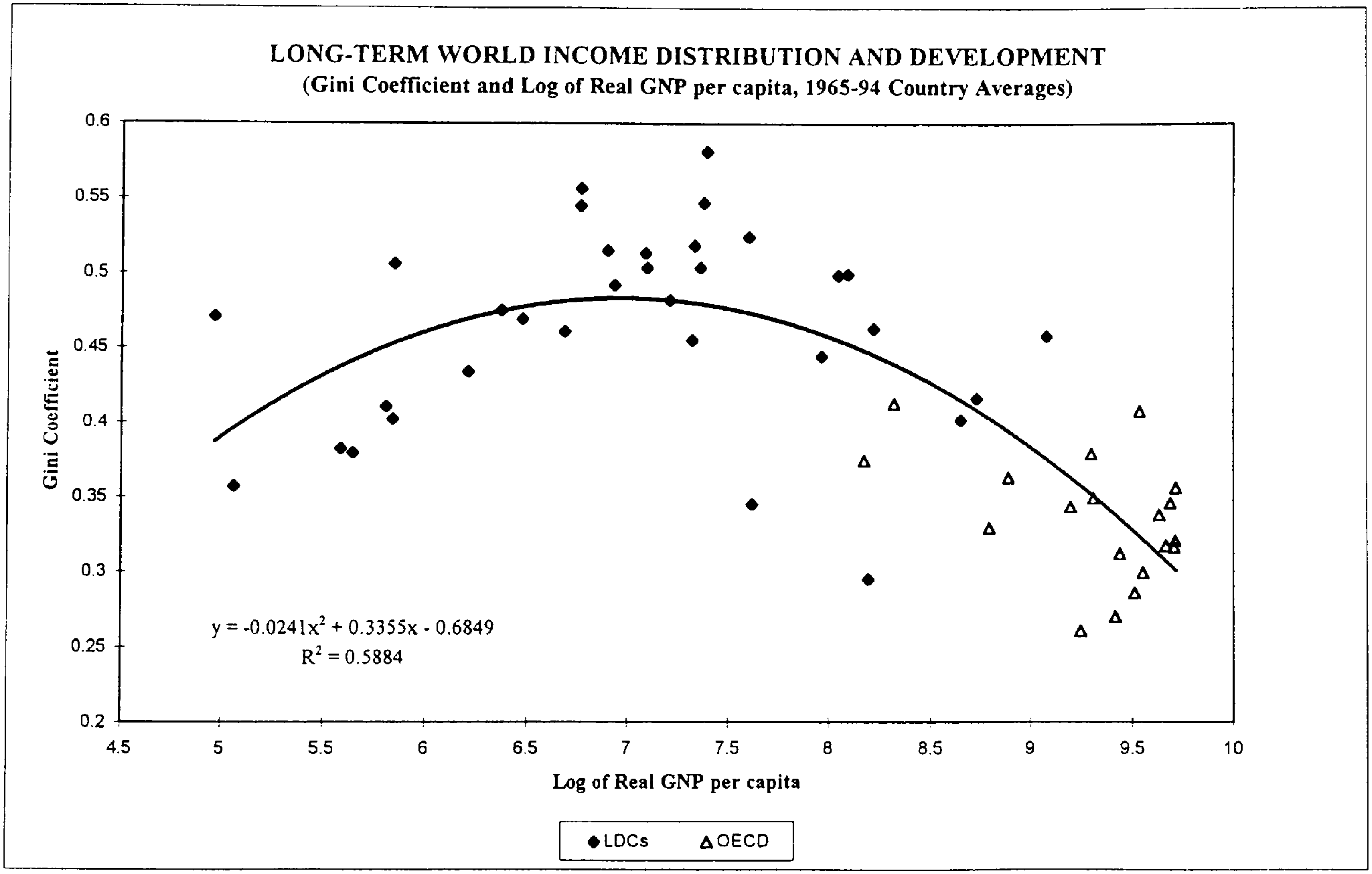
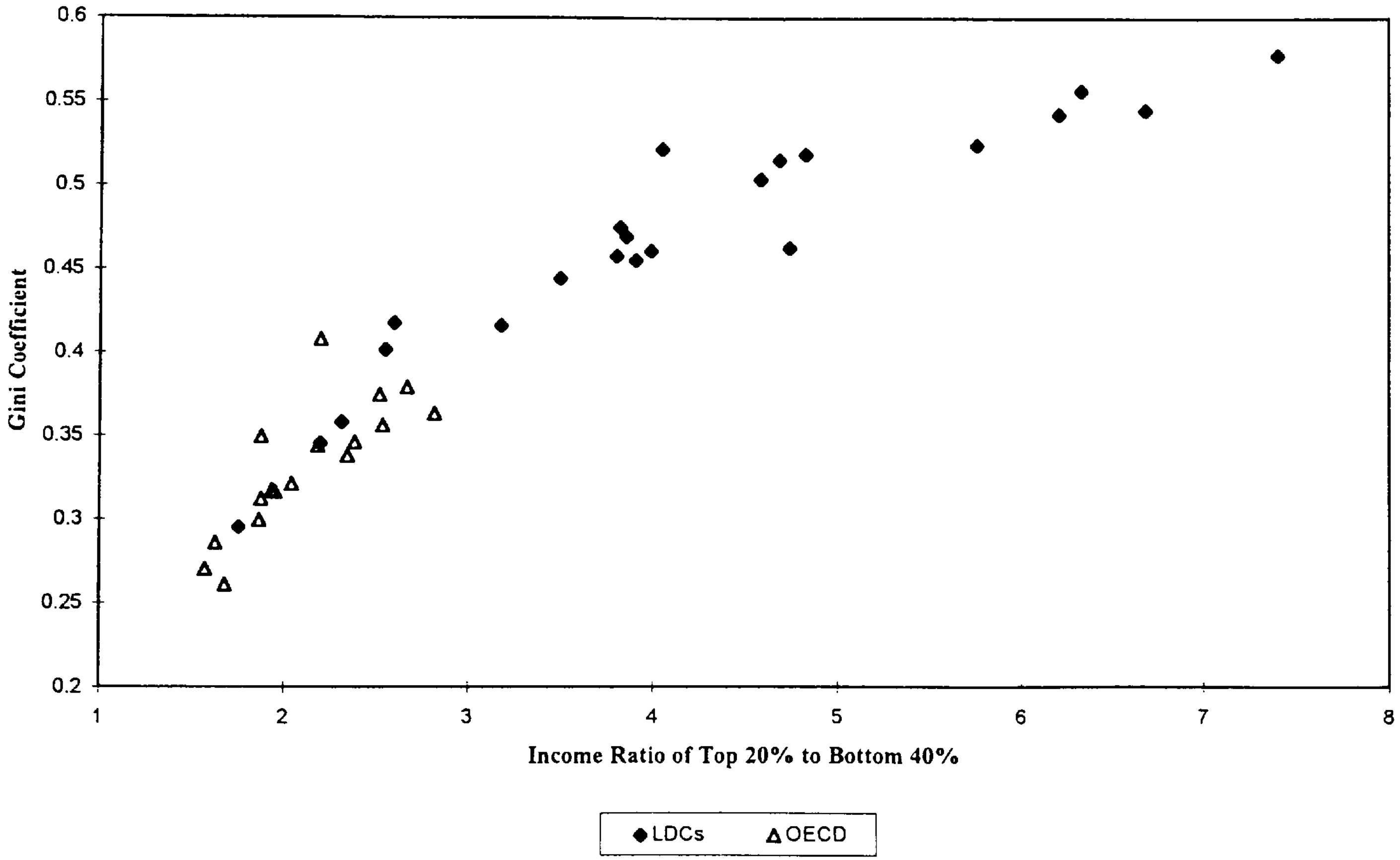

LONG-TERM WORLD INCOME DISTRIBUTION AND DEVELOPMENT
(Gini Coefficient and Log of Real GNP per capita, 1965-94 Country Averages)
Gini Coefficient
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
y = -0.0241x² + 0.3355x - 0.6849
R² = 0.5884
Log of Real GNP per capita
LDCs
OECD

Figure 5

LONG-TERM WORLD INCOME DISTRIBUTION MEASURES

(Gini Coefficient and Ratio of Income of Top 20% to Bottom40% of Population, 1965-94 Country Averages)



Note: This figure was plotted using only the income-based income distribution data