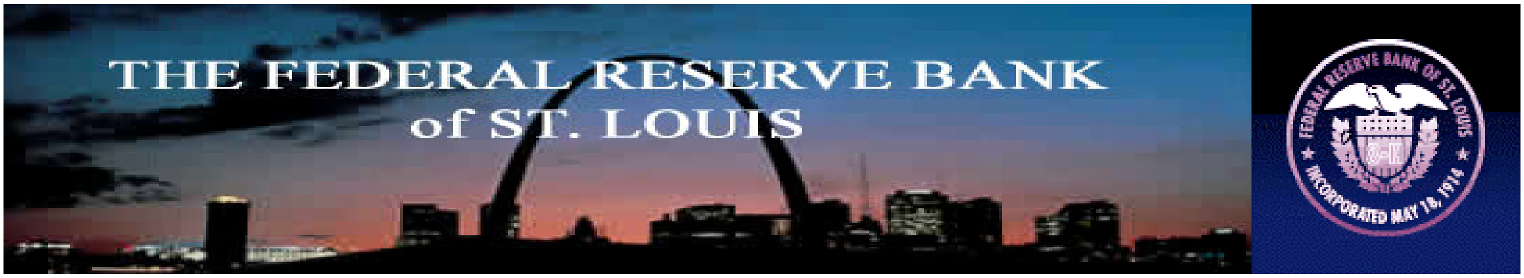

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Income Inequality and Minimum Consumption: Implications for Growth

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Income Inequality and Minimum Consumption: Implications for Growth

Donald S. Allen* and Leonce Ndikumana#

Abstract: We propose a model that recognizes hierarchical goods and income inequality among households. The model demonstrates that growth is impacted not by inequality *per se*, but "absolute" income distribution or the level of poverty underlying the income distribution. Specifically, when a large fraction of the population is below the threshold income necessary for subsistence, aggregate consumption is depressed. In low-income countries, high inequality of income retards consumption growth, whereas in high-income countries inequality may be neutral for growth. Cross-country regressions indicate a positive and significant relationship between the middle quintile share of income and aggregate consumption. In all cases analyzed, increasing income in the middle quintile increases consumption growth.

Keywords: Growth, Development, Income Inequality, Consumption.
JEL Codes: E21, D31, O11, O57.

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Income Inequality and Minimum Consumption: Implications for Growth

"…there are also strong forces for stagnation: a quarter of the 60 countries with initial per capita GDP of less than $1000 in 1960 have had growth rates less than zero, and a third have had growth rates less than .05 percent." Pritchett (1997)

"A number of questions remain unresolved among economists regarding the complex linkages between growth and distribution: [one of them is] *How does income distribution interact with economic growth in the short and long runs?" Introduction to "Income Distribution and High-Quality Growth" Tanzi and Chu*

1. Introduction

The empirical fact of disparate growth in national incomes across countries challenges theoretical growth models for an explanation. The neoclassical growth model predicts convergence (or at least conditional convergence) in income among economies. Lower-income less-capitalized economies should grow faster than high-income countries and, *ipso facto*, should attract more capital in a global financial market. Yet the data do not bear this out. Both rich and poor countries have increased per capita output, but the gap between rich and poor has increased steadily.[1] Among countries that were equally poor three to four decades ago, there have been successes and disasters. Some, like Venezuela, have stagnated sufficiently to move from high-income to middle income status.

Controlling for the multitude of characteristics that differ across countries, -institutions, political climate, level of education, income distribution etc. has been the

[1] Parente and Prescott (1993) summarize the stylized facts as changes in the distribution of wealth across nations from 1960 to 1985. Barro and Sala-I-Martin (1995), Jones and Manuelli (1997b), and Aghion and Howitt (1998) provide surveys of the evolution of endogenous growth research, while Durlauf and Quah (1998) survey the evolution of the empirical research in economic growth.

challenge of growth and development empiricists.[2] Income distribution has been one conspicuous (and constant) difference between East Asian countries and Latin American countries. East Asian economies began the period of the early 1960s with more equitable distribution of income, for the most part, than their Latin American counterparts. Growth outcomes have been equally disparate for these two groups, begging the question of an income-distribution growth nexus. Does income inequality enhance or retard economic growth? If so, can this be demonstrated using existing growth models?

In this paper, we expand existing representative-agent, single-good equilibrium growth models to recognize hierarchical goods and heterogeneous consumers.[3] The model generalizes research that identifies a minimum consumption level (Chatterjee and Ravikumar (1997) for example) to a scheme where the hierarchy of goods will cause consumption bundles to vary as a function of income. Consumers are heterogeneous in initial income, and consumption/savings decisions reflect individual intertemporal utility maximization. We simulate the short run dynamics in two economies characterized by equal mean incomes with different income distributions, starting from a point just below the equilibrium point in a Ramsey model. The results indicate that both income and consumption grow faster initially for the more egalitarian economy. We follow Blinder's proposition that consumption depends on income and that the marginal propensity to

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[2] In keeping with the awareness of the data, most of the new models predict multiple equilibria or "convergence clubs" as observed by Baumol (1986) and Ben-David (1998). Unfortunately, the characteristics that result in membership in a given club are still not explicitly modeled, leaving the empirical analysis no better than with the exogenous growth neoclassical model. The conventional approach has been to model a vector of control variables such as: political climate, "governance", education attainment, initial income and so on.
See Durlauf and Quah (1998) and Temple (1999) for surveys of recent developments in empirical and theoretical work in economic growth.

[3] Heterogeneity of consumers reflects differences in productivity and inability to insure against aggregate or idiosyncratic shocks, sometimes resulting in corner solutions. See Rios-Rull (1995) and Krussel and Smith (1998) for a discussion of heterogeneity.

consume is a function of the distribution of income (Blinder 1975). Blinder's study is a time series analysis based on US data from 1947 to 1972. We extend the model to a cross-country analysis using quintile income shares. We find a strong positive correlation between the income share of the middle quintile and consumption growth.

2. Literature Survey

Old and New Growth Theory

The neoclassical growth model developed by Solow and Swan (1956) focuses on the aggregate concave production function. Limitations to growth are imposed by limitations to aggregate investment/savings while exogenous technological progress ensures nonzero growth in per capita output in the long term. Residuals of growth accounting that cannot be attributed to input-factor increases are identified as technology shocks.

The most important feature of the neoclassical model for development is its prediction of convergence. For countries with similar stocks of knowledge etc., countries that are further below the stationary capital-labor ratio should grow faster than countries above, leading eventually to convergence in income. The neoclassical growth model also implies that the returns to capital should be much greater for less-developed countries. Therefore, in a frictionless global financial market, capital should flow naturally from developed to less-developed countries. Lucas (1990) questioned the empirical contradiction to this result.

The limitations imposed by assuming exogenous technological advances motivated research that embedded growth in an equilibrium framework with savings and technological advances stemming from decisions by optimizing agents. Seminal work by

Lucas (1988) and Romer (1986) suggest a complementary relationship between physical capital and human capital as an explanation for the limited flow of private capital to less developed countries. Lucas's observation spawned the new "endogenous growth" theory that eschewed the exogenous technology growth assumption. Now capital is frequently modeled as a combination of human and physical capital. Romer (1987, 1990), Aghion and Howitt (1992) and Grossman and Helpman (1991) incorporated R&D theories into the growth models, generating endogenous technological change.

Endogenous (new) growth theory predicts conditional convergence to multiple equilibria, consistent with the observed divergence. Empirical tests of conditional convergence, controlling for education level and other measures of human capital appear to confirm the predictions of endogenous growth models. Mankiw, Romer and Weil (1992) add human capital to a Solow-Swan model and predict a slower convergence rate.

Both "new" and old growth theories focus primarily on the shifting of the production function (technological improvement) as the prime source of sustainable output growth. Movement along the production function (capital deepening) is central to convergence in the neoclassical model, but both types assume equilibrium in all markets. Underutilization, or inefficient use of factor inputs (i.e. economies operating inside the production possibility frontier) is not considered. Equilibrium conditions are modeled in a single-good, representative consumer framework. In this framework, growth theory has little to say about income distribution.

Income inequality

Kuznets suggested that income inequality was most likely to increase during the initial phase of development, then decrease as the economy reached higher income levels.

Empirical tests of the Kuznets hypothesis have produced mixed results. Kuznets suggested causality running from development to inequality, as population shifted from a rural/agriculture base with low sectoral inequality, to an urban manufacturing base with high sectoral inequality. Anand and Kanbur (1993) formalize Kuznets' model to show how population shifts between sectors affect aggregate inequality based on the dominant distribution.

Others, like Kaldor, suggest that increasing inequality was a necessary precondition to development. Implicit in the causal relationship of income inequality to growth is the notion of an increased propensity to save by the rich. Here again empirical work on marginal propensity to consume out of income has produced mixed results. Blinder (1975) explores the distribution effect on aggregate consumption in a life-cycle framework including bequests. He concludes that the relative relationship of the intertemporal elasticity of substitution and the elasticity of the marginal utility of bequests will determine how redistribution affects the aggregate marginal propensity to consume. Specifically, if the elasticity of the marginal utility of consumption is greater than the elasticity of the marginal utility of bequests, then the marginal propensity to consume is decreasing in wealth (defined as lifetime disposable resources). Under this condition the wealthy will save more.

Atkeson and Ogaki (1996) detect empirical evidence of a wealth-varying intertemporal elasticity of substitution, supporting the notion that the poor are less likely to defer consumption to invest in higher future consumption despite potential high returns. In effect, when current income is at or close to subsistence, the option of increasing saving to boost future production is limited.

Some researchers have concluded that income inequality can be detrimental to growth. Birdsall, Pinckney, and Sabot (1996) exposit a case where liquidity constrained households can be induced to save more when there are higher returns to savings. They compare outcomes in East Asia and Latin America and suggest that policies aimed at reducing income inequality without “growth-inhibiting transfers and regulations” can make savings and investment by the poor an engine of growth. Barro (1999) finds that inequality is detrimental to growth in low-income countries but has negligible impact on growth in high-income countries.

Minimum consumption

Consumption usually accounts for more than 60 percent of Gross Domestic Product in most countries. Chaterjee and Ravikumar (1997) explore the evolution of per-capita consumption and wealth in a poor economy during early stages of economic growth. The model shows that, by introducing a wealth dependent intertemporal elasticity of substitution, there is a transition phase during which distributions of wealth, consumption, and permanent income become more unequal. The motivation for Chatterjee and Ravikumar’s (1997) work comes from earlier work by Atkeson and Ogaki (1996 and 1997) and by Rosenzweig and Wolpin (1993) that estimate minimum consumption requirements from a panel of Indian villages and found the minimum consumption to be a large fraction of total income. Other work by Rebelo (1992) and Ogaki, Ostry and Reinhart (1996) also explained the low savings rate in poor countries to be indirect evidence of minimum consumption requirements.

A natural extension of this concept of minimum consumption is that of hierarchic demand. Jackson (1984) uses a hierarchic demand system for which only a subset of commodities is in the purchased set. His empirical analysis shows how the number of commodities purchased expands with total expenditure in the aggregate and for commodity groups.

Various authors have explored implicit demand for variety. Oulton (1993) explores the impact of new consumer goods on labor-leisure choices and economic growth in a Solow-Cass exogenous growth model and a Lucas human capital endogenous growth model and finds opposite effects. In the exogenous growth model, the faster the rate of introduction of new goods, the lower the proportion of time devoted to leisure; in the endogenous growth model the opposite effect is observed. This work extends models by Grossman and Helpman (1990 and 1991) and Romer (1987) where increased variety plays a role in the growth process.

The purpose of this paper is to test the hypothesis that growth is impacted not by inequality *per se*, but "absolute" income distribution. That is to say, the level of poverty underlying the income distribution determines aggregate consumption levels, the potential for savings, and the net investment in productive capital. In other words, given two (poor) countries with the same average income per capita, we ask whether the country with the more equitable distribution of wealth will grow faster.

This hypothesis neither contradicts nor supports the Kuznets curve. Instead it suggests that there is no underlying mechanism which will automatically shift the distribution of income as a country grows, but at low-income levels countries with more equitable income distributions grow faster.

3. The Model

The typical evolution of industrial development has been along a path from agricultural production to manufacturing of durable goods. In industrialized economies, services have become an increasing portion of the economy as the manufacturing sector's share shrinks. The number and variety of products have increased in tandem with increasing incomes. Whether demand drives the introduction of new goods or the introduction of new goods increases income, which increases the demand for new goods is difficult to ascertain. However, with decreasing marginal utility, new goods may provide higher marginal utility than increased consumption of existing goods. Oulton (1993) recalls Adam Smith's discussion in the Wealth of Nations:

> "Adam Smith remarked that 'The desire of food is limited in every man by the narrow capacity of the human stomach' (*The Wealth of Nations*, Book I, chapter XI). Suppose that the economy produced nothing but food and economic progress consisted simply of more and more efficient ways of doing so. Would we expect that people would continue to work just as hard, solely in order to be able to cram more and more food into their stomachs? Surely not. In such an economy, we should not expect (after a while) to observe very much economic growth, in the usual sense of a rise in *per capita* consumption; instead we should expect the fruits of technical progress to appear in the form of increasing leisure. However, in the passage just quoted, Smith went on to assert that 'the desire for the conveniences and ornaments of building, dress, equipage, and household furniture, seems to have no limit or certain boundary'. So whether or not technical progress is accompanied by increasing leisure would seem to depend on the nature of the goods available." Oulton (1993) p. 364.

Abstracting from individual taste, most consumers rank their preferences over categories of goods. For example, daily meals may take priority over entertainment expenditures. So, for goods that are not perfect (or imperfect) substitutes, consumption choices can be ranked.

We model individual commodities as hierarchic by using a modified constant relative risk aversion (CRRA) utility function (or addilog function). Each good is distinguished by a unique IES, producing hierarchical marginal utility. Total utility is the aggregate of utility from each good. The result will be a "composite" IES implied by the commodity bundle, which is determined by the budget constraint.

The minimum commodity good has highest marginal utility until the first unit is consumed, after which all other goods have higher marginal utility. Figure 1 shows the marginal utility curves for four hierarchic commodities.[4] Maximizing utility requires equating the marginal utility of each commodity. For a liquidity-constrained consumer, the chosen commodity bundle will be determined by the corner solution imposed by the budget constraint. The marginal utility will be set by the budget constraint. In this example, for a marginal utility of 700 "utils", say, the chosen bundle will include the minimum consumption good and some of the second good in the hierarchy. A "wealthier" individual may be able to maximize utility at a marginal utility rate of 400 "utils" with a commodity bundle that includes some of the third good as well as some of the second good and the minimum consumption good. The wealthy individual that is "unconstrained by income" will consume a bundle of commodities with all four goods. As marginal utility of consumption falls with income, the intertemporal tradeoff between consumption and saving favors saving. If we assume that interest rates are determined in the aggregate market, then income levels will determine whether the marginal utility of consumption exceeds the marginal utility from saving. For a given interest rate, the propensity to save increases in income. For a given minimum consumption level, the more households above this level the larger the pool of savings available for investment.

[4] As in Ogaki and Reinhart (1998) we can think of the service received from the goods over time as the utility. Thus durable goods would be modeled by the utility provided each period.

3.1 Preferences

There is a hierarchy across goods, which include a minimum consumption good and a range of other goods. Preferences are the same among households but consumption bundles will vary depending on the level of income. Differences in the intertemporal elasticity of substitution can be attributed to the presence of uninsurable risk to allow for lasting differences in income between the rich and the poor, especially by preventing the poor from taking the risk to invest in 'non-traditional' activities accessible to the rich. Preferences are represented by the following utility function:

$$u(c_{it}) = \sum_{j=1}^{m} \left(\frac{c_{j,it}^{(1-\sigma_j)} - 1}{1-\sigma_j} \right) \tag{1}$$

where $c_{j,it}$ is consumption of good *j* by household *i* in period *t*, $\sigma_j > 0$ is an indicator of the curvature of the utility function for good *j*. This specification implies that $u(c_t) \rightarrow \log(c_t)$ as $\sigma \rightarrow 1$[5]

The postulated form of preferences implies that household's intertemporal choices of consumption goods depend on each good's position on the household-specific hierarchy of goods. The utility maximizing consumption bundle will equate marginal utilities across goods. The individual's marginal utility will be income-dependent, occurring at higher values for lower income. Specifically, the intertemporal elasticity of substitution η_j depends on σ, which varies across goods:

[5] The results from this model can be generalized for specifications that do not include the term $1/(1-\sigma)$ (see Barro and Sala-i-Martin (1995) and Koopmans (1965)).

$$\eta_j = \left[\frac{(c_{j,i,t+1} / c_{j,it})}{-u'(c_{j,i,t+1}) / u'(c_{j,it})} \bullet \frac{d[u'(c_{j,i,t+1}) / u'(c_{j,it})]}{d(c_{j,i,t+1} / c_{j,it})} \right]^{-1} = \frac{1}{\sigma_j} \tag{2}$$

The highest σ_j corresponds to the lowest intertemporal elasticity of substitution (and highest marginal utility). This is the case for the minimum consumption good, consistent with the fact that, especially for low-income households, there is little flexibility to transfer consumption of minimum consumption good across time. Consumption is nearly smooth across time for this particular good. In contrast, high-income households, which are less budget-constrained, are able (and more willing) to trade current consumption for future consumption.[6]

For the less budget-constrained households, abstention from consumption today materializes in higher saving (or increased leisure – Oulton, 1993). If the desired goods are not available in the domestic market, the increased saving can either finance the production of new goods domestically or imports. Demand for variety by the wealthy will generate higher growth when the demand is satisfied by domestic production than when it results in higher imports. In the presence of low income and substantial income inequality, openness may thus be detrimental to long-run growth. We defer the analysis of open economy effects of the introduction or availability of new goods to future research.

A two-good example: To illustrate some of the characteristics of the utility function described, assume a two-good economy where $\sigma_1 = 0.98$ and $\sigma_2 = 0.46$. Thus $\sigma_1 / \sigma_2 = 2$ for tractability, implying that at equal marginal utility, the quantity of good 2 is the square of the quantity of good 1. This means that at consumption levels where the quantity of good 1, $c_1 \leq 1.0$, the quantity of good 1 in the agent's consumption bundle is increasing faster than the quantity of good 2. Once the minimum level for good 1, ($c_1 = 1.0$), is passed, then the quantity of good 2 in the consumer's bundle grows faster than the quantity of good 1.

Figure 2 shows the indifference curves associated with the two goods. When good 1 is below 1.0, the consumer favors good 1 over good 2. Once the minimum level is achieved, good 2 is favored. If we restrict the consumer to spending his entire income on the minimum good until the minimum is acquired, then the consumption/income path will go from the origin up the y-axis to point A, horizontally to point B, then along the remainder of the Engel curve. Note that the Engel curve follows a quadratic path because of the 2:1 relationship between the IES of each good. In the intertemporal optimization process, we can force this expenditure path by forcing good 1 to be either 1.0 or the corner solution of the budget until consumption of good 2 is also 1.0. A less restrictive method would be to increase the subjective rate of discounting for good 2 until the consumption bundle reaches {1,1}. Even with no restrictions the "effective" rate of discounting varies for each good. Consider the intertemporal trade-off between the total bundle at time *t* versus time *t+1*. The marginal utility from consumption at time *t* must be equal to the marginal utility from the consumption bundle at time *t+1*, discounted by the subjective discount rate.

$$c_{1t}^{-\sigma_1} + c_{2t}^{-\sigma_{21}} = \beta(c_{1t+1}^{-\sigma_1} + c_{2t+1}^{-\sigma_{21}})$$

Since the marginal utility from each good is also equalized, the relationship between the quantities of each is fixed. If we define the "effective" rate of discounting as:

[6] We assume that new goods are lower in the hierarchy, but small quantities of new goods provide higher

$$\tilde{\beta}_i = \frac{c_{it}}{c_{it+1}}$$

Then for good 1, $\tilde{\beta}_1 \to \beta$ as $c_1 \to 0$ and $\tilde{\beta}_1 \to \sqrt{\beta}$ as $c_1 \to \infty$. For good 2, $\tilde{\beta}_2 \to \beta$ as $c_2 \to \infty$ and, $\tilde{\beta}_2 \to \beta^2$ as $c_2 \to 0$. So that when the minimum good dominates the bundle, good 2 is "discounted" more. That is, a higher consumption of good 2 in the future is worth the same as a lower consumption of good 2 today. Thus the consumer is "more willing" to defer consumption. As the consumption bundle becomes larger, good 2 dominates and is discounted at the aggregate rate, while good 1 is discounted less. Figure 3 shows evolution of the "effective discount rate for good 1 and good 2 over time for an assumed β of 0.97.

Saving implication:

The decision to save is determined by the marginal product of capital compared to the marginal utility from consumption. That is, the consumer is willing to defer consumption today if the increased income/production from the amount saved results in future consumption with a higher present value than today's consumption. In the abstract, we can equate interest rates to the marginal product of capital, however, since interest rates are determined in the aggregate market, the equilibrium interest rate also will be determined by the income of the marginal saver. If the marginal saver is wealthy, the trade-off from future consumption will reflect a low marginal utility. Intermediation ensures that the market interest rates reflect both the aggregate demand for and aggregate supply of capital. With heterogeneous agents, the distribution of wealth will affect the supply of and demand for capital.

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marginal utility than additional quantities of existing goods.

3.2 Production

Households produce output using capital *K* and labor *L* as inputs.[7] Technology can vary across households depending on income, with the rich households having access to better technology than the poor. Allowing for labor-augmenting technology, the production function for household *i* can be represented as:[8] $Y_{it} = F(K_{it}, A_i L_{it})$. Dividing both sides by *AL*, we get the production function in intensive form as:[9] $y_{it} = f(k_{it})$.

3.3 Optimization

Household's optimal consumption is the solution to the following problem:

$$\max \sum_{t=0}^{\infty} \beta^t \left[\sum_{j=1}^{n} \left(\frac{C_{j,it}^{(1-\sigma_j)} - 1}{1-\sigma_j} \right) \right] \tag{3}$$

subject to:[10]

$$\sum_{j=1}^{n} c_{j,it} + \dot{k}_{it} + \delta k_{it} = f(k_{it}) \tag{4}$$

$$k_{i,t+1} = (1-\delta)k_{it} + \dot{k}_{it} \tag{5}$$

where $\beta \in (0,1)$ is a discount factor and δ is the depreciation rate. Two results arise from the first-order conditions for utility maximization:

a) The marginal utility of each good *j* equals the shadow price of investment (λ).

$$u'(c_{j,it}) = \lambda = (c_{j,it})^{-\sigma_j} \tag{6}$$

[7] The analysis can be replicated easily with a technology that includes human capital.
[8] Barro and Sala-I-Martin (1995) prove that technological progress must be labor-augmenting to have non-constant steady-state growth rates of capital stock and output.
[9] Lower case letters are used to represent household's quantities rather than the typical per-capita or per-worker quantities.
[10] Equation (4) can be extended to include population growth and technological change (see equation 11 below).

b) Households choose consumption of each good to equate marginal utility across time, in the limits of the budget constraint:

$$u'(c_{j,it}) = \beta[1-\delta - f'(k_{it})]u'(c_{j,i,t+1}) \tag{7}$$

This equation[11] can be rearranged to get:

$$\frac{\beta u'(c_{j,it})}{u'(c_{j,it+1})} = \frac{1}{1-\delta + f'(k_{it})} \tag{8}$$

Equation (8) implies that household's utility is maximized intertemporally when the marginal rate of substitution is equal to the marginal rate of transformation. Using the specified utility function (equation 1), equation (8) yields:

$$\beta\left(\frac{c_{j,i,t+1}}{c_{j,it}}\right)^{-\sigma_j} = \frac{1}{1-\delta + f'(k_{it})} \tag{9}$$

which can be modified to get:

$$\frac{c_{j,i,t+1}}{c_{j,it}} = \left[\beta(1-\delta + f'(k_{it})\right]^{\sigma_j} \tag{10}$$

This result (equation 10) implies that the consumption path for each good *j* depends on the parameter σ_j. For a good with high σ, consumption is smoothed across time, i.e., consumption in period *t*+1 is close to consumption in period *t*. This is the case for the minimum consumption good in the basket of the poor households who cannot afford to defer consumption. As $\sigma \to 0$, households are willing to transfer large proportions of current consumption to consume more in the future. This is likely to be the case for non-necessity goods in the basket of the wealthier households.

[11] See Blanchard and Fisher (1989) and Jones and Manuelli (1997) for a discussion of the intuition behind equation (7).

4.0 Simulation

We simulate an economy using a Ramsey intertemporal optimization growth model with two variations. We modify the constant relative risk aversion (CRRA) utility function to include multiple goods and we assume the economy is made up of agents with access to different production functions reflecting capital share. We simulate closed economies with hierarchical goods and heterogeneity in income. We assume three goods with different intertemporal elasticities of substitution, and three types of agents, distinguished by different parameters in production functions, and distributed as tertiles of a Beta distribution. Individual i intertemporally optimizes utility over consumption:

$$u(c_i) = \int_0^\infty \left[\sum_{j=1}^{3} \left(\frac{c_{j,it}^{(1-\sigma_j)} - 1}{1-\sigma_j} \right) \right] e^{-\rho t} dt, \qquad (11)$$

Maximization of utility implies marginal utility of each good is the same and the marginal intertemporal utility is also equated. So for each time t

$$\frac{\partial u_t}{\partial c_{1t}} = \frac{\partial u_t}{\partial c_{2t}} = \frac{\partial u_t}{\partial c_{3t}} \text{ or } \frac{1}{c_{1t}^{\sigma_1}} = \frac{1}{c_{2t}^{\sigma_2}} = \frac{1}{c_{3t}^{\sigma_3}} \text{ such that } c_t = c_{1t} + c_{2t} + c_{3t} \qquad (12)$$

Given the assumption that $\sigma_1 > \sigma_2 > \sigma_3$, the share of each good in the consumption bundle changes as total consumption increases. The share of the higher good in the hierarchy decreases in income (or total consumption).[12] More specifically, when aggregate consumption is less than 3, the share of goods two and three in the

[12] The relationship is nonlinear, depending on the ratio of the σ s, the solution to $c = \sum_{k=1}^{3} c_j^{\frac{\sigma_k}{\sigma_j}}$

consumption basket are less than good one. When aggregate consumption exceeds 3, the share of goods two and three are higher than good one.

The budget constraint for each agent i, is given as

$$\dot{k}_i(t) = y_i(t) - c_i(t) - \delta k_i(t) \tag{13}$$

and the production function for each agent i given by:

$$y_i(t) = f_i(k) = a_i k^{\alpha_i} \tag{14}$$

(We assume one production function for simplicity)

The first order conditions yield the following set of nonlinear differential equations:

$$\dot{c}_j = -\frac{\rho}{\sigma_j} c_j + \frac{\alpha_i a_i}{\sigma_j} c_j k_i^{\alpha_i - 1} \tag{15}$$

$$\dot{k} = -\sum c_j - \delta k + a_i k^{\alpha_i} \tag{16}$$

This is the basic model for the simulation. Our focus is on determining the impact of the distribution of income on the short run dynamics of the growth path. To do this we disturb the agent representing each income level from the steady state to a region resulting in both consumption and capital growth. Because the Ramsey model is unstable away from the saddle path, the economy will not return to the stable path. We identify the steady state equilibrium point ($\dot{c} = \dot{k} = 0$) for each type of agent as determined by capital share. We apply a shock to capital and consumption, which moves the economy into a region off the equilibrium path where both consumption and capital will increase.[13] We

[13] We acknowledge that this path is no longer along the stable arm, but the short run dynamics (before equilibrium forces push the economy back to the stable path) indicate that income inequality is bad for growth. Adjustments that return the economy to the stable path will involve agents changing parameters such as subjective discount rates or capitalization ratio and can be assumed to take time. Heller (1971) demonstrates, (and logic suggests), that if the economy is moved off the stable path, other forces will adjust

observe the dynamic path for the period immediately after the shock when both capital and consumption are increasing. We note the difference in the income and consumption paths of each economy distinguished by income distribution.

The phase diagram of the Ramsey model (See p. 73 of Barro and Sala-I-martin (1995) or p. 20 of Aghion and Howitt (1998)), reproduced in figure 4, shows a stable growth path to the steady state, $c(k)$, that is effectively of measure zero. For the simulation, any choice of consumption and capital that does not lie on this saddle path will lead to an unstable trajectory that either violates the transversality condition, (ever increasing capital and decreasing consumption) or is infeasible (ever increasing consumption and ever decreasing capital). This makes it difficult to simulate movement along the balanced path. However since the focus is on the relative growth of one economy compared to the other, we look at the very short run dynamics away from the balanced path (point A in figure 4).

The capital shares (α_i's) are assumed to be 0.55 for the low income third, 0.65 for the middle third and 0.75 for the high income third. The discount rate (ρ) is assumed to be 0.9 and the depreciation rate (δ) is assumed to be 0.01. The curvature parameter (σ_i's) for each good are assumed to be 0.98, 0.46, and 0.23. The equivalent equilibrium capital/consumption points for each agent type (c_{0i}, k_{0i}) are: (2.506, 1.524), (3.852, 2.771), and (5.789, 4.165) for the lowest, middle, and rich thirds respectively.

As predicted by the Ramsey model, in each case both consumption and capital increase initially, then consumption falls as capital increases further. For our purposes,

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parameters as necessary to return to the (new) stable path. Thus it is sufficient to find the short run dynamics of the economy after a disturbance.

we are interested in the short run difference in the growth path. The ratio of income or consumption indicates the relative growth in each distribution. Figure 5 shows the short run paths (2 periods) of the ratio of income (panel 2) and the ratio of consumption (panel 3) of two economies with income distributed according to a Beta distribution with parameters (2, 2) and (11, 11). A ratio greater than 1.0 means that the economy with the more equitable distribution, (11,11) has a higher income or consumption. The assumed distributions are shown for reference (panel 1). The income shares of the lowest and highest third of the economy respectively, are 16.4 percent and 50.3 percent for the (2, 2) distribution and 25.6 percent and 41.1 percent for the (11, 11) distribution. In both cases the middle third has one-third the income share.

The dynamic path for the first two periods after the disturbance indicates that the economy with lower income inequality (as represented by the mix of agents) follows a path of higher growth. This is reflected in the ratio greater than 1 in figure 5. Initially, consumption growth in the lower inequality economy is faster than in the high inequality economy. The increasing ratio shows that income (consumption) is higher initially and growing faster for the economy with lower inequality. The curve in the graphs illustrate that the growth rates converge and the downward sloping section indicates that the high income inequality country is growing faster. When the ratio fall below 1.0, the high-inequality economy has overtaken the low-inequality economy. After two periods, consumption falls in both economies as the instability of the Ramsey model predicts. Income growth reflects capital accumulation at the expense of consumption.

This suggests that for two economies with the same mean income, the impact of a negative shock to capital and consumption results in faster short run growth in income for the more egalitarian economy. The driving factor is the capital accumulation rate. The shock moves each segment of the population onto a path to the left of and down from the stable path (point A in figure 4), where both capital stock and consumption increases. However the relative rate of increase in capital accumulation of the less capitalized group is faster, resulting in a faster net increase in income. This is consistent with the idea that along the stable path growth is faster when the IES is lower. (See Barro and Sala-I-Martin, 1995, p. 77). When there are more agents at this faster capital accumulation rate, the net growth in the economy is higher.

There are two primary shortcomings of the model. First the results reflect the choices of parameters. The assumed capital share (and technological level) determines the equilibrium point of each type of agent. So, the resulting capital accumulation rate after the shock is a function of both the capital share and the initial capital level. However, intuitively, the idea that wealthier individuals have a greater capital share in their production function and have a higher capital level makes sense. The second problem is that the simulation focuses on the short run dynamics after a shock moves the "economy" away from the balanced path. The feature of the Ramsey model is instability away from the balanced path, so that, depending on the direction, the economy collapses to zero capital and high consumption, or high capital and zero consumption. However, as Heller (1971) shows, there are forces that are likely to move the economy back to a new stable path. Even though the Ramsey model admits only one saddle path of stability, a dynamic economy and rational agents will respond as necessary to return to the feasible path.

5. Consumption and Inequality: Empirical analysis

5.1 Empirical model and data

The model used in this paper draws from earlier studies that examine the effects of income distribution on consumption. Specifically, we follow Blinder's proposition that consumption depends on income and that the marginal propensity to consume is a function of the distribution of income (Blinder 1975). Blinder's study is a time series analysis based on US data from 1947 to 1972. We extend the analysis to cross-country data. For a country *i* at time *t*, aggregate consumption is specified as follows:

$$\begin{aligned} C_{it} &= \alpha_i Y_{it} + \beta C_{i,t-1} + u_{it}, \\ \alpha_i &= \alpha(D_i, \mathbf{Z}) \end{aligned} \tag{17}$$

where C is consumption, Y is income, D is an indicator of income distribution, $\boldsymbol{Z}$ is a vector of other factors that determine consumption, including the interest rate, and u is the error term. Dividing both sides of the above equation by income, we get the following estimation equation:

$$(C/Y)_{it} = a_{0i} + \alpha_1 r_{it} + \alpha_2 D_{it} + \beta(C_{i,t-1}/Y_{it}) + v_{it} \tag{18}$$

where a_{0i} is a country-specific intercept and r is the real interest rate.

A major constraint in this study is the lack of consistent data on income distribution. Such information is generally available for only a few years for most countries. Moreover, the data on inequality is not reported in a synchronized fashion across countries. We use the data from Deininger and Squire (1996), which include Gini coefficients and income shares by quintile. We selected a sample of 67 countries based on the availability of data. The sample includes 11 countries from Africa, 16 from Asia, 19 from Europe, 6 from Latin America, 13 from North America, and 2 from Oceania.

We organized the data in cross sections around the years 1960, 1965, 1970, 1975, 1980, 1985, 1990. When inequality indicators are not reported in a particular year, we used the values that are closest to that year whenever possible. This allowed us to obtain up to 7 observations by country. The data on consumption and per capita GDP (income) is from Penn World Tables. The real interest rate is from World Development Indicators (1999 CD-ROM edition).

The data reveal wide disparity in inequality and growth across regions (see Table 1). Over the 30-year period from 1960 to 1990, the African and Latin American sub-samples have experienced a much slower growth than the Asian sub-sample. In 1960 Africa's GDP per capita was about 83 percent of Asia's per capita GDP. In 1990, the ratio had dropped to 45 percent, implying a 2 percent annual decline. In 1960, average per capita GDP was substantially higher in the Latin America sample than in the Asia sample. By 1990, Latin America's average GDP per capita had dropped to 71 percent of Asia's, down from 197 percent in 1960, implying a 3.5 percent slide annually over the 30-year period.

The African and Latin American sub-samples exhibited the highest inequality in the beginning of the sample period. In 1960, the income share of the poorest 20 percent of the population was twice as high in Asia as in Africa and Latin America. The gap has narrowed down for Africa, but little change has occurred for Latin America. The empirical question that arises from these findings is whether the disparity in income inequality may have played a role in explaining growth differentials across regions. Preliminary analysis shows a negative, albeit weak relationship between growth and initial inequality (see Figure 6). Empirical evidence on this question is rather mixed.

Some researchers argue that inequality negatively affects growth (Perotti 1996; Benabou 1996). The results in other studies suggest a positive relationship between inequality and growth (Li and Zou 1998; Forbes 1997). Barro (1999) concludes that the effects of inequality on growth are negative at low-income levels and positive among high-income countries, but that the overall effects on growth (and investment) are rather weak. The empirical analysis in this study focuses on the links between inequality and consumption.

5.2 Empirical results

The regression results are presented in Tables 2 and 3. We present results with two indicators of income inequality: the Gini coefficient and income shares by quintile. We include the 1st, 3rd, and 5th quintiles to examine the effects of the skewness of the income distribution.[14] This analysis allows us to make inferences on the effects of shifts in the distribution of income towards the lower tail, the center, or the upper tail of the income distribution.

Overall, the results indicate some negative effect of income inequality on consumption. However, the results are not robust to alternative specifications and thus should be interpreted with caution. The results in Table 2 indicate a negative but insignificant effect of quintile shares in the entire sample (column 2). However, when fixed effects are included (column 3),[15] the coefficient of the first quintile share becomes negative and significant, and the coefficient of the third quintile share becomes positive and significant. The regressions by income category indicate a similar pattern:[16] The coefficient on the third quintile is positive and significant in both income groups; the

[14] For practical (econometric) purposes, not all quintiles can be included in the same regression at once. So, one has to eliminate at least one quintile.
[15] To account for country-specific fixed effects, we take differences from a country's mean for each regression variable.

coefficient on the first quintile is negative and significant only in the high-income category. Overall, the results suggest that a mean-preserving shift in the distribution of income towards the middle leads to an increase in aggregate consumption. The negative coefficient on the first quintile share is a priori surprising and almost counter-intuitive. However, the fact that the result does not hold at low-income level mitigates such an impression. In high-income countries, it is possible that an increase in income for the relatively poor consumers results in an increase in non-consumption expenditures (given that his groups is income constrained) and a less-than-proportional increase in consumption expenditures. Therefore, a decline in consumption in high-income categories may not be offset by an increase in consumption by low-income consumers. There is some indication that an increase in the income share of the 5th quintile results in a decline in consumption (Table 2, column 5), consistent with the lower marginal propensity to consume at high income levels. This result is consistent with Blinder's proposition that "if income is taken from one individual and given to another individual who is identical in all relevant respects save that his income is higher, then total consumption will decline" (Blinder 1975: 448, Proposition C).

The results with the Gini coefficient show generally no effect of income inequality on consumption. However, a negative and marginally significant effect is observed in the low-income category. This result is consistent with earlier studies that failed to find any effects of inequality on economic growth in high-income countries (Barro 1999).

[16] We split the sample into low-income and high-income countries based on initial per capita GDP (in 1960). The cutoff point is the median per capita GDP in 1960 ($1786 at 1985 prices).

The results show a negative effect of interest rate on consumption. When the sample is split between low-income and high-income countries, the result holds only for the low-income category. This finding is consistent with the view that high income levels correspond to lower marginal utility of consumption. So, wealthy consumers are willing to forego current consumption in favor of future consumption (saving) even for small increases in the interest rate. Low-income consumers, in contrast, would require a substantial increase in the interest rate to reduce their current consumption given that they are operating closer to (and possibly below) minimum consumption level.

6.0 Summary and Conclusions

This paper tests the hypothesis that at low income levels, *ceteris paribus*, economies with more equal distribution of income are likely to grow faster. Simulation of a Ramsey-type growth model with hierarchical goods finds that starting from capital and consumption level below the equilibrium point, the income growth of the more egalitarian economy is faster. Although the Ramsey model becomes unstable, one can assume that in the real world adjustments would be made to return the economy back to a stable path. The empirical results suggest that a mean-preserving shift in the distribution of income towards the middle leads to an increase in aggregate consumption. The implication is that growth is not neutral to income distribution and the impact is negative at income levels closer to some conceptual "minimum consumption" levels.

Policy recommendations do not follow immediately from these results. In cases like Japan and Korea, exogenous forces resulted in redistribution of income at a specific time in history. Redistribution of income by a democratically elected government involves a different set of political economy questions. Political instability can occur as much from attempts at redistribution as from income inequality. The findings of this study show, as Barro (1999), that income inequality at low income levels helps in part to explain divergence among economies.

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Figure 1 Marginal Utility Curves of Hierarchical Goods

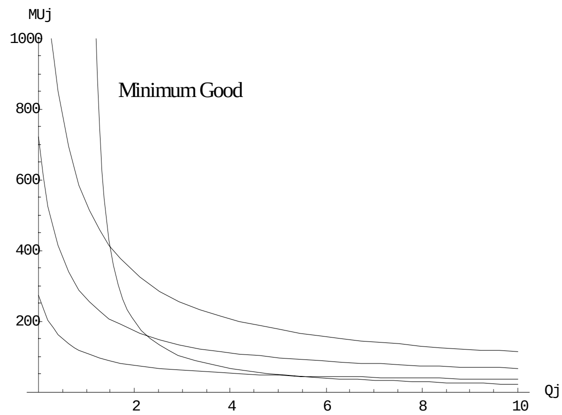


Figure 2 Indifference Curves

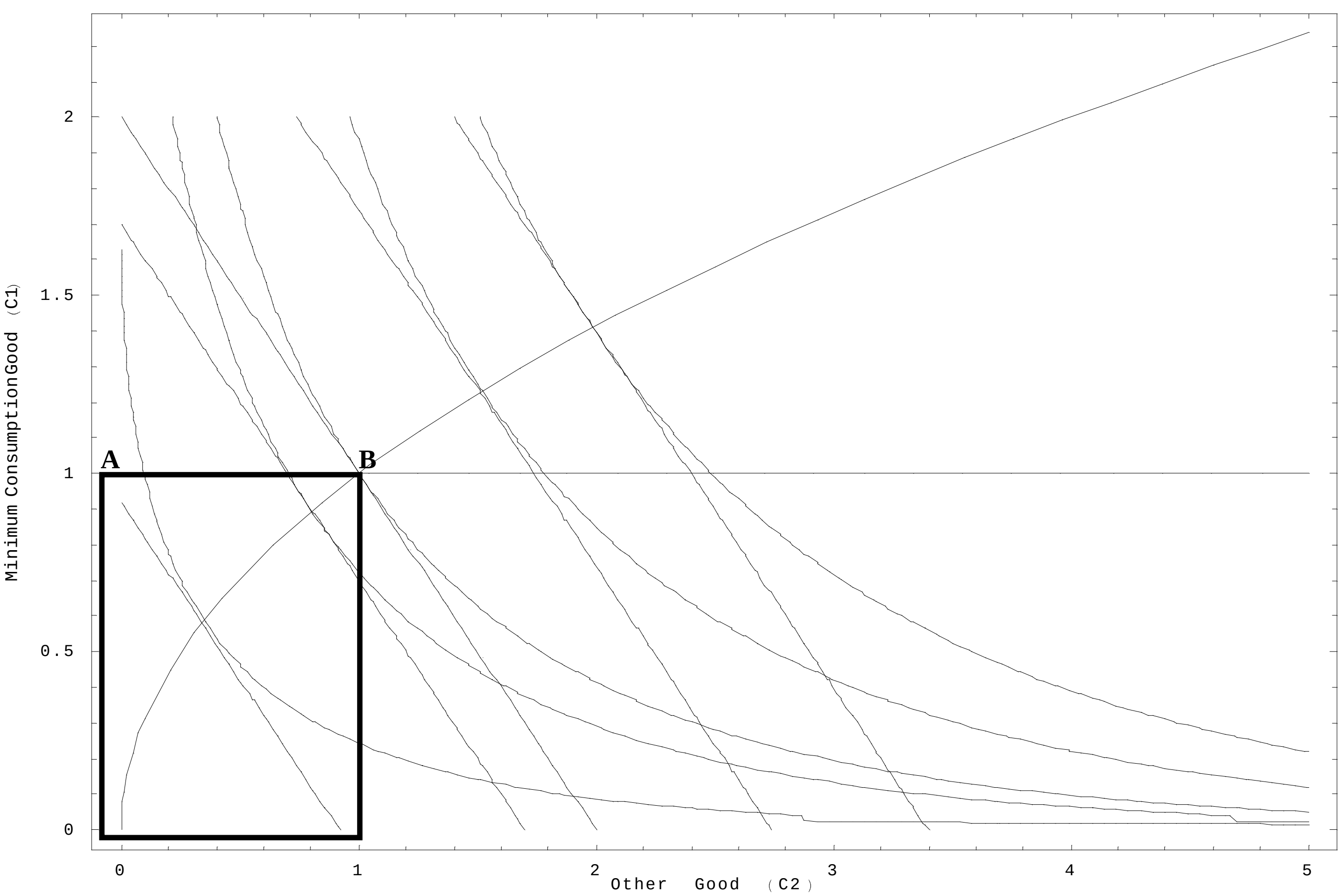


Figure 3: “Effective” Discount Rate (ß=.97)

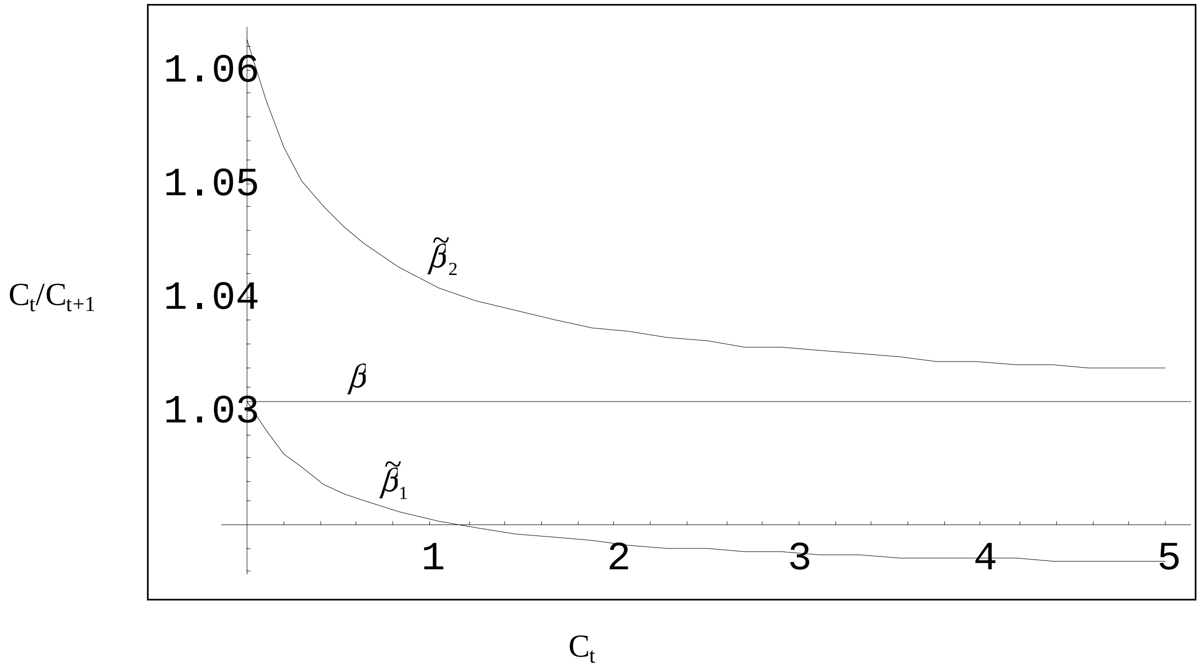


Figure 4 Phase Diagram for Ramsey Model

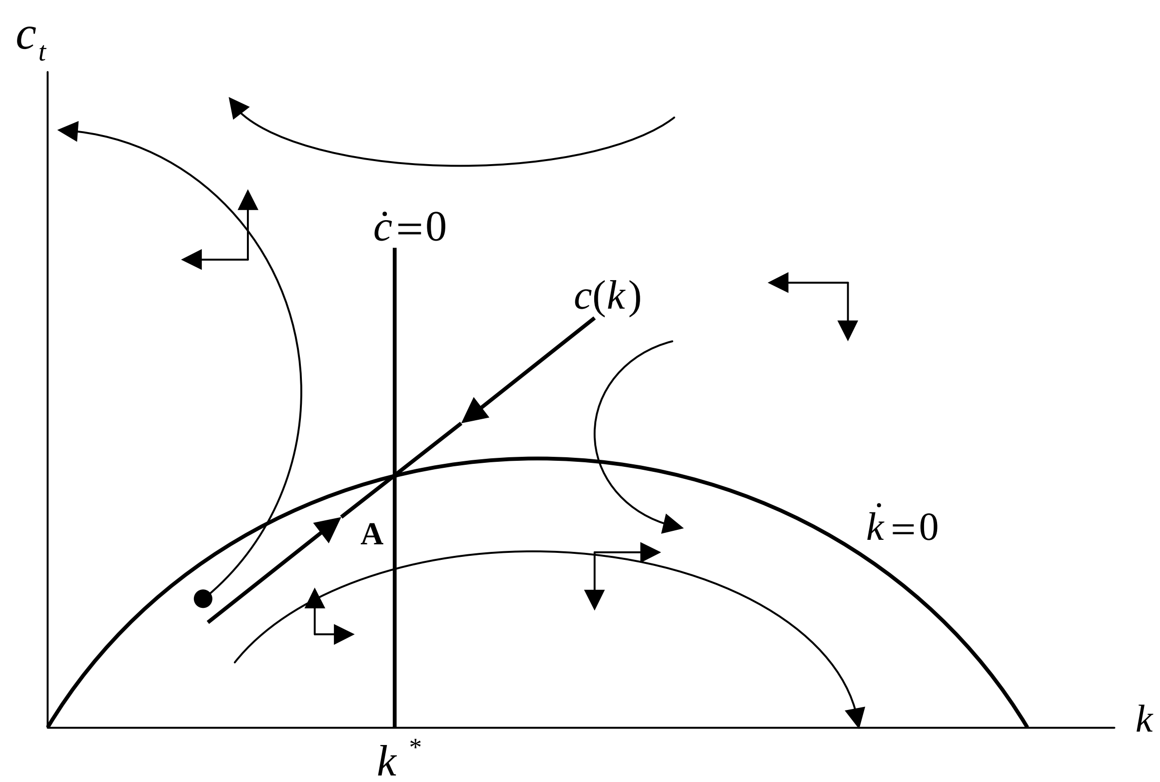
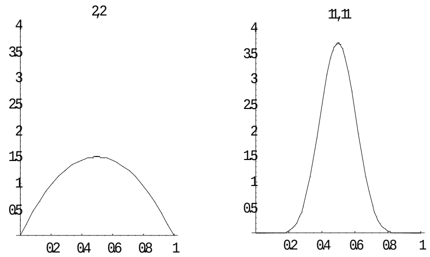
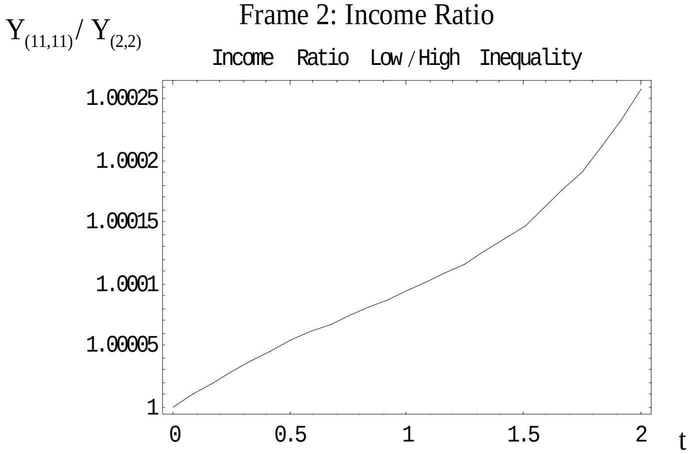


Figure 5 Short run dynamics of the Ramsey model simulation

Frame 1: Income distributions



Frame 2: Income Ratio



Frame 3: Consumption Ratio

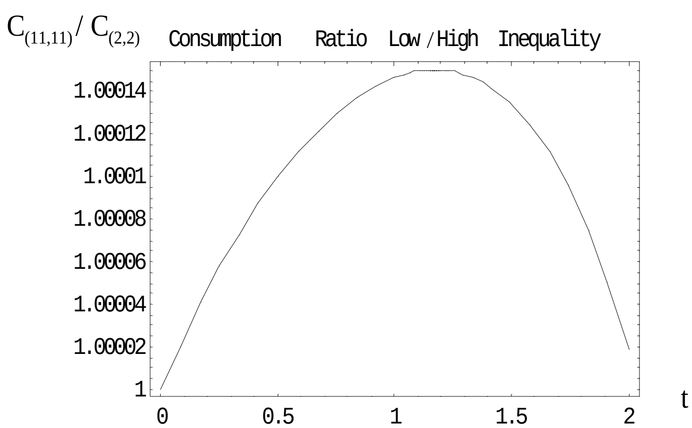


Figure 6 Growth and Inequality

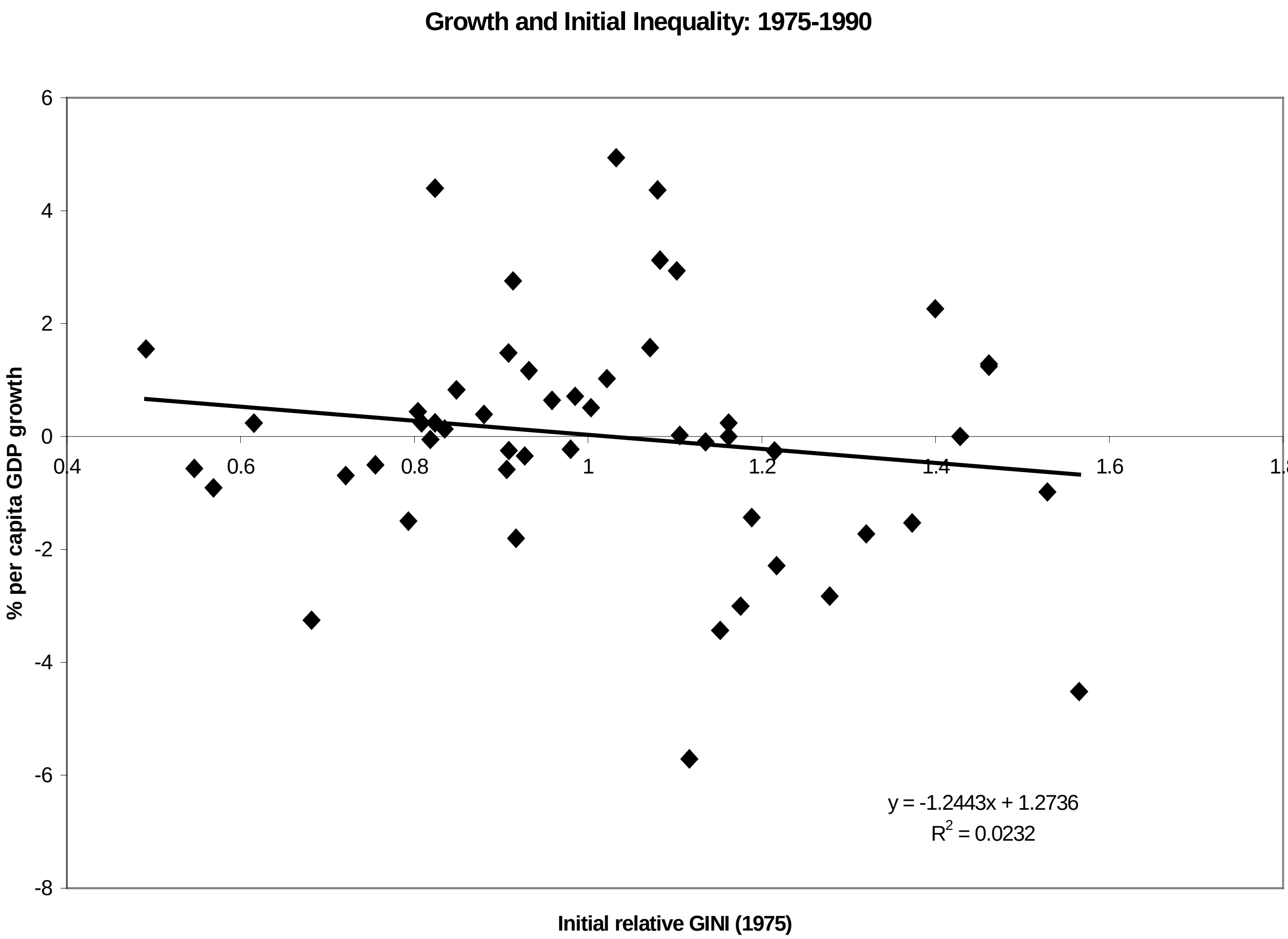


Table 1: Per capita GDP (1985 $) and inequality by region: annual averages

AFRICA (11 countries)					
	YEAR	GDP (1985 USD)	GINI	Quintile 1	Quintile 5
	1960	1113	54	0.030	0.647
	1965	1310	44	0.064	0.572
	1970	1435	53	NA	NA
	1975	1894	47	0.038	0.635
	1980	2012	51	0.050	0.531
	1985	2004	43	0.054	0.495
	1990	2301	42	0.059	0.489
ASIA (16 countries)					
	YEAR	GDP (1985 USD)	GINI	Quintile 1	Quintile 5
	1960	1340	37	0.069	0.463
	1965	1670	37	0.064	0.452
	1970	2235	38	0.064	0.460
	1975	2770	37	0.062	0.458
	1980	3439	37	0.067	0.440
	1985	4055	38	0.068	0.456
	1990	5115	37	0.070	0.452
EUROPE (19 countries)					
	YEAR	GDP (1985 USD)	GINI	Quintile 1	Quintile 5
	1960	4686	36	0.059	0.416
	1965	5790	32	0.084	0.370
	1970	6677	30	0.080	0.381
	1975	7767	31	0.077	0.380
	1980	8579	29	0.078	0.378
	1985	9139	29	0.081	0.374
	1990	10383	30	0.076	0.380

Table 1 (cont'd): Income and inequality by region: annual averages

LATIN AMERICA (6 countries)					
	YEAR	GDP (1985 USD)	GINI	Quintile 1	Quintile 5
	1960	2643	53	0.032	0.599
	1965	3287	62	0.022	0.680
	1970	3294	52	0.043	0.574
	1975	3387	48	0.041	0.545
	1980	3768	51	0.043	0.567
	1985	3547	50	0.046	0.550
	1990	3656	54	0.036	0.591
NORTH AMERICA (13 countries)					
	YEAR	GDP (1985 USD)	GINI	Quintile 1	Quintile 5
	1960	3290	47	0.052	0.478
	1965	3916	44	0.052	0.514
	1970	4532	46	0.034	0.519
	1975	5124	45	0.041	0.515
	1980	6376	44	0.043	0.484
	1985	6409	44	0.048	0.475
	1990	5931	46	0.041	0.513
OCEANIA (2 countries)					
	YEAR	GDP (1985 USD)	GINI	Quintile 1	Quintile 5
	1960	7871	NA	NA	NA
	1965	8927	NA	NA	NA
	1970	10074	31	0.069	0.380
	1975	11016	32	0.062	0.377
	1980	11441	37	0.053	0.424
	1985	12513	36	0.053	0.417
	1990	12979	40	0.046	0.456

Source:
- Deininger, Klaus and Lyn Squire (1996), "A New Data Set Measuring Income Inequality," World Bank Economic Review 10(3): 565-591.
- Summers, Robert and Alan Heston, Penn World Tables

Table 2: Results with quintile shares

Explanatory variable	Full sample without fixed effects	Full sample with fixed effects	Low income group	High income group
Intercept	0.198 (1.33)			
Lag(C) / Y	0.864[a] (24.27)	0.428 [a] (10.06)	0.379 [a] (4.75)	0.588 [a] (12.57)
Interest rate	-0.089 [b] (-2.22)	-0.055 [b] (-2.49)	-0.137 [b] (-2.54)	-0.006 (-0.32)
Quintile 1	-0.314 (-1.15)	-0.655 [a] (-2.78)	-0.326 (-0.32)	-0.573 [a] (-2.77)
Quintile 3	-0.152 (-0.367)	0.483 [b] (2.09)	2.042 [c] (1.92)	0.342 [c] (1.76)
Quintile 5	-0.122 (-0.74)	-0.129 (-1.16)	0.368 (0.81)	-0.175 (-1.64)
Adj. R^2	0.848	0.554	0.611	0.693
Observations	108	109	35	75

Notes: The dependent variable is consumption = C/Y. The t statistics are in parenthesis. The subscripts a, b, c indicate 1%, 5%, and 10% significance level.

Table 3: Regressions with the GINI coefficient

Explanatory variable	Full sample without fixed effects	Full sample with fixed effects	Low income group	High income group
Intercept	0.116[a] (4.81)		0.207 [a] (4.68)	0.063[b] (2.55)
Lag(C) / Y	0.857 [a] (23.86)	0.409 [a] (8.55)	0.801 [a] (11.19)	0.934 [a] (27.29)
Interest rate	-0.111 [a] (-2.74)	-0.085 [a] (-3.27)	-0.256 [a] (-2.99)	-0.021 (-0.59)
GINI	-0.0002 (-0.74)	-0.0003 (-0.69)	-0.001 [c] (-1.70)	-0.0002 (-0.75)
Adj. R^2	0.828	0.398	0.805	0.904
Observations	123	123	42	81

Notes: The dependent variable is consumption = C/Y. The t statistics are in parenthesis. The subscripts a, b, c indicate 1%, 5%, and 10% significance level.