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Household Saving Behavior and the Real Interest Rate: An Empirical Study

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Contents

1. Introduction

The real interest rate performs several important functions by which it influences economic decisions and affects the rate of growth of an economy. Foremost among these functions is the influence on how consumers allocate income between present and future consumption. Since intertemporal decisions can affect economic growth, there has been considerable research on the nature and importance of interest rate policies in developing countries. Still, disagreement remains on the effects of interest rates and interest rate policies on important macroeconomic variables. In particular, the relationship between the interest rate and one of these variables—the saving rate—has been debated more than others. The interest responsiveness of saving clearly is a parameter of crucial importance in macroeconomics. It is central to a host of questions ranging from the effectiveness of monetary policy to the impact of changes in government spending. If interest rates do affect saving decisions of households, then there is a direct link between both monetary and fiscal policy and economic performance.

For developing countries, the issue of the interest rate responsiveness of saving is particularly relevant. This stems from the debate over financial liberalization policies, which aim to achieve higher rates of saving, investment, and growth. Proponents of such policies argue that raising the real interest rate is one way to stimulate saving and thus provide the resources for growth. In fact, these recommendations have been a matter of policy practice in several developing countries, even though the evidence on the success of such policies is mixed. Clearly, the argument in favor of financial liberalization is based on the assumption that households respond to a rise in real interest rates by

deferring their consumption and increasing their saving. If such policies fail to have the desired effect on saving rates, there would be reason to believe that the interest responsiveness of saving is low.

A careful examination of the determinants of the interest responsiveness of household saving is necessary to better understand the consequences of financial liberalization programs. Such an exercise will also explain why the higher real interest rates that typically accompany financial liberalization have failed to elicit an appreciable rise in the household saving rates of many developing countries and why households in these countries have seemingly been unresponsive to real rates of return. While the evidence from the success and failure of financial liberalization programs would tend to indicate that there is at least some variation in the responsiveness of households to changes in real interest rates, there has, however, been very little investigation of the actual reasons for this variation. The lack of data that are both reliable and comparable across countries has perhaps been the primary constraint in performing such an investigation.

This paper tests several hypotheses about the responsiveness of household saving to the real interest rate. It tests how the interest responsiveness in a country depends on certain common macroeconomic and demographic variables. These include per-capita income, the income distribution, the pervasiveness of borrowing constraints, the degree of financial depth, and demographic characteristics. The rationale for considering these variables is provided in the context of a theoretical model of household saving behavior, which then leads to the estimation of a structural equation for household saving.

The approach used here differs from previous work in three important ways. First, much of the empirical work on saving in developing countries has resorted to data on aggregate saving due to the shortage of household data. Since most models of saving are based on decisions made by households, the use of aggregate saving data may provide misleading results on household behavior. Indeed, trends in household saving are often quite different from those in either gross saving or even private saving.[1] This can be seen in Appendix A, which displays the evolution of household saving and gross domestic saving ratios for 32 countries of varying income levels. By using panel data on household saving from the U.N. System of National Accounts, this paper is more likely to achieve an accurate estimation of the household saving function. Second, while individual studies have addressed one or two aspects of the relationship between the real interest rate and saving, none have accounted for several of the determinants of the interest responsiveness of saving. The framework developed here will make it possible to examine why this responsiveness may vary among countries. Third, while it is important to use a complete specification that relates the real interest rate to household saving, it is just as important to carefully consider the role of variables that affect household saving independent of the interest rate. In particular, durable goods expenditures have consistently been excluded from previous specifications, and this paper uses data from the OECD to determine its effects on household saving decisions.

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[1] The correlation between household saving ratios and gross domestic saving ratios in my sample is 0.271. As for the components of private saving, the relative sizes of household sector and corporate sector saving varies considerably between countries, with private saving being comprised primarily of household saving in some countries but corporate saving in others. See OECD (1994) for data on OECD countries.

Ultimately, the results indicate that across countries, the real interest rate does indeed have a non-linear effect on household saving. Demographic characteristics and income distribution prove to be the most important variables in determining household responsiveness to changes in real interest rates. By themselves, they also have a significant effect on household saving ratios of countries. Durable goods expenditures are also found to influence the household saving ratio, thereby confirming that the measure should really be thought of as a form of saving. This finding, combined with the evidence of non-linear effects of real interest rates, indicates that previous work on this important subject may have incorrectly specified the true determinants of household saving.

The rest of the paper is organized as follows. Section 2 offers an overview of the theory and policy practice associated with saving and the real interest rate and reviews the empirical literature on saving behavior, with an emphasis placed on the role of real interest rates. Section 3 presents a life-cycle overlapping-generations model of saving which is used to illustrate the links between the household saving ratio and a number of variables, including the real interest rate. Section 4 presents an empirical framework for examining household saving behavior, discusses the data set being used, and presents results. Section 5 offers some concluding remarks.

2. Saving and the Real Interest Rate: Theoretical and Empirical Literature

2.1. Theoretical Literature

Much of the discussion on saving and the real interest rate has taken place within the framework of the relationship between financial development and economic growth. Following on models developed by McKinnon (1973) and Shaw (1973), proponents of financial liberalization argue against financial "repression"—which is characterized by interest rates that are below market-clearing levels—and provide a rationale for financial liberalization as a means to promote saving and hence growth. As stated earlier, the solution offered by the authors—an increase in interest rates—has been implemented in many developing countries, often as part of the stabilization and adjustment programs sponsored by the IMF and World Bank. However, the higher interest rates have not always led to greater saving. Case study evidence on this issue is presented in studies by Gibson and Tsakalotos (1994) and Diaz-Alejandro (1985). Thus the debate over real interest rates and their effects on saving in developing countries is ultimately a debate over the McKinnon-Shaw hypothesis. For this reason, the theory underlying this hypothesis needs to be clearly stated, as it will facilitate the evaluation of empirical results.

The arguments made by McKinnon and Shaw are illustrated in Figure 1, in which saving is assumed to be an increasing function of the real interest rate. Financial repression is evident in the form of interest rate controls, with deposit rates held below their market-clearing (equilibrium) levels. In Figure 1, this is represented by a ceiling r_1 on real interest rates offered on deposits. At this rate, saving in the economy is equal to S_1, and investment, which is limited by the amount of saving, is also equal to S_1, despite investment demand of I_1. If the interest rate ceiling applies only to deposits, the loan rate

7

that would ration available saving is r_3. However, assuming that the ceiling applies to the loan rate as well, the average efficiency of the investment that does take place is lowered as a result of some investment with expected rates of return only slightly above r_1. The benefits of financial liberalization can be seen if institutional interest rates are raised so that the real interest rate is equal to r^*. Higher saving and investment (both equal to S^*) now takes place in the economy and additionally, the average efficiency of investment also rises. These factors combine to produce a higher rate of economic growth as well. The policy recommendation from the McKinnon-Shaw model is then fairly clear. Financial liberalizations that eliminate institutional interest rate ceilings will lead to increased saving and investment and therefore higher economic growth.
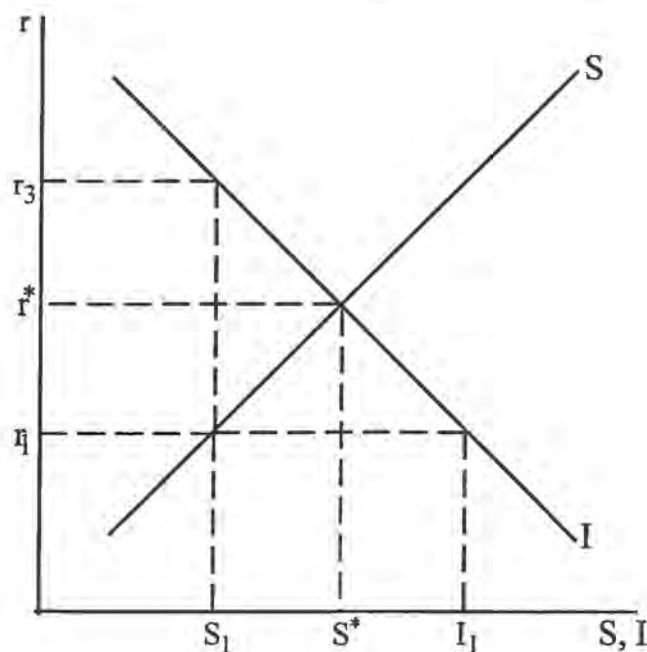

Figure 1:The McKinnon-Shaw hypothesis

While the McKinnon-Shaw hypothesis may provide a clear description of the mechanism by which financial development can foster economic growth, it is valid only

under the key assumption that household financial saving responds positively to the real interest rate. This issue is one that is addressed by standard models of household consumption. In general, most such models (including the one that is presented in Section 3) imply that households will tend to smooth consumption over time. Additionally, the models predict that the effect of real interest rates on household saving is ambiguous since it depends on the relative strength of the income and substitution effects. A higher real interest rate makes current consumption more costly than future consumption and thus leads to a substitution of future consumption for current consumption (the substitution effect). But higher real interest rates also make it possible to enjoy more future consumption without decreasing current consumption (the income effect). Thus the substitution effect of higher interest rates will cause household saving to increase, and the income effect will cause it to decrease. This means that the framework developed by McKinnon and Shaw is based on the assumption that the positive substitution effect dominates the negative income effect in developing countries. It also means that since the theory provides an ambiguous answer, it is necessary to empirically determine which effect dominates in order to know whether interest rates will necessarily have a positive effect on household saving.

2.2. Empirical Literature

The empirical literature on the interaction between saving and the real rate of interest in developing countries has produced very little consensus, and predictions are

almost as ambiguous as those made by the theory.[2] Generally, most studies have found that real interest rates have little or no effect on saving. However, the results often seem to depend on the particular data sets, sample choices, and specifications. Maxwell Fry has even gone so far as to say that "those investigators looking for interest sensitivity find it, while those expecting no influence find none."[3]

Empirical work can usually be placed in one of two categories: traditional savings studies and studies that investigate the intertemporal elasticity of substitution (IES) in consumption. Studies that take the traditional approach have estimated structural saving equations. In these studies, the saving rate (often the rate of national saving or private saving) is regressed on a set of variables that are chosen based on theories of household consumption. Typically, the real interest rate is included as one explanatory variable. Studies that employ the alternative approach estimate the IES directly. The IES is a parameter that describes household preferences and represents how easily households can substitute between future consumption and current consumption. If the IES is large then a given change in real interest rates induces a large shift in consumption (and therefore saving as well).

The Conventional Approach

Fry (1978) examines the validity of the McKinnon-Shaw hypothesis using data on seven Asian developing countries.[4] Using pooled cross section time-series data, he

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[2] A review of the literature is provided by Khatkhate (1988) and Arrieta (1988).

[3] Maxwell Fry, *Money, Interest, and Banking in Economic Development* (Baltimore: The Johns Hopkins University Press, 1995) p. 157.

[4] The sample countries are Burma, India, Korea, Malaysia, Philippines, Singapore, and Taiwan.

estimates the effects of several variables, one of which is the real deposit rate of interest, on domestic saving rates. He finds that the real deposit rate of interest has a positive and significant effect on domestic saving rates. Similarly, in another study Fry (1980) again finds that the real deposit rate of interest has a positive influence on saving rates, this time for a larger sample of developing countries. In both studies, a 1 percentage point rise in the real deposit rate of interest is predicted to raise the domestic saving rate by 0.1 to 0.2 percentage points. The author himself concedes that from a policy perspective, this effect is not highly significant.[5]

Using pooled cross section time-series analysis, Gupta (1987) estimates an aggregate real savings function for a sample of 22 Asian and Latin American developing countries. The nominal deposit rate of interest is found to have a positive influence on saving, but only for Asian developing countries. The effect of the expected inflation rate, however, is not negative, suggesting that support for the McKinnon-Shaw hypothesis is not very strong in Asia either. Still, the finding of different behavioral relationships for countries of similar income levels but different regions (Asia and Latin America) provides support for the hypothesis that the interest responsiveness of saving is not the same for all countries.

While the studies by Fry (1978, 1980) and Gupta (1987) are the prominent ones that find evidence of positive real interest rate effects on saving, other important studies have found saving behavior to be independent of the real interest rate. Giovannini (1983) reproduces Fry's (1978) equations using data on the same set of countries over a different sample period, but finds that the coefficient of the real interest rate is never significant.

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[5] Fry, 1995. p. 164.

Thus, results that Fry obtained using 1960s data cannot be reproduced in the 1970s. Moreover, Giovannini (1985) also finds that inclusion of two observations corresponding to the Korean financial reform period (in 1967 and 1968) explains why Fry found the coefficient of the real interest rate to be significant.

Regardless of the exact results obtained by both Fry and Giovannini, the use of aggregate saving data is problematic if it is household saving that we seek to understand. It is often rationalized that private saving is typically the predominant part of aggregate saving, but the results do nonetheless depend on changes in government saving (or dissaving).

Using data on private saving rates, Edwards (1995) also finds little empirical support for the hypothesis that real interest rates influence saving rates. He estimates a private saving function using pooled cross-country time-series observations for a sample of 36 countries, twenty five of which are developing countries. The coefficient on the real interest rate is negative and statistically insignificant, as is the coefficient on an interactive term between the real interest rate and real GDP per capita. The latter finding suggests that the degree of intertemporal substitutability in consumption does not increase with a country's income level, as suggested by Ogaki, Ostry, and Reinhart (1996, see below). While the use of private saving rates is an improvement over the use of aggregate saving rates, it too does not reflect the true behavior of households. In fact, as mentioned earlier, the relative proportions of corporate saving and household saving (which together form private saving) vary between countries, and it is not always the case that household saving is the larger component of private saving for any given country.

In one of few studies that analyze household saving behavior by actually using data on household saving, Schmidt-Hebbel, Webb, and Corsetti (1996) find that the real interest rate has a small, mostly negative, and insignificant influence on household saving rates. The 10 developing countries contained in their sample are also present in my sample of developing countries.[6] Using data from the U.N. System of National Accounts for the period between 1970 to 1985, Schmidt-Hebbel, Webb, and Corsetti are likely to have arrived at a more accurate representation of household saving. Yet one issue that their study (along with others previously mentioned) fails to address is the variation is the interest responsiveness of saving between countries. With the exception of Edwards (1995) all the studies mentioned above present one estimate for the coefficient of the real interest rate in the saving function. Although Edwards finds that the income level of a country does not have a significant effect on the coefficient of the real interest rate, the role of other variables have not been explored in this literature.

The Less Conventional Approach

Studies by Giovannini (1985) and Ostry, Ogaki, and Reinhart (1996) employ a method of testing the IES: the sensitivity of consumption growth with respect to the real interest rate. Giovannini (1985) finds that in only 5 of the 18 countries in his sample is the estimate of the IES significantly different from zero; the hypothesis of a high IES in consumption is rejected in 13 of the 18 countries.

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[6] The sample countries are Botswana, Colombia, Ecuador, Honduras, Republic of Korea, Philippines, Paraguay, Thailand, South Africa, and Taiwan.

Ogaki, Ostry, and Reinhart (1996) are the first to empirically investigate the relationship between the IES and the level of a country's income. The authors reason that the interest sensitivity of private saving will be close to zero in low-income countries, where a large proportion of households are likely to be living at the subsistence consumption level. For low-income countries, a large proportion of households are likely to be living at the subsistence consumption level, therefore, a weak responsiveness of saving to the real interest rates is expected. As a country's income rises, subsistence considerations decrease in importance, and households are expected to be more responsive to changes in expected rates of return. Using data from a sample of 13 developing countries with diverse income levels[7], the magnitude of the IES is found to be an increasing function of income. In low-income countries, the IES (and hence the interest responsiveness of private saving) is close to zero and there is a marked rise in the IES in lower-middle income-countries. Specifically, point estimates of the IES range from a low value of about 0.05 for Uganda and Ethiopia to a high of about 0.64 for several high-income countries.

The degree of borrowing constraints is another influential factor that has been discussed and empirically investigated in this literature. While several traditional studies of saving, including those by Schmidt-Hebbel, Webb, and Corsetti (1992) and Jappelli and Pagano (1994), have shown that the availability of credit has strong effects on saving rates, few have examined the implications for the interest rate elasticity of saving. Individuals facing borrowing constraints are restricted in their ability to substitute

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[7] The sample countries are Brazil, Colombia, Costa Rica, Cote d'Ivoire, Egypt, Ghana, India, Korea, Mexico, Morocco, Pakistan, Philippines, and Sri Lanka.

consumption intertemporally, and therefore might be less responsive to changes in the real interest rate. Studies by Rossi (1988) and Patterson and Pesaran (1994) claim that since liquidity constrained individuals are unlikely to follow the life cycle hypothesis (that is, they are unable to smooth consumption at all times), a more realistic consumption/saving function needs to be specified. By developing models that include individuals facing borrowing constraints, Rossi and Patterson-Pesaran are able to arrive at what might be considered more accurate estimates for the IES. Both studies involve estimation of an equation where the change in consumption is a function of the real interest rate as well as a proxy for borrowing constraints. Since the assumption is that changes in real income, not real interest rates, determine the consumption (and saving) path of consumers facing borrowing constraints, Rossi's empirical framework contains the term $E_t(z_{t+1}-c_t)$ as a proxy, where Z_t is real disposable income and C_t is consumption in time period t. A similar approach is taken by Patterson and Pesaran. The use of appropriate proxies for borrowing constraints is still debated in the literature, and this issue will be addressed in greater detail in Section 5. Rossi finds that for a sample of 49 developing countries, intertemporal substitution is weaker where borrowing constraints are substantial, while Patterson and Pesaran find that for the United States and the United Kingdom, the estimate of the IES falls as the fraction of the population that faces borrowing constraints rises. Thus, both results suggest that availability of credit is an important consideration when assessing the sensitivity of saving to changes in real interest rates.

In summary, although much of the empirical research on saving behavior in developing countries has found the role of real interest rates to be insignificant, there

remain a few studies that find a positive interest responsiveness of saving. More importantly, little effort has been made to explain cross-country variations in the way saving responds to real rates of return. The studies by Ogaki, Ostry, and Reinhart (1996), Rossi (1988) and Patterson and Pesaran (1992) have shown that the level of development and the presence of borrowing constraints matter, but the role of other variables have yet to be tested.

3. An Overlapping-Generations Model of Household Saving

To understand how aggregate household saving in an economy is determined, it is vital to examine the choices by individuals about their consumption and saving. Saving is defined as a sacrifice of current consumption for future consumption, and is inherently an intertemporal process. In other words, by saving some income, individuals lower their consumption level today but increase their consumption level tomorrow. Thus, any model of rational decision-making by savers must consider the trade-offs involved in making such a sacrifice. For this reason, I use an overlapping-generations model in which individuals live for three periods and make intertemporal decisions regarding consumption and saving. In the context of such a model, it becomes possible to illustrate the effects of several key variables such as income, demographics, real interest rates, and borrowing constraints. Section 3.1 begins with a simple model in which individuals are assumed to be unconstrained in their ability of borrow, while Section 3.2 makes the more realistic assumption that they are constrained.

3.1 A Model Without Borrowing Constraints

Building upon the model presented by Jappelli and Pagano (1994), I assume that individual preferences are defined over consumption in three periods. Individuals earn labor income in both their second and third periods of life. But, due to decreased productivity or retirement, labor income of third-period workers is a fraction ψ of the labor income of second-period workers. This differs from Jappelli and Pagano's assumption that individuals earn labor income in only their second period of life, and is intended to account for the possibility that a higher life expectancy may translate to a longer average working life, which in turn would have implications for saving behavior.[8]

Regardless of the assumption that individuals do or do not earn labor income in their third period, there is clearly an incentive for intergenerational borrowing in this model. Young individuals borrow against their future income to finance current consumption. Middle-aged individuals repay first period loans and save to meet consumption needs in the third period of their lives. Finally, old individuals consume both savings from the second period of their lives and current labor income. For simplicity, it is assumed that individuals leave no bequests.[9]

The representative utility function is of the form

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[8] If higher life expectancies also correspond to longer working lives for individuals, then individuals have fewer incentives to save in the second period of their lives. For further discussion of the likely effects of life-expectancy on saving, see Russett and Slemrod (1993).

[9] The bequest motive provides another reason for saving. A theoretical discussion is found in Gersovitz (1988). Primarily because the data are difficult to obtain, there are no empirical studies of saving which consider bequest behavior. One possibility is that bequests are a relatively more important phenomenon in larger households. This is examined in the empirical model contained in Section 4.

(1) $u = u(c_{i,t}, c_{i,t+1}, c_{i,t+2})$

where c denotes consumption and the first and second subscripts indicate the generation and the timing of the consumption. The exact utility function is a constant elasticity of substitution (CES) utility function as used by Ostry and Reinhart (1992) and is given by

(2) $u(c_{i,t}, c_{i,t+1}, c_{i,t+2}) = \left[(c_{i,t})^{1-\frac{1}{\sigma}} + \beta(c_{i,t+1})^{1-\frac{1}{\sigma}} + \beta^2(c_{i,t+2})^{1-\frac{1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}};$ $0 < \beta < 1, \sigma > 0.$

β is the subjective discount factor and σ is the intertemporal elasticity of substitution. Although the CES utility function used by Ostry and Reinhart was for a model which assumed that individuals live for two periods, it is easily extended to three periods. This representation of individuals' preferences is chosen over the one assumed by Jappelli and Pagano primarily because it allows for the presence of income and substitution effects of changes in real interest rates, which the latter does not.

Consumption in the three periods of an individual of generation t can be written as

(3)
$c_{i,t} = b_t$
$c_{i,t+1} = y_{t+1} - R_{t+1}b_t - S_{t+1}$
$c_{i,t+2} = \psi y_{t+2} + R_{t+2}S_{t+1}$

where y_{t+1} is labor earnings at time t, b_t is the amount borrowed at time t, S_{t+1} is the amount saved at time $t+1$, R_{t+1} is the real interest factor between time t and $t+1$, and ψ is the fraction of labor earnings at time $t+2$ that generation t can expect to earn. The utility function in equation (2) can be rewritten as

(4) $u(c_{i,t}, c_{i,t+1}, c_{i,t+2}) = \left[(b_t)^{1-\frac{1}{\sigma}} + \beta(y_{t+1} - R_{t+1}b_t - S_{t+1})^{1-\frac{1}{\sigma}} + \beta^2(\psi y_{t+2} + R_{t+2}S_{t+1})^{1-\frac{1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}.$

Subject to the budget constraints in equation (3), individuals seek to maximize utility by choosing to borrow an amount b_t and save an amount S_{t+1}. The optimization problem is therefore to

$$(5) \quad \max_{b_t, S_{t+1}} u = \left[(b_t)^{1-\frac{1}{\sigma}} + \beta(y_{t+1} - R_{t+1}b_t - S_{t+1})^{1-\frac{1}{\sigma}} + \beta^2(\psi y_{t+2} + R_{t+2}S_{t+1})^{1-\frac{1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}.$$

Using the first-order conditions for maximizing utility, the following expressions for optimal borrowing and saving are obtained:

$$(6) \quad b_t^* = \frac{R_{t+2}y_{t+1} + \psi y_{t+2}}{(\lambda_{t+1}\lambda_{t+2}) + R_{t+2}(\lambda_{t+1} + R_{t+1})},$$

$$(7) \quad S_{t+1}^* = \frac{(\lambda_{t+1}\lambda_{t+2})y_{t+1} - (\lambda_{t+1} + R_{t+1})\psi y_{t+2}}{(\lambda_{t+1}\lambda_{t+2}) + R_{t+2}(\lambda_{t+1} + R_{t+1})}$$

where $\lambda_{t+1} = (\beta R_{t+1})^\sigma$ and $\lambda_{t+2} = (\beta R_{t+2})^\sigma$. For an economy with N_t individuals in generation t, aggregate household saving at time t, represented by A_t, is then

$$(8) \quad A_t = N_{t-1}S_t^* - N_t b_t^*,$$

and the aggregate household saving rate at time t is simply aggregate saving divided by the labor income of those who work at time t, namely generations $t-1$ and $t-2$. In terms of notation being used here, it is

$$(9) \quad \frac{A_t}{N_{t-1}y_t + N_{t-2}\psi y_t}.$$

Substituting equations (6)-(8) into equation (9), we get that the aggregate household saving rate is given by

$$(10) \quad \frac{A_t}{N_{t-1}y_t + N_{t-2}\psi y_t} = \frac{N_{t-1}}{N_{t-1} + \psi N_{t-2}} \left[\frac{(\lambda_t \lambda_{t+1}) - (\lambda_t + R_t)\psi\left(\frac{y_{t+1}}{y_t}\right)}{(\lambda_t \lambda_{t+1}) + R_{t+1}(\lambda_t + R_t)} \right]$$

$$- \frac{N_t}{N_{t-1} + \psi N_{t-2}} \left[\frac{R_{t+2}\left(\frac{y_{t+1}}{y_t}\right) + \psi\left(\frac{y_{t+2}}{y_t}\right)}{(\lambda_{t+1} \lambda_{t+2}) + R_{t+2}(\lambda_{t+1} + R_{t+1})} \right].$$

Even though the model above is relatively simple, it still addresses important issues of household saving:

The household saving rate depends negatively on expected growth rates of labor income $\frac{y_{t+1}}{y_t}$ and $\frac{y_{t+2}}{y_t}$. With current income being held constant, an increase in future income will increase current consumption and hence lower current saving. Thus, an increase in future income, with all else being constant, will result in a lower saving rate. Saving acts as a consumption smoothing device. Furthermore, equation (10) shows that the saving rate depends on current labor income y_t only to the extent that changes in the latter variable alter expected growth rates of labor income.

From equation (10), it is clear that demographic variables matter. The size of the cohort of young (N_t) has a negative influence on the household saving rate since young individuals always choose to borrow (thereby dissaving). The size of the cohort of old (N_{t-2}) has a negative influence on the household saving rate since old individuals earn labor income but do not save. The effect on the household saving rate of the size of the middle-aged cohort (N_{t-1}) is most likely positive, but could be negative if ψ is sufficiently

large. In other words, the middle-aged will have a positive impact on the household saving rate since they save for future consumption. This may not be true if (in the unlikely case) they expect to very productive (large ψ) in the third-period of their lives, in which case there is less incentive to save for retirement years. If we think of ψ as being a parameter that is closely related to the average life expectancy (with high values of ψ for countries that have high average life-expectancies), then the model predicts that the average life-expectancy will exert a negative influence on the household saving rate.

The household saving rate depends positively on the size of the parameters β and σ. β, the subjective discount factor, has a positive impact on saving since individuals for whom the relative value of future consumption to current consumption is higher will be higher savers. The intertemporal elasticity of substitution (IES) in consumption, σ, represents how easily individuals can substitute future consumption for current consumption. An increase in this parameter has the effect of making it easier to save more.

The theoretical effect on saving of changes in real rates of return is ambiguous, as equation (10) confirms. As was stated in Section 2, it is often noted that due to the presence of income and substitution effects, which work in opposite directions, real interest rates could have almost *any* effect on saving. When the real interest rate rises, future consumption becomes cheaper relative to current consumption, giving rise to a substitution effect. Yet the same rise in real interest rates makes it possible for individuals to enjoy higher future consumption without lowering current consumption, giving rise to an income effect. Since the former effect acts to increase current saving

21

while the latter acts to decrease current saving, it is claimed that the two effects may offset each other in developing countries, thus explaining the low interest-rate responsiveness that is often detected.

Simulations of equation (10) suggested that the income and substitution effects depend critically on the size of the parameters σ and β. These two parameters determine whether or not a change in expected real interest rates is likely to have an effect (either positive or negative) on the household saving rate. σ has a positive effect on the interest elasticity of saving, confirming the well known fact that larger values of the IES imply greater responsiveness of saving to changes in the real interest rate. The effect of β is opposite to that of σ, as the interest elasticity of saving is lower for larger values of β. With their given definitions, the two parameters can be thought of as representing the substitution and income effects. The strength of the former is determined by σ, while the strength of the latter is determined by β.

3.2 A Model With Borrowing Constraints

Borrowing constraints have been shown in several studies to be an important determinant of saving rates, both theoretically and empirically.[10] However, as stated earlier, the importance of such constraints in determining the interest-rate elasticity of household saving rates has been overlooked. In order to formally investigate this

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[10] A theoretical model can be found in Jappelli and Pagano (1994). Others, such as Callen and Thimann (1997), Edwards (1995), Jappelli and Pagano (1994), and Schmidt-Hebbel, Webb, and Corsetti (1992) find empirical evidence for the positive impact of borrowing constraints on saving rates.

relationship, the theoretical model in Section 3.2 is modified in such a way as to allow for the presence of borrowing constraints.

Individual preferences are still given by the utility function in equation (2), namely

$$(11) \quad u(c_{t,t}, c_{t,t+1}, c_{t,t+2}) = \left[(c_{t,t})^{1-\frac{1}{\sigma}} + \beta(c_{t,t+1})^{1-\frac{1}{\sigma}} + \beta^2(c_{t,t+2})^{1-\frac{1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}; \quad 0<\beta<1, \sigma>0.$$

However, the young cannot borrow (and thus consume) the desired amount b_t. Instead, they can borrow no more than a fraction ϕ of the present value of their lifetime income. Individuals then maximize utility subject to the added constraint

$$(12) \quad c_{t,t} = \overline{b}_t \le \phi \left[\frac{y_{t+1}}{R_{t+1}} + \frac{\psi y_{t+2}}{R_{t+1} R_{t+2}} \right].$$

With the binding constraint in equation (12), the optimal saving of adults $\overline{S}_{t+1}$ is also chosen differently. Using the first order conditions, it is given by

$$(13) \quad \overline{S}_{t+1} = \left[\frac{\lambda_{t+2} R_{t+2} y_{t+1}(1-\phi) - \psi y_{t+2}(\phi \lambda_{t+2} + R_{t+2})}{R_{t+2}(\lambda_{t+2} + R_{t+2})} \right],$$

and aggregate household saving $\overline{A}$ is

$$(14) \quad \overline{A}_t = N_{t-1} \overline{S}_t - N_t \overline{b}_t.$$

The household saving ratio can then be written as

$$(15) \quad \frac{\bar{A}_t}{N_{t-1}y_t + N_{t-2}\psi y_t} = \frac{N_{t-1}}{N_{t-1} + \psi N_{t-2}} \left[\frac{\lambda_{t+1}R_{t+1}(1-\phi) - (\phi\lambda_{t+1} + R_{t+1})\psi\left(\frac{y_{t+1}}{y_t}\right)}{R_{t+1}(\lambda_{t+1} + R_{t+1})} \right]$$

$$- \frac{N_t}{N_{t-1} + \psi N_{t-2}} \left[\frac{\phi}{R_{t+1}}\left(\left(\frac{y_{t+1}}{y_t}\right) + \frac{\psi}{R_{t+2}}\left(\frac{y_{t+2}}{y_t}\right)\right) \right].$$

Equation (15), which represents the binding case where $\bar{b} < b^*$, shows that a tighter borrowing constraint (smaller ϕ) not only decreases the amount that the young borrow, but also increases the amount that the middle-aged save. Simply, the middle-aged have fewer loans to repay if they were kept from borrowing while young. Thus, the household saving rate is higher when borrowing constraints on the young are more severe.

To better illustrate the effects of borrowing constraints on the saving rate, Figure 2 describes an economy in which aggregate household saving is determined by the saving of the middle-aged (represented by the saving function S_t) and the borrowing, or dissaving, of the young (represented by $-b_t$). Higher real interest rates, R_{t+1}, lead the young to borrow less, as is indicated by $-b_t$. Depending on the relative sizes of the income and substitution effects, the middle-aged will either increase or decrease their saving when real interest rates change. S_t captures the fact (based on the simulations) that the substitution effect dominates the income effect when real interest rates are low, and that the reverse is true when real interest rates are high. In the unconstrained case where individuals in generation t may borrow optimally, aggregate household saving (represented by A_t) is simply the sum of $-b_t$ and S_t. However, if a constraint such as that

24

Figure 2 : The effects of borrowing constraints on saving
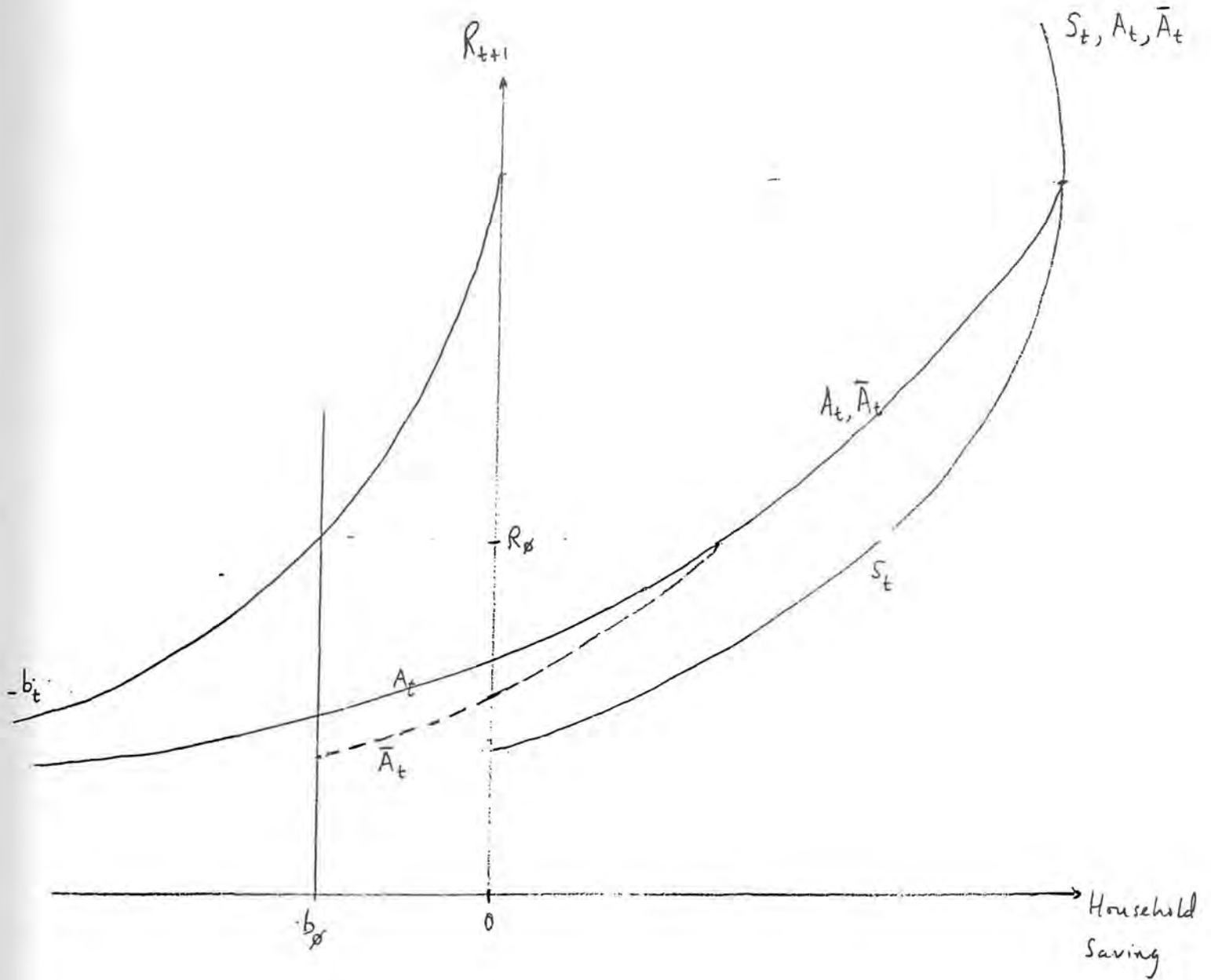
$$\overline{A}_t > A_t \qquad \text{for } R_{t+1} < R_\emptyset$$

$$\frac{\partial \overline{A}}{\partial R_{t+1}} < \frac{\partial A}{\partial R_{t+1}} \qquad \text{for } R_{t+1} < R_\emptyset$$

described by equation (12) is introduced, borrowing by the young cannot exceed $\bar{b}_\phi$ and

the aggregate household saving function is described by $\overline{A_t}$. Clearly, in comparison to

A_t, $\overline{A_t}$ is greater at all real interest rates up to R_ϕ, indicating that the existence of

borrowing constraints indeed leads to higher aggregate household saving. This is to be

expected: restrictions that prevent individuals from dissaving more than a certain amount

will result in aggregate household saving being higher than it would otherwise be at every

interest rate for which the restrictions are binding.

Similar to the discussion of Section 3.1, we find here that demographic variables

remain important, although the size of the cohort of young has a less negative impact on

the saving rate in the constrained case (small ϕ) than in the unconstrained case (ϕ closer

to 1). Also, the household saving rate in equation (15) still depends on expected growth

rates in labor income rather than current income alone.

The role of real interest rates might be different under the new set of assumptions.

I use Figure 2 again to show why real interest rates might affect saving in a manner

different from that discussed in the unconstrained scenario of Section 3.1. Aggregate

household saving in the unconstrained case is represented by A_t. With a borrowing

constraint denoted by $\bar{b}_\phi$, aggregate household saving is described by $\overline{A_t}$. Comparing

the two functions A_t and $\overline{A_t}$, it is evident that for all real rates up to R_ϕ, the interest-rate

elasticity of saving is actually lower for $\overline{A_t}$ than for A_t. This indicates that as borrowing

constraints are tightened, there should be a lowered responsiveness of household saving

to changes in real interest rates: a result of the fact that the young are not able to respond

to interest rates by altering the amounts they borrow. Thus, there are good reasons to

believe that not only the household saving rate, but also the interest-rate elasticity of the household saving rate is influenced by the presence (or lack thereof) of borrowing constraints.

4. Evidence on the Interest Responsiveness of Household Saving

While much can be learned from the theoretical model presented in Section 3, the determinants of saving and, more importantly, its responsiveness to changes in real interest rates must be evaluated empirically. Section 4.1 discusses the framework that is used to do this, Section 4.2 describes the data set, and Section 4.3 presents the main empirical results that were obtained.

Prior to discussing the empirical work, it is useful to examine the dependent variable, the household saving ratio, more closely. As Table 1 highlights, average household saving ratios for the lower middle-income countries in my sample were about 2 percentage points below those of the high-income countries in the 1970s. In the period 1980-92, however, the two groups of countries had more similar average household saving ratios. Moreover, the averages for the four upper middle-income countries in the sample were the highest among all income groups in both periods, though this is partly explained by the unusually high observations for Greece and Portugal. Clearly, Table 1 does not provide strong support for previous findings that countries of

higher income levels tend to have higher saving ratios.[11] It should be noted here that in comparison to the sample in Ogaki, Ostry, and Reinhart (1996), the low-income and lower middle-income countries in my sample seem to be the ones with above-average private saving ratios, partly explaining why Table 1 is not very consistent with previous cross-country comparisons. Figures in the Appendix A show how household saving ratios and gross national saving ratios have evolved over time for each of the 32 countries in my sample. Several important facts emerge from here as well. As claimed in Section 2, household saving ratios and national saving ratios do not always move together, indicating that the choice of a particular ratio is an important consideration in being able to properly represent household saving. Also, the stability of household saving ratios over time varies considerably from country to country, with developing countries displaying far greater variation than industrial countries.

4.1 Empirical Framework

To test for the factors that have an effect on the interest rate sensitivity of household saving, a behavioral function for household saving is estimated. In most cases, the life-cycle overlapping generations approach that was presented in Section 3 can provide a rationale for the inclusion of the variables that were ultimately used in the empirical estimations. That is, the main results of Section 3, which were given by equations (10) and (15), are useful in deciding which variables should be used to represent a behavioral function for household saving. However, to the extent that the

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[11] See Ogaki, Ostry, and Reinhart (1996). Table 1 is consistent with the theoretical model of Section 3: household saving ratios should depend on expected growth rates of income and not current income y_t.

Table 1: *Household Saving Rates and GDP per capita for Selected Countries*

Country	GDP per capita in 1987 $		Household saving as percentage of disposable income	
	1970-79 average	1980-93	1970-79 average	1980-93
Low-income countries				
India	248.7	325.9	11.89	13.28
Sri Lanka		396.8		1.47
Average	**248.7**	**361.4**	**11.89**	**7.40**
Lower middle-income countries				
Botswana	664.6	1089.3	6.09	-0.38
Cameroon		1140.5		7.93
Colombia	892.1	1116.4	10.67	9.59
Congo	749.6	1144.0		0.35
Costa Rica	1592.2	1619.6	4.41	8.59
Ecuador	976.5	1192.2	12.13	9.65
Honduras	871.5	907.7	4.34	1.05
Jamaica	1559.1	1304.8	-2.09	-5.75
Mauritius		1780.0	15.46	7.89
Paraguay	739.1	1005.5	7.96	6.21
Peru		1062.3		18.53
Philippines	571.4	623.3	11.06	12.63
Thailand	572.9	1034.2	15.87	15.49
Zimbabwe		641.9		17.37
Average	**918.9**	**1118.7**	**8.59**	**7.80**
Upper middle-income countries				
Greece	3952.0	4705.2	18.46	18.77
Korea	1429.9	3122.8	9.63	14.36
Portugal	3201.2	3987.9	17.75	22.97
South Africa	2475.6	2429.8	9.64	3.50
Average	**2764.7**	**3561.4**	**13.87**	**14.90**
High-income countries				
Australia	10412.2	12374.0	14.27	7.71
Austria	12004.3	15679.7	9.12	9.96
Canada	11815.4	14872.9	9.51	11.27
Finland	12936.4	17206.3	4.40	3.70
France	12821.4	16071.1	12.86	8.38
Israel		8549.1		9.22
Italy	9749.6	13303.9	19.23	16.56
Japan	13930.6	20054.9	18.63	13.77
Spain	6190.0	7608.1	9.82	6.21
Sweden	15529.7	18536.9	3.47	1.51
United Kingdom	9369.4	11623.0	7.20	5.20
United States	15251.4	18256.2	8.70	7.82
Average	**11819.1**	**14511.3**	**10.66**	**8.37**

model of Section 3 is not exactly a "complete" one, some variables that cannot be "explained" by it are also included.[12]

The dependent variable is the ratio of household saving to household disposable income (HSAVERATIO), or the household saving ratio. A ratio is chosen over the absolute level of household saving primarily due to the lack of an adequate deflator that would enable one to calculate saving levels at constant prices. Moreover, the use of saving ratios makes cross-country comparisons easier since appropriate exchange rates need not be chosen.[13] The general saving function estimated includes the following explanatory variables, summary statistics for which are contained in Table 2:

RGDPGROWTH:	the rate of growth in real GDP per capita
MQMRATIO:	the amount of money and quasi-money as percentage of GDP
PRIVCREDIT:	the amount of credit extended to the private sector as percentage of GDP
LTVRATIO:	the maximum loan-to-value ratio for the purchase of a house
LESS15RATIO:	the percentage of population under age 15
PLUS65RATIO:	the percentage of population above age 65
AGEDEP:	the ratio of dependents—the population under age 15 and above age 65—to the working-age population—those aged 15-64
AGLABOR:	the percentage of the labor force in agriculture
LIFEEXP:	the average life expectancy in years
GINI:	the measure of income distribution, ranging from 0 for perfect equality to 100 for extreme inequality
REALR:	the domestic real interest rate
RGDPCAP:	real GDP per capita, in 1987 US dollars
RSTAR:	the foreign real interest rate
DURCONS:	consumption of durable goods as percentage of household disposable income

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[12] Durable goods consumption as a percentage of household disposable income (DURCONS) is perhaps the most prominent one.

[13] For further discussion of issues relating to the measurement of household saving over time and across countries, see Callen and Thimann (1997) and Schmidt-Hebbel, Webb, and Corsetti (1992). Specifically, since the household sector (as defined by the UN) includes unincorporated enterprises but excludes incorporated enterprises (some of which may be owned by households), the picture of household decision-making might be altered.

The discussion of the coefficient of RGDPGROWTH is complicated by the fact that the links between saving and growth are not clearly identified. As a start, the theoretical model in Section 3 predicts (as do most models of intertemporal decision-making) that growth in income will exert a negative influence on the saving ratio. Households with higher expected growth rates in income are likely to be low savers (they may even be dissavers), simply because they try to smooth consumption over time. Under this assumption, the coefficient of RGDPGROWTH is expected to be negative.

Table 2: *Summary statistics*

	Mean	Median	Std. Dev.	Maximum	Minimum
HSAVERATIO	9.71	9.5	6.61	27.22	-13.59
AGEDEP	0.67	0.61	0.17	1.11	0.43
AGLABOR	29.66	26.69	21.82	79.81	2.16
DURCONS	7.47	7.95	3.14	14.52	1.19
GINI	39.3	36.7	9.6	62.3	25.9
LESS15RATIO	31.6	30.9	9.9	50.5	15
LIFEEXP	68.3	70.7	7.6	79.7	46.6
LTVRATIO	68.9	75	16.3	95	30
MQMRATIO	45.1	42.1	21.5	110.8	8.6
PLUS65RATIO	7.9	6.2	4.7	17.9	1.7
PRIVCREDIT	52.0	43.6	34.4	208.6	3.6
REALR	-5.83	0.41	94.94	445.5	-1960.8
RGDPCAP	6608.8	2676.8	6527.2	23951.5	236.1
RGDPGROWTH	2.26	2.27	4.06	23.48	-14.58
RSTAR	-19.2	-0.52	271.83	22.94	-6161.13

Yet, several cross-country empirical studies, such as those by Collins (1989), Fry (1978, 1980), and Giovannini (1983), have found that the growth rate exerts a positive influence on saving ratios. The model of Collins may justify this finding. If growth is concentrated in households that tend to be higher savers, such as rich or middle-aged households, the average household saving will rise. Still, the positive coefficient may

simply result from the fact that the studies listed above used either national or private saving ratios as the dependent variable.

Serious estimation problems arise, however, if household saving is simultaneously determined with income growth, as is the case in models of endogenous growth. In a closed economy (or in a world with low capital mobility), investment is constrained by the amount of national saving. Since investment in the form of capital accumulation is considered to be a key determinant of growth, a cyclical relationship will exist between growth and saving. Under such a relationship RGDPGROWTH will correlated with the error term of the saving equation, and a simultaneity bias is introduced. To get consistent estimates, an instrumental variables approach to estimating saving behavior is necessitated.

As shown in Section 3.2, borrowing constraints should influence household saving behavior. However, since this variable is one that is difficult to measure, it is not easy to account for it empirically. Several studies of saving have resorted to the use of proxy variables. Perhaps the proxy that is most often employed is the ratio of money and quasi-money (MQM) to either disposable income or GDP. (see Edwards 1995; and Schmidt-Hebbel, Webb, and Corsetti 1992) It is reasoned that borrowing constraints are less likely to prevail in countries with larger financial sectors, the size of which is represented by the ratio of MQM to GDP. Since there are fewer incentives for saving as borrowing constraints become less severe, the coefficient of MQMRATIO should be negative. However, this measure has been found by some to be a poor proxy for

borrowing constraints, making the expected sign of the coefficient somewhat ambiguous.[14]

A second variable that might serve a proxy for borrowing constraints is the ratio of private sector credit to GDP. Since the household sector is one of the two components of the private sector (the other being the corporate sector), it may be the case that a low private sector credit-GDP ratio corresponds to severe borrowing constraints for households. Based on arguments that borrowing constraints affect saving positively, the coefficient of PRIVCREDIT should then be negative. However, this needs to be qualified on the basis of the study by Jappelli and Pagano (1994), who claim that there is "no necessary connection between the degree to which credit is available to firms and the degree to which it is available to households."[15] Using data on consumer credit for selected OECD countries, they find that total private sector credit is not very highly correlated with consumer credit. Thus, the implications for measuring financial repression are that no single measure might be ideal.

As a last attempt at capturing the effects of borrowing constraints, the maximum loan-to-value (LTV) ratio for the purchase of a house is used as an indicator of the availability of credit to households.[16] The data are not available for all 32 countries in my sample, but rather for 17 of the countries, most of them being OECD members. The maximum LTV ratio might be a better indicator of the availability of credit to households (hence the severity of borrowing constraints), particularly since it is highly correlated

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[14] In particular, Edwards (1995) reports a positive coefficient, and suggests that the ratio of MQM to GDP is not a good proxy for the nature of borrowing constraints.

[15] Tullio Jappelli and Marco Pagano, "Saving, Growth, and Liquidity Constraints," *Quarterly Journal of Economics* 109 (1) p. 94.

[16] Jappelli and Pagano (1994) use the measure for the same purpose.

with consumer credit in the OECD.[17] If indeed the LTV ratio is an appropriate indicator, its coefficient is expected to be negative; a higher LTV ratio would correspond to greater availability of credit and thereby fewer incentives for households to save.

Turning to the role of demographic variables, it was shown in Section 3 that the age distribution of a country's population affects the aggregate household saving ratio. In the context of the three period overlapping-generations model, younger cohorts will tend to be borrowers (i.e. dissavers), thereby depressing the aggregate household saving ratio. On these grounds, the coefficient of LESS15RATIO is expected to be negative. Also, LESS15RATIO serves as a proxy for the average size of households, data on which are difficult to acquire. Deaton (1990) provides a rationale for why this might be a variable of importance in understanding saving behavior. In countries where the average size of households is large, there is a greater tendency for individuals of several generations to live together, and intra-household lending and borrowing is more likely to take place. As a result, aggregate household saving will be lower, strengthening the hypothesis that the coefficient of LESS15RATIO should be negative.

Under the assumptions of the model in Section 3, the old-age dependency ratio (measured as the percentage of population above age 65) should have a negative influence on the household saving ratio, as the old-aged typically dissave by consuming out of their savings. The coefficient of PLUS65RATIO is also expected to be negative under the assumptions made by Deaton since the probability that transfers within households take place is greater when there are more of the elderly. From the discussion

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[17] See Jappelli and Pagano (1994).

above, it follows that the coefficient of the overall age dependency ratio (AGEDEP) is expected to be negative.

In addition to the demographic measures above, the percentage of the labor force involved in agriculture (AGLABOR) will be used as a proxy for average household sizes in countries. The assumption here is that rural households (those involved in agriculture) are larger and also have limited access to financial institutions, both of which make intra-household transfers more likely (and saving less likely). In this way, AGLABOR can also be thought of as an indicator of the inverse of financial depth.

The average life expectancy is another demographic variable that can exert an influence on the saving decisions of households. From the standpoint of intertemporal decision-making, expectations regarding the "number" of future periods for which consumption is necessary will alter the way in which individuals allocate income for consumption and saving. Specifically, longer life expectancies should correspond to higher saving by the working-age population at any given income level. From this perspective, the coefficient of LIFEEXP is expected to be positive. However, it could be that higher life expectancies also lead individuals to work (thereby earn income) for more years, in which case the coefficient of LIFEEXP will be negative. This is the prediction made by the overlapping generations model in Section 3. If we assume that the elderly earn a fraction of the wage income of the middle-aged, then the saving ratio is a declining function of that fraction. In other words, the more productive the elderly are (proxied by LIFEEXP), the smaller will be the saving ratio.

Although the issue of income distribution is one that the theoretical model in Section 3 does not address explicitly, there are reasons to believe that it is an important

35

determinant of saving.[18]   However, very little theoretical and empirical analysis has been conducted, the study by Cook (1995) being an exception. If we assume that low-income individuals save a smaller fraction of their income than do high-income individuals, then a redistribution of income from the former to the latter (that is, greater inequality, and a rise in GINI) will necessarily lead to an increase in the aggregate household saving rate. The assumption regarding the marginal propensities to save (MPS) of the two types of individuals can be explained by the theoretical model of Section 3 if low-income individuals face better growth prospects than high-income individuals. In this case, low-income individuals should indeed save a smaller fraction of their income than high-income individuals.   Another explanation that would provide support for the MPS assumption is based on subsistence considerations: low-income individuals typically live at the subsistence level of consumption, which restricts their ability to save. Thus, similar to what was found by Cook (1995), a positive coefficient for GINI is expected.

The responsiveness of household saving to financial incentives is the main issue that the empirical estimations try to address. The domestic real rate of return is the primary variable of interest. As stated earlier, theory does not offer any predictions as to whether the net effect of expected real interest rates on household saving should be either positive or negative. For this reason, the coefficient of REALR is undetermined a priori. However, there are many reasons to believe that this coefficient will vary across countries—either due to differences in income levels, differences in the severity of borrowing constraints, or differences in demographic characteristics. To test whether

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[18] A detailed discussion is found in Gersovitz (1988).

such differences influence the interest-rate responsiveness of household savings, several interactive terms with the real interest rate are considered.

The paper by Ogaki, Ostry, and Reinhart (1996) found evidence supporting the hypothesis that the intertemporal elasticity of substitution (IES) in consumption is an increasing function of a country's income level per capita. If so, the coefficient of the interactive term between the real interest rate and real GDP per capita (REALR*RGDPCAP) should be positive. This would indicate that in low-income countries, household decisions on consumption and saving are heavily influenced by subsistence considerations, thereby causing the relationship between real interest rates and saving ratios to be weak. The empirical evidence on the existence of such a relationship is by no means solid. Edwards (1995) was unable to find support for the claims made by Ostry, Ogaki, and Reinhart.

Borrowing constraints are the other main reason offered for cross-country differences in the interest-rate elasticity of saving. While the existence of constraints should raise the saving ratio, it should also lower the responsiveness of the saving ratio to changes in real interest rates. The latter is a proposition that has seldom been tested empirically. Rossi (1988) argues that individuals facing borrowing constraints will base saving decisions on changes in current income rather than changes in real interest rates. Moreover, as Figure 2 showed, the responsiveness ought to be lower for a very simple reason: borrowing constraints imply that some individuals are *entirely* unresponsive to changes in interest rates over a certain range.

Interactive terms such as REALR*LTVRATIO, REALR*MQMRATIO, and REALR*PRIVCREDIT are all designed to test the above set of hypotheses. The

coefficients of these terms should be positive if LTVRATIO, MQMRATIO, and PRIVCREDIT are indeed good proxies for borrowing constraints. However, interpretation problems for some of these variables, such as those mentioned earlier, make it hard to place a sign on the coefficients of the interactive terms a priori.

Terms such as REALR*LESS15RATIO, REALR*AGLABOR, and REALR*PLUS65RATIO are included to test for the role of factors such as intra-household sharing of resources. According to this hypothesis, countries in which intra-household transfers predominate should exhibit a low interest-rate responsiveness of saving, largely because the financial sector (and hence the real interest rate) is likely to be irrelevant to much of the population. Moreover, based on the theoretical model of Section 3, which assumes that the elderly do not save, there is added reason to believe that the old-age dependency ratio should have exert a negative influence on the interest-rate responsiveness of saving.

The foreign real rate of return (RSTAR) is a variable that has seldom been included in empirical models. The rationale for including it is that it may serve as an additional interest rate to which households making saving decisions may respond. Given the measure of household saving that is used (specifically, it is any income that is not used for consumption) the coefficient of this variable should be positive if saving rises when interest rates (in this case foreign interest rates) rise. However, there are income and substitution effects associated with changes in the real interest rate (either domestic of foreign) and the coefficient is thus undetermined a priori.

The issue of durable goods consumption and its implications for the saving behavior of households is one that is seldom discussed, or empirically investigated in the

literature. Nonetheless, the issue remains an important one. In national income accounts, spending on consumer durables is typically classified as consumption. However, if we consider that consumers do not purchase durable goods simply to satisfy current "wants", then such purchases should really be treated as a form of investment. Moreover, consumers typically save for several periods (or borrow) in order to purchase durable goods, which suggests that the results of several studies of saving may be misleading. Thus, accounting for household expenditures on durable goods in the estimation of standard saving functions will result in a better understanding of cross-country trends in saving. The coefficient of durable goods consumption as a percentage of disposable income (DURCONS) is expected to be negative: an increase in consumption of durable goods should correspond to a reduction in the household saving ratio.

4.2 Data

Annual time-series data on household saving and disposable income for a group of 32 countries are used to calculate household saving ratios. For the countries in the sample, at least 6 and as many as 22 consecutive observations are available from the period 1970-93. The data come from the U.N. System of National Accounts, which separates income and consumption into three different sectors: government, corporate, and households.

The World Bank's *World Development Indicators* is the source of the following data: the ratio of MQM to GDP, the ratio of private sector credit to GDP, the percentage of the labor force involved in agriculture, the average life-expectancy ratio, and the young-age and old-age dependency ratios. In addition, real GDP per capita and the

growth rate in real GDP per capita are both calculated using raw data from the above source. Annual time-series data for the gini coefficient are not available. Thus, the analysis uses single observations for 29 of the 32 countries in the sample.

The maximum loan-to-value (LTV) ratio is taken from the study by Jappelli and Pagano (1994). Single observations for the 1970s, 1980s, and 1990s are used for each of the 17 sample countries for which data are provided. Household sector consumption of durable goods as a percentage of disposable income is calculated using the national income accounts that appear in the U.N. System of National Accounts. The series is compiled with observations for 15 countries, the majority of them being OECD members. Since there is significant overlap in the LTV ratio sample and the durable goods sample, the two are combined to form a sample of 12 countries.

Real interest rates are calculated using data on nominal deposit rates and inflation, the latter being calculated using data on consumer price levels. All of the data are taken from the IMF's *International Financial Statistics (IFS)*. In cases where little or no information on deposit rates are published, discount rates are used instead. Thus, the real interest rate is determined using the deposit rate for some countries and the discount rate for others. The real rate of return on foreign assets is calculated using the Eurodollar Rate in London, published in the IFS. The final series is arrived at after accounting for both domestic inflation and changes in exchange rates with the US dollar. It is important to note here that for both domestic and foreign real interest rates, the appropriate measurement is especially difficult. Two major problems are associated with (a) choosing a particular interest rate series and (b) correctly deflating nominal interest rates.

The exact manner in which the two problems are addressed is likely to have a strong influence on the interest-rate responsiveness of saving that is empirically measured.

4.3 Estimation Methods and Results

Using the rationale from Sections 3 and 4.1, several equations were estimated using the following fixed effects specification:[19]

$$(16) \quad \mathbf{S}_{it} = \beta_0 + \sum_{i=1}^{N-1} \alpha_i \mathbf{D}_{it} + \sum_{k=1}^{K} \beta_k \mathbf{X}_{kit} + \varepsilon_{it}.$$

The subscripts i, t, and k represent countries, time, and explanatory variables, respectively. $\mathbf{S}_{it}$ is the vector of household saving ratios, $\mathbf{D}_{it}$ is the vector of country dummies which take on a value for 1 for country i and 0 for others, $\mathbf{X}_{kit}$ is the matrix of explanatory variables, and ε_{it} is the vector of error terms. N and K are the number of countries in the sample and the number of explanatory variables. This model allows for the intercept term to vary across countries and assumes that any omitted explanatory variables (such as cultural variables) are country-specific and explain some of the differences in the saving ratio which are constant over time. The relationship between household saving and all other explanatory variables, however, is the same for all countries.

Tables 3 and 4 show some of the key results obtained from estimating equations of the form shown in equation (16). Table 3 displays results from estimations on a large sample of 32 countries, while Table 4 does the same for estimations on a sub-sample of

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[19] Fixed-effects models have been used in several studies of saving. See Callen and Thimann (1997), Jappelli and Pagano (1994), and Schmidt-Hebbel, Webb, and Corsetti (1992).

12 countries. Limited data on the maximum loan-to-value ratio (LTVRATIO) and durable goods consumption as a fraction of disposable income (DURCONS) resulted in the use of two samples, particularly since the two variables were believed to be (and proved to be) important determinants of household saving ratios. Also Appendices B and C contain a correlation matrices for the explanatory variables that are used, the first for the full sample of 32 countries, and the second for the limited sample of 12 countries. Since the correlations do not differ very much, it is safe to assume that the results obtained with the smaller sample can be generalized for many countries.

Full Sample

Equations 1a through 4b in Table 3 summarize results obtained for four equations, each with two different estimation methods (fixed effects with and without instrumental variables) and several different explanatory variables. For brevity, coefficients of the country dummies are not included. Instrumental variable (IV) estimation is used to deal with possible simultaneity bias arising from the growth rate in GDP per capita being endogenous and thus correlated with the error term of the saving equation. The instrument used is the one-year-lagged growth rate, which is the instrument used most often in the literature on saving.[20] The R^2s are quite high (0.7) for all of the equations.

Although the life-cycle overlapping generations model suggests that income growth exerts a negative influence on the saving rate, the coefficient of the rate of growth

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[20] See Callen and Thimann (1997), Edwards (1995), Jappelli and Pagano (1994) and Schmidt-Hebbel, Webb, and Corsetti (1992). Some of these studies also use other instruments such as primary/secondary school enrollment rates and beginning of period per-capita GDP. Tests for the validity of instruments indicated that the lagged growth rate was indeed an adequate instrument.

in real GDP per capita is always found to be positive but insignificant. Several studies, including those by Edwards (1995) and Collins (1992), have found that growth exerts a significantly positive influence on private saving rates.

To account for biases that arise if the growth rate is endogenous and positively correlated with the error term in equation (16), instrumental variables estimation was performed. The results from such estimations are also displayed next to the results from the corresponding OLS estimations. One important observation is that the coefficient of the rate of growth in real GDP per capita rises relative to coefficient that is obtained using OLS (although it still remains insignificant). Such a pattern is to be expected under endogenous growth conditions. A second observation is that the coefficients of other variables are largely unaffected by the choice of estimation method (with and without instruments).

The coefficients of demographic variables are significant in all regressions, indicating that such variables are indeed important determinants of the household saving ratio, as the model in Section 3 suggests. The two variables that stand out as being the most important are the young-age (LESS15RATIO) and old-age (PLUS65RATIO) dependency ratios, both of which have a negative impact on the saving ratio. The coefficient of the old-age dependency ratio is more negative than the coefficient of the young-age dependency ratio in every equation but one. However, when interactive terms with the real interest rate are introduced, the old-age dependency ratio is no longer significant, suggesting that for the larger sample, the young-age dependency ratio is the more important of the two. As equations 1a and 1b show, the coefficient of the overall age-dependency ratio (AGEDEP) is negative and significant under the OLS estimation

43

procedure, but insignificant under the IV procedure. This suggests that it is important to decompose the two components of the dependency ratio, since one might be more important than the other. In general, the results mentioned above provide some support for Deaton's (1990) hypothesis that larger households (proxied by larger dependency ratios) will tend to do borrowing and saving within the household itself, thereby reducing the saving rate.

The coefficient of average life-expectancy is negative and significant at the 10 percent level in equation 1a. However, the variable loses its significance under IV estimation (1b). Also, it was significant at only the 20 percent level in equations that contained the two components of the overall age dependency ratio (young and old). Still, there is at least some support for the claim made in Section 3 that the saving ratio need not be an increasing function of the average life-expectancy if increases in the latter also mean longer working lives. As such, the result obtained here is somewhat contradictory to the general result of Russett and Slemrod (1994), who found that in the United States average life-expectancies are positively correlated with personal savings.

For the larger sample of countries, two proxy variables are used to test for the importance of liquidity constraints. The coefficient of the ratio of MQM to GDP was insignificant in every regression in which it was included. This indicates that it is probably not a good indicator of the severity of borrowing constraints. The coefficient of the ratio of private credit to GDP is significantly negative in all equations except for those that contained an interactive term between the real interest rate and the ratio of MQM to GDP. (4a and 4b) In general, these results provide some support for the view that

borrowing constraints tend to lower household saving rates, which is the prediction made by the model in Section 3.

The regressions in Table 3 also show that income distribution has a strong effect on household saving ratios. The positive coefficient of the gini in equations in which it is included (3a-4b) suggests that a more unequal distribution in income will tend to result in a higher household saving ratio. The rationale behind such a relationship was provided in the discussion in Section 4.1. This is consistent with the finding of Cook (1995), who also used data on the gini for a sample of LDCs. The result is an interesting one, particularly because it suggests that more unequal distributions of income will have the positive effect of raising overall saving ratios.

The foreign real rate of return was consistently found to exert a significant and positive influence on the household saving ratio. This suggests that in examining the relationship between saving and growth, the link between saving and investment is an important one, with investment being negatively correlated with the foreign real rate of return. One explanation along these lines is that higher foreign rates of return lead to reduced growth (due to a fall in investment), which in turn causes consumers to save a larger portion of their current income. The latter is a prediction made by the theoretical model in Section 3. Still, the result suggests that the role of investment and its determinants need to be explored in greater detail, possibly in the context of a model of investment and growth.

The coefficients of the domestic real interest rate are found to be significantly negative in all regressions except those that contain interactive terms. A positive coefficient (significant at the 10 percent level) is found in equation 4b, which contains

Table 3: *Determinants of Household Saving*

Dependent Variable: Household Sector Saving as a Percentage of Household Disposable Income (HSAVERATIO)
Sample: 26 countries in equations 5, 6, and 8; 32 countries in equations 1-4, and 7.

Equation	1a	1b	2a	2b	3a	3b	4a	4b
Estimation Technique	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Constant	31.723	23.660	21.89	20.592	12.232	11.742	7.886	2.945
	(2.824)	(1.578)	(4.883)	(4.335)	(1.574)	(1.484)	(0.975)	(0.297)
RGDPGROWTH	0.042	0.227	0.046	0.207	0.044	0.174	0.032	0.287
	(0.946)	(1.113)	(1.069)	(1.101)	(0.932)	(0.698)	(0.628)	(1.015)
PRIVCREDIT	-0.036	-0.034	-0.035	-0.032	-0.041	-0.040	-0.021	-0.022
	(-3.033)	(-2.772)	(-2.854)	(-2.528)	(-3.282)	(-3.106)	(-1.352)	(-1.370)
AGEDEP	-10.32	-8.104						
	(-2.118)	(-1.454)						
LIFEEXP	-0.202	-0.115						
	(-1.610)	(-0.689)						
LESS15RATIO			-0.184	-0.180	-0.205	-0.200	-0.230	-0.267
			(-1.991)	(-1.918)	(-2.103)	(-2.030)	(-2.294)	(-2.371)
PLUS65RATIO			-0.557	-0.494	-0.631	-0.576	-0.359	-0.133
			(-2.437)	(-2.031)	(-2.564)	(-2.136)	(-1.351)	(-0.361)
GINI					0.305	0.290	0.359	0.441
					(2.414)	(2.248)	(2.580)	(2.591)
REALR	-0.018	-0.021	-0.0175	-0.020	-0.023	-0.025	0.315	0.283
	(-3.418)	(-3.365)	(-3.390)	(-3.356)	(-4.295)	(-3.603)	(1.994)	(1.619)
RSTAR	0.005	0.006	0.005	0.005	0.007	0.007	0.006	0.007
	(2.619)	(2.746)	(2.599)	(2.721)	(3.550)	(3.277)	(3.160)	(3.197)
REALR*RGDPCAP							-4.01E-05	-3.74E-05
							(-5.156)	(-4.302)
REALR*MQMRATIO							0.002	8.51E-05
							(1.608)	(0.042)
REALR*GINI							-0.007	-0.006
							(-2.064)	(-1.580)
N	526	523	526	523	460	457	440	437
Adjusted R-squared	0.736	0.727	0.737	0.729	0.736	0.732	0.752	0.738

Note: t-statistics in parentheses.
All regressions include country dummies.
Instrument for growth is lagged growth.

three interactive terms between the real interest rate and real GDP per capita, the ratio of MQM to GDP, and the income distribution. The result suggests that real GDP per capita and income distribution are two variables which exert a significantly negative influence on the responsiveness of the household saving ratio to changes in real interest rates. A lower interest-rate responsiveness of household saving ratios is predicted for high-income countries, as well as for countries with more unequal distributions of income. The first prediction is contrary to that made by Ogaki, Ostry, and Reinhart (1996). This might reflect the fact that in higher income countries, households are more responsive to the foreign real interest rate instead of the domestic real interest rate. The second prediction is most likely a direct result of the fact that a larger number of individuals are able to save as the income distribution becomes more equal. Thus, the coefficient of the interactive term REALR*GINI is negative. Finally, convincing evidence that borrowing constraints lead to a lower interest-rate responsiveness of saving is not found, as the coefficient of the interactive term with the ratio of MQM to GDP is significantly positive under OLS, but insignificant under IV procedures.

In general, the significantly negative coefficients of the domestic real interest rate in equations 1a through 3b are slightly contradictory to findings in previous studies, which mostly find insignificant (positive or negative) coefficients for the real interest rate. However, the result in equation 4b suggests that the relationship between the real interest rate and household saving ratio is a positive one, and that it may indeed be nonlinear. Specifically, for any given country, the effects of a change in real interest rates on the saving ratio will depend of the level of real GDP per capita as well as the skewness of the income distribution.

A number of other equations were estimated. Excluding the foreign real rate of return did not affect the coefficient of the domestic real interest rate, which remained negative. The coefficient of the percentage of the labor force in agriculture was always insignificant, suggesting that the variable may be a poor proxy for average household sizes, or even financial "depth". Also insignificant were the interactive terms between the real interest rate and demographic variables.

Finally, time dummies in the form of country dummy variables were included to test whether certain shocks (in particular, those associated with oil prices) can explain cross-country variations in household saving ratios. The main result was that household saving ratios in the sample were significantly higher in the 1970s than in the 1980s and 1990s.[21] A dummy variable for the 1970s had a coefficient of 1.61 and was significant at the 1 percent level. There can be many explanations for this. One could be that the oil price shocks of the 1970s led to increased uncertainly regarding future income flows, and that consumers saved a larger portion of their incomes as a result. Another possibility is that higher inflation in the 1970s led to an erosion the value of households' financial assets, which encouraged them to save more. However, it is also possible the dummy variables are picking up changes in variables already included in the equation for household saving ratios. One example is inflation (included in the real interest rate); another could be borrowing constraints—if these were eased in all sample countries during the 1980s, then saving ratios would be expected to be higher in the 1970s than the 1980s.

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[21] The finding is not a surprising one. It is well known that saving ratios in both industrial and developing countries declined in the 1980s. See *Economist* (1989).

LTV Ratio and Durable Goods Sample

Estimations on this sample are conducted in order to address two issues regarding household saving: the role of borrowing constraints, and the treatment of durable goods consumption. To a varying degree, both have been largely ignored in the empirical literature. Equations 5a through 7b in Table 4 summarize the key results that are obtained. The R^2s for the equations in this sample (0.8) are higher than those for the equations in the larger sample. Again, instrumental variables estimation was conducted to handle simultaneity biases.

The key observation here is that, in general, both borrowing constraints and durable goods consumption are found to exert significant influences on saving. The coefficient of the LTV ratio is consistently negative and significant, confirming that the severity of borrowing constraints is an important determinant of the household saving ratio. Specifically, a 1 percentage point increase in the maximum LTV ratio is predicted to cause a decline in the saving ratio of about 0.2 percent. Such results, in comparison to those obtained for MQMRATIO and PRIVCREDIT in both samples, also corroborate Jappelli and Pagano's (1994) claim that the maximum LTV ratio is a better indicator for the nature of borrowing constraints.

The coefficient of the ratio of household durable goods consumption to disposable income is always negative and in all cases but two, significant as well. (equations R11 and R12 are the exception) In general, the size of this coefficient is also economically significant, with a 1 percentage point increase in the explanatory variable resulting in a decline in the saving ratio of between 0.4 and 1.2 percent. The results support the

49

hypothesis that an increase in consumption of durable goods will be associated with a decrease in saving. They also imply that the failure to account for consumer durables may have led to flawed representations of household saving behavior in previous empirical studies.

Demographic variables have similar but stronger effects in the smaller sample. This is indicated by the more negative and more significant coefficients associated with LESS15RATIO and PLUS65RATIO in equations 5a through 7b. The coefficient of PLUS65RATIO is especially large in magnitude; in equations 6a and 7a, a 1 percentage point increase in the percentage of the population above age 65 leads to a decline in the saving ratio of almost 1.4 percent. The coefficients of the rate of growth of real GDP per capita are virtually unchanged compared to the estimates for the larger sample. However, as equation 5b indicates, the ratio of private credit to GDP is no longer significant under IV estimation. Instead, the ratio of MQM to GDP is consistently negative and significant, which is not the case in the larger sample. This suggests that it serves as a proxy for borrowing constraints in the smaller sample but not in the larger sample.

Coefficients of the domestic real interest rate are not always significant in the smaller sample. However in the equations that contain interactive terms (namely, 7a and 7b), the coefficient is positive and significant for the first time. The coefficient of the interactive term with the income distribution remains significantly negative. Also, the interactive term with the percentage of the population above age 65 (PLUS65RATIO) is significantly negative. This finding can be explained by the theoretical model in which the elderly earn some labor income but do no saving. Due to this, they are also less responsive to changes in real interest rates than young or middle-aged individuals, who

Dependent Variable: Household Sector Saving as a Percentage of Household Disposable Income (HSAVERATIO)
Sample: 12 countries

Equation	5a	5b	6a	6b	7a	7b
Estimation Technique	OLS	IV	OLS	IV	OLS	IV
Constant	61.343	62.095	70.013	70.806	69.156	79.345
	(6.056)	(5.885)	(6.105)	(5.870)	(8.153)	(6.538)
RGDPGROWTH	0.029	0.301	0.022	0.355	0.055	0.589
	(0.382)	(0.501)	(0.273)	(0.559)	(0.707)	(1.496)
MQMRATIO			-0.094	-0.077	-0.053	-0.081
			(-3.034)	(-1.700)	(-1.986)	(-2.220)
PRIVCREDIT	-0.029	-0.024				
	(-2.169)	(-1.523)				
LESS15RATIO	-0.667	-0.710	-0.778	-0.815	-0.780	-0.961
	(-6.142)	(-4.833)	(-6.427)	(-5.631)	(-6.591)	(-5.129)
PLUS65RATIO	-1.135	-0.982	-1.362	-1.132	-1.382	-1.064
	(-4.205)	(-2.261)	(-5.295)	(-2.214)	(-5.015)	(-2.736)
LTVRATIO	-0.213	-0.207	-0.217	-0.224	-0.177	-0.223
	(-2.104)	(-1.965)	(-1.991)	(-1.957)	(-2.152)	(-2.243)
DURCONS	-0.399	-0.669	-0.371	-0.711	-0.807	-1.237
	(-2.221)	(-1.080)	(-2.003)	(-1.059)	(-4.895)	(-3.419)
REALR	-0.084	-0.136	-0.046	-0.115	1.243	1.132
	(-1.313)	(-1.035)	(-0.680)	(-0.777)	(3.764)	(2.939)
RSTAR	0.021	-0.003	-0.020	-0.016	-0.048	-0.068
	(0.412)	(-0.040)	(0.378)	(-0.179)	(-0.789)	(-0.962)
REALR*MQMRATIO					-0.004	-0.004
					(-1.434)	(-1.113)
REALR*GINI					-0.017	-0.022
					(-2.004)	(-2.144)
REALR*LTVRATIO					0.002	0.008
					(0.512)	(1.220)
REALR*PLUS65RATIO					-0.066	-0.089
					(-2.500)	(-2.592)
N	234	234	218	218	177	177
Adjusted R-squared	0.822	0.811	0.828	0.813	0.853	0.808

Note: t-statistics in parentheses.
All regressions include country dummies.
Instrument for growth is lagged growth.

try to optimize the amounts they borrow or save. Thus, real interest rate changes will elicit smaller changes in the saving ratio for countries with high relative proportions of the elderly.

To test for the effects of borrowing constraints on the interest responsiveness of saving, interactive terms with the ratio of MQM to GDP were included. These proved to be insignificant. As equations 7a and 7b show, the use of the LTV ratio does not change this result either. Also, in contrast to the larger sample of countries, the interactive term with real GDP per capita was never significant in the smaller sample, and was thus excluded from the regressions.

5. Conclusion

The main proposition tested in this paper is that real interest rates will have a non-linear effect on the household saving rates of countries. In other words, the relationship between the two variables is not constant across countries. The estimation of a structural equation of household saving indicates that allowing for a non-linear relationship between real interest rates and household saving rates does indeed alter the results that are otherwise obtained. Specifically, the real interest does not always exert a negative influence on the household saving rate. Three variables in particular (the percentage of the population aged above 65, the income distribution, and the real GDP per capita) are found to alter the size of the effect of real interest rates. To the extent that these variables are important, much can be learned about the effectiveness of financial liberalization

52

policies in developing countries and the ability of various public policies to influence important macroeconomic variables such as the saving ratio and the rate of growth in income.

More generally, this paper is able to address the issue of household saving behavior and its determinants by using what might be considered a more appropriate measure: household saving as a percentage of household disposable income. In this context, a standard study of the determinants of the household saving ratio is performed. Apart from the non-linear effects of real interest rates, the role of durable goods is found to be an important one. Overall, the results indicate that borrowing constraints, demographic variables, real interest rates, and consumption of durable goods are the key explanatory variables. While the treatment of durable goods has largely been ignored in both theoretical and empirical studies of saving, the finding here that spending on durable goods exerts a negative influence on household is not very surprising, particularly since expenditures on durables are essentially a substitute for consumption smoothing. The important observation is that previous studies of saving behavior might contain serious flaws by having ignored the role of durable goods. In that respect, improved data and a more accurate representation of the household saving function can be cited as two reasons to take more seriously the results that have been presented here. Nonetheless, better proxies for certain variables that are theoretically important (for example, borrowing constraints and income distribution) are essential in order to resolve the debate over interest rates and household saving.

Finally, the results do indicate that in some countries, real interest rates have little effect on the saving ratio. While this can partly be explained by the interactive terms that

are used, it is important to realize that in developing countries, financial liberalization can take on many meanings. Some individuals might associate an increase in real interest rates with faster economic growth in the future, and therefore reduce their saving. Other might associate interest rate policy interventions with increased economic uncertainty, or confusion, and therefore increase their saving. Thus, even if saving in inherently responsive to changes in real interest rates, the relationship can be hidden by the presence of beliefs and expectations such as those just mentioned. In summary, it is possible that the debate over the interest elasticity of saving has been an ongoing one because consumers may have many different interpretations of changes in real interest rates.

APPENDIX A

Household Saving-Disposable Income [A] ratios and Gross Saving-GDP [B] ratios for Selected Countries (1972-1993)

Sources: Key: ◆— Shousehold
[A] United Nations   —■— Sgrossnational
[B] World Bank

BOTSWANA

CAMEROON

COLOMBIA

CONGO
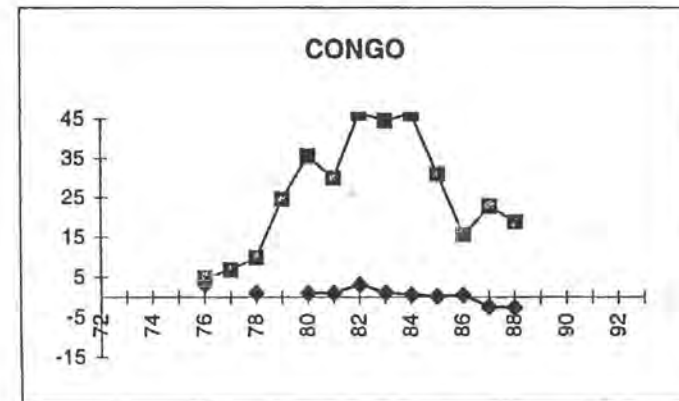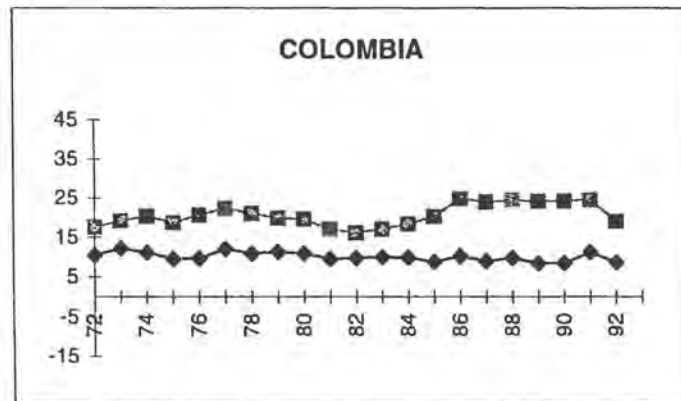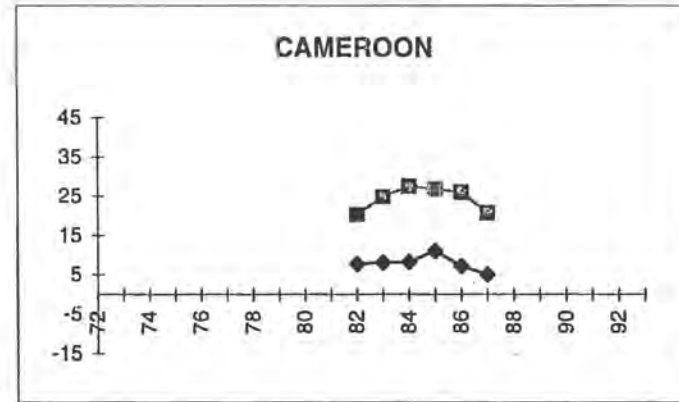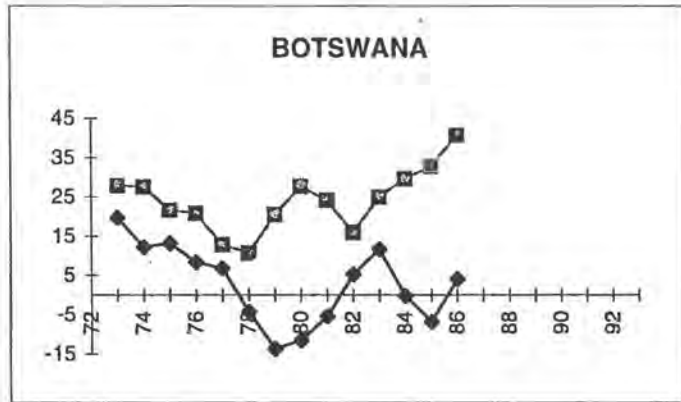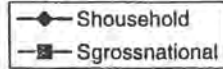
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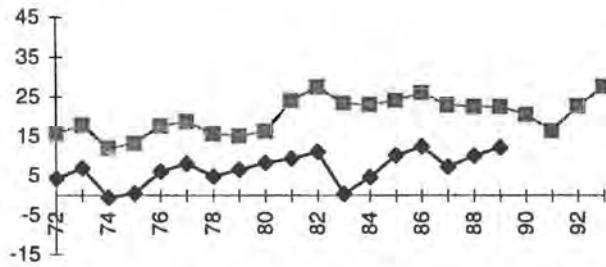
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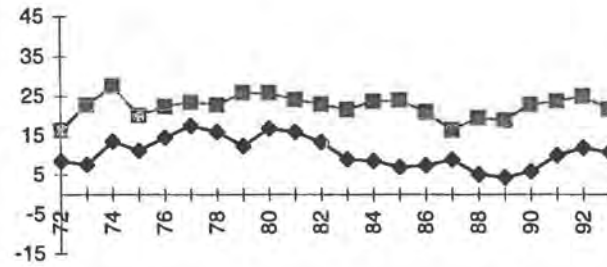
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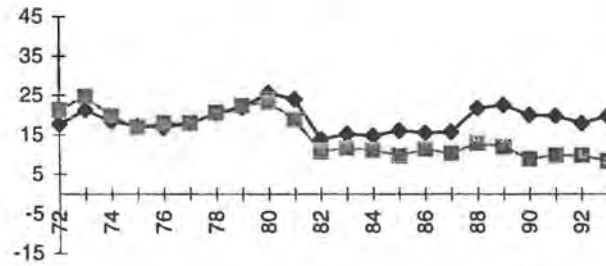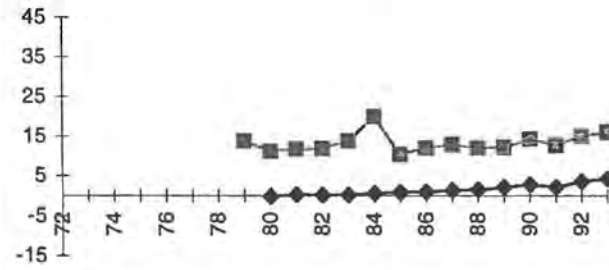

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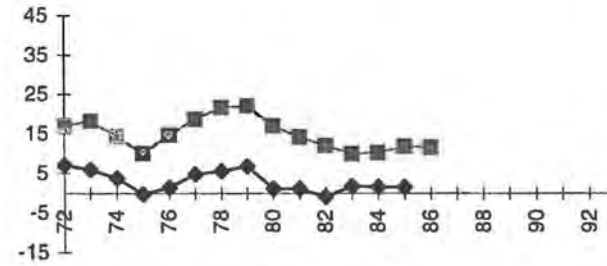
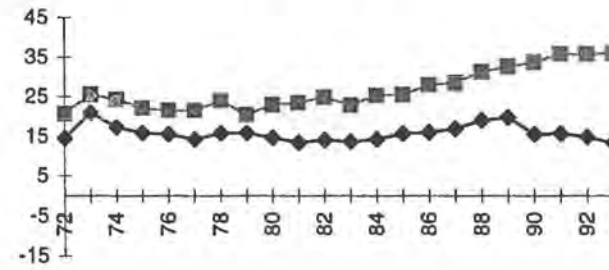

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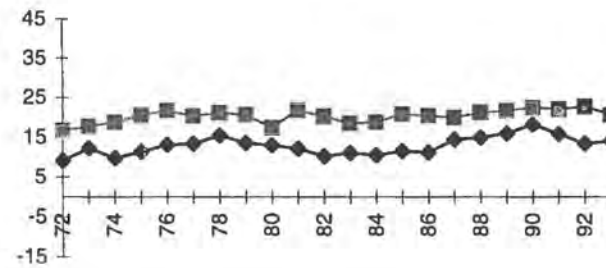
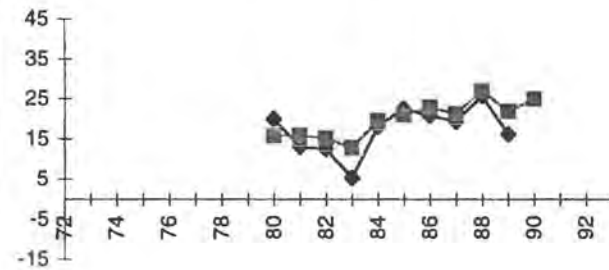
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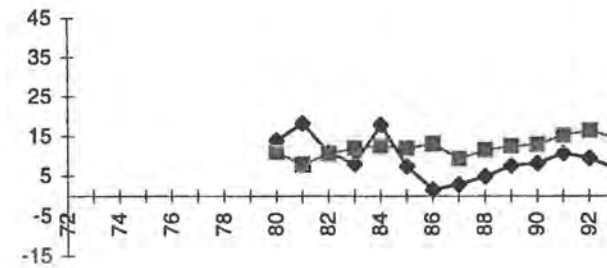
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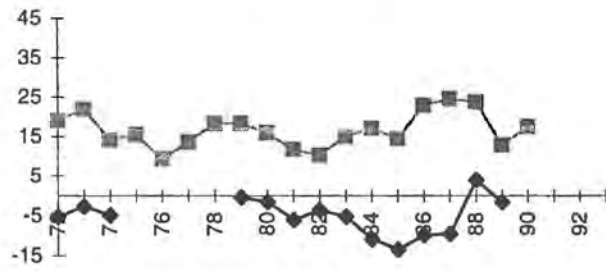
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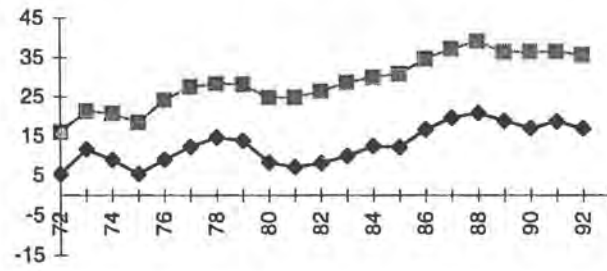
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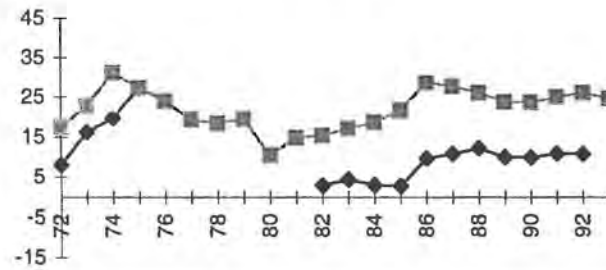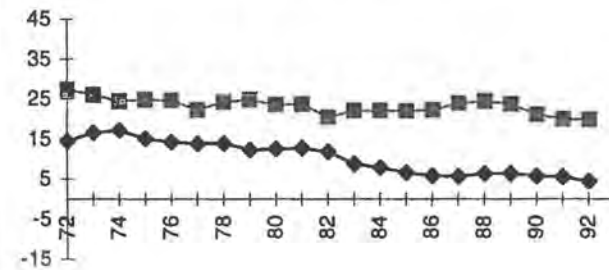
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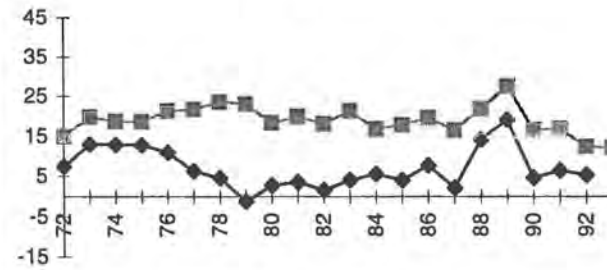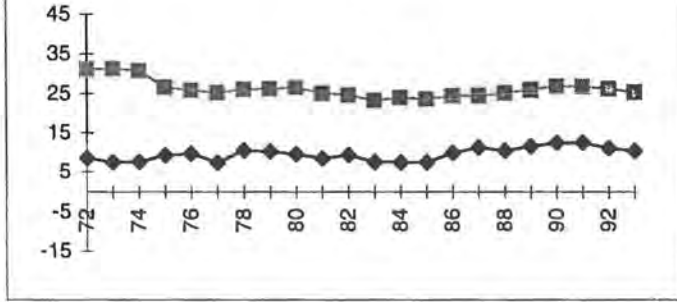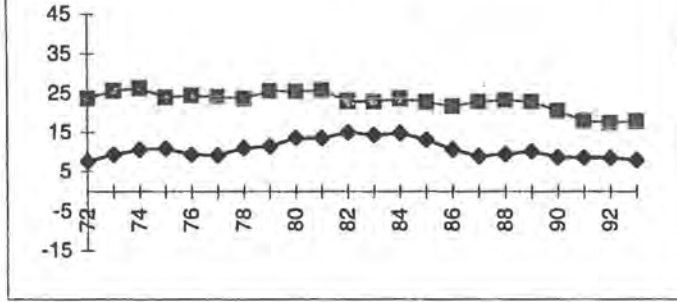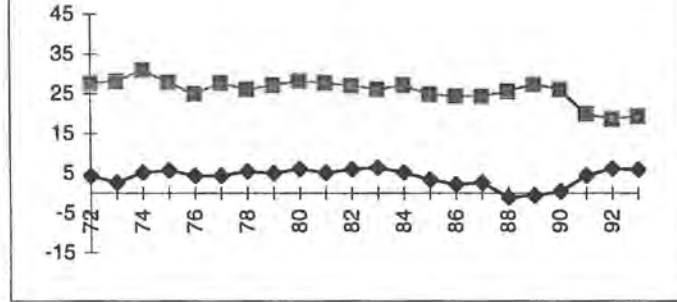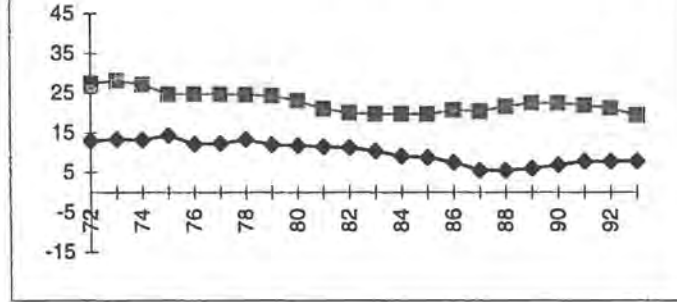
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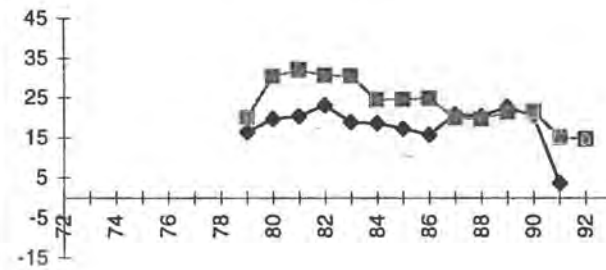
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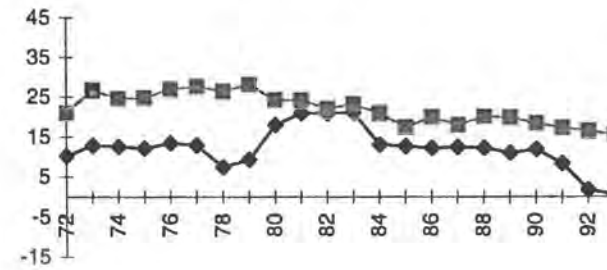
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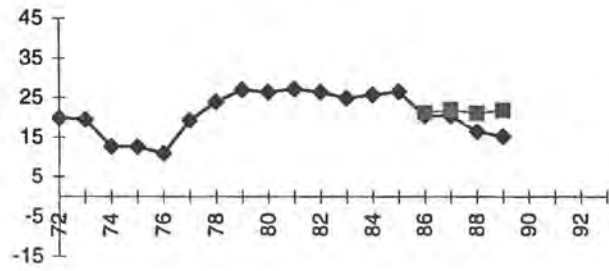
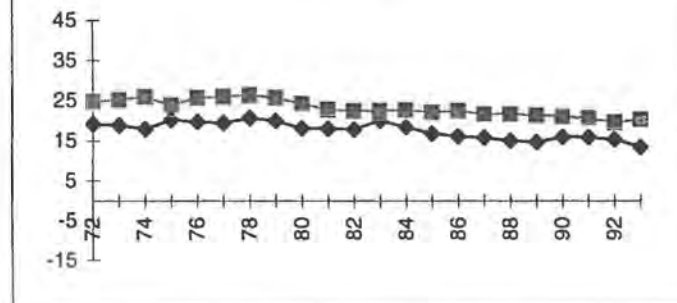

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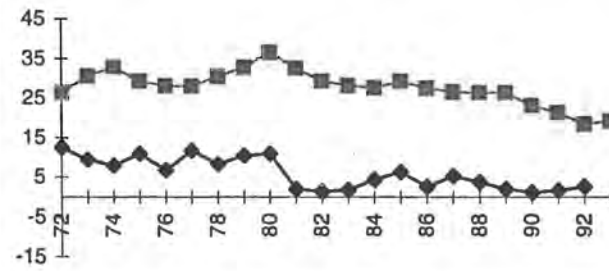
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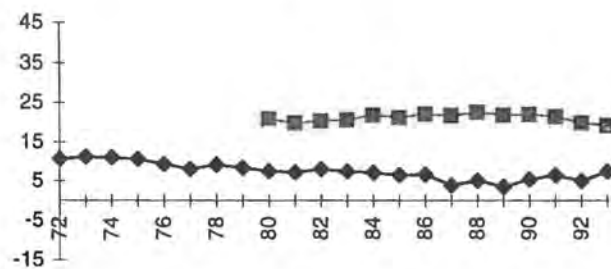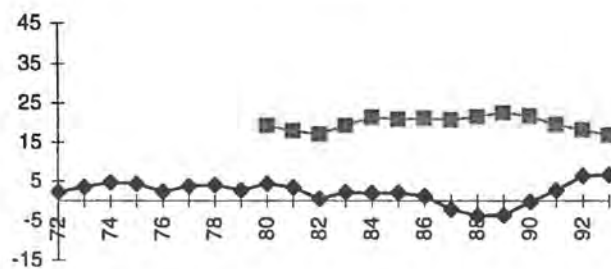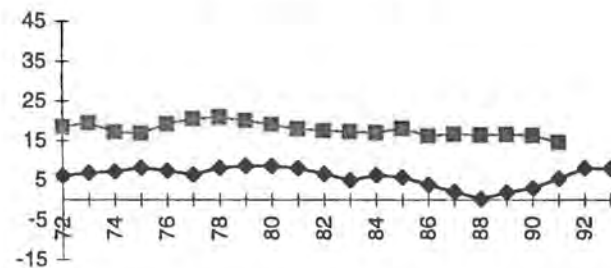
ITALY

JAPAN
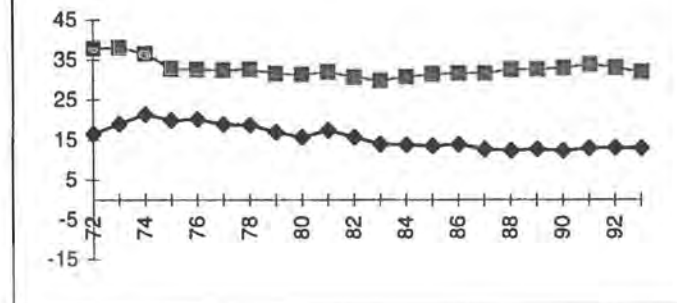
SPAIN

SWEDEN

UNITED KINDOM

UNITED STATES
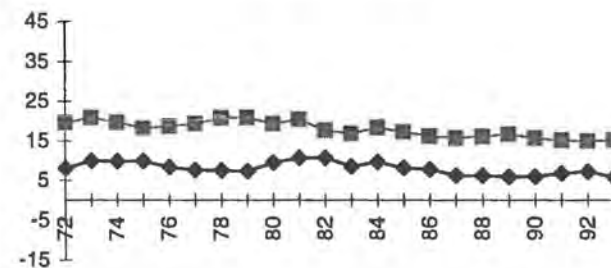
APPENDIX B

Matrix of correlations (full sample)

	HSAVERATIO	AGEDEP	AGLABOR	DURCONS	GINI	LESS15RATIO	LIFEEXP	LTVRATIO	MQMRATIO	PLUS65RATIO
HSAVERATIO	1	0.08	0.43	-0.34	0.44	0.44	-0.28	-0.56	0.14	-0.62
AGEDEP	0.08	1								
AGLABOR	0.43	0.78	1							
DURCONS	-0.34	-0.35	-0.41	1						
GINI	0.44	0.64	0.73	-0.39	1					
LESS15RATIO	0.44	0.82	0.90	-0.42	0.60	1				
LIFEEXP	-0.28	-0.79	-0.88	0.39	-0.48	-0.94	1			
LTVRATIO	-0.56	-0.29	-0.54	0.63	-0.19	-0.68	0.63	1		
MQMRATIO	0.14	-0.41	-0.36	-0.14	0.14	-0.48	0.60	0.25	1	
PLUS65RATIO	-0.62	-0.46	-0.77	0.37	-0.41	-0.88	0.81	0.81	0.41	1
PRIVCREDIT	0.06	-0.45	-0.44	-0.17	0.09	-0.50	0.66	0.19	0.86	0.41
REALR	-0.01	-0.0003	-0.07	0.20	0.22	-.01	0.03	0.08	-0.03	0.01
RGDPCAP	-0.47	-0.68	-0.86	-0.38	-0.50	-0.88	0.90	0.71	0.53	0.81
RGDPGROWTH	0.33	0.26	0.46	-0.27	0.24	0.47	-0.50	-0.58	-0.21	-0.51
RSTAR	0.05	-0.23	-0.12	0.09	0.17	-0.22	0.33	0.23	0.33	0.16

	PRIVCREDIT	REALR	RGDPCAP	RGDPGROWTH
HSAVERATIO	0.06	-0.01	-0.47	0.33
AGEDEP				
AGLABOR				
DURCONS				
GINI				
LESS15RATIO				
LIFEEXP				
LTVRATIO				
MQMRATIO				
PLUS65RATIO				
PRIVCREDIT	1			
REALR	-0.12	1		
RGDPCAP	0.64	-0.08	1	
RGDPGROWTH	-0.26	0.24	-0.55	1
RSTAR	0.31	0.61	0.26	0.01

APPENDIX C
Table of correlations (sample of 12 countries)

	HSAVERATIO	AGEDEP	AGLABOR	DURCONS	GINI	LESS15RATIO	LIFEEXP	LTVRATIO	MQMRATIO	PLUS65RATIO
HSAVERATIO	1	0.11	0.44	-0.37	0.41	0.43	-0.30	-0.56	0.17	-0.56
AGEDEP	0.11	1								
AGLABOR	0.44	0.73	1							
DURCONS	-0.37	-0.33	-0.43	1						
GINI	0.41	0.63	0.71	-0.37	1					
LESS15RATIO	0.43	0.79	0.90	-0.42	0.60	1				
LIFEEXP	-0.30	-0.78	-0.87	0.39	-0.49	-0.94	1			
LTVRATIO	-0.56	-0.26	-0.57	0.64	-0.19	-0.68	0.63	1		
MQMRATIO	0.17	-0.39	-0.34	-0.15	0.14	-0.46	0.58	0.22	1	
PLUS65RATIO	-0.56	-0.39	-0.77	0.37	-0.40	-0.87	0.80	0.81	0.38	1
PRIVCREDIT	-0.01	-0.45	-0.44	-0.14	-0.01	-0.49	0.65	0.20	0.81	0.37
REALR	-0.08	-0.06	0.08	0.18	0.20	0.01	0.03	0.05	-0.04	-0.06
RGDPCAP	-0.52	-0.66	-0.85	0.41	-0.49	-0.86	0.89	0.72	0.47	0.77
RGDPGROWTH	0.29	0.23	0.47	-0.26	0.22	0.46	-0.48	-0.57	-0.20	-0.51
RSTAR	-0.08	-0.26	-0.11	0.11	0.14	-0.19	0.30	0.19	0.25	0.08

	PRIVCREDIT	REALR	RGDPCAP	RGDPGROWTH
HSAVERATIO	-0.01	-0.08	-0.52	0.29
AGEDEP				
AGLABOR				
DURCONS				
GINI				
LESS15RATIO				
LIFEEXP				
LTVRATIO				
MQMRATIO				
PLUS65RATIO				
PRIVCREDIT	1			
REALR	-0.06	1		
RGDPCAP	0.64	-0.03	1	
RGDPGROWTH	-0.24	0.25	-0.52	1
RSTAR	0.33	0.66	0.29	0.06

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SENIOR HONORS EXAM IN ECONOMICS

Oberlin College

NAME _____

<u>Instructions</u>:

1. There are a total of 400 points on this exam.

2. You have four (4) hours to complete the exam.

3. All work must be done in this exam booklet.

4. Read through entire exam first to aid in allocating time efficiently

1. 63 points. (Suggested time: 30 minutes)

Suppose that there are two generations of people, parents and children, and that for simplicity we can think of them as a single parent-child pair. The parent is altruistic toward the child, in the sense that she cares about the child's consumption in addition to her own. So the parent's utility function is given by the formula:

$$U = U(c_p, c_k)$$

a.) (7 pts.) Putting c_p on the vertical axis and c_k on the horizontal axis, draw a set of indifference curves representing the preferences of the parent. What would happen to these indifference curves if the parent became more altruistic? What would the indifference curves look like if the parent were completely selfish?

b. (7 pts.) The parent allocates her income, I_p, to both her own consumption and to transfers to the child. These transfers take the form of bequests, and are denoted by T. Express this idea in symbols by writing down the parent's budget constraint. (Assume that the prices of c_p and c_k have been normalized to one.)

c) (7 pts.) The child finances his consumption out of his own income, I_k and from the bequests received by the parent. Write down the child's budge constraint.

2

d) (7 pts.) Using your results from parts b and c, show that total family consumption, i.e., the parent's consumption plus the child's, has to add up to total family income. Call this result the family budget constraint.

e) (7 pts.) Denote total family income by I. Plot a graph of the family budget constraint. Show that the ordered pair (I_k, I_p) must lie on the budget constraint and, for the sake of illustration, when drawing your constraint, assume that the parent's income is higher than the child's income.

f) (7 pts.) Now put the indifference curves and the budget constraint together. Draw a set of convex indifference curves which are roughly consistent with equal weighting of parent and child utility. (An example of such a utility function would be one in which $U = c_p c_k$.) Redraw the budget constraint from part (e) and show the utility-maximizing choice of parental and child consumption. Identify on the graph the bequest from the parent to the child.

g) (7 pts.) Suppose that parental consumption takes place today, and child consumption takes place in the future, but that, for simplicity, interest rates equal zero, so that this additional wrinkle does not affect how the graph is drawn in part f.

Suppose that today the government decides to run a deficit, D, which is used to finance consumption of the current generation and is financed by taxes on the **future** generation, τ, in such a way that the intertemporal government budget constraint is balanced ($D = \tau$).

Using a diagram, show what the impact of the deficit is on the consumption of current and future generations. (Assume that the current value of D is less than the value of the bequests T) Do deficits affect the well-being of either the current or future generations? Do they impose a burden on future generations? Explain why or why not. What variables are affected by the deficit?

h) (7 pts.) Go back to part (g), but this time assume that D is greater than T. How does your answer to part (g) change, if at all?

i) (7 pts) Suppose that parents are not altruistic, and give bequests not because they care for children but because they want children to pay attention to and care for them. How does your answer to part (g) change?

2. 48 points (suggested time: 30 minutes)

Suppose that your income today is $\$I_1$, and your income tomorrow is $\$I_2$. If you wish, you can put money in a bank today and get it back tomorrow with interest; or, alternatively, you can borrow today and pay back tomorrow with interest. The interest rate is r, which means a dollar saved today becomes $(1 + r)$ dollars tomorrow, and a dollar borrowed today becomes $(1 + r)$ dollars which must be paid back tomorrow. Let $X_1 =$ your consumption of goods today, and $X_2 =$ your consumption of goods tomorrow. Assume that a unit of consumption today costs $\$1$, and a unit of consumption tomorrow will also cost $\$1$.

a) (12 pts.) If you have no other sources of money and you must clear your debts tomorrow, what is your budget constraint?

b.) (12 pts.) Represent your preferences and your budget constraint graphically. Show whether you are a borrower or a saver today, and why. (Hint: You might be either.)

c) (12 pts.) Given that you are a borrower or a saver (choose <u>one</u>), indicate how an increase in the interest rate r affects your consumption decision today. Decompose the change in desired consumption into an income and a substitution effect, and discuss their "directions." What sort of policy might you recommend to encourage saving and/or discourage borrowing?

d) (12 pts.) There are many consumers who choose neither to borrow nor to save, and there are many more of them than the simple model above would predict. Make the model above more realistic by incorporating the assumption that the borrowing rate, r_b, exceeds the rate of return for saving, r_s. Show how this change in the model can lead to the outcome that consumers in each period spend exactly their paycheck.

3. 45 points (Suggested time: 30 minutes)

In the February, 1993 issue of the *Quarterly Journal of Economics*, Alan Krueger estimated the impact of computer usage on wages in an article entitled, 'How Computers Have Changed the Wage Structure: Evidence from Microdata 1984-1989.' Krueger regressed the logarithm of hourly wages on a variety of worker characteristics. His primary variable of interest is an indicator of computer usage. The actual results are given below:

Ordinary Least Squares Estimates for Log Wages of Secretaries, 1984
Dependent Variable: Logarithm of Hourly Wage Rate
(Standard deviations of Estimated Coefficients in Parentheses)

Independent Variable	Coefficient	Standard Deviation of Estimated Coefficient
Intercept	1.387	(0.019)
Uses Computer at Work (1 = yes, 0 = no)	0.059	(0.024)
Years of Education	0.014	(0.008)
Age	0.009	(0.003)
Age Squared	-0.00008	(0.00002)
Black (1 = yes, 0 = no)	-0.079	(0.012)
Hispanic (1 = yes, 0 = no)	-0.095	(0.080)
Part-time (1 = yes, 0 = no)	-0.321	(0.031)
Lives in City (1 = yes, 0 = no)	0.159	(0.024)
Female (1 = yes, 0 = no)	0.090	(0.166)
Married (1 = yes, 0 = no)	0.422	(0.219)
Married X Female*	-0.387	(0.220)
Union Member (1 = yes, 0 = no)	0.016	(0.040)
R^2	0.256	
Sample Size	751	

*NOTE: This term is the product of MARRIED times FEMALE.

Answer the following questions, and, in the case in which you are asked to provide a numerical value, give the exact number and put a circle around it.

a) (5 pts.) What does the equation say about the impact of computers on wages, other factors held constant? Discuss both the magnitude and the statistical significance of the result.

b) (5 pts.) In percentage terms, how much more would a secretary with a college degree be expected to earn compared to one who has just a high school degree? Put a 95% confidence interval around the result.

c) (5 pts) Give a rough sketch of the estimated relationship between hourly wages and age (putting age on the horizontal axis). At what age is hourly wages expected to reach a maximum?

d) (5 pts.) What is the partial derivative of log wages with respect to FEMALE? What is the estimated effect on the wage of being female if she is single? Married?

e) (5 pts.) Is there evidence here of race discrimination in the market for secretaries? Explain.

f) (5 pts.) Suppose that a key determinant of wages is _motivation_, but we have no measure of it. If motivation were positively correlated with using computers at work, what would be the effects of its exclusion?

g) (5 pts) Suppose you thought that the impact of education on wages was much higher for those who use computers than for those who do not. What variable would you add to the regression equation? Why?

h) (5 pts.) A critic thinks the low value for the variable "Part time" is not really due to being a part-timer *per se* but just reflects the low representation of part-timers in unions. How do you answer the critic in one sentence?

i) (5pts.) How do you interpret the R^2 in the regression?

4. 18 points (Suggested time: 10 minutes)

Recently, Senator Daniel Patrick Moynihan of New York suggested that one way to stop the spread of guns in inner cities is to tax ammunition. Using supply and demand analysis, show how Moynihan's proposal would affect the market for guns.

5. 48 points (Suggested time: 30 minutes)

A profit maximizing high school (Ridgemont High) charges $5.00 per ticket for its football games. The team is a monopoly, with marginal costs of zero. Though the stadium has a capacity of 30,000, the high school's profit-maximizing quantity is 20,000.

a) (16 pts.) Why doesn't Ridgemont High fill its stadium? (A diagram is almost essential for explaining why).

b) (16 pts.) Next week, Ridgemont plays Montridge, and Montridge fans have offered to buy an unlimited quantity of tickets (not to be resold) at $4.00 apiece. How many tickets should Ridgemont sell to Montridge?

        (i)   10,000
        (ii)   more than 10,000
        (iii)   less than 10,000
        (iv)   30,000
        (v)   zero

Explain your answer.

c) (16 pts) How much should Ridgemont charge its <u>own</u> fans for tickets?

    (i) $5
    (ii) more than $5
    (iii) less than $5

Explain your answer.

6. 34 points (Suggested time: 20 minutes)

A very small country's production possibility frontier is given by the formula $A + F = 12$, where A denotes the number of automobiles and F denotes the number of tons of food.

a) (7 pts.) Plot a graph of the production possibility frontier and show its slope and y-intercept.

b) (7 pts) suppose the country's utility function is given by $U = A F$ (utility equals A times F) and the country cannot trade with other countries. What will be the utility-maximizing levels of auto and food consumption? Give the exact numbers.

c) (7 pts.) Suppose now that the small country can buy or sell autos on the world market for $10,000 per auto, and it can buy or sell food for $5,000 per ton. How many autos will the country produce? How many tons of food will it produce? Give the exact numbers.

d) (13 pts.) What is the new utility-maximizing level of consumption of autos? Of food? How many autos does the country export? How much food does the country import? Give the exact numbers.
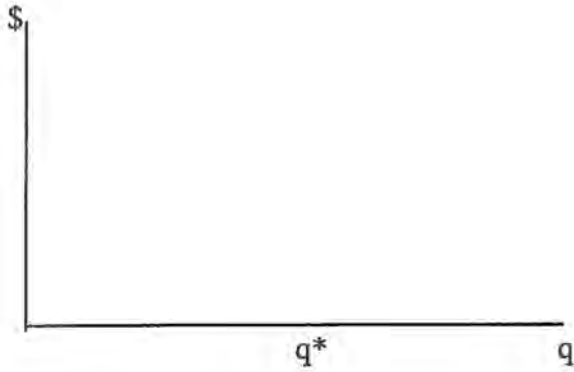
What are the normative implications of the result?
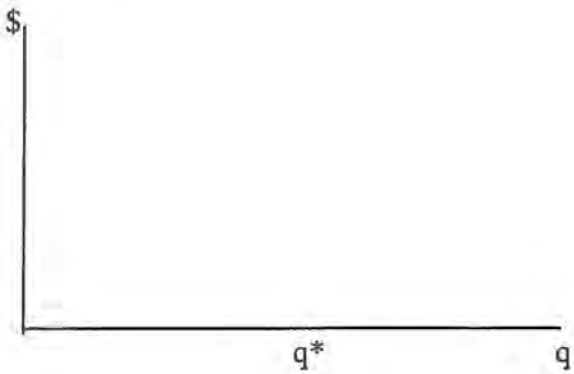
7. 34 points (Suggested time: 20 minutes)

A firm's total cost and total revenue curves are drawn below.
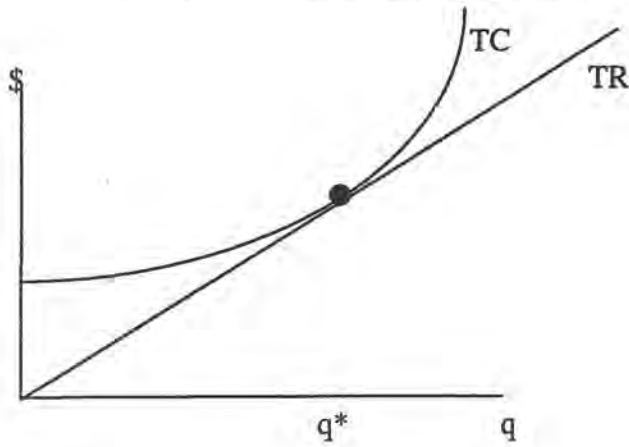
a) (8 pts.) Carefully draw the marginal cost curve associated with the total cost curve above.

b) (8 pts) Carefully draw the average cost curve associated with the total cost curve above.

c) (8 pts.) Carefully redraw the marginal and average cost curves and put in the average revenue curve.

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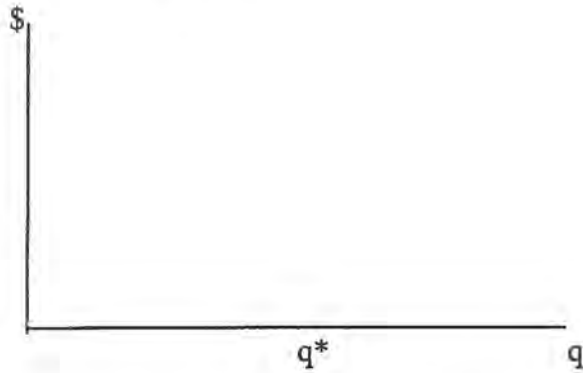
d) (10 pts) The firm's profit is TR - TC. How much should the firm produce to maximize profit? How much profit does the firm make?

8. 25 points. (Suggested time: 15 minutes)

Bands that sign to a major record company usually collect a fraction of total compact disc *sales*, rather than a share of the company's *profits*. Certain artists, such as Elvis Costello and others that have some monopoly power, have often complained about the high prices of compact discs. There is one and only one reason for their complaint. Discuss and use a diagram to illustrate your point.

9. 25 points. (Suggested time: 15 minutes)

Suppose the demand curve for doctor visits is given by $P = 100 - 2 Q_d$, where P denotes price and Q_d denotes quantity demanded. The supply of doctor visits is fixed at $Q_s = 25$.

   a) (4 pts.) Solve for the equilibrium price and quantity.

   b) (4 pts.) Suppose an insurance system is created, which reimburses consumers 50 percent of what they pay for a doctor visit. What is the new formula for the demand curve?

   c) (4 pts.) Give the new equilibrium price and quantity with insurance.

   d) (4 pts.) Do consumers gain from the insurance program? Do doctors gain from it?

10. 40 points. (Suggested time: 25 minutes)

A consumer has utility function $U = xy$ (utility equals x times y). He has income of $12, and $P_x = \$1$, and $P_y = \$1$.

a) (10 pts.) Solve for the consumer's equilibrium consumption of goods x and y, and solve for the consumer's level of utility in equilibrium. Give the exact numbers.

b) (10 pts.) Suppose the price of x rises to $4, while the price of y and income remain the same. Solve for the new equilibrium quantity of x. Give the exact numbers.

c) (20 pts.) When the price of x rose from \$1 to \$4, how much of the fall in demand was due to the substitution effect? How much was due to the income effect? Give the exact numbers.

11. 20 points. (Suggested time: 10 minutes)

A consumer has utility function $U = x^{1/3}y^{2/3}$. Goods x and y have positive prices. Prove that the consumer will spend a third of her income, I, on good x.