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Savings, Growth and Capital Markets Imperfections: The Case of Borrowing Constraints

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Abstract

This paper studies the effects that borrowing constraints have on savings and growth and argues that, though they increase savings, their effect on growth is ambiguous. Empirical evidence on the extent of borrowing constraints as well as savings, investment, human capital accumulation and growth performance for industrialized countries is presented. A simple model to show the effects of borrowing constraints on savings is developed. Then the model is extended to analyze the effects of borrowing constraints on human capital accumulation and growth. It is shown that borrowing constraints increase savings, but reduce human capital accumulation.

JEL Classification Numbers:

E21, O16, O41

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Contents

		Page
I.	Introduction	1
II.	Savings and Capital Market Development: Italy in a Comparative Perspective	3
III.	Evidence on Growth, Productivity, Investment, and Human Capital	7
IV.	Individual Behavior and Borrowing Constraints	9
	1. Savings and consumption under perfect capital markets	10
	2. Savings and consumption in the presence of borrowing constraints	11
	3. Human capital accumulation and borrowing constraints	13
V.	Endogenous Growth and Borrowing Constraints	15
	1. Savings and growth under borrowing constraints	15
	2. Human capital accumulation and the productivity of capital	16
VI.	Conclusions	17

Tables

1.	Italy: Savings 1951-1990	4
2.	Savings in G7 Countries	5
3.	Indicators of Capital Market Development	7
4.	Investment and Growth in G7 Countries	11

Figures

1.	Earnings Profile, Italy, Japan, and the United States	10a
2.	Investment in Human Capital and Consumer Credit, OECD	12a
3.	Human Capital Investment and Downpayment, OECD	12b

References 23

I. Introduction

The determinants of savings have long been a fundamental concern of economists and policy makers. Renewed interest has arisen as a result of recent developments in the theory of economic growth that emphasize the importance of savings in sustaining long-run growth. Therefore, understanding savings behavior may help in providing policy guidelines to promote economic growth.

In the savings literature, an area that has received detailed attention is the effects of capital market imperfections on savings, in particular the effects of borrowing constraints. Most of that work argues that when individuals are not allowed to borrow against future income they will save more (or dissave less) than otherwise. 1/ Hence, although the connection with growth has not been generally made, one could conclude that the existence of borrowing constraints leads to higher growth. 2/ This paper examines this issue. First it is shown that borrowing constraints increase savings. Then, this result is incorporated in an endogenous growth model to illustrate other effects that borrowing constraints may have on growth. While growth may be favored by high savings rates, it may be hindered by a low productivity of capital. An important cause for this low productivity of physical capital is low investment in human capital. While borrowing constraints may increase savings, and hence physical capital accumulation, they are likely to reduce the accumulation of human capital.

Two clarifications about the scope of this paper must be made. First, this paper focuses on household behavior. Consequently, borrowing constraints are defined here as the inability of people to borrow against future income. The evidence presented later refers to households restrictions on credit markets, and the model developed in this paper assumes that, whereas firms have free access to capital markets, households may not be allowed to borrow. Therefore, in contrast to most of the literature on financial markets and economic growth, which centers on the relationship between financial development and the operation of firms, this paper shifts the focus to household behavior and its implications for growth. 3/ Second, borrowing constraints are assumed to be exogenous, and consequently, the paper does not provide microfoundations to characterize the source of these restrictions. One reason why borrowing constraints are observed across countries is that they are the result of informational problems. Financial intermediaries could voluntarily restrict the availability of credit (e.g., Stiglitz and Weiss, 1981). Another reason for

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1/ See, for example, Gersovitz (1988), and Hubbard and Judd (1986).

2/ Two exceptions are De Gregorio (1992), and Jappelli and Pagano (1991).

3/ For an overview of the different channels through financial markets affect growth and recent evidence on the positive relationship between financial market development and growth in a large cross section of countries see De Gregorio and Guidotti (1992), King and Levine (1992), and Roubini and Sala-i-Martin (1991).

the existence of borrowing constraints is that they are the result of government regulation. Since this paper considers that only households are borrowing constrained and it is unlikely that only households, and not firms, are subject to informational problems, it may be more appropriate to think of borrowing constraints, in the following analysis, as being the result of government intervention.

To highlight the importance of the issue of savings, growth and borrowing constraints, the paper presents evidence from industrialized countries. In particular, the Italian experience is a clear case where borrowing constraints have been associated with high savings rates. The paper also compares the degree of capital markets developments, savings, investment and growth rates across the G7 countries. Evidence on the correlation between human capital accumulation and the extent of borrowing constraints for OECD countries is also presented.

The paper is divided in six sections. Section II compares some indicators of capital market developments and savings in the major industrialized countries, with special emphasis on the Italian experience. An economy can experience high savings and investment rates, but can have low growth because what determines the rate of growth is a combination of investment and its marginal productivity. For this reason, Section III presents evidence on investment and growth for the G7 countries. It also presents evidence on investment in human capital and borrowing constraints in OECD countries. This evidence shows that the extent of borrowing constraints is negatively correlated with human capital accumulation.

Section IV presents a formal model of individual behavior based on the life cycle hypothesis (Modigliani and Blumberg, 1954) to analyze whether borrowing constraints increase aggregate savings. Most of the models on borrowing constraints and savings imply that when the constraints are binding, the individuals consume exactly their income, which is a conterfactual feature. 1/ In contrast, in the model presented in this paper young people increase their already positive savings rate when borrowing constraints are binding. The model shows that, in the aggregate, borrowing constraints increase savings. The model is then extended to show that although borrowing constraints can increase physical capital accumulation, they are likely to reduce human capital accumulation. Individuals have an incentive to work, instead of increasing their human capital, in order to maximize income when borrowing constraints are binding. Consequently, the effects of borrowing constraints on growth are uncertain. Section V incorporates individual behavior in a model of endogenous growth to discuss the implications of borrowing constraints on long-run growth. Finally, the conclusions are in Section VI.

1/ See Ando et al. (1991) for further details on this argument.

II. Savings and Capital Market Development: Italy in a Comparative Perspective

The behavior of the savings rate in Italy is characterized by two main facts. 1/ First, from an international perspective, the savings rate in Italy is high. Second, although still high by international standards, Italy's national savings rate has declined in the last decade at a faster pace than in other countries.

The main trends are shown in Table 1. Total gross savings declined moderately in the 1980s, owing entirely to a decline in public sector savings. 2/ In the private sector, the reduction in household gross savings has been offset by an increase in firms gross savings.

In terms of net savings (net of depreciation) there are, however, important differences. The most important is that after the peak of the 1960s, savings have declined substantially, from 22 percent to 14 percent. The difference lies in the increase of depreciation rates. This is the result of a shift in the composition of investment towards components with shorter lives. This fact is common to most countries (Table 2) and therefore it does not significantly change international comparisons at a given period of time when using gross instead of net savings rates. The difference emerges, however, when analyzing the evolution of savings over time.

The evolution of net savings reveals a strong negative correlation between savings of households and firms, but the decline in the savings rate of households has not been compensated by the increase in the savings rate of firms.

An international comparison of G7 countries is provided in Table 2. In the 1960s and 1970s only Japan had higher savings rate than Italy. In the 1980s Germany also had higher savings rate than Italy. Italy and Germany show the highest ratio between net savings and growth. These figures have been interpreted as a greater responsiveness of savings to income and hence indicate the existence of liquidity constraints. An alternative explanation, however, is that productivity of capital is lower when the ratio of savings to growth is high. Nevertheless, this explanation should be supported with evidence on investment rather than savings rates, an issue which is discussed in the next section.

1/ See Guiso, Jappelli, and Terlizzese (1991), and references therein.

2/ The figures in Table 1 correct savings of the public and private sector for inflation. The correction for inflation is the product of the inflation rate and the net stock of public debt. This correction does not change significantly the figures for aggregate savings, because of the small magnitude of the Italian net foreign position, but it affects the composition between public and private savings. For this reason a country can have a budget deficit but a positive savings rate for the government.

Table 1. Italy: Savings 1951-90

(In percent of GDP)

	1951-60	1961-70	1971-80	1981-90
Gross savings				
Total	27.8	30.6	30.0	26.9
Public	2.1	2.5	2.2	0.3
Private	25.7	28.1	27.8	26.5
Households	15.5	18.8	16.4	15.0
Firms	10.2	9.3	11.4	11.5
Net savings				
Total	18.8	22.1	19.0	13.6
Public	2.1	2.5	2.2	0.3
Private	16.8	19.7	16.8	13.5
Households	14.2	17.0	12.7	9.8
Firms	2.6	2.7	4.1	3.7
Rate of growth of GDP				
(percent)	5.6	5.6	3.9	2.2

Source: Bank of Italy. Savings data have been revised in Pagliano and Rossi (1991). Net savings discount depreciation.

Table 2. Savings in G7 countries

(In percent of GDP)

Average	1960s	1970s	1980s	
Canada				
Gross savings	21.9	22.9	20.7	21.8
Net savings	11.3	11.3	9.4	10.7
Net savings/growth	2.4	3.0	3.0	2.7
France				
Gross savings	26.2	25.8	20.4	24.1
Net savings	19.3	16.3	8.0	14.5
Net savings/growth	3.9	4.8	4.4	4.1
Germany				
Gross savings	27.3	24.3	22.5	24.7
Net savings	19.9	14.3	10.7	15.0
Net savings/growth	4.9	5.1	6.7	5.5
Italy				
Gross savings	28.1	25.9	21.9	25.3
Net savings	20.8	16.7	10.9	16.1
Net savings/growth	5.0	4.5	5.7	5.0
Japan				
Gross savings	34.5	34.3	31.6	33.3
Net savings	25.6	24.6	20.2	23.5
Net savings/growth	2.7	5.0	5.5	3.7
United Kingdom				
Gross savings	18.4	17.9	16.6	17.6
Net savings	11.2	8.2	6.2	8.5
Net savings/growth	4.3	4.6	1.9	3.5
United States				
Gross savings	19.7	19.4	16.3	18.5
Net savings	10.6	8.9	3.9	7.8
Net savings/growth	3.0	3.1	1.0	2.5

Source: Gross savings from Elmerskov, et al. (1990) and cover the period 1960-89. Net savings and Net savings/growth from Modigliani (1990) and cover 1960-87. Both studies are based on OECD, Annual National Accounts.

The leading explanation provided for the behavior of Italy's savings rate compared to that of other industrial countries is the relatively lower degree of development of Italy's capital markets in Italy. 1/ Table 3 provides some evidence to support this argument. In 1988 consumer credit in Italy was 4 percent of consumption expenditure, while the average for G7 countries is 14 percent. The largest percentage of consumption credit in 1988 was that of the United States, where it reached 23 percent. The short maturity of consumer loans and the large spread between borrowing and lending rates emerge as the main explanations for the small fraction of consumer credit in Italy.

The mortgage market is also much smaller in Italy than in other major OECD countries. The minimum downpayment is usually 50 percent, and by law it cannot be less than 25 percent. In contrast, average downpayment is 25 percent in the United States and Germany, 20 percent in Canada, and 15 percent in the United Kingdom. The only country with comparable downpayment is Japan, where the average is 35-40 percent. Maturity is also low in Italy, on average between 10 and 15 years. In contrast, in other G7 countries, such as Canada, the United States, and Germany, the average maturity is about 25 years. As a consequence, Italy's mortgage market is the smallest among G7 countries. Outstanding mortgage as a percentage of consumption expenditure is 4 percent in Italy, while the average for the G7 countries is about 44 percent.

The fact that the incidence of mortgage loans is low in Italy does not necessarily imply that the accumulation of savings for the purpose of buying a house is larger in Italy than in other developed countries. Mortgage market imperfections could also result in a low proportion of home-owners as percentage of total population. However, census data of the late 1970s and early 1980s reveal that in Italy the incidence of home-ownership is 59 percent, and the average for the G7 countries is 56 percent. The proportion of home-owners in younger cohorts in Italy is, however, small. Therefore, home-ownership in Italy is attained later in life than in countries like Canada, the United States, and the United Kingdom, because prospective owners have to accumulate a much larger amount of savings before being eligible to buy a house. The relative price of housing is also not significantly lower in Italy than in other industrialized countries. All this evidence confirms the fact that savings by Italy's young households to become home-owners is much larger than in other developed countries.

1/ This issue is analyzed in greater detail in Guiso, Jappelli, and Terlizzese (1991). The existence of liquidity constraints have also been used to explain savings behavior in the United States (e.g., Hubbard and Judd, 1986). The argument in this paper, however, refers to the relatively larger constraint in Italy's capital market vis-à-vis other G7 countries. See also Muelbauer and Murphy (1990) for the United Kingdom, and Lehmussaari (1990), and Koskela and Virén (1992) for Nordic countries.

Table 3. Indicators of Capital Market Development

	Consumer Credit Loans 1988 (1)	Housing Mortgage Loans 1982 (2)	Downpayment for Housing Mortgage Loans (3)	Owner-Occupation Percentage (4)	Share of Population Liquidity Constrained (5)	Insurance Premiums to National Income (6)
Canada	22	60	20	62	--	5.4
France	8	44	--	47	--	5.1
Germany	15	65	25	37	--	6.4
Italy	4	6	40-50	59	58	2.4
Japan	18	25	35-40	60	34	8.7
United Kingdom	10	45	15	59	40	8.4
United States	23	61	11-33	65	21	9.1
Average	14	44	--	56	--	6.5

Sources: (1)-(3) and (6) from Guiso, Jappelli and Terlizzese (1991); (4) from Boleat (1985); and (5) from Jappelli and Pagano (1989).

Notes: (1) and (2) as a percentage of consumer expenditures; (3), (5) and (6), percent; and (4) figures for 1978-81.

The insurance market in Italy is also relatively small compared to that other developed countries. The ratio of insurance premiums to GNP in 1987 was 6.5 percent in the G7 and 5.5 percent in the OECD countries, but 2.4 percent in Italy. The difference is even greater in terms of life insurance premiums, where the average for the OECD is 2.9 percent, while for Italy it is 0.5 percent. Cross-country comparisons reveal also that the small size of Italy's insurance market is not the result of large public provision of insurance.

Table 3 also presents some evidence on the proportion of the population which is liquidity constrained. These measures are indirect, and they are based on the estimation of Euler equations to measure the excess sensitivity of consumption to current income performed by Jappelli and Pagano (1989) for a sample of OECD countries. These estimates show that while in the United States the proportion of liquidity-constrained individuals is about 20 percent, in Italy this proportion is close to 60 percent. Moreover, the proportion of households which are liquidity constrained in Italy is even greater than those of Greece and Spain (52 percent and 54 percent, respectively). 1/

Overall, the imperfections in capital markets, in the form of credit restrictions, account for most of the difference of Italy's savings rate compared to that of other industrial countries. Young people have to make a large savings effort to finance consumption, since the ability to borrow from future income is constrained. Similarly, the lack of insurance induces a greater proportion of precautionary savings, since people are not be able to insure against unexpected changes in expenditure and income.

There may be other reasons why Italy's savings rate is high, which deserve mentioning. First, Italy's savings rate could be high because of a strong bequest motive. 2/ This explanation, however, is not supported by empirical evidence (Barca, Cannari, and Guiso, 1989) which shows that bequeathed wealth in Italy accounts for 20 percent to 30 percent of aggregate wealth, which is not high compared to the United States.

1/ See also Campbell and Mankiw (1991) for additional estimates of the fraction of people that is subject to borrowing constraints and comparisons with related studies. However, the evidence from Jappelli and Pagano (1989), and Campbell and Mankiw (1991) has to be interpreted with caution. They identify liquidity constraint individuals with those that consume all of their income. As discussed in this paper, and the evidence from Ando et al. (1991) confirm, individuals subject to borrowing constraints do not necessarily consume all of their income. For consumption to be equal to income it is also necessary to have lending constraints, which do not exist. Finally, the expressions borrowing constraints and liquidity constraints are used interchangeably.

2/ This appears to be an important explanation for Japan's savings rate (Hayashi, 1986).

Other reason for high savings could be that in Italy the earnings profile is flatter than in other countries. Not only a flat individual earnings profile, but also the age structure of the population may cause an aggregate flat income profile. A flat income profile may lead young households to borrow (dissave) less against future income to achieve a smooth consumption path. Figure 1 compares earnings profiles for Italy, the United States, and Japan. Income is corrected by productivity growth to reflect more appropriately the path of income faced by individuals. Italy's earnings profile is flatter than Japan's profile, but is steeper than that of the United States, which does not lend support to the view that a flat incomes profile in Italy explains its relative savings performance.

It could also be argued that intergenerational transfers could overcome capital markets imperfections. Therefore, the extent of capital market imperfections would have no effect on savings. This aspect has been analyzed using survey data in Guiso and Jappelli (1989). They conclude that inter-vivos transfers help to reduce the extent of borrowing constraints, but that there is still a significant fraction of liquidity-constrained households.

Finally, Ando et al. (1991) have shown that in Japan and Italy young households dissave too little compared to the predictions of standard life cycle hypothesis. In fact, they show that households save even when they are young and their income is relatively low. This could be consistent with the existence of liquidity constraints, but they argue that binding liquidity constraints for young people imply consumption equal income, and not positive savings. To explain this behavior, they develop a theory of "consumption lumping," based on the random occurrence of future consumption opportunities not available today. However, the "consumption lumping" explanation of Italy's relatively high savings rate does not explain why there is more consumption lumping in Italy compared to other countries with lower savings rates. Furthermore, buying a house with a relatively small loan can also be interpreted as consumption lumping, but its origin is the inability to borrow against future income and not the random occurrence of consumption needs.

Can the degree of development of the capital market explain cross-country behavior of savings besides Italy? Although additional determinants of savings, as well as additional countries, should be considered for more formal statistical analysis, a look at the data from Tables 2 and 3 provide some indications.

Canada and the United States appear to be the countries with the most developed capital markets, form all the indicators shown in Table 3. They also are among the countries with the lowest savings rates. The exception is the United Kingdom, which has a low savings rate, but a relatively less developed capital market. Japan is another country for which the availability of credit for consumption cannot account, by itself, for its high savings rate. Japan has the highest savings rate and is about average

in terms of development of its capital market. Finally, France and Germany are about average in both, capital market developments and savings rate.

Jappelli and Pagano (1991) estimate savings equations for OECD countries, with measures of downpayment and consumer credit as explanatory variables. They find evidence that borrowing constraints have a positive effect on the savings rate.

III. Evidence on Growth, Productivity, Investment, and Human Capital

Unless financial markets are fully integrated, a high rate of national savings will ultimately be translated in a high investment rate. Table 4 presents data on investment for the G7 countries. The figures from Tables 2 and 4 show a high correlation between savings and investment, consistent with the Feldstein-Horioka findings. 1/ It is beyond the scope of this paper to explain this correlation. Instead, it is taken as a fact that the availability of national savings is a determinant of investment rates, and therefore, the rate of growth. This is also one of the main reasons why the study of the determinants of national savings is particularly relevant: national savings is to a large extent a determinant of investment and growth performance.

Table 4 presents cross-country evidence on investment and growth. Data have been taken from Summers and Heston (1991). They are expressed in international prices of 1985 and extend through 1988. The use of a common price basket facilitates international comparisons. Japan and Italy, the countries with the highest savings rate, are also the ones with the highest investment and growth rates. The United Kingdom and the United States have experienced the lowest investment rates and the lowest growth rates. Germany has also been one of the countries with the poorest growth performance between 1960 and 1988, but this is mainly due to the steep decline of its growth rate during the 1980s, despite having comparatively high savings and investment rates.

The savings-investment correlation indicate that an increase in national savings will be accompanied by an increase in investment. Higher investment will in turn foster growth. High growth rates, however, may be the result of not only high investment rates, but also high productivity of investment. In Table 4, the last line for each country is the coefficient of growth over investment. This is a crude measure of the productivity of investment, but the figures show two interesting facts. First, there are significant dissimilarities across countries and over time. Second, the

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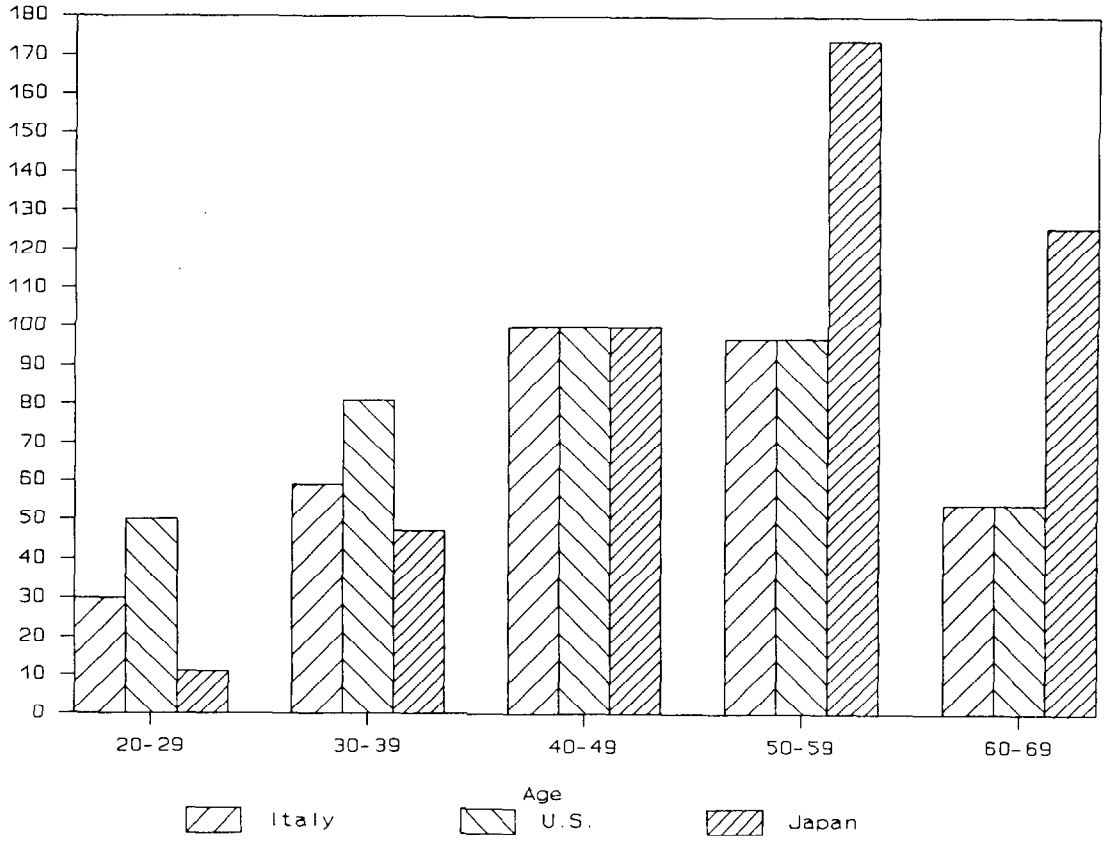
1/ For the data in tables 2 and 4, the coefficient of a regression of investment on savings is 0.86, and is not significantly different from one. For recent discussion on this topic see Bayoumi (1990), Feldstein and Bacchetta (1991), and Frankel (1991).

Figure 1: Earnings Profile, Italy, Japan, and the United States

(Index, age group 40-49 = 100)



Source: Guiso, Jappelli and Terlizzese (1991). The earnings profiles are corrected by productivity growth.

Table 4. Investment and Growth in G7 Countries

(Percent)

	1960s	1970s	1980s	Average
Canada				
GDP growth	5.1	4.0	3.0	4.1
GDP per-cap. growth	3.2	2.8	1.9	2.7
Gross investment	21.5	22.4	24.3	22.7
Growth/investment	0.24	0.18	0.12	0.18
France				
GDP growth	5.7	3.5	1.6	3.7
GDP per-cap. growth	4.6	2.9	1.1	2.9
Gross investment	24.7	28.2	24.2	25.8
Growth/investment	0.23	0.13	0.07	0.14
Germany				
GDP growth	4.8	2.9	1.4	3.1
GDP per-cap. growth	3.9	2.7	1.5	2.7
Gross investment	29.9	27.1	24.0	27.1
Growth/investment	0.16	0.11	0.06	0.11
Italy				
GDP growth	5.7	4.0	2.6	4.2
GDP per-cap. growth	5.0	3.5	2.4	3.6
Gross investment	31.0	28.6	24.3	28.9
Growth/investment	0.18	0.14	0.11	0.15
Japan				
GDP growth	10.6	5.1	3.6	6.5
GDP per-cap. growth	9.5	3.9	3.0	5.5
Gross investment	27.3	34.7	29.6	30.6
Growth/investment	0.39	0.15	0.12	0.22
United Kingdom				
GDP growth	2.9	2.5	2.5	2.7
GDP per-cap. growth	2.3	2.4	2.3	2.4
Gross investment	17.3	19.2	17.2	17.9
Growth/investment	0.17	0.13	0.14	0.15
United States				
GDP growth	4.1	2.8	2.9	3.3
GDP per-cap. growth	2.8	1.7	1.9	2.1
Gross investment	16.2	17.1	18.0	17.1
Growth/investment	0.25	0.16	0.16	0.20

Source: Summers and Heston (1991). All data are in 1985 international prices.

growth-investment ratio has declined persistently since the 1960s. That is, the investment requirements for the same rate of growth have increased over time.

Across countries, Table 4 shows that the four European countries of the G7 countries have had the lowest coefficient for the period 1960-88. A similar pattern is observed when every decade is considered separately. The case of Italy is interesting, because in spite of being the second ranked in terms of savings, investment and growth, it is the fourth in terms of the growth-investment ratio. Japan has the highest coefficient in the 1960s, and Canada and the United States in the 1970s and 1980s, respectively.

There are certainly many reasons that explain the disparities in the productivity of investment across countries. The next sections discuss how capital market imperfections, in particular the existence of borrowing constraints, can account for a reduction in the productivity of investment. The main channel emphasized later on is the effect of capital market imperfections on human capital accumulation.

As it will be shown later, the existence of borrowing constraints may induce agents to reduce their time devoted to human capital accumulation and to increase time devoted to work. The reason is that borrowing constraints increase the opportunity cost of receiving education, since the marginal utility of current income increases.

To complete a review of relevant facts on the effects of borrowing constraints, some evidence on the extent of borrowing constraints and investment in human capital is presented in Figures 2 and 3. Those figures plot measures of capital market imperfections and investment in human capital for OECD countries. 1/ The data for investment in human capital were taken from Mankiw, Romer, and Weil (1992) and represent, approximately, the average percentage of the working-age population that is in secondary school for the period 1960-85. It is constructed as the product of the fraction of the eligible population enrolled in secondary school (UNESCO) and the fraction of the working-age population that is of school age. For the degree of development of capital market the data were taken from Jappelli and Pagano (1991). Figure 2 uses the ratio between consumer credit and net national product for 1980, and Figure 3 uses the minimum downpayment as a percentage of the house price for the 1970s.

Consumer credit displays a strong positive correlation with investment in human capital. To a lesser extent, the downpayment as a fraction of the price of housing displays a negative correlation with investment in human capital. Therefore, borrowing constraints appear to be negatively correlated with human capital accumulation. The evidence is, naturally, not conclusive and could reflect spurious correlation. In particular, the measure of investment in human capital is imperfect. In OECD countries

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1/ The only outlier excluded from the sample is Sweden.

Figure 2: Investment in Human Capital and Consumer Credit, OECD

(Percent)

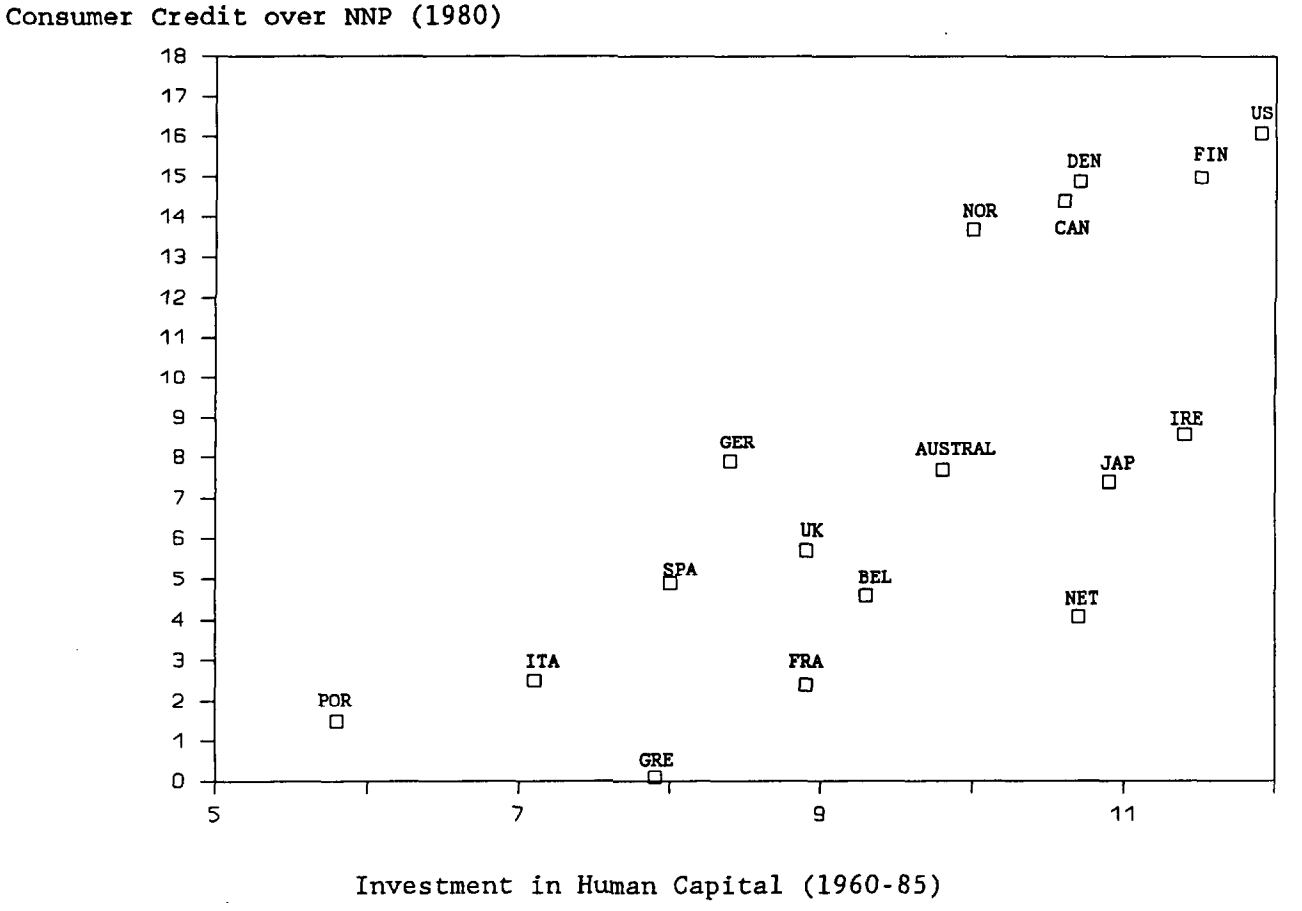
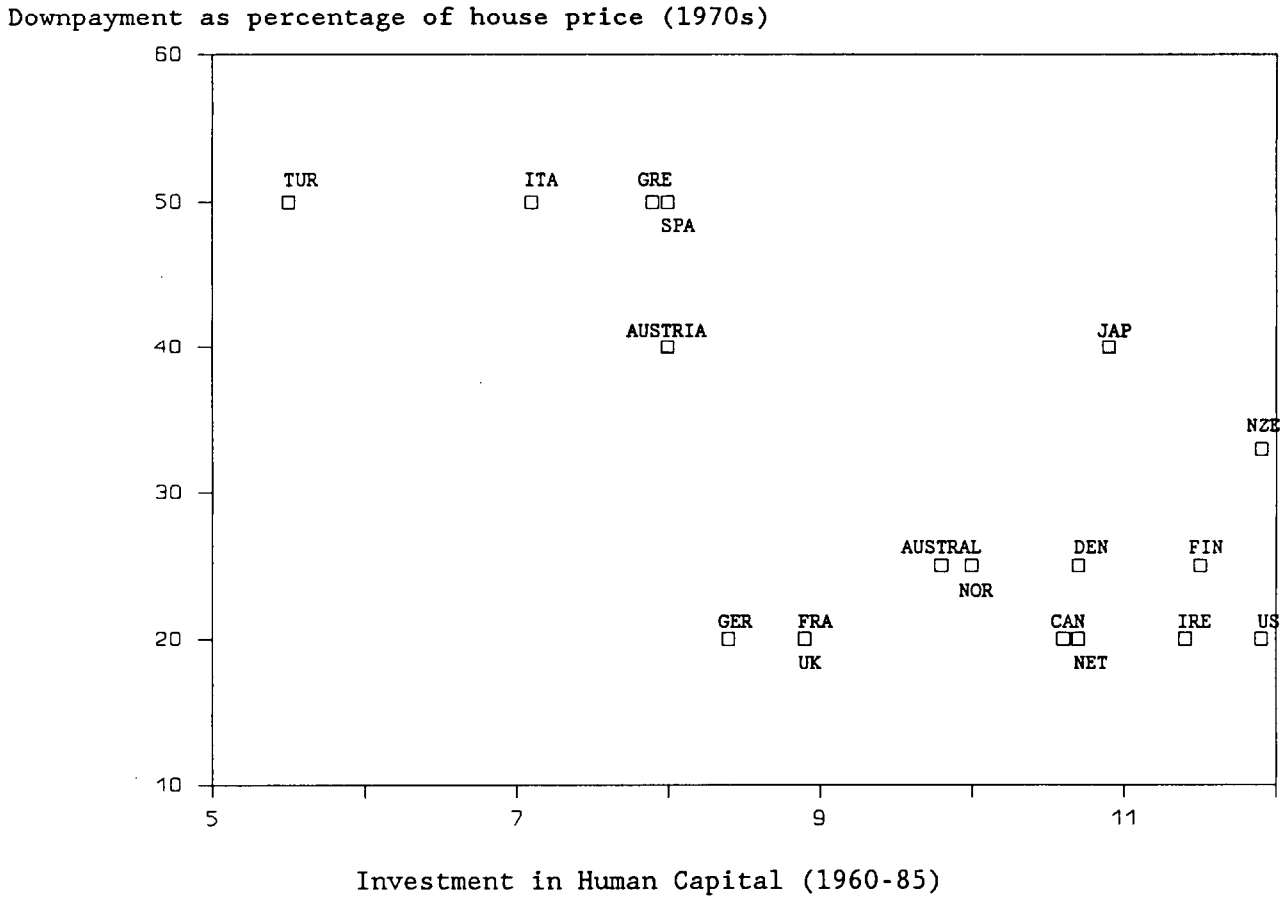


Figure 3: Human Capital Investment and Downpayment, OECD

(Percent)



secondary schooling is high and a measure on advanced education (tertiary schooling) could be a better proxy for human capital accumulation. De Gregorio (1992) provides econometric evidence on the effects of borrowing constraints on human capital accumulation using indices of secondary and tertiary school enrollment, and controlling for other relevant determinants of human capital accumulation. The results are consistent with the correlations shown in Figures 2 and 3. It is also worth to note that the correlations hold independently of the level of development. In fact, excluding (or leaving alone) the G5 or G7 countries does not change the conclusions.

IV. Individual Behavior and Borrowing Constraints

This section presents a three period overlapping generation (OLG) model to show that the existence of borrowing constraints leads to higher savings and lower human capital accumulation than in an economy with perfect capital markets. The basic model considers income growth as exogenous. The next section incorporates a production side in order to discuss the effects of borrowing constraints on investment and growth.

Consider a representative agent born at time t, that lives for three periods (young, middle age, and old) and has the following utility function:

$$u_t = \log(c_{t,t}) + \beta \log(c_{t,t+1}) + \beta^2 \log(c_{t,t+2}), \qquad (1)$$

where $c_{t,t'}$ is consumption at period t' of an individual born at t and β is the discount factor. Individuals are assumed to receive income in the first and the third period of their life. More concretely, it is assumed that a proportion θ of total human wealth (W_t) is received during the first period and $(1-\theta)W_t$ is received when old. Since human wealth is the present discounted value of labor income, first period income is θW_t and third period income is $(1-\theta)(1+r)^2 W_t$, where r is the interest rate. 1/ During the second period income is zero. Although this assumption may appear not realistic it is the simplest one that makes consumption in the second period to be financed out of first period savings and borrowing against third period income.

Traditionally, borrowing constraints for individuals facing an increasing income stream result in a consumption path equal to the income path. The assumption made here, however, intends to capture the fact that young households have positive savings, motivated to a large extent for the need of buying a large indivisible and expensive durable good in the middle

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1/ This is equivalent to assume that labor is inelastically supplied. Normalizing first period labor supply to one, third period labor supply, in efficiency units, has to be equal to $(1-\theta)(1+r)^2/\theta$.

age. The most important case is housing. The inability to borrow can be interpreted as the requirement of a high downpayment. 1/

1. Savings and consumption under perfect capital markets

The first case to be discussed is when individuals do not face borrowing constraints. In this case, the individual faces one intertemporal budget constraint, by being allowed to lend and borrow in order to transfer income from one period to another, that makes the present discounted value of consumption equal to total wealth:

$$c_{t,t} + \frac{c_{t,t+1}}{1+r} + \frac{c_{t,t+2}}{(1+r)^2} = W_t. \tag{2}$$

The consumer maximizes (1) subject to equation (2), which yields the following expressions for consumption:

$$c_{t,t} = \frac{W_t}{B}, \tag{3}$$

$$c_{t,t+1} = (1+r)\beta\frac{W_t}{B} \tag{4}$$

and

$$c_{t,t+2} = (1+r)^2\beta^2\frac{W_t}{B}, \tag{5}$$

where B is equal to $1+\beta+\beta^2$. The path of consumption is independent of θ, since the timing of income, adjusted by the interest rate, does not matter when the individual is allowed to transfer income across periods through the capital market.

Savings in the first period of life are:

1/ The model could be extended to allow positive second period income and an increasing earnings profile. For this purpose it would be enough to assume that in the second period the consumer has to decide whether or not to purchase an indivisible good, D, at a relative price P_D--in addition to $c_{t,t+1}$. D would also report utility. For utility functions such that the purchase of this good is made (e.g., log(D)), total spending in the second period would be $P_D D + c_{t,t+1}$. Therefore, the same results that are discussed in the rest of the section would be obtained by assuming that second period spending is greater than second period income.

$$S_{t,t} = (\theta B-1)\frac{W_t}{B}, \tag{6}$$

and savings in the second period are:

$$S_{t,t+1} = (1+r)(\theta B-1-\beta)\frac{W_t}{B}. \tag{7}$$

According to equation (6), savings in the first period will be positive if $\theta B > 1$, that is, if the share of total wealth received when young, corrected by the discount factor, is large enough so the individual will want to transfer some part of income for future consumption. By equation (7), savings in the second period will be negative if $\theta B < 1+\beta$, that is, if income in the first period is not too large, otherwise first period income would be transferred not only for second period consumption but also for third period consumption. Since the interest of this paper is in an economy in which second period consumption is financed by both, first and third period income (savings and borrowing), in what follows it is assumed that $1 < \theta B < 1+\beta$. Finally, savings of old individuals are equal to zero since, in the absence of bequest motive and uncertainty, they consume all of their income.

2. Savings and consumption in the presence of borrowing constraints

When individuals are not allowed to borrow against future income the utility function is still (1), but the budget constraint cannot longer be written as (2). In the case of borrowing constraints, the individual will have the following two budget constraints:

$$c_1 + \frac{c_2}{1+r} = \theta W_t \tag{8}$$

and

$$c_3 = (1+r)^2(1-\theta)W_t. \tag{9}$$

The first constraint sets the present value of consumption during the first two periods equal to income in the first period. Equation (9) sets third period consumption equal to income. Because of borrowing constraints (8) and (9) cannot be collapsed into one intertemporal budget constraint. The problem is solved by maximizing utility for the first two periods subject to equation (8), and then setting consumption when old equal to current income. The resulting consumption path for the borrowing constrained individual is (a bar over the variables will be used to denote values for the case of borrowing constraints):

$$\bar{c}_{t,t} = \theta \frac{W_t}{1+\beta}, \tag{10}$$

$$\bar{c}_{t,t+1} = \theta\beta W_t \frac{1+r}{1+\beta} \tag{11}$$

and

$$\bar{c}_{t,t+2} = (1+r)^2(1-\theta)W_t. \tag{12}$$

First period savings will be given by:

$$\bar{S}_{t,t} = \theta\beta \frac{W_t}{1+\beta}. \tag{13}$$

Because $1 < \theta B < 1+\beta$ borrowing constraints are binding and it can immediately be verified that $S_{t,t} < \bar{S}_{t,t}$. During the first period the consumer will save more when borrowing constraints are binding. The intuition is that the individual will need higher savings in the first period to smooth second period consumption.

Comparing equations (4) and (11) can also be checked that $S_{t,t+1} < \bar{S}_{t,t+1}$. To aggregate, it is necessary to add savings over all cohorts. Since in both cases old generation savings is equal to zero, aggregate savings in the economy subject to borrowing constraints is greater than total savings in the economy with perfect capital markets, i.e.,

$$\bar{S}_t \equiv \sum_{j=0}^{2} \bar{S}_{t-j,t} > S_t \equiv \sum_{j=0}^{2} S_{t-j,t}. \tag{14}$$

The intuition for this result is simple and quite general. The effects of borrowing constraints can be separated in three stages: before, at the moment, and after borrowing constraints are binding. First, borrowing constraints increase savings in anticipation of future consumption needs that cannot be financed through credit. Second, when borrowing constraints are binding dissavings (borrowing) will be lower. And third, borrowing constraints have no effects on savings of the old generation.

Note that this analysis is contrary to the view associated with McKinnon (1973) and Shaw (1973) that argues that financial liberalization, by increasing interest rates, will increase savings. In contrast, in this model, financial liberalization allows people to anticipate consumption by borrowing against future income, with a consequent reduction in savings.

3. Human capital accumulation and borrowing constraints

This subsection extends the previous framework to discuss the effects of borrowing constraints on human capital accumulation, which could ultimately affect the productivity of capital and the rate of growth.

There is an straightforward way in which borrowing constraints affect human capital accumulation. This is the case where human capital accumulation is costly. However, the channel explored in this section is a different one, and does not rely on borrowing constraints for education because education is assumed to be provided free of charge.

Young people have to allocate their non-leisure time between education and work. In the absence of borrowing constraints individuals choose the activity that yields the higher present value of income (human wealth). In contrast, under borrowing constraints, individuals end up choosing a combination work-education that yields higher current income than in the absence of borrowing constraints, and hence does not maximize human wealth. The reason why borrowing constraints reduce human capital accumulation is that the returns on education are received after borrowing constraints are binding. Thus, individuals may choose a lower level of education in order to increase labor income to finance present consumption. This is the argument developed formally in the remaining of this section.

Consider again the consumer with utility function (1). In addition, when young, the individual has to choose how much time to spend accumulating human capital and how much to work. The return on physical capital come at the period immediately after savings are made, but the return on human capital are received two periods later, when borrowing constraints are no longer binding. The individual has one unit of time which has to be allocated to study h units of time and to work 1-h at a wage ω_t. By studying, the individual is able to supply f(h) units of labor when old, where $f'>0$ and $f''<0$. Therefore, third period income will be equal to $\omega_{t+2}f(h)$. 1/

For the individual without borrowing constraints the intertemporal budget constraint is given by:

$$c_{t,t}+\frac{c_{t,t+1}}{1+r}+\frac{c_{t,t+2}}{(1+r)^2}=\omega_t(1-h)+\frac{\omega_{t+2}f(h)}{(1+r)^2}. \tag{15}$$

To focus on the case where accumulation of human capital always increases current value of future income, it is assumed that $\omega_t(1-h) < \omega_{t+2}f(h)$, for all h. The first order conditions for the optimal level of education is:

1/ See De Gregorio (1992) for a general equilibrium model of growth with human capital accumulation and linear returns to education.

$$\omega_t = \frac{\omega_{t+2} f'(h)}{(1+r)^2} . \tag{16}$$

It will be shown that when individuals are not allowed to borrow, they will accumulate less human capital, which could cause a lower rate of growth. Although education is free, its opportunity cost is equal to ω_t, since it reduces current income when young. Therefore, individuals will invest less in human capital than when capital markets are perfect.

The budget constraints for an individual not allowed to borrow are now given by:

$$c_1 + \frac{c_2}{1+r} = \omega_t(1-h) \tag{17}$$

and

$$c_3 = \omega_t f(h) . \tag{18}$$

The first order conditions for the optimal choice of h is:

$$\omega_t = \omega_{t+2} f'(\bar{h}) \frac{\eta}{\lambda} , \tag{19}$$

where λ and η are the Lagrange multipliers associated with (17) and (18), respectively. Using the other (not presented) first order conditions it can be shown that η/λ is equal to $\beta^2\bar{h}\omega_t/[(1+\beta)f(\bar{h})\omega_{t+2}]$, which after being substituted in (19) yields the following optimal choice for $\bar{h}$:

$$\frac{\beta^2}{1+\beta}(1-\bar{h})f'(\bar{h}) = f(\bar{h}) . \tag{20}$$

Note that in this case the values of ω_t and ω_{t+2} do not matter for the optimal choice of h. The reason is that at the optimum h is chosen such that income and substitution effects exactly offset each other.

Given that $\omega_t(1-h)<\omega_{t+2}f(h)$, it can be shown that the following inequalities hold:

$$F(h) \equiv (1-h)f'(h)/f(h) < 1 < (1-\bar{h})f'(\bar{h})/f(\bar{h}) \equiv F(\bar{h}) . \tag{21}$$

It is easy to check that F(h) is a decreasing function of h (because $f'(h)>0$ and $f''(h)<0$), then we have that:

$$\bar{h} < h \tag{22}$$

This result is important because it shows that though borrowing constraints increase the accumulation of physical capital, they decrease the accumulation of human capital. The main difference between human and

physical capital accumulation is that the former involves a trade-off with labor income, since to accumulate human capital it is necessary to reduce employment, while the latter does not have effects on labor supply decisions.

V. Endogenous Growth and Borrowing Constraints

This section extends the discussion from the effects of borrowing constraints on individual behavior to their impact on growth. The discussion starts by focusing on the effects of physical capital accumulation on growth. Then, the discussion is extended to consider the effects of human capital.

1. Savings and growth under borrowing constraints

The production side of the economy is modelled following Romer (1986). At a firm level, production exhibits constant returns to scale and for simplicity is assumed to be Cobb-Douglas in labor (ℓ) and capital (k), $\Phi k^{1-\alpha}\ell^{\alpha}$, where the parameter representing the state of technology, Φ, can be interpreted as public knowledge. Public knowledge, in turn, depends on the aggregate capital stock. In particular, increases in aggregate capital increase public knowledge. The idea behind this formulation is that investment increases public knowledge, which cannot be appropriated by the investor and is transferred to the whole economy. In this view, capital has to be interpreted as a broad concept of capital, but we start by considering capital to be only physical capital. Specifically, the aggregate production function in the economy is assumed to be:

$$y = \phi \hat{k}^{\alpha} k^{1-\alpha} \ell^{\alpha}, \tag{23}$$

where $\hat{k}$ is average capital per worker, and Φ is equal to $\phi\hat{k}^{\alpha}$. Since firms are relatively small $\hat{k}$ is not under their control, so they do not consider the effect that k has on $\hat{k}$. This externality makes possible a competitive equilibrium with permanent growth.

Each generation is assumed to be of unitary size (there is no population growth), and, as discussed earlier, only the young and the old supply inelastically their labor endowment (ℓ=2). The equilibrium wage rate will then be equal to $\phi\alpha k/2$ and the equilibrium interest rate will be equal to $\phi(1-\alpha)$. 1/

1/ In equilibrium $\hat{k}$ is equal to k/ℓ and ϕ is the social marginal productivity of capital. The social productivity of investment, which differs from private productivity ($\phi(1-\alpha)$) because of the externality.

In the economy with borrowing constraints, aggregate savings will be given by equation (13), where θW will be labor income of the young generation, $\phi\alpha k_t/2$: 1/

$$S_t = \frac{\phi\alpha k_t}{2}\frac{\beta}{1+\beta}. \tag{24}$$

Equilibrium in the capital market implies that savings equal the capital stock available for production in the following period ($S_t=k_{t+1}$). 2/ Then, equation (24) also corresponds to the expression for k_{t+1}. It is possible to show that in a steady state growth path, income, consumption and capital, all grow at the same rate (γ), which will be given by:

$$\gamma = \frac{\phi\alpha}{2}\frac{\beta}{1+\beta}-1, \tag{25}$$

and is positive for ϕ large enough, which is assumed to be the case.

The resulting savings rate in this model (S/y) is $\alpha\beta/2(1+\beta)$, which as discussed before is higher than in the case of no-borrowing constraints. If borrowing constraints have no effect on the production side of the economy the growth rate will be unambiguously higher when borrowing constraints are binding. However, capital market imperfections also introduce inefficiencies in the allocation of credit, and hence they could end up reducing the rate of growth. This argument could be interpreted as borrowing constraints having effects on ϕ, which corresponds to the social marginal productivity of capital (after replacing $\hat{k}$ by k). Since the model does not incorporate explicitly the role of capital market imperfections on the allocation of capital, one can presume, following Roubini and Sala-i-Martin (1991), that ϕ will be negatively related to the degree of the capital market distortions. Therefore, the borrowing-constrained economy could have a larger savings rate but a lower growth rate than the unconstrained economy.

2. Human capital accumulation and the productivity of capital

A simple way to capture the effects of human capital on growth is to assume that the relevant labor input in the production function is effective units of labor, which corresponds to total labor inputs adjusted by the level of skills (human capital). Denoting by H the stock of human capital, equation (23) can be modified to:

1/ The analytics for the case of perfect capital markets are not presented because there is no closed form solutions for the rate of growth.

2/ This framework could also be used to analyze the effects of public debt on growth by noting that in the presence of public debt total financial wealth is equal to the stock of capital plus the stock of public debt.

$$y = \phi \hat{k}^{\alpha} k^{1-\alpha} (H\ell)^{\alpha}. \tag{26}$$

Recalling that $\hat{k}$ represent average capital per-worker (k/ℓ), total output corresponds to:

$$y = \phi k H^{\alpha}. \tag{27}$$

According to (27) the social marginal productivity of capital is equal to ϕH^{α}, and therefore, it is affected positively by the stock of human capital accumulation. Thus, an economy with low human capital accumulation may end up having a low rate of growth despite having a high savings rate.

To find an expression for the rate of growth it is necessary to make some assumption about human capital accumulation. For this purpose, it is assumed that education is the engine of human capital growth. In particular, the evolution of human capital is assumed to follow (Lucas, 1988):

$$H_t = H_{t-1}(1+h), \tag{28}$$

that is, the rate of growth of human capital accumulation is equal to time devoted to education. Differentiating equation (27) and combining with (28), the following expression for the rate of growth is obtained:

$$\gamma = \alpha h + \gamma_k, \tag{29}$$

where γ_k denotes the rate of growth of physical capital.

According to (29) output growth results from a combination of physical and human capital growth. Although borrowing constraints increase physical capital accumulation (high γ_k) they also reduce time devoted to human capital accumulation (h), and therefore, the total effect of borrowing constraints on growth is ambiguous.

VI. Conclusions

This paper has shown that an economy with borrowing constraints will have a higher savings rate than an economy where individuals can freely borrow in order to smooth consumption. The effects on growth are, however, less clear. In a simple framework where savings drive growth, the higher savings rate of an economy subject to borrowing constraints will lead to higher growth. There may be, however, additional effects not considered in the simplest model.

The existence of borrowing constraint may have a negative effect on human capital accumulation. The argument developed in the paper is that individuals will prefer to devote a larger fraction of their non-leisure time to work rather than accumulate human capital. The empirical evidence

reveals that in fact there is a negative correlation between the extent of borrowing constraints and investment in human capital.

The welfare implications of borrowing constraints are ambiguous. They have two effects on welfare. There is a distortion in the intertemporal allocation of consumption which is welfare reducing, but there is also a growth effect. If the rate of growth of the economy declines as the result of borrowing constraints, because of low human capital accumulation, welfare will unambiguously fall. If growth rises, there is a positive effect. In this case there is a conflict between distorting the intertemporal allocation of consumption and increasing the rate of growth of consumption. In the long run one can expect the growth effect to dominate. But, the main short-run effects of borrowing constraints will be to reduce the extent of consumption smoothing.

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