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SOCIAL SECURITY AND GROWTH:
NEW EMPIRICAL EVIDENCE

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Social Security and Growth: New Empirical Evidence

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Abstract

In this paper, we show that the positive estimated coefficient of average social security expenditure, often detected in cross-country growth regressions, can not be imputed to reverse causation, that is on economic growth pulling social security expenditure, nor to omitted variables or to other misspecification problems. Moreover, we show that the positive effect of social security expenditure on growth is much stronger in poor countries than in rich countries. As for the channels through which the positive effect of social security expenditure on growth takes place, our results point out that social security influences human capital formation. On the other hand, we do not find support for theories claiming that generous social security benefits should enhance investment productivity and growth by inducing retirement of umproductive workers or by improving political stability and social cohesion.

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1. Introduction

One widely-accepted prediction of most economic growth models is that purely redistributive policies have a depressive effect on physical capital accumulation and growth, since they imply a reduction of national savings and national investment.

In particular, it is usually argued that intergenerational redistributive policies, such as social security programs, displace private savings and crowd out national investment, while other types of redistributive expenditures, such as welfare programs, imply a reduction of national investment, since they are financed through distortionary taxes. On the grounds of similar arguments, various reforms of the Welfare State are often invoked by growth-oriented policy-makers and advisers.[1]

Yet, when turning to the empirical analysis of the relation between redistributive expenditure and growth, one is quite surprised to find out that the data do not support these predictions. Following the seminal work of Feldstein [15], a substantial amount of research has been devoted to determine if social security expenditure indeed has a negative effect on savings, using both time-series and cross-country data. However, as argued by Aaron [1], who extensively surveys empirical work in this direction, the results of this approach do not strongly support the presumption that private savings are displaced by social security. A complementary approach tries to determine if variations in social security benefits can explain international differences in the average income growth rate. By including social security expenditure among explanatory variables of the average GDP growth rate in cross-country regressions, Barro [4], Perotti [22] and Sala-i-Martin[26] obtain some preliminary results, pointing out that social security expenditure bears a positive, rather than a negative, association with growth. Similar results are obtained by Cashin [13], who finds evidence of a positive effect from transfers to growth for a set of OECD countries, by using a time-series cross-sectional approach.

The goal of this paper is to determine if the positive association between social security expenditure and growth detected in growth regressions is due to misspecification errors implying an upward bias of the estimated coefficient of social security expenditure, or if it must be interpreted as evidence that redistributive expenditure has a positive effect on growth. Indeed, even from a theoretical point of view, the relation between social security expenditure and growth is not unambiguously negative. On the contrary, there are a few models predicting a positive effect of redistributive expenditure on growth. As argued by Feldstein [15], social security may influence positively savings, and therefore growth, if it induces earlier retirement. Moreover, social security expenditure may have a positive effect on the level and productivity of investment, and therefore on growth, if it is seen as a part of a social compact which enhances social cohesion and political stability, as suggested by Sala-i-Martin [25], or if it is a way to bribe unproductive workers out of the labor force, as in Sala-i-Martin [26], or if it provides incentives to invest more in human capital and infrastructure, as in Becker [10] and Bellettini and Berti-Ceroni [11] and Buiter and Kletzer [12].

[1] See, for instance, Feldstein [16].

Our empirical analysis shows that the positive association between social security expenditure and growth detected in cross-sectional studies can not be imputed to reverse causation, that is on economic growth pulling social security expenditure, nor to the effect of potentially relevant omitted variables, nor it can be explained by the inclusion in the sample of some country with "abnormally" small (large) social security programs and low (high) growth. Our specification tests also provide evidence of the importance to correct for potentially different behavior between rich and poor countries. In particular, we find that the effect of transfers on growth is four times as large in poor countries than in rich countries. Having established the empirical robustness of the positive association between social security and growth found in cross-sectional studies, we proceed to pin down empirically the mechanisms through which social security may foster growth. We obtain some evidence in favor of explanations implying a positive effect of social security on the productivity (rather than on the level) of investment in physical capital and in favor of arguments such that social security expenditure is beneficial for growth since it fosters investment in human capital. Explanations based on the idea that generous social security benefits should enhance investment productivity since they induce retirement of umproductive workers or since they improve political stability and social cohesion are not equally supported by our empirical analysis.

Our paper contributes to the recent empirical literature on the determinants of long run growth. The obvious reference is therefore the empirical section of the huge work on growth by Barro and Sala-i-Martin [8], which we take as a benchmark for our analysis. Other related papers, besides those of Barro [4], Cashin [13], Perotti [22] and Sala-i-Martin[26], which we cited above, are those studying the effects of fiscal policies on growth, such as Easterly and Rebelo [14].

The plan of the paper is as follows. Section 2 briefly surveys theories implying a relation between social security expenditure and growth. Section 3 presents the basic results of our empirical analysis. Section 4 verifies the robustness of such results to various misspecification problems. Section 5 atteimpts to disentangle empirically the mechanisms through which social security expenditure matters for growth. Section 6 concludes.

2. A Brief Survey of the Theoretical Literature

This section is divided in two parts. In the first part, we briefly survey the theoretical reasons why social security expenditure should matter for growth. In the second part, we look at the opposite causal link, that is we enumerate reasons why growth should affect the level of social security expenditure.

2.1. Social Security and Growth

In surveying theories explaining why social security affects growth, we classify them into two groups, depending on the mechanism through which such effect takes place. There are essentially two relevant mechanisms. The first relies on the idea that variations in the size of social security expenditure may have a direct effect on the *level* of real national investment and therefore on growth. The second is based on the idea that variations in social security expenditure may affect the *productivity* of investment, and therefore have an indirect effect on growth, for a given investment level.

2.1.1. Social Security and the investment level

According to theory, different types of social security expenditure should have different effects on the level of investment, depending on their characteristics and on the method of financing them.

As notably argued by Feldstein [15], pensions will crowd out private savings, and therefore may depress real national investment and growth, if they are *unfunded*. On the other hand, unfunded pensions may induce earlier retirement, and therefore have a positive effect on private savings, if they are *income-tested*. If we consider public investment in infrastructure and some part of private and public expenditure in education as national investment, there are other reasons why variations of the size of an unfunded social security system may matter for investment. Becker [10] first argued that social security systems can be seen as part of a social compact, whereby the young transfer resources to the old and carry out investments that benefit future generations, in exchange for the old's previous investment and expecting the future generation to follow the same rule. Bellettini and Berti-Ceroni [11] formalize this intuition and show that an unfunded social security system, where pension benefits are *indexed to wages*, can indeed provide agents with the incentives to finance public investment in infrastructure, in a world where fiscal policy are endogenously determined as the outcome of an intergenerational game and where the growth rate of wages depends on public investment. Similar incentives may also be at work when the social security system is *funded*. In this case agents will be willing to finance investment in infrastructure and human capital since these investments increase the return on private physical capital and therefore on their pensions. Buiter and Kletzer [12] argue that a permanent increase in the scale of an unfunded social security retirement scheme can favor human capital formation, if the interest rate is higher than the growth rate of the economy. In such context, a permanent increase in the scale of the social security system amounts to an increase in the present discounted value of life time lump-sum taxes paid by each generation. This can raise private human capital accumulation, if individuals try to make up the loss in life time income implied by such increase, by investing more in education. All types of social security expenditure (pensions, health, housing, etc.) will hamper private investment, if they are financed through *distortionary taxation* (e.g. income taxes, contributory taxes). However, increasing redistributive expenditure may reduce socio-political instability and create favourable conditions to investment.

2.1.2. Social security expenditure and investment productivity

Existing social security schemes have features that may prime increases in investment productivity. Sala-i-Martin [26] argues that pensions can be good for productivity in that they imply *compulsory retirement*. If skills depreciate with age and if low-skill workers have a negative external effect on high-skill workers, investment productivity may increase, as old workers are substituted by young workers. Some of the explanations we reviewed in the previous subsection also imply that investment productivity can increase with social security. As human (infrastructure) capital grows larger, physical capital becomes more productive, if human (infrastructure) and physical capital are complementary in production. The more politically stable is the economy, the more organized are market activities and the more productive is investment in physical capital (Sala-i-Martin, [25]).

2.2. Growth and Social Security

It is often argued that the empirical association between social security expenditure and growth should not be taken as evidence that social security expenditure matters for growth, but rather can be explained by saying that economic growth pulls social security expenditure.[2] This kind of argument usually makes reference to Wagner's Law, that predicts a positive relation between the level (growth rate) of GDP and the level (growth rate) of government expenditure. However, Wagner's Law does not strictly apply to the present case, since we are looking at the relation between the GDP growth rate and the level of social security expenditure. Still, there are many reasons why growth may affect the size of the social security system. Huntington [19] argues that periods of rapid growth may increase socio-political instability, in the absence of a well-developed social security system. This will trigger a deep social conflict that increases the political pressure for redistribution and may lead to the expansion of the social security system itself. On the other hand, in presence of well-developed social security systems, firms may wind up using the system as a buffer against recessions and periods of slow growth, by

[2] Among others, this argument is invoked by Barro [4].

temporarily laying-off redundant workers or by inducing workers to retire earlier. In the former case, faster growth will imply increasing social security expenditure. In the latter case, the reverse is true. In general, there is no reason to presume that growth, if it has any, should have a positive rather than a negative effect on social security expenditure.

Summing up, from a theoretical point of view, the final effect of variations in social security expenditure on growth is ambiguous and so is the reverse effect. Empirical work is therefore called on to determine whether the association between social security and growth is positive or negative and whether such association is due to a causal link running from social security expenditure to growth or in the opposite direction. Empirical work is also needed to understand through which channels social security affects growth.

3. Empirical Analysis

The huge empirical research program initiated by Feldstein, devoted to assessing if social security expenditure does depress physical capital accumulation via the crowding out of private savings, has not so far provided clearcut conclusions. Moreover, it is our opinion that this approach to the issue is quite limited in that it disregards potentially important mechanisms through which social security expenditure may be relevant for growth. Therefore, we follow Barro [4] (from now on, B), Perotti [22] (from now on, P) and Sala-i-Martin [26] (from now on, SM) and include average social security expenditure among explanatory variables of the average GDP growth rate in cross-country regressions. This approach, which is close in spirit to the work of Barro and Sala-i-Martin [8] (from now on, BSM) on the determinants of long run growth, is potentially more fruitful than Feldstein's, since it allows to take into account effects of social security on growth via public and private investment in human capital and public investment in infrastructure, as well as via investment in physical capital, and via variations in investment productivity. Moreover, if we embrace such more general approach, other types of social security expenditure, on top of unfunded pensions, can play a role in determining the growth rate.

B, P and SM find evidence of a *positive* association between social security and growth in a cross-section of countries. Our contribution extends these results by testing the robustness of such association against the possibility of its being due to reverse causation, omitted variables and outliers. Moreover, we provide evidence of the importance to correct for potentially different behavior between rich and poor countries. Having established that the positive association between social security and growth in cross-country data is pretty robust, we further extend previous empirical work, by trying to disentangle empirically the mechanisms through which social security should foster growth.

We are aware of the potential problems arising from choosing a cross-sectional approach, which can not take care of persistent unobserved heterogeneity across countries. However, the use of panel data restricts the horizon of analysis to a limited set of industrialized countries, for which relevant information is available. Since, on economic grounds, there is no *a priori* reason to prefer panel data to standard cross-sectional techniques in the analysis of the causes of economic growth, we stick to the latter, so as to be able to include in our sample less-developed-countries, where, on the grounds of our empirical analysis, the association between social security and growth seems to be stronger. Evidence of the fact that the positive association between transfers and growth can not be imputed to the latter merely picking up some country-specific effect, is, however, provided by Cashin [13], who applies panel data estimation techniques to a set of OECD countries and finds a strong positive effect of redistributive expenditure on growth.

3.1. A Look at the Data and Previous Empirical Results

Our data set comprises the period 1970-1985 and includes 61 countries for which data on the relevant variables are available. With a few exceptions, the main data source is Barro and Lee [6]. A complete description of the data and their source can be found in the data appendix. Tables A and B, in the data appendix, report summary statistics and the correlation matrix for selected series.

Although the simple correlation coefficient between average social security expenditure in percentage to GDP (SS7085) and the average growth rate of per capita GDP (GR7085) is positive (0.234), observation of Figure (7.1) seems to suggest that SS7085 is basically unrelated to GR7085. Naturally, this is too hasty a conclusion. As predicted by Wagner's Law, SS7085 is highly positively correlated with the GDP level in 1970 (GDP70).[3] Since initial GDP is usually found to affect growth negatively in cross-country data (convergence hypothesis), this may imply a downward bias in the correlation coefficient between SS7085 and GR7085. It is therefore necessary to control for the initial level of GDP, in order to eliminate potential sources of bias in the association between SS7085 and GR7085. This is done by P and SM, who, after including measures of the initial level of GDP, find that SS7085 enters with a positive coefficient in the growth regressions they specify.[4] Equation 7.1, in the appendix, reports the results ob-

[3]See Table B, in the data appendix.

[4]P's and SM's specifications are more recent and more complete than B's one. This explains why we omit to talk in detail about B's very preliminary results in our exposition.

tained estimating the specification proposed by P in the context of our sample. The dependent variable is the average GDP growth rate between 1960 and 1985. Besides SS7085, the list of regressors includes the level of GDP in 1960 (GDP60), average years of secondary schooling in the male and female population over age 25 in 1960 (respectively SYRM60 and SYRF60), as measures of the human capital stock at the beginning of the period, and the PPP value of the investment deflator relative to the US in 1960 (PPI60D), as a measure of market distortions. The chosen estimation method is TSLS, since SS7085 is assumed by P to be endogenously determined through a political mechanism. The proportion of population over age 65 (POP65) and an index of inequality of the income distribution (MID[5]) serve as instruments for SS7085. As for POP65, the idea is simply that the older the population, the higher social security expenditure. As for MID, the maintained hypothesis is that higher income inequality (lower MID) should imply higher social security expenditure ("political economy approach" to fiscal policy).[6] The estimated partial correlation between SS7085 and GR6085 is 0.275, which is close to the sample correlation between SS7085 and GR7085 and is significant at 5% level.[7] Equation 7.2, in the appendix, reports SM's results. The estimation method is OLS. The dependent variable is GR7085. Besides SS7085, the list of regressors includes the logarithm of GDP70 (LGDP70), average real national investment (INV7085), and other government expenditures, such as average public investment in percentage to GDP (GINV7085) and government consumption expenditure in percentage to GDP (GCON7085). The estimated partial correlation coefficient between SS7085 and GR7085 is now 0.111 and is significant at 5% level.[8]

Both P's and SM's specifications are open to question. P's specification overlooks many of the variables that are usually included in growth regressions, such as real national investment, government consumption expenditure and measures of openness to trade, while SM does not include measures of human capital formation in his specification. As Table B shows, SS7085 is positively correlated with INV7085 and with measures of openness to trade, such as the average ratio of exports to GDP (EX7085) and the average ratio of imports to GDP (IM7085), which are usually found to positively associated with growth, while it is negatively correlated with GCON7085 and with measures of market distortions, such as the (logarithm) of the average black market premium (LBMP7085), which are usu-

[5]The index MID, constructed by P, is the income share of the middle class. This information is available for 46 out of the 61 countries in our sample.

[6]For the "political economy" approach to fiscal policy and growth, see, among others, Alesina and Rodrick [3], Perotti [21] and Persson and Tabellini [23].

[7]Estimation by OLS reduces such partial correlation to 0.116 (not shown).

[8]Note that, in the OLS case, P's estimated coefficient for SS7085 is very close in value to SM's estimated coefficient.

ally found to be negatively associated with growth. Moreover, SS7085 is highly positively correlated with measures of human capital formation which are usually found to be positively associated with growth, such as the average gross enrollment ratio in secondary school (ENR7085), which can be taken as a measure of investment in human capital, and the average years of secondary schooling in the male and female population over age 25 in 1970 (respectively SYRM70 and SYRF70).[9] Therefore, omission of relevant variables may bias the estimated coefficient of SS7085 upwards in both P's and SM's regressions. SM's results are also subject to an endogeneity bias, since he does not correct for the potential endogeneity of right-hand side variables. In particular, if SS7085 is endogenous, SM's estimated coefficient will be biased, although, as we noted in section (2.2), the direction of such bias is not *a priori* clear on theoretical grounds. The following sub-section takes care of these problems.

3.2. Basic Results

In this sub-section we present the basic results of our empirical analysis. The equation we estimate is the following:

$$\begin{aligned} GR7085 &= C + a_1 LGDP70 + a_2 SYRM70 + a_3 SYRF70 + \\ &+ a_4 GCONS7085 + a_5 SS7085 + \\ &+ a_6 LBMP7085 + a_7 INV7085 + a_8 EX7085 \end{aligned} \tag{3.1}$$

This specification is more complete than P's and SM's ones and is similar to that proposed by BSM. On the right-hand side we include state variables, such as LGDP70, SYRM70 and SYRF70, as well as control and environmental variables, such as GCONS7085, LBMP7085, INV7085 and EX7085. The main difference between BSM's specification and ours is the inclusion of social security expenditure among control variables.[10] When possible, we follow BSM in correcting for the potential endogeneity of control and environmental variables by using lagged variables as instruments, that is by using as instruments averages taken over the period 1960-1970.[11] Since data on social security are not available before 1970 for

[9] The benchmark specification we have in mind is obviously that proposed by BSM, ch.12.

[10] Other regressors included in BSMs specification, which are not included in equation 3.1, are the growth rate of terms of trade, average years of primary and higher schooling in the male and female population over age 25, an index of socio-political instability, life expectancy at birth and an interaction term between GDP and human capital. We later show that the main results of our analysis are not changed by the inclusion of these variables.

[11] Lagged variables are satisfactory instruments since the error term in the equation for the per capita growth rate displays little serial correlation. In particular, the correlation between the 1960-1970 residuals and the 1970-1985 residuals is only 0.077, when social security expenditure is not included, and 0.126, when SS7085 is included in the GR6070 and in the GR7085 regressions.

most countries in our sample, we can not follow this method for SS7085. A list of possible instruments for SS7085 might reasonably include, demographic variables, such as POP65 and life expectancy at birth (LIFEE070), and MID. However, LIFEE070, is sometimes used as a proxy for the quality of human capital and found to enter with a significantly positive coefficient in growth regressions.[12] As shown by P, two problems arise, regarding the use of MID as an instrument for SS7085. On one hand, contrary to the predictions of the political economy approach, MID turns out to be (insignificantly) positively associated with growth. On the other hand, MID is significantly positively associated with growth, via mechanisms different from the political one. Therefore, we stick to POP65 as an instrument for SS7085.

Column (1) and (2) in Table 1, in the appendix, present estimation results for our basic equation, for the OLS case and the TSLS case respectively. The t-statistics associated to each coefficient appear in parenthesis. Note that the estimated coefficient of SS7085 is *positive* and significant in both cases and that it increases by around 25% when we use TSLS instead of OLS. The OLS coefficient (0.168) is higher in value than the coefficients estimated using P's and SM's specifications (around 0.11), although it is lower in value than the sample correlation between SS7085 and GR7085 (0.234). The TSLS coefficient (0.266) is close in value to the coefficient estimated by P (0.275) and to the sample correlation between SS7085 and GR7085 (0.234). The estimated coefficients of other variables have the expected sign and are consistent with BSM's findings. In particular, we find that LGDP70 is significantly negatively associated with GR7085 (convergence hypothesis) and so is LBMP7085. Male secondary attainment is significantly positively associated with GR7085, while female attainment is insignificanly negatively associated with it.[13] Two of our control variables become insignificant when instrumented: GCONS7085 (which is negatively associated with GR7085) and INV7085 (which is positively associated with GR7085). There is only one unexpected result: EX7085 is negatively (and, at least in the TSLS estimation, significantly) associated with GR7085.[14] In the next section, however, we show that such negative sign is not robust.

So far, our results support the findings of P and SM, in that they provide further evidence in favor of social security expenditure being positively associated

[12] See BSM.

[13] To explain the negative estimated coefficient of female secondary schooling, BSM argue that less female attainment (or a large spread between male and female attainment) is a good measure of backwardness and hence signifies a larger growth potential through the convergence mechanism.

[14] Similar results are obtained if IM7085 is used as a measure of openness to trade, instead of EX7085. See columns (3) and (4) in Table 1. When TSLS is used, SS7085 is significant at 10% level, in this case.

with growth, even after controlling for the variables usually included in growth regressions and after correcting for the potential endogeneity of right-hand side variables.

In particular, as far as the endogeneity issue is concerned, our results indicate that the positive association between SS7085 and GR7085 can not be due to reverse causation, that is to a pulling effect of GR7085 on SS7085. In fact, the coefficient of SS7085 remains positive and increases in magnitude when TSLS is used in place of OLS. This behavior is consistent with an effect of GR7085 on SS7085 in either direction (hence, our analysis can not dispel the theoretical ambiguity on whether growth should augment or depress social security expenditure) but is only consistent with a positive effect of SS7085 on GR7085.

In the rest of this section and in the following one we test these results against other sources of misspecification, such as omitted variables, instability of coefficients and outliers.

3.3. Omitted Variables

The positive coefficient of SS7085 in our basic regression might be due to social security expenditure picking up the effect of some relevant omitted variable.

A list of omitted variable which are potentially relevant in this case includes LIFEE070, MID, measures of development such as the urbanization rate in 1970 (URB70) and regional dummy variables. As we discussed above, LIFEE070 and MID are believed to play a significant role in growth regressions. Moreover, as shown in Table B, they are highly correlated with SS7085. Urbanization is historically concomitant of industrialization and growth (or immediately preceding it) and as a measure of development, should be positively associated with social security expenditure. Table B shows that the sample correlation between URB70 and SS7085 is indeed very high. Hence, the omission of these variable may bias the coefficient of SS7085 upward. Finally, country-specific cultural or historical factors may be responsible for the positive association between SS7085 and GR7085. One way to partially take care of such factors is to include regional dummy variables in growth regressions.[15] In particular, we include dummies for Latin America (LAAM) and Africa (AFRICA).[16]

In the first three rows of Table 2 in the appendix, we report the estimated

[15]More satisfactory ways to take care of country-specific factors can be devised in the context of a cross-sectional time series approach, as proposed by Cashin. His findings support the existence of a positive association between social security expenditure and growth.

[16]We do not include a dummy variable for East Asian countries, since only two such countries appear in our sample, Korea and Thailand. When testing for outliers, however, we will make sure that the behavior of SS7085 is not to be imputed to the inclusion of any particular country *per se*.

coefficient of SS7085 (t-statistics in parenthesis) obtained adding one variable at a time to equation 3.1. The last row but one presents the estimated coefficient of SS7085, when all omitted variables are included together, except MID. Finally, in the last row, we report the estimated coefficient SS7085, when all omitted variables are included together. Note that in no case the coefficient of SS7085 changes substantially and that it becomes insignificant only when all omitted variables are included together. This, however, is likely to be due to the loss of degrees of freedom implied by having such a long list of regressors. This is especially true when MID appears among regressors, since in this case the sample size is considerably reduced. Also, it should be noted that, at 5% significance level, none of the variables we tried is individually significant for GR7085, nor is significant the set of variables we considered as a whole.[17]

Hence, provided that our list of potentially relevant variables is comprehensive enough, there is no evidence that the positive effect of SS7085 on GR7085 should be due to the former picking up the effect of some omitted variable. In this respect, an important omission so far is political instability. In fact, measures of political instability are usually found to be negatively associated with per capita growth and Table B shows that measures of political instability, such as SPI7085 and SPI, are negatively associated with SS7085.[18] However, since the reduction of political instability is one of the theoretical explanations we gave for a positive influence of social security on growth, we postpone the discussion of this issue to Section 5, where we deal with the problem of empirically pinning down the channels through which social security matters for growth.

3.4. Stability of Coefficients

There are plenty of theoretical and empirical reasons to suspect that the regression we specified does not fit equally well for rich and poor countries. For instance, as for empirical reasons, the correlation coefficient between SS7085 and GR7085 is 0.464 in countries with per capita GDP in 1970 below the median (2.285) and 0.290 in countries with initial GDP above the median. Moreover, BSM find evidence that an interaction term between initial per capita GDP and human capital is

[17]Performing a test for the joint significance of LIFEE070, POP65, URB70, AFRICA, LAAM and MID, we are lead to accept the null hypothesis of no joint significance. In fact, we obtain a Log Likelihood Ratio of 4.09, which is below the critical value (12.59), associated by the χ^2-distribution (with 6 degrees of freedom) to a probability of 95%.

[18]SPI7085 is obtained as the sum of the number of assassination per million population per year, the number of coups per year and the number of revolutions per year between 1970 and 1985. SPI is an index of political instability constructed by Alesina and Perotti [2] using the method of principal components. It includes political assassinations, violent deaths per million population, successful and unsuccesful coups and a dummy variable for democracies.

significantly negative in their regression.[19]

In order to allow for the possibility that some coefficients vary across rich and poor countries, we include interaction terms between human capital variables and per capita GDP in 1970 (SYRMGDP, SYRFGDP) and between the ratio of exports to GDP and per capita GDP in 1970 (EXGDP) in our basic regression.[20] Table 3, columns (1) and (2), reports the estimated coefficients of interaction terms and other regressors. As in BSM, the interaction terms for human capital variables are significantly associated with the per capita growth rate. Note that all interaction terms enter our regression with the opposite sign with respect to the corresponding non-interactive regressor. This can be taken as evidence that poor and rich countries behave differently and, in particular, that the coefficients of SYRM70, SYRF70 and EX7085 in our basic regression represent the behavior of poor countries, rather than that of the entire sample.

Similar evidence is also provided by a Chow's test of differential intercept and regression slopes across poor and rich countries. Placing the breakpoint at $GDP70 = 2.285$, the output of the test is a F-statistic of 3.42, when equation 3.1 is estimated by OLS, and of 3.20, when equation 3.1 is estimated by TSLS. Such statistic must be compared with the theoretical value of F with (9, 41) degrees of freedom, in the OLS case, and with (9, 32) degrees of freedom in the TSLS case. The null hypothesis of equal coefficients for rich and poor countries is rejected in both cases at 5% significance level, the critical value for rejection being respectively 2.12 and 2.31.

We then fit two separate regressions, one for countries with $GDP70 > 2.285$ and one for countries with $GDP70 < 2.285$.[21] Table 3, columns (3) and (4), report the estimated coefficients for the two samples. Note that human capital variables, GCONS7085 and EX7085 change sign and are all insignificant in the rich countries' sample. Moreover, in poor countries, the coefficient of SS7085 is highly significant and almost four times as large as in rich countries, where it is only significant at 10% level.

Summing up, in this section we provided evidence of a positive association between social security expenditure and the per capita GDP growth rate. Such positive association can not be imputed to endogeneity bias or to the omission of variables jointly associated with social security expenditure and growth. More-

[19]They interpret such finding as meaning that the growth rate is more sensitive to GDP when human capital is higher.

[20]We tried interaction terms for other variables as well (including SS7085), but they turned out to be insignificantly associated with GR7085.

[21]In this case we only look at ouput from OLS estimation, since the sample size is quite small in relation to the total number of exogenous variables.

over, we provided evidence of differential behavior across rich and poor countries. In particular, the coefficients we estimated for the entire sample seem to heavily reflect the behavior of poor countries.

4. Robust Estimation

In this section we perform various second-order tests on our basic regression, in order to ascertain the robustness of our results.

4.1. Errors in Variables and Heteroschedasticity

There is no way to exclude that our data set is subject to sizable measurement errors. However, random errors in data on social security expenditure would bias the coefficient of SS7085 downward, and therefore can not be responsible for the observed positive association between SS7085 and GR7085, should the true relation be a negative one.

As for heteroschedasticity, although OLS estimators are still unbiased when errors are not homoschedastic, usual inference procedures, such as the construction of t-statistics, will be invalidated in this case. Moreover, application of TSLS requires the error term of the reduced form equation to be homoschedastic. Hence, we perform various tests for heteroschedasticity on the OLS residuals from equation 3.1. A routine test to detect heteroschedasticity consists in regressing the square of the estimated residuals on the explanatory variables included in the basic regression and their squares. The output from such test is a F-statistic with a χ^2-distribution with degrees of freedom equal to the number of regressors and squared regressors in the test regression. The null hypothesis of zero coefficients for all the right-hand side variables in the test regression (homoschedasticity) is rejected if such F-statistics exceeds the critical value defined by the χ^2-distribution at the desired significance level (White [27]). In our case the F-statistic takes a value of 1.32, which is well below the critical value at 5% significance level (27.58). In our case, it is reasonable to expect the variance of residuals to decrease with per capita GDP in 1970. In order to assess whether or not this is indeed the case, we regress the absolute value of residuals from our basic regression on various transformation of GDP70 (e.g. 1/GDP70,$1/(GDP70)^2$, etc). A decreasing residuals' variance would imply a significant association between one of the transformed variables and the absolute value of the residuals from the basic regression (Glejser [17]). We find no evidence of heteroschedasticity, using this method. Again, trying to assess whether the variance of residuals from the basic regression is associated to the level of GDP in 1970, we fit two separate regressions for the 22 poorest countries and the 22 richest countries in the sample. By dividing the sum of squared residuals for the two regressions, we obtain a F-statistic of 0.2. Such statistic must be compared with the theoretical value of F with (13, 13) degrees of freedom (Goldfeld and Quandt [18]). The null hypothesis of homoschedasticity is then accepted at 5% significance level, the critical value for rejection being around 2.60.

4.2. Outliers

In this section, we want to make sure that the positive association between social security expenditure and growth is not due to a few slow (fast) growing countries with low (high) social security expenditure. In order to do so, we run two tests. First, we re-estimate equation 3.1 after excluding countries with "abnormal" (with respect to the sample mean) social security expenditure and per capita GDP growth. Second, we re-estimate equation 3.1 dropping from the sample one observation at a time. Instability of the coefficient of SS7085 will then be taken as evidence that the positive effect of social security expenditure on per capita GDP growth does not reflect average behavior, but rather that of outliers along such dimensions.[22]

4.2.1. First test of outliers

Table C2 (C3), in the data appendix, reports descriptive statistics for GR7085 (SS7085) in subsamples obtained excluding countries with SS7085 (GR7085) above or below the sample mean by a value equal to the sample standard deviation. Descriptive statistics of GR7085 and SS7085 in the entire sample are replicated in table C1, for convenience. Careful inspection of such tables shows that there is ground to suspect that the positive coefficient of SS7085 in the growth regressions we estimated so far might be due to the inclusion of countries with abnormally slow growth ($GR7085 < -0.019$), which tend to spend much smaller shares of their GDP on social security than the average, or to the inclusion of countries with abnormally high social security expenditure ($SS7085 > 0.113$), which tend to grow much faster than the average, or to the inclusion of countries with abnormally low social security expenditure ($SS7085 < 0.001$), which tend to grow much slower than the average.

Table 4a and 4b in the appendix, report the estimated coefficient of SS7085 (t-statistics in parenthesis) obtained re-estimating equation 3.1 by OLS and TSLS respectively, after excluding abnormal observations from the sample. Note that, if the five countries with $GR7085 < -0.019$ are excluded from the sample, the

[22] In our opinion, the second test is superior to the first, in that it is less open to selection bias.

coefficient of SS7085 falls by almost 50% (from 0.168 to 0.099) and becomes barely significant at 5% level, when OLS is used.[23] It falls by 35% (from 0.266 to 0.171) and becomes insignificant even at 10% significance level, when TSLS is used.[24] Instead, the coefficient of SS7085 does not change substantially if countries with abnormal social security expenditure are excluded.[25]

Thus, our first test seems to imply that the strong and statistically significant positive effect of social security expenditure on per capita GDP growth is to be imputed to a bunch of slow-growing countries with lower than average social security expenditure. Before drawing this conclusion, however, it might be wise to take a closer look at our results. For example, it should be noted that, when countries with $GR7085 < -0.019$ are excluded and equation (3.1) is estimated by TSLS, the sample size is reduced to only 45 observations. The substantial loss of degrees of freedom may be responsible for the statistical insignificance of SS7085 in this case. In fact, as shown in Table 4c, if we eliminate from the set of regressors LBMP7085 and EX7085, for which many observations are missing, and replenish the sample size to 56 observations, the coefficient of SS7085 is again significant at 5% level (the t-statistic is 2.46) and it is higher in value (0.183) than in the corresponding entire sample case (0.177). Moreover, if we allow for coefficient instability across rich and poor countries by including interaction terms for human capital variables and the ratio of exports to GDP, the coefficient of SS7085 gains further significance in the OLS estimation (the t-statistic is 2.41), though it remains lower in value (0.113) than in the corresponding entire sample case (0.175).[26]

Summing up, although our first test of outliers provides some evidence that the positive effect of social security expenditure on growth might not be so strong as it is implied by our previous results, still evidence of a positive effect of SS7085 on GR7085 is maintained.

4.2.2. Second test of outliers

Another way to test the stability of SS7085's coefficient to the presence of outliers consists in comparing estimates obtained from our basic regression dropping one

[23]The five countries with $GR7085 < -0.019$ are Ghana, Liberia, Venezuela, Zaire and Zambia.

[24]It should be noted (not shown) that the coefficient of EX7085 is also highly sensitive to the exclusion of countries with $GR7085 < -0.019$. In particular, when countries with $GR7085 < -0.019$ are excluded from the sample, the coefficient of EX7085 turns from negative and significant at 5% level to positive and insignificant at 5% level,when OLS is used, and to negative and insignificant at 5% level, when TSLS is used.

[25]The fact that, when countries with $SS7085 > 0.113$ are excluded, the coefficient of SS7085 becomes insignificant is likely to be due to the fact that the sample size is considerably reduced in this case.

[26]Not shown.

observation at a time. When OLS is used as estimation method, the coefficient of SS7085 is always significant at 5% level. The maximum estimated value is 0.178, which is obtained when France or Barbados are excluded from the sample. The minimum estimated value is 0.127, which is obtained, when Venezuela is excluded from the sample. It should be noted that the exclusion of no other country implies a decline in the estimated coefficient of SS7085 below 0.159, while 15 out of the 60 estimates we obtained are above 0.170. When TSLS is used and Venezuela is excluded from the sample, the estimated coefficient of SS7085 is 0.170, which is almost significant at 10% level (the t-statistics is 1.42). These findings imply that the coefficient of SS7085 is pretty stable, as long as Venezuela is included in the sample. Exclusion of Venezuela seems to give rise to somewhat lower estimates of the coefficient of SS7085. Still, our findings do not provide evidence that the sole presence of Venezuela is responsible for the positive effect of SS7085 on GR7085. In fact, though lower in value, the coefficient of SS7085 is still positive and significant (even if only at 10% level in the TSLS estimation) when Venezuela is excluded from the sample. Regarding this point, it should also be noted that Venezuela is an outlier with respect to GR7085, but not with respect to SS7085. In fact, although Venezuela is the country which experienced the minimum growth rate (-0.041) in the 1970-1985 period, its social security expenditure share in the 1970-1985 period (0.016) well above the sample minimum (0.000).

Therefore, our second test of outliers also provides some evidence that the positive effect of social security expenditure on growth might be somewhat smaller than it is implied by our basic results, since the sole exclusion of Venezuela implies a sizable reduction in the estimated coefficient of SS7085. However, it does not provide evidence that the positive effect of SS7085 on GR7085 can be imputed entirely to the presence of outliers.

Summing up, in this section we showed that the positive effect of social security expenditure on growth is a robust result. In particular, the positive estimated coefficient of SS7085 can not be imputed solely to the presence of a few countries with abnormally slow growth and low social security expenditure. Moreover, we showed that standard inference procedures can be used with reasonable confidence.

5. Social Security and Growth: the Explanatory Power of Different Theories

The empirical analysis we conducted so far shows that the positive association between social security expenditure and growth detected in cross-country growth regressions can not be imputed to misspecification errors implying an upward bias of the estimated coefficient of social security expenditure. In fact, the estimated coefficient of social security expenditure in growth regressions remains positive and significant, even after correcting for endogeneity, omitted variables and the presence of outliers. Having established the robustness of the empirical positive association between social security expenditure and growth and having determined the direction of causation to be from social security to growth, we now turn to the task of identifying empirically the mechanisms through which social security fosters growth.

A first distinction to draw is between mechanisms that involve an effect of social security expenditure on the investment level and mechanisms that involve an effect on investment productivity. As for the former effect, observation of Figure (7.2), where real national investment is plotted against social security expenditure, seems to suggest that it is not an important one. In fact, once we control for other potentially relevant variables, social security expenditure turns out to have an insignificant negative effect on real national investment (Table 5, columns (1) and (2)).[27] As for the latter effect, note that in our growth regressions we always held real national investment constant. The estimated positive coefficient for SS7085 may then be taken as evidence that social security has a positive effect on growth via increased investment productivity. However, such positive association might also be due to an effect of social security expenditure on investment in human capital, which is not included in measures of real national investment.

According to our survey of the theoretical literature, there are basically three possible explanations for the positive association between social security and growth observed for given levels of real national investment. The first explanation (from now on E1) relies on the idea that contingent-on-retirement pension benefits are used to bribe old umproductive workers out of the labor force. The second explanation (from now on E2) argues that redistributive expenditure reduces socio-political instability making investment more productive. The third explanation (from now on E3) argues that social security expenditure provides agents with the incentives to invest in human capital. In the rest of the section, we put to test these different explanations.

5.1. Social Security Expenditure, Compulsory Retirement and Growth.

According to E1, conditional-on-retirement intergenerational transfers are the mean to induce old unproductive workers to abandon the labor force. This removes the negative externality produced by old workers on young productive ones,

[27]Similar results are obtained when real private investment (PINV7085), rather than real national investment, is the dependent variable (Table 5, columns (3) and (4)).

raising the productivity of capital and the rate of growth of output. E1 is obviously consistent with the finding that social security expenditure has a positive effect on growth, holding real national investment constant. Yet, according to E1, intergenerational transfers will be good for growth, provided they require compulsory retirement.

Sala-i-Martin [26] provides information for a sample of 108 countries on whether retirement is legally required to collect pensions or not.[28] We use this information to construct a dummy variable (RETIR), taking value one, if retirement is required, and zero otherwise. A natural way to test E1 consists in including RETIR among regressors, as well as an interaction term between SS7085 and RETIR (SSRET). Columns (1) and (2) in Table 6, in the appendix, report the estimated coefficient of RETIR, SSRET and other regressors. Note that, although the coefficient of SS7085 becomes less significant when SSRET is included (in the OLS case, it also falls slightly), the estimated coefficient of SSRET, is not statistically significant (and, in the TSLS case, contrary to the predictions of E1, it is negative). Even more unsatisfactory results are obtained if we split the sample in two and run separate regression, one for the subsample of countries where retirement is required and one for the subsample of countries where it is not. Columns (3) and (4) in Table 6 report the OLS estimated coefficients for these subsamples. Note that, in strong opposition to the predictions of E1, the estimated coefficient of SS7085 is four times as large in the subsample of countries where retirement is *not* required (column (3)) than in the other subsample, where the coefficient of SS7085 is not even significant (column (4)).[29] On the grounds of these findings, we can conclude that the data do not support E1.

5.2. Social Security Expenditure, Political Instability and Growth.

According to E2, social security and other redistributive expenditures contribute to raising investment productivity in that they reduce socio-political instability and favour the smooth development and functioning of market activities.

As we have previously noted, measures of socio-political instability are indeed negatively correlated with SS7085 in cross-country data, the correlation coefficient being of the order of 30-40% in absolute value, depending on the index used. The simplest way to test E2 consists in including measures of socio-political instability among regressors in our basic equation and check whether this reduces the estimated coefficient of SS7085. Table 7, in the appendix, reports the results obtained using SPI7085 as a measure of socio-political instability.[30] There appears to be

[28]This information is available for 46 out of the 61 countries in our sample.

[29]Using TSLS instead of OLS does not change these results in any substantial respect.

[30]In TSLS estimation, SPI6070, that is the sum of the number of assassination per million

no evidence in favor of E2. In the OLS case (column (1)), where the coefficient of SS7085 falls slightly, the estimated coefficient of socio-political instability, though negative as expected, is far from significant. In the TSLS case (column (2)), where political instability turns out to be almost significantly negatively associated with growth, the estimated coefficient of SS7085 increases.[31]

5.3. Social Security Expenditure, Human Capital and Growth.

E3 argues that social security expenditure provides agents with the incentives to invest in human capital. This has a direct effect on growth, as well as an indirect effect through increased productivity of physical capital.

Following P, we take enrollment in secondary school as a measure of investment in human capital.[32] Columns (1) and (2) in Table 8, in the appendix, report the results obtained including the average secondary school enrollment ratio between 1970 and 1985 (ENR7085) among regressors in our basic equation: the coefficient of SS7085 falls (by 30%, in the TSLS case, slightly in the OLS case), but ENR7085 is not significant.[33] This result, however, might be due to the high positive correlation (above 70%) between ENR7085 and human capital stock variables. In fact, once we omit SYRM70 and SYRF70, ENR7085 gains significance both in the OLS (column (3)) and in the TSLS case (column (4)). Moreover, the estimated coefficient of SS7085 now falls by more than 10%, in the OLS case, and countinues to fall by more than 30% in the TSLS case. These findings are consistent with E3.

Further evidence in favor of E3, instead bringing discredit to E2, is obtained by joint estimation of a set of equations where GR7085, SPI7085 and ENR7085 figure as dependent variables. The specification we propose is reported in the appendix (equations 7.3, 7.4 and 7.5). The determinants of GR7085, appearing in 7.3, have already been discussed. In equation 7.4, we include a measure of the initial level of development (LGDP70), SS7085, and an index of socio-political instability between 1960 and 1970 (SPI6070) as explanatory variables of SPI7085. We expect socio-political instability to be decreasing with the initial level of development and to be a persistent phenomenon. Moreover, consistently with E2,

population per year, the number of coups per year and the number of revolutions per year between 1960 and 1970 is used to instrument SPI7085, which is potentially endogenous.

[31] No evidence in favor of E2 is obtained if SPI, instead of SPI7085, is used to measure political instability.

[32] This choice is justified by the fact that while primary education is compulsory in practically all countries, secondary schooling is not, especially in poor countries. Moreover, the level of enforcement is much lower for secondary education.

[33] In TSLS estimation we use the average secondary school enrollment ratio between 1960 and 1970 (ENR6070) as an instrument for ENR7085.

we expect higher social security expenditure to imply lower socio-political instability. In equation 7.5, we include a measure of the initial level of development (LGDP70), human capital stock variables and SS7085 as explanatory variables of ENR7085. We expect all regressors to be positively associated with the dependent variable in this equation. In particular, according to E3, social security expenditure should display a positive estimated coefficient in equation 7.5. Table 9, in the appendix, reports the results obtained jointly estimating equations 7.3, 7.4 and 7.5 by TSLS.[34] Note that in the growth equation, all the estimated coefficients have the expected sign. ENR7085 is significantly positively associated with GR7085, while the coefficient of SPI7085, though negative, is not significant. In the socio-political instability equation, LGDP70 and SPI6070 have the expected sign, though only the latter is significant. In contrast with the predictions of E2, the estimated coefficient of social security expenditure in this equation is positive (and insignificant). Finally, in the secondary-enrollment ratio equation, all the estimated coefficients (except that of SYRF70, which, anyway is insignificant) have the expected positive sign and are significant at 5% confidence level. In particular, SS7085 seems to have a positive and significant effect on ENR7085, although its coefficient is estimated very imprecisely.

Summing up, in this section, we obtained some evidence in favor of explanations implying a positive effect of social security on the productivity (rather than on the level) of investment in physical capital and in favor of arguments such that social security expenditure is beneficial for growth since it fosters investment in human capital. Explanations based on the idea that generous social security benefits should enhance investment productivity since they induce retirement of unproductive workers or since they improve political stability and social cohesion are not equally supported by our empirical analysis.

6. Concluding Remarks

In this paper, we show that the positive estimated coefficient of average social security expenditure detected in cross-country growth regressions can not be imputed to reverse causation, that is on economic growth pulling social security expenditure, nor to the omission of relevant variables, nor it can be explained by the presence of random errors in data on social security expenditure or by the inclusion of countries with "abnormally" small (large) social security programs and low (high) growth. Moreover, we show that standard inference procedures can

[34] We continue to use lagged variables whenever possible to instrument potentially endogenous variables for which we did not specify an equation. As before, since lagged observations are not available for social security expenditure, we use POP65 as an instrument for SS7085.

be used with reasonable confidence in this context. In particular, the empirical results that we obtained in a sample of 61 countries, for the 1970-1985 period, indicate that the observed behavior of social security expenditure in growth equations is only consistent with theories predicting a *positive* effect of average social security expenditure on the average GDP growth rate. On the other hand, our results can not dispel the theoretical ambiguity regarding the sign of the relation between these variables in the opposite direction of causation. Our results also seem to imply that the positive effect of social security expenditure on growth is much stronger in poor countries than in rich countries. As for the channels through which the positive effect of social security expenditure on growth should take place, our empirical results imply that the relevant mechanism at work is increased investment productivity. In particular, social security expenditure seems to have a positive effect on human capital formation. On the other hand, theories claiming that generous social security benefits should enhance investment productivity and growth by inducing retirement of umproductive workers or by improving political stability and social cohesion do not find support in our empirical analysis.

Although in our empirical analysis we often treated social security expenditure as an endogenous variable, we did not make reference to a specific theoretical model of fiscal policy determination in our choice of the instrument to use. We simply assumed that an older population implies higher social security expenditure. This constitutes an obvious limit of our analysis, especially when we try to look deeper at the mechanisms through which social security expenditure influences growth. Interesting insights into the relation between social security and growth might come from the specification of a complete model, where social security expenditure explicitly appears as an endogenous variable, along with growth. Few valuable indications on how such system should be specified, however, can be found in recent theoretical work on the issue. The "political economy approach", suggesting income inequality as an instrument for social security expenditure in growth regressions, does not perform well empirically, as shown by Perotti [22]. Bellettini and Berti-Ceroni's [11] model, where the size and composition of government expenditure and growth are jointly determined as the outcome of an intergenerational game, does not enumerate a set of instruments sufficiently large to identify a system where fiscal policy variables and growth are jointly estimated. Therefore, in order to arrive at a more detailed specification of the relation between social security expenditure and growth, further theoretical work is needed .

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7. Appendix

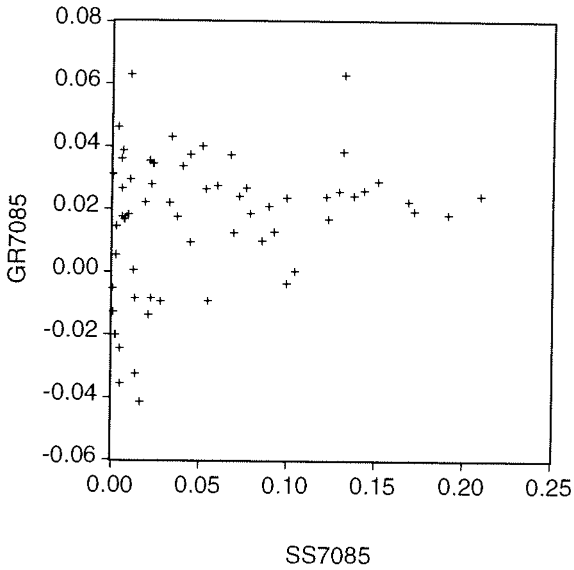

Figure 7.1:

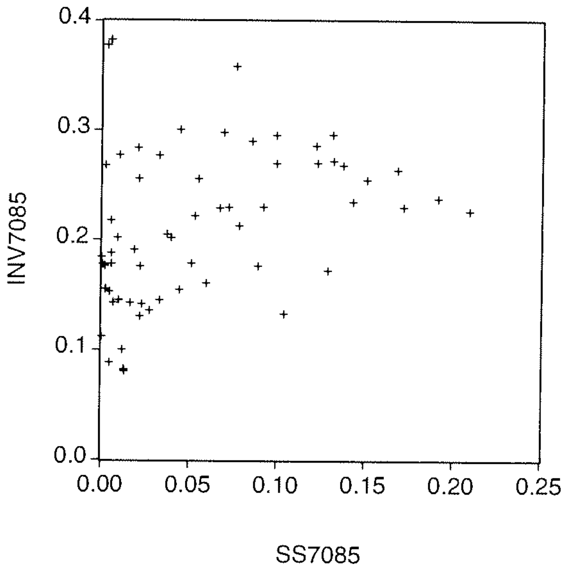

Figure 7.2:

P's specification:[35]

$$
\begin{aligned}
GR6085 &= \underset{(1.91)}{0.0190} - \underset{(-2.87)}{0.007}\, GDP60 + \underset{(0.29)}{0.004}\, SYRM60 \\
&- \underset{(0.18)}{0.002}\, SYRF60 + \underset{(3.22)}{0.257}\, SS7085 + \underset{(0.11)}{0.001}\, PPI60D
\end{aligned} \tag{7.1}
$$

SM's specification:[36]

$$
\begin{aligned}
GR7085 &= -0.000 - \underset{(0.004)}{0.015}\, LGDP70 - \underset{(0.047)}{0.129}\, GCONS7085 \\
&- \underset{(0.155)}{0.228}\, GINV7085 + \underset{(0.054)}{0.111}\, SS7085 + \underset{(0.041)}{0.217}\, INV7085
\end{aligned} \tag{7.2}
$$

Table 1
Dependent variable: GR7085

	(1)	(2)	(3)	(4)
C	0.009 (1.16)	0.011 (0.62)	0.010 (1.15)	0.013 (0.82)
LGDP70	-0.020 (-5.36)	-0.013 (-2.15)	-0.020 (-5.12)	-0.013 (-1.83)
SYRM70	0.012 (1.71)	0.016 (1.75)	0.012 (1.63)	0.016 (1.7)
SYRF70	-0.006 (-0.42)	-0.013 (-1.25)	-0.006 (-0.81)	-0.013 (-1.25)
GCONS7085	-0.072 (-2.38)	-0.01 (-0.31)	-0.076 (-2.32)	-0.017 (-0.26)
SS7085	**0.168 (3.15)**	**0.266 (2.70)**	**0.148 (2.63)**	**0.205 (1.95)**
LBMP7085	-0.049 (-6.36)	-0.046 (-1.97)	-0.049 (-6.15)	-0.045 (-2.14)
INV7085	0.154 (5.07)	0.108 (1.50)	0.148 (3.72)	0.075 (1.00)
EX7085	-0.024 (-1.39)	-0.087 (-3.01)		
IM7085			-0.009 (-0.51)	-0.050 (-1.65)
R^2	0.68	0.59	0.66	
obs.	59	50	58	51
est. method	OLS	TSLS	OLS	TSLS

[35]N. obs: 46. $R^2 = -0.03$. Estimation method: TSLS. T-statistics are shown in parenthesis.

[36]N. obs: 74. $R^2 = 0.39$. Estimation method: OLS. Standard errors of coeffients are shown in parenthesis.

Table 2

	OLS	obs.	TSLS	obs.
LIFEE070	0.125 (2.27)	57	0.211 (1.94)	50
POP65	0.181 (2.68)	59		
URB70	0.179 (3.03)	59	0.308 (2.58)	50
MID	0.134 (2.45)	44	0.239 (2.15)	42
REG. DUMMIES.	0.171 (3.10)	59	0.221 (2.12)	50
all ab/MID	0.156 (2.01)	57		
all above	0.126 (1.50)	43		

Table 3
Dependent variable: GR7085

	(1)	(2)	(3)	(4)
C	0.005 (0.72)	0.012 (0.76)	0.012 (0.90)	0.019 (1.92)
LGDP70	-0.017 (-3.99)	-0.017 (-2.97)	-0.023 (-3.52)	-0.011 (-1.74)
SYRM70	0.032 (2.98)	0.037 (2.54)	-0.000 (-0.08)	0.015 (1.52)
SYRF70	-0.024 (-1.97)	-0.034 (-1.76)	0.005 (0.60)	-0.022 (-1.32)
GCONS7085	-0.062 (-.07)	0.031 (0.47)	0.013 (0.38)	-0.152 (-3.46)
SS7085	0.175 (3.33)	0.184 (1.93)	0.094 (1.84)	0.332 (2.94)
INV7085	0.153 (5.10)	0.118 (1.79)	0.126 (3.69)	0.200 (5.03)
LBMP7085	-0.054 (-7.01)	-0.058 (-2.52)	-0.060 (-3.51)	-0.042 (-5.03)
EX7085	-0.027 (-0.90)	-0.184 (-2.97)	0.001 (0.10)	-0.041 (-1.39)
SYRMGDP	-0.008 (-2.40)	-0.008 (-2.14)		
SYRFGDP	0.007 (2.18)	0.008 (1.91)		
EXGDP	0.002 (0.54)	0.021 (2.48)		
R^2	0.72	0.67	0.70	0.86
obs.	59	50	30	29
est. method	OLS	TSLS	OLS	OLS

Table 4a
OLS

	0.001 < SS7085	SS7085 < 0.113	- 0.019 < GR7085
SS7085	0.174	0.171	0.098
t-stat	3.05	1.89	2.03
obs.	56	47	54

Table 4b
TSLS

	0.001 < SS7085	SS7085 < 0.113	- 0.019 < GR7085
SS7085	0.256	0.333	0.171
t-stat	2.57	1.59	1.42
obs.	49	39	45

Table 4c
Dependent Variable: GR7085

	GR7085>0-0.019	entire sample
C	0.013 (0.99)	0.005 (0.35)
LGDP70	-0.017 (-3.10)	-0.010 (-1.54)
SYRM70	0.015 (1.81)	0.010 (0.99)
SYRF70	-0.010 (-1.20)	-0.006 (-0.58)
GCONS7085	-0.079 (-1.79)	-0.058 (-0.93)
SS7085	0.183 (2.46)	0.177 (1.90)
INV7085	0.088 (1.34)	0.070 (0.82)
R^2	0.41	0.29
obs.	56	61
est. method	TSLS	TSLS

Table 5
Dependent variable: INV7085 ((1), (2)); PINV7085 ((3), (4))

	(1)	(2)	(3)	(4)
C	0.150 (4.69)	0.160 (2.44)	0.132 (4.83)	0.127 (2.30)
LGDP70	0.043 (2.64)	0.029 (0.95)	0.041 (2.96)	0.034 (1.31)
SYRM70	0.018 (0.89)	0.038 (0.90)	0.027 (1.00)	0.040 (1.15)
SYRF70	-0.035 (-1.04)	-0.043 (-0.90)	-0.032 (-1.11)	-0.046 (-1.14)
GCONS7085	0.109 (0.79)	0.295 (1.09)	0.061 (0.52)	0.291 (1.28)
SS7085	-0.302 (-1.25)	-0.024 (-0.05)	-0.268 (-1.31)	-0.120 (-0.30)
LBMP7085	-0.043 (-1.23)	-0.142 (-1.41)	-0.042 (-1.41)	-0.124 (-1.46)
EX7085	0.145 (1.82)	-0.028 (-0.21)	0.108 (1.54)	-0.026 (-0.22)
R^2	0.33	0.22	0.37	0.27
obs.	59	50	59	50
est. method	OLS	TSLS	OLS	TSLS

Table 6
Dependent variable: GR7085

	(1)	(2)	(3)	(4)
C	0.017 (1.38)	0.004 (0.15)	0.040 (2.61)	0.021 (1.46)
LGDP70	-0.016 (-3.04)	-0.014 (-1.48)	-0.042 (-5.02)	-0.005 (-0.82)
SYRM70	0.009 (0.89)	0.005 (0.39)	-0.012 (-0.94)	0.019 (1.27)
SYRF70	-0.004 (-0.44)	-0.001 (-0.12)	0.023 (1.57)	-0.013 (-0.78)
GCONS7085	-0.041 (-0.97)	-0.023 (-0.17)	-0.051 (-1.05)	-0.113(-1.70)
SS7085	0.144 (2.00)	0.277 (2.09)	0.174 (2.46)	0.037 (0.27)
SSRET	0.083 (0.96)	-0.010 (-0.07)		
RETIR	-0.009 (-0.97)	-0.001 (-0.08)		
LBMP7085	-0.047 (-5.02)	-0.035 (-1.38)	-0.065 (-4.99)	-0.045 (-3.32)
INV7085	0.108 (2.94)	0.143 (2.58)	0.128 (2.90)	0.119 (2.27)
EX7085	-0.047 (-2.18)	-0.097 (-2.54)	-0.000(-0.01)	-0.043 (-1.43)
R^2	0.67	0.57	0.83	0.75
obs.	44	40	21	23
est.method	OLS	TSLS	OLS	OLS

Table 7
Dependent Variable: GR7085

	(1)	(2)
C	0.012 (1.36)	0.021 (1.11)
LGDP70	-0.020 (-5.29)	-0.017 (-2.20)
SYRM70	0.013 (1.84)	0.017 (1.60)
SYRF70	-0.013 (-0.97)	-0.014 (-1.14)
GCONS7085	-0.074 (-2.44)	-0.033 (-0.47)
SS7085	0.162 (3.00)	0.282 (2.59)
LBMP7085	-0.048 (-6.00)	-0.037 (-1.42)
INV7085	0.150 (4.83)	0.090 (1.19)
EX7085	-0.025 (-1.43)	-0.090 (-2.80)
SPI7085	-0.006 (-0.81)	-0.024 (-1.40)
R^2	0.68	0.48
obs.	59	49
est.method	OLS	TSLS

Table 8
Dependent Variable: GR7085

	(1)	(2)	(3)	(4)
C	0.007 (0.90)	0.006 (0.32)	0.008 (1.01)	0.006 (0.34)
LGDP70	-0.021 (-5.23)	-0.015 (-2.15)	-0.021 (-5.53)	-0.018 (-3.00)
ENR7085	0.011 (0.69)	0.035 (0.99)	0.028 (2.04)	0.036 (1.58)
SYRM70	0.010 (1.45)	0.014 (1.43)		
SYRF70	-0.005 (-0.78)	-0.015 (-1.35)		
GCONS7085	-0.068 (-2.23)	0.010 (0.14)	-0.070 (-2.29)	-0.020 (-0.36)
SS7085	0.155 (2.75)	0.184 (1.62)	0.143 (2.57)	0.184 (1.78)
LBMP7085	-0.049 (-6.30)	-0.050 (-2.09)	-0.047 (-6.04)	-0.044 (-1.90)
INV7085	0.146 (4.40)	0.064 (0.73)	0.135 (4.16)	0.105 (1.38)
EX7085	-0.025 (-1.43)	-0.087 (-2.85)	-0.025 (-1.30)	-0.084 (-3.02)
R^2	0.68	0.55	0.65	0.57
obs.	59	50	59	50
est.method	OLS	TSLS	OLS	TSLS

$$\begin{aligned} GR7085 &= \alpha_0 + \alpha_1 LGDP70 + \alpha_2 ENR7085 + \alpha_3 GCONS7085 + \\ &+ \alpha_4 LBMP7085 + \alpha_5 INV7085 + \alpha_6 EX7085 + \alpha_7 SPI7085 \end{aligned} \tag{7.3}$$

$$SPI7085 = \beta_0 + \beta_1 LGDP70 + \beta_2 SS7085 + \beta_3 SPI6070 \tag{7.4}$$

$$\begin{aligned} ENR7085 &= \gamma_0 + \gamma_1 LGDP70 + \gamma_2 SYRM70 + \\ &+ \gamma_3 SYRF70 + \gamma_4 SS7085 \end{aligned} \tag{7.5}$$

Table 9

	GR7085	**SPI7085**	**ENR7085**
C	0.015 (0.75)	0.153 (2.29)	0.207 (6.01)
LGDP70	-0.023 (-3.00)	-0.086 (-1.25)	0.120 (3.05)
ENR7085	0.085 (2.97)		
SYRM70			0.135 (1.95)
SYRF70			-0.044 (-0.56)
GCONS7085	-0.019 (-0.30)		
SS7085		0.234 (0.17)	1.733 (2.80)
LBMP7085	-0.039 (-1.51)		
INV7085	0.012 (0.14)		
EX7085	-0.058 (-2.00)		
SPI7085	-0.026 (-1.44)		
SPI6070		0.601 (4.10)	
R^2	0.39	0.80	0.37
obs.	49	49	49

8. Data Appendix

List of countries

Our sample includes 61 countries. There are three variables for which many observations are missing: MID, RETIR and SPI. In the following list, * indicates that information on MID and SPI is available for that particular country, while ◇ indicates that information on RETIR is available for that particular country.

Botswana*, Cameroon◇, Ghana◇, Kenya*◇, Liberia◇, Malawi*, Mauritius, Senegal*◇, Swaziland, Tunesia*◇, Zaire◇, Zambia*◇, India*◇, Iran*◇, Israel*, Japan*◇, Jordan, Korea*, Philippines*◇, Sri Lanka*◇, Thailand*, Belgium◇, Cyprus*◇, Denmark*◇, Finland*◇, France*◇, Germany*◇, Greece*◇, Ireland*◇, Italy*◇, Malta, Netherlands*◇, Norway*, Spain*◇, Sweden*◇, Switzerland*◇, Turkey*, United Kingdom*◇, Barbados*, Canada*◇, Costa Rica*◇, El Salvador*◇, Mexico*◇, Nicaragua◇, Panama*◇, United States*◇, Argentina*◇, Bolivia*, Brazil*, Chile*◇, Colombia◇, Ecuador*◇, Guyana◇, Paraguay◇, Peru*◇, Uruguay*◇, Venezuela*◇, Australia*◇, Fiji◇, New Zealand*◇, Papua New Guinea◇.

Description of variables and data sources

Unless otherwise noted, all variables included in the following list are taken directly from Barro-Lee's [6] data set or constructed using data therein contained.

AFRICA: dummy variable for Africa (Barro-Wolf [9]).
ENRxy: total gross enrollment ratio for secondary education, average over the 19x-19y period, x=60, 70; y=70, 85.
EXxy: ratio of exports to GDP in current international prices, average over the 19x-19y period, x=60, 70; y=70, 85.
GDPx: GDP per capita in real terms, x=60, 70.
GRxy: growth rate of per capita GDP, average over the 19x-19y period, x=60, 70; y=70, 85.
GCONSxy: ratio of real government consumption expenditure to real GDP, average over the 19x-19y period, x=60, 70; y=70, 85.
IMxy: ratio of imports to GDP in current international prices, average over the 19x-19y period, x=60, 70; y=70, 85.

INVxy: ratio of real national investment (private plus public) to real GDP, average over the 19x-19y period, x=60, 70; y=70, 85.
LAAM: dummy variable for Latin America (Barro-Wolf [9]).
LBMPxy: logarithm of the black market premium, average over the 19x-19y period, x=60, 70; y=70, 85.
LGDPx: logarithm of GDPx.
LIFEE070: life expectancy at birth in 1970.
MID: share in income of the third and fourth quintiles, in or around 1960 (Perotti [22]).
PINV7085: ratio of real private investment to real GDP, average over the 1970-1985 period,
POP65: population proportion over age 65, average over the 1970-85 period.
PPI60D: deviation of the 1960 PPP value for the investment deflator from the sample mean (Barro-Wolf [9]).
RETIR: dummy variable for compulsory retirement (SM).
SPI: index of socio-political instability (Perotti [22]).
SPIxy: sum of the number of assassinations per million population per year, the number of coups per year and the number of revolutions per year between 19x and 19y, x=60, 70; y=70, 85.
SS7085: ratio of nominal social insurance and welfare payments to nominal GDP, average over the 1970-85 period (Barro-Wolf [9]).
SYRM70: average years of secondary schooling in the male population over age 25.
SYRF70: average years of secondary schooling in the female population over age 25.
URB70: urbanization rate in 1970 (World Bank).

Table A[37]
Descriptive Statistics

	mean	median	max	min	st.dev.	obs.
ENR7085	0.531	0.532	0.967	0.036	0.264	61
EX7085	0.206	0.164	0.593	0.025	0.133	60
GDP70	3.300	2.285	9.459	0.301	2.638	61
GR7085	0.017	0.022	0.063	-0.041	0.022	61
GC7085	0.186	0.169	0.380	0.076	0.067	61
IM7085	0.227	0.195	0.593	0.032	0.142	59
INV7085	0.213	0.213	0.383	0.081	0.070	61
LBMP7085	0.179	0.082	1.535	0.000	0.268	60
LIFEE070	61.522	63.500	74.500	40.400	10.072	59
MID	0.345	0.345	0.420	0.220	0.054	46
POP65	0.063	0.039	0.149	0.024	0.038	61
SPI	-0.268	-0.445	4.360	-1.120	1.146	46
SPI7085	0.161	0.000	1.444	0.000	0.275	61
SS7085	0.057	0.037	0.210	0.000	0.056	61
SYRF70	0.832	0.555	3.972	0.005	0.880	61
SYRM70	1.073	0.847	3.722	0.032	0.885	61
URB70	50.225	47.600	94.300	6.000	23.951	61

[37] GC7085 stnds for GCONS7085.

Table B
Correlation Matrix

	ENR7085	EX7085	GDP70	GR7085	GC7085
ENR7085	1.000				
EX7085	0.461	1.000			
GDP70	0.811	0.506	1.000		
GR7085	0.309	0.034	0.102	1.000	
GC7085	-0.294	0.155	-0.313	-0.268	1.000
INV7085	0.558	0.372	0.452	0.447	-0.045
SS7085	0.743	0.597	0.729	0.234	-0.167
IM7085	0.429	0.949	0.401	0.100	0.298
LBMP7085	-0.432	-0.222	-0.448	-0.597	0.247
LIFEE070	0.877	0.390	0.817	0.313	-0.370
MID			0.763	0.309	-0.154
POP65	0.837	0.579	0.856	0.267	-0.252
SPI			-0.455	-0.369	-0.094
SPI7085	0.218	-0.286	-0.312	-0.255	-0.070
SYRF70	0.756	0.316	0.776	0.156	-0.167
SYRM70	0.747	0.289	0.710	0.205	-0.206
URB70	0.778	0.341	0.813	0.058	0.322

	INV7085	SS7085	IM7085	LBMP7085	LIFEE070
ENR7085					
EX7085					
GDP70					
GR7085					
GC7085					
INV7085	1.000				
SS7085	0.344	1.000			
IM7085	0.402	0.559	1.000		
LBMP7085	-0.350	-0.366	-0.221	1.000	
LIFEE070	0.516	0.763	0.334	-0.457	1.000
MID	0.477	0.670			
POP65	0.466	0.868	0.501	-0.479	0.813
SPI	-0.334	-0.396			
SPI7085	-0.315	-0.294	-0.308	0.333	-0.305
SYRF70	0.342	0.558	0.250	-0.316	0.676
SYRM70	0.318	0.533	0.230	-0.266	0.644
URB70	0.303	0.753	0.269	-0.349	0.798

	MID	POP65	SPI	SPI7085
ENR7085				
EX7085				
GDP70				
GR7085				
GC7085				
INV7085				
SS7085				
IM7085				
LBMP7085				
LIFEE070				
MID	1.000			
POP65	0.835	1.000		
SPI	-0.565	-0.452	1.000	
SPI7085		-0.277		1.000
SYRF70		0.651		-0.183
SYRM70		0.608		-0.108
URB70	0.606	0.738	-0.202	-0.173

	SYRF70	SYRM70	URB70
ENR7085			
EX7085			
GDP70			
GR7085			
GC7085			
INV7085			
SS7085			
IM7085			
LBMP7085			
LIFEE070			
MID			
POP65			
SPI			
SPI7085			
SYRF70	1.000		
SYRM70	0.953	1.000	
URB70	0.678	0.638	1.000

Table C1

	GR7085	SS7085
mean	0.016	0.057
median	0.022	0.037
max	0.062	0.209
min	-0.041	0.000
stand. dev.	0.021	0.056

Table C2[38]

GR7085

	SS > 0.113	SS < 0.001	SS < 0.113	SS > 0.001
mean	0.027	0.004	0.013	0.017
median	0.024	-0.005	0.018	0.022
max	0.062	0.031	0.062	0.062
min	0.016	-0.012	-0.041	-0.041
stand. dev.	0.012	0.023	0.022	0.021

Table C3[39]

SS7085

	GR<-0.019	GR>0.037	GR>-0.019	GR<0.037
mean	0.008	0.053	0.061	0.057
median	0.004	0.044	0.044	0.034
max	0.016	0.132	0.209	0.209
min	0.002	0.002	0.000	0.000
stand. dev.	0.006	0.049	0.057	0.057

[38] SS stands for SS7085.

[39] GR stands for GR7085.