

**OPTIMAL SAVING, OPTIMAL INVESTMENT AND ECONOMIC
GROWTH: EVIDENCE FROM COUNTRIES WITH DIFFERENT
INCOME AND OPENNESS LEVELS**

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This study explores the relation between both saving rate and the ratio investment/GDP on economic growth for a wide sample of countries with different income and openness levels. The evidence indicates that in general higher saving and investment are growth promoting, in special in lower and closer economies. There the capital marginal return must be higher because of the scarcity of capital proper of less developed economies. In turn, the lack of external markets imposes the necessity to increase saving and investment in order to expand the domestic markets. Besides, savings and investment that maximize the growth rate are higher than the modal values. Thus, to increasing them should promote higher growth rates. Economic policy recommendations are that the governments should impulse austerity both at public and private level, as fiscal policies and a tax system tending to achieve higher saving and investment rates.

Keywords: Economic Growth, Saving, Investment, Openness, Nonlinear Relation
JEL Classification: O47, O49

1. INTRODUCTION

A long-term economic growth is a result of several factors, which differs, among sundry features, of the different level of development as their insertion in the world market, but saving and investment are clearly two variables widely accepted as necessities to impulse the growth process. Nonetheless, these can influence differently between countries with different income levels and degree of openness degree. More developed economies present both higher per capita income level and more abundant stock capital, so that investment must be more decreasing returns than those of poorer

countries. Meanwhile, may be than both saving and investment play a different role on economic growth among countries with different level of openness. These determinants should present a higher impact on growth in closer and poorer economies, because to developed such countries face the necessity to expand their small domestic market, in particular if these have difficulties to insert in the international trade.

There is abundant evidence showing that both investment and savings are growth promoting. First, the pioneer research presented in Levine and Renelt (1992) states a positive and robust correlation between the investment/GDP ratio and economic growth. Moreover, this rather intuitive result was corroborated by a huge body of literature published after their paper. Between them there are several studies carried out for Latin America, as Bermudez et al. (2015), among others. In the same sense, a voluminous literature shows a positive effect of investment for Asian countries, as Sihna and Sihna (2002), Behname (2012), Azam et al. (2014), and more recently Nguyen (2021), into a numerous contribution on this issue for this region. Besides, Cheung et al. (2012) present similar evidence for a wide sample of rich and poor countries. Finally, Sharma and Abekah (2008), Adams (2009), Doku et al. (2017), Awolusi et al. (2018), Masipa (2018), and later Yeboua (2021) presents evidence on a positive investment-economic growth relationship for African countries.

In second place, savings finance investment projects, so that these should favors long term growth process. In fact, also in this case there is a lot of literature supporting this hypothesis. Among other contributions, Otani and Villanueva (1990) for developing countries, De Gregorio (1992) for Latin America and, Krieckhaus (2002) for different kind of countries states a positive nexus between savings and growth. In turn, in two different works, Odhiambo (2008) and Odhiambo (2009) for South Africa arrives to similar conclusions. Finally, in a study of Kosovo for the 2010-2017 period, Ribaj and Mexhuani (2021) conclude that savings impulse economic growth.

In sum, abundant literature indicates that both savings and investment impulse process of long-term economic growth, which is a rather intuitive hypothesis. In this sense, the following of this paper present evidence that also support this idea. Nonetheless, saving and investment could have a nonlinear relation with economic growth, as a different influence in economies with different levels of openness and development. Hence, the long run growth effects of both savings and investment deserve a more detailed research. In this frame, the motivation of this investigation is to determine how much effort, in terms of present privation of consumption, is necessary to foster higher saving, investment, and then economic growth among countries with different level of development and openness. In this sense, the objective here is to determine the profile of such relation, as the optimal levels of saving and investment to maximize the rate of growth. The study is carried out for a wide sample of 116 countries for the 1980-2018 period, using both non-parametric and parametric regressions. Hence, the contribution is to approximate the optimal levels of saving and investment that maximize the rate of growth by means of non-linear estimations in countries with different level of development and openness.

The paper is structured as follows. Section 2 presents a brief review of the literature on this issue. Section 3 describes the data and methodology employed in the empirical analysis. Section 4 presents the empirical evidence and section 5 resumes the findings. Finally, section 6 concludes.

2. LITERATURE REVIEW

The positive relation between both saving and investment with economic growth is widely documented in the literature. In turn, empirical evidence supporting this link endorses the conclusions of both the traditional and new growth theory. In this sense, a clear case of this statement is China, a large emerging country with a very successful path that went from a relative initial low per capita income since the beginning of the economic reforms of 1978. In this sense, since the early transition saving was the link between inequality and high economic growth (Lin 2013). According to the classic approach, the idea is that since the rate of savings is generally increasing in income, inequality fosters economic growth because of higher savings finance higher investment, which in turn promotes economic growth. In this vein, Dabús and Delbianco (2021) find that the comparative advantage of Southeast Asian of having a very abundant labor force endowment allowed a very successful insertion of this area in the world market, so that increasing production is exported to the rest of the world. Thus, an initial high inequality that was canalized to high saving and investment allowed that the increasing production could be exported to the international market. In this sense, a positive inequality-growth relationship for the case of China since the post-reform period can be found in Chan et al. (2014). Meanwhile, Li et al. (2016) show a robust positive long run relationship in a panel of 27 provinces for the 1984-2012 period.

On the contrary, in Latin America the historically high inequality was not growth promoting because this do not have an endowment of resources favorable to a successful insertion in the world market. Hence, this region faced an historical external restriction. This discouraged the incentives to save and investment, leading the region to a long run relative stagnation, in comparison with the Southeast Asian countries.

In addition, despite there is not a unanimous consensus on the positive role of openness on the economic growth, the evidence trends to support that this is growth promoting, in particular in developing countries, because of the limitation to face a small domestic market mentioned above. In fact, the contributions of Edwards (1992), Edwards (1998), Karras (2003) for a wide sample of countries and Mercan et al. (2013) for the BRIC countries and Turkey present evidence showing that trade openness affects positively economic growth. Similarly, Vogiatzoglou and Nguyen (2016) for five Southeast Asian countries, and Dao (2014) shows a positive impact of trade liberalization on economic growth for a sample of 71 developing and developed countries during the 1980-2009 period, while Tahir and Azid (2015) find that the trade openness-economic growth relationship is positive and significant in developing

countries, while previously Yanikkaya (2003) presents similar evidence in both developed and developing countries. Finally, for the case of African countries Brueckner and Lederman (2016) find that trade openness is growth promoting in the Sub-Saharan Africa. Similar results for exports are documented in Bakari and Krit (2017) for Mauritania during the 1960-2015 period. In turn, the positive role of FDI on economic growth is documented in Sakyi et al. (2015) for Ghana.

In short, not surprisingly abundant literature supports a positive relationship between saving, investment and growth, in particular in those economies with an adequate endowment of resources to achieve a successful insertion in the world economy, as in developing countries that have to face the limitation of a small domestic market. Besides, in general the evidence indicates that exports and openness also promote higher growth. In this sense, in the next sections a comparative study by means of a non-linear approach is carried out for a wide sample with different the level of development and openness. This will allow determine the optimal levels of saving and investment that maximize the economic growth. Therefore, such a study is carried out in the sections 3 and 4 of this paper.

3. DATA AND METHODOLOGY

The empirical analysis carried out are in this paper is in base to five-year average data of the World Bank¹. The list of countries can be seen in the appendix. This study uses the concepts of Local Averaging of Friedman (1984) and Local Regression of Cleveland (1979), whose work develops the idea that adjust the regression line to a neighborhood of the observations. In the first case is performed by averaging this observation with a group of nearby observations while the second case fit a weighted least squares regression model conditioned on the distance of the observations. Finally, we also use a Kernel regression (from the seminal works of Nadaraya (1964) and Watson (1964)) that as the name indicates use a kernel-weighted linear combination, usually defining a gaussian distribution. The first two can be obtained with the *loess*² function in R, and the *ksmooth*³ function also in R is useful to estimate the kernel regression⁴.

Parametric regressions were made in order to compare linear and nonlinear effects of savings and investment on economic growth with the results of the non-parametric regressions. A robust linear estimation and a fixed-effects panel regression in each

¹ <https://data.worldbank.org/>

² <https://www.rdocumentation.org/packages/stats/versions/3.6.2/topics/loess>

³ <https://www.rdocumentation.org/packages/stats/versions/3.6.2/topics/ksmooth>

⁴ See <http://users.stat.umn.edu/~helwig/notes/smooth-notes.html> for a tutorial on how to use Non-parametric regressions methods in R.

subsample and capture the possible non-linearity with the addition of the savings in level and squared is carried out. In turn, the estimations are controlled for the heterogeneity of each country and five-year period.

Table 1. Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
Growth	overall	2.03	3.47	-30.25	24.93	N = 687
	between		1.65	-1.82	8.53	n = 116
	within		3.06	-27.63	27.56	T-bar = 5.92
Income US2010	overall	15234.12	19096.95	182.64	108124.80	N = 683
	between		18769.35	245.48	94271.07	n = 116
	within		3557.23	-7965.67	38183.75	T-bar = 5.93
Savings (%GDP)	overall	20.81	14.24	-103.71	57.57	N = 675
	between		13.54	-56.18	50.32	n = 116
	within		6.11	-26.72	68.25	T-bar = 5.81
Exports	overall	41.35	28.06	5.90	221.99	N = 681
	between		26.49	7.75	188.18	n = 116
	within		9.37	-18.14	105.98	T-bar = 5.87

4. SAVING, INVESTMENT AND ECONOMIC GROWTH:

NON LINEARITIES AND OPTIMAL SAVING AND INVESTMENT VALUES

To conduct our empirical analysis, we use data from the Organization for Economic Cooperation and Development (OECD) from the national accounts database. The main variable of interest is the current account which is the dependent variable. The current account balance of payments is a record of a country's international transactions with the rest of the world. Such transactions involve transactions that involve economic value such as goods and services. Our indicator is measured as a percentage of GDP.

In first place, in order to find out a possible causality behind the relationship between saving, investment and economic growth, a first non-parametric causal analysis between saving, investment and economic growth is carried out by means of kernel regressions on the R package "*GeneralCorr*"⁵ (Vinod, 2019). The strength index built by the author and correlation values suggests that the most likely causal paths are from investment to economic growth (strength=31.496 and correlation=0.309), as well as from savings to economic growth (strength=31.496 and correlation=0.277).

⁵ <https://www.rdocumentation.org/packages/generalCorr/versions/1.2.6/topics/causeSummary2>

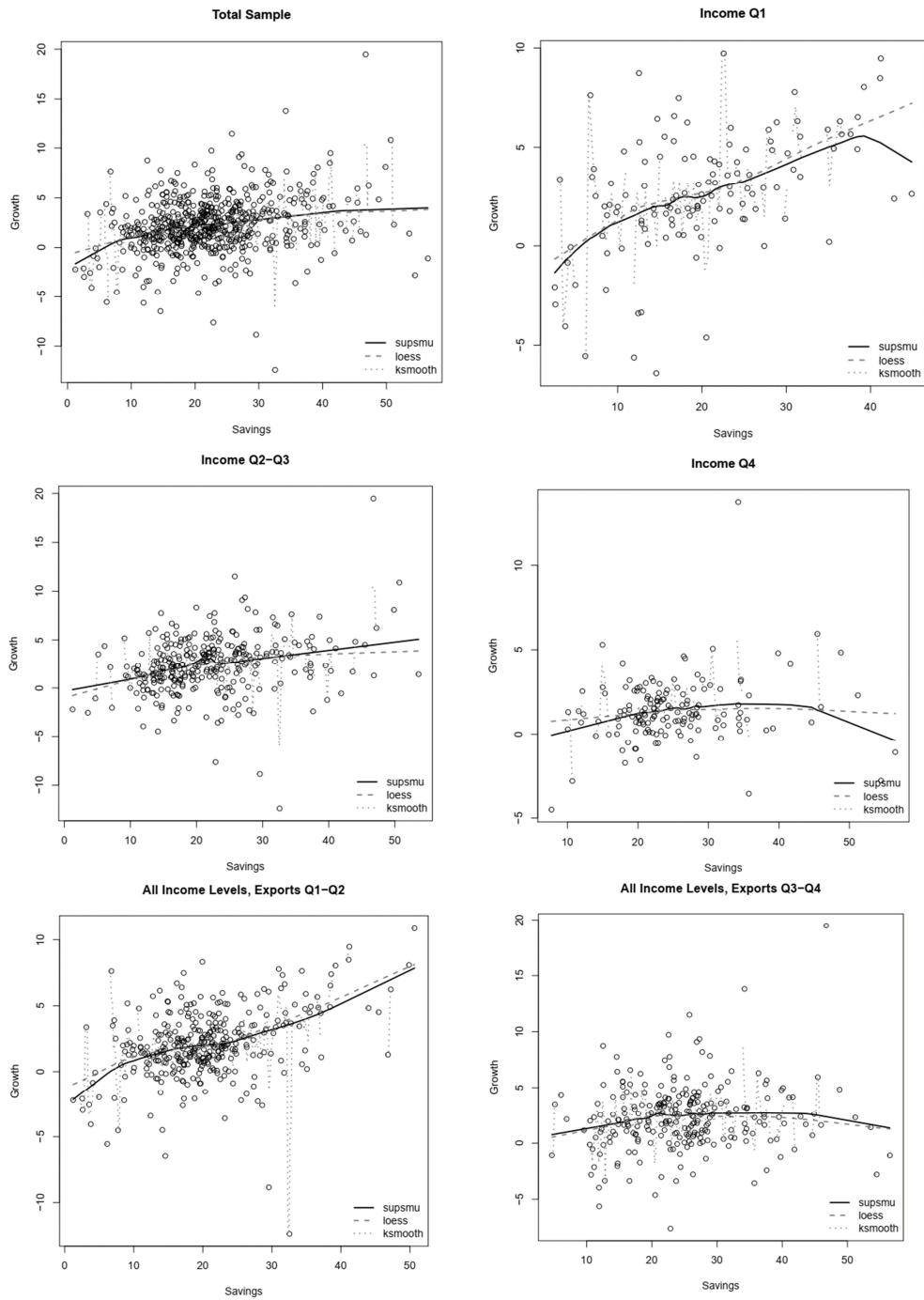


Figure 1. Non-parametric Regressions between Saving Rate and Growth

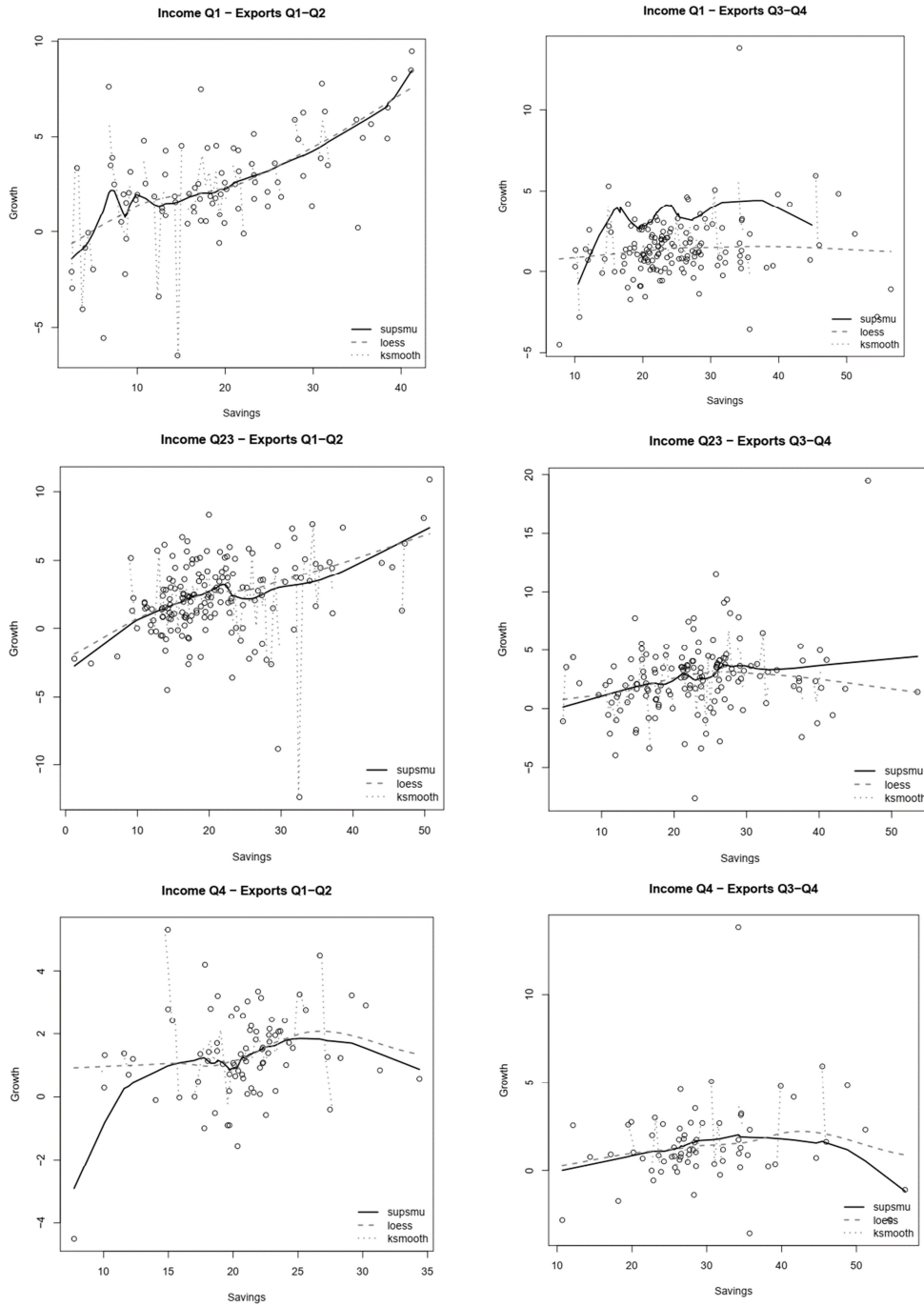


Figure 1. Non-parametric Regressions between Saving Rate and Growth (cont')

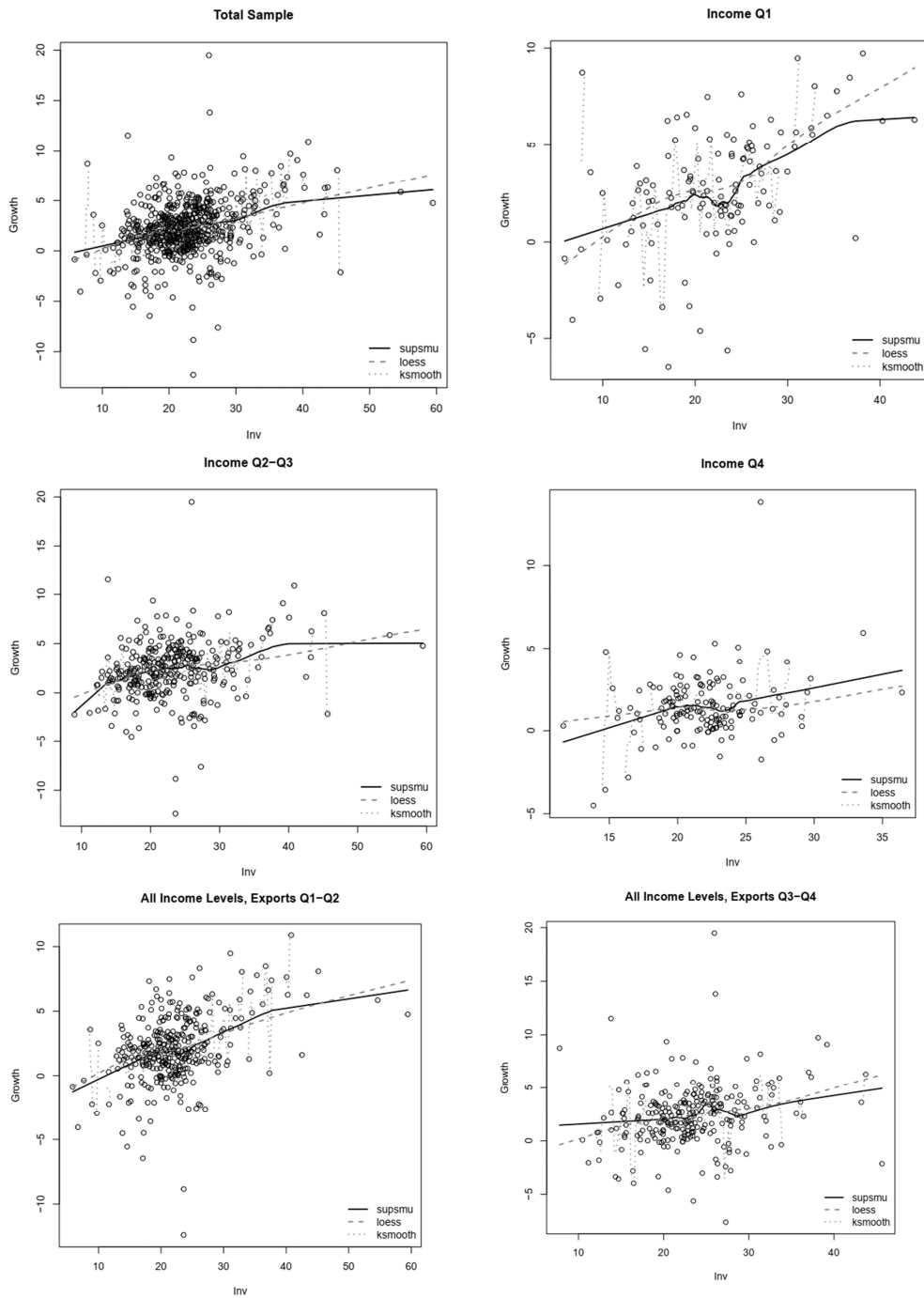


Figure 2. Non-parametric Regressions between Investment (Inv) and Growth

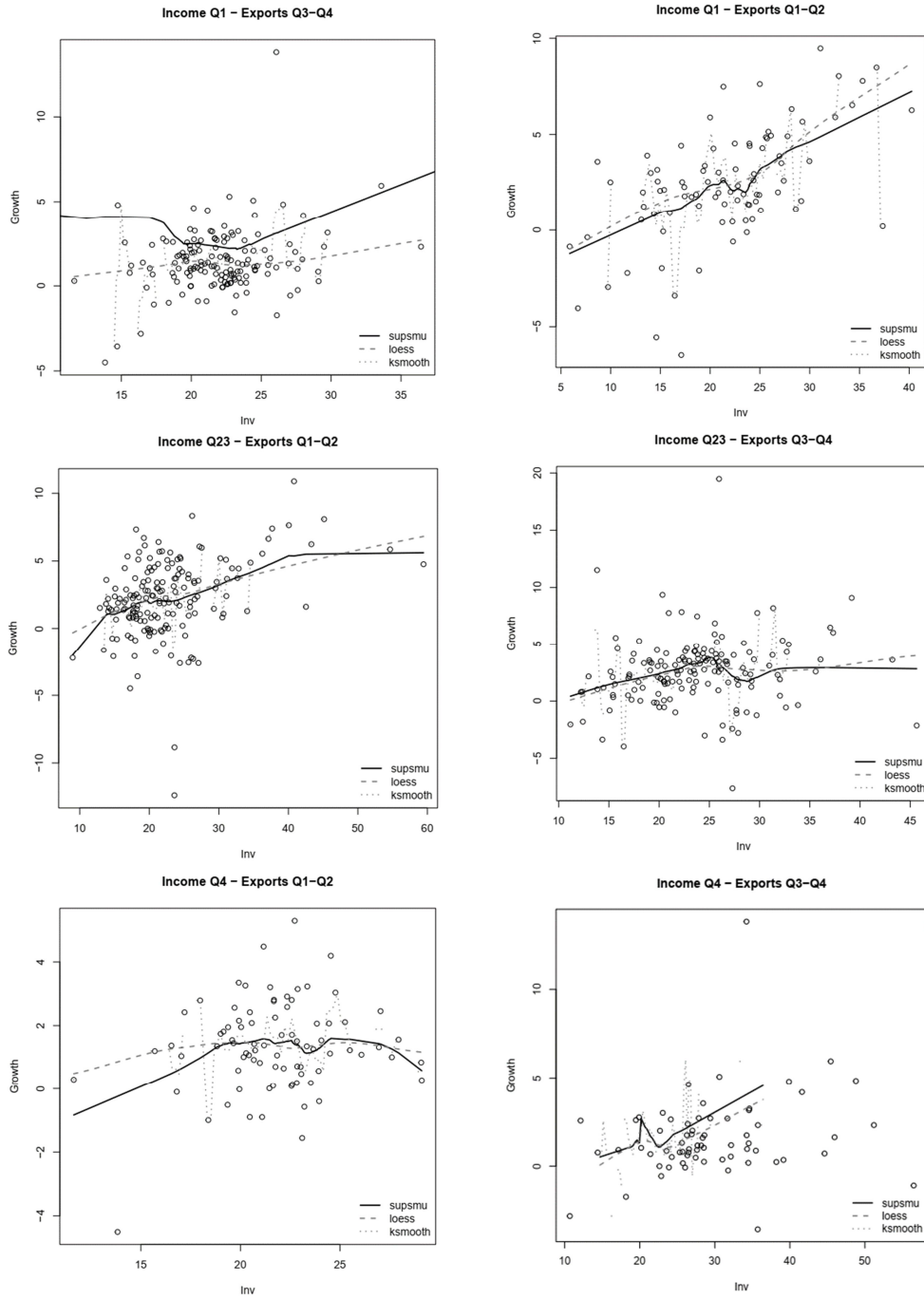


Figure 2. Non-parametric Regressions between Investment (Inv) and Growth (cont')

In second place, Figures 1 and 2 show the relation between saving and investment with economic growth. This allows have a first glance of the profile of the relationship among these variables among countries with different level of development and openness. There, an optimal value in this context is referred to the value in which the fitting curve has the maximal value. On the other hand, the modal value in this paper refers to the bin of the histogram of the distribution which peak is maximum (i.e. the most common range of values of the variable).

In first place, the figures for the saving rate-economic growth relationship show that this is generally increasing, while the optimal saving rate value is in all cases notoriously higher than the modal value. For example, for the total sample the first is 56%, while the modal saving rate is only 20%. Besides, in order to achieve a more precise idea of this relationship the total sample was divided in countries with three different per capita income and openness level: high, middle and low. This division indicates that in the countries of low- and middle-income levels such relationship is monotonously increasing. Nonetheless, the slope is clearly higher in the economies with lower income level, so that the marginal effect of increasing the saving rate impulse to higher economic growth, in comparison with those countries of higher income levels. In turn, there the optimal saving rate is near 45%, clearly higher than the modal value of 15%. Meanwhile, middle income economies also present a positive relation, but its slope is visibly lower, and in this case once again the optimal value of the saving rate exceeds markedly the modal value (54% and 15%, respectively). On the contrary, in high income countries the relations are not monotonously positive, but presents and “inverted U” shape. Meanwhile, as the rest of the sample the optimal saving rate is higher than the modal value, but here both the optimal saving rate values and its difference with the modal saving rate is lower than that of lower income level countries.

Therefore, the saving rate-economic growth relationship, with exception of highest income level countries, is always positive and monotone, while its slope is higher in low income countries, and in high income level countries the optimal saving rate is lower than the slope of less developed economies. The intuition is that in less developed countries the capital marginal return is higher because of the scarcity of capital proper of less developed economies, so that increasing savings that finance additional investment should promote faster economic growth. Moreover, the great difference between the optimal and modal values of saving rate once again suggests that higher savings must be beneficial for growth.

On the other hand, in order to state if the saving-economic growth relationship changes among economies with different levels of developed and openness, the total sample was divided among countries with different per capita income levels and into them between more open and closer countries. Thus, there are eight groups of countries. There are closer and open countries both for the total sample and for high, middle- and low-income level economies, where the openness is defined by the ratio between the sum of exportations and importations with respect to GDP, and these are classified into closer or open countries according their position with respect to the median of the

sample.

Table 2A. Optimal and Modal Values of the Non-Parametric Regressions between Economic Growth and Savings.

Group	S* (red line)	S* (black line)	Peak (bins=10)	Histogram
Total	56.50	56.50	(20,25)	
Income Q1	44.89	39.22	(15,20)	
Income Q2Q3	53.57	53.57	(15,20)	
Income Q4	37.59	34.22	(20,25)	
Exports Q1Q2	50.66	50.66	(15,20)	
Exports Q2Q3	23.71	37.63	(25,30)	
Income Q1 - Exports Q1Q2	41.22	41.22	(15,20)	
Income Q1 - Exports Q3Q4	34.35	37.63	(20,25)	
Income Q2Q3 - Exports Q1Q2	50.66	50.66	(15,20)	
Income Q2Q3 - Exports Q3Q4	27.63	53.57	(20,25)	
Income Q4 - Exports Q1Q2	26.76	25.13	(20,25)	
Income Q4 - Exports Q3Q4	42.47	34.22	(25,30)	

Table 2B. Optimal and Modal Values of the Non-Parametric Regressions between Economic Growth and Investment.

Group	S* (red line)	S* (black line)	Peak (bins=10)	Histogram
Total	59.44	59.44	(20,25)	
Income Q1	43.72	43.72	(20,25)	
Income Q2Q3	59.44	59.44	(20,25)	
Income Q4	36.43	36.43	(20,25)	
Exports Q1Q2	59.44	20.54	(20,25)	
Exports Q2Q3	45.63	45.63	(20,25)	
Income Q1 - Exports Q1Q2	40.25	40.25	(20,25)	
Income Q1 - Exports Q3Q4	43.72	43.72	(20,25)	
Income Q2Q3 - Exports Q1Q2	59.44	59.44	(20,25)	
Income Q2Q3 - Exports Q3Q4	25.23	45.63	(20,25)	
Income Q4 - Exports Q1Q2	24.54	20.54	(20,25)	
Income Q4 - Exports Q3Q4	36.43	36.43	(20,25)	

In second place, not surprisingly the figures for the relation between the ratio

investment/GDP and growth in most cases are similar to the savings-growth relationship. In this sense, even though in more open countries this does not adopt an “inverted U” form, also its slope is lesser than in closer economies with low- and middle-income level. Besides, also for the investment the optimal values are clearly higher than the modal levels. This difference is found both in the figures that relate investment and growth and the values of the histograms shown in Table 2B. In turn, this is in line with the evidence presented for the relation between saving rates and growth, so that also here higher investment should impulse faster economic growth.

5. PARAMETRIC REGRESSIONS RESULTS AND OPTIMAL LEVELS OF SAVING AND INVESTMENT

This section presents the estimation results of both saving rate and the ratio investment/GDP as explanatory variables of economic growth. The purpose of this section is to parameterize the relations shown in the 2D figures of the previous section, by using the panel regressions sample. There, the robust control variable found in Levine and Renelt (1992), i.e. the investment/GDP ratio, is included here. In fact, this is an explanatory variable. Besides, the level of openness is implicitly considered by the inclusion of partitions of the sample based on the export's values.

The following tables present the estimations results of explaining economic growth in function of both saving rates and this in quadratic terms of this variable, which allow determine its non-linear effect on growth. Tables 3 and 4 show the results of the fixed-effects regressions. Tables 5 and 6 in the appendix contain the heteroskedasticity robust OLS results, and tables 7 and 8 performs fixed-effect with Investment instead of Savings as explanatory variable for control purposes. Finally, tables 9 and 10 repeats the OLS robust regressions of table 5 and 6 but using investment as control variable.

Table 3. Saving Rate and Economic Growth: Results from Fixed-Effects Regressions

	TOTAL (1)	yq1 (2)	y q 23 (3)	y q 4 (4)	xq34 (5)	xq12 (6)
VARIABLES	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g
Savings (% GDP)	0.190*** (0.029)	0.215*** (0.039)	0.0937 (0.0671)	0.348*** (0.089)	0.184*** (0.041)	0.207*** (0.047)
Savings (squared)	-0.001*** (0.000)	-0.001 (0.001)	0.000 (0.001)	-0.004*** (0.001)	-0.002*** (0.000)	-0.001 (0.001)
Constant	-0.870** (0.386)	-0.840 (0.560)	0.296 (0.821)	-3.924*** (1.324)	-0.312 (0.595)	-1.401** (0.583)
Observations	617	140	326	151	265	352
No. of Country	114	36	68	31	66	86

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

Table 4. Saving Rate and Economic Growth: Results from Fixed-Effects Regressions

	yq1-xq34	yq1x-q12	yq23-xq34	yq23-xq12	yq4-xq34	yq4-xq12
	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g
Savings (% GDP)	0.233*** (0.044)	0.156*** (0.060)	0.141 (0.114)	0.143 (0.101)	0.477*** (0.158)	0.367** (0.170)
Savings (squared)	-0.002 (0.001)	0.000 (0.001)	-0.001 (0.002)	-0.000 (0.002)	-0.006*** (0.002)	-0.007* (0.004)
Constant	-0.157 (1.178)	-0.843 (0.559)	0.0536 (1.420)	-0.787 (1.222)	-6.621** (2.633)	-3.080* (1.768)
Observations	41	99	155	171	69	82
No. of Country	16	30	39	49	20	18

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

Table 5. Saving Rate and Economic Growth: Robust Results of OLS Regressions

	TOTAL	yq1	y23q	y4q	xq34	xq12
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g
Savings (% GDP)	0.166*** (0.037)	0.197*** (0.044)	0.0947 (0.074)	0.230** (0.101)	0.175*** (0.038)	0.113* (0.060)
Savings (squared)	-0.001** (0.000)	-0.001 (0.001)	-0.000 (0.001)	-0.003* (0.001)	-0.002*** (0.000)	0.000 (0.001)
Constant	-0.543 (0.440)	-0.693 (0.569)	0.318 (0.753)	-2.070 (1.443)	-0.149 (0.532)	-0.454 (0.683)
Observations	617	140	326	151	265	352
R-squared	0.114	0.327	0.078	0.066	0.072	0.179

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

Table 6. Saving Rate and Economic Growth: Robust Results of OLS Regressions

	y1qx34q	y1qx23q	y23qx34q	y23qx12q	y4qx34q	y4qx12q
	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g
Savings (% GDP)	0.213*** (0.035)	0.148* (0.091)	0.141 (0.158)	0.0598 (0.073)	0.324* (0.165)	0.367 (0.253)
Savings (squared)	-0.003*** (0.001)	-0.000 (0.002)	-0.001 (0.003)	0.000 (0.001)	-0.004* (0.002)	-0.007 (0.005)
Constant	0.506 (0.847)	-0.824 (0.906)	0.053 (1.631)	0.503 (0.810)	-3.946 (2.600)	-3.080 (2.849)
Observations	41	99	155	171	69	82
R-squared	0.303	0.372	0.053	0.102	0.072	0.097

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

Table 7. Investment/GDP Ratio and Economic Growth: Results from Fixed-Effect Regressions

	TOTAL	yq1	y23q	y4q	xq34	xq12
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g
Investment / GDP (%)	0.298*** (0.068)	0.437*** (0.115)	0.172 (0.107)	0.272 (0.242)	0.125 (0.155)	0.384*** (0.0813)
Inv. Squared	-0.002** (0.001)	-0.004* (0.002)	-0.000 (0.001)	-0.003 (0.005)	-0.000 (0.003)	-0.003*** (0.001)
Constant	-3.210*** (0.894)	-5.131*** (1.442)	-1.107 (1.448)	-2.747 (2.704)	-0.550 (1.900)	-4.493*** (1.098)
Observations	670	159	341	170	287	383
No. of Country	116	36	69	34	68	88

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

Table 8. Investment/GDP Ratio and Economic Growth: Results from Fixed-Effect Regressions

	y1qx34q	y1qx23q	y23qx34q	y23qx12q	y4qx34q	y4qx12q
	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g
Investment / GDP (%)	-0.175 (0.379)	0.483*** (0.116)	0.356 (0.236)	0.233 (0.164)	0.0722 (0.324)	0.809** (0.344)
Inv. Squared	0.007 (0.007)	-0.004** (0.002)	-0.005 (0.004)	-0.001 (0.002)	0.001 (0.007)	-0.0166** (0.00778)
Constant	2.330 (4.525)	-5.662*** (1.382)	-2.766 (2.955)	-2.224 (2.274)	-0.705 (3.619)	-8.241** (3.798)
Observations	43	99	161	180	83	87
No. of Country	16	30	40	49	23	19

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

Table 9. Investment and Economic Growth: Robust Results of OLS Regressions

	TOTAL	yq1	y q 23	y q 4	xq34	xq12
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g
Savings (% GDP)	0.124*** (0.024)	0.162*** (0.048)	0.0767** (0.033)	0.105* (0.060)	0.0965** (0.043)	0.118*** (0.026)
Savings (squared)	0.008** (0.000)	0.001*** (0.000)	0.0011 (0.000)	0.000 (0.000)	0.000 (0.000)	0.001*** (0.000)
Constant	-1.111** (0.470)	-2.110** (0.972)	-0.007 (0.565)	-1.144 (1.215)	-0.096 (0.907)	-1.366*** (0.495)
Observations	613	138	326	149	263	350
R-squared	0.126	0.271	0.093	0.071	0.046	0.205

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

Table 10. Investment and Economic Growth: Robust Results of OLS Regressions

	yq1-xq34	yq1x-q12	yq23-xq34	yq23-xq12	yq4-xq34	yq4-xq12
	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g	GDPpc_g
Savings (% GDP)	0.232*** (0.044)	0.156 (0.106)	0.0343 (0.055)	0.111*** (0.034)	0.140 (0.095)	0.0439 (0.063)
Savings (squared)	-0.002 (0.001)	0.000 (0.000)	0.001 (0.001)	0.000 (0.000)	0.000 (0.000)	0.001 (0.001)
Constant	-0.157 (1.177)	-0.873 (2.547)	1.052 (1.033)	-0.755 (0.609)	-1.818 (1.818)	-0.164 (1.392)
Observations	41	99	155	171	67	82
R-squared	0.287	0.092	0.047	0.142	0.085	0.051

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

The estimation results presented before are compatible with the evidence shown in the figures mentioned before. In this sense, with the exception of middle-income countries saving rates affect positively economic growth, while the negative sign of the quadratic term captures the decreasing marginal effect. The idea is that in the long-term savings becomes in investment, and the additional stock of capital face such decreasing returns beyond certain level of accumulation. In turn, the fact that savings are not significant to explain growth in middle income countries comes from the roughly flat shape of the saving rate-economic growth relationship, which is an unexpected result, and deserves future study. In turn, the effect of investment on economic growth shown in the estimations on Tables 7-10 are also very similar to those of saving rate. Thus, the economic interpretation for the saving rate-growth relationship is also applicable here.

To summarize, the empirical evidence shown in the previous section and the estimation results indicates that in most cases the optimal rates of saving and investment are higher than the modal values, and both variables in general are growth promoting, so that the economic policy recommendation is to apply measures to increase aggregated saving and investment, as for public and private sectors. The idea is to impulse policies to through austerity in public spending and a tax system that promotes savings and investment at the aggregate level, in order to achieve higher levels of global saving and investment. Even though in the short run higher austerity should reduce the aggregate consume and demand, and then should provoke recessive effects, in the long term such measures will impulse investment and a faster economic growth. In turn, such measures seem particularly necessary in less developed and closer countries, due to that in these cases is highest the difference between optimal and modal values of such variables. In fact, as it was mentioned above, is in these cases where the scarcity of capital is associated with its higher marginal returns, so that increasing levels of savings that finance additional investment should impulse higher economic growth. Finally, the

effects of saving and investment differ among countries with different levels of income and openness, so that policy recommendations must adequate to the degree of development and insertion in the world market of each particular case.

6. CONCLUSION

This study explores the effect of both saving rate and the ratio investment/GDP on economic growth for a wide sample of countries with different levels of per capita income and openness. The division of the total sample according these features allows find differential impacts of such variables. First, the evidence suggests a causal relation going from saving and investment to economic growth. In second place, the main results that arises from this research are that in general higher saving and investment are need to achieve more elevated growth rates. This is particular clear in closer and less developed economies. The intuition is that in these cases the capital marginal return is higher because of the scarcity of capital proper of less developed economies, so that increasing savings that finance additional investment should promote faster economic growth. In turn, in lower income and closer countries the small domestic market and the lack of insertion in the world economy implies that higher saving and investment is need to expand the domestic market. This allow them to compensate these limitations.

In addition, in more advanced countries the optimal values and their difference with the modal levels are lower in comparison with the rest of the sample. The intuition is that in these case more advanced countries have higher levels of capital, so that this factor faces more decreasing returns in comparison with poorer countries, and then minor requirements of saving and investment. Meanwhile, in most cases there is a great difference between the optimal and modal values, which indicate that higher efforts to elevated rates of saving and investment could allow reach a more dynamic growth process. Once again this is particularly clear in lower income and closer countries. As it was explained above is an intuitive result.

Finally, economic policy recommendations that arise from the evidence found here are that the governments should impulse measure of austerity both at public and private level, as fiscal policies and a tax system tends to achieve higher saving and investment rates that impulse more elevated economic growth process.

Future lines of research that follows this work can be to explore what measures are more adequate to impulse savings and investment in different economic environments. The evidence presented in this paper indicates that these should differ among economies with different levels of openness and development, among other possible economic and social features. In turn, an interesting benchmark may be to disaggregate the total investment at sectorial level in each subsample of poorer and richer countries, as those with lower and higher level of openness. This should indicate what sectors are more favorable for growth among different economic contexts.

APPENDIX

Table A1. Sample of Countries

Albania	Cote d'Ivoire	Lebanon	Sierra Leone
Algeria	Cyprus	Liberia	Singapore
Angola	Czech Republic	Lithuania	Slovak Republic
Argentina	Denmark	Luxembourg	Slovenia
Australia	Dominican Republic	Malaysia	South Africa
Austria	Ecuador	Malta	Spain
Azerbaijan	Egypt	Mauritius	Sri Lanka
Bahamas	El Salvador	Mexico	Sweden
Bahrain	Estonia	Moldova	Switzerland
Bangladesh	Ethiopia	Mongolia	Syrian Arab Republic
Barbados	Fiji	Morocco	Thailand
Belarus	Finland	Namibia	Togo
Belgium	France	Netherlands	Tonga
Belize	Germany	New Zealand	Trinidad and Tobago
Bhutan	Greece	Nicaragua	Tunisia
Bolivia	Guatemala	Nigeria	Turkey
Botswana	Honduras	Norway	Uganda
Brazil	Hungary	Oman	Ukraine
Bulgaria	Iceland	Pakistan	United Arab Emirates
Burkina Faso	India	Panama	United Kingdom
Burundi	Indonesia	Paraguay	United States
Cambodia	Iran	Peru	Uruguay
Cameroon	Ireland	Philippines	Venezuela
Canada	Israel	Poland	Vietnam
Chile	Italy	Portugal	Zambia
China	Jamaica	Puerto Rico	Zimbabwe
Colombia	Japan	Romania	
Congo, Dem. Rep.	Korea, Rep.	Russian Federation	
Congo, Rep.	Kuwait	Rwanda	
Costa Rica	Latvia	Senegal	

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