THE PRICE OF CRIME: HOW CRIME AFFECTS PRIVATE INVESTMENT IN SOUTH AMERICA

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The capacity to ensure a secure return on an investment is one of the most powerful incentives to invest. Since investment in human, physical or other forms of capital contributes to growth, it follows that the degree of insecurity prevailing in an economy is a key determinant of development. Indeed, recent empirical work has found that indexes of the degree of investment insecurity and government measures to induce greater security are strongly correlated with international variations in both levels and growth rates of labor productivity

HUWAND LLOYD AND NICHOLAS MARCEAU,
2003, p.2

ABSTRACT

This paper analyzes the impact of crime on private investment in eleven South American countries. We adapt a model proposed by Acevedo and Mora (2008) to include crime, understood as the insecurity due to violence and criminal and illegal actions. We find that crime affects private investment in two levels. First, an increase in the expected cost resulting from crime diminishes private investment. Second, the variance of crime decreases the amount of investment. Using

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data from the Penn World Tables and the OAS Hemispheric Security Observatory, we build a panel data set for the South American countries from 2000 to 2010 and quantify our model using a unique index of crime that accounts for average and variation effects within each country. After accounting for time invariant unobservable heterogeneity and using a fixed effect panel data approach, we find that crime has a negative effect on increases in private investment. These results are consistent after several robustness checks.

Keywords: Crime, insecurity, investment, development, South America.

JEL **Classifications:** K4, F21, F36, O40.

RESUMEN

El precio del crimen: Cómo el crimen afecta la inversión privada en Sur América

Este artículo analiza el impacto del crimen sobre la inversión privada en once países de Sur América. Se adaptó el modelo de Acevedo y Mora (2008) para incluir el crimen, entendiéndolo como la inseguridad causada por actos criminales, ilegales y de violencia en un país. Se encontró que el crimen afecta a la inversión privada en dos aspectos. Primero, el aumento del costo esperado resultante del crimen disminuye la inversión privada. Segundo, la varianza del crimen disminuye el monto de inversión. Seguidamente, usando información del Penn World Tables y OAS Hemispheric Security Observatory, se construyó un panel de datos de países suramericanos de 2000 hasta 2010 y cuantificamos nuestro modelo usando un índice único del crimen que tiene en cuenta los efectos promedio y su variación en cada país. Teniendo en cuenta una heterogeneidad no-observable invariable en el tiempo y una aproximación de efectos fijos en un modelo de datos de panel, encontramos que el crimen tiene un impacto negativo sobre los aumentos en la inversión privada. Estos resultados son robustos a diferentes niveles de prueba.

Palabras Clave: Crimen, inseguridad, inversión, desarrollo, Sur América.

Clasificaciones JEL: K4, F21, F36, O40

I. INTRODUCTION

As with any inter-temporal decision, investment is affected by individuals' expectations about the future. Crime and insecurity create an unstable environment that negatively affects these expectations. According to the United Nations 2013 Global Study on Homicide, Latin America is the world's most violent region, superseding Africa: of the world's 437.000 homicides in 2012, more than a third (36%) were committed in North America, Latin America and the Caribbean. In the South American sub-region, five countries lead these statistics: Venezuela, Colombia, Brazil, Uruguay, and Chile. However, there exists a large gap among them, with the last two countries showing homicide rates of less than 10%. Alongside these high crime rates, the levels of investment have shown a downward trend in some of these countries. According to Manrique (2006, pp. 1-2), in Latin America "criminal impunity intimidates civil society, and the social and economic costs of insecurity affect foreign investment...".

The purpose of this paper is to shed some light on the relationship between crime and private investment in a country and a region. More specifically, we estimate the effect of crime on private investment using a panel dataset of 11 South American countries from 2000 to 2010.Part of our goal is to develop a measure of crime and its effect on investment. To measure crime we use the OAS Hemispheric Security Observatory statistics on homicide, crime, suicide and violence in each country and build a country-specific composite index.[1] The construction of this index is inspired in the Uniform Crime Reports (UCR) used by the Federal Bureau Investigation in the United States, known also as 'crime index'.

Crime negatively affects individuals' investment decisions. The cost of uncertainty of future returns diminishes the incentive for investing and increases the propensity to consume more today. Furthermore, not only would the average rate of crime affect investment, but also its variability, since the stability of expectations affects investment and planning for the future. Empirically, we find that the rate of private investment decreases almost 0,26% when the crime index increases 1%. Given the high levels of crime in some parts of South America, crime reduction would have a significant positive impact on investment. Although we work with different model specifications, it is remarkable that in all models the variable representing crime is significant and shows the expected negative sign.

[1] In this paper we will use the words crime and crime index interchangeably.

Crime and insecurity have different layers and presentations, so they may affect differently individuals' perceptions about the future. Other ways of viewing crime is considering personal security versus private property security, or distinguishing between organized crime, on the one hand, and random and common crime, on the other. These different events may create different types of crime that, we hypothesize, would affect investment levels in diverse ways in regions where crime and insecurity are higher than in developed countries. However, the aggregation of these events would still create a feeling of an unstable environment that would impact individuals' forecasts about the future of the economy.

The paper is divided as follows. Section II reviews the literature. Section III explains the conceptual framework and hypotheses in developing the theoretical model. Section IV presents the methodology and model specification. Section V offers an overview of the data. Section VI shows the different tests applied to the series to check for unit roots and cointegration. Section VII shows the results and Section VIII provides the robustness check. Some concluding remarks are offered in Section IX.

II. REVIEW OF THE LITERATURE

In recent years, many authors have studied the relationship between crime, as a rate and an index, and economic variables. The social framework behind the concept of crime could be a possible motivation for these kinds of studies. The literature on this topic is ample and has several different presentations. Starting with Becker's (1968) seminal paper on crime and punishment, economists have been incorporating the analysis of crime, criminal behavior, and economic outcomes to mainstream economic literature.

So far, two branches of this literature have been developed. One examines the determinants of crime and the other studies its social consequences. This paper addresses the second line of research. Numerous studies have examined the mechanisms through which crime, directly or indirectly, affects society and generates costs (European Commission, 2010). For instance, using a county-level comparison in the United States, Burnham, *et al.* (2004) find that there is a negative effect of crime, specifically violent crime, on *per capita* income growth. On the other hand, Peri (2004) finds a negative impact of crime on per capita income growth and employment at provincial levels in Italy. In a cross-country

analysis, the World Bank (2006 and 2007) finds a strong negative effect of crime on growth, even after controlling for human capital accumulation and income inequality. Beginning with Cornwell and Trumbell (1994), panel data approaches are standard in the economic literature on the costs of crime.

Our goal here is to underline the most relevant findings to date on the effects of crime on private investment. First, we emphasize the importance of using panel data techniques in these types of studies because they increase the robustness of the results and can account for variations that enhance the identification of these effects. Second, we want to show the mixed results found in the literature on this relationship. Some of these studies use crime rates, such as homicide rates, as indicators of crime, while others use some kind of index or combination of indexes that include a broader definition of crime.[2] In what follows, we present what we believe is a novel approach, using a country-specific index that accounts for crime levels in each economy.

In our review of the literature we found no studies of South America as a region. There are, however, studies on Latin America as a whole (Di Tella, *et al.*, 2012). This is, perhaps, because the latter is a larger economic region. But given the closeness in terms of economic, geographic, social, cultural and political connections among the countries of South America, this part of the Latin American subcontinent deserves a study that specifically focuses on it.

Lloyd and Marceau (2003) use an equilibrium model in a dynamic setting that links insecurity, credit market imperfections and economic development. They highlight the importance of improving security to increase investment and emphasize how the degree of insecurity perceived by investors is the result of many factors, such as corrupt officials, the crime rate, rent-seekers, the number of individuals who prefer to undertake illegal and, as Bhagwati (1982) alleged, directly unproductive profit-seeking activities. Others, such as Rosenfeld (2009), find a relationship between crime, measured by the homicide rate and acquisitive crime, and regional economic conditions. Rosenfeld studies four regions of the United States using a data panel model with fixed effects, and finds that there is

[2] One of the difficulties of working with crime rates in Latin America is the differences in the measurement of crime across countries. Even after accounting for population, the gross numbers would be counting different measures from different countries (Di Tella, *et al.*, 2012). Institutional differences in recording crime, as well as differences in the way they are reported and the efficiency of public security agencies, make the straight crime rates harder to compare across these countries.

a significant effect of collective perception of economic conditions on acquisitive crime. His findings underline the important dynamic relationship between crime and economic conditions. That is, negative local economic perceptions could encourage criminal behavior, while local high crime could affect individuals' willingness to invest in the area.

Even in cases where researchers find no evidence of a relationship between crime rates and economic conditions, their recommendations still emphasize the importance of programs that enhance public safety. For instance, Krisberg, Guzmán and Vuong (2009) found no evidence of a relationship between economic downturns and crime rates. However, they recommend investing in effective-community based programs in order to improve the economy and stop the growth of crime rates. Their analysis also supports the idea that using only crime rates to account for crime would limit the actual analysis behind this relationship. Our study attempts to shed some light into this discussion by building up the concepts of crime and societal order, and incorporating several indicators that would probably affect individuals' behavior towards investment and savings.

Lozano, Cabrera and Lozano (2012), following Barro (1990), include government spending in Mexico to derive a relationship between crime and economic variables. Using data for 32 Mexican states to examine the impact of crime rates on investment and income, they conclude that investment is inversely related to crime in that country.

Finally, Gómez (2012) studied the link between organized crime, foreign direct investment (FDI) and economic growth using a panel dataset for 19 countries. With three different specifications, she showed that there is no significant relationship between organized crime and FDI when a fixed effects model is used. However, when the regression is estimated with random effects, organized crime is significant at a 90% level, and has a negative relationship with FDI and growth.

III. CONCEPTUAL FRAMEWORK AND HYPOTHESIS

A. A Theoretical View

Our goal is to develop a theoretical link between private investment and crime. Private investment is defined as the savings in physical capital that allows people to increase their wealth and future consumption and which is undertaken

by people and not by government. In this paper we define crime as the level of instability resulting from criminal acts and violence that reflects the institutional and judicial condition of a country. Instability, in our model, would translate into higher uncertainty for investors with respect to their future returns.

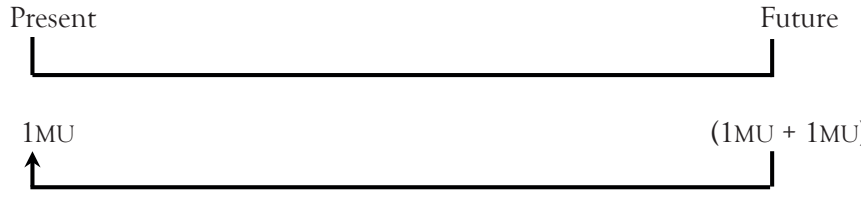
Following Manrique (2006), Lloyd and Marceau (2003), Gómez (2012) and Acevedo and Mora (2008), investment in a country is not only the result of macroeconomic variables. On the contrary, investment and, particularly, private investment are affected by individuals' behavior and forecasting of a country's performance and the likelihood of obtaining profits. Private investment is affected by other variables such as personal feelings or intuitions (Keynes, 1936, p.58). It is different from public investment, which, in theory, seeks social benefits for its citizens and political profits of its decision makers. Crime, although it may also affect society as a whole, is generally perceived as the result of a combination of individual and social perspectives. Even without having been a victim of crime, an individual may perceive crime through his/her acquaintances' experiences or the social knowledge with regard to criminal activities in the country or area.

Acevedo and Mora (2008) found a direct relationship between real GDP *per capita* and the government share of real GDP, on the one hand, and the rate of private investment, on the other. They estimated a regression model with panel data for twenty Latin American countries from 1995 to 2003. Not only is the rate of private investment affected by GDP *per capita* and the government's share of GDP, but also by its lagged value. Therefore, private investment derives from an autoregressive process, so past values affect current values. In this paper we will extend the theoretical work of Acevedo and Mora (2008) to include the relationship between private investment and crime.

In our model, we assume that an individual has an income of 1 monetary unit. In the present he has to decide how much to consume and how much to invest. We also assume that each monetary unit invested by the individual will give him a future return of 1 more monetary unit (his profit), so that he has to decide between the utility of present versus future consumption. Figure 1 shows this trade-off.

One fact about crime stands out: there is no country without crime; that is, there is no country or place with perfect security. If we compare countries with different cultures and economic and political realities we can construct a relative scale, in which countries with low crime rates score 0, and so on. However, crime could never be 0 when we compare nations with similar characteristics, such as

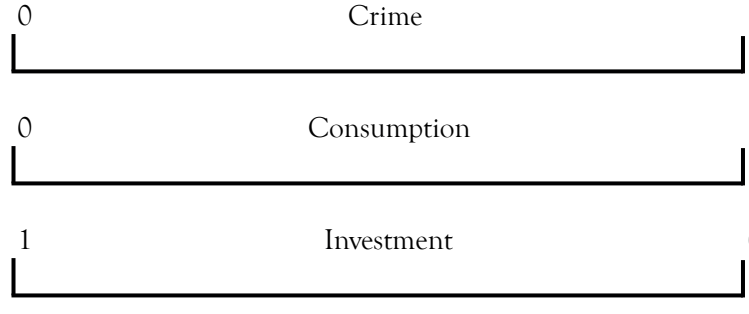
FIGURE 1
The Trade-Off between Present and Future Consumption



If 1MU in the present > (1MU + 1 MU) in the future ⇒ CONSUMES
If 1MU in the present < (1MU + 1 MU) in the future ⇒ INVESTS

the South American countries. Or, even more interesting, when we compare a country across time with its own crime levels. In relative terms, in the same country individuals may sense higher levels of crime even if, overall, that particular country's crime levels are low. Therefore, variations from its level of crime may be internally more relevant than the actual gross level comparison across countries when individuals decide on private investments. Now the same individual presented in the previous figure will take into account a new factor: crime (Figure 2).

FIGURE 2
Consumption and Investment Values when Crime is Included



So, when:
Crime ≅ 0 ⇒ *Consumption*(0,1) ∧ *Investment* (0,1)
Crime = 1 ⇒ *Consumption*(0,1) ∧ *Investment* (0,1)

Therefore, crime replaces the individuals' pleasure or utility of consumption. It is possible that the sensation of uncertainty and insecurity diminishes the relevance of the return (pleasure to consume) analysis. So, crime could produce a negative shock on an individual's private investment decision because it would represent an indirect cost that diminishes future pleasure (or expected return).

B. Private Investment and Crime

In our model, then, crime is a determinant of private investment. It is assumed that individuals weigh the possibility of investing by considering the rate of return between different options (investments) or the pleasure of consuming at different moments (present or future). In our case, we will assume that the rate of return is measured by the pleasure to consume. Thus,

$$r^* = r(1 - (\lambda)) \tag{1}$$

Where,

r is the return without crime, and
λ is the cost that crime represents to investors.

It is assumed that λ is normally distributed, with an expected value $\overline{\lambda}$ and a variance σ_λ^2, i.e., $\lambda \alpha N(\overline{\lambda}, \sigma_\lambda^2)$. When crime does not affect investment, $\lambda = 0$; otherwise, crime produces a negative effect on investment.

$$r^* = r \tag{2}$$

In Equation (2) individuals would be motivated to invest his or her money if the future return affected by crime (r*) is equal to the return of consuming in the present (in our analysis, the rate of return represents consumption pleasure). Suppose that there are N investors defined by Equation 1, and each is endowed with one unit of capital. Equation (2) determines whether investors will consume today or the next period. Further we assume that to consume in the present investors have to bear an opportunity cost: $\varphi \in [0, \infty)$. This opportunity cost is the security of having some wealth or profit in the future or the possibility

to consume more in the future, and differs between investors according to the probability $f_{(\varphi)}$. Consequently, the value of switching to consume in the present, with opportunity cost φ, is:

$$V_p = \frac{r}{\delta} - \varphi \tag{3}$$

Where δ is a discount factor.

For simplicity, it is assumed that, after an individual makes his/her decision, he/she cannot switch back (Rodrik, 1991, pp. 236-237). If the individual decides to invest (or consume in the future) his/her future value is:

$$V_f = \frac{r^*}{\delta} - v\left(\sigma_\lambda^2\right) \tag{4}$$

Because the high variance of crime reduces the risk-adverse individuals' investment values, a risk-averse individual will invest or consume in the future if $V_f > V_p$, so:

$$V_p = \frac{r}{\delta} - \varphi < V_f = \frac{r - \bar{\lambda} r}{\delta} - v\left(\sigma_\lambda^2\right) \tag{5}$$

Which leads to

$$\varphi > \left(\frac{\bar{\lambda} r}{\delta} + v\left(\sigma_\lambda^2\right) = \varphi_0 \right) \tag{6}$$

Where φ_0 is the critical value of opportunity cost.

An individual with $\varphi > \varphi_0$ will prefer to invest or postpone his/her present consumption. From equations (5) and (6), the total individuals who would invest when crime affects investment decisions is:

$$I = N \int_{\varphi_0}^{\infty} f_{(\varphi)}\, d\varphi \tag{7}$$

From equations (6) and (7) we can derive the effects of crime on investment:

$$\frac{dI}{d\bar{\lambda}} = -Nf_{(\varphi_0)} \frac{d\varphi_0}{d\bar{\lambda}} = -Nf_{(\varphi_0)} \frac{r}{\delta} < 0 \tag{8}$$

and

$$\frac{dl}{d\sigma_{\lambda}^{2}} = -Nf_{(\varphi_0)}\frac{d\varphi_0}{d\sigma_{\lambda}^{2}} = -Nf_{(\varphi_0)}v'\left(\sigma_{\lambda}^{2}\right) < 0 \tag{9}$$

Equation (8) confirms the basic intuition behind the effect of crime on private investment. The increase in the expected cost resulting from crime reduces private investment. Meanwhile, Equation (9) implies that the variance of crime reduces the amount of investment. Therefore, not only crime affects private investment on average levels but also on second moments. Low crime is not enough for stable private investment if the variation of crime levels is too high. Investors have a long-run vision, so they will not only consider short-run levels of crime but also its variability across years until a low-crime trend is clearly defined. The degree of insecurity in an economy may affect that level of security and, as a result, the rate of economic growth. Even labor productivity would be affected by the degree investment insecurity and security level overall (Lloyd and Marceau, 2003).

IV. THE MODEL

A. Methodology

We use panel data for 11 countries in South America which allows us to examine the variation in crime across countries with relatively similar cultural and social backgrounds. Our basic framework is a model where y_{it} is a linear function of k explanatory variables x_k, where $k = 1, 2, 3, \ldots, k$:

$$y_{it} = \beta_0 + \sum_{k=1}^{k} \beta_k x_{kit} + u_{it} \tag{10}$$

Where,

i = N countries and $t = 1, \ldots, T$ observations over time;

u_{it} = is a country/time specific error term that includes a group of omitted variables and can be written as:

$$u_{it} = \alpha_i + \phi_t + \varepsilon_{it} \tag{11}$$

So, the error term has an individual component that never varies across time, α_i; a temporal component that never varies across countries *i*, ϕ_t (country specific effect); and, finally, a component ε_{it} that represents the effects of all other variables that vary over time and countries.

B. Specification

We develop a model that relates individual private investment to crime. Acevedo and Mora (2008) find that private investment in Latin American countries in any given year is determined by its value in the previous year (autoregressive level 1) and other variables. Gómez (2012), following Montero (2008), shows that one of the determinants of foreign direct investment is lagged real GDP. Although foreign direct investment does not necessarily translate into local private investment, their trends are most likely parallel. Therefore, we define our model as follows:

$$S_{it} = \alpha + \beta_1 \left(g_{i(t-1)}\right) + \beta_2 \left(gy_{it}\right) + \beta_3 s_{i(t-1)} + \gamma \left(CRIME_{it}\right) + \beta_4 pop_{it} + \varepsilon_{it} \tag{12}$$

Where,

α is a constant;
g is the government share of real GDP (Laspeyres);
gy is real GDP *per capita*;
$s_{i(t-1)}$ is the lagged private investment rate;
pop is population, and
ε the error term.

CRIME is defined as an index that represents crime levels relative to country specific levels and varies across time and countries. The error term, ε, also varies by country and period of time. On the basis of the Uniform Crime Reporting Crime Statistics (crime index) used by the Federal Bureau of Investigation, and following the indexation methodology used by Feng (2001) and Lee (2004), we compute the following:

$$CRIME_{it} = \left(\frac{hc_{it} + hi_{it} + su_{it} + ad_{it} + rob_{it}}{MaxVal_i} \right) \quad (13)$$

The denominator is the Max Value of the Numerator (without missing values), so, CRIME = (0,1), where 1 represents the highest level of insecurity.[3] This indicator wsould allow us to account not only for the average crime levels but also for country-specific deviations from this level.

We expect a positive effect related to all the explanatory variables (g, gy, $s_{i(t-1)}$), while the coefficient related to the variable CRIME should be negative, as derived from the model. After tests of cointegration, we use the variables in log terms.

V. DATA

The panel data was obtained from the Penn World Table 7.1 (Heston, Summers and Aten, 2012) and the Organization of American States Hemispheric Security Observatory (OAS, 2015). The sample includes information for 11 countries (Argentina, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela). The panel includes yearly data from 2000 to 2010 (11 years). The information covers a total of 121 observations.

Table 1 shows the summary statistics of the variables used in the analysis. Countries are listed alphabetically.

The variable *CRIME* was constructed with OAS crime variables. It is an index that represents changes within a country's crime trend and it is different to the crime rates used to rank countries in terms of crime levels. As noted before, it is difficult to compare raw indicators of crime levels across countries when they report these indicators differently (Di Tella, *et al.*, 2012). However, within a country the variation of crime would be consistent. This second notion is what our variable crime captures. We included suicide rates to build the variable crime. Though some may not consider suicide an indicator of crime, it can be understood as

[3] In comparing countries with different institutional backgrounds, statistical standardization is necessary (Di Tella, *et al.*, 2012). The usefulness of a crime index is originally discussed by Sellin (1931). Some researchers criticized the balance weighted system used in this index, but Blumstein (1974) shows that the direction of a modified index with weight differentiation across offences was following similar trends and was also based on an arbitrary assignation of gravity levels to each crime.

TABLE 1
South America: Summary Statistics

COUNTRY	*s*		*g*		*gy*		CRIME		*pop*	
	Mean	Obs.	Mean	Obs.	Mean	Obs.	Mean	Obs.	Mean	Obs.
Argentina	19,51 (3,91)	11	5,36 (0,3)	11	9.928,64 (1.498,55)	11	0,8186 (0,0969)	8	39.139.473 (1.379.831,00)	11
Brasil	20,31 (1,85)	11	10,47 (0,21)	11	7.390,81 (566,03)	11	0,9485 (0,0499)	6	187.912.940 (7.592.840,00)	11
Chile	25,59 (3,81)	11	4,14 (0,22)	11	10.941,54 (1.189,58)	11	0,9048 (0,083)	7	16.095.063 (610.476,00)	11
Colombia	19,77 (3,95)	11	6,52 (0,13)	11	6.606,83 (679,75)	11	0,8716 (0,0863)	5	43.233.975 (1.834.507,00)	11
Ecuador	25,55 (2,87)	11	5,59 (0,31)	11	5.451,3 (540,07)	11	0,7924 (0,2524)	10	13.757.678 (763.052,00)	11
Guyana	25,83 (2,77)	11	17,32 (1,12)	11	3.716,3 (453)	11	0,7946 (0,1208)	5	745.203 (3.863.724,00)	11
Paraguay	15,15 (1,18)	11	4,87 (0,42)	11	3.515,5 (246,19)	11	0,6303 (0,2435)	9	5.778.085 (299.810,20)	11
Perú	22,36 (4,66)	11	4,79 (0,22)	11	5.803,38 (965,02)	11	0,9203 (0,0767)	5	27.623.547 (1.138.707,00)	11
Suriname	71,13 (6,7)	11	7,93 (1,67)	11	9.052,47 (1.666,56)	11	0,7277 (0,3025)	6	495.855 (12.238,78)	11
Uruguay	20,96 (2,84)	11	5,07 (0,36)	11	9.180,49 (1.362,44)	11	0,766 (0,1751)	6	3.337.296 (17.758,65)	11
Venezuela	20,81 (5,98)	11	4,52 (0,54)	11	8.893,89 (890,51)	11	0,8565 (0,0835)	8	26.756.814 (1.499.477,00)	11
All	26,09 (15,12)	121	6,96 (3,79)	121	7.316,47 (2.586,00)	121	0,8122 (0,186)	75	33.170.539 (51.240.894,00)	121

Note: Standard deviations in parentheses.

Sources: Penn World Tables 7.1, OAS, The World Bank, and authors' calculations.

an indicator of aggressiveness in a society.[4] Other crime variables, such as sexual offenses, were not included because generally victims do not report sexual assaults, so numbers are often underestimated.

In constructing the variable CRIME, the number of observations decreases because the index is a compound of all the available indicators of crime. So when an individual country misses one of the variables in a particular year, we are unable to build the indicator. Nevertheless, in the final data there is no country with more than six missing values for the variable CRIME.

As reported in Table 1, Suriname, at 71,13%, has the highest mean rate of investment. Guyana has the highest mean government share of RGDPL (17,32%). Chile has the highest mean real GDP *per capita* (US$10.941,54 at 2000 prices). Finally, the country with the highest mean crime variation is Brazil (0,94847), followed by Colombia, Chile, and Venezuela. This, however, is not a ranking of crime levels across countries because our measure of crime shows the deviation of average of crime within countries rather than a raw indicator of crime.

VI. TESTING THE SERIES

A. Unit Root Test

In any time series analysis, it is important to verify that the variables are stationary to prove that the results are not biased. Therefore, we tested for the presence of unit roots in the time series. For this we used three tests: the Augmented Dickey Fuller-Fisher (ADF-Fisher), Phillips Perron-Fisher (PP-Fisher) and the Levin, Lin and Chu (LLC). The results are shown in Table 2.

Although the variable of interest is *CRIME*, we analyzed individual variables to gauge the effect of each one on the aggregate variable (see Apendix 2 and Apendix 3). When an individual intercept is included in the test equation, the ADF-Fisher test shows that the variable *CRIME* has an individual unit root process. With the PP-Fisher test the variable has an individual unit root process. LLC shows

[4] McKenna, *et al.* (1997) show evidence that suggests, in general, a positive correlation between suicide and homicide rates. Overall, suicide, homicide and indictable crimes are positively correlated and reflect the level of disorder in society.

TABLE 2
Summary of Unit Root Tests Results

	ADF-FISHER			PP-FISHER			LLC		
	I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
s	I(1)	I(0)	I(1)	I(1)	I(0)	I(1)	I(1)	I(0)	I(1)
g	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)	I(0)	I(1)
gy	I(1)	I(0)	(–)	I(1)	I(0)	I(1)	I(1)	I0)	I(1)
pop	I(0)	I(0)	I(0)	I(0)	I(1)	I(1)	I(1)	I(0)	(–)
CRIME	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)

Notes: (1) Individual Unit Root Tests: ADF-Fisher: Augmented Dickey Fuller-Fisher test; PP-Fisher: Phillips Perron-Fisher test.

(2) Include in test equation: I: Individual intercept; II: Individual intercept and trend; III: None.

(3) I(0): Integrated in order 0; I(1): Integrated in order 1; (–): Nor I(0) neither I(1).

Source: Authors' calculation.

that just the variable *CRIME* rejects the null hypothesis of a common unit root process.

When individual intercepts and trends are included in the test equation, the ADF-Fisher's test shows that *CRIME* is not stationary. But the PP-Fisher test shows that *CRIME* has an individual unit root process.

When the test equation does not include an exogenous variable, the ADF-Fisher and PP-Fisher tests show that *CRIME* has an individual unit root process. The LLC test shows a similar result because the series have a common unit root process. Thus, all the series are non-stationary.

The results shown by the different tests in level are not sufficiently robust to prove that the series are stationary. Therefore, we conducted a test in first difference to see if the series are integrated of order 1.

Crime is not I(0) but I(1) under the ADF-Fisher and LLC tests. On the other hand, crime is I(1) in the ADF-Fisher test with individual intercepts.

Finally, the results in the first difference show that there is no unit root process in the variables. So, it is possible that some of the series have a linear tendency and are stationary in the first difference.

B. Cointegration

With series that are integrated of first order, I(1), it should be proved that the series are cointegrated. If we prove cointegration, we can then estimate the model with the series in levels. We can also use logarithms to strengthen the results. To test for cointegration, we used the Augmented Dickey Fuller-Fisher, Phillips Perron-Fisher and the Levin, Lin and Chu. Table 3 shows a summary of the results of these tests. We tested different versions of a combination of series (I to IIIa). Column IIIa shows the relevant results for our final model.

TABLE 3
Summary of Cointegration Test Results

	PEDRONI				KAO
	I	**II**	**III**	**IIIa**	**I**
Panel v-Statistic	NC	NC	NC	NC	–
Panel rho-Statistic	NC	NC	NC	NC	–
Panel PP-Statistic	C	NC	NC	C	–
Panel ADF-Statistic	C	NC	C	C	–
Group rho-Statistic	NC	NC	NC	NC	–
Group PP-Statistic	C	NC	C	C	–
Group ADF-Statistic	C	NC	C	NC	–
ADF	–	–	–	–	C

Notes: (1) Variables: I: *s*, *g*, *gyhc*, *hi*, *su*, *rob*; II: *g*, *hc*, *hi*, *su*, *ad*, *rob*; III: *s*, *g*, *hc*, *hi*, *su*, *ad*, *rob*; IIIa: *s*, *g*, *crime*, *pop*.
(2) Include in test equation: I: Individual intercept; II: Individual intercept and trend; III: None.
(3) C: Cointegrated; NC:Not-Cointegrated.

Source: Authors' calculation.

The Pedroni test shows that the series *g, hc, hi, s, pop* and *rob* are not cointegrated only when a deterministic trend specification — with individual intercept and individual trend — is considered (see Appendix 4). Meanwhile, Kao tests rejected the null hypothesis of No-Cointegration. Overall, the results are consistent with regard to rejecting the null hypothesis of No-Cointegration when a deterministic

trend is not considered. For this reason, we look at the model in levels with no deterministic trend, and also analyze the series in logarithmic form.

VII. ECONOMETRIC RESULTS

To determine the relationship between private investment and crime in South America we developed an econometric exercise using panel data. In the analysis, we use a panel data fixed effects approach.[5] Individual decisions are dynamic and are affected by the expectations for the future.

The fixed effects model assumes that the error term u_{it} (Equation 10) is not random. As shown by Equation 11, it has: 1) a fixed individual component (α_i) that does not change through the period but changes through individuals; 2) a fixed temporal component (ϕ_t)that does not change through individuals (or cross section) but changes through the period; 3) a random component (ε_{it}), that is the residual with characteristics of white noise that are assumed in the least square estimations. We calculated different versions of the model, as shown in Table 4.

In Table 4, three different specifications are shown, combined with two different fixed effect styles (period and cross-section).[6] In model type 1, log (CRIME) is not significant when we look at period fixed effects. However, looking at period fixed effects in this model wouldn't make sense. The panel data design calls for cross-section fixed effect that accounts for country specific time invariant characteristics. Model specification 2 shows similar results to specification 1, with the exception that the exclusion of the log of the lag of GDP results in the significance of the log of CRIME. Similar to model 1, in model 2 the cross-section specification shows a significant effect of crime index on individual investment. Model 3 represents a non-dynamic panel. In this version of the model, the specification with cross-section fixed effects shows consistent results with the first two models. The estimated coefficient for our variable of interest log of CRIME is negative and is significant at a 5% significance level, with a high R squared and an F-statistic

[5] To check for robustness we also consider a model with random effects. However, both the F-test and Hausmann test rejected the hypothesis of a random effects model. Furthermore, the theoretical model specification supports a fixed effect model better than a random effects model. Nevertheless, the results were consistent.

[6] We performed a Hausmann test for each model and rejected the fitness of random effect model.

TABLE 4
Summary of Econometric Results

	1a	1b	2a	2b	3a	3b
c	–65,5396	–10,7978**	–213,6511	–13,4743**	–61,1423	–71,6533*
log(g(-1))	17,0436***	–0,5404	–	–	16,9766***	8,5305*
log(gy)	35,53191***	2,0559***	28,5661***	2,3351***	37,2138***	20,435***
log(crime)	–2,872149***	–0,6382	–2,97613***	–0,7598*	–3,22134***	–6,6573
log(pop)	–15,67565*	–0,2766	–0,84337	–0,3138*	–16,7372*	–6,1195***
s(-1)	0,07584	0,9424***	0,013668	0,93547***	–	–
R2	0,956583	0,985353	0,948919	0,985702	0,956367	0,705398
F-Statistic	79,31662***	289,7875***	72,9801***	327,456***	86,10804***	11,3741***
Likelihood	14,8237***	3,1708***	10,7451***	3,16918***	89,17422***	1,0373
Jarke-Bera	0,10373	5,1347*	0,3513	3,2789	0,04424	0,2781

Notes: (1) Method: Panel Least Square (OLS). Fixed Effects.

(2) a: Cross section. b: Period.

(3) *, **, ***: significant levels at 10%, 5%, and 1%, respectively.

(4) For accessing to the dataset as well as the results using individual variables please contact the authors.

(5) Results obtained with E-Views 7.

Source: Authors' calculation.

that shows that all variables are jointly significant at a 5% significance level. The likelihood test shows that the fixed effects model is adequate.

Still, it is remarkable that in almost all models the logarithm of the variable CRIME is significant, consistent, and shows the expected sign (negative). The cross-sectional analysis makes more sense here, given that the comparative structures and trends according to our theoretical model are within an economy. The estimated coefficient gives us the elasticity of investment with respect to the independent variables, after accounting for country-specific fixed effects. However the results could improve with a larger dataset.

Overall, these results confirm the hypothesis that the uncertainty generated by crime in South American countries has decreased private investment by at least by 0,287%-0,322%, for each 1% increase in country-specific crime levels.

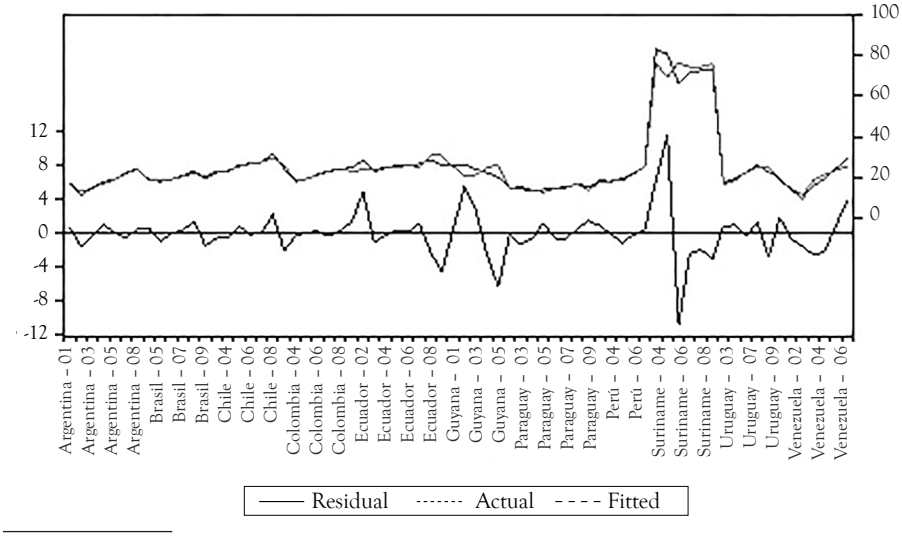
Finally, Figure 3 shows the actual, fitted and residual of the two best models in this data panel exercise. In particular model 3a (fixed effects) shows the best adjustment to real observations.

VIII. ALTERNATIVE TESTS

In a panel exercise such as this, the robustness of the results must be tested. Although our model does not assume any sequence in the process, we used TSLS to check for the possibility of simultaneity.[7] Nevertheless, there exist strong limitations to this exercise. On the one hand, the reduction of degrees of freedom for our estimates to be consistent and efficient, and, on the other hand, small sample issues. Furthermore, we need to formally establish the exogeneity of the instruments used in the model. On the other hand, in this alternative model the assumption of period fixed-effects would not have sense. When we assume period fixed-effect in practice we are pooling all the countries together each year and the

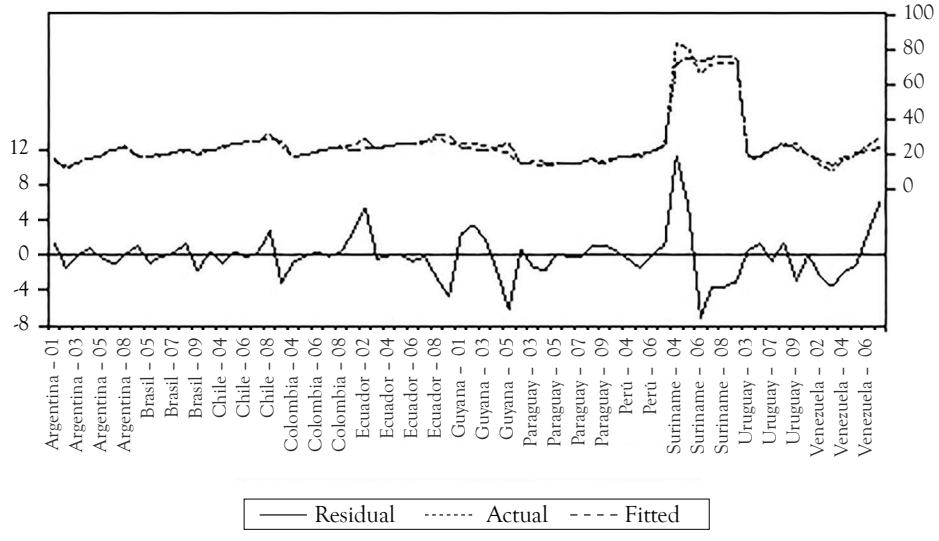
FIGURE 3
Actual, Fitted and Residual Graphs.

(a) Model 1a

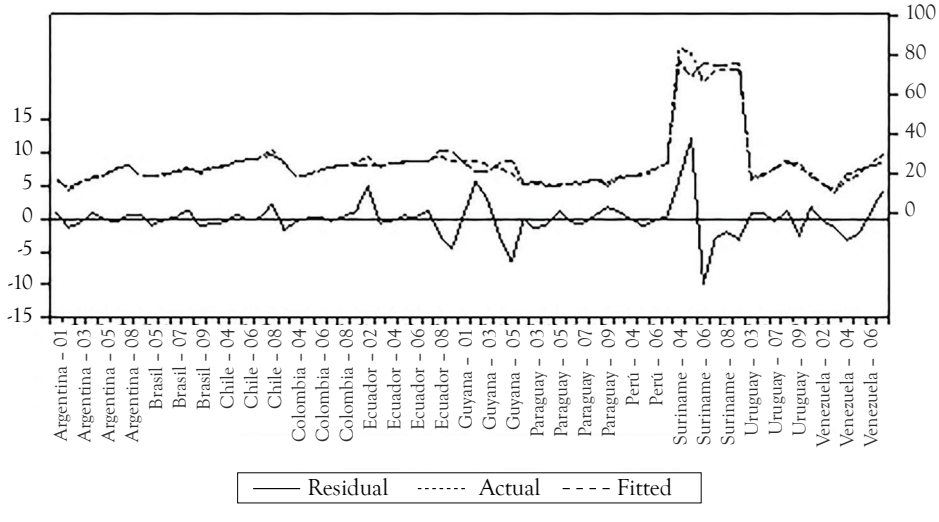


[7] For results using TSLS, see Appendix 4.

(b) Model 2a



(c) Model 3a



Source: Authors' calculation.

differences across them is not considered in the estimation of the effect of crime on investment. Also, when we are pooling all countries, the data behaves as a simple time series. In this representation, the autoregressive process of the series investment drives all the results. In the alternative models, we cannot mimic the versions of model 3 from Table 4 because of its non-dynamic nature. Furthermore, the results are sensitive to the assumptions of instrumental variables; in all cases instruments are weak instruments.

IX. CONCLUSIONS

Crime and violence have been affecting South American countries' attractiveness to private investment (internal and external). Regardless of each country's political tendency, the problem with respect to security and violence is real, a daily reality for individuals living in those countries. The level of crime is high, so that if it has not yet touched a person, the likelihood is that it will touch him/her someday.

Our study shows the important role that crime plays in the determination of future private investment in South American countries. The results show that crime has a negative effect in the rate of the private investment, by at least by 0,287%-0,322%, for each 1% increase in country-specific crime levels. Nevertheless, we should keep in mind that this effect may be larger because crime also has medium term effects on the present value of the private investment rate. Given the dynamic version already embedded in private investment, these effects would be transferred across years.

Our results also support ideas already discussed in the previous literature. Governments in South America have to implement better policies of personal security, together with establishing strong judicial systems and crime prevention institutions. In this line, working only on improving economic indicators and launching economic policies won't be enough if governments do not combine those with crime reduction strategies. If they wish to improve their attractiveness to private investors (internal and external) policy analysis should include the issues of personal security and violence that these nations face. We strongly believe, therefore, that the effectiveness of policies to boost private investment would likely be enhanced when measures that improve security are also adopted.

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APPENDIX 1

Description of Variables and Sources

Variable name	Description	Source
s	Investment Share of Real Gross Domestic Product (Laspeyres). % in 2000 Constant Prices	Penn World Table 7.1
g	Government Share of Real Gross Domestic Product (Laspeyres). % in 2000 Constant Prices	Penn World Table 7.1
gy	Real Gross Domestic Product *per capita*. Unit $ in 2000 constant prices	Penn World Table 7.1
hc	Homicide (Criminal System): "Number of victims of offences of intentional homicide recorded by the police. Intentional homicide means death deliberately inflicted on a person by another person, including infanticide"	OAS, Observatory on Citizen Security - Data Repository.
hi	Homicide (health system): "Number of victims of homicide and mortal injuries inflicted by another person with intent to injure or kill, such as deaths resulting from all kinds of assault, sexual violence, neglect and abandonment, maltreatment, non accidental manslaughter, legal intervention, assassination, and murder".	OAS, Observatory on Citizen Security - Data Repository.
su	Suicide: "Deaths caused by self-inflicted and intentional injuries, for people aged 5 years and older".	OAS, Observatory on Citizen Security - Data Repository.
ad	Accidental death by Illicit Drug Overdose: Number of deaths caused by an illicit drug overdose. "An illicit drug overdose is the accidental or intentional use of an illicit drug in an amount that is higher than is normally used. Illicit drug, commonly called controlled substances, is a substance that alters the mind in a psychoactive way and is illegal in the eyes of the law and punishable with criminal justice".	OAS, Observatory on Citizen Security - Data Repository.
rob	Robbery: Total number of offences of robbery recorded by police. Robbery means the theft of property from a person, overcoming resistance by force or threat of force. The category "Robbery" should include muggings (bag-snatching) and the theft with violence, but should exclude pick pocketing and extortion.	OAS, Observatory on Citizen Security - Data Repository.
pop	Total population: total number of individuals living in a particular country in a year.	World Development Indicators
CRIME	Crime: Proxy variable that represents the feeling or sensation of insecurity for illegal and criminal acts in a country. This factor was built with crime variables obtained in the OAS hemispheric security observatory. It is obtained through the equation: $$CRIME_{it} = \frac{hc_{it} + hi_{it} + su_{it} + ad_{it} + rob_{it}}{MaxVal_i}$$ The denominator is the Max Value of the Numerator (without missing values), so, CRIME = (0,1] where 1 represents the more insecurity.	OAS, Observatory on Citizen Security - Data Repository and own calculus

Source: Authors.

APPENDIX 2

Unit Root Test. Series in Level

	ADF-FISHER			PP-FISHER			LLC		
	I	II	III	I	II	III	I	II	III
s	21,3612	40,9047***	7,16481	26,6118	51,9960***	5,90011	−1,23656	−7,41315***	1,88709
hd	24,9459	19,3748	26,1979	22,358	33,9575**	21,1035	−3,25542***	−2,46610***	−1,2418
hi	28,1015	25,3366	13,1784	31,2764*	27,6903*	11,8763	−3,59965***	−13,6299***	−0,04671
su	21,4132	17,6431	8,3276	38,6727**	56,4844***	15,6987	−1,06113	−0,73049	3,16883
ad	33,6601**	25,7829	10,7448	88,2666***	72,9260***	26,904	−3,42856***	−9,70088***	0,82239
rob	13,9834	21,0018	11,1393	13,0447	9,53629	13,6231	0,36146	−8,63921***	1,51246
pop	41,0213***	1290178***	37,8384**	94,2669***	10,5182	0,08967	2,60881	−17,2429***	−1,275
CRIME	9,59501	3,92886	7,27542	5,01685	6,72923	7,1933	−2,02672**	−1,46988*	1,22592

Notes: (1) Individual Unit Root Tests: ADF-Fisher: *Augmented Dickey Fuller-Fisher test*; PP-Fisher: *Phillips Perron-Fisher test*. Common Unit Root Test: LLC: *Levin, Lin & Chu test*.

(2) Include in test equation: I: Individual intercept; II: Individual intercept and trend; III: None.

(3) *, **, ***, significant levels at 10%, 5% y 1% respectively.

(4) The null hypothesis were: ADF-Fisher and PP-Fisher: "There is an individual unit root process"; LLC: "there is a common unit root process".

(5) If $p > a$ the null hypothesis is accepted. If $p < a$ the null hypothesis is rejected.

(6) a = 0,1; 0,05 and 0,01 at levels 10%; 5% and 1%, respectively.

(7) The lag length were determined by: ADF-Fisher: Automatic selection *Akaike* (0 to 1). E-Views 7. PP-Fisher: Bandwidth selection *Newey West* using *Bartlett Kernel*. E-Views 7. LLC: Automatic selection *Akaike* (0 to 1). E-Views 7.

Source: Authors' calculation.

APPENDIX 3

Unit Root Test. Series in First Difference

	ADF-FISHER			PP-FISHER			LLC		
	I	II	III	I	II	III	I	II	III
s	54,0470***	27,861	83,7111***	97,9453***	81,5297***	140,328***	–9,72796***	–6,21223***	–9,53329***
g	38,9030**	38,1387**	73,5189***	87,9522***	88,8411***	118,588***	–2,33596***	–6,80316***	–6,56872***
gy	37,1247**	21,3163	26,2871	61,7385***	76,1255***	51,6477***	–5,51966***	–2,57872***	–2,69182***
hd	37,5509**	33,4766*	68,3027***	76,7794***	68,5280***	114,253***	–4,77769***	–9,43290***	–7,35908***
hi	41,1630***	21,1531**	61,4783***	54,3910***	29,9098***	89,5112***	–28,5034***	–19,4556***	–17,5485***
su	31,6880*	9,36308	59,2678***	79,9339***	60,8398***	97,6237***	–4,30374***	2,99186	–5,80751***
ad	39,5491***	23,8834**	77,9914***	95,9292***	66,3004***	130,710***	–643919***	–8,96099***	–10,9163***
rob	27,5134**	18,2629*	52,8303***	35,0893***	34,8647***	77,6508***	–7,54180***	–6,90904***	–6,86824***
pop	125,954***	105,620***	41,6446***	9,74134	38,6896**	53,3436***	–13,7021***	–13,7783***	0,23964
CRIME	62,1647***	49,1528***	100,694***	64,7790***	85,0136***	101,236***	–9,77508***	–9,76700***	–9,48710***

Notes: (1) Individual Unit Root Tests: ADF-Fisher: *Augmented Dickey Fuller-Fisher test*; PP-Fisher: *Phillips Perron-Fisher test*. Common Unit Root Test: LLC: *Levin, Lin & Chu test*.

(2) Include in test equation: I: Individual intercept; II: Individual intercept and trend; III: None.

(3) *, **, ***, significant levels at 10%, 5% y 1% respectively.

(4) The null hypothesis were: ADF-Fisher and PP-Fisher: "There is an individual unit root process"; LLC: "there is a common unit root process".

((5) If $p > a$ the null hypothesis is accepted. If $p < a$ the null hypothesis is rejected.

(6) a = 0,1; 0,05 and 0,01 at levels 10%; 5% and 1%, respectively.

(7) The lag length were determined by: ADF-Fisher: Automatic selection *Akaike* (0 to 1). E-Views 7. PP-Fisher: Bandwidth selection *Newey West* using *Bartlett Kernel*. E-Views 7. LLC: Automatic selection *Akaike* (0 to 1). E-Views 7.

Source: Authors' calculation.

APPENDIX 4

Summary of Econometric Results

	1c	1d	2c	2d
c	−1473,54**	2,2838	−314,1241*	−6,642
log(g(-1))	−40,7105**	−1,3216*	−	−
log(gy)	−10,588	0,5996	11,7577	1,5472
log(crime)	2,5784	4,9946***	0,5445	3,6386*
log(pop)	102,079**	−0,1739	13,7989	−0,2686
s(-1)	0,051	0,9588***	0,4437**	0,9384***
R2	0,944844	0,9785	0,95811	0,9806
F-Statistic	74,301***	255,1663***	56,611***	276,519***
Likelihood	−	−	−	−
Jarke-Bera	0,8365	0,5989	2,8402	0,5638

Notes: (1) Method: Panel Two Stages Least Square (TSLS). Fixed Effects.

(2) c: Cross section. d: Period.

(3) *, **, ***: significant levels at 10%, 5% and 1%, respectively.

(4) For accessing to the dataset as well as the results using individual variables please contact the authors.

(5) Results obtained with E-Views 7

Source: Authors' calculation.