Social, technology and public education protection: Promoter factors of the Latin American economic development. Empiric evidence from models of autoregressive vectors

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This research examines how the topics such as social protection, science and technology (S&T), and state education, can correct structural historical of social backwardness (poverty and inequality) in Latin America. The paper applies statistical methods of multivariate time series (VAR models) to demonstrate the importance of the topics mentioned, and the urgency of developing public policies based on these themes, and aimed at strengthening the technical progress and welfare of the general population.

Social Protection, State Education, Poverty, Inequality, Technical Progress.

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Introduction

Not considering the peripheral countries on the politic and economic international reforms when organizing the postwar capitalist economy, would become later in an element that emphasizes the whole system vulnerability, blocking the third world development, and obtaining fragility in the international economic relationships. Among the main problems of the underdevelopment state, there are low growing rates in the production, inequity in health and education systems, inflationary pressure intensification, changing uncertainty and absence of an institutional framework capable of facing the new worldwide changing situations of great financial and speculative volatility. (Espinosa y Vaca, 2011a).

This paper pretends to show the importance these three public politic fields, fundamentals for the progress of Latin-American nations, have, for example:

- In the social protection system that has been held as a study topic for the last few years, there has been an unprecedented increase of people working in the informal economy (Cecchini & Martinez, 2011), generating a meager, unstable and fluctuating incomes as well as the uneven development of the productivity of labor, and thus the deterioration of living standards of families found in this situation.
- Science and Technology (S&T), because it produces a more labor productivity in a long-term, which allows to be more competitive in the international market, based not only in the exportation of low added value goods (such as raw materials or light manufacturing goods), but also in goods that have high knowledge and innovation, based on the continuous improvement of technical progress.

- In the economic field, the knowledge is a crucial source of added value in the production of services and goods. For example, the development of new medications and its effectiveness, the advance in telecommunications and software, the mechanization of productive process, among others, state the primary role of knowledge in the contemporary world (Piñón, 2004). Therefore, in public politics this topic plays a decisive role with the growing scientific council institutionalization in the more diverse spheres, as for example infrastructure, public health, industry, agronomy, agriculture and transportation.
- State education, since it has a dynamic role in the equitable development of societies.
- Education allows the societies to transform and construct their own mental structure (culture, sentiments, wishes, ideologies, aspirations, etc.)
- On other hand, the academic and human resources formation in people who doesn't count with needed means to pay for a private education, balanced under certain conditions their access to employment, to the possibilities of holding it, and determines in part, the labor income we could have, the work expectations and another set of complex factors that affect the salary distribution of population in general.

Theoretical framework

Nowadays the social problems that are more attained to underdeveloped countries make constantly reference to countryside poverty, social marginality in cities, thecnological backwardness in the means of production, distributions disparities and limitation of oportunities.

Following a brief analysis about the importance of each topic is made, in order to begin to give answer in a progressive way to these problems and limitations of the Latin American society.

At the same time indicators that show a general contextualization about contemporary situation of the region.

Social protection

A good approach and handling of social protection systems in the region will be necessaries to forge the basements of a social and economic development.

Through social protection high poverty and inequality levels can be fought, which contributes to the formation of a more inclusive and fair society, where economic, social and cultural rights are respected and recognized for all the citizens (Cecchini & Martinez, 2011).

As a consequence of the strengthening of the social protection, a better life quality for the community is aimed and in this way the creation of higher possibilities of human capital progress, which allows an intensive use of research and technology that influence in the generation of industry and a more competitive regional productive system, reaching a sustainatable development able to answer macroeconominc crash and natural disasters that influence the growing path (Hernandez & Rico, 2011).

In order to achieve the already mentioned social and economic development, it is indispensable to start a promotion plan of social protection systems that, through health, pension and social welfare, promotes a social cohesion (Gasparini et al, 2007) and in this manner to guarantee the minimum for life quality levels (Cecchini & Martínez, 2011).

Nevertheless, there are different approaches to address the politics over social protection topic, those that are executed according to the principles of development models in each country (Mejía & Franco, 2007).

In Latin American, generally the following approaches are identified (Gasparini et al, 2007; Cecchini & Martínez, 2011):

- Social security approach, with which contributive social protection is developed and economic means that allow reaching the minimum life conditions in term of health, education and recreation of society as a whole, are guaranteed, giving importance to economic, social and cultural rights. This seeks to establish common grounds of quality and coverage.
- Social insurance approach, with which non-contributive social protection is developed and an improvement in living conditions is searched through the diminution of labour risk and the promotion of the quality of labour markets with the of generation of formal jobs. From this approach, social insurances arise as a mean to overcome poverty and labour legislation, which limits the social protection coverage to individual linked to a formal job, excluding in this manner vulnerable social sectors such as rural and urban informal workers.
- Social welfare approach, with which a non-contributive social protection is developed and in which social promotion programs are promoted, both universal and focused to the most economically vulnerable population.

The impacts of this approach are in the long-term, since it aims to reduce intergenerational poverty through health and education policies' promotion that allow to strengthen human capital and as a result improve the employment and income rates of disadvantaged people.

Usually these approaches are executed simultaneously, in the sense that countries aim to promote social protection systems through various mechanisms, for example, the promotion by the contributory and non-contributory via. Concerning the first via, between the 1990-decade and the beginnings of the XXI century, little progress in access to social protection has been observed. Since in the region coverage reached 38.7% of the occupied on average.

In the rural-urban relationship, between the same dates the regional average of employed with access to social security in rural zones was 21,9 % while for employed in urban regions was 45,9% (CEPAL, 2006). Referring specifically to countries, this deterioration was accentuated in Bolivia, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Nicaragua, Paraguay, Paraguay, Peru and Venezuela who in the period between 1997 and 2002 had a coverage under 36 % of employed.

In the same period Colombia, Mexico, Panama and Dominican Republic had a coverage inferior to 50%, being Argentina, Brazil, Costa Rica, Chile and Uruguay, the countries of the region who showed a coverage over 50 % (Uthoff, 2008).

This declining trend has been marked since 1990, in which the fraction of workers who contribute to the social security has been reduced (with the exception of Mexico and El Salvador who had substantial growth).

This behaviour is explained in the volatile economic growth of the region and precariousness of employment that has generated a structural unemployment rate ranging between 10% and 15% over the past two decades (CEPAL, 2006). This situation has prevented the strengthening and coverage of contributory social protection.

On the other hand, the detriment of the labour market has increased the rate of informal employment, characterized as unstable, with low productivity and low salaries (Bertranou & Gasparini, 2004), which prevents the increase of social security coverage, since informal workers are the least protected in the region because they are unable to enrol in a social protection system. Moreover, the few membership rates reduce fiscal capacity, which limits State's social expenditure for the promotion of social security policies (Uthoff, 2008).

Regarding the improvements, Latin America has had a moderate progress in the last decades in the social welfare in education. For 2005, the region reduced the analphabetic rate of people over 15 years old to 9.5%, after reaching rates of over 20% in the 1970s.

In contrast, the gross primary enrolment rates have increased from 77% in 1970 to 96% in 2001 (CEPAL, 2006). In terms of health, public expenditure in percentages of Latin America's GDP in 2005 was 6.6%, close to the world average (6.2%) and to the OECD countries (8.9%). Nevertheless, there is still a difference of more than 200 dollars per capita between the region and the world average at the expenditure per capita level that prevents a better redistribution and equity of health system performance (CEPAL, 2006).

Referring to the scope of action and implementation of public policies, it can be observed that according to social and economic structure of each Latin American country, different and varied social protection schemas have been implemented to fight (and/or eradicate) poverty and inequity in the region.

Equally, intranational and international cooperation programs have been promoted in order to encourage with more efficacy and effectiveness, health, employment and wellness in the society. Thus, different programs have emerged around the region, like "progresa" in 1997 in Mexico, "Mi Familia" in 2000 in Nicaragua, "Familias en Accion" in 2000 in Colombia, "Bono de Desarrollo Humano" in 2002 in Ecuador, "Jefes y Jefas de Familia" in 2002 in Argentina, "Bolsa Familia" in 2003 in Brazil, the project "Chile Solidario" in 2004 in Chile, "Solidaridad" in 2005 in Dominican Republic , "Ingreso Solidario" in 2005 in Paraguay, "Red de Oportunidades" in 2006 in Panama, "Programa Tekopora" in 2005 in Paraguay, among others, which consider within their designs historical and cultural conditioning of each country.

Science and Technology (S & T)

Investment in S & T becomes vital, it allows qualifying technically to the population in the long-term, increase the discovery of new inventions, improving the already existent goods and services, generate innovations in the production process and incentivize the creation of new technologies that permit to rise different industries competitiveness in the economy.

For this reason, the society of knowledge has become in the mean of access to opportunities and benefits of progress for different actors of a nation, because it attempts achieve high levels of human development that affect economic development and thus allow improving the life conditions of society (Miranda, 2007).

In Latin America, the promotion of science and technology has not been consistent in the various countries of the region.
In the middle of the twentieth century, the S & T had more relevance in Argentina, Brazil and Mexico.

Since 1950, policies for the development of this field started to be executed, which led to an institutionalization process that allowed the professionalization of the different scientific disciplines, getting to strengthen the academic and practice settings and increasing their participation in different activities and sections of economics. (Vaccarezza, 1998).

At the end of the 1950's and during the 1960s and the 1970s, the development of this field was held in great proportion by the State, which showed, despite the government efforts, a separation between productive system and research.

In the 1980s, Latin America faced to economic reforms where the State reduced its role in economics and opened to international commerce, obtaining consciousness, because of competition, of the importance of science and technology in the industrial innovation and production processes (Vaccarezza, 1998), which led that, at the end of the XXth century, science and technology were taken in mind as knowledge and added value producers.

Consequently, the intensive use of knowledge has been promoted by different multilateral agencies, those who have developed programs such as the "Programa Iberoamericano de Ciencia y Tecnologia para el desarrollo" (Iberoamerican Program of Science and Technology for Development) –CYTED- in which a contribution to the development of the Ibero American region formed by Spain, Portugal and several Latin American countries is searched.

This program aims to improve the productive system and the life quality in the region thrpugh cooperation among research groups of universities, research centers and innovational companies of these countries (Bellavista & Renobell, 1999).

In regard to the role of the State in the evolution of science and technology, in Latin America the public expenditure in this field is far lower regarding the one of other developed countries, where for the last ones ranges from a tier 4.7% and a rooftop of more than 7.6%.

While for the first ones, it is about 1% in countries like Ecuador, and 5% in other countries such as Mexico, Colombia and Costa Rica (Miranda, 2007). At a general level (private and public sector) according to the information of the Organization for Economic Co-operation and Development (OECD), developed countries invest an average of 2.5% of its GDP in research and the private sector participates with an average of 80% of those resources.

This trend reflects the fact that in these countries priority to investment in S & T is given in order to increase industrial competitiveness of its economy.

In contrast, developing countries have a lower availability of resources to invest in S & T, which implies that the GDP share of this strategic area is very small (below 0.15% of GDP for most Latin American nations).

However, although the product of the region is insignificant compared to the world total, it has been observed since 2001 an output growth in the region which has led to increased investment in research and development (R&D) similar to GDP growth, being the region of Latin America and the Caribbean the one that has grown more in R&D during the XXI century (RICYT, 2010); within Latin America, Brazil, Mexico and Argentina are the countries that have experienced a greater share of investment in R & D accounting in 1999 and 2008, 54.5% and 66.5% in Brazil, 20.2% and 14.1% in Mexico, and 12.6% to 6.4% in Argentina, respectively. The rest of the region rose from 12.8% in 1999 to 13% in 2008 (RICYT, 2010).

The results of these policies were seen in the increase in the Human Development Index (HDI) in Latin America for the period 1990-2000, highlighting Brazil with 11.3%, Colombia with 8%, Chile 6.8%, Panama with 6% and Mexico with 5.5%, these being the states with growth above 5%.

Although the region's growth was diverse, since there was HDI growth rates between 1990 and 2007 inferior to 2% like in Trinidad and Tobago and Venezuela, most countries had a growth of over 3.5% during the period 2000-2007 (UNDP, 2010), which allows to observe that, even though a slow growth of indicators have been given, great advance in the medium and long term are happening, could positively induce the path of socio-economic growth.

Consequently, S&T is highlighted as an essential development topic that can be used as a mechanism to fence in the divergence of the region with the rest of the world, defining efficient policies that promotes research and technology, which in the medium term allows to generate a growing accumulation of human capital stock that has the ability to promote productive development of technical progress in the means of production (increasing the factors' productivity), as well as in different sectors of economics, with the aim unclog the persistent problems of poverty and low macroeconomic growth.

However, despite the results discussed in earlier paragraphs and according to Maloney and Perry (2005) .

The Latin American countries lack the capacity for innovation, which has prevented the sustained growth in the region over the past decades. By 2008 the region contributed to the total number of researchers in the world only by 3.5%, although they have increased their participation since at the end of 1990 they contributed with less than 3% (RICYT, 2010). So that, even though the number of researcher in the region has increased, they should not only strengthen the quality of their training, but also increase their involvement with firms, so an increase of economic support funds could be achieved, generating better innovation levels.

Public education

The exercise of education should be understood as a program that contains ideas, principles, requirements, regulations, laws, codes, standards, customs, etc.., that are intended to guide and point an outline of theoretical and practical behaviour in which the generation of added value increase due to applicative technical effort and the productive improve of tasks to exercise.

With the main purpose of reaching a model of optimal social welfare, specifically knowing the requirements for the inhabitants to have the most favourable macro-environment that can be maintained, prolonged and reproduced in the bets material and intellectual conditions (Espinosa & Vaca, 2011b).

Nonetheless, despite these benefits of education and the structure of the state educational system is considered of vital importance for any society, since it gives guidance, training, education and knowledge bases to the less fortunate members of the community.

Improving their staff training and human development at the same time (ECLAC, 2002) in recent years it has been observed in the region the deterioration of public education thus generating great social movements fighting for the defence of it.

Besides, low quality, the reduction of public expenditure and education budgets in many countries, precarious working conditions of the education professionals and the stagnation or slow progress of access to education, confirm a setback that widens the gap between the current situation and the goals of the governments, and multilateral organizations (UNDP, 2010).

This can be observed between 1980 and 2000, where the low income countries barely spent 3.2% of its GDP in education (Neira, 2000), this percentage has only increased by 0.6%, which together with the lowest GDP per capita becomes insufficient numbers for education expenditure at the time of the achieving proposed educational goals. Reason why it is difficult to achieve equity intended to be achieved with the universalization of education for all the vulnerable population.

In this context, private education systems that charge money for their offered services face many difficulties to answer in an effective way the demands of a society increasingly complex and uneven, because of the resulting costs to parents of their children study. Therefore, there is no guarantee of an appropriate access to the different stages and types of education unless there are entities subsidized by the state who have coverage on the disadvantaged population.

This lack of education in the region is one of the causes to continue in poverty because an uneducated person is less likely to access the different existing distribution circuits in society than a well-trained one. Therefore, a relationship between education and poverty is set, where, as affirmed by Aguerrondo (1993, p 8) "a vicious circle is established between these two phenomena, because on one hand poverty generates less education and on the other, having less education prevents to get away from poverty.

Therefore, in the implementation of public policies related to education, the state should have regulatory mechanisms to enable auditing public spending efficiency in schools, technical institutes and universities. In this way, it is intended to promote education as a pillar of human development, since it acts as a knowledge transmitter, driver of creativity and innovation, productivity generator and builder of a society in favour of equality and the potential development of science and technology. Reason why it has acquired a strategic and priority role in the policies of developed and emerging countries, like in the case of the Asian tigers.

Data, series stationarity, integration order and models approach

To represent the importance of the mentioned topics in this document, we proceed to the application of models of multivariate time series, specifically of bivariate VAR systems, estimating 57 total models (the three topics for each of the 19 countries and Latin America).

Where for the period between 1990 and 2010 the GDP growth rate is related (Crec_PIB) versus: 1) Investment in the social protection system as a percentage of GDP (%Prot_Soc), 2) Investment in science and technology as a percentage of GDP (%CyT), y 3) investement in public education as a percentage of GDP (%Educ_Estat).

To determine the stationarity of the series, and their integration order, the ADF (Augmented Dickey Fuller) statistic was used, taking a significance level of 5%.

In table 1, in the column entitled "Outcome", there are numbers in parenthesis that follows the next definition (1): Stationary series, modelled without constant and without tendency- integration order 0 $i(0)$ -, (2): stationary series, modeled with constant – integration order 0 $i(0)$-, (3): Stationary series, modeled with constant and tendency – integration order 0 $i(0)$-, and (4): non-stationary series. For cases in which occurs (4), an integration order 1 $i(1)$- is held, nevertheless it is modeled without correcting the non-stationarity in order to analyze and compare uniformly the impulse-response of the three variables over the Crec_PIB of the different countries.

OPTIMIZATION

Results, analysis and interpretation of the applied models.

Below the results of the 60 econometric models developed are presented, taking a significance level of 5% for all statistical, except Granger Causality Test which is analyzed based on a significance level of 10%.

In the chart entitled "p-value", is the criterion used to define whether the %Prot_Soc or %CyT or %Educ_Estat causes the GDP growth rate. The following box named "IMP-RES (2 and 3 Step Ahead)", presents the impulse-response analsys results using a Cholesky methodology for the second and third moment, after an exogenous crash of a standard deviation of one of the three variables of study over the Crec_PIB. The chart named "p" refers to the optimal lag number for each model. Finally, in the called LM and SB, there is the LM autocorrelation test and the multivariate normality Shenton-Bowman test respectively.

	Tipo de Resultados (Causalidad en el Sentido de Granger)
1	%Educ_Estat / %Prot_Soc / %CyT, **_SI_** causa Crec_PIB, y Crec_PIB **_SI_** causa %Educ_Estat / %Prot_Soc / %CyT
2	%Educ_Estat / %Prot_Soc / %CyT, **_SI_** causa Crec_PIB, y Crec_PIB **_NO_** causa %Educ_Estat / %Prot_Soc / %CyT
3	%Educ_Estat / %Prot_Soc/ %CyT, **_NO_** causa Crec_PIB, y Crec_PIB **_SI_** causa %Educ_Estat / %Prot_Soc / %CyT
4	%Educ_Estat / %Prot_Soc / %CyT, **_NO_** causa Crec_PIB, y Crec_PIB **_NO_** causa %Educ_Estat / %Prot_Soc / %CyT

Chart 2

Making an analysis of chart 1 it can be deduced that starting from the Impulse-response columns and p-value of the Granger test, there are different gropus of countries, with very similar characteristics among them. In a "first group" composed by Aregntina, Brazil, Chile, Colombia, Costa Rica, Cuba, Mexico and Uruguay, the impact of an exogenous collision of a standard deviation of one of the three variables of study, have a positive response in the GDP growth rate, on orders of 0.01% to 1%, for more than 5 periods, beginning to stabilize Crec_PIB between the fifteenth and the eighteenth period. At the same time, based on Chart 2, no country presents a result type 4

In the "second group" formed by Bolivia, Chile, Ecuador, Paraguay, Panama, Peru and Venezuela, at least one response of the Crec_PIB by country, have negative values between -0.1% and -0.3%, and Granger causality ranges between the type 2 and 3 result mostly.

On average, Crec_PIB stabilizes between twelfth fifteenth period.

On the other hand, in the "third group" composed of Salvador, Guatemala, Dominican Republic, and Honduras, there are the nations in which variables that define the investment in social protection systems, or Sciences and Technology or public education, are not primordial to determine the behavior of the GDP forecast.

CAUSALIDAD EN SENTIDO GRANGER Y ANÁLISIS IMPULSO-RESPUESTA

PAÍS	PROTECCIÓN SOCIAL (p-valor / Resul-tado)	IMP-RES (2 y 3 Paso Adelante)	p	LM	S-B	EDUCACIÓN ESTATAL (p-valor / Resul-tado)	IMP-RES (2 y 3 Paso Adelante)	p	LM	S-B	CyT (p-valor / Resul-tado)	IMP-RES (2 y 3 Paso Adelante)	p	LM	S-B
AMÉRICA LATINA	0.077 / 0.906 — 2(3)	0.0025424 / 0.0074960	3	0.12	0.93	0.022 / 0.890 — 2(2)	0.0029591 / 0.0013978	3	0.27	0.31	0.055 / 0.092 — 1(3)	0.0038521 / 0.0023006	5	0.41	0.31
Argentina	0.079 / 0.478 — 2(1)	0.00216964 / 0.00216350	1	0.08	0.43	0.607 / 0.028 — 3(3)	0.0011398 / 0.0018324	4	0.65	0.43	0.067 / 0.272 — 2(3)	0.0070891 / 0.0057299	1	0.15	0.92
Bolivia	0.348 / 0.033 — 3(4)	-0.0035437 / 0.0000697	4	0.88	0.66	0.095 / 0.093 — 2(3)	0.0035701 / -0.0013536	5	0.83	0.40	0.195 / 0.184 — 4(3)	0.0008171 / 0.0021547	5	0.93	0.63
Brasil	0.062 / 0.189 — 2(3)	0.0019840 / 0.0034043	3	0.20	0.56	0.013 / 0.081 — 1(2)	0.0010183 / 0.0083288	2	0.93	0.68	0.054 / 0.363 — 2(3)	0.0069499 / 0.0018134	2	0.73	0.27
Chile	0.094 / 0.658 — 2(1)	0.0013731 / 0.0049084	2	0.27	0.75	0.077 / 0.498 — 2(2)	0.0008129 / -0.0023970	2	0.23	0.18	0.620 / 0.928 — 4(3)	0.0021559 / 0.0043752	3	0.06	0.05
Colombia	0.014 / 0.802 — 2(3)	0.0034163 / 0.0018564	3	0.76	0.49	0.070 / 0.492 — 2(2)	0.0092672 / -0.0066374	3	0.54	0.05	0.008 / 0.348 — 2(2)	0.0049133 / 0.0040555	4	0.56	0.05
Costa Rica	0.002 / 0.323 — 2(4)	0.0010749 / 0.0022612	2	0.60	0.35	0.022 / 0.198 — 2(3)	0.0056916 / 0.0025709	3	0.54	0.35	0.011 / 0.241 — 2(2)	0.0029928 / 0.0040509	2	0.31	0.91
Cuba	0.046 / 0.642 — 2(2)	0.0008622 / 0.0000476	2	0.06	0.62	0.021 / 0.023 — 1(1)	0.0067226 / 0.0028551	4	0.28	0.64	0.038 / 0.583 — 2(2)	0.0076541 / 0.0062503	5	0.66	0.13
Ecuador	0.358 / 0.088 — 2(2)	0.0061177 / 0.0052693	5	0.64	0.37	0.223 / 0.004 — 3(2)	0.0053588 / -0.0017813	3	0.09	0.30	0.089 / 0.089 — 1(4)	0.0009493 / 0.0041535	2	0.16	0.09
El Salvador	0.993 / 0.291 — 4(3)	0.0016234 / -0.0023416	3	0.55	0.09	0.221 / 0.695 — 4(3)	0.0012111 / 0.0016644	1	0.93	0.20	0.428 / 0.171 — 4(3)	0.0018186 / -0.0011894	4	0.86	0.14
Guatemala	0.127 / 0.391 — 4(3)	-0.0011895 / 0.0023408	2	0.18	0.24	0.657 / 0.697 — 4(3)	0.0026076 / 0.0019094	3	0.83	0.35	0.234 / 0.029 — 3(2)	0.0013413 / -0.0024679	4	0.34	0.16
Honduras	0.521 / 0.164 — 2(3)	-0.0039331 / 0.0050987	3	0.34	0.70	0.179 / 0.174 — 4(3)	0.0024495 / -0.0055740	4	0.14	0.11	0.807 / 0.190 — 4(2)	0.0085484 / -0.0087210	3	0.59	0.08
México	0.059 / 0.087 — 1(3)	0.0107657 / 0.0028014	3	0.68	0.42	0.091 / 0.116 — 2(2)	0.0095154 / 0.0054431	4	0.87	0.96	0.063 / 0.166 — 2(2)	0.0027162 / -0.0006431	5	0.90	0.13
Panamá	0.271 / 0.047 — 3(2)	0.0051998 / 0.0086751	1	0.96	0.25	0.256 / 0.190 — 2(2)	0.0006898 / -0.0017018	1	0.91	0.73	0.057 / 0.418 — 2(2)	0.0044104 / 0.0007054	1	0.80	0.11
Paraguay	0.059 / 0.769 — 2(4)	0.0098707 / -0.0012140	2	0.89	0.12	0.256 / 0.653 — 4(2)	0.0043022 / -0.0009566	2	0.39	0.69	0.005 / 0.903 — 2(3)	0.0014785 / 0.0001506	2	0.45	0.20
Perú	0.092 / 0.956 — 2(3)	0.0068423 / 0.0036064	2	0.31	0.49	0.925 / 0.991 — 4(2)	-0.0026472 / 0.0052353	3	0.26	0.17	0.062 / 0.492 — 2(2)	0.0077967 / 0.0035837	2	0.78	0.47
Rep. Dom.	0.001 / 0.892 — 2(3)	0.0081967 / -0.0025996	4	0.18	0.77	0.005 / 0.047 — 1(1)	0.0069973 / 0.0054100	3	0.90	0.33	0.022 / 0.401 — 2(2)	0.0074537 / -0.0030760	1	0.10	0.07
Uruguay	0.350 / 0.526 — 4(2)	0.0063115 / 0.0039257	3	0.83	0.22	0.271 / 0.719 — 4(3)	0.0092065 / 0.0033139	2	0.74	0.12	0.647 / 0.383 — 4(1)	0.0091434 / 0.0061679	3	0.83	0.11
Venezuela	0.219 / 0.64 — 4(3)	0.0018072 / 0.0041752	4	0.23	0.62	0.070 / 0.778 — 2(3)	0.0076278 / -0.0009614	5	0.24	0.18	0.284 / 0.790 — 4(3)	0.0001279 / 0.0015770	2	0.34	0.94

Chart 1

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Crec_PIB responses to take negative values of -0.8%, softening between the tenth and thirteenth period.

These econometric results confirm some analysis made by United Nations in their different annual reports. Where for example, countries where %Educ_Est doesn't cause Crec_PIB (or vice versa) have as an special case a "failed" public educative system (ranking among the last of the region) on aspects of coverage, efficiency, quality, equity, autonomy, evaluation standards, teaching profession and budgetary financing (UNDP, 2010).

Concerning %Prot_Soc, the negative IMP-RES values, coincide with countries where labor illegality is more pronounced, especially in SMEs since there is no focused execution policies about social security that allows to reduce the generation of informal work, for it is in these kind of businesses in which much of the economically active population is concentrated.

The negative effects over the GPD growth rates, starting from an initial shock in %CyT, id¡s found in all the countries that belong to the called "third group", where historically none policies to ensure the prioritization of investment and financing of scientific activity and technological management were consolidated, at the same time they haven't been legitimized. Nor standards and laws in areas such as intellectual property and incorporation of technologies have been legislated.
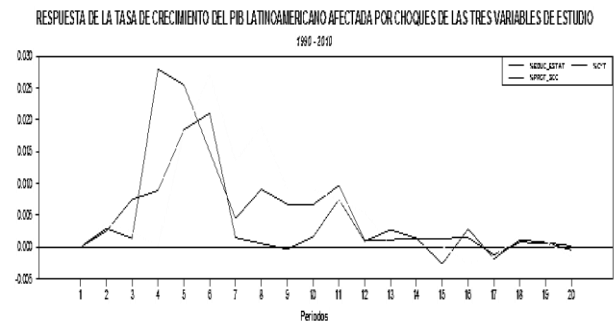
Graphic 1

Analyzing Latin America as an aggregate, it can be observed that exogenous investments collisions in public education generates the better positive answer in the medium term in the GPD growth rate (0.02784 to the fourth year). In turn, investment in social protection systems have smaller average responses (approx. 0.01153), being only significant results from third to sixth period. Investment collisions in science and technology are the most influential in Crec_PIB, and although its response is more delayed, (reacts to the fifth period), it reflects the current importance of the technical progress as a motor of economic growth and gives relevance to the establishment of a regulatory frame that guarantees S&T prioritization as an pillar activity of the development in the region.

Conclusions

From the study with VAR models (impulse response and Granger causality analysis), we can deduce that the three topics in question are a fundamental base for building a more prosperous and educated society.

Where the problems of extreme poverty and inequality that have always plagued Latin America for many years can be eradicated. Therefore:

- The State must be based on the study of its structure and historical conditioning in order to, through judicious and responsible policies, make efficient use of fiscal resources to ensure social cohesion.

- This cohesion will tend through support to disadvantaged through sustainable and economically viable social protection systems which allows to progressively reduce the informal economy and conceive increasingly better work environments that influence the construction of human capital generator of knowledge and added value and succeeding in improving the living conditions of the whole society

- It is urgent to intensify cooperation and participation between State, Researchers and Companies, with the aim of increasing scientific and technological achievements in Latin America and in this manner convert the S &T topic in a useful tool for industrial competitiveness and technical progress.

    This will generate synergies in knowledge that permits to adapt new technologies and innovation ideas to the economic structure of the region, reaching a more stable growing in the long- term.

- The social policies to be executed must consider that the progress of public education system in their different levels (primary, secondary and pre-grade) depends on various factors such as its faculty and the structure of their academic curriculum structure; environment and cultural system of the society that fixes their orientation and action ratio.

The advancement and dissemination of science, doctrines, disciplines and arts; economic resources available to the educational centers; mission and contribution of the educational centers to society; the government of each educational institution.

- Legal system that enables to run or invalidate certain processes. If a good exercise of the discussed above is performed, educational investment plans that may decrease the gap between the poorest qualifications and people in high-income as well as the present inequality between urban and rural, could be made in a more objectively way.

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i. i. These cooperation programs not only are developed through the support between countries, but also through the support of international organizations such as the International Labour Organization ILO, the Organization of American States OAS, the Pan American Health Organization PAHO, among others.

ii. For more details on programs of social protection in each Latin American country, see the excellent article by Fonseca (2006), where a detailed and rigorous study of the historical development is carried out, and there are implications for public policy (in the decades of 1990 and 2000) for different existing social protection systems.

iii. The Organization of American States OAS, the Inter-American Development Bank, the Economic Commission for Latin America and the Caribbean ECLAC, the Organization of the United Nations Educational Scientific and Cultural Organization UNESCO, among others.

iv. Some cooperation programs are Bolívar-Link of UNESCO and IDB, Academy of Sciences of Latin America (ACAL) and the Regional Office for Education (CRESALC) in which the workforce promotes the exchange of researchers allowing the dissemination of scientific knowledge and technology (Bellavista & Renobell, 1999).

v. This program has the support of the governments of Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Dominican Republic, Uruguay and Venezuela.

vi. The evolution of R & D in Latin America and the Caribbean is measured in current dollars.

vii. The distribution of R & D Investment in Latin America and the Caribbean is measured in current dollars.

viii. Distribution of researchers in the world measured in Full Time Equivalency researchers.

ix. In Latin America, researchers who have designed their R & D activities in the companies sector have gone from under 20% to just over 40% during the 2000s (RICYT, 2010).

x. Currently in the region the cases of Chile, Colombia, Dominican Republic, among others stand out.

xi. For the econometric applicatio, RATS 7.2 and CATS 2.0. softwares were used.

xii. This sum more than 90% of the Latin American GDP (http://pwt.econ.upenn.edu/).

xiii. The statistical data were extracted from web pages of ECLAC and the World Bank; and Penn Database Table (University of Pennsylvania). This study period due to institutional constraints information was taken.

xiv. Protección Social for Bolivia and Costa Rica, and CyT for Ecuador.

xv. For all countries the Crec_PIB series was stationary with trend and constant except for Cuba who had only constant.

xvi. Causality in the sense of Granger (1969) start of the intuitive idea that the cause must precede the effect. But it is brought to causality in the strict, logical sense. According to Lütkepohl (2005) causality is defined in terms of improving measured as the minimization of mean square error forecast. Ie, one variable causes in the Granger sense to another, if the variable helps improve the outcome variable; I trying to imply that the variable has important information about the future behavior of the variable (Novales, 2003).

xvii. Estimating confidence intervals for each of these impulse response results, it was obtained that statistically effects equal to zero were: 3rd impulse response of Bolivia and Cuba to% Prot_Soc, 3rd impulse response of Paraguay for% S & T, and 2nd impulse response for% S & T Paraguay.

xviii.   To estimate the VAR model, the selection of appropriate lags are made from the following ratio of verisimilitude test:

$$\chi^2 \; con \; g \; grados \; de \; libertad \sim ln$$

$??_u$ = Matriz de covarianzas de residuales.
T =
N??m de la muestra (n) por N??m de variables (k)
.

Having the hypothesis:

H_0 = Coefficients of the unrestricted model versus restricted.
H_1 = At least one of these coefficients differs from zero.

xix.   Similarly seasonality test was performed, but no model had significant dummy variables at a level of significance of 5% . This is very likely to happen because the series are annual and do not have historical repetitive behaviors in different periods of study as some monthly series do.

xx. Better known as the Breusch-Godfrey test, where the statistical distribution LM test for autocorrelation of order or less, is asymptotically distributed as a $\chi^2(j)$.

xxi.   Prueba conjunta entre asimetría y kurtosis a partir del principio Score de Rao, construyendo así, una prueba conjunta de multinormalidad (Shenton & Bowman, 1977).

xxii.   This procedure is performed using the Cholesky approach where it is assumed that the first variable entered into the system (which for this work is Prot_Soc% or% or% Educ_Estat & T) is having an immediate impact on the second (Crec_PIB).

So formally, it must first diagonalize the matrix of variance and covariance of the bivariate system, so that the shocks are not contemporaneously correlated and therefore prevent contemporary shocks that may affect more than one variable.

xxiii.   This country is a special case because even though the variables do not cause Crec_PIB (or vice versa), responses to exogenous shocks are highly positive (between 0.3% and 0.9%), showing the inherent importance of the topics.

xxiv.   Honduras, El Salvador, Paraguay, Peru, Guatemala. Uruguay does not enter in this analysis even thought it fulfills with the econometric conditions to do so.

xxv.   The forecasts for latter variable improve when taking into account the historical behavior of the topics of study, concluding that Prot_Soc%,%% Educ_Est & T and have important information about the future behavior of the variable Crec_PIB.