POLITICAL STABILITY, PEACE AND ECONOMIC DEVELOPMENT IN 164 COUNTRIES, 2010-2020

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Abstract

We analyze Political Stability, in 164 countries for te period 2010-2020, as a variable that has positive effects on Peace, Economic Development and other indicators of Quality of Life. We include tables with groups of countries classified accordingly to their Indicators of Political Stability, Economic Development and Peace. We estimate equations for the effects of Political stability on Development and Peace and other variables. We, also, estimate and equation for Political Stability in year 2019 related with its lagged value in year 2010, one indicator of Quality of Government in year 2019 and the increase of the Educational Level of adult population for the period 2010-2019. The coefficients are positive and significant, showing that the indicator of Quality of Government selected in this study (Voice of Citizens) and the educational level of adult population, have positive effects on the Index on Political Stability. Besides we include two dummy variables to have into account some special cases of countries with levels of political stability lower than expected in the equation (Libya, Mali, Hong-Kong and Ukraine). One conclusion is that to foster quality of government and education is usually of great importance for political stability and thus to increase Peace and to avoid or diminish conflictiveness. Finally, we include a section with some references to interesting studies addressed to avoid wars and to foster peace in the World.

Keywords: Political Stability, Peace, Economic Development, Econometric Models of Quality of Life, Education, World

JEL Codes: C5, I2, I3, O57

1. Introduction

We analyze the relationship of the Index of Political Stability with Peace and Economic Development

In this study we present an international comparison of the Index of Political Stability (IPS) and its relation with Peace and Economic Eevelopment.

Section 2 is devoted to Data ans Methodology. Section 2.2 present a summary of data of groups of countries and territories, classified by Political Stability, Economic Development and Peace. We include 8 groups accordingly to the Index of Political Stability (IPS), 11 groups accordingly to the value of real Production per head (PH) and in 7 groups by the Indicator of Peace (X4). In section 2.3, we calculate the correlation of IPS with PH and with other indicators of Quality of Life (including X4=Indicator of Peace) and we find the highest positive correlation between IPS and Peace, with a value of 90.85%. Section 2.4 includes important contents related with methodology and the interpretation of results when there may be effects of missing explanatory variables.

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Section 3.1 estimates the positive impact that the Index of Political Stability (IPS) has on Production per capita and section 3.2 estimated the effects of IPS on several indicators of quality of life (including the Indicator of Peace). The results show that Political Stability usually contributes positively to economic development, quality of government, peace and quality of life. Section 3.3 includes an analysis of the possible impact of Political Stability on Military Expenditure per capita and section 3.4 present the estimation of the positive effects of Education and Quality of Government (measured by the Indicator Voice of Citizens) on the increase of Political Stability.

Section 4 presents references to data from reports related with the negative impact of conflicts and war on the life security in many countries. The human history has, unfortunately, experience many conflicts and wars, and it is important nowadays to develop social and economic policies addressed to avoid increases of conflictiveness and foster Peace. All initiatives to get reasonable and pacific rules to solve conflicts without vilences should be welcome.

Section 5 presents the main conclusions.

Annex 1 is a supplement to section 2.1, with data of the Index of Political Stagility in 164 countries for the period 2010-2020. nnex 2, on econometric methodology, is a supplement to section 2.4 on the effects of missing relevant explanatory variables on the significance of the coefficients of the included variables and on causality tests. Annex 3 includes some supplementary information related with section 4.

2. Data and methodology

2.1. Sources of data

World Bank WDI: The World Development Indicators database provides information of many variables for long periods (some of them since 1960 to 2020). This is our source of information for Production per capita (in Dollars at 2017 prices and Purchasing Power Parities), for the Educational Level of population, among other indicators.

World Bank WGI: In the last decades, there have been advancements in the empirical studies of Social Capital, thanks to the elaboration of interesting statistics by Kaufmann and Kravis on several indicators including Political Stability, Voice of Citizens and Government Efficiency, among others. The World Bank publishes these indicators in the World Government Indicators (WGI) database.

United Nationas, in agreement with Gallup: In the last decades, the UN in agreement with Gallup, publishes interesting indicators of Life Satisfaction and other indicators.

IEP(2021). The Institute for Economics and Peace, an international center with headquarters in Sidney (Australia), publish the indicator GPI, to measure conflict in a society.

UCDP (Uppsala Conflict Data Program) of the University of Uppsala, in Sweden, presents analyse the evolution of fatalities in state and non-state conflicts.

PRIO of Oslo present an overview of conflict trends for the period 1946-2019.

2.2, Groups of countries by Political Stability, Development and Index of Peace.

Political Stability in year 2020

Table 1 presens several groups of countries accordingly to their value of IPS in year 2020 (IPS20) and table A1, in the Annex, present sthe values of IPS (Indicator of Political Stability in decimal scales, with values between 0 and 10, and the values of real Production per inhabitant, in years 2010, 2019 and 2020.

Table 1. 164 Countries classified accordingly to Politica Stability (IPS) in year 2020.

IPS20	Countries or Territories
<1	Afghanistan, Central African R, Iraq, Libya, Mali, West Bank&Gaza
1-2	Burkina-Faso, Cameroon, Congo DR, Ethiopia, Iran IR, Lebanon, Myanmar, Niger, Nigeria, Pakistan, Sudan
2-3	Burundi, Chad, Egypt AR, Haiti, Kenya, Mozambique, Turkey, Ukraine, Zimbabwe
3-4	Algeria, Angola, Armenia, Azerbaijan, Bahrain, Bangladesh, Belarus, Bosnita&Herzegovina, Colombia, Congo R, Côte d´Ivoire, Guinea, Guinea Bissau, Honduras, India, Indonesia, Israel, Mauritania, Mexico, Nicaragua, Papua-New Guinea, Philippines, Russian Fed., Saudi Arabia, Tajikistan, Thailand, Togo, Tonga, Tunisia, Uganda.
4-5	Benin, Bolivia, Brazil, Cambodia, China, Comoros, Djibouti, Ecuador, El Salvador, Equatorial Guinea, Eswatini, Gabon, Georgia, Guatemala, Guyana, Jordan, Kazakhstan, Kyrgyz R, Lesotho, Liberia, Madagascar, Malawi, Moldova, Montenegro, Morocco, Nepal, Peru, Senegal, Serbia, Sierra Leone, South Africa, Sri Lanka, Tanzania, Turkmenistan, United States, Uzbekistan, Vietnam, Zambia
5-6	Albania, Argentina, Bulgaria, Chile, Cyprus, Dominican R, France, Gambia, Ghana, Greece, Hong-Kong (China), Italy, Jamaica, Kuwait, Latvia, Malaysia, Maldive, New Macedonia, Oman, Panama, Paraguay, Puerto Rico, Rwanda, Sao Tome&Principe, Spain, Timor-Leste, Trinidad&Tobago, United Kingdom
6-7	Australia, Austria, Belgium, Cabo Verde, Costa Rica, Croatia, Czech R, Denmark, Estonia, Finland, Germany, Hungary, Ireland, Korea R, Lao PDR, Lithuania, Malta, Mauritius, Mongolia, Namibia, Netherlands, Poland, Qatar, Romania, Seychelles, Slovak R, Slovenia, United Araba Emirates
7-8	Bermuda, Botswana, Canada, Iceland, Japan, Luxembourg, New Zealand, Norway, Portugal, Samoa, Singapore, Sweden, Switzerland, Tonga, Uruguay

Source: IPS is an Index of Political Stability in scale 0 to 10, calculated by M.C. Guisan from the World Bank(2022) (WGI indicator PS in scale -2.5 to 2.5) with the formula: IPS=5+2*PS. Data by country for the period 2010-2020 in the Annex.

Worl Average of IPS, in the decimal scale, is 5, and we found that 57 countries have values clearle below the average (between 0 and 4), 43 have high values (between 6-8) and 64 countries are in an intermediate posititon, within the interval 4-6.

IPS index (in decimal scale), as well as the World Bank PS (in scale -2.5 to 2.5) indicate a relative position of a country in comparison with World average. It should be interesting the availability of indicators allowing to measure the evolution of the quality of political stability thorugh time, both for each country and for World average. A decline in the World index would be a call of attention to avoid deterioration.

Economic development in year 2020

Table 2 present countries in groups accordingly to the value of Production per inhabitant in year 2020 (PH20), expressed in thousand Dollars at 2017 international prices. There are 47 countries below 5 thousand Dollars of Production per head, 47 in the intervalor 5-15, 30 countries in the intervalor 15-30, 25 countries in the interval 30.50, and 16 with PH20 higher than 50.

Table 2. 164 Countries and Territories classified by Production per head in year 2020 (PH20 in thousand Dollars at 2017 international prices)

PH20	Countries or Territories
<2	Afghanistan, Burundi, Central African R, Chad, Congo DR, Guinea-Bissau, Liberia, Madagascar, Malawi, Mozambique, Niger, Sierra Leone, Togo
2-5	Bangladesh, Benin, Burkina Faso, Cambodia, Cameroon, Comoros, Congo R, Ethiopia, Gambia, Guinea, Haiti, Kenya, Kyrgyz R, Lesoto, Mali, Mauritania, Myanmar, Nepal, Nigeria, Pakistan, Papua-New Guinea, Rwanda, Sao Tome&Principe. Senegal, Sudan, Tayikistan, Tanzania, Timor-Leste, Uganda, Zambia, Zimbabwe
5-10	Angola, Bolivia, Cabo Verde, Côte d´Ivoire, Djibouit, El Salvador, Eswatini, Ghana, Guatemala, Honduras, India, Iraq, Jamaica, Jordan, Lao PDR, Morocco, Namibia, Nicaragua, Philippines, Samoa, Tonga, Tunisia, Uzbekistan, Viertnam, West Bank&Gaza
10-15	Albania, Algeria, Armenia, Azerbaijan, Bosnia-Herzegobina, Brazil, Colombia, Ecuadror, Egypt AR, Gabon, Georgia, Indonesia, Iran IR, Lebanon, Maldives, Moldova, Mongolia, Paraguay, Peru, South Africa, Sri Lanka, Ukraine
15-20	Argentina, Belarus, Botswana, China, Costa Rica, Dominican R, Equatorial Guinea, Guyana, Mauritius, Mexico, Montenegro, North Macedonia, Serbia, Thailand, Turkmenistan,
20-30	Bulgaria, Chile, Croatia, Greece, Kazakhstan, Latvia, Malaysia, Oman, Panama, Romania, Russian Fed., Seychelles, Trinidad&Tobago, Turkey, Uruguay
30-40	Cyprus, Czech R, Estonia, Hungary, Israel, Italy, Japan, Lithuania, Malta, Poland, Portugal, Puerto Rico, Slovak R, Slovenia, Spain
40-50	Australia, Bahrain, Belgium, Canada, Finland, Korea R, Kuwait, New Zealand, Saudi Arabia, United Kingdom
50-60	Austria, Denmark, Germany, Hong-Kong (China), Iceland, Netherlands, Sweden
60-80	United States, Norway, Switzerland, United Arab Emirates
>80	Bermuda, Qatar, Ireland, Singapore, Luxembourg

Source: Elaborated in this Report from WB(2022) WDI statistics.

There are big differences in Production per inhabitant. As analyzed in Guisan(2021) and other studies, the main cause of low levels of production per capita is the low level of Schooling of adult population. Many low-income countries with low educational level, have moderate rates of growth of real Production and high rates of Population growth, due to excessively high Fertility rates, and the consequence is staganation or little growth of real Production per inhabitant (PH).

Index of Peace in year 2020

Table 3 presents several groups of countries classified by the Index of Peace, in decimal scale, where the minimum (0) indicates the minimum and 10 the maximum of Peace.

The Indicator of Pease (IPeace)=X4) is in decimal scale, being 0 the minimum and 10 the maximum of Peace. It has been calculated, by Guisan(2021) as:

X4=(4-Index of Conflict)*2.5,

by Guisan(2021), being the Index of Conflict the Indicator GPI, published by IEP(2021) with the name "Global Peace Index". GPI is, in fact, an Index of Conflict with a minimum value equat to 0 , in case of non conflict, and a maximum equal to 4 for a high level of conflict.

Table 3. 162 countries by increasing value of the Index of Peace in year 2019

Index of Peace	Countries by alphabetic order in each group
<2.5	Afghanistan, Central African R, Congo DR, Irak, Libya,
2.5 - 3.5	Cameroon, Colombia, Ethiopia Iran IR, Israel, Lebanon, Mali, Mexico, Nigeria, Russian Fed., Sudan, Pakistan, Turkey, Ukraine, West Bank&Gaza
3.5 - 4.5	Algeria, Azerbaijan, Belarus, Brazil, Burkina-Faso, Burundi, Chad, Congo R, Egypt AR, Honduras, India, Kenya, Lesotho, Mauritania, Myanmar, Nicaragua, Niger, Philippines, Puerto Rico, Saudi Arabia, South Africa. Thailand, Togo, Uganda, USA, Zimbabwe
4.5 - 5	Angola, Armenia, Bahrain, Bangladesh, Benin, Bolivia, Cambodia, China, Cote d'Ivoire, Djibouti, Dominican R, Ecuador, El Salvador, Eq Guinea, Gabon, Georgia, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Kyrgyz R, Liberia, Maldives, Morocco, Mozambique, Nepal, Papua New Guinea, Peru, Rwanda, Samoa, Sri Lanka, Tajikistan, Tonga, Trinidad&Tobago, Tunisia, Turkmenistan, Uzbekistan
5 - 6	Albania, Argentina, Bosnia Herzegobina, Botswana, Cabo Verde, Chile, Costa Rica, Cyprus. Estonia, Eswatini, France, Gambia, Ghana, Greece, Indonesia, Italy, Jamaica, Jordan, Kazakhstan, Korea R, Kuwait, Lao PDR, Latvia, Lithuania, Madagascar, Malawi, Malta, Moldova, Mongolia, Montenegro, Namibia, North Macedonia, Oman, Panama, Paraguay, Sao Tome&Principe, Senegal, Serbia, Sierra Leone, Spain, Tanzania, Timor-Leste, UAE, UK, Uruguay, Vietnam, Zambia
6 - 6.5	Australia, Belgium, Bulgaria, Croatia, Finland, Hong-Kong (China), Germany, Hungary, Luxembour, Malaysia, Mauritius, Netherlands, Norway, Poland, Qatar, Romania, Seychelles, Slovak R, Sweden
6.5 - 7.5	Austria, Canada, Cezech R, Denmark, Iceland, Ireland, Japan, New Zealand, Portugal, Singapore, Slovenia, Switzerland

Source: Elaborated from the Index of Peace (X4) of Guisan(2021), calculated as X4=Index of Peace=10-GPI*2.5, where GPI is the Global Index published by the Institute for Economics and Peace with headquarter at Sidney (Australia), IEP(2021). Note: Includes 162 countries out of 164 countries of table A1. Not available data for Bermuda and Comores.

2.3. Correlation of Political Stability with PH and Indicators of Quality of Life

Table 3 presents the correlations of IPS20 with economic development, measured by PH20, and 5 indicators of Quality of Life, around year 2020. Data of IPS in table A1 and data of X1, X2, X4 and XM in Guisan(2021).

IPS20 (Index of Political Stability in year 2020) shows a positive correlation of:

0.63 with X1=Life Happiness (index of United Nations and Gallup)

0.76 with X2=Quality of Government, measured by Voice of Citizens (WB(2022)

0.90 with X4=Index of Peace (maximum peace=10: see footnote in table 3).

0.91 with XM that is the arithmetic average of X1, X2 and X4.

PS presents a negative correlation with indicator X3=Conflict=GPI*2.5, and a positive correlation of 0.6145 with economic development represented by PH20.

Table 3. Correlation coefficients of IPS20 with X1, X2, X3, X4, XM and PH20

	IPS20	X1	X2	X3	X4	XM	PH20
IPS20	1.0000	0.6349	0.7599	-0.9085	0.9085	0.8614	0.6145

Note: Data of 164 countries in year 2020. Source: Elaborated by the author from WB(2021) statistics. The indicator of peace=10-X3; beint X3 the indicator of conflict X3=GPI*2.5

These correlations suggest that Political Stability contributes to quality of life and that Economic Development usually helps to reach Political Stability. In the Next section we estimate several equations that show interesting relationships.

2.4. Methodology: the question of missing variables.

In Guisan(2018) we include several interesting suggestions in order to the specification and estimation of equations related with economic development, including analysis of causality, the selection of the type of variables (in levels, first differences, shares, per capita, indexex, etc.), the effectos of missing variables and other important questions. In the Annex 2, we cite some contents of that study.

Here we would like to insist on the effects of missing variables, because it is frequent to find publications where authors declare that if an explanatory variable has a significan coefficient it implies that the variable is important in the equation and even they say that the included variables "explain more than 90% of the variations of Y", if R^2 is higher than 90. Really, when there are missing variables, we should not say that the included variables explain, but that the "included variables together with the effects of the missing explanatory variables linearly related with them " explain the percentage indicated by the goodness of fit.

Economic Development depends on many factors, from the supply and the demand side, including Capital (Physical Capital, Human Capital, Social Capital), as well production of raw materials, indusrtrial development, foreign trade and other ones. In Guisan(2018) we include figure 1 with a general view of those realationships.

Missing variables: In Guisan(2015) we include selected suggestions for a good spectification and other methologicas issues. One of the questions is the effects of missing relevant variables and the interpretation of tests of significance. We include an Annex with an anlysis of those effects.

3. Econometric models that relate Political Stability with other variables

3.1. Effects of Political Statibility on Development

Equation 1 presents the estimation of the relationship of Economic Development in year 2019 with its lagged value of year 2010 (PH10) and the increase of the Indicator of Political Stability for the period 2010-2019 (IPS19-IPS10)

Equation 1.PH19 related with PH10 and increase of IPS (IPS19-IPS10)

Dependent Variable: PH19. Method Least Squares, Observations 164				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PH10	1.100970	0.013219	83.28712	0.0000
IPS19-IPS10	704.0975	352.0947	1.999739	0.0472
R-squared	0.954792	Mean dependent var		21563.96
Adjusted R-squared	0.954513	S.D. dependent var		21772.21
S.E. of regression	4643.500	Akaike info criterion		19.73644
Sum squared resid	3.49E+09	Schwarz criterion		19.77425
Log likelihood	-1616.388	Hannan-Quinn criter.		19.75179
Durbin-Watson stat	2.058065			

Source. Elaborated by M.C. Guisan

The results indicate that on average PH has multiplied by a factor 1.10 for the period 2010-2019, and that the increase of Political Stability, together with the evolution of missing explanatory variables related with the included variables, show a positive impact on PH19. The included explanatory variables are X1=PH10, X2= (IPS19-IPS10) and there are may be many missing relevant variables. The high value of R^2 indicates that many of the missing variables are linearly related with the included explanatory variables.

3.2. Effects of Political Stability on several indicators of Quality of Life

Combined Index of Quality of Life

Equation 2 relates the combined index of Quality of Life in year 2019 (XM=(X1+X2+X4)/3, with the Index of Political Stability in years 2010 and 2019.

Equation 2. Combined Index of Quality of Life (XM), in year 2019, related with IPS

Dependent Variable: XM. Method Leas Squates. Observations 151				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.517965	0.137096	18.36638	0.0000
IPS10	0.353692	0.029389	12.03477	0.0000
IPS19-IPS10	0.375694	0.040288	9.325265	0.0000
PH19/1000	0.022190	0.002838	7.817697	0.0000
TYR19	0.062145	0.017043	3.646319	0.0004
R-squared	0.870537	Mean dependent var		5.142397
Adjusted R-squared	0.866990	S.D. dependent var		1.240730
S.E. of regression	0.452500	Akaike info criterion		1.284496
Sum squared resid	29.89446	Schwarz criterion		1.384406
Log likelihood	-91.97942	Hannan-Quinn criter.		1.325084
F-statistic	245.4341	Durbin-Watson stat		1.801833

Source. Elaborated by M.C. Guisan

The equation also includes an intercept and the variables PH19 (production per capita in 2019) and TYR10 (average years of schooling of adult population).

Political Stability both in year 2010 and 2019, together with other included and missing variables, seem to have a positive impact on the combined Index of Quality of Life (XM). As seen in Guisan(1997), and other studies, the coefficients of the estimated equation are not only the effects of the included explanatory variables but also other effects of missing relevant variables linearly related with the included ones.

Happiness (Life Satisfaction)

Equation 1 showa the relationship between one component of XM (X1= Happiness) with IPS, Production per head (PH), the Educational Level of population (Tyr) and one Indicator of Quality of Government (X2=Voice of Citizens).

Equation 3. Happiness in year 2019 (X1) related with PH19, IPS, XTYR and X2

Dependent Variable: X1. Method Leas Squates. Observations 153				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PH19/1000	0.015514	0.004591	3.379559	0.0009
IPS19	0.084104	0.043582	1.929781	0.0556
TYR19	0.095376	0.024733	3.856190	0.0002
X2	0.102999	0.055178	1.866676	0.0639
C	3.468595	0.207397	16.72439	0.0000
D18	-2.368791	0.638625	-3.709205	0.0003
R-squared	0.676200	Mean dependent var		5.525013
Adjusted R-squared	0.665187	S.D. dependent var		1.084052
S.E. of regression	0.627265	Akaike info criterion		1.943531
Sum squared resid	57.83886	Schwarz criterion		2.062372
Log likelihood	-142.6801	Hannan-Quinn criter.		1.991806
F-statistic	61.39691	Durbin-Watson stat		1.704663

Source. Elaborated by M.C. Guisan

The coefficient of Schooling (Tyr19) is significant at 5% level, the coefficients of PH and IPS19 are signigicant at 6% level and the coefficient of X2 at 7% level. The 4 explanatory variables show to be positively related with Happiness (X1).

We have included a Dummy variable (D18) to have into account the particular situation of Botswana, a country with a value of X1 lower than expected accordingly to the model. It should be interesting to find more information for exceptional countries like Botswana, for example with information of X1 for different social groups by age, gender, income level, territorial distribution, etc. This would help to understand the causes of the low value of X1 in that country.

Voice of Ctizens

Equation 4 includes IPS20, PH20 and the indicator of Schooling in year 2019 (XTYR) as explanatory variables for the indicator of Quality of Government corresponding to Voice of Citizens.

Equation 4 Voice of Citizens (X2) related with IPS, PH and Schooling

Dependent Variable: X2. Method Least Squates, Observations 163				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.289071	0.252086	5.113607	0.0000
IPS20	0.371102	0.052711	7.040328	0.0000
PH20/1000	0.042303	0.005125	8.254335	0.0000
XTYR	0.130271	0.032216	4.043714	0.0001
R-squared	0.781658	Mean dependent var		4.958160
Adjusted R-squared	0.777538	S.D. dependent var		1.928163
S.E. of regression	0.909434	Akaike info criterion		2.672246
Sum squared resid	131.5042	Schwarz criterion		2.748166
Log likelihood	-213.7880	Hannan-Quinn criter.		2.703068
F-statistic	189.7384	Durbin-Watson stat		1.732901

Source: Elaborate by M.C. Guisan. Note= XTYR=Tyr19-Tyr10. Schooling data: UNDP(2021). Data of X2, IPS and PH20 from WB(2021) WDI and WGI.

Political Statibility, together with level of Schooling and Production per head, has a positive impact on the indicator X2=Quality of Governement (measured by Voice of Citizens). All the coefficients are significant.

Index of Peace

Eqution 5 shows a significant and positive relationships between the Indicator of Peace (x4) and Political Stability. Please notice that X4, defined in Guisan(2021) is not an Index of Conflict but an Index of Peace, with zero in case of

Equation 5.1. Peace (X4) related with Political Stability in year 2019

Dependent Variable: X4. Method of Least Squares. Included observations: 161				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.232361	0.108611	20.55373	0.0000
IPS10	0.579116	0.021848	26.50693	0.0000
IPS19-IPS10	0.534172	0.039991	13.35745	0.0000
R-squared	0.820432	Mean dependent var		4.927422
Adjusted R-squared	0.818158	S.D. dependent var		1.142132
S.E. of regression	0.487038	Akaike info criterion		1.417508
Sum squared resid	37.47852	Schwarz criterion		1.474925
Log likelihood	-111.1094	Hannan-Quinn criter.		1.440822
F-statistic	360.9435	Durbin-Watson stat		2.176440
Prob(F-statistic)	0.000000			

Source: Calculared my author with data of table A1 of the Annex of this report, for IPS, and the Indicator of Peace, X4, included in the Annex of Guisan(2021).

Both the coefficient of the lagged value of Political Stability (IPS10) and the increase of the indicator of Political Stability (IPS19-IPS10) show a positive and significant effect on the increase of Peace.

3.3. Effect of Political Stability on Military Expenditure per capita

Equation 6 estimates a relationship between Military Expenditure per inhabitant in year 2019 (MEH19) with its lagged value in year 2010 (MEH10), the increase of Political Stability measured by (IPS19-IPS10) and the increase of real Production per inhabitant (PH19-PH10),, with data from WB(2022) statistics, in Dollars per capita at 2017 prices and Pruchsing Power Parities.

Equation 6. MEH19 function of its lagged value and increases of IPS and PH

Dependent Variable: MEH19. Method Least Squares. Observations 137				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
MEH10X	1.016146	0.018465	55.03021	0.0000
IPS19-IPS10	-7.405044	12.15653	-0.609141	0.5435
PH19-PH10	0.007647	0.002290	3.340012	0.0011
R-squared	0.947448	Mean dependent var		414.2234
Adjusted R-squared	0.946663	S.D. dependent var		577.6843
S.E. of regression	133.4147	Akaike info criterion		12.64646
Sum squared resid	2385131.	Schwarz criterion		12.71040
Log likelihood	-863.2823	Hannan-Quinn criter.		12.67244
Durbin-Watson stat	1.803491			

Source: Estimated by M.C. Guisan with data elaborated from WB(2022)

The increase of Production per capita (PH) shows a positive impact on MEH19 while the increase of Political Stability seems to have a negative effect, although there is a high degree of uncertainty because the coefficient of the increase of IPS is not significantly and the confidence interval for the parameter of is very wide. Even if we include only MEH10 and the increase of IPS, as regressors, without other explanatory variable, the coefficient of the increase of IPS is not statistically significant, with a very wide confidence interval for the parameter.

Military Expenditure may stabilize or diminish when the Index of Political Stability is high and there is not need to increase preventive measures of defense.

At World level, the percentage of Military Expenditure on GDP, decreased for the period 1990-2020, accordingly to the WB(2021) statistics, from 3.31% to 2.35%, and the non weighted average of real Military Expenditure per inhabitant (MEH) evolved from 301 in 1990 to 382 Dollars at 2017 constant and international prices. There where 25 countries with more than 100 Dollars of increase, 5 with with more han 100 Dollars of diminution and 134 countries without great increases or decreases.

Data in table A1 show the evolution of Military Expenditure per capita (MEH) for the period 2010-2019, calculated applying the percentages of military expenditure on GDP from WB(2022) to the data of Production per capita in years 2010 and 2019.

Policies addressed to increase life security should have into account not only defensive expenditure on military equipment but also educational policies, voice of citizens and communication addressed to increase political stability and to find peaceful solutions to domestic and foreign conflicts. In this regard, we suggest some interesting readings in section 4.

3.4. IPS related with its lagged value, X2, Education and dummy variables

Equation 7 relates IPS19 with its lagged value in year 2010 (IPS10), X2 and X4.

Political stability is positively related with its lagged value and with X2=Indicator of Quality of Government given by "Voice of citizens", and X4=Indicator of Peace. We have included also some dummy variables to have into account particular circumstances of some countries. Besides we have tried to measure the effect of Military Expenditure per capita (MEH on Political stability, but we did not find a general significance of MEH on the increase of IPS, although there are some positive effects in some periods or countries.

Equation 7.1, IPS19 relared with IPS10, X2 and Tyr19, without dummy variables

Dependent Variable: IPS19. Method: Least Squares. Included observations: 163				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
IPS10	0.621352	0.047120	13.18646	0.0000
XTYR19-TYR10	0.327712	0.119682	2.738185	0.0069
X2	0.302860	0.045595	6.642329	0.0000
R-squared	0.763894	Mean dependent var		4.654356
Adjusted R-squared	0.760943	S.D. dependent var		1.789982
S.E. of regression	0.875184	Akaike info criterion		2.589469
Sum squared resid	122.5516	Schwarz criterion		2.646409
Log likelihood	-208.0417	Hannan-Quinn criter.		2.612586
Durbin-Watson stat	1.982691			

Equation 7.2, IPS19 relared with IPS10, X2 and Tyr19, with dummy variables

Dependent Variable: IPS19. Method: Least Squares. Included observations: 163				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
IPS10	0.694430	0.040722	17.05294	0.0000
XTYR-TYR10	0.580983	0.201224	2.887247	0.0044
X2	0.251516	0.039156	6.423504	0.0000
DN1	-3.702449	0.535129	-6.918803	0.0000
DN2	-2.487135	0.524914	-4.738178	0.0000
R-squared	0.836120	Mean dependent var		4.654356
Adjusted R-squared	0.831971	S.D. dependent var		1.789982
S.E. of regression	0.733738	Akaike info criterion		2.248866
Sum squared resid	85.06273	Schwarz criterion		2.343766
Log likelihood	-178.2825	Hannan-Quinn criter.		2.287394
Durbin-Watson stat	1.875651			

DN1 and DN2 are dummy variables that take account of some negative factors, due to special circumstances, that diminish the value of IPS. DN1= 1 in 87) Libya and 94) Mali. DN2=1 in 31) Hong-Kong (China) and 157) Ukraine. Both variables are equal to zero in other countries.

The econometrics models estimated by Guisan(2021) also show a positive impact of the Indicator of Education and the Indicator of Economic Development on the Index Voice of Citizens (X2). Education besides has a positive impact on economic development and quality of life. Thus Education and Voice of Citizens are very important to prevent conflics and foster peace.

Voice of Citizens and Political Stability have some type of bilateral relationship: Current Political Stability often contributes to increase current Voice of Citizens and Voice of Citizens may contribute to increase future Political Stability.

4. War and Peace: how to diminish conflictiveness and increase life security.

Life security is very important to foster development and quality of life. Life expectancy depends not only on health conditions and health care, but also on natural disasters, accidents (road, workplace or other ones), violence related with individual delinquency, violence related with organized groups, wars or other conflicts.

Countries with low levels of quality of government, development and educational level of population, have usually low levels of life expectancy not only related with health conditions but also related with lack of prevention of unintended or intented violent deaths.

In the study by Guisan and Exposito(2016) there is a comparison between the Adjusted Specific Death Rates (ASDR) of Sub-Saharan countries and World averages and found that the rates in year 2015 where higher in Sub-Saharan countries, both related with health care and those related with injures (both unintentional and intentional). The ASDRL was 118.0 per 100 thousand inhabitants in Subsahara and 66.4 in the World.

The World Health Organization (2021) indicates that "I*njuries, both unintentional and violent-related, take the lives of 4.4 million people around the world each year and constitute nearly 8% of all deaths",* and reports that injuries and violence are responsible for an estimate 10% all years lived with disability.

Petterson and Oberg(2020) analyze the evolution of organized violence for the period 1989-2019, with data of the Uppsala Conflict Data Program (UCDP). Table 1 presents of that study present data of the 10 more conflict-affected countries in terms of fatalities for 1989-2019, with a total of morte than 1.8 million out of total estimated for the World of 2,5 million of fatalities. More than 70% of World fatalities due to conflicts affected to 10 countries: Rwanda (515793), Syria(361193), Afghanistan (258746), Ethiopia (178779), Iraq (122560), Congo DR (116422), Sudan (93980), Sri Lanka (65716), Nigeria (59434) and India (58690).

Yamchuk (2014) analyzes the European Union and United Nations cooperation for maintaining international peace and security.

In spite of the efforts of some individuals and committees for peace in international organizations, the question is that many aggresions and violent conflicts have not got successful politices of prevention in order to avoid the increase of conflictiveness and a dramatic result of violence.

Hamburg(1997) publishes an interesting Carnegie´s Report and suggests several strategies to address the root causes of deadly conflict in order to develop *structural prevention* or *peace building* and declares *"Too often in the past, these activities have been givn less attention than they deserve" "This chapter discusses both the international and national dimensions of structural prevention. It argues that, while there are no vaccines to immunize societies against violence, a number of measures promote conditions that can inhibit its outbreak. By and large, these measures must be generated*

… through a vibrant social contract between societies and governments,,,The central argument of this chapter is that such startes are less likely to succumb to widespread internal violence and less likelly, as well, go fight other states.

Leitenberg (2006) includes many information about the deaths in wars conflicts in the 20th century. Table 2 includes a list of Deaths in Wars and Conflicts for 1945-2020, with a total of around 41 million. Besides the wars caused a lot of suffering to many millions of people: disability, violence, delinquency, poverty, lost of house, city or country, etc.

5. Conclusions

Here we confirm the positive effect of Educarion on Peace, through the impact of Education on Political Stability (IPS) and the positive effect of IPS on the increase of the Index of Peace (X4).

We found that 57 countries have low values of IPS (lower than 4) and 43 have relatively high values (between 6 and 8), while there is a group of 64 countries in an intermediate positition, within the interval 4 to 6. It should be interesting the availability of an Index showing the evolution of stability in the world, through time, and not inly the position of a country relative to the average.

In some cases, there has been important diminutions of IPS, as in the case of Ukraine for the period 2000-2019, from 5.02 to 2.16, related with conflicts for the period 2014-2021 in an East area (border with Russian Federation).

Education and Voice of Citizens are important variables with positive impact on Political Stability. Our conclusions confirm the approach by Hamburg(1997) who notice the great importance of a compromise between citizens and governments to develop efficient policies to foster peace and avoid violence. An important way to work for peace is to work for Education and Voice of Citizens, to improve quality of governments and to provide support from society to international initiatives for peace.

Before estimating the econometric models, we have remembered important questions related with the effects of missing explanatory variables, accordingly with Guisan(1997) and (2015), which are important for the interpretation of results.

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Annex 1. Data.

Table A1. Index of Political Stability (IPS), Production per capita(PH) and Military Expenditure per capita (MEH) in years 2010 and 2019 (Dollars at 2017 international prices)

Nb	Country	IPS 10	IPS 19	IPS 20	PH 10	PH 19	PH 20	MEH 10	MEH 19
01	Afghanistan	-0.16	-0.32	-0.46	1957	2065	1979	38	23
02	Albania	4.62	5.22	5.16	10749	13671	13295	168	177
03	Algeria	2.48	2.92	3.28	10971	11511	10682	386	693
04	Angola	4.54	4.28	3.96	7692	6670	6198	321	110
05	Argentina	4.84	4.82	5.08	23521	22064	19687	192	156
06	Armenia	5.14	4.18	3.86	9286	13654	12593	396	651
07	Australia	6.78	6.82	6.70	44992	49456	48698	835	930
08	Austria	7.30	6.84	6.70	51769	55833	52120	425	406
09	Azerbaijan	4.52	3.62	3.54	14313	14439	13700	399	559
10	Bahrain	4.02	3.74	3.82	44600	45060	40933	1462	1827
11	Bangladesh	2.14	3.14	3.16	2883	4754	4818	38	64
12	Belarus	4.82	5.66	3.54	17288	19283	19148	232	236
13	Belgium	6.62	5.94	6.18	47965	51736	48204	520	462
14	Benin	5.52	4.18	4.12	2705	3287	3323	NA	16

15	Bermuda	6.82	7.14	7.02	88400	81804	81804	NA	NA
16	Bolivia	4.16	3.54	4.06	6613	8724	7932	110	128
17	Bosnia+H	3.62	4.16	3.98	10938	14897	14340	140	122
18	Botswana	6.98	7.22	7.18	14126	17777	16040	385	500
19	Brazil	5.02	3.58	4.16	14868	14759	14059	229	208
20	Bulgaria	5.72	6.16	5.94	17441	23192	22384	288	730
21	Burkina Faso	4.76	2.40	1.90	1716	2178	2161	24	57
22	Burundi	1.74	1.76	2.18	846	752	731	NA	19
23	Cape Verde	6.68	6.74	6.76	6200	7172	6045	31	35
24	Cambodia	4.00	4.82	4.52	2717	4389	4192	41	98
25	Cameroon	3.52	1.88	1.94	3086	3642	3576	42	40
26	Canada	6.88	7.04	7.22	44871	49017	45910	536	627
27	Central Af. R	0.96	0.72	0.64	1201	945	929	31	18
28	Chad	1.96	2.32	2.48	1733	1580	1520	100	35
29	Chile	6.36	5.02	5.14	21263	24969	23325	476	459
30	China	3.68	4.48	4.42	8885	16092	16411	155	278
31	HK-China	6.88	4.56	5.18	51361	59586	56154	NA	NA
32	Colombia	1.92	3.10	3.66	11783	14585	13441	429	458
33	Comoros	3.88	4.70	4.42	2878	3059	3141	NA	NA
34	Congo. DR	0.60	1.82	1.58	866	1098	1072	7	8
35	Congo. R	4.36	3.20	3.20	5212	3872	3476	93	106
36	Costa Rica	6.38	5.90	6.52	16265	20106	19018	0	0
37	Côte d'Ivoire	1.84	2.94	3.04	3661	5213	5174	57	64
38	Croatia	6.22	6.38	6.22	24281	28754	26465	412	474
39	Cyprus	5.90	6.12	5.58	38379	40227	37655	713	647
40	Czech R	6.98	6.88	6.84	33483	40981	38509	400	476
41	Denmark	7.08	7.00	6.88	50825	57162	55820	711	744
42	Djibouti	5.50	4.30	4.36	3794	5535	5481	NA	NA
43	Dominican R	4.92	5.02	5.34	12782	18413	17003	85	127
44	Ecuador	3.82	4.54	4.28	10341	11371	10329	311	254
45	Egypt. A.R.	3.20	2.78	2.58	10340	11763	11951	202	139
46	El Salvador	5.12	4.78	4.96	7329	8796	8057	80	103
47	Eq. Guinea	5.48	4.68	4.62	34732	18503	17008	NA	243
48	Estonia	6.32	6.26	6.42	26042	36437	35251	439	737
49	Eswatini	4.84	4.46	4.76	7459	8622	8393	171	163
50	Ethiopia	1.72	2.38	1.52	1259	2221	2297	14	13
51	Finland	7.84	6.70	6.88	45800	48563	47091	683	654
52	France	6.36	5.60	5.62	42148	46018	42313	830	849
53	Gabon	5.60	4.86	4.84	14415	14950	14400	270	236
54	Gambia. The	5.14	5.44	5.50	2347	2223	2159	NA	18
55	Georgia	3.56	4.02	4.14	9737	14989	14089	361	262
56	Germany	6.60	6.14	6.34	46894	53809	51259	594	683
57	Ghana	5.06	5.26	5.26	3739	5411	5319	14	24
58	Greece	4.74	5.36	5.26	33754	29723	27287	928	792
59	Guatemala	3.30	3.86	4.14	7332	8648	8388	32	40
60	Guinea	1.62	3.32	3.72	1871	2567	2671	NA	37
61	Guinea-Bissau	3.62	3.88	3.80	1747	1939	1847	35	32
62	Guyana	4.08	4.50	4.70	9789	13082	18680	135	210
63	Haiti	3.12	3.22	2.92	2735	2905	2773	NA	0
64	Honduras	4.00	3.84	3.92	4867	5736	5138	52	93
65	Hungary	6.38	6.54	6.72	24428	32554	31008	250	408
66	Iceland	7.04	8.28	7.78	46997	56383	51873	NA	NA
67	India	2.44	3.46	3.28	4237	6717	6121	122	169

68	Indonesia	3.30	4.02	4.00	8287	11812	11445	51	95
69	Iran. I. R	1.74	1.58	1.66	13806	12389	12433	385	260
70	Iraq	0.52	-0.20	-0.06	8955	10815	9474	243	366
71	Ireland	7.04	6.94	6.96	53002	86710	90687	304	242
72	Israel	2.32	3.42	3.34	34858	40074	38405	2069	2081
73	Italy	5.94	5.80	5.88	42664	42663	38992	640	562
74	Jamaica	4.14	5.80	5.54	9434	9775	8740	82	165
75	Japan	6.76	7.06	7.08	37576	41477	39201	360	389
76	Jordan	4.38	4.48	4.36	11316	10071	9817	667	468
77	Kazakhstan	6.04	4.66	4.48	20751	26352	25337	211	280
78	Kenya	2.66	2.80	3.00	3330	4330	4220	52	51
79	Korea. Rep.	5.66	6.10	6.12	34394	42719	42251	847	1142
80	Kuwait	5.90	5.38	5.48	58810	49854	49853	2209	2734
81	Kyrgyz R	2.92	4.52	4.14	4141	5258	4707	67	82
82	Lao PDR	4.44	6.04	6.36	4850	7887	7806	10	NA
83	Latvia	6.06	5.88	5.92	21024	30859	29932	229	626
84	Lebanon	1.74	1.66	1.70	19499	14552	11649	805	685
85	Lesotho	5.92	4.16	4.34	2448	2695	2378	70	44
86	Liberia	4.06	4.34	4.26	1420	1428	1354	11	20
87	Libya	5.06	-0.14	0.04	22540	15174	10282	NA	NA
88	Lithuania	6.44	6.56	6.74	23943	37063	36732	210	744
89	Luxembourg	7.92	7.70	7.46	107704	113940	110261	603	727
90	Madagascar	3.04	4.36	4.08	1553	1619	1510	10	10
91	Malawi	5.08	4.44	4.52	969	1086	1066	7	12
92	Malaysia	5.28	5.28	5.24	20536	28364	26435	306	293
93	Maldives	4.66	5.06	5.82	16306	19531	13049	NA	NA
94	Mali	4.64	0.60	0.70	2083	2322	2217	29	63
95	Malta	7.50	7.04	6.90	32683	43703	39002	213	243
96	Mauritania	2.84	3.86	3.50	4767	5197	4983	NA	103
97	Mauritius	6.28	6.62	6.78	16798	22870	19470	25	36
98	Mexico	3.54	3.32	3.30	17790	19701	17888	81	103
99	Moldova	4.24	4.22	4.16	8550	13022	12325	22	46
100	Mongolia	6.20	6.26	6.58	7480	12317	11471	57	87
101	Montenegro	6.16	5.14	5.00	16764	21534	18279	304	302
102	Morocco	4.24	4.32	4.34	6281	7537	6916	213	234
103	Mozambique	5.78	3.50	2.68	1027	1282	1229	9	18
104	Myanmar	2.42	2.34	1.98	3130	5083	4544	NA	106
105	N.Macedonia	3.96	5.00	5.20	13412	16600	15848	185	193
106	Namibia	6.70	6.06	6.30	8924	9728	8788	314	301
107	Nepal	1.84	4.10	4.60	2350	3436	3303	37	47
108	Netherlands	6.88	6.70	6.70	52033	56784	54326	690	751
109	New Zealand	7.48	7.82	7.98	37657	42878	42404	501	611
110	Nicaragua	4.00	3.00	3.70	4612	5452	5280	23	33
111	Niger	2.68	2.18	1.52	1037	1225	1197	12	32
112	Nigeria	0.58	1.16	1.28	4932	5135	4917	27	24
113	Norway	7.66	7.34	7.50	61354	64453	63584	930	1194
114	Oman	6.18	6.18	5.74	33871	27299	27299	2180	2358
115	Pakistan	-0.36	0.46	1.30	3907	4690	4623	134	193
116	Panama	4.76	5.60	5.46	21349	31440	25389	0	0
117	Papua NGuinea	3.38	3.60	3.52	3407	4350	4101	11	16
118	Paraguay	3.34	4.98	5.04	10419	12619	12339	78	122
119	Peru	3.00	4.70	4.42	10066	12854	11261	147	153
120	Philippines	1.70	3.16	3.42	5918	8915	7954	69	82

121	Poland	7.04	6.12	6.14	23996	33121	32238	440	654
122	Portugal	6.44	7.14	7.06	31798	34880	32178	630	640
123	Puerto Rico	5.72	5.28	5.86	32961	34805	33443	NA	NA
124	Qatar	7.30	6.40	6.34	95908	90044	85266	1414	NA
125	Romania	5.54	6.12	6.18	20303	29858	28833	255	550
126	Russian Fed	3.14	3.88	3.54	23961	27211	26456	859	1043
127	Rwanda	4.46	5.12	5.06	1507	2228	2099	19	28
128	Samoa	6.54	7.32	7.32	6006	6517	6296	NA	NA
129	São Tomé&P.	5.24	6.02	5.96	3357	4005	4052	NA	NA
130	Saudi Arabia	4.54	3.78	3.68	44037	46962	44328	3772	3669
131	Senegal	4.16	5.10	4.96	2797	3361	3300	34	51
132	Serbia	4.16	4.86	4.82	14511	18292	18210	303	405
133	Seychelles	6.72	6.36	6.44	20893	27521	24362	154	368
134	Sierra Leone	4.52	4.90	4.52	1414	1720	1648	14	13
135	Singapore	7.34	8.00	7.94	77958	97989	92996	2636	2808
136	Slovak R	7.10	6.34	6.28	25431	31888	30346	320	547
137	Slovenia	6.74	6.62	6.42	33349	38945	37089	535	412
138	South Africa	4.94	4.46	4.52	12452	12482	11466	139	122
139	Spain	4.36	5.62	5.80	37319	40804	36220	518	503
140	Sri Lanka	3.12	4.56	4.90	9127	13070	12537	246	263
141	Sudan	-0.34	1.60	1.48	3090	4186	4023	NA	69
142	Sweden	7.18	7.08	7.04	47791	52851	51003	567	581
143	Switzerland	7.52	7.64	7.38	63528	68474	66359	433	479
144	Tajikistan	2.94	3.96	3.96	2270	3402	3474	22	35
145	Tanzania	5.02	4.26	4.18	2007	2660	2635	18	27
146	Thailand	2.12	4.04	3.76	14397	18451	17285	209	250
147	Timor-Leste	4.06	5.46	5.36	2930	3553	3181	19	44
148	Togo	4.64	3.16	3.16	1225	1599	1589	20	50
149	Tonga	6.38	7.06	7.04	5167	6378	6378	NA	NA
150	Trinidad&T.	4.90	5.20	5.36	28995	25931	23823	184	184
151	Tunisia	4.88	3.26	3.74	10113	10756	9727	131	276
152	Turkey	3.16	2.26	2.62	20028	28199	28385	455	764
153	Turkmenistan	5.66	4.62	4.42	8617	15538	15538	NA	NA
154	UAE	6.60	6.38	6.26	54922	67119	67119	3317	NA
155	Uganda	3.00	3.62	3.44	1861	2187	2178	42	39
156	United Kingdom	5.82	6.08	5.94	42089	46406	41627	1085	934
157	Ukraine	5.02	2.16	2.68	11778	12809	12377	224	451
158	Uruguay	6.64	7.08	7.10	17881	21346	20026	335	440
159	United States	5.88	5.26	4.96	54250	62555	60163	2671	2144
160	Uzbekistan	3.56	4.44	4.12	4652	7014	6994	NA	NA
161	Vietnam	5.30	5.06	4.86	5089	8041	8200	117	NA
162	WBank&Gaza	1.06	1.20	0.90	5411	6245	5394	NA	NA
163	Zambia	6.04	4.78	4.74	3126	3470	3270	43	42
164	Zimbabwe	2.80	3.08	2.84	2273	2800	2538	19	20

Notes: 1) IPS is an Indicator of Political Stability calculated by the author (from the WB PS in scale -(2.5 to 2.5) to decimal escale with IPS=5+2*PS. 2) PH=Production per inhabitant and MEH=Military Expenditure per capita are measured at constant prices (Dollars at 2017 international prices), calculated from the percentage on GDP provided by WB(2022). NA=Not available.

Annex 2, Methodoloy; Effects of relevant missing variables.

Following Guisan(2015) we analyze effects on estimation and causality tests

Effects of missing variables on the significance of coefficients:

"Suppose that Y(t) is explained by three explanatory variables (X1, X2, X3).

$$Y(t) = \beta_1 X1(t) + \beta_2 X2(t) + \beta_3 X3(t) + \varepsilon1(t) \quad (1)$$

Now suppose that X3 is highly correlated, by direct or indirect causality realtions, with X1 and X2, by means equation (2)

$$X3(t) = \alpha_1 X1(t) + \alpha_2 X2(t) + \varepsilon2(t) \quad (2)$$

Then the substitution of (2) into (1) gives equation (3):

$$Y(t) = (\beta_1 + \beta_3 \alpha_1) X1(t) + (\beta_2 + \beta_3 \alpha_2) X2(t) + (\varepsilon1(t) + \beta_3 \varepsilon2(t)) \quad (3)$$

$$Y(t) = \beta_1^* X1(t) + \beta_2^* X2(t) + \varepsilon3(t) \quad (4)$$

Where $\beta_1^* = \beta_1 + \beta_3 \alpha_1$; $\beta_2^* = \beta_2 + \beta_3 \alpha_2$; $\varepsilon3(t) = \varepsilon1(t) + \beta_3 \varepsilon2(t)$

The variance of the random shock will increase when X3 is missing from the equation, depending on the values of the variance of $\varepsilon2(t)$ *and* β_3^2*.The lowest the value of the varianza of* $\varepsilon2(t)$ *it is expected a better lower variance of* $\varepsilon3(t)$ *and higher goodness of fit of equation (4).*

The significance of β_2^* *does not always imply the significance of* β_2*. If the coefficients of the other included variables have signs and values as expected and the goodness of fit is high, then it is frequent that the significance of* β_2^* *also implies the significance of* β_2*. The no significance of* β_2^* *nos always imply that* $\beta_2=0$*.*

Effects on non significance of X(t-1) in Granger´s Causality tests

In the case of a mixed dynamic model where Y(t) dependens on its lagged value Y(t-1) and the increase of one or more exogenous variables (for example X(t)), then the actual model is:

$$Y(t) = \beta_1 Y(t-1) - \beta_2 X(t-1) + \beta_2 X(t) + \varepsilon1(t) \quad (5)$$

when we perform Granger´s test, which does not include the contemporaneous value of the exogenous variable, there is a problem of missing variable (X3(t)=X(t)), and the included predetermined variables are X1t=Y(t-1) anad X2t=X(t-1). If the missing variable is related with its lagged value, as $X3(t) = \alpha_2 X2(t) + \varepsilon2(t)$*, then we can express:*

$$Y(t) = \beta_1 Y(t-1) + \beta_2 (\alpha_2-1) X(t-1) + (\varepsilon1(t) + \beta_2 \varepsilon2(t)) \quad (6)$$

Then, if α_2 *is close to 1, then* $\beta_2^* = \beta_2 (\alpha_2-1)$ *may be close to zero, and the acceptance of the nullity of this parametros does not imply the nullity of* β_2*. The conclusion is that in a model that includes Y(t-1) the inclusion of X(t-1) may not be relevant but the inclusion of D(X1t) may be highly relevant."*

My suggestion is to use the modified version of Granger´s test suggested by Guisan(2001), with differente lags for the dependent variable and for the explanatory variable , for example: Y(t) = f (Y(t-2), X(t-1))