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THE REGRESSION CALCULUS OF ECONOMIC CONVERGENCE AND THE CONTRIBUTION OF THE INSTITUTIONAL FACTOR*)

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This working paper aims to stress the role of the institutional capital and its components, as primary factors, in economic results at the national level, using adequate measurement indicators and econometric models. For this purpose, we analysed the following aspects: the definition of institutional capital and its components with regard to its operationalisation; the numerical expression of the institutional capital and its components by indicators, as well as the description of their content; the confirmation of the significant influence of the institutional capital on economic results.

For applying several variants of econometric models including two or more variables to two samples (EU countries and world countries), special attention is paid to matters concerning the checking of the assumption about factor independence, multicolinearity and the attenuation of the consequences of this characteristic. Among the components of the institutional capital, the highest influence on the economic results indicated by the selected samples is exerted by the macroeconomic environment, and, within this environment, by the country rating and the macroeconomic stability.

Key words: *institutional capital, public institutions, macroeconomic environment, indicators, econometric models, regression analysis, testing multicolinearity, production function.*

JEL: C5; C8; 043; O47.

1. Introduction

For dealing with growth and economic convergence, research focused mainly on the size of the accumulation rate of physical capital and human capital and on the generation and the effects of technological progress. The research made in the last half century produced and developed refined models that used an advanced analytical apparatus and included many empirical analyses based on the regression calculus. Some of these results were underlined also in our studies conducted within the excellence programme, when we tried to make our own assessment of economic convergence of world countries, of EU countries and Romania's convergence with EU countries, based on a large amount of international statistics[1].

*) A study within the CEEX Programme – Project: "Economic Convergence and the Role of Knowledge in the Context of EU Integration", No. 220/2006. The Romanian version has been published in *Studii Economice*, Institutul Național de Cercetări Economice, 2009, http://www.studii-economice.ro/2009/seince090904.pdf.

[1] Aurel Iancu, (ed.), 2007, *Economic Convergence*, Romanian Academy Publishing House and CHBeck Publishing House, Bucharest; Aurel Iancu, *Tipurile de convergenţă; convergenţa*

The experience of the former socialist countries during the transition shows that keeping analyses and applications only between the limits of the existence, the action and the effects of some traditional factors like the above-mentioned ones in not enough and that the institutional system should not be ignored at all. We should recognize that it represents the general framework of the economic activities and, for this reason, it is considered the primary factor that either unleashes initiative and stimulates production or hinders the development and capitalisation of the economic factors producing corresponding effects on the entire economic system. Facing the absence of institutions or a weak or improper institutional system, a modern economy cannot function or is confronted with a deep crises. But also the experience of other countries shows that the differences in income among countries and regions and, finally, the gap widening could be explained by differences both in the institutional construction and quality among those countries and regions and in the enforcement of the rules imposed by institutions. The institutional factor influences directly the determinant factors, like the accumulation rate of physical capital, the development rate of human capital (by learning, training, etc.), the rate of technological progress, etc. and indirectly the economic growth. In turn, the economic system and its evolution influence the institutional system by education, learning and innovation and make it more effective. That is why the institutional factor became one of the decisive factors of development, which, on the one hand, should be considered for economic growth and, on the other hand, policies should be implemented for improving its quality and increasing its contribution to economic growth. Nsouli (2003) points out that the development of institutions is a key element of economic growth. Rodrik (1997) shows that institutions play a crucial role in the economic performance of East Asia, and Hall & Jones (1999) and Rodrik (1997) demonstrate that differences in institutional quality explains why certain countries produce better results than other countries. Considering the contribution of the three primary factors represented by institutions, economic integration and geographic natural environment to the increase in incomes of the countries, Rodrik *et al.* (2002) point out that the quality of institutions has the highest contribution and that, in their relations with the economic system, institutions and integration should be considered endogenous factors: on one hand, they influence economic development and, on the other hand, it is the economic system that determines the development and quality improvement. The type of relation between the three factors and the economic system is illustrated by the arrows shown in Annex 1.

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instituţională (Types of Convergence. Institutional Convergence), NIER, Working Papers Series, No. 1/2007; Aurel Iancu, "The Question of Economic Convergence", *Romanian Journal of Economic Forecasting*, No. 3/2007; Aurel Iancu, "Economic Convergence. Application", *Romanian Journal of Economic Forecasting*, No. 4/2007; Aurel Iancu, "Real Convergence and Integration", *Romanian Journal of Economic Forecasting*, No. 1/2008; Eugen Ştefan Pecican, 2008, *Indicatori privind convergenţa reală şi aplicaţii ale acestora (Indicators of Real Convergence and Applications)*, NIER, Working Papers Series, No. 10, Bucharest.

Similarly to technological progress, the institutional factor cannot easily be measured directly, in order to be introduced as certain aggregated variable into a growth or convergence model. But this factor differs from the technological one in the relatively small extent of the theoretical and empirical quantitative research done so far. Given the role of the institutional system in economic growth and convergence, we analyse in this paper the following aspects: defining the institutional capital and its components with regard to its operationalisation (Section 2); expressing the institutional capital and its components by means of indicators used by world institutions and describing their content (Section 3); clarifying the problem concerning the significant influence of the institutional capital on economic results (Section 4); assessing the contribution of institutional capital components on economic results (Section 5); conclusions (Section 6).

2. The Definition of Institutional Capital and its Components with Regard to its Operationalisation

Institutions represent a network of formal rules (constitutions, laws, regulations) or informal rules (agreements, codes of conduct, rules of behaviour, customs, beliefs, etc.) destined to ensure order in economic and social life and to build a mechanism for enforcing and monitoring these rules in order to improve economic and social performance. The definition refers not only to the existence of rules, but also to their effective enforcement and steady monitoring by public authority. The quality, utility and enforcement of the rules in all fields of economic and social life depend on the capability of the administrators of these fields – their level of education, knowledge, experience, fairness and trust[2]. Referring to market economies and their effective functioning, Nsouli (2003) points out that governments should be able to establish and enforce critical rules of the game, i.e. to make necessary corrections and to exert control on the private sector, to monitor the contract fulfilment, to protect the property rights and to stimulate incomes for funding activities of the public sector.

Institutions include all categories of existing rules and regulations enforced in all fields of human activity (economic, social, scientific, cultural) and at all levels (national, regional, global). For instance, economic institutions include formal and informal rules of market and non-market relations, regulations concerning the property rights, competition, bankruptcy, capital movement and the functioning of capital, monetary, labour markets, etc.[3] Governance is part of the

[2] The term "administrator" is considered in its broadest sense. It includes parliament, the government, coordinating institutions or/and their heads, company managers, etc.

[3] Referring to institutional change and economic performance, Paul Hare lays the stress on the proper operation of emerging market economies. They should include institutions or institutional arrangements in order to ensure certain key economic functions such as: private property rights and contracts, safe access in reasonable terms to credits, properly regulated bandruptcy policy, labour market institutions, clear fiscal environment for companies, etc., confidence in economic agents, in

institutional typology. Defined as institution by which public authority is exerted, governance refers to the following: 1) processes by which governments are selected, monitored or changed; 2) government's capacity to formulate and effectively implement sound policies; 3) economic and social interactions among citizens and between citizens and state authorities (Kaufmann *et al.*, 1999).

Viewing things on three levels – national, regional and world levels – we find out that the overwhelming part of the institutions consists of rules established and enforced at the national community level. An increasing number of national rules is represented by rules established by the EU and compulsorily enforced by member states in accordance with the principle of subsidiarity. Only a small number of rules established at the world level is enforced by every country. Among them we find those regarding human rights, health, environment, trade and financial relations, intellectual property rights, transports, telecommunications.

The need to introduce rigour by measurement and to model the relations between the institutional system and the economic growth led to the creation of adequate (aggregated) synthetical terms. For example, Hall and Jones (1999) introduced the term "social infrastructure" as a determinant factor of productivity. Fukuyama and others after him used the term "social capital" especially for expressing social relations (or informal institutions). Only recently, the term "institutional capital" was introduced.

Viewing things from a dynamic, temporal perspective, generally institutions represent accumulations of rules and experience or good practice acquired in time. They are defined as stocks, which, on the one hand, increase by new investments in institutions, and, on the other hand, are eliminated by abolishing them or those components that become harmful or turn into actual obstacles to economic development. Thus, institutions are assimilated to a special category of capital called institutional capital (K_{inst}). The stock of institutional capital includes all experience and innovations in the field, including a higher level of knowledge and personnel qualification, its entire contribution to improving or raising the quality and performance of those institutions. In other words, institutional capital represents an accumulation of formal rules conceived and enforced by policy in all fields of the economic and social life, as well as an accumulation of informal rules emerging and evolving in the course of time.

The stock of institutional capital increases along with the expansion, strengthening and improvement of institutions[4]. It decreases along with ageing or

public institutions, corruption elimination, law enforcement (Paul Hare, "Institutional Change and Economic Performance in the Transition Economies", Session II of the UNECE Spring Seminar, May 7th, 2001, Geneva).

[4] Usually, sociological studies on informal institutions adopted the term "social capital". Francis Fukuyama points out the importance of social capital for an efficient functioning of modern economies, since it is the cultural component of the modern society (Fukuiama F. (1999), "Social Capital and Civil Society" - Internet). Also, Sirianni and Friedland (1995) define social capital as a stock of confidence, rules and schemes, which people can use for resolving common (Sirianni & Friedland L., 1995, "Social Capital", - Internet). Being and expression of cultural propensities of groups of individuals or an expression of customs, mentalities and attitudes inherited or acquired by

wearing-out of its components, which begin to hinder economic development (Olson, 1982), irrespective of whether these elements continue to exist or they are eliminated.

Considering the term "institutional capital" in a broad sense, Ahsan (2003) includes all categories of institutions mentioned above, i.e. formal, informal and governance institutions[5].

The meaning of the notion of institutional capital considered by economists is of major importance. It is fully relevant from an operational perspective when we define and build adequate indicators and when we aggregate partial indicators as combined indicators.

3. Indicators of the Institutional Capital

In spite of the difficulty to express numerically the institutional capital and its components, progress has been made in this area in the last decade. Many scientific entities and international institutions have been involved in this activity[6].

The indicator of the institutional capital in an aggregated form is an approximative notion, which poses problems in making measurements, but generally it tends to raise the level of certainty in reflecting reality.

3.1. Methods for Institutional Capital Computation

So far, two methods for institutional capital computation have been considered: a) econometric deduction by means of synthetic performance indicators; b) expert opinion surveys and the establishment and computation of indicator indicators reaching different degrees of aggregation of certain parts or components of the institutional capital.

a) *Econometric computation of the institutional capital* is based on two assumptions: first, according to which the institutional capital (in a broad sense) is the fundamental determinant of the economic performance of a country on long term, since it forms the economic environment that provides support to productive

education, informal (non-regulated) rules have a highly subjective character, since they are directly linked to actions or reactions of individuals or social groups. That is why, they were called social capital or social infrastructure (Arrow, 1970; Coleman 1988).

[5] Ahsan S.M., "Institutional Capital and Poverty: A Transition Perspective", in A. Ashorrocks and R. van der Hoeven, Eds., *Perspective on Poverty and Growth,* United Nations University Press, Tokyo, 2003.

[6] The institutions involved in working out and computing sets of indicators concerning the institutional capital and in publishing year-books on such matters are the following: World Economic Forum, Heritage Foundation, Freedom House, Wall Street Journal, Business Environment Risk Intelligence, Standard and Poor's, European Bank for Reconstruction and Development, Economist Intelligence Unit, Gallup International, Political Economic Risk Consultancy, Political Risk Services, Institute Management Development, World Bank.

activities and stimulates the individuals and the companies to acquire capital, knowledge and experience, to invent, to innovate, to transfer technologies, etc., as the institutional capital produces results, either positive, if it forms a sound competitive environment of high quality, or negative or weak, if it forms a distorted environment, improper for economic activities[7].

The second assumption implies that the institutional capital itself is the result of the performance of the economic system. In this case, the institutional capital is considered an endogenous factor.

According to these assumptions, we establish the econometric relations (1) and (2), which show the linkages between productivity (Q/L=Y) and the institutional factor (K_{inst}), in its two states: determined and determinant.

$$logY = a + bK_{inst} + \varepsilon \tag{1}$$

$$K_{inst} = \alpha + \delta logY + \theta X + \eta \tag{2}$$

where: Q – production,
L – employed personnel,
Y – Q/L (production per capita),
K_{inst} – institutional capital,
X – set (vector) of additional variables that determines (influences) the institutional capital.

Without approaching the technical aspects of the matter, one may see that the indicator of the institutional capital can be explained through the level of productivity, by means of a set of other indicators concerning the state or the quality of the influence factors.

b) *The computation of the institutional capital by operationalizing the definition through specific statistical research and building composite indicators*. There are many organisations (companies, foundations, banks) in the world, which currently work out, compute and publish or deliver on request sets of indicators that express on a quantitative basis various aspects concerning the state or the quality of institutions for a large number of countries. These states, expressed by adequate indicators (of different aggregation degrees), regard the business environment, economic and political risks, economic, political and social reforms, economic, political and social freedom and constraints, competitiveness, the rule of law and the corruption level, etc.

[7] Robert E. Hall, Charles I. Jones, "Why Do Some Countries Produce So Much More Output Per Worker Than Others?", *The Quarterly Journal of Economics*, vol. 114, No. 1, Febr. 1999; Mancur Olson, *The Rise and Decline of Nations*, New Haven, CT, Yale University Press, 1982.

By means of these indicators, we can express – for a large number of countries – the development level of institutions, including their qualitative level, as a whole or by components.

3.2. Research on the Construction and Computation of Institutional Capital Indicators and Components

Since in our econometric analysis of the relation between institutions and economic results we use several indicators of the institutional capital, we present and briefly comment below on the content and the method of computation of some important indicators conceived and computed per countries by two prestigious international organisations (World Economic Forum[8] and Heritage Foundation[9]).

A. Indicators computed by the World Economic Forum

World Economic Forum (WEF) publishes every year *The Global Competitiveness Report*. This report evaluates the potential of world economies to ensure sustainable economic development on medium term and long term, taking into account the determinant role of the institutional factor. In accordance with this objective, the WEF determines every year the global indicator of growth for each country by combining available data with the opinion of executive managers from the countries where they work. Based on the economists' understanding of the determinants of the complex economic growth process, during different periods – which understanding is far from bing perfect – the indicator undergoes certain adjustments in time, especially with regard to the explanatory part and its components[10].

We deal here with components of the global competitiveness indicators for 2002–2003 and 2007–2008, which we will use in our analyses presented below.

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[8] World Economic Forum – an independent, non-profit organisation that gather members of the business world, governments, academic community and media, preoccupied with economic, social and political issues and trying to find solutions in partnership. Established in 1971 in Geneva, it has sponsored since 1996 *The Global Competitiveness Report*, a yearly publication, in cooperation with the Harvard Institute for International Development. This report is based on the survey conducted by the Forum on about 3000 enterprises from 60 countries. The survey measures the managers' perception of the country where they work, and the aswers to questions represent their opinions ordered on a 1-to-7 scale. The survey covers important issues that change from one year to another.

[9] The Heritage Foundation is an organisation whose purpose is the formulation and promotion of public policies. It was estabilished in 1973 in Washington, D.C. In partnership with *The Wall Street Journal* it launched, in 1995, the indicator "economic freedom", which covers a large number of countries and measures the economic freedom and surveys the growth of the global economy. The indicator is destined for comparative (cross-section) surveys and is used as a means of information and orientation of investors for allotting resources in accordance with the existing conditions in various countries.

[10] The 2002–2003 Report points out that those involved in drawing up the report learn from experience and available data.

The 2002–2003 competitive indicator of growth and its components

The construction of this indicator and its components follows the trend of the economic thought that reconsiders the role of the determinant factors in the process of economic growth. Here, institutions are considered a determinant factor of this process, on which also the evolution, the behaviour and the role of traditional factors in economic growth and convergence depend.

The competitive growth indicator for 2002–2003 takes into account the existence and action of three important factors (pillars) of growth: macroeconomic environment, quality of public institutions and technology. These three factors are numerically presented by indicators bearing the same name, based on evaluations and assessments made by experts.

In turn, the three indicators consist of the following sub-indicators (Table 1).

Table 1

Indicators	Sub-indicators
Economic environment	• Macroeconomic stability • Governmental prodigality • Country rating for credit grating
Public institutions	• Contracts and laws • Corruption
Technology	• Innovation • Information Technology and Communications • Technology transfer

The analysis of the denominations and the content of the sub-indicators presented in Table 1 clearly shows that the first two indicators, the content of which is described in Annex 2 are part of the family of institutional mechanisms. According to the methodology conceived by Sachs and McArthur and used for drawing up annual reports, institutional mechanisms carry weight in the global competitiveness indicators, which vary in relation to countries' technological potential or, more exactly, the condition of the innovation process. If a country belongs to the group of core innovators, the proportion of technologies is ½ and the proportion of institutional mechanisms is ½, of which ¼ for the macroeconomic environment and ¼ for public institutions. Unless the country belongs to the group of non-core innovators, the proportion of technologies is 1/3, and each of the institutional mechanism receives 1/3[11].

[11] Countries are considered core innovators if they have over 15 invention patents per one million people registered in the USA. The countries ranking below this level pertain to the group of non-core innovators.

To make data comparable, they are transformed by a standard formula (normalized) and take on values ranging between 1 and 7. All countries having the weakest institutions and no technological creation and absorbing only low technologies take on values of indicators and sub-indicators close to 1, while countries having strong and functional institutions and very low technological potential take on values of indicators and sub-indicators close to 7.

The global indicator of competitiveness and its components (2007–2008)

The methodology for computing the global indicators is that drawn up and applied since 2004 (Sala-i-Martin *et al.,* 2008). The authors of the methodology, used from 2004 to 2008, took into account the evolution of the thought on institutions, policies and factors that determine competitiveness, defined as the productivity level of a country. The reason for drawing up and using the new methodology was the fact that investments in physical capital, infrastructure and human capital presented in growth models cannot provide any longer explanations regarding the level and dynamics of the countries' productivity. Also, nor even the three mechanisms (pillars) analysed above (the macroeconomic environment, the quality of public institutions and the technological factor) are not analytical enough to provide all causal explanations regarding the level and dynamics of competitiveness of the countries. That is why we detailed the factors (pillars) so that they should properly reflect real processes. They are twelve in number and refer to the following:

- institutions;
- infrastructure;
- macroeconomics;
- health and primary education;
- higher education and training;
- effectiveness of the goods market;
- effectiveness of the labour market;
- refining the financial market;
- capacity to adopt technologies;
- market size;
- refining businesses;
- innovation.

For each factor (pillar), we compute the level indicator using assessment values on the same scale: 1 to 7. The weighted summing of these values helps us to determine the global competitiveness indicator, which measures the nations' productive potential.

B. Indicators computed by The Heritage Foundation

Economic freedom is another important global indicator for measuring the institutional capital per national economy, computed since 1995. The Heritage Foundation is an institution that ensures the computation of this indicator and the

publication in the Report called Index of Economic Freedom. From the first report to present, the concept on which the indicator is based and the methodology for determining it have not undergone major changes – although gradually improved – so that data series remain comparable in time[12].

The indicator (including its components) is computed for a large number of countries (165 in 2003 and 156 in 2008).

Considering the general belief that an individual becomes economically free when he fully controls his work and property and that the government (public power) protects freedom and eliminates anarchy, the authors of this indicator found an operational definition of the concept "economic freedom" for expressing it by means of adequate indicators. The definition includes the forms of freedom protected by freedom rights, the right of movement of labour, goods, services and capital, the absence of constraints on economic freedom, as well as the punishment for violations of economic rights and freedoms. Governmental corrections and constraints are necessary, but they should be limited to prevent market distortions and violations of principles regarding the effective allocation of national resources and to protect the property rights.

The multiple forms taken by economic rights and freedoms can be quantified by indicators. Quantification is based on specific components of these rights and freedoms, using the scoring system on a scale of 0 to 100 and aggregating them as indicator indicators of different degrees of generalisation.

Economic freedom is expressed by a synthetical indicator as a form of maximum generalisation and by ten of its components, which indicate specific freedoms, defined, in turn, by elements that can be aggregated through specific formulas or simple average.

In essence, as shown below, the freedom indicators describe the qualitative levels of institutions from each country, expressed in comparable measures. We present below (Table 2), in a synthetical form, the ten indicators forming the indicator indicator called economic freedom.

Table 2

The components of the indicator indicator called economic freedom and their content

Name	Content
1. Business freedom	The possibility to easily and quickly start a business and the existence of rules and regulations that hinder businesses and pose obstacles to business freedom.
2. Trade freedom	No tariff and non-tariff barriers that affect the import and export of goods and services
3. Fiscal freedom	Defined by the size of fiscal rates (taxes) on income paid by natural and legal persons and/or the amount of the income tax as against GDP

[12] William W. Beach and Tim Kane Ph.D., *Methodology Measuring the 10 Economic Freedom*, 2008 Index of Economic Freedom, p. 39 and 55.

4. Size of governance	Defined by the amount of public expenditure, including public consumption and transfers. The best case is the inclusion of public goods incurring minimum expenses, only.
5. Monetary freedom	Defined by combined measures for price setting and control. Since inflation and price control distort the labour relations, their absence indicate the state of freedom of the market.
6. Investment freedom	Characterized by the freedom of movement of capital, especially of foreign capital.
7. Financial freedom	It expresses the safety level of the banking system and its independence in relation to government control. The type of property over banks and financial institutions is important for defining and measuring the level of financial freedom. Private property ensures a higher efficiency than state property and implements an objective policy free of favouritism and less exposed to the corruption risk.
8. Property rights	The numerical assessment of this indicator takes into account the fact that the existence and ability of private property to accumulate as well as the rule of law are the main forces that motivate and ensure the normal functioning of a market economy. Also, the numerical assessment of property rights takes into account the fact that different degrees of protection of property rights result in different degrees of citizens's confidence to do business, to save and to make medium-and long-term plans.
9. Freedom from corruption	It is a quantitative expression of the perception of corruption in the business environment, as well as at government level, in justice, police and public administration.
10. Labour freedom	Defined by the flexibility degree of the labour market and employees' and employers' capacity to conclude agreements without constraints or actions of the state to favour one party at the expense of the other party and of efficiency.

Source: The Heritage Freedom, *2008 Index of Economic Freedom*, William W. Beach and Tim Kane, Ph. D., *Methodology: Measuring the 10 Economic Freedoms*, Chapter 4.

Analysing the content of the indicators of the 10 freedoms, we may say it is actually a numerical assessment, on a scale of 0 to 100, of the state and functioning of economic institutions in every country under survey. The numerical assessment is made by the degree of freedom versus constraints of businesses and economic mechanisms within the markets of goods, services and factors (capital and labour).

Although the indicator of economic freedom was not especially designed to explain economic growth [Beach, Kane, 2008], many studies show that there is a connection between the degree of freedom of the economies and their economic performance. Encouraged by these studies, we shall use data on indicators of the 10 freedoms to check the existence of possible linkages with the necessary testing required by general rules of the simple and multiple regression calculus.

4. The Question Regarding the Confirmation of the Significant Influence of the Institutional Capital on Economic Results

If one compares to the one-factor model (1) the simultaneous action of several factors, including institutional factors, changes the problem data to some extent. So, what seems to be an influence power of factor K_{inst} on variable-effect Y in the one-factor model is very often a consequence of the quality of variable K_{inst} of being the sole representative of all important factors that produce the effect (Y). Therefore, in the multifactor model, the overestimated influence of the single factor is expected to be also distributed to the other factors introduced into the model, in relation to the power of influence of each one. We also expect that the degree of determination, expressed by coefficient R^2, increases.

Initially, we try to argue to what extent each new factor (in our case, it could be a component of the single factor) is justified as regards the significance of its contribution to explaining the changes in the effect variable. In this respect, we use the econometric method called Granger causality as well as the comparative analysis of variants considered with regard to the variables and also to the functions (forms of dependence) used.

The method suggested by C.W. Granger for the argumentation of the inclusion of a variable into a model as a factor is mainly recommended when variability is monitored in time, which implies the utilisation of data ordered as chronological series (Griffiths *et al.,* 1993). The inclusion of a factor (in our case, the institutional capital) for explaining the evolution of a variable that also depends on its own evolution in the past (an aspect frequently met in the economy) is justified if for the model variables:

$$Y_t = a + b\, Y_{t-1} + u_t \tag{3}$$

that is,

$$Y_t = a + b\, Y_{t-1} + c\, K_{inst,t} + d\, K_{inst,t-1} \tag{4}$$

the following inequality is valid:

$$\sigma_{Y_{t-1},\, K_{inst,\,t-1}} < \sigma_{Y_{t-1}} \tag{5}$$

where: σ represents the square average deviation of variable Y.

As regards the Granger causality and the exogeneity, we consider a model including two interdependent equations (model VAR)

$$Y_t = a_1 K_{inst,t-1} + a_2 Y_{t-1} + u_t \tag{6}$$

$$K_{inst} = b_1 K_{inst,t-1} b_2 Y_{t-1} + u_t \tag{7}$$

The significance or the non-significance (according to t test) of the coefficients on the diagonal (denoted by a_1 and b_2) offers arguments for determining "what influences what" as well as the existence or non-existence of bilateral causality.

When data are obtained as cross-section series, the possibilities to approach the analysis on the basis of the Granger causality are limited or rather conditioned by knowing the level (both of the effect and of the factor) reached earlier (*t-1*).

Available data allow us to partially take the action implied by such an approach for estimating and testing the equations:

$$log\ Y_{GDP,t} = a\ log\ k_{1,t-1} + b\ log\ Y_{GDP,t-1} \quad (8)$$

and

$$log\ Y_{GDP,t} = a\ log\ k_{2,t-1} + b\ log\ Y_{GDP,\ t-1}\ . \quad (9)$$

The results obtained are based on data concerning the Gross Domestic Product per capita (Y_{GDP}) expressed by PPP in US dollars (Annex 3) and two institutional components: public institutions (k_1) and macroeconomic environment (k_2) (Annexes 4 and 5). We estimated the two equations for 23 EU countries as well as for a sample of 97 world countries, on which data were available.

The result based on data on GDP from Annexes 4 and 5 and the factors mentioned are presented below:

For relation (8)

Variable	**European countries**			**World countries**		
	Intercept	**log $k_{1,t-1}$**	**log $Y_{GDP,t-1}$**	**Intercept**	**log $k_{1,t-1}$**	**log $Y_{GDP,t-1}$**
Coefficient	0.436	0.052	0.895	0.095	0.065	0.988
t-statistic	6.67	0.52	30.66	1.65	1.61	110.63

For relation (9)

Variable	**European countries**			**World countries**		
	Intercept	**log $k_{2,t-1}$**	**log $Y_{GDP,t-1}$**	**Intercept**	**log $k_{2,t-1}$**	**log $Y_{GDP,t-1}$**
Coefficient	0.446	0.113	0.881	0.115	0.107	0.980
t-statistic	11.70	2.33	58.74	2.03	2.38	101.24

It follows that component k_2 (macroeconomic environment) always occurs as a significant factor (in relation 9, the computed level of t test is higher than tabled level t of both groups of countries, which indicates significance in a statistical sense). On the contrary, the other component, k_1 (public institutions included in relation (8)) plays a less significant role since the resulted level of t is lower than the tabled one. The difference is also amplified, especially in the case based on relation (5), by the colinearity found between the two components. This is one important reason for maintaining both components in the regression analysis.

Another important reason is the interest in knowing the role of either component in differentiating the national income per capita between countries.

We point out that econometrics avoids the justification of the introduction or non-introduction of a factor into the regression model by using as argument the level resulted for the correlation coefficient. This coefficient – even if it differs significantly from zero (in the sense implied in t test) – does not necessarily signal a causality relation and so much the less the direction of influence (what influences what). The causality relation is demonstrated by economic theory, and the coefficient – when it is close to 1 as absolute value – shows to what extent deviations from average, found for each case for a given sample of values, resemble by level and direction. Therefore, from the perspective of statistical covariance, the linkage between variables is confirmed or not confirmed by the sample data available to us, and, in a synthetic mode, by the correlation coefficient. Such a linkage could be produced by a causality relation between those variables, a resemblance in evolution produced by a common cause (the question for the third factor) or a resemblance accidentally repeated from case to case, especially when the sample is very small.

The method used (Granger causality) is intended to overcome these limitations by accepting the idea that the introduction of an actually important factor results in a higher accuracy of estimation of the effect variable (diminution of dispersion, according to relation (5)), i.e. the assumption that the modification of the cause is prior to the modification of the effect (the principle of precedence) as well as the testing of the significance of the estimation of the parameter attached to the presumptive factor (relations 6 and 7).

5. Assessments Regarding the Contribution of the Institutional Capital Components on Economic Results

The analysis of the contribution of each factor on an economic result that differs from country to country – while factors occur simultaneously in different proportions in every country – is also important because the multifactorial approach is realistic and the interaction of factors and the conditions in which the processes take place are also considered, even indirectly.

5.1. Analysis Based on the Bifactorial Regression Model

The regression model in a linear form

$$y = a_o + a_1 x_1 + a_2 x_2 + u \tag{10}$$

includes variables as well as parameters (regression coefficients) whose level – resulted from estimation and transformation into standardized values (β coefficients) – is important for analysis since it provides information on the role of each factor included.

Parameters are estimated by the least square method (but also other more or less effective methods) and represent solutions that lead to a global minimum (for the linear case) of the sum of the squares of the differences between real levels and adjusted levels (generated by the model). The parameters resulted from the application of the mentioned method – for providing undistorted information – imply the fulfilment of certain conditions regarding the data used in calculus, the accepted model, and the constraints and limits of the estimation method. Since such conditions are considered for assessing the results, we mention here the most important ones: sample size and representativeness, factor independence or, at least, the low level of correlation, correct determination of the model regarding the form (linear or non-linear) and the explanatory variables (the presence of all important factors in the model), the aleatory behaviour of the residual variable. The solutions found under these conditions (parameters a_j) show (each of them) the contribution of the modifications of factor j on effect variable y, if the other factors included in the model are considered constant by level. In terms of economic theory, such a result may be considered a marginal value since it shows the modification of the effect (economic result) produced by a one-unit increase in the factor. Information is important for an economic analyst, the more so as it can be completed with assessments of the level of importance of each factor in comparison with the other ones (the factor ranking is possible if we take into account standard coefficients), as well as with the percentage expression of the extent to which the included factors determine the effect variable by their concerted action.

The multifactor regression model offers – by providing information of this kind – several advantages if compared to the one-factor variant: an accurate description of the economic process analysed, since it takes place under the simultaneous action of several significant factors, information regarding the structure of the process by the quantification of causal linkages, increasing level of determination numerically expressed by the approximation to 1 (or to 100%) of coefficient R^2. But there is a serious potential disadvantage represented by the colinearity of explanatory variables, often inadequate and still dangerous because of an intense correlation of the factors included in the model. This might be the explanation of the econometricians' recommendation to reduce the number of factors in the regression equation and to keep only more important factors, the evolution of which is characterized by variability, without obvious associations (resemblance with regard to modifications) with any other factor (factors) included in the regression model supposed to undergo estimation [Charemza, Deadman, 1992, Leamer, Leonard, 1988].

Both advantages and disadvantages presented above are shown in the results obtained for most of the models proposed as analysis variants. For the application of a model containing two independent variables represented by the two elements

of the institutional capital – public institutions (k_1) and macroeconomic environment (k_2) – using data on 23 EU countries and 97 world countries (Annexes 4 and 5), we used the following variants:

a) Logarithmic variant, considered the most plausible one, if we consider the relations between indicators (with non-linear dependences, which can be made linear by logarithms) and the production behaviour in relation to determinant factors (with the effect represented by GNI);

$$logY_{GNI,t} = a_0 + a_1 logk_{1,t} + a_2 logk_{2,t} + u_t \tag{11}$$

leading to the following solutions:

Coefficient	European countries			World countries		
	Intercept	log k_1	log k_2	Intercept	log k_1	log k_2
Variable	2.569	-0.219	2.953	3.799	0.822	2.924
σ_{aj}	0.17	0.67	0.69	0.45	0.55	0.57
t-statistic	35.4	-0.34	4.25	8.43	1.49	5.09
F-statistic	58.9			70.04		
R^2 adjusted	0.84			0.59		
σ_y	0.08			1.15		
DW	1.78			1.89		

b) Linear variant (with an effect represented by GNI):

$$Y_{GNI,t} = a_0 + a_1 k_{1,t} + a_2 k_{2,t} + u_t \tag{12}$$

with the following solutions:

Coefficient	European countries			World countries		
	Intercept	k_1	k_2	Intercept	k_1	k_2
Variable	-32144	-317.6	12676.8	-28154	2577.6	7448.6
σ_{aj}	5898	2646	3550.9	2692	1136	1387
t	-5.45	-0.12	3.57	-10.46	2.27	5.36
R^2 adjusted	0.80			0.70		
F-statistic	45			116		
σ_y	3933			10907		
DW	1.91			2.08		

c) Semilogarithmic variant (with the effect represented by GNI):

$$logY_{GNI,t} = a_0 + a_1 k_{1,t} + a_2 k_{2,t} + u_t \tag{13}$$

with the following solutions:

Variable	European countries			World countries		
	Intercept	**k_1**	**k_2**	**Intercept**	**k_1**	**k_2**
Coefficient	2.956	0.025	0.275	4.922	0.140	0.862
σ_{ai}	0.089	0.042	0.090	0.326	0.138	0.168
t	33.2	0.58	3.05	15.10	1.02	5.13
R^2 adjusted	0.80			0.61		
F-statistic	46			76		
σ_v	0.08			1.15		
DW	1.77			1.84		

Although the semilogarithmic variant seems equally advisable, our option (according to the above-mentioned reason) takes into account the logarithmic variant illustrated by relation (11).

d) Linear variant (with the effect represented by GDP):

$$Y_{GDP,t} = a_0 + a_1 k_{1,t} + a_2 k_{2,t} + u_t \tag{14}$$

with the following solutions:

Variable	European countries			World countries		
	Intercept	**k_1**	**k_2**	**Intercept**	**k_1**	**k_2**
Coefficient	-29330	-502	11928	-27426	2546	7288
σ_{ai}	6894	3197	4192	2718	1147	1400
t	-4.25	-0.16	2.84	-10.09	2.22	5.20
R^2 adjusted	0.71			0.69		
F-statistic	27.98			109		
σ_v	8597			10793		
DW	1.66			2.07		

e) Semilogarithmic variant (with the effect represented by GDP):

$$\log Y_{GDP,t} = a_0 + a_1 k_{1,t} + a_2 k_{2,t} + u_t \tag{15}$$

with the following solutions:

Variable	European countries			World countries		
	Intercept	**k_1**	**k_2**	**Intercept**	**k_1**	**k_2**
Coefficient	6.95	-0.06	0.72	5.02	0.16	0.82
σ_{ai}	0.32	0.15	0.20	0.32	0.14	0.17
t	21.42	-0.38	3.65	15.52	1.15	4.92
R^2 adjusted	0.79			0.60		
F-statistic	41.78			74		
σ_v	0.47			1.13		
DW	1.65			1.81		

f) Logarithmic model variant with the effect represented by GDP

$$logY_{GDP,t} = a_0 + a_1 logk_{1,t} + a_2 logk_{2,t} + u_t \quad (16)$$

with the following solutions:

Variable	European countries			World countries		
	Intercept	**log k_1**	**log k_2**	**Intercept**	**log k_1**	**log k_2**
Coefficient	2.131	-0.7366	4.038	3.913	0.903	2.757
t	10.97	-1.00	4.97	8.73	1.64	4.83
R^2 adjusted	0.84			0.58		
F-statistic	62.8			67.4		
σ_v	0.094			1.131		
DW	1.88			1.85		

Irrespective of the variant used, we find the same inconsistencies (as regards the expectations and data evolution) in the analysis of the 23 European countries: the minus sign as well as the non-significance of factor k_1, and this in conditions of validation of the model, with a computed level of F test higher than the tabled one and a determination level R^2 satisfactory for this sample of European countries (≈0.80). These signals, correlated, indicate the presence of multicolinearity. Nor should we omit the weak influence that factor k_1 (public institutions) could actually exert on the national income. Before accepting this conclusion, it is necessary to check whether variables are intensely correlated. If this is confirmed, we should attenuate such a connection as much as possible, so that the role of this prime factor should not be excluded from analysis.

As regards the analysis of the sample consisting of world countries, the negative sign of the parameters of institutional factor k_1 disappears from all equations and parameters become even significant in the linear equations (12) and (14) (t=2.27, and 2.22, respectively), for a significance threshold α=0.05; only the degree of determination is a little lower. These results make us conclude that the influence of the two institutional variables (k1 and k2) on GDP and GNI is rather a linear one.

A remark should be made with regard to coefficient DW: residual deviations (errors) are not self-correlated; this is shown by the level of the coefficient, which is close to measure 2 and specific to the absence of error self-correlation.

2.5.2. The Question of the Colinearity of Institutional Components. Methods for Attenuating this Characteristic in the Case of the European Countries

In the two-factor case, a quite convincing signal indicating the presence of colinearity (even not perfect), that is the resemblance of the ratio between the two factors (k_1 and k_2), irrespective of the country, is given by the correlation coefficient. It results that in all EU countries, factorial variable k_1 (public institutions) is strongly correlated with the other factorial variable, k_2

(macroeconomic environment). The simple correlation coefficients (Pearson coefficients) take on the following values:

$R_{k_1;k_2} = 0.95$ for the linear variant and the semilogarithmic variant;

$R_{k_1;k_2} = 0.93$ for the logarithmic variant.

Since the correlation coefficients exceed the level of 0.85 (as absolute value), we consider that solutions (estimated values of parameters) are affected, so that their interpretation, both in an economic sense and with regard to statistical significance, is more or less compromised. Also, the presence of colinearity is confirmed by obtaining a satisfactory determination coefficient (84%), an extremely high computed level F (over 50), while one of the two factors appears to be non-significant in accordance with t test. These are undesired implications for an analyst, since, on one hand, the solutions obtained for parameters are distorted (in our case, the estimation of parameter a_1 has a minus sign, somewhat contrary to what data and economic practice signal) and, on the other hand, the level of average square deviation of that parameter is oversized (it signals a lack of accuracy). Such an oversized level, located in the denominator of the ratio required for obtaining the "*t*-statistical" value, could produce a significantly reduced result, often below the *t*-tabled level, which signals non-significance in a statistical sense. This kind of situation is also present in our case (in relations 11, 12, 14, 15 and 16), since the parameter attached to component k_1 is negative and much below the tabled level of 2.069, for $\alpha = 0.05$, in all four variants of the model.

To attenuate the above consequences on parameters, so that a sufficiently correct assessment of the role of each institutional component should be possible, it is required to eliminate or, at least, to attenuate the intensity of colinearity between variables considered factorial. Out of the methods proposed by econometrics, we omit the solution suggesting to ignore one variable (solution based on the assumption that such a variable is properly represented by the variable maintained in the model, being strongly correlated with that model), since, with a view to the purpose of our analysis, what matters is the role of each institutional component in economic results (GNI, GDP). The recommendation to use data collected on a cross-section basis [Paelink, 1979] is fulfilled, and the cases refer to EU countries under observation in a certain year. As regards the recommendation to use transformed values, we notice that the logarithms of original values (scores) did not bring about a significant decrease in the correlation of factors (from 0.95, for the variant based on original data, to 0.93, for the variant based on values transformed by mean of logarithms).

As regards the other ways used to attenuate colinearity, we keep in mind the method called ridge regression, as well as the procedure implying an increase in number of sample cases.

Ridge regression is based on adding up a scalar to all elements placed on the diagonal of the reverse matrix implied by the following relation used for parameter estimation:

$$A = (X^{'}X)^{-1}X^{'}Y \tag{17}$$

so that, after this operation, relation (17) becomes:

$$A^{*} = (X^{'}X + sI)X^{'}Y \tag{18}$$

After the application of (18), final results for s=0.1 are expressed by parameters of model (19).

$$logY_{GNI,t} = a_0 + a_1 logk_{1,t} + a_2 logk_{2,t} + u_t \tag{19}$$

Solutions obtained by estimation:

Variable	**Intercept**	**log k_1**	**log k_2**
Coefficient	2.659	0.5791	1.9362
σ_{aj}	0.194	0.4	0.542
t-statistic	1.36	1.18	3.57
R^2 adjusted	0.769		
F-statistic	37.69		

In relation (19) there is a diminishing dispersion (expressed by σ_{aj}) of the estimation of each parameter in comparison with the initial variant (11). Thus, the standard error diminished for a_1 from 0.67 to 0.4 and for a_2 from 0.694 to 0.542. We should also note the sign of parameter a_1, which became positive in accordance with expectations, although its statistical significance remains in a very risky area. To this "failure" we should also add the fact that the economic interpretation of both parameters attached to factorial components turns difficult following the introduction of the scalar in relation (18). Given the research objectives, the latter disadvantage determines us to use another way of reducing multicolinearity and it consists, in the early stage, in adding new cases (sample re-sizing). Following the increase in the sample, the level of the determinant computed for obtaining the values of the reverse matrix of (17) increases, which causes a diminution of the elements of the reverse matrix and, implicitly, of the standard error (σ_{aj}) of the parameters (since the elements of the reverse matrix diagonal are directly proportional to the dispersion of the estimates expressed by the standard error of the parameter estimates).

Therefore, we proceeded to sample increase by including five countries (Turkey, Croatia, FYR Macedonia, Norway and Ukraine) which – although not EU members – have enough economic characteristics that justify their inclusion into the sample: they belong to the European zone, send signals concerning their inclusion into the EU, provide data on the institutional capital. The data concerning these countries are presented in Annex 4. The regression analysis applied to a re-sized sample produced, in the case of the logarithmic variant of the model

$$logY_{GNI,t} = a_0 + a_1 logk_{1,t} + a_2 logk_{2,t} + u_t, \quad (20)$$

the following results:

Variable	intercept	log k_1	log k_2
Coefficient	2.453	0.487	2.352
σ_{aj}	0.11	0.413	0.464
t	21.09	1.17	5.06
R^2 adjusted	0.901		
F-statistic	124.2		
σ_v	0.078		
DW	1.83		

We notice that the sample size has a good influence on the results of the model, since it contributes to the diminution in the spreading degree of each estimate (from 0.67 to 0.413 for a_1, and from 0.694 to 0.464 for a_2). The fact that estimate a_1 stays in the non-significance area is the reason why we use a method proposed in an earlier paper [Pecican, 2005].

This method is destined to ensure a majority weight of cases showing variability in the ratio between the values of the factorial components. For this purpose, we intend, in the early stage, to find the cases generating colinearity, that is, cases in which we repeatedly find the same linear relation between the levels of the factors. For example, if in case *i* we find out that the level of the first factors is twice as much as the level of the second factor, and this proportion occurs in most cases, when keeping all this cases "generates multicolinearity" (more exactly, the presence of all cases of this kind in the sample increases the similarity of the factor values and, consequently, the size of the factor correlation coefficient). These cases are considered to be irrelevant to analysis, since they provide redundant information as regards the combination of factor levels, when we consider the occurrence in cases included in the sample. Their replacement, in the next stage, with cases for which factor values do not represent the same ratio and, consequently "ensure a variety of proportions regarding the level of the factors, is beneficial to accuracy (i.e. diminishing σ_{aj}) and to the significance (according to t

test) of the estimation results. The realistic description of factor behaviour is not distorted by this "manoeuvre", since, in terms of average assessment, nothing changes. Moreover, variability – both from case to case (or from period to period) and from factor to factor – is a feature that determines the success of factorial-type statistical analyses, when we refer either to the dispersion analysis or to the elasticity coefficient or indices, but, especially, to the multifactor regression.

Concretely, we found in the EU countries a repetability of the maximum frequency, equal to six cases (out of a total of 23), of the ratio of sector k_1 (public institutions) to sector k_2 (macroeconomic environment). The ratio is situated around the level of 1.1628. As mentioned above, five countries were eliminated (Austria, Finland, France, Ireland, Lithuania) and, instead, we introduced other five European countries, mentioned above, with a different ratio between factors. We point out that the coefficient of correlation between factorial components in the case when the sample underwent such changes decreased from $R_{K_1;K_2} = 0.95$ to 0.71.

After estimating and testing the parameters of the model:

$$logY_{GNI,t} = a_0 + a_1 logk_{1,t} + a_2 logk_{2,t} + u_t \tag{21}$$

we obtained the following results:

Variable	Intercept	log k_1	log k_2
Coefficient	2.436	0.543	2.32
σ_{ai}	0.1195	0.3975	0.4512
t-statistic	20.3	1.3677	5.1419
St. parameter	-	0.205	0.771
R^2 adjusted	0.9166		
F-statistic	116.16		
σ_y	0.0749		
DW	2.3		

The results of the last method used confirms the diminution in the dispersion of σ_{aj} of each estimate: from 0.67 to 0.3975 for a_1 and from 0.69 to 0.4512 for a_2. One should note that dispersion indicators σ_{aj} are smaller than in the previous case, when the sample was re-sized. It is worth mentioning that a satisfactory value of t-statistical was obtained for parameter a_1, so that we may say that its estimated level of 0.543 differs significantly from zero, if we accept an error risk of 18%. The risk is relatively high, which situation does not occur when the effect variable is GDP, according to relation (22) below, for which a 5% threshold is accepted. As for parameter a_2, its significance can be confirmed at a risk below 5%. Signals given by other indicators (R^2, F test, DW) confirm the validity of the model – satisfactory degree of determination, confirmed global significance of estimates, non-self-correlation of residual deviations.

In the variant using variable GDP as an effect variable, the model becomes:

$$logY_{GDP,t} = a_0 + a_1 logk_{1,t} + a_2 logk_{2,t} + u_t \quad (22)$$

with the following results:

Variable	Intercept	log k_1	log k_2
Coefficient	1.825	1.452	2.0549
σ_{ai}	0.204	0.679	0.771
t-statistical	8.93	2.137	2.6629
R^2 adjusted	0.853		
F-statistical	62.34		
σ_y	0.128		
DW	1.84		

Results are also confirmed in the case of the institutional factor influence on GDP, the more so as the estimate of the "fragile" parameter, a_1, is located in the area of significance.

At the end of this section, we interpret the results of the last two variables of the two-factor model (21 and 22).

The proportion in which institutional components (as the only responsible) determine economic results is extremely high: R^2 = 91.66 % for national income (GNI) and R^2 = 85.3% for GDP. The proportion expressed by each determinant coefficient should be accepted in a more special form for models (*21*) and (*22*), considering that the two factorial components, k_1 and k_2, represent primary factors that determine economic growth.

The ranking of institutional capital components in relation to the power of influence of the national income places first the macroeconomic environment, when the parameter shows a standard level of 0.771 in relation to public institutions, whose standard coefficient is much smaller (0.205). The case is similar with model (22), when we used the effect variable GDP.

Regression parameters show, as mentioned above, the amount by which the effect variable changes when that factor (to which the parameter refers) increases by one unit. When we consider the solutions obtained for models (*21*) and (*22*), we should not omit that the linearity of the logarithmic model required that the estimation should be based on logarithms of the factor values and logarithms of the effect variable values. Therefore, the resulted coefficients could be interpreted in relation to partial elasticities. National income and GDP are very sensitive to changes in the factorial component called macroeconomic environment (over-unit elasticity) and inelastic (that is less sensitive to changes in the factorial component called public institutions, with an under-unit coefficient).

5.3. The Multifactor Regression Model and the Role of the Institutional Factor Sub-Components

First, we intend to extend the regression analysis and include a third category of capital, namely, the degree of freedom (decentralisation), denoted by k_3. This factorial component remains in the area of qualitative variables because it is difficult to quantify its level for each country. A possibility to get out of this area, i.e. numerical expression, is the selection of a representative variable capable to meet the following requirements: a) to be strongly correlated or to represent the main sub-component of the qualitative variable; b) to be a numerical variable on which quantitative data are available or can be collected. Since the third category of capital can be described by sub-components such as trade, k_{31}, government intervention, k_{32}, wages and prices, k_{33}, this variable could be trade freedom. Available statistical data on a large number of countries regarding the national income (GNI) per capita (effect variable) and trade freedom (presumably causal variable) allow us to estimate, even in a graphic form, the relation of dependence between the two variables (Figure 1).

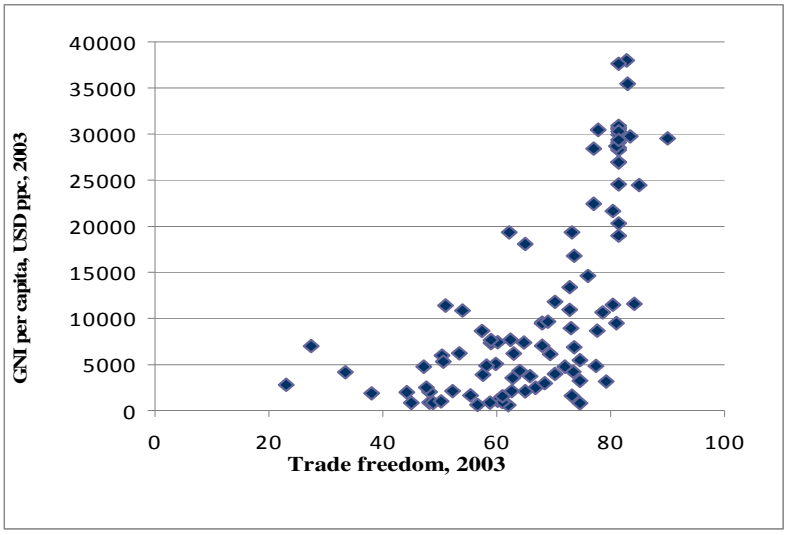


Figure 1. The correlation between trade freedom and gross national income per capita.

The diagram of the coordinate point dispersion regarding the two variables (Figure 1) confirms the presence of the presumed relation of dependence, and the

logarithmic function seems to suit best this case. The analysis will be made simultaneously for European countries (most of them are EU members) and world countries, as we did with the two-factor model, and the estimation of the parameters is made by means of model (23):

$$logY_{GNI,t} = a_0 + a_1 logk_{1,t} + a_2 logk_{2,t} + a_3 logk_{31,t} \quad (23)$$

with the following solutions:

Variable	European countries				World countries			
	Intercept	log k_1	log k_2	log k_{31}	Intercept	log k_1	log k_2	log k_{31}
Coefficient	7.20	-0.24	3.20	-0.39	-0.93	0.98	2.44	1.23
t	2.61	-0.35	3.47	-0.51	-0.88	2.14	5.10	4.41
R^2 adjusted	0.83				0.72			
F-statistic	37.01				81.60			
DW	1.81				1.47			

In this case too, multicolinearity complicates the analysis of the European countries, and this for a reason quite unusual for the application of regression, namely, the invariability of one factor, that is, the variable regarding trade freedom. This is the reason why there is a strong colinearity between the newly introduced factor (trade freedom) and the artificial factor taking on values equal to one, considered necessary for estimating the intercept (a_0). Since for most European countries included in the sample, the level (score) of the trade freedom variable is 81 (the data in Figure 1 refer to world countries) and all values of "the artificial factor" are considered equal to one, the correlation between these two factorial variables is very strong.

An enlargement of the sample with countries from other continents, whose score regarding trade freedom shows a wide range of values (between 50.4, for Algeria, and 90, for Hong Kong) is a suitable method for making estimations of minimum dispersion. The calculations for world countries led to the elimination of negative parameters of factors k_1 and k_{31}, as well as an important increase in the significance level of factor k_{31}, which allows us to conclude that trade freedom influences the level of the income per capita. Unfortunately, the estimation of parameter k_1 is insignificant.

We deal further with sub-components of the institutional capital and their role in economic results. Thus, as we mentioned in Section 3, the explanatory sub-indicators of the component of public institutions are the following:

– contracts and laws (k_{11})

– freedom from corruption (k_{12}),

and the sub-indicators regarding the component of the macroeconomic environment are:

– macroeconomic stability (k_{21});

– the reverse of government prodigality (k_{22});

– country rating for loans (k_{23}).

The graphic representations (dispersion diagrams) worked out [Iancu, 2007] confirm the influence of these sub-components on national income, and the multifactor model, presented below in a logarithmic form (24).

$$\log Y_{GNIt} = a_0 + a_1 \log k_{11t} + a_2 \log k_{12t} + a_3 \log k_{21t} + a_4 \log k_{22t} + a_5 \log k_{23t} + u_t \qquad (24)$$

is used for estimating and testing the influences on the basis of data provided by the initial sample of countries.

The results are presented in the table below:

European countries						
Variable	**Intercept**	**log k_{11}**	**log k_{12}**	**log k_{21}**	**log k_{22}**	**log k_{23}**
Coefficient	2.85	0.40	-0.17	0.72	-0.16	1.31
t-statistic	6.77	0.86	-0.4	0.64	-0.45	0.27
R^2 adjusted	0.91					
F-statistic	30.8					
DW	1.81					
World countries						
Variable	**Intercept**	**log k_{11}**	**log k_{12}**	**log k_{21}**	**log k_{22}**	**log k_{23}**
Coefficient	6.79	-1.38	-0.59	-0.89	0.37	1.94
t-statistic	9.93	-3.35	3.89	-1.44	0.96	10.7
R^2 adjusted	0.86					
F-statistic	116.55					
DW	1.76					

Multicolinearity seems to be also present in sub-components in their quality of factors. Thus, a first checking showed very strong correlations between factorial sub-component k_{11} and k_{22}, as well as between sub-components k_{11} and k_{23}. Also, the relatively high degree of determination (0.91 and 0.86), as well the global significance confirmed (F test) in conditions of non-significance of most estimated parameters prove the presence of multicolinearity.

The extension of the sample from European countries to world countries caused a substantial increase in the parameter significance, but other negative parameters were maintained or produced. In this case, results show that, among the factors considered, a significant influence on the income per capita is exerted by the reverse of corruption (k_{12}) and, especially the reverse of government prodigality k_{22}, and the country rating (k_{23}).

As regards the European countries, the method used at the end of paragraph 2. was also used in this case for diminishing multicolinearity, and the results of the estimation and the testing of the same model (24) are shown in the table below:

Variable	**Intercept**	**log k_{11}**	**log k_{12}**	**log k_{21}**	**log k_{22}**	**log k_{23}**
Coefficient	2.88	0.09	-0.13	0.65	0.14	1.10
t-statistic	8.76	0.25	-0.39	1.46	0.43	5.02
R^2 adjusted	0.93					
F-statistic	63.4					
DW	1.76					

Although estimates come up to expectations signalled by data as regards the sign (all are positive, except for the sub-component regarding the freedom from corruption), and the degree of determination increased, if compared to previous results (24), the question of statistical significance still is partially unsolved, since only parameter a_5=1.10 (and, to a smaller extent, parameter a_3=0.65) differs significantly from zero (in conditions of lower risk, 5%). Therefore, country rating (k_{23}) and, to some extend, macroeconomic stability (k_{21}) are factors having a significant influence in a statistical sense.

6. Conclusions

To reveal the effects caused by the institutional capital and some of their components – as primary factors – on economic results at national level, by means of data samples observed in EU member countries and world countries, the research effort was oriented towards defining the institutional capital and improving its quality for making this definition operational through numerical expressions and towards using variants of econometric models and their testing. The institutional capital is a qualitative factor like other often invoked factors of the same nature, such as technological progress, quality of management, labour qualification, etc. Since institutions and their organisation, on the one hand, draw the economists' attention as a production factor, and, on the other hand, since it was possible to quantify the intensity of the presence and action of this factor, we could analyse on a statistical basis the linkage between macroeconomic results and the institutional factor.

By studying this linkage, we tried first to find adequate answers to the following question: To what extent do differences in the level of the institutional capital components in different samples of countries determine the level of the macroeconomic indicators (national income and GDP)? Of course, for interpreting the data resulted from the regression calculus, we should consider the fact that, on one hand, the differences among EU countries in the level of development and the functioning of the institutions are more attenuated because of the integration based on the implementation of the acquis communautaire in accordance with EU treaties and, on the other hand, the implementation of cohesion policies in the EU lead to filling the gaps in economic and social development between member countries and Community regions.

A major problem of using econometric models including two or several factors refers to the checking of the assumption regarding the independence of factors and the solutions found by applying model variants. The failure to prove this assumption often implies a high degree of association (i.e., similar evolutions) of factors, an aspect also found in cases analysed with regard to the role of institutional components in the above-mentioned economic results. For this reason,

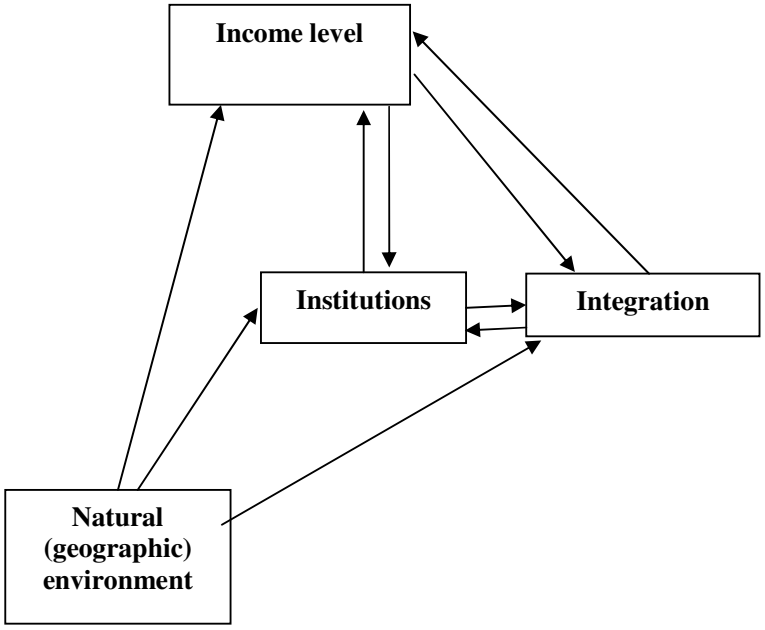
we paid special attention to issues regarding the multicolinearity and the attenuation of the consequences of this undesirable feature originated in the available data.

In our opinion, the estimation results, obtained after a significant attenuation of multicolinearity, express with a reasonable accuracy how each component of the institutional capital influences the level of economic results. Also, we obtain more useful data for an economic analysis, such as the proportion in which the factors included in the model determine the evolution of the national income and GDP as well as the degree of importance of each factor included in the model. Our analysis is focused on components and sub-components of the institutional factor and on the study of the simultaneous action of these factors. From all components of the institutional capital, the macroeconomic environment exerts notable influence on the synthetic indicators of the national economy and this aspect occurs in most of the computed model variants. The same thing happened to sub-components of the macroeconomic environment – country rating and macroeconomic stability. The data resulted from the application of model variants show that the role of public institutions and of their components is less evident or insignificant.

In conclusion, we may say that a quick economic growth leading to economic convergence cannot be achieved without paying due attention to the factor regarding the institutional capital, its development and quality improvement.

Annex 1

Types of relations between the income level and primary determinant factors



Source: Dani Rodrik, Arvind Subramanian, Francesco Trebbi, "Institutions Rule: The Primacy of Institutions Over Integration and Geography in Economic Development", IMF Working Paper 2002/189.

Annex 2

Denomination and description of the content of the indicator elements (indicators and sub-indicators) of the global indicator of competitive economic growth

Indicators	Sub-indicators	Component (indicator) elements
Macroeconomic environment	• Macroeconomic stability	Inflation size; if a country is in recession or goes into a recession; difficulties in receiving loans; budget surplus or deficit; size of saving rate; fluctuations in exchange rates and in interests on loan granting
	• Government prodigality	Subsidies granted by the government for keeping non-competitive industries artificially in operation; the amount of public expenditure for keeping a large bureaucratic system; public expenditure in election years for influencing the electorate; the degree of public trust in the financial honesty of politicians.
	• Country rating for loans	The economic, political and social state of the country and prospects for stability, the state of the business environment at present and in the future; the degree of economic and financial risk to investments and businesses.
Public institutions	• Contracts and laws	The independence of justice from political influence exerted by government members, citizens or companies; clear description and protection of property rights by the law; government neutrality in public procurement and contracts; high cost of businesses run by organized crime.
	• Corruption	Frequency and amount of bribing for import and export licences and public utilities; bribing related to taxes and duties.

Source: The Global Competitiveness Report 2002-2003.

Annex 3

Gross Domestic Product per capita (PPP, USD), 2003 and 2004

Country	GDP per capita (PPP, USD), 2003	GDP per capita (PPP, USD), 2004
Algeria	6107	6603
Angola	2344	2180
Argentina	12106	13298
Australia	29632	30331
Austria	30094	32276
Bangladesh	1770	1870
Belgium	28335	31096
Bolivia	2587	2720
Botswana	8714	9945
Brazil	7790	8195
Bulgaria	7731	8078
Cameroon	2118	2174
Canada	30677	31263
Chad	5003	5896
Chile	1210	2090
China	10274	10874
Colombia	6702	7256
Costa Rica	9606	9481
Croatia	11080	12191
Czech R.	16357	19408
Denmark	31465	31914
Dominican R.	6823	7449
Ecuador	3641	3963
Egypt	3950	4211
Estonia	13539	14555
Ethiopia	711	756
Finland	27619	29951
France	27677	29300
Gambia	1859	1991
Germany	27756	28303

Annex 3 (continued)

Ghana	2238	2240
Greece	19954	22205
Guatemala	4148	4313
Haiti	1742	1892
Honduras	2665	2876
Hong Kong	27179	30822
Hungary	14584	16814
Iceland	31243	33051
India	2892	3139
Indonesia	3361	3609
Ireland	37738	38827
Israel	20033	24382
Italy	27119	28180
Jamaica	4104	4163
Japan	27967	29251
Jordan	4320	4688
Kenya	1037	1140
Korea, Rep. Of	17971	20499
Latvia	10270	11653
Lithuania	11702	13107
Madagascar	809	857
Malawi	605	646
Malaysia	9472	10232
Mali	994	998
Malta	17633	18879
Mauritius	1766	1940
Mexico	9168	9803
Morocco	4004	4309
Mozambique	1117	1237
Namibia	6180	7418
Netherlands	29371	31789
New Zealand	22582	23413
Nicaragua	3262	3634
Nigeria	1050	1154

Annex 3 (continued)

Norway	37670	38454
Pakistan	2097	2225
Panama	6854	7278
Paraguay	4684	4813
Peru	5260	5678
Philippines	4321	4614
Poland	11379	12974
Portugal	18126	19629
Romania	7277	8480
Russia	9230	9902
Salvador, El	4781	5041
Senegal	1648	1713
Singapore	24481	28077
Slovakia	13494	14623
Slovenia	19150	20939
South Africa	10346	11192
Spain	22391	25047
Sri Lanka	3778	4390
Sweden	26750	29541
Switzerland	33080	33040
Tanzania	621	674
Thailand	7595	8090
Trinidad & Tobago	10766	12182
Tunisia	7161	7768
Turkey	6772	7753
Ukraine	5491	6394
United Kingdom	27147	30821
Uruguay	8280	9421
USA	37562	39676
Venezuela	4919	6043
Vietnam	2490	2745
Zambia	877	943
Zimbabwe	2443	2065

Source: Human Development Report 2005, 2006, UN Development Programme.

Annex 4

The gross national income per capita (PPP, USD) (Y_{GNI}), and indicators of institutional factors (k)[*], in European countries, 2003

Countries	Y_{GNI}	k_1	k_{11}	k_{12}	k_2	k_{21}	k_{22}	k_{23}	k_{31}
Austria	29610	5.83	5.47	6.2	5.07	4.57	4.46	6.67	81.4
Belgium	28930	5.41	5	5.82	4.82	4.44	3.89	6.5	81.4
Bulgaria	7610	4.1	2.71	5.5	3.18	3.7	2.28	3.04	62.4
Czech R.	15650	4.51	3.81	5.71	4.08	4.49	2.58	4.76	73.6
Denmark	31210	6.56	6.3	6.82	5.38	4.68	5.63	6.64	81.4
Finland	27100	6.52	6.35	6.68	5.54	4.9	5.75	6.62	81.4
France	27460	5.5	4.96	6.03	4.8	4.43	3.58	6.78	81.4
Germany	27460	6.1	5.8	6.39	4.78	4.31	3.71	6.79	81.4
Greece	19920	4.71	4.63	4.79	4.38	4.34	3.3	5.53	81.4
Ireland	30450	5.46	4.88	6.03	4.74	4.49	3.58	6.4	81.4
Italy	26760	4.56	4.15	4.96	4.48	4.25	3.22	6.22	81.4
Latvia	10130	4.61	4.37	4.85	4.31	4.75	3.85	3.86	78.6
Lithuania	11090	4.71	3.89	3.53	4.04	4.71	2.9	3.83	80.4
Netherland	28600	6.02	5.66	6.37	5.07	4.15	5.08	6.85	81.4
Poland	11450	4.17	3.59	4.75	3.88	4.04	2.71	4.54	70.2
Portugal	17980	5.52	5.22	5.81	4.41	3.83	3.82	6.03	81.4
Romania	7140	3.27	2.97	3.58	2.93	3.57	1.95	2.64	60.2
Slovenia	19240	5.11	4.44	5.78	4.27	4.2	3.71	4.95	62.2
Slovakia	13420	4.33	3.42	5.24	3.82	4.35	2.72	3.87	72.8
Spain	22020	5.28	4.46	6.09	4.83	4.44	4.11	6.35	81.4
Sweden	26620	6.28	6	6.55	5.13	4.57	4.83	6.56	81.4
Hungary	13780	5.18	4.52	5.84	4.09	3.97	3.54	4.88	76.0
United Kingdom	27650	6.01	5.67	6.35	4.99	4.2	4.75	6.82	81.4

	Y_{GNI}	k_1	k_{11}	k_{12}	k_2	k_{21}	k_{22}	k_{23}	k_{31}
Turkey	6690	4.07	4.03	4.12	2.93	3.27	2.47	2.71	73.6
Croatia	10710	3.87	3.06	4.08	3.71	4.24	2.82	3.55	72.8
Macedonia, FYR	6480	3.11	2.48	3.75	3.01	3.94	2.35	1.8	56.0
Norway	37300	5.73	5.4	6.06	5.43	5.15	4.59	6.8	82.8
Ukraine	5410	3.09	2.57	3.61	3.27	4.37	2.3	2.04	74.6

[*]) k_1 = public institutions; k_{11} = contracts and laws; k_{12} = corruption; k_2 = macroeconomic environment; k_{21} = macroeconomic stability; k_{22} = government prodigality; k_{23} = country rating for loans; k_{31} = trade freedom.

Source: The Global Competitiveness Report 2002-2003, World Bank.; 2008 Index of Economic Freedom, The Herrtage Foundation.

Annex 5

The gross national income per capita (PPP, USD) (Y_{GNI}), and indicators of institutional factors (k)*, in world countries, 2003

Countries	Y_{VN}	k_1	k_{11}	k_{12}	k_2	k_{21}	k_{22}	k_{23}	k_{31}
Algeria	5940	3.92	3.85	3.98	3.78	4.91	2.68	2.6	50.4
Angola	1890	3.16	2.76	3.56	2.22	2.73	2.07	1.35	-
Argentina	10920	3.22	2.28	4.15	2.61	3.58	2.03	1.26	54.0
Australia	28290	6.36	6.1	6.62	5.15	4.64	5.18	6.15	77.0
Austria	29610	5.83	5.47	6.2	5.07	4.57	4.46	6.67	81.4
Bangladesh	1870	2.48	2.93	2.04	3.2	4.19	2.18	2.24	38,0
Belgium	28930	5.41	5	5.82	4.82	4.44	3.89	6.5	81,4
Bolivia	2450	3.51	2.93	4.1	2.9	3.66	1.89	2.41	66.8
Botswana	7960	5.45	5.43	5.47	4.44	4.57	4.39	4.23	68.0
Brazil	7480	4.27	3.92	4.62	3.16	3.38	3.07	2.8	59.0
Bulgaria	7610	4.1	2.71	5.5	3.18	3.7	2.28	3.04	62.4
Cameroon	1980	3.04	3.02	3.06	3.1	4.13	2.47	1.65	48.2
Canada	29740	5.48	4.99	5.98	5.04	4.71	4.11	6.62	83.4
Chad	1100	2.36	2.2	2.52	2.5	3.31	2.08	1.31	48.2
Chile	9810	5.62	4.93	6.3	4.36	4.49	3.64	4.83	69.0
China	4990	4.33	3.81	4.84	4.56	5.05	3.66	4.49	50.6
Colombia	6520	4.13	3.16	5.1	3.33	3.94	2.54	2.9	63.0
Costa Rica	9040	4.49	4.17	4.81	3.38	3.5	3.19	3.36	77.6
Croatia	10710	3.87	3.06	4.68	3.71	4.24	2.82	3.55	72.8
Czech R.	15650	4.51	3.81	5.21	4.08	4.49	2.58	4.76	73.6
Denmark	31210	6.56	6.3	6.82	5.38	4.63	5.63	6.64	81.4
Dominican R.	6210	4.05	4.02	4.07	3.27	3.81	2.76	2.71	53.4
Ecuador	3440	3.48	2.77	4.18	2.72	3.49	2.02	1.88	62.8
Egypt	3940	4.18	4.23	4.14	3.7	4.02	3.44	3.34	57.6
Estonia	12480	5.36	4.85	5.86	4.37	4.55	3.93	4.43	84.2
Ethiopia	710	3.69	3.5	3.89	2.89	3.79	2.71	1.28	48.8
Finland	27100	6.52	6.35	6.68	5.54	4.9	5.75	6.62	81.4
France	27460	5.5	4.96	6.03	4.8	4.43	3.58	6.78	81.4
Gambia	1820	4.73	5.05	4.42	3.85	3.77	4.02	-	55.4
Germany	27460	6.1	5.8	6.39	4.78	4.31	3.71	6.79	81.4
Ghana	2190	3.97	4.07	3.87	3.29	3.87	3.4	2.02	62.6
Greece	19920	4.71	4.63	4.79	4.38	4.34	3.3	5.53	81.4

Annex 5 (continued)

Guatemala	4060	3.22	2.33	4.12	2.85	3.49	1.83	2.58	73.4
Haiti	1630	2.28	1.91	2.64	2.45	3.3	1.82	1.39	73.2
Honduras	2580	2.85	2.5	3.2	2.77	3.49	2.05	2.07	68.4
Hong Kong	28810	6.03	5.65	6.42	4.91	4.84	4.86	5.1	90.0
Hungary	13780	5.18	4.52	5.84	4.09	3.97	3.54	4.88	76.0
Iceland	30140	6.44	6.08	6.8	4.9	4.48	5.21	5.43	77.8
India	2880	4.26	4.65	3.86	3.75	4.36	2.56	3.74	23.0
Indonesia	3210	3.63	3.63	3.64	3.37	3.98	3.5	2.01	74.6
Ireland	30450	5.46	4.88	6.03	4.74	4.49	3.58	6.4	81.4
Israel	19200	5.82	5.39	6.26	3.93	3.67	4.17	4.22	77.0
Italia	26760	4.56	4.15	4.96	4.48	4.25	3.22	6.22	81.4
Jamaica	3790	3.77	3.38	4.15	2.83	3.34	2.34	2.32	65.8
Japan	28620	5.3	4.57	6.04	4.57	4.61	2.98	6.06	81.0
Jordan	4290	5.58	5.44	5.72	4.03	4.4	4.34	2.97	47.2
Kenya	1020	3.16	3.09	3.22	3.1	4.1	2.4	1.8	60.2
Korea, Rep. of	17930	5.03	4.72	5.34	4.67	4.9	3.8	5.08	0.0
Latvia	10130	4.61	4.37	4.85	4.31	4.75	3.85	3.86	78.6
Lithuania	11090	4.71	3.89	5.53	4.04	4.71	2.9	3.83	80.4
Madagascar	800	3.04	2.84	3.24	3.04	3.39	2.33	-	74.6
Malawi	600	4.79	4.44	5.14	2.49	2.85	2.65	1.61	62.0
Malaysia	8940	5.12	4.95	5.28	4.49	4.77	3.97	4.44	73.0
Mali	960	3.33	3.71	2.96	2.67	3.36	2.38	1.58	61.0
Malta	17870	5.68	5.28	6.08	4.47	4.41	4.04	5.01	65.0
Mauritius	11260	4.61	4.64	4.58	3.66	4	2.83	3.83	37.4
Mexico	8950	4.35	3.7	5	3.74	3.81	2.96	4.39	81.0
Morocco	3950	3.86	3.96	3.76	3.95	4.42	3.46	3.51	33.4
Mozambique	1070	3.33	2.89	3.78	2.57	3.15	2.33	1.64	50.2
Namibia	6620	4.5	4.33	4.66	3.75	4.29	3.37	3.04	68.0
Netherlands	28600	6.02	5.66	6.37	5.07	4.18	5.08	6.85	81.4
New Zealand	21120	6.36	6.03	6.69	4.98	4.58	4.86	5.91	80.4
Nicaragua	2400	3.57	2.94	4.19	2.45	3.01	2.26	1.53	79.2
Nigeria	900	2.99	3.17	2.81	3.16	4.45	2.08	1.65	61.0
Norway	37300	5.73	5.4	6.06	5.43	5.15	4.59	6.82	82.8
Pakistan	2060	3.67	3.46	3.88	3.4	4.59	2.73	1.69	44.2

Annex 5 (continued)

Panama	6310	3.75	3.26	4.23	3.59	4.32	2.32	3.41	69.4
Paraguay	4740	3.01	2.29	3.73	2.65	3.31	1.71	2.26	64.0
Peru	5090	4.27	3.19	5.34	3.61	4.52	2.6	2.81	59.8
Philippines	4640	3.29	3.2	3.39	3.52	4.33	2.11	3.31	77.4
Poland	11450	4.17	3.59	4.75	3.83	4.04	2.71	4.54	70.2
Portugal	17980	5.52	5.22	5.81	4.41	3.89	3.82	6.03	81.4
Romania	7140	3.27	2.97	3.58	2.93	3.57	1.95	2.64	60.2
Russia	8920	3.34	2.74	3.94	3.44	4.04	2.46	3.19	57.4
Salvador, El	4890	4.72	3.65	5.79	3.84	4.4	3.4	3.18	72.0
Senegal	1660	3.64	3.4	3.88	3.33	4.19	2.74	2.19	61.0
Singapore	24180	6.28	5.89	6.68	5.69	5.16	6.12	6.31	85.0
Slovakia	13420	4.33	3.42	5.24	3.82	4.35	2.72	3.87	72.8
Slovenia	19240	5.11	4.44	5.78	4.27	4.2	3.71	4.95	62.2
South Africa	10270	4.69	4.51	4.87	4.08	4.38	3.61	3.95	68.0
Spain	22020	5.28	4.46	6.09	4.83	4.44	4.11	6.35	81.4
Sri Lanka	3730	3.7	3.57	3.84	3.35	3.85	2.99	2.7	70.2
Sweden	26620	6.28	6	6.55	5.13	4.57	4.83	6.56	81.4
Switzerland	32030	6.2	5.87	6.53	5.31	4.78	4.69	7	83.0
Tanzania	610	4.15	4.31	3.98	3.12	3.61	3.47	1.8	56.6
Thailand	7450	4.97	4.88	5.06	4.54	5.28	3.67	3.94	64.8
Trinidad & Tobago	9450	4.21	4.03	4.39	3.85	4.44	2.63	3.88	51.0
Tunisia	6840	5.19	5.2	5.18	4.38	4.46	4.77	3.83	27.4
Turkey	6690	4.07	4.03	4.12	2.93	3.27	2.47	2.71	73.6
Ukraine	5410	3.09	2.57	3.61	3.27	4.37	2.3	2.04	74.6
United Kingdom	27650	6.01	5.67	6.35	4.99	4.2	4.75	6.82	81.4
Uruguay	7980	5.31	4.74	5.89	2.75	2.42	3.67	2.48	59.0
USA	37500	5.71	5.42	6.01	4.94	4.23	4.44	6.86	81.4
Venezuela	4740	3.21	2.27	4.15	2.59	3.21	1.63	2.33	58.2
Vietnam	2490	4.11	4	4.22	3.87	4.65	3.57	2.61	47.6
Zambia	850	3.86	3.92	3.79	2.49	3.16	2.32	1.35	58.8
Zimbabwe	2180	3.21	2.64	3.77	1.98	2.56	1.78	1.00	52.2

*) k_1 = public institutions; k_{11} = contracts and laws; k_{12} = corruption; k_2 = macroeconomic environment; k_{21} = macroeconomic stability; k_{22} = government prodigality; k_{23} = country rating for loan granting; k_{31} = trade freedom.

Source: The Global Competitiveness Report 2002-2003, World Bank; 2008 Index of Economic Freedom, The Herrtage Foundation.

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