Relationship Between Gross Domestic Product (GDP) and Hidden Wealth Over the Period 2000-2008: An International Study

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Abstract: In this paper we show that it is possible to measure the development and management of knowledge in a country using indicators of intellectual capital that consider non visible assets not included in Gross Domestic Product. Using this idea, we obtained a measure of the intellectual capital for 72 countries selected in accordance with the information available for 2000, 2005 and 2008. These measures allows us to verify the hypothesis that knowledge acts as a divergent factor of wealth, that is, that rich countries are richer in knowledge and manage it more efficiently than poor countries. Thus, in a global economy, intellectual capital circulates in the opposite direction to development, that is, from poor to rich countries. In this sense, economic growth in developing countries displays a stronger relationship with intellectual capital. We show how national intellectual capital anticipated the economic crisis before GDP, as real GDP averages increase in all the years considered, whereas national intellectual capital decreased in last year analysed. Moreover, we used a data panel model with common coefficients to emphasize the most influential factor in the recession in order to ascertain the areas where governments must act to overcome a crisis.

Keywords: economic growth, intellectual capital, international panel data models, divergent factor

1. Introduction

In a knowledge society, a nation's wealth cannot be measured in economic terms alone as it is necessary to consider other aspects such as the real abilities of citizens, the chance of attaining sustainable development and the country's technological potential. In this sense, a couple of contributions aim to uncover the non-measurable aspects of economic growth. This is due to several factors, including human capital, research, development and innovation (R&D&I), quality and the environment. These factors have become influential in recent times where economic and social growth is concerned. In short, hidden wealth or intellectual capital is becoming one of the main driving forces behind growth.

Hence, researchers have proposed measures related to GDP that take into account negative externalities and the impact of economic activity on the environment in order to obtain a more comprehensive indicator that is directly related to social wellbeing. Some examples worth highlighting include the Index of Sustainable Economic Welfare (ISEW) proposed by Daly and Cobb (1989) and the research by Chen and Dahlman (2005), Corrado et al. (2006), Montañez (2008), Pulido (2008, 2009) and Yeh-Yun Lin and Edvinsson (2010a, 2010b), which studies intangibles and their contribution to economic development.

All of the above indicate the need to establish a measure of intellectual capital in order to gain insight into the relative advantage that some countries or regions have over others in order to develop policies to guide future economic development. For this reason, this paper analyses the relationship between intellectual capital and economic growth, considering aspects that are beyond the scope of GDP. In this sense, intellectual capital can usually be divided into technological or structural capital and human capital (it is also divided into human, relational and structural capital). These components make it possible to elaborate and estimate an indicator of intellectual capital for a nation, capable of analysing the progress made in terms of the society of information and comparing it.

We analyse an international data panel for 2000. We study the dynamic relationship between GDP and intangibles or hidden wealth using a macro econometric model. More specifically, it is a panel data model with fixed effects that estimates the relationship between GDP and proxies variables of hidden wealth. These are generated as synthesis of variables reduced by principal component analysis (PCA) techniques. The method used to develop such indices is inspired by the intangible

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accounting management models implemented in enterprises by Edvinsson and Malone (1997), Kaplan and Norton (1997), and López and Nevado (2002).

The contribution of this paper is to show that it is possible to measure a country's development and knowledge management using indicators of intellectual capital. Using this idea as a basis, we have established the following hypothesis: knowledge acts as a divergent factor of wealth, that is, rich countries are richer in knowledge and manage it more efficiently than poor countries. Thus, in a global economy, human capital circulates in the opposite direction to development, that is, from poor countries to rich countries. In summary, we aim to show how relationships between economic development and knowledge are stronger in richer countries.

The paper is structured in five sections. Section 2 describes the main approaches in the literature towards elaborating intellectual capital indicators. Later, in Section 3, we show the model used in this paper to measure intellectual capital per capita at constant prices. In Section 4 we determine the intellectual capital components to ascertain the most influential in regard to the differences between rich and poor countries. Moreover, we show that structural capital anticipates the economic crisis better than human capital. In Section 5, a regression analysis is performed to measure the effect of intangibles on economic development. Finally, we present the main conclusions of our research.

2. Methods to measure national intellectual capital

First of all, it is necessary to establish the concept that we are going to study: intellectual capital of nations. As a basis to define it, we started from a business perspective. Intellectual capital in a firm is based on value that is hidden from traditional accounting systems and which is based on the ability to generate future value. When investigating the value of intellectual or intangible capital in a nation or region, the main difference is the quantity of information involved, as well as the peculiarities of the entity being studied (firm versus State). Sánchez (2004) briefly reviews these definitions, highlighting that for Bradley (1997) a country's intellectual capital is its ability to transform knowledge and intangible resources into wealth. Edvinsson and Stenfelt (1999) perceive intellectual capital as the value of ideas generated by the union between human and structural capital, which allow knowledge to be produced and shared. According to Malhotra (2000), the definition would involve a set of hidden assets that explain the growth of a country and the added value of stakeholders. Therefore, this perception of intellectual capital, methodologically speaking, completes the definition of the value of a country's production. That is, its value would coincide with the value of hidden or immaterial production stemming from factors such as the development of its inhabitants, quality of life and wellbeing and technical progress. This definition of intellectual capital will be used in this research considering aspects other than the simple value of production.

In the literature, the approaches to and indicators of intellectual or intangible capital at macroeconomic level can be divided into two large groups:

- Models specifically aimed at measuring and managing the intellectual capital of nations or regions that have been adapted from company management systems, particularly those based on the Skandia Navigator. Among these, it is worth highlighting Rembe (1999) for Sweden, López et al. (2008) for the European Union 25 (regional level), Lin and Edvinsson (2008) for 40 countries, or Schiuma et al. (2008) for Italian regions.
- Competitiveness analysis and other studies related to establishing national or regional indicators. In this case, information systems use the aggregate level directly as a starting point. Examples include 'European Scoreboard' by the European Commission from 2000, Atkinson (2002) for the United States, Chen and Dahlman (2005), who assess the effects of knowledge on economic growth using an array of indicators for 92 countries over the period 1960 to 2000, the research by World Bank (2006) on 120 countries, or Ståhle and Bounfour (2008), with an analysis that includes data for 51 countries for the period 2000 to 2005.

The conclusion that can be drawn from the above is that no single method or reference framework exists to measure the intellectual capital of a territory, as is also the case at firm level, although interesting progress is beginning to be made. This situation is what aroused our interest in performing this research, which proposes a methodology to measure the intellectual capital of a nation by including information relating to the formation of each and every type of capital it comprises.

It we decided to use a method that involved transferring the classification of intangible assets, used by Nevado and López (2002) and López and Nevado (2006) in models at company level to

macroeconomic level, making any necessary adjustments. We thereby establish some visible intangible assets and some hidden ones. The latter are the basis for the main models, such as the Skandia Navigator, Integrated Analysis and Balanced Scorecard, in the territories in order to obtain tools for managing intellectual capital and not confine our research to merely measurement and assessment. In this approach, national intellectual capital is defined as an immaterial element that generates future benefits and which can be controlled by the State. However, within the current framework of national accounts, there are few items that can be defined as such, except for education and innovation and development costs. These expenses are an ongoing reference to the intellectual capital of a country (traditional analysis). However, even when their definition is changed to investment, they remain insufficient, as a series of capitals that would complete the picture are omitted. It is these uncontrollable, non separable capitals that must be studied further in order to measure them and, in turn, exert control over them, consider their relationship to GDP, the potential wealth they entail, as well as ascertaining whether or not this new wealth is more disperse than the wealth measured traditionally by means of production value.

Therefore, the intellectual capital of a country is made up of visible, separable and controllable assets, in the sense that the government is able to control them in some way (for example, by means of the Budget) and hidden, non separable and uncontrollable assets, which have an enormous potential for future wealth, but which the government is unable to control entirely. The structures for measuring intangible capitals are summarised in Figure 1, which includes several capitals in each group. While the majority of research carried out at macroeconomic level to date focuses on the use of visible capitals, in this case emphasis is placed on hidden capitals, including human, structural and non explicit capitals. The main difference is that hidden assets (intellectual capital) cannot be observed directly. Instead, indicators are required to estimate the generators of a country's wealth. For example, the traditional approach uses expenditure on education per inhabitant as a visible asset for human talent. However, in the hidden asset approach, talent is the result of a combination of indicators of human resources, using expenditure on education per inhabitant, but also the activity and literacy rates. The result determines both investment (accountable expenditure) and how well it has been used or the level of efficiency and combination. The main limitation of this approach is the difficulty involved in obtaining all the necessary information, a problem that is overcome at microeconomic level by conducting surveys. The advantage is that results, despite the aforementioned shortfall, are more relevant and more accurately represent the asset being measured. Finally, this approach measures and values national intellectual capital, in accordance with Andriessen (2004), who demonstrates that measurement is not enough and that valuation is paramount in leveraging intangibles for strategic benefit.

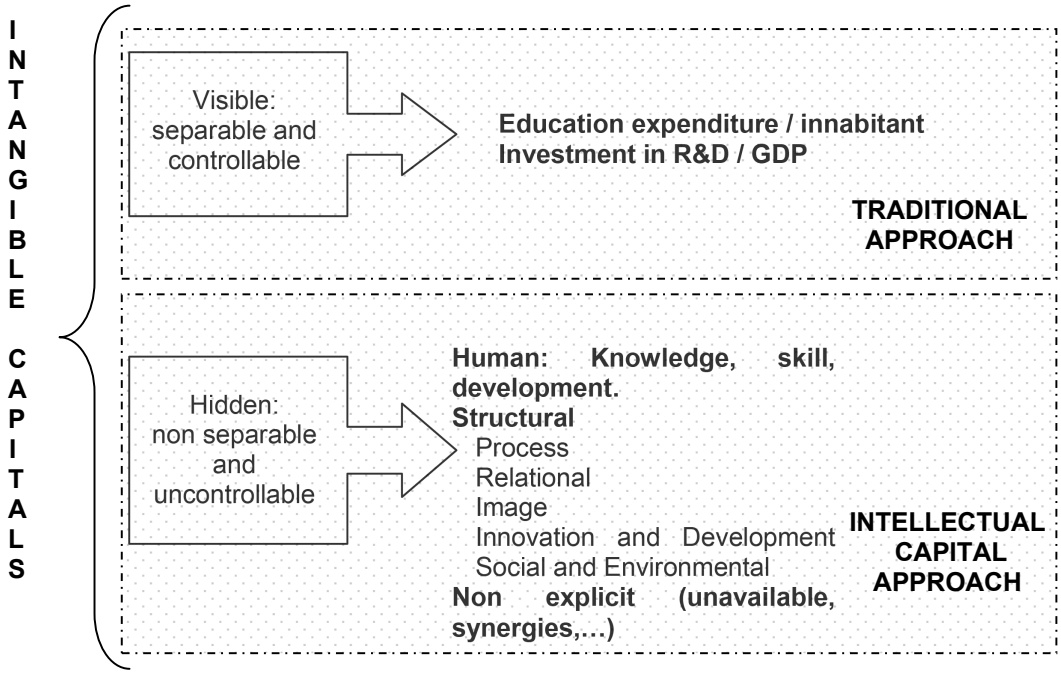

Figure 1: Structures for measuring intangible capitals (source: own elaboration)

3. A model to estimate national intellectual capital or hidden wealth

Using this conceptual framework as a basis, an integrated ad hoc model is designed on a global scale. This is based on models of firm intellectual capital management and competitiveness analysis, under the theoretical and conceptual view of national intangible capital as an 'invisible value' of that space. Finally, for this transfer, it must also be taken into account that, apart from establishing the model, a method is incorporated to determine national intellectual capital. In order to do so, the changes in reporting systems made in the microeconomic approach must undoubtedly be transferred to the reporting systems for national accounts, as regards intellectual capital.

We begin with the following equation in order to define the wealth (W) of a nation (n) as economic production (GDP) plus National Intellectual Capital (NIC).

$$W_n = GDP_n + NIC_n \quad (1)$$

Following this method, two large groups of capital are identified as intangibles: human capital (HC) and structural or non human (SC) capitals. Structural capital, due its nature, will undergo the most changes in the case of nations.

$$NIC_n = HC_n + SC_n \quad (2)$$

Human capital encompasses knowledge, skills and personal development towards achieving objectives (that is, Qualifications – QHC). It also includes cultural values, national labour market conditions and resource inflows from workers abroad (that is, the labour market –MHC).

On the other hand, structural capital covers several intangibles related to the socio-economic framework of a country, namely the non human structure that enables a country to generate future benefits: business structure, bureaucracy, image, international market share, technology, innovation and sustainability. This capital has been divided into:

- Process capital (PrC), which focuses generally on a country's private sector structure. More specifically, it measures information and management systems, bureaucracy and also organisational structures.
- Relation or trade capital (RC), which captures the quality of the balance of trade.
- Marketing or image capital (MC), which contemplates a country's domestic and foreign image and international relations.
- Research, development and innovation capital (RDC), which explicitly measures innovation, research and development possibilities through investment and how efficiently existing resources are exploited.
- Social and environmental capital (SEC), which is determined by the social commitment of the social welfare state in relation to the quality of life of its inhabitants, together with action related to the environment and sustainable development.

The next stage is to establish the indicator scorecard (Table 1) in order to be able to determine the intangibles considered in equation 2. Following the intellectual capital model, the first column defines the intangibles to be estimated as generators of long term benefits. We then justify each of these generators or intangibles in theoretical terms. Finally, overcoming the main problem related to obtaining information, two kinds of indicators are used: absolute indicators (AI), in monetary terms, and efficiency indicators (EI), on a percentage scale. In order to obtain the latter, when the variable does not have a percentage scale, variables have been rescaled assigning 100 to the highest value and 0 to the lowest. As a result, all the variables generated by the indicators have values ranging from 0 to 100 (minimum and maximum). That is, the maximum must coincide with the highest score obtained by the country with the highest value in the sample for the year in question, whereas the minimum will coincide with the countries that record the lowest scores.

Table 1: Scorecard for national intangibles

Intangibles	Theoretical justification	Indicators	
		Absolute (AI)	Efficiency (EI)
Human Capital			
Knowledge Skill Development	Qualifications	Education expenditure Capital formation Internal human capital (UNESCO)	Literacy index (adjusted gross school enrolment) (UNESCO)
	Motivation and employability	Non residential wage mass and remittances. Human capital exported	Activity rate (UN)
	Excess employability		Adjusted migration (ONU)
Process Capital			
Reporting and Management systems Organisational structure	System/structure quality	Capitalisation/Market value over resident firms as of 31st December	Adjusted firm start-up time GDP Ranking
	Level of management: technology		Line index: adjusted mobile and land lines/inhabitant
			Internet users per 100 inhabitants
Intangibles	Theoretical justification	Indicators	
		Absolute (AI)	Efficiency (EI)
Relational or Trade Capital			
Client Portfolio	Product brand name quality	Trade balance in goods and services	High Technology Export Index
			1-Development aid index
Marketing or Image Capital			
Image and International Institutional Relations	Internal image	Foreign direct investment	GDP Ranking
			Life Expectancy Index
	External image		Travel and Tourism Infrastructure Index (WEF)
Research, Development and Innovation Capital			
Innovation, Research and Development	Level of innovation and development	Investment in R&D&i (UNESCO)	Line Index: adjusted mobile and land lines/inhabitant
	Technological level		Internet users per 100 inhabitants
Social and Enviornmental Capital			
Social and Environmental Responsibility	Environment	Health expenditure (WHO)	CO_2 emissions per capita
	Sustainability		Hectares of green areas/habitant
	Quality of life, welfare society		Life Expectancy Index
			Access to health system in rural areas
			Access to water

Source: own elaboration. Note: Sources in brackets if not WBG.

Each intangible capital is obtained by the process presented for the first time for Skandia by Edvinsson and Malone (1997) and later modified in the method of Integrated Analysis by López and Nevado (2006) and Alfaro and López (2008).

$$C = \sum_{c=1}^{m} \left(AI_c \cdot \sum_{i=1}^{k} w_i \, PC_{ic} \right) \quad , with \;\; PC_{ic} = \sum_{i=1}^{k} u_i x_i \qquad (3)$$

where human or structural capitals (C) are estimated by one or m absolute indicators (AI), filtered by k efficiency indicators synthesized into only one indicator, weighted in accordance with an objective

weighting w. Thus, we propose an objective procedure to establish the weights in the synthesis of the efficiency indicator. The procedure followed to allocate weights to efficiency indicators is based on a principal component analysis (PCA) that makes it possible to assign weights to each indicator highly objectively. More specifically, bearing in mind that it is impossible to directly assign weights to each efficiency indicator, we proceeded to transform them into the same number of principal components (PC), where ui are the characteristic vectors of each principal component and xi the variables used to build the efficiency indicators.

Once these components have been obtained, we proceeded to build one indicator of efficiency by weighting each component in accordance with the percentage of variance retained by each, as we show in equation 4, where w is the percentage of variance retained by each component (a total of k, the same number as variables).

$$EI_c = \sum_{i=1}^{k} w_i PC_{ic} \text{ , } then\ simplifying \quad C = \sum_{c=1}^{m} AI_c \cdot EI_c \tag{4}$$

As a result, we can obtain efficiency indicators to filter the absolute indicators, which are far from being as subjective as the person performing the analysis due to being based on a widely used technique in economics: principal component analysis.

Finally, the international model of wealth, in per capita terms, proposed for n countries is the following:

$$Wpc_n = GDPpc_n + \left[\begin{array}{l} \left(QHCpc_n + MHCpc_n\right) + \\ + \left(PCpc_n + RCpc_n + MCpc_n + RDCpc_n + SECpc_n\right) \end{array} \right] \tag{5}$$

where each capital is obtained using equation 4.

In this sense, using information referring to 72 countries, selected considering statistical data availability limitations, we have estimated national intellectual capital and its components in per capita terms at constant dollars. This allows us to compare the values of intangible capitals across different countries. In order to do so, we have created a database using information from the World Bank Group (WBG), the United Nations (UN) and the World Economic Forum (WEF) for the period 2000-2008. More specifically, we have considered information for the years; 2000, 2005 and 2008 in order to construct a panel data model.

Having estimated national intellectual capital and each of its elements, the next section analyses the difference between developed and developing countries from a static perspective. Later we perform a dynamic analysis using the relationships between each element of intellectual capital and economic growth, comparing developments in the years considered.

4. National intellectual capital components: Results

Using the information from the World Bank (2010) as our main source, we proceeded to apply the proposed model to 72 countries with information referring to 2000, 2005 and 2008, except in some cases where the most recent data available were used. The countries were chosen depending on the availability of information for the majority of variables considered, as there were not enough data from the sources mentioned to be able add more countries. We must remember that in order to synthesize the efficiency indicators under consideration into one indicator for each kind of capital, weightings have been allocated according to the variance weight of their principal components. Moreover we have calculated a monetary value for each component of national intellectual capital. Human and Structural capital (as the sum of process, relational, marketing, R&D&I and social capital) for each country considered in this paper are shown in table 2.

The results show that the difference between rich and poor countries is large when we consider structural capital because the variation coefficient that measures data dispersion is higher for this capital. This situation can also be appreciated using the log of standard deviation.

Table 2: Human and structural capital per capita at constant dollars

Country	Human Capital			Structural Capital		
	2000	2005	2008	2000	2005	2008
Argentina	353.879	105.513	156.935	1733.046	662.123	447.331
Armenia	17.785	43.510	95.607	31.632	58.841	134.982
Australia	1139.616	1439.686	1764.437	12662.248	21984.754	16919.565
Austria	1388.202	1952.066	2400.163	4731.839	19475.706	10314.690
Belgium	1422.765	2101.469	2588.146	25175.212	19687.283	15744.644
Bolivia	55.633	55.382	67.072	98.578	102.225	112.301
Brazil	149.202	135.745	233.260	396.342	660.161	754.862
Bulgaria	53.860	131.148	167.060	113.406	555.115	835.766
Chile	175.121	180.304	217.058	1698.798	3529.334	2659.771
China	23.810	43.693	78.320	149.497	269.172	709.930
Colombia	85.300	102.041	131.293	163.485	442.796	634.897
Costa Rica	178.032	155.555	161.299	432.660	256.936	314.814
Croatia	172.212	385.762	485.560	535.561	1727.491	3247.862
Cyprus	660.678	1208.693	1635.588	3290.089	5192.538	6503.323
Czech Republic	207.250	453.787	716.495	807.876	3044.522	3544.037
Denmark	2526.224	3612.241	4313.870	21286.094	27039.296	18072.733
Egypt. Arab Rep.	61.088	39.628	40.648	140.121	292.728	248.507
El Salvador	66.154	96.088	124.369	166.547	279.873	314.125
Estonia	218.587	427.084	576.609	744.025	2502.196	1438.515
Finland	1398.093	2281.335	2778.712	40453.530	31429.210	22373.884
France	1290.721	1843.896	2238.737	14401.738	18494.134	15297.509
Georgia	15.552	28.482	56.706	35.454	103.309	172.111
Germany	1043.883	1475.120	1850.213	11959.283	12982.296	12216.150
Greece	467.736	766.948	1022.626	5204.691	6669.898	4624.862
Hong Kong SAR. China	927.400	1185.369	1083.071	73318.562	92493.744	147111.604
Hungary	224.807	461.658	542.630	664.332	1936.244	3239.990
Iceland	1850.950	3417.784	2501.873	13922.647	65407.779	10542.946
India	14.187	16.551	18.566	34.779	104.154	121.540
Indonesia	17.037	23.025	33.786	63.938	79.147	69.969
Ireland	1121.384	1935.715	2496.013	21185.666	16033.556	9931.877
Israel	1358.669	1149.136	1635.493	7874.165	10352.475	10661.158
Italy	843.610	1182.274	1345.586	9270.297	9141.751	5648.678
Jamaica	182.695	143.578	156.178	575.185	1712.848	691.703
Japan	1351.885	1347.354	1460.808	17964.277	27722.913	20622.005
Kazakhstan	38.357	47.601	76.870	120.466	305.298	748.409
Korea. Rep.	423.670	623.181	666.526	2689.114	8879.509	5451.126
Kyrgyz Republic	8.824	20.573	39.289	6.630	17.760	31.534
Latvia	167.644	276.159	382.697	240.422	779.651	632.063
Lithuania	192.915	348.674	490.241	282.221	1703.628	966.405
Luxembourg	2982.872	3583.919	5175.282	237809.660	265558.741	216250.095
Malaysia	200.269	297.259	220.350	2556.661	4225.216	3612.219
Mauritius	144.333	166.864	156.271	542.493	699.834	810.942
Mexico	272.287	273.565	279.917	595.206	778.196	646.497
Mongolia	21.614	27.155	36.396	23.479	23.523	55.128
Morocco	52.390	94.813	123.244	127.719	399.968	771.511
Netherlands	1218.734	1905.737	2429.637	31437.134	27978.451	17351.743
New Zealand	920.267	1606.195	1395.906	3805.844	7328.451	4486.284
Norway	2483.049	3921.874	4452.013	17667.880	36965.611	25447.471

Country	Human Capital			Structural Capital		
Pakistan	5.177	7.784	10.477	19.086	73.855	34.613
Panama	176.592	157.110	202.402	597.068	1069.091	1191.136
Paraguay	67.347	29.807	45.457	78.150	39.633	45.539
Peru	70.412	72.255	101.777	129.798	474.370	674.102
Poland	224.529	394.288	568.930	451.636	1415.589	1450.004
Portugal	727.484	914.703	1083.130	3604.436	4020.269	3981.966
Romania	41.781	60.075	109.519	65.333	240.185	230.173
Russian Federation	47.798	81.736	95.589	328.912	1107.104	702.027
Saudi Arabia	445.789	515.165	572.756	1853.639	9861.696	4365.164
Slovak Republic	189.251	352.260	500.276	369.332	916.070	1187.558
Slovenia	617.440	769.641	957.701	1040.958	2514.652	3531.143
South Africa	166.471	200.051	169.124	1549.542	3706.001	2079.376
Spain	668.681	1046.141	1170.660	6421.450	11623.968	9945.127
Sweden	2006.794	2637.036	2971.707	30702.241	35517.204	23688.319
Switzerland	1830.449	2789.632	3191.565	84242.221	90241.228	78937.427
Thailand	89.724	91.177	133.225	300.182	740.829	627.232
Tunisia	135.545	184.998	226.279	173.607	212.139	370.038
Turkey	91.878	59.981	63.840	435.021	395.866	251.383
Uganda	5.860	10.573	11.391	12.881	9.695	12.317
Ukraine	26.526	60.124	63.050	46.735	177.019	121.675
United Kingdom	1166.591	1859.523	1971.078	31465.112	34408.884	17895.123
United States	1701.137	1922.995	2052.759	36572.206	35979.674	23223.265
Uruguay	167.504	99.283	142.950	420.173	266.035	367.825
Zambia	4.457	4.332	4.177	17.391	22.440	19.652
Average	567.590	797.804	937.767	10973.439	13793.110	11089.892
Log (Std. Deviation)	2,848	3,006	3,074	4,495	4,549	4,500
Variation Coefficient	1.243	1.271	1.264	2.850	2.566	2.854
%GDP	5,33	5,57	5,48	103,06	96,38	64,81

Source: Own elaboration.

Moreover, if we analyse the values of this coefficient, we can see that the variations in human capital over these three years are smaller. Therefore, structural capital anticipates the economic crisis, because the difference between rich and poor countries narrows during the expansive period between 2000 and 2005, and increase at the beginning of the crisis in 2008. This situation can also be detected in the average value, with a continuous increase in human capital in the years considered, but with two different situations in structural capital: an increase between 2000 and 2005 and a decrease in 2005-2008.

If we consider the importance of structural capital in intellectual capital, then it is easy to assure that intellectual capital will behave in similar fashion to structural capital. Moreover, the results show that the relevance of this capital, in terms of GDP, decreased by 32.7% between 2005 and 2008, whereas human capital remains stable in terms of GDP. Structural capital fell drastically in 2008, which leads us to consider this factor as one of the most important aspects of the economic crisis that began in 2008.

5. A data panel model to analyse the relationship between national intellectual capital and gross domestic product

One interesting aspect in the analysis of national intellectual capital is to consider its relationship with Gross Domestic Product (GDP). Several studies find a positive relationship between these two indicators, but we are going to test this affirmation and analyse the evolution of these relationships in the years considered. Table 3 shows the values of intellectual capital and GDP per capita at constant dollars. Moreover, the appendix includes detailed results by country for comparative purposes.

Table 3: Intellectual capital and GDP per capita at constant dollars

Country	Intellectual Capital			GDP		
	2000	2005	2008	2000	2005	2008
Argentina	2086.925	767.637	604.267	7693.923	2790.565	3169.702
Armenia	49.417	102.350	230.590	621.483	1314.768	2700.219
Australia	13801.863	23424.440	18684.002	21768.043	28600.689	35447.378
Austria	6120.041	21427.772	12714.853	23865.458	33986.964	43110.318
Belgium	26597.977	21788.752	18332.790	22623.278	32237.125	39850.401
Bolivia	154.211	157.607	179.372	1009.677	856.121	1008.173
Brazil	545.544	795.906	988.122	3701.472	2974.478	4454.318
Bulgaria	167.266	686.263	1002.826	1563.200	2834.029	4079.304
Chile	1873.920	3709.639	2876.829	4877.875	5476.447	6525.545
China	173.308	312.866	788.250	949.182	1466.170	2388.945
Colombia	248.785	544.837	766.190	2364.753	2417.571	3206.437
Costa Rica	610.692	412.491	476.113	4056.728	2891.517	3037.263
Croatia	707.773	2113.253	3733.422	4817.071	8302.336	11428.629
Cyprus	3950.767	6401.231	8138.911	11844.153	17715.254	22594.539
Czech Republic	1015.126	3498.309	4260.533	5521.189	10609.101	17032.531
Denmark	23812.318	30651.537	22386.603	29992.941	42673.512	51424.564
Egypt. Arab Rep.	201.209	332.356	289.155	1422.733	870.999	1105.033
El Salvador	232.701	375.961	438.494	2209.159	2431.338	2687.762
Estonia	962.612	2929.280	2015.125	4144.381	8410.037	11342.198
Finland	41851.623	33710.545	25152.596	23530.124	35845.284	46453.144
France	15692.459	20338.031	17536.245	22547.792	31938.276	38736.443
Georgia	51.006	131.791	228.817	644.387	1073.936	1699.635
Germany	13003.166	14457.416	14066.363	23114.233	32170.201	40315.368
Greece	5672.427	7436.846	5647.488	11500.648	18692.473	24137.733
Hong Kong SAR. China	74245.962	93679.113	148194.674	25374.515	30416.880	34584.879
Hungary	889.140	2397.902	3782.620	4689.608	8250.051	10149.182
Iceland	15773.597	68825.563	13044.819	30951.203	44372.908	33040.041
India	48.966	120.705	140.106	452.969	599.872	701.463
Indonesia	80.976	102.172	103.755	803.882	827.131	953.833
Ireland	22307.050	17969.271	12427.890	25383.856	41424.725	49461.843
Israel	9232.833	11501.612	12296.651	19836.098	18080.474	24806.650
Italy	10113.907	10324.025	6994.264	19269.022	26421.536	30898.139
Jamaica	757.879	1856.426	847.880	3479.057	2567.615	2246.339
Japan	19316.162	29070.267	22082.813	36789.220	38231.781	42322.516
Kazakhstan	158.823	352.899	825.279	1229.003	2109.759	2781.176
Korea. Rep.	3112.784	9502.691	6117.652	11346.665	15143.831	15737.602
Kyrgyz Republic	15.454	38.333	70.823	278.659	375.028	499.372
Latvia	408.067	1055.810	1014.760	3302.305	5370.178	7577.923
Lithuania	475.136	2052.301	1456.647	3267.355	6969.226	10118.935
Luxembourg	240792.532	269142.660	221425.377	46456.624	69915.262	88025.675
Malaysia	2756.930	4522.475	3832.569	4029.874	4647.290	5889.830
Mauritius	686.826	866.698	967.213	3861.039	3813.566	4477.118
Mexico	867.493	1051.761	926.413	5934.982	5331.084	5572.036
Mongolia	45.093	50.678	91.524	455.881	526.169	689.038
Morocco	180.109	494.782	894.755	1284.229	1857.187	2379.622
Netherlands	32655.868	29884.188	19781.381	24179.856	34094.192	43163.389
New Zealand	4726.111	8934.646	5882.190	13192.959	23680.336	21994.326
Norway	20150.929	40887.484	29899.484	37472.371	55436.229	65621.353

Country	Intellectual Capital			GDP		
Pakistan	24.263	81.639	45.090	535.576	531.443	545.020
Panama	773.660	1226.201	1393.538	3938.083	4420.561	5658.135
Paraguay	145.497	69.440	90.996	1321.674	768.327	1211.878
Peru	200.210	546.625	775.879	2049.302	2510.912	3540.994
Poland	676.165	1809.877	2018.933	4454.080	7075.709	11381.036
Portugal	4331.921	4934.972	5065.095	11016.221	15019.444	18124.408
Romania	107.114	300.260	339.693	1650.966	1698.823	2459.734
Russian Federation	376.710	1188.840	797.616	1775.141	2438.190	3436.864
Saudi Arabia	2299.428	10376.861	4937.921	9128.113	9757.888	10022.451
Slovak Republic	558.582	1268.330	1687.834	5326.060	9176.892	13709.929
Slovenia	1658.398	3284.292	4488.844	9998.994	13632.169	18606.476
South Africa	1716.012	3906.051	2248.499	3019.947	3725.285	3187.302
Spain	7090.132	12670.109	11115.787	14421.941	21404.531	26073.412
Sweden	32709.035	38154.240	26660.025	27688.893	37562.845	44272.625
Switzerland	86072.670	93030.860	82128.992	34787.104	48610.520	59246.779
Thailand	389.906	832.006	760.457	1968.428	2399.283	3194.140
Tunisia	309.151	397.137	596.317	2033.071	2540.660	3063.100
Turkey	526.900	455.846	315.222	4010.972	2196.438	2471.303
Uganda	18.741	20.268	23.709	253.480	247.856	308.752
Ukraine	73.260	237.144	184.726	635.709	1019.842	1189.212
United Kingdom	32631.703	36268.407	19866.201	25089.446	33300.984	34899.793
United States	38273.343	37902.668	25276.024	34605.843	37441.400	38417.902
Uruguay	587.677	365.318	510.775	6914.363	3608.104	5053.541
Zambia	21.849	26.772	23.829	309.318	243.215	319.305
Average	11,541.031	14,590.920	12,027.659	10,647.750	14,310.734	17,111.416
% GDP	108.389	101.958	70.290			
Correlation with GDP	0.675	0.737	0.670			
Beta Convergence	--	-0.068 (-2.583)	-0.156 (-5.456)	--	0.034 NS	-0.001 NS

Source: Own elaboration. (NS: Non Significant).

Intellectual capital is measured as an aggregate of human and structural capitals, as in equation 5. As regards the results of intellectual capital, Luxembourg, China, Switzerland, Norway and Sweden stand out within the 72 countries in 2008. On the other hand, Uganda, Zambia, Pakistan, Kyrgyz Republic and Paraguay were the worst ranked. The United States and Japan are well poised in terms of intellectual capital and Spain is ranked twentieth.

If we analyse the relationships between the traditional economic indicator used (GDP) and the measure proposed in this paper, which considers non visible wealth (intellectual capital), the results confirm the existence of a positive relationship. Furthermore, during the expansive period the correlation between these measurements increased by 9.2%. However, the crisis (2008) resulted in the correlation between these measures decreasing to the same level as that observed in 2000.

When we analyse the average values of these measurements in the years considered, we can see that intellectual capital was capable of detecting the crisis before GDP. Average national intellectual capital records a decrease in 2008, whereas GDP increases in all the years considered.

Furthermore, as we anticipated in the previous section, intellectual capital is identified as divergent for economic growth. In order to verify this, we conducted a beta convergence analysis, the results of which appear in table 3. These show the absence of convergence in terms of GDP for the periods 2000-2005 and 2000-2008, as the equations show non significant convergence coefficients along with very low determination coefficients. On the contrary, intellectual capital registers negative and significant beta coefficients, the highest being observed in 2000-2008. Therefore, intellectual capital is

a divergent factor in the economic growth of the decade, that is to say, the differences between poor and rich countries are greater when considering this measurement.

Finally, we have conducted a study on the relationship between GDP and the different components of intellectual capital to determine the most relevant factors in economic growth. More specifically, we have considered three models in which the endogenous variable is GDPpc and we have analysed its relationship with the different components of human capital (regression 1), structural capital (regression 2) and human and structural capital as a whole (regression 3).

We have used a data panel model with common coefficients the results of which appear in table 4. In regression 1, the most important factor in terms of elasticity is the skills of the inhabitants of the country. In regression 2, all the components display a significant relationship that we show with the t statistic of regression 2. The most relevant results in terms of elasticity are for Social and Environmental capital and Research, Development and Innovation capital. Moreover, two explanatory variables are included in regression 3, namely structural and human capital, with all of these components. The results are significant for both, although, human capital is seen to be more relevant in terms of elasticity.

Table 4: Panel data relationships between intellectual capital components and GDP (per capita at constant dollars)

Components	Regression 1:Human Capital		Regression 2: Structural Capital		Regression 3: Intellectual Capital	
	Coefficient (Elasticity)	T-Stat	Coefficient (Elasticity)	T-Stat	Coefficient (Elasticity)	T-Stat
Qualifications	15.54272 (0.804)	49.15132			14.67855 (0.803)	43.84944
Motivation and employability Excess employability	18.44895 (0.056)	12.60838				
Process			0.083239 (0.047)	3.925446	0.056509 (0.048)	5.543384
Relational			1.670248 (0.062)	5.644141		
External and internal Image			0.050209 (0.0096)	2.247112		
Research, Development and Innovation			9.360531 (0.114)	3.800079		
Social and Environmental			14.22958 (0.555)	14.34199		
R^2	0.936433		0.937913		0.943563	

Source: Own elaboration. Pooled Least Squares. Total panel observations: 216 (3x72).

6. Conclusions

GDP has traditionally been used to measure national economic development. However, in the current knowledge economy, other factors have a great influence on growth and do not appear to be captured by GDP. In this sense, we propose a model of intellectual capital valuation that serves as a complement to GDP to determine the wealth of a nation. Moreover, we have estimated the value of this capital for each of its main components, namely human and structural capital. Using these valuations as a basis, we analysed the relationship between intellectual capital components and economic production (GDPpc).

In order to value national intellectual capital, we have used objective weights (obtained from a principal component analysis) to elaborate efficiency indexes for each component in order to obtain unbiased efficiency indicators.

The most important results are firstly that national intellectual capital was a divergence factor in terms of economic growth over the period 2000-2008. Therefore, if we use this measure of wealth, the difference between countries will be greater.

Secondly, intellectual capital anticipates the economic crisis that began in 2008. While intellectual capital decreased that year, GDP continued to grow. In this sense, structural capital figures prominently and, therefore, governments should pay greater attention to aspects related to this type of capital.

Finally, when we analyse each component of these capitals we find that the most relevant factor in terms of economic growth is human capital and, more specifically the skills of a country's inhabitants. In the case of structural capital, the most important aspects are Social and Environmental (SE) capital and Research, Development and Innovation (R&D&I) capitals.

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