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# MEASUREMENT OF NATIONAL NON-VISIBLE WEALTH THROUGH INTELLECTUAL CAPITAL

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Abstract

The economy of knowledge requires measures of national wealth that take into account aspects not contemplated by GDP, in order to portray the situation of a country more truthfully. In this paper, we use a new model to measure the intellectual capital of nations, adapted from microeconomics. It is based on the observation of hidden capital as implicit generator of long-term wealth, considering not only sustainability and social wellbeing, but also intangible assets such as human development, economic structure, international trade, foreign image and innovation. This empirical study reveals the importance of hidden capital in a nation's wealth, making the difference where economic growth is concerned, as the most developed countries record the highest scores of efficiency in terms of intangible capital.

**Keywords:** knowledge economy indicators, hidden wealth, intangibles, GDP **JEL Classification**: F02, J24, O3, O57

## . Introduction

The economy of knowledge needs information and management systems aimed at estimating and monitoring intangible capital as a primary source of wealth creation.

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Researches continuously question the suitability of GDP as a measure of economic growth, at least as the sole indicator. While GDP and measures related to social wellbeing are positively correlated, particularly in poor countries, the former does not include, among other things, personal use, the underground economy, altruism, environmental value, externalities or image. In this sense, Stiglitz (2003), in reference to GDP, argues that: "It doesn't measure changes in well-being, it doesn't measure comparisons of well-being across countries'. [...] It doesn't necessarily mean that there will be a replacement of current measures, but maybe a construction of complementary measures. [...] The standard measures of GDP do not measure the degradation of the environment, the depreciation of natural resources".

In this same line, institutions such as the World Bank are moving towards the use of indicators that take into account all the aspects that affect the development and growth of wealth in a nation and its real value over time. The aim is not only to include them, but also to understand their interrelations. That is, wealth can be measured not only in terms of output and sales, but also by the construction and stability of an economic model that takes into account perishables in order to administer them in the long term, and institutions, as catalysts capable of prolonging wealth over time. Hence, indicators related to GDP are being proposed that report negative externalities and the effect of economic activity on the environment to obtain a more complete measure that is more directly related to social wellbeing. For this reason, there is an emerging need for tools that give a complete picture of the future of any given country, organisation or institution.

Following in the same line, this paper proposes a model to build an indicator of 'nonvisible wealth' that portrays a situation more realistically than if only GDP is considered. This indicator will make possible to obtain the comprehensive value of a country by observing hidden capital as an implicit generator of long-term wealth. The uniqueness of the method proposed stems from the superimposition of the microeconomic systems of firms on the national accounts. The former define the nature of their hidden assets as intangible, non-visible and uncontrollable, but as generators of future value. As such, they can feasibly be monitored by absolute indicators filtered by efficiency indicators. As regards the latter, intangible capital is vital in order to improve the estimation of wealth in a territory, using a similar process to that developed in microeconomics, whereby efficiency indicators would filter some items considered as expenses or outside the production value of a nation. This proposal will provide a more comprehensive knowledge of countries' economies.

## Approaches to the 'New Wealth of Nations'

The study and analysis of how to measure and valuate intangibles has matured in recent years, particularly at macroeconomic level. The environment for innovation and technology transfers is undoubtedly vital when it comes to designing a model of intellectual capital and its relationship system, bearing in mind that it is based on the creation and exchange of information and knowledge in various socioeconomic circles. The result is a set of territories with the ability to generate social value and wellbeing in developed economies, in line with "intelligent nations" (Quinn, 1992).

Before analysing the different approaches, it is necessary to establish the concept we are going to work with. Intellectual capital from a firm's perspective is based on value

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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 territory, 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 intangible capital, methodologically speaking, completes the definition of the value of a region's production, in the sense that 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 to construct an indicator of country wealth that is more accurate than GDP, such that comparisons may be established between countries considering aspects beyond the simple value of production.

The models and indicators of intellectual or intangible capital at macroeconomic level can be divided into two large groups:

- 1. Models specifically aimed at measuring and managing the intellectual capital of nations that have been adapted from firm management systems, particularly those based on the Skandia Navigator. It is worth highlighting the following papers: Rembe (1999) applied in Sweden; Bossi *et al.* (2005) proposed a model of intellectual capital in the public sector or Yeh-Yun Lin and Edvinsson (2008) establish a model of intellectual capital of 40 nations.
- 2. 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. The following are worthy of mention: The European Commission has published a document entitled the "European Scoreboard" since 2000; Atkinson (2002) proposes a model referring to the United States that aims to measure and study trends in US economic policy in order to determine the best ways to adapt to the New Economy; and the research by the World Bank (2006) entitled "Where is the wealth of nations? Measuring Capital for the 21st Century".

Generally speaking, 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 it 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.

## III. Model of National Index of Knowledge Capital

After reviewing the various approaches, we decided to use a method that involved transferring the classification of intangible assets (Nevado and López, 2002 and 2006) in

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models at firm level to macroeconomic level, making any necessary adjustments. We thereby establish some visible intangible assets and some hidden ones, the latter being the basis for the main models, such as the Skandia Navigator, Integrated Analysis and Balanced Scorecard, in order for regions to obtain tools for managing intellectual capital and to not confine the research to merely measurement and evaluation.

Using this approach, national intangible 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 expenditures are an ongoing reference of the intellectual capital of a country, but even when their definition is changed to investment, they remain insufficient, 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 determine, as well as ascertaining whether or not this new wealth is more dispersed than the wealth measured traditionally by means of production value.

Therefore, the intangible 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. In this sense, the structure for measuring intangible capitals is summarised in Figure 1, which includes the various capitals in each group. While the majority of the research carried out at macroeconomic level to date focuses on the utilisation of visible capitals (traditional approach), in this case emphasis is placed on hidden capitals, including human, structural and non-explicit capitals (intellectual capital approach).

Figure 1



Source: Authors' own elaboration.

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Using this conceptual framework as a basis, an integrated ad hoc model is designed on a global scale, which is based on both the models of firm intangible capital management and also competitiveness analysis, under the theoretical and conceptual view of national intangible capital as an 'invisible value' of that space which represents the new wealth of nations. Finally, for this transfer, it must also be taken into account that, apart from establishing the model, a method is incorporated to build a new synthetic indicator. 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 the intellectual capital.

In accordance with considerations made in other models, first it is worth establishing the vision of a country and its activities and projects and hidden intangible capitals as a whole by means of a National Index of Knowledge Capital (NIKC), identifying the indicator for each and allocating them to the capitals already defined. Following this method, two large groups of capital are identified: human and non- human capital. Structural or non-human capital, due its very nature, will undergo the most changes in the case of nations. Apart from these two capitals, a set of capitals that are not contemplated due to identification errors, lack of information or not being included among those listed above, are added under the category of non-explicit capitals (equation 1).

Human capital encompasses knowledge, skills and personal development towards achieving objectives (equation 2). It also includes cultural values, national labour market conditions and resource inflows from workers abroad.

Human = Knowledge +Skill + Development (2)

On the other hand, structural capital covers various intangible capitals related to the socio-economic framework of a country through:

- Process capital, 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, which captures the quality of the balance of trade.
- Marketing or image capital, which contemplates a country's domestic and foreign image and international relations.
- Research, development and innovation capital (R&D&I), which explicitly measures innovation, research and development possibilities through investment and how efficiently existing resources are exploited.
- Social and environmental capital, 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.

Structural = Processes + Customer + Image + R&D&i + Social (3) Finally, non-explicit capital, as explained above, completes the picture provided by the integrated model, assuming variable estimation errors, omission of relationships, synergies and/or intangible capitals and data unavailability. This variable is, nevertheless, non-observable.

The next stage of this research, once the measuring system has been determined, is to establish the indicator scorecard in order to be able to determine the intangibles

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included in equations 2 and 3. In order to do so, two types of indicators are used: absolute (AI) and efficiency (EI). The latter filter book expenditure included by the national government in the budget or its market value, according to the objective efficiency recorded and equation 4 below. This process of filtering expenditures was inspired by the process presented for the first time for Skandia by Edvinsson and Malone (1999), later modified by Nevado and López (2002 and 2006).

$$\mathbf{C} = \sum_{c=1}^{m} \mathbf{AI}_{c} \cdot \sum_{i=1}^{k} w_{i} EI_{ic}$$
(4)

where: human or structural capital, C, is estimated by one or more absolute indicators m, filtered by k efficiency indicators and synthesized into one sole indicator, weighted in accordance with a subjective weighting w.

In this paper, the procedure followed to allocate weights to efficiency indicators is based on the development of a principal component analysis that makes possible to assign weights to each indicator highly objectively. More specifically, bearing in mind that it is impossible to assign weights directly to each efficiency indicator, we proceeded to transform them into the same number of principal components (CP) as indicators available:

$$CP_{i} = \sum_{i=1}^{k} u_{i} EI_{i}$$
(5)

where:  $u_i$  are the characteristic vectors of each principal component; and  $El_i$ , the efficiency indicators (variables) under consideration

Once these components have been obtained, we proceeded to build one single indicator of efficiency by weighting each component in accordance with the percentage of variance retained by each.

$$EI_{c} = \sum_{i=1}^{k} W_{i} CP_{i}$$
(6)

where: *w* is the percentage of variance retained by each component (a total of k, the same number as variables). Hence, equation 4 would be transformed into:

$$\mathbf{C} = \sum_{c=1}^{m} \mathbf{AI}_{c} \cdot \sum_{i=1}^{k} w_{i} CP_{ic}$$
(7)

As a result, following a similar procedure to that proposed by Alfaro and López (2008), we have obtained efficiency indicators to filter the absolute indicators, which are far from being as subjective as the person performing the analysis because they are based on a widely used technique in economics, namely principal component analysis.

Now the method has been developed, we decided to apply it, but always with one fundamental limitation: the availability of statistical information. In this sense, the most complete data base in the world that is the closest to this approach is compiled by the World Bank Group (WBG). Notwithstanding, it must be complemented in some cases

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by information from other sources, namely the data bases of the structure of the United Nations (UN) and the World Economic Forum (WEF). Furthermore, proxies are used on more than a few occasions, as the desired variables are not included in the sources mentioned. Using these information, we have designed a scorecard, which includes an open system of indicators to estimate intangible capitals on a national scale in accordance with the proposed method, always allowing efficiency or relative indexes, nevertheless, to be comparable, whereas the absolute indexes and the final values of intangibles may only be compared in relative terms (GDP and per capita).

## IV. Results of the National Index of Knowledge Capital

We apply the proposed model to 82 countries with information referring to 2006, 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 to add more countries.

As regards how the indicators used to determine the NIKC were obtained, certain points must be clarified. Absolute indicators in millions of dollars have been used. As a result, when variables were explained as percentages of GDP, data were transformed into monetary terms. Efficiency indicators, on the other hand, are expressed in percentages, which means that the scale must range from 0 to 100. That is, the maximum (100) 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.

In order to elaborate the capitals, a consensus had to be reached on the information needs of absolute and efficiency indicators with the statistics available. Hence, capitals were obtained as follows:

Human Capital. A two-fold view of generation - on the one hand, external, comprising migrant remittances, fine-tuned by labour market conditions and on the other hand, the internal viewpoint, resulting from classifying a nation's human resources through education expenditure filtered by qualifications (literacy/school enrolment). Non Human or Structural Capital:

- Process Capital, measured by the value of capitalization of the most important firms in a country, refined by bureaucratic processes and the management systems implemented.
- Relation Capital, only feasible when trade balances are positive, filtered at the same time by the technology involved in the product or service exported and how competitive the country is.
- Image of the country in the rest of world, in which two angles are considered: internal, according to income and life expectancy of inhabitants, along with external, including tourist attraction backed by developed infrastructures.
- Innovation and Development Capital, which implies expenditure channelled to this area by the government budget, refined by indexes of technology utilisation (only data referring to telephone lines and Internet users are available).

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 Social and Environmental Capital, based on health expenditure by means of a filter summarising a set of indexes regarding hygiene and health together with those referring to the quality of the surrounding area. In this case, the statistical system is missing the item devoted to the environment for each country.

Despite limitations, an open system is proposed which can easily incorporate more information should it be available.

The model estimates the value of each country's intangibles, which if added to the tangible value of product (GDP), provide, in accordance with the proposed model, the real visible and non-visible wealth of a country. Table 1 displays the intangibles value of each country's (NIKC per capita), the wealth (visible and non-visible, that is GDP plus NIKC) value and two rankings of the countries using this indicators. Analysing the results of the NIKC and wealth per capita, the countries that recorded the highest scores were Luxembourg, Iceland, the Scandinavian countries, the United States, the United Kingdom and Ireland, whereas the Sub-Saharan Africa registered the lowest scores, with the exception of South Africa, ranked mid-table. Scores are generally speaking quite similar, because all the studies show that the highest level of intellectual capital is recorded in the most developed nations. Moreover, if we compare this ranking with the classifications from the World Bank (2006), Yeh-Yun Lin and Edvinsson (2008) in all three studies, the results are very similar. Therefore, the model proposed could be considered a coherent alternative for measuring national intellectual capital. In the same line, the studies reach the conclusion that intellectual capital divergent that is, there is an intellectual gap if this measure of wealth in nations as complementary to GDP were considered.

The intellectual capital of nations is correlated to GDP. However, the wealthiest nations are even more efficient in terms of knowledge than the poor nations. As a result, intangibles are widening the global gap in development. In terms of variation coefficient, we have results with 1.22 in GDP per capita and 1.77 for NIKC per capita. In addition, using intangible capital as a basis, we align this paper with the theory of endogenous growth, the management of said capital turning out to be a diverging factor for economic development. The inequalities between countries increase when measured in terms of hidden wealth.

As regards the average structure of intangible capitals for the 82 countries under analysis, human capital would account for 3.4%, while structural capital would represent 96.6%. Furthermore, the structural factor is more closely related to non-visible wealth or the NIKC than the human factor. Structural capital would be basically distributed as follows: processes 47.8% and image 41.9%, followed by social and environmental capital with 4.8% and relation and innovation capital with 1%. Therefore, on average, the private sector framework of a country and firm management systems, along with innovation and the internal and external image of a country account for close to 90% of non-visible capital. That is, the capitals of image and processes account for the bulk of the structure of the hidden wealth og a country.

Considering the relationships of different intangible capitals to GDP, are irrelevant to the case of external human and relational capitals. For the remaining cases are important, highlighting the order: training, image, R&D, social-environmental and processes. Thus, a pentagon is set for economic growth in terms of intellectual capital (Figure 2). However, problems arise when they do not develop in a balanced way. In

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this sense, former socialist economies were characterized by a relatively high human capital (education, etc.); however, they have lower structural capital. Furthermore, most human capital immigrated into the rich countries as it was shown in the study of the migratory flows of Nevado *et al.* (2010). This paper confirms that the migrations go to the rich countries because they achieve a more efficient management of the intellectual capital. Therefore, the economic growth of the richest countries, also in intangible or intellectual capital, attracts human capital and, this way, they are becoming richer; therefore, a balanced development of this pentagon of intellectual capital is necessary.





Source: Authors' own elaboration.

Finally, through analysis of the values for the efficiency or quality indicators we can conclude that richer countries are more efficient in managing their hidden wealth. These countries have a human capital pattern open to inflow of resources and they have a well trained human capital. In the case of structural capital indicators, they have high external image, are intensive in innovation, its processes are rapid and flexible and finally, they have high standards in international trade and sustainable welfare societies. On another hand, many developing countries have a pattern with high levels of social-environmental efficiency, but they lack, basically, flexible business structures and innovation, to show serious problems of evasion of quality human resources, because their internal training rates are high.

### V. Conclusions

In economics, it is becoming increasingly necessary to consider aspects beyond production in order to measure the wealth and social wellbeing of a country. Therefore, this paper proposes a model to determine the intellectual capital of nations. More specifically, various hidden capitals have been considered in order to provide a more truthful picture of the real economic potential of nations by means of a National

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Index of Knowledge Capital (NIKC), identifying indicators for each and assigning them to the capitals defined.

The advantages of this method include establishing a tool that generates comparable efficiency indexes, synthesized into the main strategies for intangible assets to create wealth via knowledge. Furthermore, intangible capitals are assigned a value through monetary items, which makes it possible to estimate them in economic terms and ascertain their relationship with the value of production (GDP). Finally, an indicator is obtained that enhances the picture and position of wealth in a country. The results include an estimation of the value of each country's intangibles that provides a tool for governments to measure their intangibles and, using this as a basis, control them, that is, design adequate strategies with policies aimed at enhancing their countries' image, market openness and flexibility, professional training, innovation and sustainability management.

The model has been applied to a worldwide scenario of 82 countries with sufficient statistical information for the year 2006, finding that, on average, the hidden value of wealth represents 93% of tangible wealth measured as GDP. Furthermore, non-human capital is a vital part of the non-visible wealth, and within this subgroup, the private sector framework, firm management systems and innovation, bureaucratic processes along with the internal and external image of the country, considering tourist occupation, accessibility, income, security and health, figured prominently. The results also confirm that the gap in terms of intangible capital is widening.

Finally, understanding integrated wealth to be visible plus non-visible wealth, the comparison in per capita terms draws a map in which the large regions of world development are maintained, albeit recording variations therein. Northern and Central European countries, together with the United States followed by Japan are the countries with the highest level of hidden intangibles.

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# Appendix

Table 1

Country - 2006	NIKC p. c.	Ranking	Wealth p.c.	Ranking		
Argentina	3951,37	42	9425,89	44		
Armenia	909,74	66	3031,89	65		
Australia	61650,24	12	96587,21	12		
Austria	48810,30	16	87687,93	15		
Bangladesh	116,81	78	513,64	79		
Belgium	52465,66	14	89822,02	14		
Bolivia	561,43	72	1785,72	71		
Botswana	3686,03	47	9609,33	42		
Brazil	3878,42	43	9518,60	43		
Bulgaria	2852,33	53	6967,50	52		
Chile	10712,28	27	19623,60	30		
China	1640,33	58	3666,46	64		
Colombia	1886,64	57	4864,63	58		
Costa Rica	3046,88	51	8100,38	51		
Croatia	9104,94	30	18770,01	31		
Czech Republic	11487,95	26	25414,93	26		
Denmark	75035,78	7	125693,12	6		
Ecuador	1385,76	62	4521,79	60		
Egypt, Arab Rep.	1094,09	64	2543,32	67		
El Salvador	1584,11	59	4342,58	61		
Estonia	10087,24	28	22450,62	28		
Finland	66908,79	11	106909,10	11		
France	54835,77	13	91477,87	13		
Georgia	878,67	68	2626,28	66		
Germany	42511,10	17	77677,42	17		
Ghana	65,00	82	617,63	78		
Greece	30119,05	20	57786,49	20		
Hungary	8723,64	31	19935,60	29		
Iceland	135114,11	3	188657,12	4		
India	571,74	71	1397,33	73		
Indonesia	897,23	67	2531,27	68		
Ireland	70680,54	9	122346,46	8		
Israel	28084,56	21	48241,02	22		
Italy	34125,42	19	65528,75	18		
Jamaica	4439,97	41	8197,87	50		
Japan	49075,57	15	83269,15	16		
Jordan	3855,80	44	6402,20	54		
Kazakhstan	3608.45	48	8899.99	46		
Kenya	283.20	76	906.37	77		
Korea	22367.42	23	40711.81	23		
Latvia	5203.56	39	13922.93	37		
Lebanon	1319.87	63	6931.85	53		

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Country - 2006	NIKC p. c.	Ranking	Wealth p.c.	Ranking
Lithuania	5994.91	37	14764.87	34
Luxembourg	230331.93	1	318970.08	1
Macedonia, FYR	1556.48	60	4686.11	59
Malawi	68.23	81	301.36	82
Malaysia	8700.15	32	14677.31	35
Malta	9455.43	29	25155.21	27
Mauritius	3808.88	45	8872.31	47
Mexico	5786.63	38	13848.37	39
Mongolia	535.47	73	1768.82	72
Namibia	1074.05	65	4282.56	62
Netherlands	67977.74	10	108494.79	10
New Zealand	25900.99	22	51107.15	21
Nigeria	340.98	75	1355.82	74
Norway	120304.56	4	192170.32	3
Pakistan	353.56	74	1151.46	76
Panama	3503.04	49	8703.62	49
Paraguay	635.79	70	2177.55	70
Peru	2284.70	55	5662.69	56
Philippines	817.14	69	2179.96	69
Poland	6436.44	36	15398.62	33
Portugal	18788.54	24	37186.08	24
Romania	3360.12	50	8993.39	45
Russian Federation	7353.14	34	14304.56	36
Slovak Republic	6457.42	35	16815.23	32
Slovenia	15390.89	25	34423.82	25
South Africa	8497.32	33	13877.95	38
Spain	37600.45	18	65360.52	19
Sweden	82801.41	5	125067.73	7
Switzerland	160968.46	2	211799.00	2
Tanzania	108.62	79	467.93	80
Thailand	2595.26	54	5853.31	55
Tunisia	1924.50	56	4981.56	57
Turkey	4651.24	40	11913.07	40
Uganda	96.70	80	414.29	81
Ukraine	1482.89	61	3785.91	63
United Kingdom	74509.91	8	113736.85	9
United States	82730.61	6	126698.51	5
Uruguay	2993.00	52	8818.28	48
Venezuela, RB	3686.68	46	10515.04	41
Zambia	281.53	77	1212.26	75

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