Index of Honesty and Efficiency in Public Infrastructure

Analysis of the Generation of Public Infraestructure in the last 30 years

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Foreword

The lack of adequate planning and investment in infrastructure has a strong negative impact on development standards. Investment on highways, seaports, railroads, telecommunications, energy and other kind of economic infrastructure becomes a necessary condition for countries if they expect to have better chances in increasingly competitive global markets, and to generate better opportunities for sustainable growth.

In Mexico, an accelerated process of economic modernization has been under sway during the last 30 years. In this way, for instance, investment in infrastructure has been one of the most important bases for the country's attractiveness in terms of foreign investment and for its competitiveness in international markets. However, there has existed a widely shared perception that the budgets invested in infrastructure have been always higher than the real cost of the public works left by the governments at the end of their terms. All three levels of government spend more in bridges, schools, hospitals, highways, roads, electric lines, and so forth, than the real existing infrastructure on these matters. Intuitively, the average citizen considers that he/she receives fewer public infrastructures than it should be according to the public expenditure in it. The problem is that such perception has been quite difficult to prove. Moreover, until now hard data have been never used to estimate the effective cost of the gap between what is invested and what really exists in matters of public infrastructure in Mexico.

This report presents an analysis of the cost of the effectively invested public expenditure in infrastructure for the three levels of government, federal, state and municipal, and the outcome constitutes the Index of Honesty and Efficiency in Public Infrastructure. The index is based on the gap between what has been effectively spent in public infrastructure during the last 30 years and the real existing public infrastructure in the country, once that some variables such as differentiated construction costs and natural disasters, have been controlled.

The argument underlying this report is that the gap between existing infrastructure and the money spent in building it represent missing resources lost either due to bad and inefficient planning and administration *and/or* corruption and misuse of public funds. At the end, it becomes impossible to determine with all certainty if the public works elevated cost is due to bad planning or to corruption, thus the index encompasses for both, which in any case is worrisome.

The novelty of the methodology used in building this index lies in the fact that it is based on hard data that can be verifiable since they were taken from official public sources, and not taken from perceptions and other sorts of opinion-based data used normally in corruption studies. Its methodology is based on the statistical proposal presented by Lucio Picci and Miriam A. Golden (*Economics & Politics*. 17(1), 2005) in their work on the Italian provinces. Both the outcomes of Picci and Golden's work and the ones presented

here open new ways of approaching the study of corruption based on hard data. This kind of studies implies the development of measurement techniques that may overcome the problems of validity and accuracy presented by opinion-based studies.

Index of Honesty and Efficiency in Public Infrastructure

The index reflects the gap between existing infrastructure and the money spent in building it by the three levels of government during the last 30 years. The index was calculated through the difference between two other indexes: the *Existing public infrastructure index* and the *Effectively spent public expenditure index*.

The first one tells us how much public infrastructure there exist in Mexico, the other calculates how much money has been effectively invested in building all public infrastructure during the last 30 years. In addition to these indexes, other variables are taken into account for generating the Index of Honesty and Efficiency in Public Infrastructure:

- Differentiated costs of construction material
- Differentiated costs of labor
- Differentiated cost of depreciation and maintenance
- Cost of natural disasters (if applicable)

Thus, the index shows the gap between existing infrastructure and what has been effectively spent in building it. As said before, the methodology employed cannot tell whether the existing gap is due to bad planning and mismanagement or to corruption. Notwithstanding, the index contributes significantly to the discussion on corruption in Mexico, since it calculates –for the first time—the amount of missing infrastructure in each of the 31 states plus the Federal District. Existing public records between 1970 and 2003 were used to generate the index.

Here a warning must be made: the index cannot be interpreted as a measurement of inefficiency or corruption of specific years or governments, but as an accumulated loss of public infrastructure in the last 30 years.

Index data

The index is composed by two other indexes, the *Existing public infrastructure index* and the *Effectively spent public expenditure index*.

I. Existent infrastructure

The records taken into account for calculating the infrastructure index include the following:

- Urban public works (roads, streets, ways, etc.)
- Electricity and energy

- Schools
- Hospitals
- Inter urban roads and highways
- Federal roads
- Motorways
- Bridges
- Railroads
- Airport infrastructure
- Sea ports
- Telephonic infrastructure (before privatization)
- Telegraphs
- Satellite and microwaves
- Irrigation
- Water supply
- Drainage
- Installed capacity in the oil and gas industries.

The year 2003 is taken as a base for the recording of existing infrastructure data and many different sources were used including the National Institute of Statistics, Geography and Informatics (INEGI), the records of the Federal Electric Commission (CFE), data from the Secretariat of Energy, records of PEMEX, data from the Secretariat of Social Development, from the Secretariat of Health, from the Secretariat of Communications and Transports, and the Secretariat of Education, among many other sources. As the data were obtained in different units of measurement (kilometers, number of beds, number of classrooms, etc.), it was necessary to standardize the numbers in order to work with aggregate data.

All goods that were considered as "spatial public services" such as roads or railroads were normalized by the size of the geographical unit where they are located: number of roads per square kilometer; while all other goods considered as "community public services" such as public buildings were normalized by the size of the population in which there are located: number of hospital beds per each 10,000 inhabitants. For each kind of goods an index was created running from 0 to 100 and dividing each state by the maximum value found among all 32 states in Mexico.

The indexes of all the different goods were then aggregated. Goods composed by one single category (i.e. transport) were averaged arithmetically, while goods composed by many categories (i.e. hospitals) were averaged geometrically. The reason to use these two kinds of calculations is because geometric mean is more sensible to extreme values than arithmetic mean. The outcomes are expressed on a one hundred-base, so for instance a state showing 130 in highways, once that aspects such as territorial size and population have been controlled, means that it has 30% more highway infrastructure than the national average.

II. Stock of capital invested in infrastructure

The second index created was the *Effectively spent public expenditure index*, which takes into account the whole stock of capital invested in public infrastructure by all three levels of government (federal, state and municipal) during the last three decades. The calculation of such index was obtained through a cumulative measure of the price that the government paid for infrastructure expenditures using the *perpetual inventory method* (PIM), which serves to calculate capital assets.

The PIM consists of aggregating the amounts of investment and deducing at the same time the estimated depreciation. The PIM is the most used econometric method to measure public capital stocks. Accordingly, all previous past capital generated is translated into constant prices, while at the same time the value of all assets is deduced until the end of the assets' useful service life. The following equation explains better the way the PIM is calculated:

$$K_t = \sum_{i=0}^{SL} I_{t-i}$$

Where K_t represents capital stocks and I_t stands for investment. Past investments contribute to increase capital stocks, except when they have reached the end of their useful service life. In such case, the invested assets are not counted anymore.

To obtain the estimated cost of the actual capital stock is necessary to calculate the generation of previous capital, starting with an initial estimation. However, since the invested assets are not counted anymore at the end of their useful service life (every 25 years), the initial estimation is not necessary after a certain number of years.

The information used was gathered across a large number of databases, as INEGI databases, diverse federal secretariats databases and yearbooks, the Federal Public Account, states' public accounts, the Central Bank (Banco de México), *Informes presidenciales* and their statistical reports, among many others. With the information collected –encompassing more than thirty years, from 1970 to 2003—it was possible to estimate for each state (and the Federal District) public investment amounts per year, identifying as well different types of public works and the administrative unit responsible for such works. Our analysis includes new works, re-structurations, maintenance costs for actual infrastructure, major repairing, and other resources channeled to building and /or preserving public infrastructure. In this work, public infrastructure investment was considered only when:

1. Total investment was made from the federal government.
2. Total or partial investment was made from states and local governments (municipalities).

3. Total investment was made from other public institutions (PEMEX –the public oil company--, CFE –a public energy company—etc.).

Infrastructure investment data were divided in the following categories:

- Electricity and energy
- Schools and public buildings
- Public health and hospitals
- Roads, ways, motorways and highways
- Railroads
- Airports and sea ports infrastructure
- Telecommunications
- Water supply and drainage
- Other (i.e. oil and gas industries; tourism infrastructure, etc.)

Infrastructure investment was calculated firstly through an aggregation of data by state and by kind of public assets between 1973 and 2003. There were obtained 288 time series –one for each state and kind of asset. These time series were used to calculate the capital stock of each state using PIM, which was applied to each state. This means that PIM was used for each of the nine categories mentioned above in each of the 32 states. Then we employed a similar method to the one used to calculate existent public infrastructure, i.e. we normalized and standardized the date by territory and population in order to generate an index of capital invested in infrastructure.

III. Controlling costs

There are a number of factors affecting the price that is paid for a public asset in different geographical regions. Some of these factors are:

- Labour costs
- Transportation costs
- Geographical conditions
- Cost of goods and other services

A regional index of building costs was defined to consider the average cost of construction in the different states using information of 2003 that included the average prices of labour, cement, sand, and other basic materials for construction. In this way our aim was to calculate the public investment in the creation of infrastructure taking into account some of the factors that may affect the building and maintenance costs conditions. In that way, it was built and index of perpetual inventories that takes into account the regional and geographical differences in order to strengthen the accuracy and validity of the measurement. In the same way, the impact of yet another kind of factors was estimated as well, such as:

- Altitude (i.e. the different cost of building on plains than on mountains)
- Population density.
- Natural disasters that have had impact on public infrastructure (schools, roads, etc.)

The outcome, then, are two groupings of data –two indexes—that can be contrasted and compared against each other, and whose outcome is reported here as the Index of Honesty and Efficiency in Public Infrastructure. The Index gives information about the gap between existent public infrastructure and the investment paid for its building and maintenance.

In sum, with the first data grouping –the *Existing public infrastructure index*—it is possible to know the amount of public infrastructure that exist in each state; whereas with the second data grouping –the *Effectively spent public expenditure index*—it is possible to estimate how much has been spent for building such infrastructure. The gap between both indexes tells us about the resources that were effectively invested in public infrastructure, but no material infrastructure was actually built.

The obvious question is: Where are the resources spent in constructing infrastructure that was never built? We can only speculate about the answer. The closer we can get to an answer is to say that the gap shown in the index tells us that either the resources were inefficiently invested for building actual infrastructure (i.e. paying more for what was built) or they were never channeled to the construction of infrastructure (i.e. deviated into different corruption practices). The Index thus contributes as another useful instrument for public accountability, which is a fundamental ingredient for consolidating more transparent and efficient governments.

Outcomes and Data Analysis

As said above, the Index shows the proportion of public resources inadequately spent in the construction of public infrastructure, be it for lack of honesty or bad administration. The data on Table 1 show the ranking of the states in the Index of Honesty and Efficiency in Public Infrastructure.

Table 1

Index of Honesty and Efficiency in Public Infrastructure

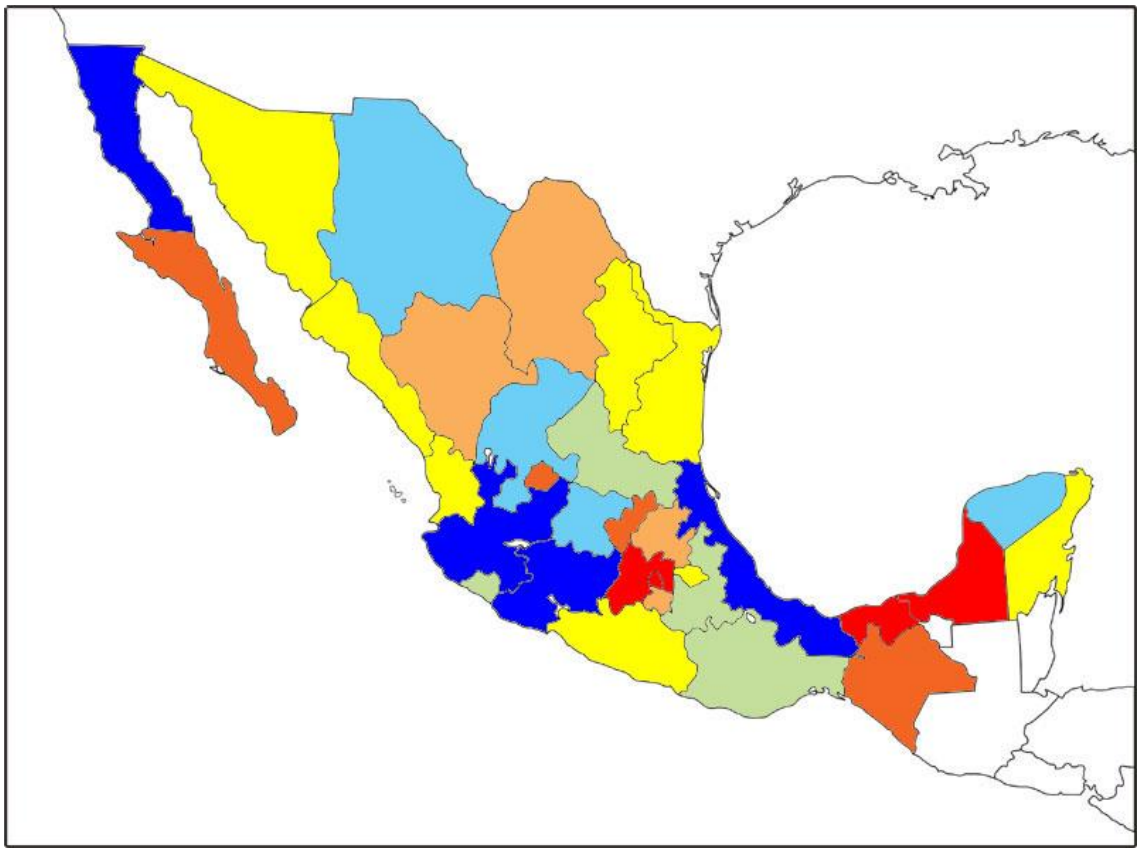
Position	*Federal Entity*	*Score*
1	Michoacán	0.1490513
2	Jalisco	0.32822616
3	Baja California	0.43400239
4	Veracruz	0.43547927
5	Colima	0.44511151
6	Puebla	0.45714477
7	Oaxaca	0.50334142
8	San Luis Potosí	0.55103789
9	Zacatecas	0.55768067
10	Chihuahua	0.56511104
11	Yucatán	0.56966003
12	Guanajuato	0.57453171
13	Sonora	0.57738206
14	Nuevo León	0.59271794
15	Tlaxcala	0.64296533
16	Sinaloa	0.64728521

Position	*Federal Entity*	*Score*
17	Tamaulipas	0.65567944
18	Guerrero	0.66160682
19	Nayarit	0.66630999
20	Quintana Roo	0.67692203
21	Durango	0.73256212
22	Morelos	0.74318437
23	Hidalgo	0.74955744
24	Coahuila	0.74979504
25	Aguascalientes	0.75004896
26	Baja California Sur	0.75503851
27	Chiapas	0.82087271
28	Querétaro	0.9956475
29	México	1.12631042
30	Tabasco	2.35526722
31	Campeche	3.23785172
32	Distrito Federal	5.79325788

In the Index the numbers must be read as follows: for instance, in the case of the Distrito Federal the number means that that in the last thirty years it has spent nearly six times more resources in infrastructure than the cost of its actual infrastructure. On the contrary, the state of Michoacán has spent 0.15 times more money in building the infrastructure it really has.

If the Index is considered as a whole, it can be observed that as an average each state should have two times the infrastructure they actually have. This situation alerts us about the serious deficit of infrastructure in Mexico in relation to the amount of resources *effectively* invested in it. In the majority of the states, around sixty percent of the public expenditures in infrastructure have not been transformed into existent infrastructure.

At this point it is important to note that this problem is not exclusive of specific governments (ruling parties) or regions. Problems are found along the whole country, though differences can be seen. The map below shows that the problems detected by the Index cannot be explained on a regional basis.



0.14-0.435	
0.44-0.551	
0.557-0.574	
0.577-0.67	
0.73-0.74	
0.75-0.99	
1.12-5.79	

More Efficient/Honest Investment

Less Efficient/Honest Investment

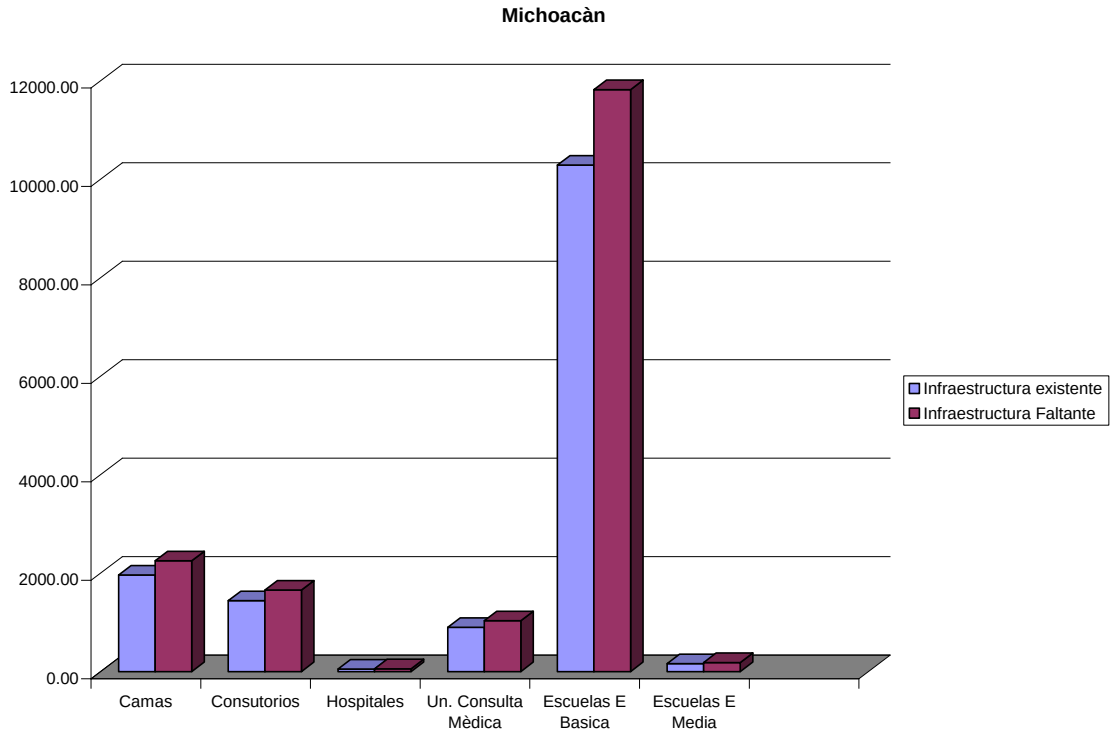
An additional advantage of this index is that it enables the observer to obtain individual state's data so it is possible to know the gap between different kind of existent infrastructure and the money that has been paid for it. Thus, it is possible to note specific aspects from the states' infrastructure. For instance:

Michoacán, the best-ranked state, should have, *additional* to its actual infrastructure:

- 6.41 more hospitals, 128.7 more medical units, 7.45 more beds and 6.10 more individual medical cabinets for each 100,000 inhabitants.

- 1533 more elementary schools and 25 more mid-level education schools.

- 120,344 more houses with energy, 112,144 more houses with water supply and 94,231 more houses with drainage.

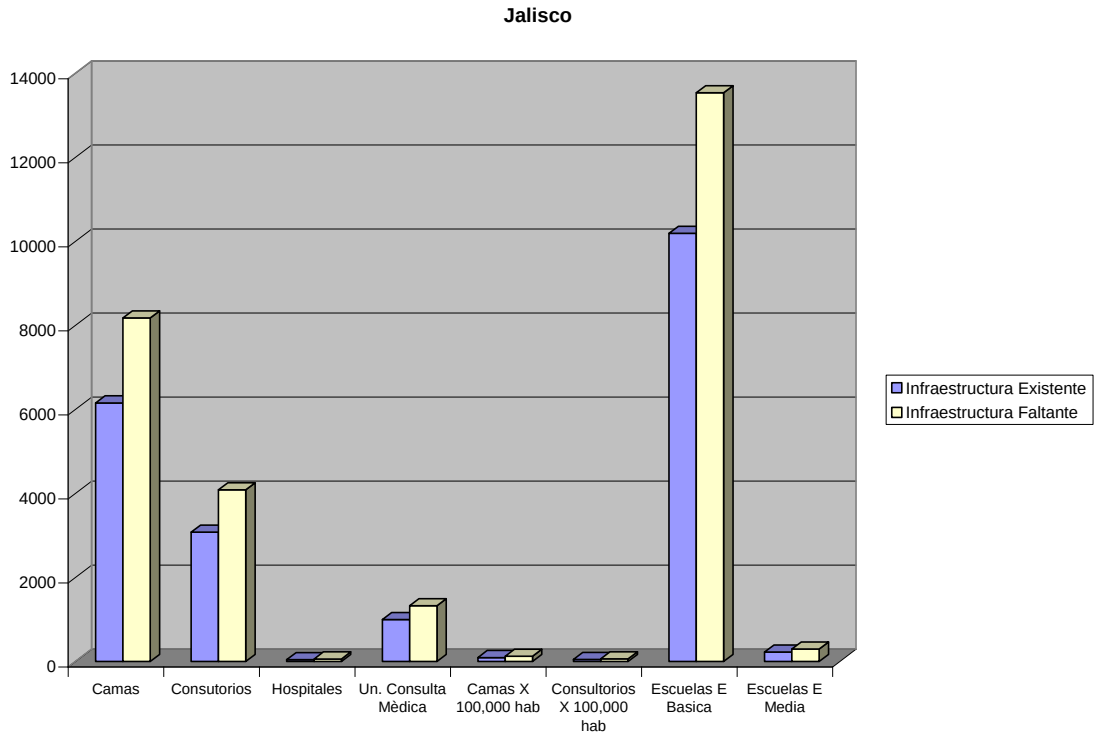


Jalisco, the second best-ranked state, should have, *additional* to its actual infrastructure:

- 14.7 more hospitals, 327 medical units, 30.6 more beds and 15.29 more individual medical cabinets for each 100,000 inhabitants.

- 3,345 more elementary schools and 73.19 more mid-level education schools.

- 441,201 more houses with electricity, 420,385 more houses with water supply and 415,408 more houses with drainage.

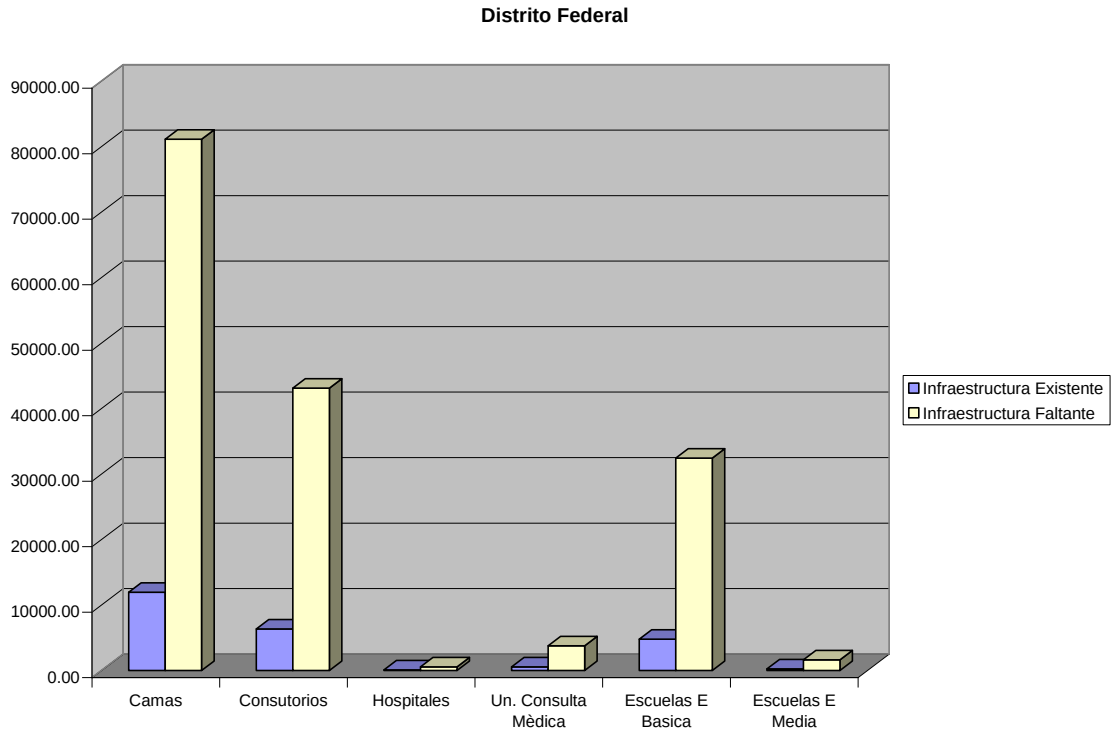


In the Distrito Federal, the worst ranked state, there should be, *additionally* to the actual infrastructure:

- 579% more hospitals and medical units than there actually are, i.e. 631 hospitals, 4,049 medical units and, 1,093 beds and 517 more individual medical cabinets for each 100,000 inhabitants.

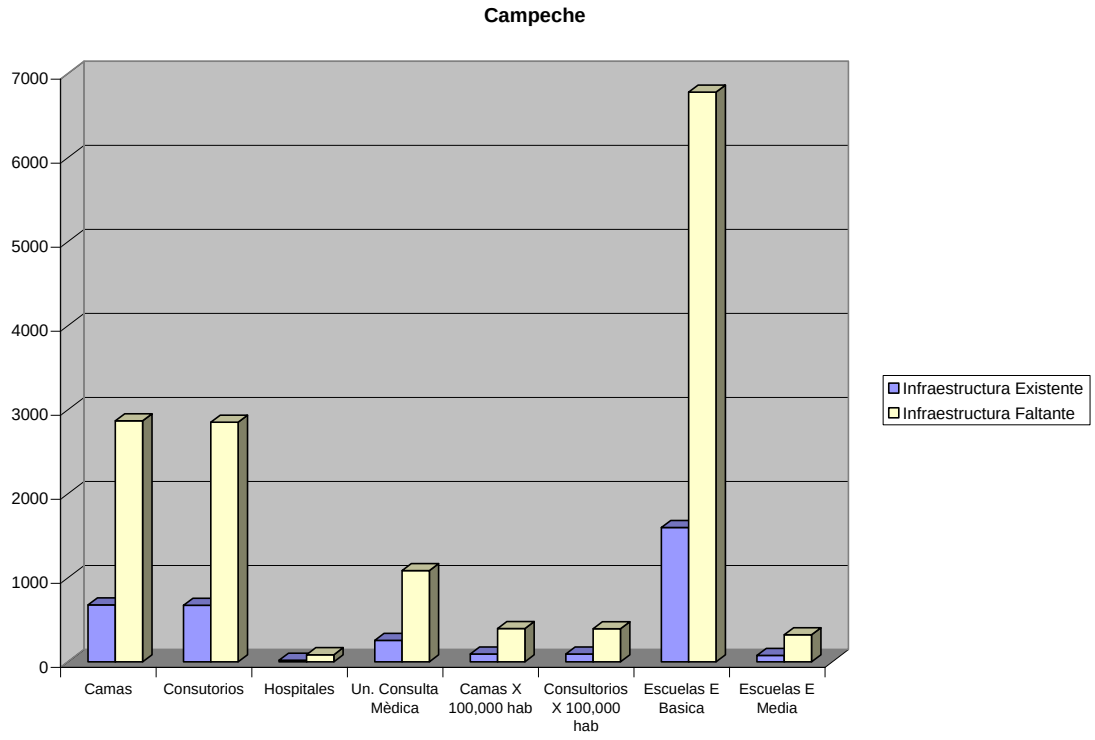
- 579% more elementary and mid-level schools that there actually are, i.e. 27,645 more elementary schools and 1,558 mid-level education schools.

- In terms of housing, Distrito Federal should have already covered the whole demand for drainage, water supply, and electricity, besides covering up their maintenance costs as well.



Campeche, the second worst ranked state, should have, *additional* to its actual infrastructure:

- 64.75 more hospitals, 828 more medical units, and 303 more beds and 301 more individual medical cabinets for each 100,000 inhabitants.
- 5,180 more elementary schools and 246 more mid-level education schools.
- 461,024 more hoses with electricity, 404,913 more houses with water supply and 322,515 more with drainage.



Importance of the Index

To verify the reliability of the study we designed a regression to control the correlation between this index and the data contained in the indexes elaborated by the Center of Strategic Studies of the Instituto Tecnológico y de Estudios Superiores de Monterrey (*Governance and Entrepreneurial Development*, 2002). The indexes used in the correlation were:

- Index of Corruption due to State's Capture (*Índice de Corrupción de Captura del Estado*), and

- Index of Bureaucratic-Administrative Corruption (*Índice de Corrupción Burocrática-Administrativa*)

The correlation (R^2) was .8967 and .8634 respectively. This means that, in both cases positive significant results were obtained, which gives an acceptable degree of reliability to the Index of Honesty and Efficiency in Public Infrastructure.

Some of the benefits obtained with the Index of Honesty and Efficiency in Public Infrastructure are:

I. Benefits for the private sector

- The Index is useful to determine in an aggregate way in which states it is more profitable to invest in economic infrastructure, such as highways, telecommunications, etc.
- For the private sector, the Index is a means to analyze the risk of investment at the local level.
- The Index shows that higher profits for the private sector could be expected in states with better infrastructure, since better infrastructure has positive impacts on costs of production and transportation.
- Since public social infrastructure is also measured, the Index could be used as a means to know in which states their population has better education, health and social services, which could indirectly have a positive impact on profits.

II. Benefits for the population in general

- The Index is a ranking that tells the citizens which states are more efficient and honest in their investment in public infrastructure.
- The citizens have an accurate radiography about the areas in which states must be more careful in fighting bad practices and improving surveillance over the uses of public resources.
- The Index serves as a measurement parameter for monitoring the honest and efficient performance of the states in the generation of public infrastructure, which serves as a citizenship tool for watching against corruption.

III. Benefits for the government

- The Index serves as an indicator based on hard data that helps in the efforts against corruption.
- The Index data avoid subjectivity and interpretation.
- The Index can be used as a medium- and long-term indicator of improvement in the allocation and investment in public infrastructure

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