

Investigating Public Governance in the Water Sector Management across 44 Countries

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Abstract

Why do countries all over the world attain different results in implementing regulatory policies? We focus on the water sector management and argue that insufficient organisational capacity of administering the phases of design, implementation and enforcement of regulatory policies is associated to poor environmental performance. While studies on the governance of regulation are often characterised by a descriptive approach or criticised because of its partial regulatory pictures and because of being too reductionist, our purpose is to provide a quantitative, more systemic and sophisticated analysis of the impact that the public governance, meant as an organisation, exerts on water sector performance: this impact is amplified by the socio-economic context in which the public governance is embedded.

Keywords: Public Governance; Regulatory Policy; Water Sector Performance

Introduction

Why do countries all over the world attain different results in implementing regulatory policies? We argue that a weak and ineffective public governance of the water sector is associated to poor environmental performance. Improving public governance, that is the national government's organisational capacity of administering the phases of design, implementation and enforcement of regulatory policies, has become a priority all over the world: policy-makers have realised that the design of policies at a certain level of government can be compromised by excessive fragmentation of competences and organisational problems at the stage of implementation, low expertise in preparing technical plans and operational programmes, lack of capacity to enforce legal obligations through inspections and controls, and so on.

For public governance we mean the ensemble of public actors in charge of designing, implementing and enforcing a given regulatory policy and understand it as an organisation in which it is relevant the capacity to supervise and coordinate the plenty of public entities involved in the political, regulatory and administrative processes. Scholars and researchers investigated the negative implications that derive from the presence of multiple and conflicting public bodies (each one has its own objective and

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tools), as well as from organisational impasses, on the performance of economies, industrial sectors and firms from very different points of view. Concerning the effects on national economies, we could mention Okten (2001) who analysed the effect of governmental bureaucracy size on investments and growth, while with regards to the adverse effects on entrepreneurs' conducts and performance, we might refer to De Soto (1989) who examined the time and cost of setting up new businesses in Lima (Peru) and identified the weight that an absent or inadequate regulatory and administrative frame would put on transactions.

Nonetheless, the study of the impact that such highly fragmented, complex and multi-tier public institutional setting produces on performance was only partially addressed on both the theoretical and applied level. On the former, it seems that economics has substantially neglected to investigate the nexus of connections among the public actors involved in regulatory regimes. Such a lack of attention might be partially routed in the mainstream Public Economics which, as well known, assumes the regulator as a single entity, with a perfect ability to commit and endowed with a clear objective function. However, also more recent theoretical developments, such as the Multi-principal agency theory, are not satisfactory in this sense (section 2). On an applied level, studies on the governance of regulatory policies are often characterised by a descriptive approach or criticised because of its partial pictures and because too reductionist.

We deem that to study the governance of regulation we cannot restraint from investigating the internal working of the public institutional setting, assessing the government's organisational capacity of managing multiple entities. All in all the final outcome of a policy is dependent on its actual implementation by the plenty of public bodies implicated in the political, regulatory and administrative processes, and implementation, as will see, depends on a series of specific, mutually interdependent, features of the public governance: governmental authority over the administration, co-ordination and cooperation between ministries, governmental capacity to decide on and really implement political and non-political reforms, existence of discord between economic, regional or other factions, regional co-operation, and so on.

We circumscribe the scope of the analysis to the impact produced by the public governance (that is, the organisational capacity of administering the phases of design, implementation and enforcement of regulatory policies) on sector performance and, more specifically, on the water resource management.

In this paper we take for granted the high fragmentation of regulatory functions and competences. Given the excessive fragmentation of competences, we perceive as extremely high the number of interactions and the risk of political, regulatory and administrative struggles (i.e., power rivalries and conflicting agendas) between entities. For such a reason it is relevant to investigate public governance as an organisation in which the national government must supervise and coordinate the multiple institutions involved at national, regional and local levels. If vertical (across tiers of governance) and horizontal (among bodies at the same tier of governance) connections are distorted

by divergences between public entities or not adequately administered, a series of negative implications might arise: overlapping competences, conflicts of interests, complex decision-making processes, longer administrative procedures, and so on. This in turn entails a suboptimal allocation of resources and poor sector performance.

It is not to say that the appraisal of the socio-economic context, in which the public governance is rooted, is crucial in our analysis. Each country has its own level of development (in terms of knowledge and education, standard of living, etc.), institutional heritage and historical transformations, which are essential determinants of our understanding of public governance and of the effectiveness of political, regulatory and administrative processes.

In section 3 we provide our contribution to the empirical investigation on the relationship between public governance of water resource management and wastewater performance. We develop a multivariate analysis whereby, before tying the two variables above, we link several variables of public governance to each other, together with the human development index (HDI), in a non-linear way and take into account their mutual effects properly and simultaneously to elaborate an original measure of the governance as organisation. In section 4 we discuss the results: it emerges that a weak and ineffective public governance is associated to low environmental performance. In section 5 we conclude.

Public Governance in Theoretical and Applied Research

In this section we provide the reader with a basic theoretical frame, emphasise main similarities and conflicts with our study perspective and outline the major implications for applied research.

According to the Multi-principal agency theory, governmental activity might be deemed as coming from a group of different principals: even though “as a whole” these principals would seem to pursue the general or public interest (like a single benevolent regulator), if we identify them singularly we realise that each one has only a limited mandate to fulfil (that is its own regulatory mission) and, hence, only a partial view of the regulatory stake. For instance, an environmental agency is turned to the sole protection of the environment, which is an important but circumscribed aspect of the social welfare, while a sector-specific regulator aims at designing a certain methodology of price determination and monitoring on its correct adoption by service providers (Estache and Martimort 1999, Moe 1986, Baron 1995 and Martimort 1996).

Nonetheless, the fact that multiple public bodies compete among themselves, take only a limited and biased view of the issue at stake and adopt non-cooperative behaviours is inconsistent with what we observe in the real world, where public actors are embedded in institutional settings in which regulatory functions are fulfilled under the supervision of someone or in coordination with each other. Identifying the factors that determine a certain regulatory outcome cannot disregard a proper assessment of the working of the public governance as organisation.

We argue that a weak and ineffective public governance shrinks environmental performance. Several factors co-intervene: excessive fragmentation of competences and organisational problems at the stage of implementation, low expertise, lack of enforcement, and so on. To circumscribe the study to the issue at stake: how to reduce the negative implications of such institutional fragmentation? The excessive number of public entities involved in the water sector management urges for well defined, functional and comprehensive institutional and organisational strategies.

Several institutions are working in this direction in diverse sectors. With regards to the waste sector, for example, the European Commission launched a feasibility study to outline the benefits and costs of creating a dedicated Agency to support the implementation and enforcement of EU waste legislation. The study, prepared by Milieu Ltd, AmbienDura and FFact, concludes that creating an EU Agency for waste implementation would provide the best institutional option. In the framework of the “Horizontal Programme on Water” (2009-2010), the OECD initiated an extensive research programme on the relevance of interdependencies between different levels of governance and across the many public actors involved in water policy. The purpose of the programme is to help policy-makers to improve supervision and coordination on both the vertical and horizontal dimension.

Nonetheless, the approach adopted in all these policy documents, as well as in many scientific studies on the governance of regulatory policies, is often descriptive and the output and prescriptions are usually criticised because of its partial pictures. In this sense it might be indicative a speech given by Aziza Akhmouch (Policy Analyst at the “Public Governance and Territorial Development” Directorate, OECD) at Arnhem (The Netherlands) in 2009 in which, among the mechanisms of horizontal coordination, she identified: - the existence of a Ministry of water; - the role played by Central Agencies and line ministries (such as the *DEFRA* in the UK or the Council of ministers in Bulgaria); - ad hoc high-level structures (e.g. *Conseil Supérieur de l’Eau et du Climat* in Morocco or the *Federal Water Resources Agency* in Russia); - Inter-ministerial commissions and committees (*Mission Interministérielle de l’Eau* in France or the *Water Fund Committee* in Hungary).

Do regulatory outcomes really depend on the setting up of the *right* institution at the *right* level? We intend to emphasise that we cannot appreciate the effects that these new institutions, offices or committees would produce if we do not consider the public governance as an organisation, taking into account all public actors at national, regional and local levels and their interdependencies.

It can be drawn a necessity to look at governance in a more comprehensive way and approach its study in a quantitative and more systemic manner, without recurring to oversimplifications.

All in all the fact that the public governance (as organization) produces effects on the final outcome was substantially neglected by empirical literature. A survey of empirical

studies closer to the theoretical path of Multi-principal agency and more conscious of the relevance of the governance was provided by Estache (2006): most of these works pertain the effects of corruption and governance on utility performance. Some of the corruption and governance indicators time by time chosen by researchers are the following (in parenthesis the definition provided by the “Worldwide Governance Indicators” of the World Bank): - control of corruption (which measures the extent to which public power is exercised for private gain); - government effectiveness (i.e., among many other variables, the degree of independence of the public service from political pressures, the quality of policy formulation and implementation, and so on); - regulatory quality (which measures the ability of the government to formulate and implement sound policies and regulations); - rule of law (i.e., the quality of contract enforcement, the police, and the courts, etc.).

Rossi and del Bo (2004), Estache and Kouassi (2002), Estache, Goicoechea and Trujillo (2006) tested the statistical significance of country-wide corruption measures on infrastructure performance. Estache and Kouassi (2002), for example, showed that corruption is negatively linked to efficiency, while good governance has a positive effect. As a consequence the authors underlined the need to investigate the effects produced by institutional variables on utility performance: governance issues and weak regulatory institutions are important factors (jointly with further considerable sources which are already subject of deeper theoretical and empirical investigations, such as the public/private ownership, lobbying and regulatory capture, etc.) that contribute to explain why utility tariffs would exceed production costs.

We recognize that in this literature governance is a significant driving factor of sector and firm performance. However, applied research usually relies on aggregate measures of governance which do not allow to perceive the internal working and the organisational capacity of administering multiple public entities. As said above the final outcome of a regulatory policy is dependent on its actual implementation by the plenty of public bodies implicated in the political, regulatory and administrative processes and this, in all evidence, depends on a series of specific, mutually interdependent, elements: governmental authority over the administration, co-ordination and cooperation between ministries, governmental capacity to decide on and really implement political and non-political reforms in various matters, existence of discord between economic, regional or other factions, regional co-operation, and so on.

It has been the need to take in such mutual effects between different features of the governance that convinced us to opt for the adoption of a more sophisticated methodology, the self-organising maps (SOMs): through them, in effect, we are able to link the above listed indicators of public governance to each other in a non-linear way.

Public Governance and Environmental Performance

In this paper we propose an analysis of the public governance “as a whole” and provide a more comprehensive quantitative representation of its institutional and organisational

dimension. Given the excessive fragmentation of competences, which we take as exogenous, it is high the number of interactions and the risk of political, regulatory and administrative struggles (i.e., power rivalries and conflicting agendas) between public entities. Therefore, it is relevant to take account of the national government's capacity to supervise and coordinate the plenty of public entities involved in the political, regulatory and administrative processes.

We refer to the ensemble of public actors in charge of designing, implementing and enforcing a given regulatory policy and represent it as an organisation. We develop a multivariate analysis whereby, before tying public governance to performance in the management of wastewater, we link several variables of public governance to each other by non-linear relationships and take into account their mutual effects properly and simultaneously to elaborate an original measure of public governance. As said above the plenty of public bodies implicated in the political, regulatory and administrative process has to be supervised and coordinated and its overall impact depends on a series of specific, mutually interdependent, features: governmental authority over the administration, co-ordination and cooperation between ministries, governmental capacity to decide on and really implement political and non-political reforms, existence of discord between economic, regional or other factions, degree of regional co-operation, and so on.

Our purpose is to provide a quantitative, more systemic and sophisticated analysis of the impact that the public governance exerts on wastewater performance: this impact is amplified by the socio-economic context (i.e., the HDI) in which the public governance is embedded. It emerges that a weak and ineffective public governance is associated to poor environmental performance. In effect, the output is an embryonic model by which to explore the robustness of our conjecture: the public governance, as predictably associated to the HDI, is also strongly associated to the performance of economies and sectors.

We gathered information on the volume of wastewater produced and treated (last available year) in 44 countries all over the world from the Aquastat database (Food and Agriculture Organization, FAO): we calculated the ratio between the volumes of wastewater produced and treated and used it as proxy of which countries do care and which do not about wastewater standards.

We also collected data on public governance variables from the Institutional Profiles Database 2009 (French Ministry for the Economy, Industry and Employment; French Development Agency and Maastricht Graduate School of Governance). Among these: - "Government's authority over the administration" (reference *A3113* in IPD 2009); - "Co-ordination and cooperation between ministries (*A5010*); - "Co-ordination and co-operation within administrations (*A5011*); - "Is government action guided by a long-term strategic vision?" (*A5020*); - "Government capacity to decide on and really implement non-political reforms in environmental matters" (*A3124*); - "Is the capacity

of the national authorities hindered by discord between economic, regional or other factions?” (*A5071*); - “Is the capacity of the public authorities hindered by a lack of regional co-operation?” (*A5073*).

Each institutional indicator is a numerical variable in the form of ordinal scales with the level of performance which could range from 1 (if low) to 4 (if high)¹. We also used data at national level on the HDI that is a good indication of the socio-economic context in which public governance is rooted. To provide a quantitative, more systemic and sophisticated representation of public governance we made use of the so-called SOMs, a specified neural network architecture (see Kohonen 1995), to link the above variables of public governance to each other, together with the HDI, in a non-linear way².

In doing so, we are able to take into account properly and simultaneously their mutual effects and get a more consistent perception of the working of public governance as organisation. This aspect is crucial in our analysis: it is accepted that all the seven variables of public governance listed above (plus the HDI) are reciprocally interdependent and these parallel interdependencies determine the overall government’s organisational capacity of administering the phases of design, implementation and enforcement of regulatory policies. To make it simple let consider two exemplifications to answer consequentially: Why do we need to look to interdependencies between institutional variables? Why do we need to look at institutional variables all together?

The former question can be addressed by investigating the effects that a high HDI has on all institutional variables: just to mention one, if it is high the educational background and level of knowledge (i.e., the HDI is high) of those people in charge of political, regulatory and administrative processes, in all likelihood also the government’s authority over the administration would be stronger (as well as the existence of discord between economic, regional or other factions would be less apparent) than in case of a poor HDI. In all evidence, this is true in absolute terms for any feature of public governance.

Concerning the latter question, we reasoned as follows. A national government would perform satisfactorily in terms of organisational capacity in all these three circumstances (circumscribing the scope of the example to institutional variables *A3113* and *A5010*):

- it is very capable in supervise over the administration (*A3113*), even if coordination and cooperation between ministries is weak (*A5010*);
- it is very capable in coordinating, but it is less in supervising;

¹ See the document entitled “Institutional Profiles Database III” available at cepii.fr for an overview of the database.

² SOMs have attracted a great deal of interest among researches and practitioners in a wide variety of fields, from engineering sciences to medicine, biology, and economics (Deboeck, 1999).

- its capacity of supervision and coordination is moderate.

It means that we cannot understand what is the contribution of indicator *A3113* to public governance as a whole if we do not account for all other institutional features in a parallel way. Moreover it highlights the necessity of appreciating simultaneously the effects that institutional features exert on each other. Looking at the existing non-linear relationships between all institutional variables (included the HDI) for all the countries in the sample, SOMs represent a more sophisticated tool than, for example, a covariance matrix by which we would be able only to observe linear relationships and not to derive any clear insights from data.

Discussion of Results

In SOMs the characterising element is a layer, even called “Kohonen layer”, made up of spatially ordered processing elements (hereinafter, *PEs*). This layer evolves during the learning, specialising the position of each *PE* to point out important statistic features of input data: such a spatial organising process is also known as “feature mapping”.

Feature maps consist of two layers: a (mono-dimensional) input layer, with a processing element (*PE*) for each of the N input components $X=(x1, x2, \dots, xN)$, and a layer (typically bi-dimensional, here the “Kohonen layer”) made of a certain number M (with $M=MC*MR$) of *PEs* organised in a grid of $MC*PE$ per row and $MR*PE$ per column. The generic *PE* in the Kohonen layer is labelled PE_r with $r=1,2,\dots,M$.

The input layer is connected to the Kohonen layer: it is important to stress that each *PE* in the Kohonen layer is affected (and, hence, its value is altered) by all the *PEs* in the input layer. A specific vector $W_r=(w_{r1}, w_{r2}, \dots, w_{rN})$, whose elements are given by the weights relative to the connections with the input *PE*, is associated with the generic PE_r in the Kohonen layer. It is useful also to underline that the input layer works as a “buffer” layer: this means that its *PEs* will not change the input values.

The output is computed through the Kohonen layer and is given by the position of the *PE* in the grid, which takes discrete values. Note that the Kohonen layer is not a simple output layer, but is the “core” layer in the network used by the algorithm; during the learning process input vectors are introduced randomly until an equilibrium state.

In Figure 1 the neighbourhood *PE* is defined in a two dimensions space, made up of the *PEs* of the Kohonen layer: obviously this is the only possible graphical representation whatever the number of the dimensions of the input space (i.e., the number of observed variables).

It is shown a strong similarity between *A3113* (the Government’s authority over the administration), *A5071* (the fact that the capacity of the national authorities is not hindered by discord between economic, regional or other factions) and *A5073* (the capacity of the public authorities is not hindered by a lack of regional co-operation): the red colour, which stands for the existence of a high correspondence, is on the left at the

bottom. Since it is the same for *WwTreat_p*, we derive that a considerable marginal productivity on environmental performance is associated to *A3113*, *A5073* and *A5071*.

It is important to underline the net overlap between most public governance indicators, HDI and *WwTreat_p*. First, supervision (Government's authority over the administration", *A3113*) and wastewater performance are strongly associated in those countries with a high HDI, while correspondence is substantially absent in countries with a low HDI. Secondly, countries with a low HDI but high environmental standards in wastewater treatment have high performance in coordination (Co-ordination and cooperation between ministries, *A5010* and Co-ordination and co-operation within administrations, *A5011*), but not in supervision.

Therefore, it exists a trade-off between levels of supervision and performance in coordination: with the exception of a few cases, we do not observe a coexistence of high performance in both supervision and coordination. Coordination seems to outweigh low levels of HDI.

Conclusions

Our purpose was to provide a quantitative, more systemic and sophisticated analysis of the relationship between the public governance, meant as organisation, and water sector performance: this impact is amplified by the socio-economic context in which the public governance is embedded.

Merging two different datasets we collected data on 44 countries and made use of the so-called "self-organising maps", a specified neural network architecture, to develop a multivariate analysis whereby we linked several variables of public governance to each other, together with the human development index, in a non-linear way, took into account properly and simultaneously their mutual effects and found out a significant correspondence between public governance and wastewater performance.

We provided an embryonic model by which first to explore the underlying (non-linear) relationships between mutually interdependent indicators of public governance, the HDI and water protection and, secondly, support empirically the robustness of our thesis.

As seen above there is a strong correspondence between some indicators of public governance and wastewater performance. It is essential to underline the existing association between on one side the Government's authority over the administration (*A3113*), the fact that the capacity of the national authorities is not hindered by discord between economic, regional or other factions (*A5071*) and that the capacity of the public authorities is not hindered by a lack of regional co-operation (*A5073*), and the waste water ratio on the other.

It is interesting to notice that the HDI largely overlaps with selected indicators of national government's organisational capacity of administering the phases of design, implementation and enforcement of regulatory policies. Nonetheless it is worth to offer some specification with regards to the association of the HDI with our selected

indicators of public governance, foremost with supervision and coordination. Evidence puts emphasis on three different aspects:

- 1) supervision (*A3113*) and water sector performance are strongly associated in those countries with a high HDI, while correspondence is substantially absent in countries with a low HDI;
- 2) countries with a low HDI but high environmental standards in wastewater treatment have high performance in coordination (*A5010* and *A5011*), but not in supervision;
- 3) it exists a considerable trade-off between levels of supervision and performance in coordination: with the exception of a few cases, we do not observe a coexistence of high performance in both supervision and coordination.

We conclude with a sound awareness and an incitement. First it is time to realise the reduced role played by policy-makers, who design policies, and stress the relevance of implementation and enforcement. Secondly it does not exist an optimal model of public governance but only models to be defined on the ground of the socio-economic context in which these models are necessarily embedded. With specific reference to our work, environmental performance in the management of wastewater seems to be the result of a complex interaction (i.e., a triangle) between public governance and human and social capital.

This is to say that public governance is affected not by the institutional setting models by which it can be realised but also and foremost by the level of human and social capital. Therefore, we call for more attention on the phases of implementation and enforcement of regulatory reforms: to design good and feasible reforms, policy objectives (expected performance) we cannot underestimate the manifest circularity between our two sets of variables and the HDI.

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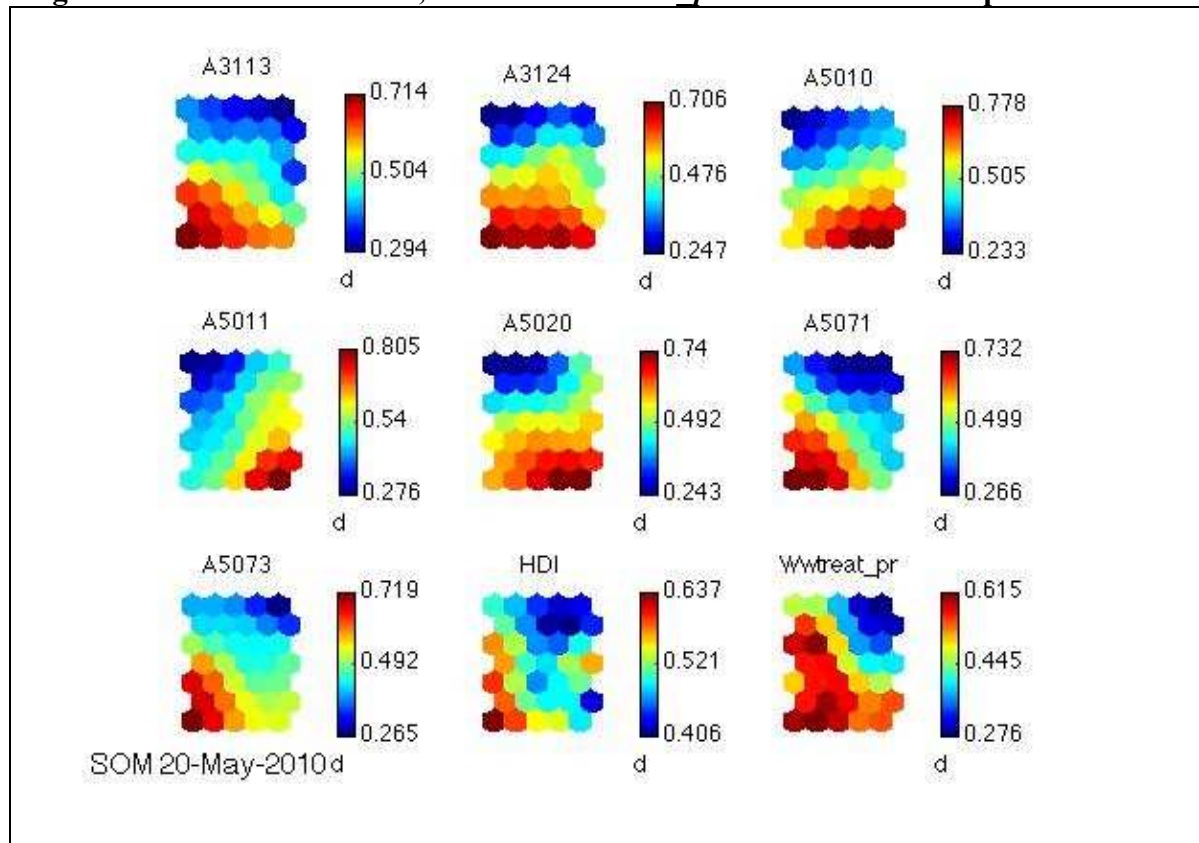
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Table 1 Public Governance and Wastewater Performance based on Aquastat, IPD 2009

Country	A 3113	A 3124	A 5010	A 5011	A 5020	A 5071	A 5073	HDI	Wastewater produced volume (10 ⁹ m ³ /yr)	Wastewater treated volume (10 ⁹ m ³ /yr)
United Arab Emirates	4	2	2	2	4	4	4	0.627	0.5	0.289
Argentina	3	3	2	2	1	2	3	0.060	3.53	0.104
Azerbaijan	4	1	1	2	2	2	2	0.526	0.659	0.161
Bolivia	3	3	2	3	2	3	3	0.502	2.903	0.033
Brazil	3	4	3	3	4	4	3	0.560	2.567	0.884
Botswana	3	3	2	2	4	3	1	0.461	0.043	0.008
Chile	3	3	2	2	3	3	4	0.607	1.065	0.047
China	4	3	3	4	4	3	3	0.529	37.28	23.33
Colombia	3	3	2	2	3	3	3	0.547	2.094	0.440
Cuba	4	3	4	4	4	2	3	0.594	0.502	0.109
Cyprus	4	3	2	2	3	4	4	0.633	0.006	0.006
Egypt	3	2	1	1	2	3	2	0.497	3.76	2.971
Estonia	4	4	3	4	3	4	4	0.605	0.396	0.378
Guatemala	3	1	2	2	1	2	3	0.483	0.365	0.006
Iran	2	1	2	3	3	2	1	0.540	3.075	0.130
Israel	3	2	3	2	4	4	4	0.065	0.45	0.283
Jordan	3	2	2	2	3	3	2	0.534	0.082	0.107
Japan	2	2	2	3	4	2	2	0.664	32.8	11.37
Kazakhstan	4	2	3	3	3	2	2	0.560	1.833	0.274
Kuwait	3	2	1	2	3	2	3	0.633	0.244	0.250
Lebanon	2	1	1	1	2	1	1	0.553	0.31	0.004
Libyan Arab Jamahiriya	4	2	1	3	3	1	3	0.058	0.546	0.040
Lithuania	3	2	2	2	2	4	3	0.603	0.3038	0.078
Latvia	4	3	2	2	2	4	3	0.599	0.2158	0.067
Mexico	3	2	3	2	2	3	3	0.585	13.34	3.110
Malta	4	4	2	2	3	4	4	0.621	0.019	0.002
Malaysia	4	3	3	2	3	3	4	0.572	2.69	0.398
Nicaragua	2	1	1	1	1	3	3	0.485	0.0674	0.007
Oman	4	3	3	3	4	4	3	0.583	0.09	0.037
Philippines	4	2	2	2	3	3	4	0.517	0.074	0.010
Qatar	4	4	2	2	3	4	4	0.624	0.055	0.058
Russian Federation	2	2	2	2	3	3	4	0.560	33.88	5.080
Saudi Arabia	3	2	2	2	3	4	4	0.580	0.73	0.547
Morocco	2	1	2	1	3	2	1	0.449	0.65	0.040
Senegal	3	1	1	1	2	2	3	0.349	0.005	0.001
Syrian Arab Republic	4	3	2	2	3	3	3	0.511	1.364	0.550
Thailand	2	2	1	2	2	2	2	0.546	0.833	0.035
Tunisia	3	3	3	2	3	4	2	0.529	0.187	0.215
Turkey	3	3	2	3	3	2	3	0.554	2.77	1.680
Ukraine	2	1	1	1	1	2	2	0.546	6.66	3.800
United States of America	3	2	3	3	3	2	3	0.066	76.75	48.71
Yemen	3	1	2	2	2	1	3	0.394	0.074	0.046
Republic of Korea	4	3	3	2	3	4	3	0.644	7.947	4.180
South Africa	4	2	2	2	3	3	3	0.047	3.2	3.200

Figure 1: Public Governance, HDI and *WWtreat_p* in the Kohonen Map



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