

THE RESULTS OF MODERNIZING NETWORK INDUSTRIES

THE CASE OF URBAN WATER SERVICES IN EUROPE

THOMAS BOLOGNESI

Abstract

Since 1980's, the European Union favours regulatory reforms in network industries and the water sector appears to be the latest to be included in this. We deal with this issue while questioning the concept of "modernization of the Urban Water Systems in Europe" (UWSE). This process began in the second middle of 1990 and the Water framework directive (2000) constitutes its main element. Three core principles provide the basis for the modernization of UWSEs: 1/ a rationalisation of the public command; 2/ an increasing use of market mechanisms; 3/ the identification of sustainable development goals. After implementation it appears that many UWSEs fall short of expectations.

Our analysis is concentrated on the impacts and the operating mechanisms, impacts of such reform. It is argue that modernization entails a change in the modalities of coordinating UWSEs, while intensifying and polarizing the problems of sustainability around economic issues. At an organizational level, modernization tends to depoliticize UWSEs and increase socio-institutional resilience. These two phenomena are mainly the result of hybridization of institutional arrangements in favour of the market. With respect to sustainability potential, the lack of coherence in the development of UWSEs re-regulation explains the relatively gloomy outlook.

Keywords: Institutional change; Network Industries; New Institutional Economics; Regulation; Urban water system

JEL: K23; L51; L95; Q56

1. INTRODUCTION

Since the 1980s successive reforms have sought to improve the efficiency of network industries in the European Union. In most cases renewed regulation involved a

combination of increased opening to the market and changes in the form of state intervention, rather than its outright disappearance (Finger *et al.*, 2007; Ménard, Ghertman, 2009). The timing of such re-regulation has been diverged and whereas the energy, rail transport, telecommunications and postal sectors have already been properly studied (Glachant, Perez, 2007; Glachant, 2008; Finger, Kunneke, 2011), this is less the case for water supply and sewerage services.

Modernization of urban water systems in the EU¹ started in the 1990s, driven by a third round of regulation enshrined in the Water Framework Directive of 2000, as an overall guideline (European Commission, 2003; Gee, 2004; Allouche *et al.*, 2008). Three key principles inspired this change in the institutional basis for EU urban water systems:

- Rationalized public command;
- Increased opening to the market and its forces;
- Allowance for environmental constraints in order to set systems on a sustainable course.

The first two principles cover the organizational side of modernizing urban water systems; the sustainable development targets reflect sustainability concerns. The twin thrust of the modernization process prompts us to address two aspects of research in institutional economics, the first focusing on modernization of urban water systems in structural terms, the second with regard to performance (Williamson, 2005; North, 2005; Brousseau *et al.*, 2011).

Much work has been published on the modernization of urban water systems and, following a period which explored other topics, it is once again a key concern of both operators and academics (Ménard, Peeroo, 2011; Massarutto, Ermano, 2012; Desrieux *et al.*, 2013; Maziotis *et al.*, 2013). There are three reasons for this renewed interest. Firstly the leading principles of such modernization have now been written into national law in the various Member States, raising new subjects for inquiry. Secondly, regulation has moved on since the 2000 Directive. The initial deadlines for its implementation have passed, so it is time to take stock. Thirdly, many urban water systems fall short of expectations, so it is necessary to define new ways of assessing modernization work.

We therefore propose an analysis of the modernization of EU urban water systems in order to better understand their operating mechanisms, impacts and why past targets have proved so difficult to achieve. Our analysis will be guided by the principles of new institutional economics.

We shall argue that modernization entails a change in the modalities of coordinating urban water systems, while intensifying and polarizing the problems of sustainability around economic issues. At an organizational level, modernization

¹ Urban water systems in the European Union are the dynamic articulation of a technico-economic component, the urban water cycle, with an institutional component, water institutions (Bolognesi, 2014).

tends to depoliticize urban water systems and increase socio-institutional resilience. The notion of depoliticization refers to a change in the perimeter of intervention and less direct state control. It is borrowed from grey literature emanating from the EU (Gee, 2004). Resilience refers to urban water system's capacity for swift socio-institutional self-reorganization, following a shock, in order to maintain the level of satisfaction of players. These two phenomena are mainly the result of hybridization of institutional arrangements in favour of the market. With respect to sustainability potential, the lack of coherence in the development of urban-water-system re-regulation explains the relatively gloomy outlook.

The article is divided into four parts. The first one presents the working methodology. The other three focus on one of the main results, concerning, respectively, the organization, dynamics and sustainability of urban water systems in the EU.

2. RESEARCH DESIGN

2.1. THEORETICAL FRAMEWORK

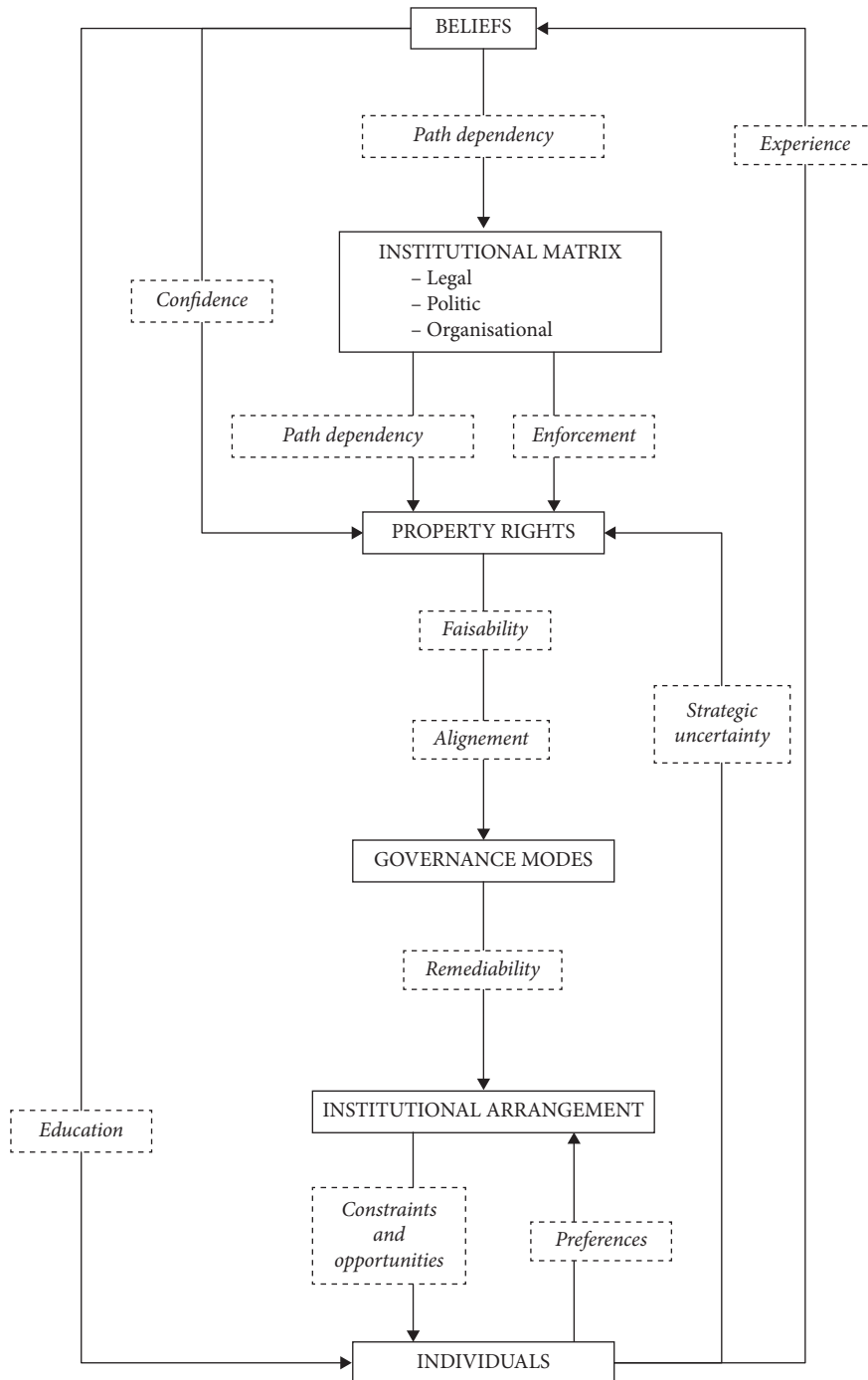
Our approach to these phenomena is based on the New Institutional Economics theoretical framework, both regarding the economics of transaction costs and analysis of the institutional environment (Williamson, 2000; North, 2005; Ménard, 2005; Brousseau, Glachant, 2008). Within this framework we can take a holistic view of modernization of EU urban water systems and include the results of classical regulation and organizational economics (Lafontaine, Slade, 2007; Gibbons, Roberts, 2013). Transactional analysis of water-system modernization highlights the micro-determinants of coordination. But it fails to explain all the factors determining the choice of institutional arrangements (Chong *et al.*, 2006; Saleth, Dinar, 2008). We have consequently linked our analysis to an appraisal of the institutional environment in such a way as to integrate the macro-determinants in the model (Figure 1).

The wiliamsonian concept of institutional embeddedness provides architecture of the framework: beliefs, institutional matrix, governance modes and institutional arrangement are the different institutional levels sorted from the more generic and stable to the more transaction-specific and flexible one. It is considered that they are interrelated in a recursive loop through three main media:

- History: path dependency (North, 2005),
- Culture: education, experience (North, 2005; Aoki, 2011)
- Bounded rationality: actors' choices are made via the so-called economizing process, e.g. alignment of governance structure and transaction, irremediability criteria, preferences (Maki *et al.*, 1993; Williamson, 2000)

Finally actors adopt an institutional arrangement, which minimizes transaction costs taking into account contingencies and uncertainty.

Figure 1. Articulation between micro and macro-institutional determinants



2.2. METHODOLOGY

Analysis is based on three axioms: we are dealing with complex systems (Morin, 2005, 2008); in realistic terms, institutions are essential to analyse the determinants of behaviour and decision-making (Coase, 1998); the water systems have a polycentric organization operating on several levels (Ostrom et al., 1961; Williamson, 2000).

Figure 1 helps to synthesize the adopted research design. The transaction analysed is the supply of drinking water and sewerage in European cities (Massarutto, Ermano, 2012; Bolognesi, 2013, 2014a; Maziotis et al., 2013). The dependant variable is the institutional arrangement of this transaction. Particularly, attention is paid to the organization, the dynamic capacity and the performance (ability to achieve sustainable development as defined by EU) of institutional arrangements after their modernization. Following the theoretical model, explanatory variables are beliefs, institutional matrix, governance modes and individuals. They approach the multilevel characteristics of UWSEs governance in their evolution time, geographic area and politico-administrative area. Causality links are mentioned by concepts in *italic*. The approach avoids over-focusing on the local dimension of UWSEs and provides complementary insights, needed to better grasp the institutional impacts of reforms in network industries regulation.

We used a case study to carry out and test institutional economics research (Wilber et al, 1978; Mäki et al., 1993; Ménard, 2001). This facilitated a holistic approach, essential for understanding the unforeseen impacts of modernizing urban water systems in the EU. Analysis was based on a pattern model: “an event or action is explained by identifying its place in a pattern that characterizes the ongoing processes of change in the whole system” (Wilber, Harrison, 1978, p. 73). To avoid the risk of tautology, our analysis was subjected (Bolognesi, 2013) to the seven-point checklist proposed by B. Ward (1972).

Our case study compared the EU’s three leading models, as identified in the literature. We then tested our hypotheses with synchronic and diachronic comparisons, and by sorting the models according to their increasing modernization: Germany, France, the United Kingdom (Lorrain, 2005, Allouche et al., 2008; Wackerbauer, 2007; Ménard, Peeroo, 2011). The German model is the least affected by the principles of modernization. Governance and provision of service are still publicly owned and locally based. In France the local level plays an essential part, but the private sector has achieved greater market penetration. The greatest modernization has been achieved in the UK, with a regional organization and private operators supervised by independent regulatory agencies.

III. SYSTEM ORGANIZATION: A FACTOR IN DEPOLITICIZATION

Initially depoliticization was a key factor in modernizing EU urban water systems. The role of the state as an operator and regulator decreased, as did its intervention. The water systems were depoliticized as a result of changes in their organizational structure. Rationalization altered regulatory configurations; the application of free-market principles (liberalization and privatization) reconfigured the market structure.

3.1. RATIONALIZATION AND CHANGES IN REGULATORY MECHANISMS

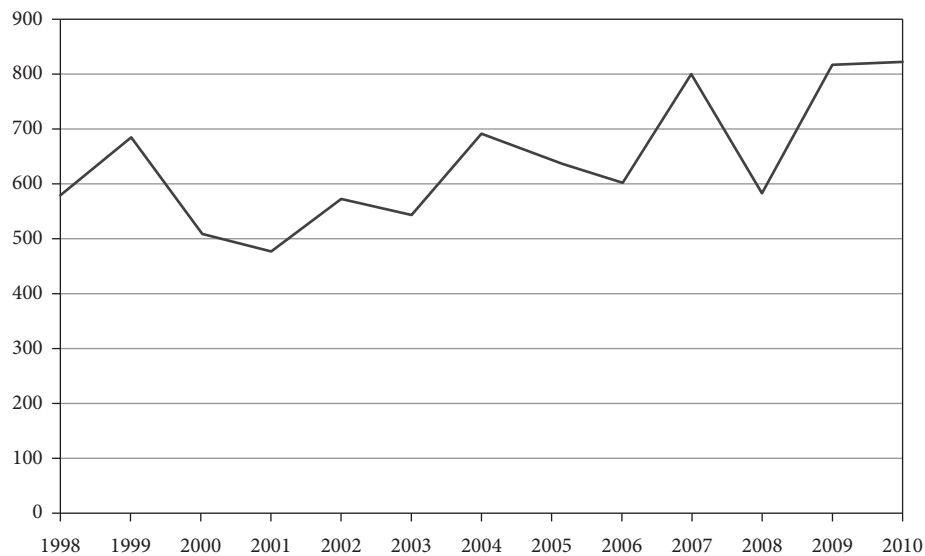
Rationalization of public command contributed to the emergence of new players and regulatory mechanisms, and to changing the procedures for access to public contracts. This was partly responsible for rule by *fiat* being replaced by incentive-based governance (Williamson, 2010). Coordination was devolved to third-party regulatory agencies and information came to play an increasingly important role (sunshine regulation, etc.). Synchronic comparison of the three water-system models confirms this trend (Lorrain, 2005; Wackerbauer, 2007; Ménard, Peeroo, 2011). In Germany the public sector retained a powerful, locally based hold on governance, whereas in the UK the 1979 reforms delegated responsibility for regulation to independent agencies: Ofwat for economic affairs; the Environment Agency for the quality of resources; and the Drinking Water Inspectorate for the end product (Balance, Taylor, 2005; Byat, 2013).

France adopted an intermediate stance, through the innovatory development of information as a means of regulation, in particular through performance indicators (Guerin-Schneider, Nakhla, 2012). A government decree, dated 2 May 2007, established 27 indicators monitoring technical (efficiency, etc.), economic (price, term for debt repayment), social (rate of unpaid bills, etc.) and environmental data (advances in resource protection). As Renou (2012) points out, these indicators and the various uses of information represent a new form of water-system governmentality. In a more general way, with progress towards modernization, water information played an increasingly important part in regulation. In the UK operators were required to publish an annual report on the quality of provision of service, on the basis of which Ofwat and the DWI directed players, by capping prices for instance.

The procedures for access to public contracts for urban water systems, a key plank in these new regulatory modalities, shifted towards regulation by incentive, rather than supervision. The aim of these changes was to make contracts contestable (Baumol *et al.*, 1982, Finger *et al.*, 2007), as set forth in the draft directives COM(2011) 897 and

COM(2011) 895, which concerned respectively the award of concession contracts and procurement. Both were rooted in the Europe 2020 strategy and sought to make the procedures for access more flexible and broaden the range of potential players. To achieve more frequent competition for the market, the duration of urban-water-system contracts was shortened, falling to an average length of 11 years. Between 1998 et 2010 the number of tendering procedures increased by about 30% (Canneva *et al.*, 2013; see also Figure 2).

Figure 2. Variation in the number of tendering procedures in France, 1998–2010



Source: Canneva *et al.*, 2013.

3.2. LIBERALIZATION, PRIVATIZATION AND CHANGES IN THE STRUCTURE OF OWNERSHIP RIGHTS

Modernization of urban water systems in the EU has transformed the structure of the market: the number and diversity of operators has increased, whereas the supply chain has gradually been de-integrated. The provision of service consequently now involves a host of contracts, each of varying scope and duration (Chong *et al.*, 2006, Nakhla, 2013). For example, an operator may hold a 12-year contract for a supply network, but periodically subcontract maintenance and repair work for periods of six months to two years. The number of players has increased accordingly.

The private sector is playing an increasingly important part in the provision of services. Two dynamics are driving this trend. Firstly, more and more private operators are involved in the industry, in particular due to the rising number of public-private partnerships. This gradual privatization is apparent in all three models

cited above, most noticeably in the UK, less so in France and Germany (Figure 3). Secondly, even when the operator is still publicly owned, the corresponding moral person increasingly tends to be governed by private law (Wackerbauer, 2009; Bolognesi, 2014a). This trend is particularly apparent in Germany, with ‘corporatization’ (Ménard, Peeroo, 2011). Between 1997 and 2005 the share of drinking water supplied by bodies operating under public law fell by 23%. In sewerage the equivalent share fell by 20%.

Figure 3. Share (%) of the population served by a private operators, 1988–2005

Population served by private sector	1988	1998	2005	2005 Sewerage
Western Europe	10	22		
France	70	80	76	57
United Kingdom	5	85	90	93
Germany	4	6	17	14

Source: Author’s construction, based on Roche (2001) and OECD (2006).

Contracts decide the share-out of ownership rights and “the bundle of rights associated with a specific resource determines the consequences that the owners bear, affecting their choices and the use of the resource” (De Alessi, 1990, p. 47). The bundle of rights impinges on decisions by distributing the *usus*, *fructus* and *abusus* (use, income and transferability) across the urban water system, giving the various players a residual right of control (Kim, Mahoney, 2005; Foss, 2010). Through its focus on organization, modernization changes the share-out of residual control rights. With an increasing number of operators involved in the provision of service, ownership rights are fragmented and diluted, which in turn tends to devolve responsibility to all levels of the water system (Groenewegen, 2011; see also Figure 4). Residual control rights are shared and increasingly in the hands of operators distinct from the state. The structure of governance is affected by increasing hybridization of institutional arrangements, shifting away from hierarchy and towards the market, reducing the state’s ability to control urban water systems directly. This transfer of governance responsibility corresponds to the depoliticization of urban water systems.

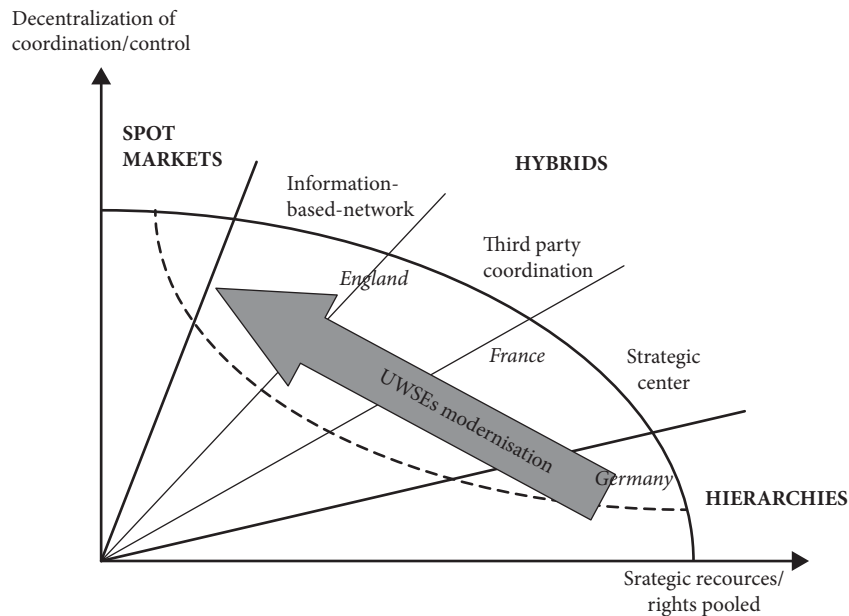
Figure 4. Share-out of ownership and decision-making rights, depending on the governance structure

Governance structures	Ownership of assets	Decision-making rights*
1. Public governance		
Direct management	Public	Government bodies and/or public authorities
Public agencies	Public	Autonomous public authority
Public companies	Public	Public company, rights held by a relatively autonomous board
2. Public-private partnership		
Service	Public	Delegation limited to private company
Management	Public	Operation and upkeep: private Investment: public
<i>Affermage</i>	Public for the core transaction, private for investments in peripheral transactions	Operation and management: private Profits: private
Buid, Operate, Transfer	Delegated to private operator for the duration of the contract	Operation: private Design: private
Concession	Delegated to private operator for the duration of the contract	Core transaction: private Operation: broad operator autonomy
3. Market		
Regulated	Private	Market competition in line with sector-specific regulation
Competitive	Private	Market competition in line with overall policy on competition

*Decision-making rights correspond to residual control rights
Source: Groenewegen, 2011, p. 77.

Modernization hybridizes the institutional arrangements in order to produce incentive signals closer to those produced by a market (Figure 5). This increases the share of private players in the bundle of ownership rights, which in turn attenuates the structure of these rights. The state gives up part of its residual right of control over urban water supplies; private operators first gain access to the *fructus*, then the *usus*. As is the case in the UK, this fragmentation process may lead to dismemberment, with the state becoming an owner with no usufruct, it all having been taken over by the operators.

Figure 5. Modernization of urban water systems as a factor in the hybridization of their governance structure



Source: Author's construction, based on Ménard (2011).

Ultimately, analysis of the governance of urban-water-system transactions in terms of ownership rights reveals two dynamics. Firstly, modernization attenuates ownership rights over urban water systems; in particular public ownership rights are transferred to private bodies. Secondly, modernization disperses residual control rights, creating the need for coordinating mechanisms other than *fiat*. Responsibility is transferred and this partial change in the ownership regime depoliticizes the water systems. Nevertheless, in so far as it retains the *abusus* and a part of the *fructus*, the state still supervises the strategy and behaviour of private operators.

3.3. THE FUNDAMENTAL ROLE OF THE INSTITUTIONAL ENVIRONMENT

Hybridization of institutional arrangements entails a change in the structure of transaction costs (Williamson, 2000). The share-out of ownership rights reduces state control and micro-institutions become necessary to limit information asymmetry and opportunistic behaviour. This need increases, the closer the structure sharing out ownership rights comes to pure market governance. With “PPPs, we are immediately confronted to standard problems of tariff increases, under-investment, especially towards the ending period of contracts, risk-averse strategies of operators so that public authorities tend to bear most of the uncertainties, and the very high rate of

renegotiations, all of which questions the presumed efficiency of this mode of organization” (Ménard, Peeroo, 2011, p.322).

Williamson (2000) emphasizes that one of the solutions to such uncertainties is to be found in the make-up of the institutional matrix which provides an environment conducive to the proper execution of transactions. The aim is first-order economization of transaction costs. The institutional matrix acts as a complement to intrinsically incomplete ownership rights (Brousseau, Nicita, 2010). This quality of the institutions is the result of a trade-off between the *ex ante* and *ex post* costs of governance (Brousseau, 2008; Dixit, 2008; Libecap, 2008; Brousseau, Nicita, 2010). It is worth enhancing the credibility of institutional arrangements with safeguard mechanisms, which may prove costly. The judicial structure is one of the first factors for making undertakings credible (La Porta et al. 1998, 2008; Levine, 2005; Hadfield, 2005, 2008).

The French legal system is characterized by increasingly rigid formalism (David, 2002).² Its German counterpart shares certain procedures but allows more jurisprudential procedures, making it more flexible. In the UK case law is an essential part of the legal system, which is much less formalized. The law is largely directed and changed by court decisions. La Porta et al. (1997, 1998, 2008) have shown that the level of case law has a positive impact on securing ownership rights, whereas formalism reduces scope for the application and execution of contracts. Correlation coefficient are 0.55 and -0.51, respectively. In this way the characteristics of the British legal system, in contrast to the two other systems, facilitate stabilization of ownership rights and thus the depoliticization resulting from modernization of urban water systems. This legal basis acts as an incentive for the development of the private-ownership regime and consequently fragmentation of ownership rights in UK water systems, which would in principles lead to a depoliticization. In practice, there is no total depoliticization but rather an intermediation of political planning. Botolotti et al. (2013) show that public actors found strategies to maintain control on sectorial activities.

This re-appraisal of the diversity of capitalism broadens the scope of analysis and highlights the extent to which the British institutional matrix allows modernization more efficient first-order economization than the French or German equivalent. Of the five different capitalist models, France and Germany belong to the Continental European model, whereas the UK adheres to the market-based Anglo-Saxon model (Amable, 2003).³ France and Germany possess social systems of innovation and production based on powerful public intervention by centralized state bodies or local

² David bases his distinction between rights on legal procedure (hierarchy of the sources of law and methods) and social organization (political, economic or religious conception of the social order). On this basis, he singles out four families of law: Romano-Germanic, common law, socialist and philosophical and religious systems. Only the first two apply in Europe. Romano-Germanic applies in mainland Europe, whereas common law underpins the legal system in Great Britain.

³ B. Amable (2003) distinguishes five forms of capitalism (Anglo-Saxon, Social-Democratic, Asian, Continental European and Mediterranean) on the basis of five criteria: 1/ the type of competition in the market for goods; 2/ the level of deregulation in the labour market; 3/ the characteristics of finance markets; 4/ the degree of welfare protection; 5/ the education system.

authorities. This type of organization forges strong links between public infrastructure and industry. The formation of national champions, such as Veolia or Suez, illustrates this dynamic in French urban water systems. In the UK the market is the basis for social systems of innovation and production. Public intervention is limited, restricting itself to supervisory bodies such as Ofwat for British water systems.

The institutional environment in the UK offers more favourable conditions for the depoliticization of urban water systems than in France or Germany. Furthermore, applying work on the diversity of capitalist models specifically to cities in the EU endorses this conclusion (Lorrain, 2005). The German model is characterized by a strong, locally-based public sector; the French model, by the important part played by policy-makers and subcontracting; the British model, by the drive to optimize functional efficiency. The organization of urban water systems in the EU is decentralized, to maintain public control in Germany and France, and to give British operators greater independence. Ménard and Peeroo (2011) reach similar conclusions.

Interventionist traditions in Germany and France led to a preference for control over public services. France is more modern in this respect than Germany, for the form of coordination made possible by PPPs corresponds to the country's long-term development trends. The French state has long supported firms operating in strategic sectors in the hope that they will become world leaders. The water industry is no exception to this development strategy and local authorities commonly delegate part of the deviation process to national champions. Meanwhile British water systems do not hinder the modernization process, because it promotes values shared by their institutional matrix: opening to the private sector, coordination by market forces, control by independent regulatory agencies.

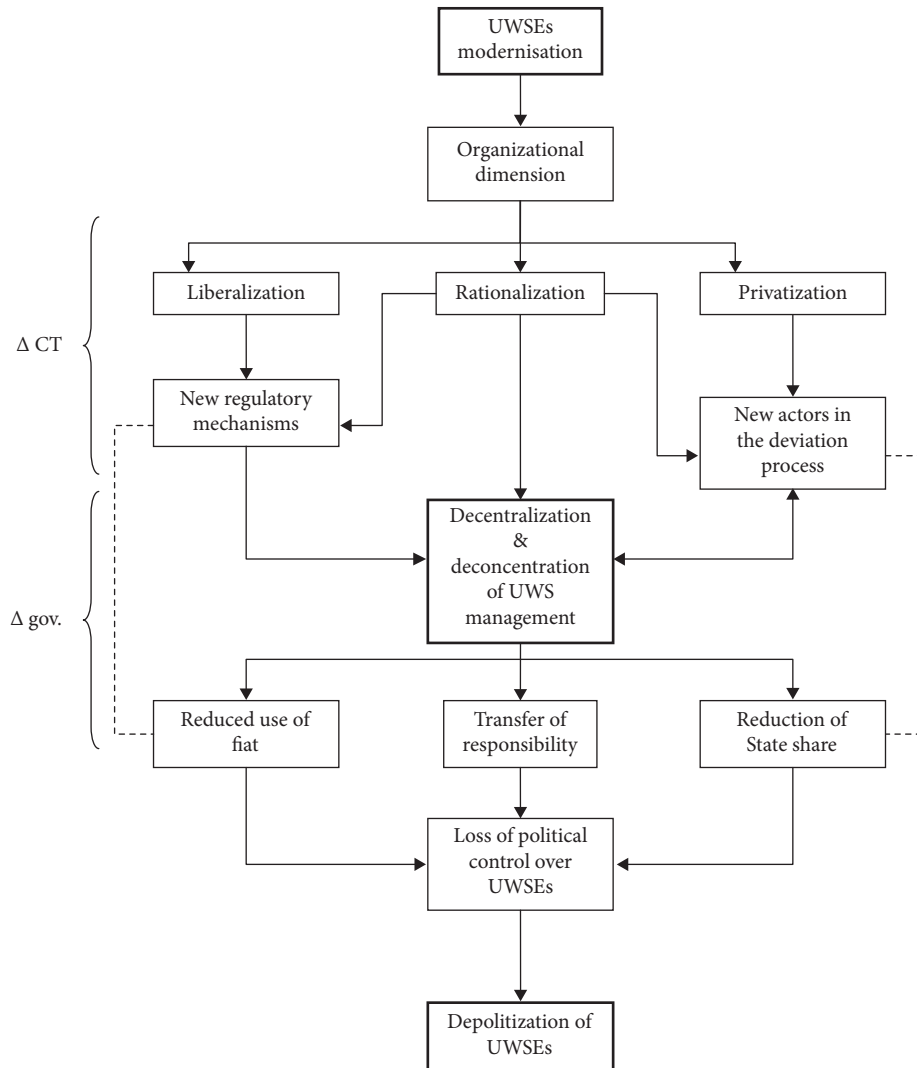
To conclude, this new hybrid organization is underpinned by three micro-institutional determinants (Figure 6):

1. Reduced coordination by *fiat*;
2. Decentralization causing transfers of responsibility;
3. Increased private participation in the supply of urban water services.

and three macro-institutional factors:

1. Attenuation of bundles of rights;
2. Transformation of adherent organizations into contractual organizations to obtain credible new hybrids;
3. Development of cooperative beliefs and routines in support of modernization.

Figure 6. Diagram of the causal process linking water-system modernization to their depoliticization



Caption:
 Δ TC: variations in the structure of transaction costs
 Δ gov.: variations in the governance structure

4. SYSTEM DYNAMICS: DEVELOPING SOCIO-ECONOMIC RESILIENCE

From an organizational point of view, modernization is hybridizing the governance structure of urban water systems in the EU. The dynamic characteristics of these new institutional arrangements enhance the capacity of water systems for adaptation and change. Our second finding is that the more far-reaching the integration of modernizing principles, the more the dynamics of urban water systems appears resilient rather than resistant.

4.1. GRANTING PLAYERS INDEPENDENCE AND CONTRACTUAL FLEXIBILITY

The socio-institutional resilience of a system is based on that of its components. It is consequently achieved by institutionalizing the spontaneous changes in players' behaviour. The institutional arrangements absorb external shocks more easily, evolving with greater speed and frequency (De Bruijn, 2004; Ostrom, Janssen, 2004). Hybridization of urban water systems develops retroactive mechanisms, stimulus-response coupling, diversity of resources and possible strategies, and factors of resilience (Levin *et al.* 1998; Rose, 2007). Modernizing urban water systems enhances their socio-institutional resilience by boosting their capacity for swift adaptation and increasing sources of institutional innovation.

With modernization, incentives take the place of *fiat*. But these instruments perform differently in terms of the dynamics of governance structures. *Fiat* is characteristic of hierarchical governance, in which adaptation is dependent on a collaborative process. In contrast, incentives are the key instruments of market governance, which evolves thanks to the autonomous adaptation of players (Williamson, 1991). Less administrative control and more powerful incentives develop the autonomous adaptive capacity of players. Individually, each player gains in adaptability and responsiveness, increasing the resilience of the system as a whole (Ostrom, Janssen, 2004; Folke, 2006; Perrings, 2006; Duit *et al.*, 2010).

With modernization, the coordination of agents is increasingly achieved through autonomous responses to market signals and information. In the UK Ofwat directs service providers with a price-capping system and performance indicators which gauge the quality of service. The system dynamic partly depends on the autonomous adaptation of players to quality-price ratios. For example, it seems that the price-capping system combined with the broadcasting of information on the quality of infrastructure is a key factor in determining the volume of funding directed towards infrastructure renewal (Bolognesi, 2014). Thanks to these measures all the operators have been redirected, with incentives to invest rather than internalizing the risks entailed by excessive deterioration of their technical assets (Bakker, 2010). Figure 7

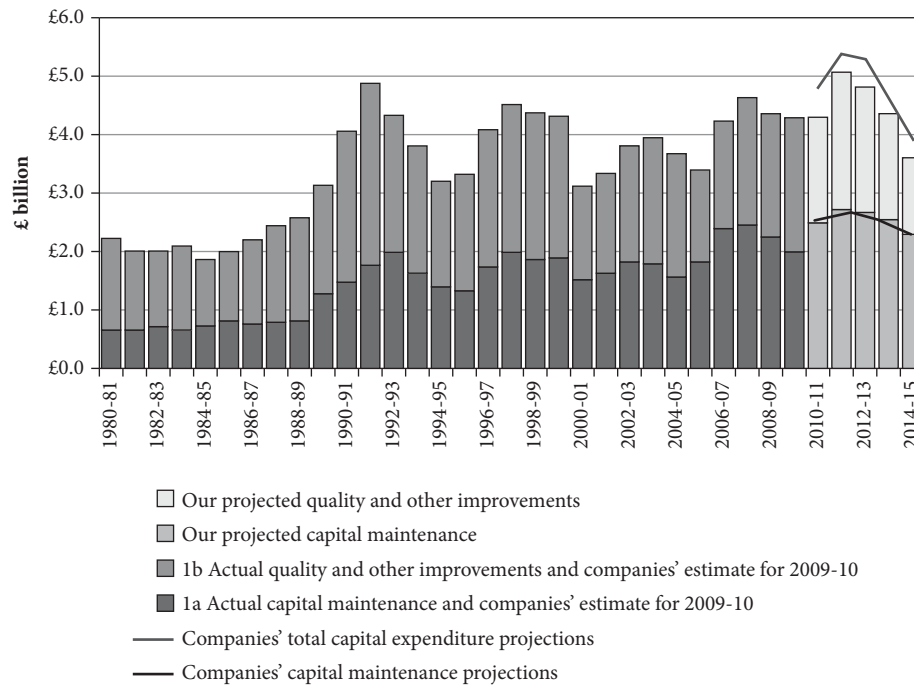
and Figure 8 show that with privatization the level of investment has become more variable. Furthermore the shape of the histogram makes it possible to distinguish each five-year plan. The average level of investment for each period corresponds to the incentive received, rather than the technical need for investment (Bolognesi, 2014).

Figure 7. Annual price-caps set for England and Wales (%)

	1990–1995	1995–2000	2000–2005	2005–2010	2010–2015
	Fixed at time of privatization	Decided by OFWAT	Decided by OFWAT		Decided by OFWAT
Water and sewerage companies	3.9	1.5	-2	4.3	0.5
Water companies	1.9	0.6	-2.8	3.1	0.3

Source: OFWAT, 1994, 1999, 2004, 2009.

Figure 8. Actual and projected capital investment 1981–2015



Source: OFWAT, 2009, p. 67.

In contrast, in France and Germany institutional change has involved more lengthy collaborative processes, leading to lower responsiveness. The reorganization of arrangements in Munich illustrates this general observation (Krimmer, 2010).

Between 1953 and 1991 the quality of water deteriorated at its source due to farming in the environs: the nitrate content rose from 0.8mg/l to 14.2mg/l; meanwhile the pesticide concentration reached 0.065µg/l, instead of the 0.05 µg/l permitted by EU directives. Discussions were organized between the municipal authorities and residents, to persuade the water board to fund incentives to promote organic farming. This reform was a success. The incentive scheme costs € 0.01 per cubic metre of drinking water delivered to consumers, which, in the last analysis, actually represents a saving on water treatment to produce artificially clean water (in France it costs € 0.28 per cubic metre just to filter out nitrates). In view of the time that elapsed between the problem being identified and institutional reorganization, this process illustrates the socio-institutional resistance to change of German urban water systems and the role of *fiat* rather incentives in instigating institutional change.⁴

Modernization has had an impact on contractual modalities and the market structure of urban water systems. Contracts have become shorter and include *ex ante* adjustment characteristics. New modalities for access to public contracts encourage competition and thus renewal (Saussier *et al.*, 2004; Wackerbauer, 2007). These 'neoclassical' contracts allow for incompleteness and environmental certainty by providing a framework for settling disputes in the event of the transaction process taking a different course from the one foreseen in the initial draft of the contract (Williamson, 1990; Brousseau, 2008). The contracts therefore include measures to facilitate the adaptation of contractual relations (Macneil, 1978; Campbell, 2001; Ménard, 2004, 2005). By making provision for short-term flexibility, they allow players to accommodate the long-term rigidities entailed in water-system transactions.

The type of contractualization, which corresponds to the framework of modernization, reveals a preference for organizational flexibility, which in the present case becomes a characteristic of regulation in the form of urban-water-system resilience. It seems that political control, as in Germany, stabilizes the form of water systems, whereas modernization tends to produce a variety of forms. However, additional flexibility also leads to uncertainty. In this case the credibility of institutional arrangements is based on safeguard mechanisms other than in the contract, underlining the importance of the institutional environment in this type of organization. So greater resilience is achieved through more autonomous adaptation and by multiplying the number of operators in urban water systems, a trend encouraged by fragmentation of ownership rights.

⁴ More broadly, B. Barraqué and C. Viavattene (2009) showed that the changes in urban water governance in Germany involved collaborative discussion between stakeholders and the setting up of partnerships between them. In Germany the supply of urban water services is a key political issue and the corresponding governance model has barely changed for more than a century (Barraqué, 1995; Isnard, Barraqué, 2010).

4.2. ENHANCING THE CREDIBILITY OF AUTONOMY AND CONTRACTS

Institutional change involves a trade-off between flexibility and security; it is impossible to do away with all transaction costs, so there must be a trade-off between *ex post* and *ex ante* costs (Brousseau, 2008; Dixit, 2008). Modernization has changed the organization of urban water systems in the EU, making them more resilient. So there has been a trade-off in favour of flexibility, a move which can be explained by the institutional environment of the water systems and beliefs. The water systems which have undergone the greatest modernization display a preference for flexibility, whereas the others are averse to risk, reflecting the dichotomy between resilient and resistant dynamics.

Lorrain (2005) confirms this points in his analysis of the diversity of urban capitalism, but it is difficult to measure as such (Figure 9). He shows that the conception of the state in France and Germany leads to powerful interventionism, which lends a significant political dimension to the provision of public services. These two countries have a legacy of public control over local affairs, which explains why there are still locally based, publicly owned companies operating urban water systems in Germany. It also explains the appearance of publicly owned companies in French law. However in France this preference for interventionism does not prevent the private sector from playing a part. It is assumed that the state cannot take care of everything and that by joining forces with large national companies the quality of service will be improved. This belief justifies the setting up of PPPs, a form of regulation often used in France’s urban water systems. The British state adopts a more regal stance, reducing the obstacles to free enterprise. According to Lorrain, the operators of British water systems seem to hold pro-cooperative beliefs favorable to creative competition which enhances system resilience.

Figure 9. Cultural factors influencing the supply of services in urban-water-system models

Germany	France	United Kingdom
Pragmatic conception of change (gradualism)	Strong state, weak local authorities: delegation of powers and management	Conflicts, disputes, culture of control
Consensus-based culture, co-production	Development of national champions in monopolistic or oligopolistic structures, freedom of corporate action, with engineers playing an important role	Trust in market and competition
More importance attached to industrial production factors than institutional design	Alliance between the élites in industry and state, regulation by checks and balances	Belief that institutions are important, with a process of constant reform
	Gradual change, practical modernization rather than changes to the institutional framework	

Source: Author’s construction after Lorrain (2005)

Three mechanisms contribute to and intensify the creative competition mentioned by North (2005), explaining the link between modernization and socio-institutional resilience:

1. Diversification of social interaction;
2. Increased volume of social interaction;
3. Acceleration of the circular relationship between individuals and beliefs.

Modernization has decentralized and deconcentrated the organization of urban water systems in the EU. This in turn has increased the diversity of players, on the one hand, and multiplied the number of relations between individuals, and their institutional and organizational expression, on the other. Social interaction, fuelling the experience of players, has become more intense and diverse. This mechanism favours creative competition, adaptive efficiency and, ultimately, socio-institutional innovation. The recursive relation between preferences and beliefs then disseminates these changes, through experience and social interaction (North, 2005; Hodgson, 2007).

Advancing hand-in-hand with these beliefs, the institutional matrices favour socio-institutional resilience by increasing the range of feasible institutional arrangements and enhancing the credibility of flexible institutional arrangements. Here again the legal system is a determining factor. Britain's common law makes more allowance for business concerns and is more flexible than Romano-Germanic law (Fairgrieve *et al.*, 2006; Cunniberti, 2011). In the UK the importance accorded to the interpretation and adaptation of the courts boosts the resilience of water systems. These two characteristics lend credibility to commitments and represent two major assets for reducing *ex post* transaction costs. The incompleteness of contracts nevertheless increases transaction costs because coordination may change in line with the economic environment, among others. In this way, the institutional matrix compensates for and fills in any contractual imperfections in order to secure the proper definition, security and performance of transactions.

To sum up, three micro-institutional determinants explain this capacity for resilience:

1. Increased use of incentives rather than *fiat*;
2. Greater unilateral, autonomous adaptation rather than conscious adaptation;
3. Greater preference for flexibility and autonomy due to neoclassical and relational contracting.

And three macro-institutional determinants:

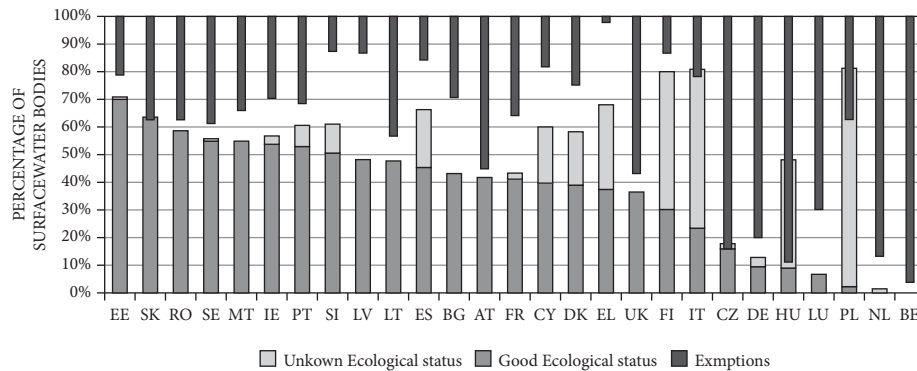
1. More innovation-friendly institutional arrangements;
2. Increased faith in autonomy due to the appearance of organizations providing protective safeguards and micro-institutions;
3. Acceleration of the upward-downward causal loop thanks to greater, more diverse social interaction.

5. SYSTEM EFFICIENCY: LOW SUSTAINABILITY POTENTIAL

The third result is that modernization of urban water systems in the EU fails per se to achieve its own sustainability goals, due to incoherent governance rooted in the increasing number of standards.

With regard to the environment, the targets for good ecological status set for 2015 will not be achieved and many exemptions have been requested (Figure 10). None of the EU Member States has achieved a good ecological status for all its surface-water bodies; in fact only a few have reached the 50% mark. Moreover, 33.7% of the EU's surface-water bodies have qualified for exemptions from good ecological status. In Belgium the proportion rises to 96.1%. In most cases of exemption, the target has been postponed to 2025. Regarding chemical status, the average level of exemption is 22.3%. It is worth noting that performance is seriously jeopardized by Sweden, with a 100% exemption rate for reasons of technical feasibility. Setting aside this country, the overall rate is 3.9%.

Figure 10. Ecological status of surface water bodies in EU



Source: EU, 2013, p.8.

Comparative analysis of the extent (number of rules) and coherence of governance partly explains the results achieved by modernization. Coherence is the ability of institutions to be relevant, efficient and no opposing each other's. Therefore coherence is both internal to institution and external, e.g. be on the connection of institutions. Drawing on the framework for the analysis of institutional resource regimes (Gerber *et al.*, 2009; Nahrath *et al.*, 2011), we may assume that increased extent contributes to regulating more forms of usage and dispute, and that the coherence of the various rules enables them to be coordinated. This being so, increasing the number of rules and enhancing the coherence of governance should contribute to sustainable development, as part of an integrated regime.

Modernization is underpinned by an increasing number of formal rules for the coordination of players. Two separate dynamics are driving this increase: extension by control; extension by self-organization (Bolognesi, 2013, 2014b). The former involves an increase in the number of formal rules due to state intervention and the deployment of public policies. These rules govern rights of use. In the latter case, the players in urban water systems frame their own formal rules, without direct state intervention. Contractualization and fragmentation of ownership rights are the main factors driving this extension. At first sight, the multiplication of formal rules should enhance the quality of governance by increasing the number of regulated uses, and by extension it should contribute to the sustainability of urban water systems. This is not the case, however, due to increasing (external) incoherence between standards, which in fact renders institutional change counterproductive (Figure 11).

Three observations are particularly revealing of such incoherence. Firstly, there is growing tension between with the various components of urban water systems in the EU and their various levels. Accounting for 20% of disputes, water is one of the areas most at odds with European environmental legislation (Keller, 2011). The measurement and comparability of classifications of water bodies are open to criticism (Beniston *et al.*, 2012). Secondly, incentives do not seem to be sufficiently effective. For example work on the renewal and upkeep of existing infrastructure is of prime importance to maintain the quality of supply, which currently falls short of requirements (Bolognesi, 2014a).⁵ In France the annual rate of renewal of the supply network was 0.56%; and 0.5% for sewerage in 2008 (Ifen, Eider data). The average rate of renewal over the past decade in the UK has been 1% per year, of which 0.8% for water supply (Ofwat, 2009). In Germany the values range between 0.4% and 1.2% per year (BDEW, 2011). At this rate it would take 166 years to renew the whole network in France, with the same process lasting between 100 and 125 years in the UK, 83 to 250 years in Germany. Bearing in mind that the infrastructure has an average service life is about 60 years, the present renewal rate is bound to result in a deterioration of service. Thirdly, increasingly high technical standards, associated with the 'water-pays-water' principle, entail major budgetary constraints for operators, whereas it is well known that such constraints are already a key challenge for regulation of urban water systems. Such forms of incoherence are a handicap for modernization, preventing it from achieving its sustainability goals and taking the form of an integrated regime.

⁵ We estimate the net depreciation of the French network at € 820 million per year (Bolognesi, 2014a).

Figure 11. Characteristics of urban-water-system governance in the EU following modernization

	Low coherence	High coherence
High extent	<p style="text-align: center;">Complex RIR</p> <p>Impact of modernisation on UWSE: – multiplication of formal rules (standards, contracts, etc.) – technical complexity – decentralisation and self-reliance of behaviors</p>	<p style="text-align: center;">Integrated RIR</p> <p>Inconsistent with the low coherence of UWSE: – difficulties to implement multi-level governance – organisational tensions – mild and variable efficiency of incentives</p>
Low extent	<p style="text-align: center;">Non-existent RIR</p> <p>Inconsistent with high extent of UWSE: – strong technical standardization – property right formulation – multiplication of contractual relations</p>	<p style="text-align: center;">Simple RIR</p> <p>Inconsistent with low coherence of UWSE: – difficulties to implement multi-level governance – organizational tensions – mild and variable efficiency of incentives</p> <p>Inconsistent with great extent of water systems: – strong technical standardization – property right formulation – multiplication of contractual relations</p>

Source: Bolognesi, 2014b, p. 9.

Modernization of urban water systems in the EU highlights the tension between making more rules and the efficient coordination of all these rules (Bolognesi, 2014b). With modernization, the intentionality of rules changes in such a way that sustainable development cannot fully attain its goals in a system as complex as urban water supply and sewerage. Extension by self-organization consolidates players’ capacity for autonomous adaptation, which in turn seeks to secure the permanence of a transaction, separately from other transactions in the system. But sustainability is a systemic issue and the proper organization of the various transactions does not ensure that the system as a whole operates as it should. There would appear to be two areas of institutional conflict: on the one hand, between standards at different institutional levels; and on the other, between extension by self-organization and control. Some authors refer to this as the desynchronization of governance (Edelenbos, Teisman, 2011; Teisman, Edelenbos, 2011). From the point of view of New Institutional Economics it is a matter of non-integration of the coordination costs associated with the development of governance (Dixit, 2009).

The limited allowance made for coordination costs entailed by modernizing the EU’s urban water systems has left room for a diversity of behavioural patterns which cannot be coordinated. This results in limited capacity for delivering incentives and

enforcing standards, which in turn makes sustainable development difficult. To be effective, the hybrid modernization of the governance of urban water systems must include mechanisms which enhance the credibility of rules. Their relative absence limits the coherence of governance. In fact modernization of urban water systems is largely based on multiplication of formal standards to coordinate players. They emerge from the willingness to control or direct public regulation (classical state regulation) or through self-organization enshrined in the signature of increasing numbers of contracts and ownership rights which bind and coordinate the increasing number of autonomous actors in a water system. This proliferation of standards seems to impair the coherence in governance. The mass of uncertainty and disincentive in water systems is constantly increasing, impeding progress on sustainable development.

6. CONCLUSION

The present article analyses modernization of urban water systems in the EU. Mobilizing New Institutional Economics it grasps its effects on organization and the divergence between the original goals and the present state of water systems. This forms the basis of an appraisal of the organization, dynamics and efficiency of these water systems. In a nutshell, the paper provides with two main inputs: a holistic diagnostic of the UWSE modernization and an integrated conceptual model designed for assessing regulatory reform impacts. Comparison of three European leading models of UWSE bases our results, from the less to the more participant of the modernization process: German, French and English one.

First input concerns the observed impacts of the modernization on UWSEs' organization and their sustainability potential. It has been shown that modernization impulses depoliticization dynamics in UWSEs. Governance and supply of services are increasingly delegated to non-state actors changing the property rights allocation and, doing so, the residual rights of control distribution. In parallel, we observed that modernization enhances the socio-institutional resilience of actors and of the system as a whole. The ability to absorb and adapt to shocks looks faster in England than in Germany, where participation and planning stay the main drivers of change. Explanations of these phenomena come from the hybridization of the governance structures of UWSEs, shifting their focus closer to the market. With regard to impacts on sustainability potential, we highlighted a paradox of the modernization. On the one hand, regulation is extended to more and more uses promoting a more sustainable dynamics. But, on the other hand, this extension results in a proliferation of rules generating institutional incoherence and limiting scope for progress towards sustainable development. It provides us with two learnings on link between modernization and sustainability: modernization is intrinsically unable to achieve its own sustainability goals, the design of the modernization process is not stabilized yet. An interesting observation is that the less modernized model is endowed with the better sustainability potential, at the opposite of the more modernized one.

These results are important as a basis for further analysis designed to improve the regulation of urban water systems in the EU. For example it seems that, as reforms stand, there is little incentive to invest in infrastructure. This point informs the debate on tariff-setting and contractual modalities. To improve investment forecasts in this industry, a fixed fee and a high, first-block tariff seem advisable, but redistribution mechanisms need to be designed to ensure that services remain accessible.

Second input, from beliefs to prices, the conceptual model integrates a wide range of determinants of the chosen institutional arrangement. We pointed out that it looks necessary to deal with institutions of various level in order to avoid unrealistic results. For instance, staying focussed on micro level institutions without considering macro level institutions could lead to misunderstandings because blocking or facilitating factors are not taken into account, such as beliefs. The model could provide an integrated framework to test novel causalities explaining the network industries reform process in a realistic fashion. Besides, because it is conceptual solely, quantitative studies would refine the model by estimating contribution of each component. Furthermore the model could usefully be transposed to others sectors such as electricity in order to grasp multilevel processes of governance.

BIBLIOGRAPHY

- AOKI, M. (2011) "Institutions as cognitive media between strategic interactions and individual beliefs", *Journal of Economic Behavior & Organization*, 79(1): 20–34.
- ALLOUCHE, J., FINGER, M., et al. (2008) "Water Sector Evolution Scenarios: The Case of Europe", *Water Policy*, 10: 221–238.
- AMABLE, B. (2003) *The Diversity of Modern Capitalism*. Oxford: Oxford University Press.
- BAKKER, K. (2010) *Privatizing Water: Governance Failure and the World's Urban Water Crisis*. Cornell University Press: Ithaca.
- BALANCE, T. and TAYLOR, A. (2005) *Competition and Economic Regulation in Water: The Future of the European Water Industry*. IWA Publishing: London.
- BARRAQUÉ, B. (1995) *Les politiques de l'eau en Europe*. La découverte: Paris.
- BARRAQUÉ, B. and VIAVATTENE, C. (2009) "Eau des Villes et Eau des Champs: vers des accords coopératifs entre services publics et agriculteurs?", *Économie rurale*, 310: 5–21.
- BAUMOL, W.J. (1982) "Contestable Markets: An Uprising in the Theory of Industry Structure", *American Economic Review*, 72(1): 1–15.
- BDEW (2011) *Profile of the German Water Sector*. BDEW: Bonn.
- BENISTON, M. et al. (2012) "Obstacles to Data Access for Research Related to Climate and Water: Implications for Science and EU Policy-Making", *Environmental Science & Policy*, 17: 41–48.

- BOLOGNESI, T. (2013) *Modernisation et soutenabilité des systèmes hydriques urbains en Europe: une approche néoinstitutionnaliste des régimes de ressources*. PhD thesis, Grenoble University.
- BOLOGNESI, T. (2014a) "Analyse structurelle des systèmes hydriques urbains en Europe: Aspects organisationnels et défis patrimoniaux", *Revue d'économie industrielle*, 147: 51–86.
- BOLOGNESI, T. (2014b) "The paradox of the modernization of urban water systems in Europe: Intrinsic institutional limits for sustainability", *Natural Resource Forum*. Online preview.
- BORTOLOTTI, B. et al. (2013) "Reluctant regulation", *Journal of Comparative Economics*, 41(3): 804–828.
- BROUSSEAU, E. (2008) "Contracts: From Bilateral Sets of Incentives to the Multi-Level Governance of Relations", In BROUSSEAU, E. and GLACHANT, J-M. (eds) *New Institutional Economics: A Guidebook*. Cambridge: Cambridge University Press.
- BROUSSEAU, E. and GLACHANT, J-M. (eds) (2008) *New Institutional Economics: A Guidebook*. Cambridge: Cambridge University Press.
- BROUSSEAU, E., GARROUSTE, P. and RAYNAUD, E. (2011) "Institutional Changes: Alternative Theories and Consequences for Institutional Design", *Journal of Behavior & Organization*, 79: 3–19.
- BROUSSEAU, E. and NICITA, A. (2010) "How to Design Institutional Frameworks for Markets. New Institutional Economics Meet the Needs of Industrial Organization", *Revue d'économie industrielle*, 129–130: 87–110.
- BYAT, I. (2013) "The regulation of water services in the UK", *Utilities Policy*, 24: 3–10.
- CAMPBELL, D. (ed) (2001) *The Relational Theory of Contract: Selected Works of Ian MacNeil*. Sweet & Maxwell: London.
- CANNEVA, G. et al. (2013) *Remise en concurrence des contrats de délégation de service public d'eau potable et d'assainissement*. Paris: Agro Paris Tech. Rapport Observatoire des délégations de service public.
- CHONG, E. et al. (2006) "Public-Private Partnerships and Prices: Evidence from Water Distribution in France", *Review of Industrial Organization*, 29: 149–169.
- COASE, R. (1998) "The New Institutional Economics", *American Economic Review*, 88(2): 72–74.
- CUNIBERTI, G. (2011) *Grands systèmes de droit contemporains*. Paris: Lextenso éditions.
- DAVID, R. (2002 [1964]) *Les grands systèmes de droit contemporains*. Paris: Dalloz.
- DE ALESSI, L. (1990) "Development of the Property Rights Approach", *Journal of Institutional and Theoretical Economics*, 146: 6–11.
- DE BRUIJN, K.M. (2004) "Resilience and Flood Risk Management", *Water Policy*, 6: 53–66.
- DESRIEUX, C. et al. (2013) "Putting all one's eggs in one basket: Relational contracts and the management of local public services", *Journal of Economic Behavior & Organization*, 89: 167–186.

- DIXIT, A. (2008) "Economic Governance", Communication à *Conference on Endogenous Market Structures and Industrial Policy*, Milan, 5th June.
- DIXIT, A. (2009) "Governance Institutions and Economic Activity", *American Economic Review*, 99(1): 5–24.
- DUIT, A. et al. (2010) "Governance, complexity, and resilience", *Global Environmental Change*, 20: 363–368.
- EUROPEAN COMMISSION (2003) *Green Paper on Services of General Interest*, COM(2003)270 final.
- EUROPEAN COMMISSION, 2013, *A water blueprint for Europe*. Bruxelles: European Commission.
- EDELENBOS, J. and TEISMAN, G.R. (2011), "Symposium on water governance: prologue: water governance as a government's actions between the reality of fragmentation and the need for integration", *International Review of Administrative Sciences*, 77(1): 5–30.
- FAIRGRIEVE, D. and MUIR WATT, H. (2006) *Common law et tradition civiliste: convergence ou concurrence?* Paris: Presses Universitaires de France.
- FINGER, M. et al. (eds) (2007) *Water and Liberalisation. European Water Scenarios*. London: IWA Publishing.
- FINGER, M. and KÜNNEKE, R.W. (2011) *International Handbook of Network Industries*. Cheltenham: Edward Elgar.
- FOLKE, C. (2006) "Resilience: The Emergence of a Perspective for Socio-Ecological Systems Analysis", *Global Environmental Change*, 16: 253–267.
- FOSS, N.J. (2010) "Property Rights Economics", In KLEIN, P. and SYKUTA, M.E., *The Elgar Companion to Transaction Cost Economics*. London: Edward Elgar.
- GEE, A. (2004) "Competition and the Water Sector", *Antitrust*, 2: 38–40.
- GERBER, J-D. et al. (2009) "Institutional Resource Regimes: Towards Sustainability through the Combination of Property-rights Theory and Policy Analysis", *Ecological Economics*, 68: 798–809.
- GIBBONS, R. and ROBERTS, J. (2013) *The Handbook of Organizational Economics*. Princeton: Princeton University Press.
- GLACHANT, J-M. (2008) "La dérégulation des industries de réseaux comme politique institutionnelle de création de marchés et de mécanismes de gouvernance", *Annals of Public and Cooperative Economics*, 79(3–4): 487–525.
- GLACHANT, J-M. and PEREZ, Y. (2007) "Institutional Economics and Network Industry Deregulation Policy", *Groupe réseaux Jean-Monnet Working Paper*, 12.
- GROENEWEGEN, J. (2011) "Evolution and Design of Institutions Supporting Liberalization", In FINGER, M. and KUNNEKE, R.W. (eds), *International Handbook of Network Industries*. Cheltenham: Edward Elgar.
- GUERIN-SCHNEIDER, L. and NAKHLA, M. (2012) "Emergence of an Innovative Regulation Mode in Water Utilities in France: Between Commission Regulation and Franchise Bidding", *European Journal of Law and Economics*, 33: 23–45.

- HADFIELD, G.K. (2005) “The Many Legal Institutions that Support Contractual Commitments”, In MENARD, C. and SHIRLEY, M.M. (eds), *Handbook of New Institutional Economics*. Dordrecht: Springer.
- HADFIELD, G.K. (2008) “The Levers of Legal Design: Institutional Determinants of the Quality of Law”, *Journal of Comparative Economics*, 36: 43–74.
- HODGSON, G.M. (2007) “Institutions and Individuals: Interaction and Evolution”, *Organization Studies*, 28(1): 95–116.
- ISNARD, L. and BARRAQUÉ, B. (2010) *Bibliographie commentée*. Eau&3^E: Livrable 1.
- KELLER, F. (2011) *Application du droit communautaire de l’environnement*. Paris: Sénat. Rapport d’information au Sénat, 20.
- KIM, J. and MAHONEY J.T. (2005) “Property Rights Theory, Transaction Costs Theory, and Agency Theory: An Organizational Economics Approach to Strategic Management”, *Managerial and Decision Economics*, 26: 223–242.
- KRIMMER, I. (2010) “La protection de l’eau potable grâce à l’agriculture biologique: l’exemple de la Ville de Munich”, *Les Cahiers de droit*, 51(3–4): 705–728.
- LAFONTAINE, F. and SLADE, M. (2007) “Vertical Integration and Firm Boundaries: The Evidence”, *Journal of Economic Literature*, XLV: 629–685.
- LA PORTA, R. et al. (1997) “Legal Determinants of External Finance”, *Journal of Finance*, 52: 1131–1150.
- LA PORTA, R. et al. (1998) “Law and Finance”, *Journal of Political Economy*, 106: 1113–1155.
- LA PORTA, R. et al. (2008) “The Economic Consequences of Legal Origins”, *Journal of Economic Literature*, 46(2): 285–332.
- LEVIN, S. et al. (1998) “Resilience in Natural and Socioeconomic Systems”, *Environment and Development Economics*, 3(2): 221–262.
- LEVINE, R. (2005) “Law, Endowments and Property Rights”, *The Journal of Economic Perspectives*, 19(3): 61–88.
- LIBECAP, G.D. (2008) “Transaction Costs, Property Rights, and the Tools of the New Institutional Economics: Water Rights and Water Markets”, In BROUSSEAU, E. and GLACHANT, J-M. (eds), *New Institutional Economics: A Guidebook*. Cambridge: Cambridge University Press.
- LORRAIN, D. (2005) “Urban Capitalisms: European Models in Competition”, *International Journal of Urban and Regional Research*, 29(2): 231–267.
- MACNEIL, I.R. (1978) “Contracts: Adjustments of Long Term Economic relations Under Classical, Neoclassical, and Relational Contract Law”, *Northwestern University Law Review*, 72: 854–906.
- MÄKI, U. et al. (1993) *Rationality, Institutions and Economic Methodology*. London: Routledge.
- MASSARUTTO, A. and ERMANO, P. (2012) “Drowned in an Inch of Water: How Poor Regulation has Weakened the Italian Water Reform”, *Utilities Policy*, 24: 20–31.

- MAZIOTIS, A. et al. (2013) *Robust Institutions for Sustainable Water Markets: A Survey of the Literature and the Way Forward*. Venice: Fondazione Eni Enrico Mattei, 58–2013.
- MENARD, C. (2001) “Methodological Issues in New Institutional Economics”, *Journal of Economic Methodology*, 8(1): 85–92.
- MENARD, C. (2004) “The Economics of Hybrid Organizations”, *Journal of Institutional and Theoretical Economics*, 160: 345–376.
- MENARD, C. (2005) “A New Institutional Approach to Organization”, In MENARD, C. and SHIRLEY, M.M. (eds), *Handbook of New Institutional Economics*. Dordrecht: Springer.
- MENARD, C. (2011) “Hybrid Modes of Organization: Alliances, Joint Ventures, Networks, and Other “Strange” Animals”, In GIBBONS, R. and ROBERTS, J. (eds), *Handbook of Organizational Economics*. Princeton: Princeton University Press.
- MENARD, C. and GHERTMAN, M. (eds) (2009) *Regulation, Deregulation, Reregulation: Institutional Perspectives*. Cheltenham: Edward Elgar.
- MENARD, C. and PEEROO, A. (2011) “Liberalization in the Water Sector: Three Leading Models”, In FINGER, M. and KUNNEKE, R.W. (eds), *Handbook of Liberalization*. Cheltenham: Edward- Elgar.
- MORIN, E. (2005) *Introduction à la pensée complexe*. Paris: Editions du Seuil.
- MORIN, E. (2008) *La methode*. Paris: Editions du Seuil.
- NAKHLA, M. (2013) *La regulation par les instruments: les services d'eau en Europe*. Paris: Presses des Mines.
- NAHRATH, S. et al. (2011) “Institutional Network Regime: a new framework to better grasp the key role of infostructure”, *Network Industries Quarterly*, 13(1): 27–30.
- NORTH, D.C. (2005) *Understanding the Process of Economic Change*. Princeton: Princeton University Press.
- OCDE (2006) “Incidences du changement sur la demande à long terme d’infrastructures dans le secteur de l’eau”, In OCDE, *Les infrastructures à l’horizon 2030: télécommunications, transports terrestres, eau et électricité*. Paris: OCDE.
- OFWAT (1994) *Future Charges for Water and Sewerage Services*. Birmingham: OFWAT.
- OFWAT (1999) *Final Determinations: Future Water and Sewerage Charges 2000–05*. Birmingham: OFWAT.
- OFWAT (2004) *Future Water and Sewerage Charges 2005–10. Final Determinations*. Birmingham: OFWAT.
- OFWAT (2009) *Service and Delivery-Performance of the Water Companies in England and Wales 2008–09*. Birmingham: OFWAT.
- OSTROM, E. and JANSSEN, M. (2004) “Multi-Level Governance and Resilience of Social-Ecological Systems”, In SPOOR, M. (ed), *Globalisation, Poverty and Conflict*. Dordrecht: Kluwer.
- OSTROM, V. et al. (1961) “The Organization of Government in Metropolitan Areas: A Theoretical Inquiry”, *American Political Science Review*, 55(4): 831–842.

- PERRINGS, C. (2006) “Resilience and sustainable development”, *Environment and Development Economics*, 11: 417–427.
- RENOU, Y. (2012) “Indicateurs de performance et gouvernementalité des ressources en eau”, Communication at *Le service public d’eau potable et ses territoires à l’épreuve du développement durable: état des lieux et perspectives*, Grenoble, 14–15 november.
- ROCHE, P-A. (2001) “L’eau au XXI^e siècle: enjeux, conflits, marché”, *Ramsès*: 71–94.
- ROSE, A. (2007) “Economic Resilience to Natural and Man-Made Disasters: Multidisciplinary Origins and Contextual Dimensions”, *Environmental Hazards*, 7: 383–398.
- SALETH, M.R. and DINAR, A. (2008) “Linkages Within Institutional Structure: An Empirical Analysis of Water Institutions”, *Journal of Institutional Economics*, 4(3): 375–401.
- SAUSSIER, S. et al. (2004) *Mode de gestion et efficacité de la distribution d’eau en France: une analyse néoinstitutionnelle*. Paris: Rapport pour le Ministère de l’Écologie et du Développement durable.
- TEISMAN, G. and EDELENBOS, J. (2011) “Towards a Perspective of System Synchronization in Water Governance: a Synthesis of Empirical Lessons and Complexity Theories”, *International Review of Administrative Sciences*, 77(1): 101–118.
- WACKERBAUER, J. (2007) “Regulation and Privatisation of the Public Water Supply in England, France and Germany”, *Competition and Regulation in Network Industries*, 8(2): 101–116.
- WACKERBAUER, J. (2009) *The Water Sector in Germany*. Liège: Ciriec Working paper, 2009–11.
- WARD, B.N. (1972) *What’s Wrong with Economics?* New York: Basic Books.
- WILBER, C.K. and HARRISON, R.S. (1978) “The Methodological Basis of Institutional Economics: Pattern Model, Storytelling, and Holism”, *Journal of Economic Issues*, 12(1): 61–89.
- WILLIAMSON, O.E. (1990) “The Firm as a Nexus of Treaties: An Introduction”, In AOKI, M. et al. (eds), *The Firm as a Nexus of Treaties*. London: SAGE Publications.
- WILLIAMSON, O.E. (1991) “Comparative Economic Organization: The Analysis of Discrete Structural Alternatives”, *Administrative Science Quarterly*, 36(2): 269–296.
- WILLIAMSON, O.E. (2000) “The New Institutional Economics: Taking Stock, Looking Ahead”, *Journal of Economic Literature*, 38: 595–613.
- WILLIAMSON, O.E. (2005) “The Economics of Governance”, *American Economic Review*, 95(2): 1–18.
- WILLIAMSON, O.E. (2010) “Transaction Cost Economics: The Natural Progression”, *American Economic Review*, 100(3): 673–690.