



Original Article

Research frontiers of new institutional economics<sup>☆</sup>

*Pesquisa fronteiras da nova economia institucional*

Claude Ménard<sup>a,b</sup>

<sup>a</sup> *Université de Paris (Panthéon-Sorbonne), Paris, France*

<sup>b</sup> *Lee Kuan Yew School of Public Policy, National University of Singapore, Singapore*

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**Abstract**

This contribution is about the ‘progressive research program’, as Imre Lakatos would have called it, initiated by New Institutional Economics. After a short reminder of the ‘golden triangle’ of concepts and tools introduced by the founders (Coase, North, Ostrom, Williamson) and their followers, the paper turns to a quick overview of the attainments of this paradigm along its dominant branches: organization theory and institutional analysis. The emphasis is on the new paths opening up, with a focus on two key issues: hybrid arrangements, which may well be the prevailing organization of transactions in developed market economies; and intermediate, ‘meso-institutions’, which likely provide the missing link between the general rules framing socioeconomic activities and the actors operating within these rules. The underlying argument is that whatever happens to the label ‘NIE’, this research program will remain with us for a long time ahead.

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*Keywords:* New institutional economics; Organization theory; Institutional analysis

**Resumo**

Este artigo trata do “programa de pesquisa” – conforme Imre Lakatos o chamaria – iniciado pela Nova Economia Institucional (NEI). Após um breve resumo do “triângulo de ouro” de ferramentas teóricas e conceitos introduzidos pelos fundadores da NEI e seus seguidores, o trabalho apresenta uma visão geral das conquistas do paradigma em suas correntes dominantes: teoria da organização e análise institucional. Ênfase é dada a novas avenidas de pesquisa, com foco em dois temas-chave: arranjos híbridos, que possivelmente constituem a principal maneira de organização de transações em economias de mercado desenvolvidas; e “meso-instituições” intermediárias, que provavelmente fornecem a ligação não identificada entre as regras gerais que influenciam atividades socioeconômicas e os atores que operam com base em tais regras. O argumento central é o seguinte: independentemente do que ocorrer com a etiqueta “NEI”, este programa de pesquisa permanecerá entre nós por um longo período adiante.

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*Palavras-chave:* Nova economia institucional; Teoria da organização; Análise institucional

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*E-mail:* [claudem.menard@univ-paris1.fr](mailto:claudem.menard@univ-paris1.fr)

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## Introduction

The task assigned to this lecture is a hard one. Drawing a broad picture of research at the frontiers of New Institutional Economics (NIE) in the context of ‘post-crisis reflections’, which is the theme of this year forum, is very demanding at a time when the founding thinkers of NIE are gone or not much active anymore, with part of the agenda they initiated already fulfilled and/or integrated in mainstream economics. In what follows I shall focus on selected issues on which NIE already made significant contributions and, even more importantly, on questions raised by contributors to NIE that still remain to be answered, whatever the label under which this will be done.

In doing so, I intend to deliver two central messages. *First*, I shall argue that understanding the conditions of *implementation* and *enforcement* of rules and norms and the institutional devices through which this is done is central for explicating how economies actually work. *Second*, I shall emphasize that numerous concepts developed over the decades following the pathbreaking contributions of Ronald Coase provide *tools* to go further on these issues.

The next sections substantiate these messages along the following lines. The first section, on ‘*New institutional economics: foundations*’, briefly summarizes the conceptual hard core of NIE that will likely remain part of any future development in institutional analysis. The second section, on ‘*New frontiers in the economics of organization*’, provides an overview of some recent contributions in the branch of NIE focusing on the economics of organization to point out possible micro-foundations to economic disequilibria. The third section, on ‘*New frontiers in institutional analysis*’, turns to the institutional dimensions, of which organizations are an important component, to show sources of misalignment that can derail an economy from its expected trajectory. The last section, on ‘*What future for NIE?*’, draws lessons and perspectives with the underlying assumption that the conceptual apparatus developed within NIE is likely to pollinate the agenda of researchers and policy-makers for quite a while since so many issues pointed out by this research program remain to be explored.

### New institutional economics: foundations

The leading figures at the origin of the development of the NIE research program (Ronald Coase, Douglass North, Elinor Ostrom, Oliver Williamson) are now well-known since they all received, at different times, the Nobel Prize in economics.

In a recent paper, Mary Shirley and I pointed out the complex set of influences that shaped their thought and some of the contributors that developed and diffused their initial intuitions (Ménard & Shirley, 2014; see also Furubotn & Richter, 1997). What is striking is the variety of contributions of those leading figures and the numerous fields they pollinated, from organization theory to public choices, law and economics, political science, economic history and so on.<sup>1</sup>

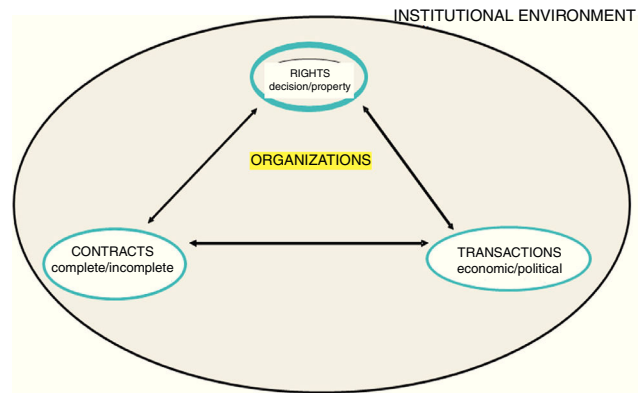


Fig. 1. Conceptual framework: the ‘golden triangle’.

### Leading concepts

However, I would like to use the limited time I have to focus on the set of concepts that progressively emerged from this network of contributors, a network that eventually ended in the creation of the International Society for New Institutional Economics (since 2015, the Society for Institutional and Organizational Economics).

This conceptual apparatus can be tagged as the ‘golden triangle’ of NIE (Fig. 1). The components of this triangle and their interactions provide powerful tools to investigate the institutional dimensions framing economies. The *first corner* of the triangle is about rights, more precisely about two types of rights, property rights and decision rights. These rights rarely fully coincide, which is an important source of potential mismatch and flaws that may derail economic activities. The *second corner* is about transactions and transaction cost. Recent developments in NIE suggest a distinction between economic transaction costs and political transaction cost<sup>2</sup>: both can be important sources of distortions in decision-making. The *third corner* is about contracts, which are most of the time incomplete, thus opening room for potential maladjustments. This emphasis on contracts has been criticized. True, they do not explain everything, by far. However, they provide a good point of entry to the analysis of the role played by rights and transactions; and they also provide a powerful point of entry to the analysis of organizations (firms, markets, and interfirm agreements) and their institutional embeddedness.

### Structuration of the domain

These concepts have structured two main branches in the New Institutional Economics program: one focusing on the micro-analytical level at which transactions are actually organized (the organizational level, very much identified to the williamsonian filiation); the other focusing on the macro-level of the political, judicial, and administrative institutions that delineate the domain within which transactions are developed and implemented (a domain associated to the name of Douglass North and, to a

<sup>1</sup> For an overview of this diversity see Ménard and Shirley (eds.) (2008).

<sup>2</sup> Although the idea of political transaction cost can be traced back to Stigler (1971).

lesser degree, Elinor Ostrom). Let me turn to a short exploration of these two domains, pointing out aspects that might be particularly relevant for the topic of this Forum.

### New frontiers in the economics of organization

Let me first pay attention to what can be identified as *new frontiers in the economics of organization*, which is the micro-institutional level, the level at which are made decisions regarding the actual organization of economic activities and their associated transactions.

#### Understanding the variety of organizational arrangements

A major contribution of NIE in that respect has been to exhibit the existence of many different ways to organize transactions, arrangements that compose and structure a market economy (and, in that respect, any economic system); and to provide tools for the analysis of this variety. This is not as trivial a statement as it could seem. Even today, most leading economic textbooks characterize economies through a dyad: markets and firms, with consumers in the background. Identifying alternative organizational arrangements has been a long process, and it is still going on. Acknowledging this diversity has a very important consequence for theoretical developments but also for policy makers: most of the time there is *no one single optimal solution for organizing transactions*. We live in a world of second, even third best, in which there is no “ONE-SIZE-FITS-ALL” solution. A short reminder might be useful here to clarify this continuing reference to transactions: ‘economic transactions’ are about the transfer across technologically separable activities of rights to use resources.

The initial conceptualization of this variety of organizational arrangements was provided by Williamson (1985,1996).<sup>3</sup> Building on the intuition of Coase (1937, 1960), Williamson made the concept of transaction operational by identifying three leading characteristics (or ‘attributes’) of transactions: the frequency (F) with which a transaction is repeated, the uncertainty (U) surrounding its organization, and the specificity of investments (AS) the transaction may require. But the main point that Williamson made is that we face a major problem here: if you have to choose a modality to organize a transaction (say, securing the supply of a strategic input), you face the problem of finding the right alignment between this organizational choice and the attributes of the transaction at stake. Hence, there is the possibility of a *misalignment* that can generate discrepancies, even a ‘crisis’, at the microeconomic level. Let me briefly mention two examples: (1) a classical reference is about the potential mismatch between coal suppliers and producers of electricity, which could produce disruption in the energy sector (Joskow, 1985,1991); (2) a much more recent and spectacular example is about the organizational disturbances following the emergence of the new technologies of information and communication, as vividly illustrated by the so-called ‘uberization’ of our economies.

Since the task I have been assigned is to look at ‘new frontiers’, let me point out what I consider the major development of the last decade when it comes to the economics of organization. It might be summarized by looking at the interaction between the attributes of transactions, mainly Uncertainty (U) and Specificity of Investments (AS) and the allocation of rights. In sum, we are looking simultaneously at two corners of the ‘golden triangle’, with a special attention to the distinction between property rights and decision rights.

*Property rights* (PR) are hereafter identified as the capacity of the holder of these rights to control the transfer of rights needed to organize transactions and to be residual claimant on the outcome. In other terms, the residual claimant determines *WHO* in last resort control what to do with the available resources and the conditions under which rights over these resources can be transferred. An example is the decision to develop a joint venture between two otherwise independent and even competing firms.

By contrast, *decision rights* are about *HOW* rights to use are going to be actually exercised, and/or about the procedures through which decision-makers can operate. The central example (and a key issue in developed economies) is of course the rights allocated to managers to reorganize tasks within the rules defined by holders of property rights (or some of them!). A great virtue of NIE in that respect is to have introduced the key role of managers in our theoretical economic landscape.

#### Capturing the variety of organizational arrangements: a framework

We can now put these ingredients together and provide a general framework to capture the resulting variety of organizational arrangements (Fig. 2).

The horizontal axis indicates the intensity at which *property rights* are put together (centralized), which depends on the strategic intensity of investments (from low to high). The vertical axis captures the intensity of decentralization (or ‘delegation’) of *decision rights*, again from low to high. Combining these two dimensions delineates the domain of possible organizational arrangements. The upper curve delineates the “possibility frontier”, above which the organization of transactions would be unsustainable with respect to the characteristics of these

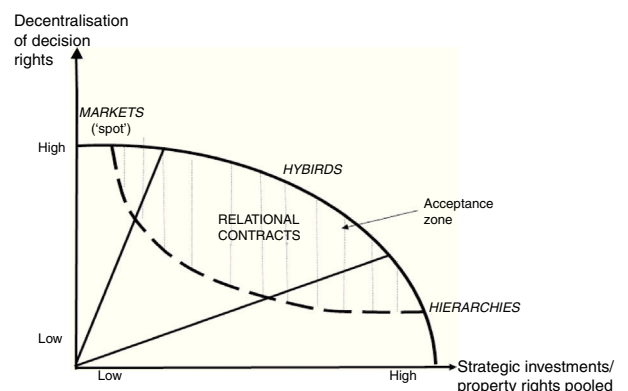


Fig. 2. The variety of arrangements conceptualized.

<sup>3</sup> A pioneering contribution is from Rubin (1978), about franchising.

transactions (e.g., the uncertainty surrounding their organization is just too high). The lower curve delineates the domain under which transactions tend to become hardly tractable or have attributes that push toward the adoption of pure forms (pure ‘spot’ markets, pure ‘hierarchies’), which tend to be rather exceptional, contrarily to the prediction of standard theory.

Most transactions are actually organized within the lens delineated by these two curves. This lens (the ‘acceptance zone’) is the domain of relational contracts (the third corner of our ‘golden triangle’), that is: the domain within which contracts are incomplete, providing only a framework, a blueprint within which parties to the transactions adjust mutually (through the role of managers; or through arbitration; or through court decisions, etc.). This is also the domain within which *hybrid arrangements* tend to prevail. Hybrids, to be short, are modalities of organizing transactions that rely neither on pure market relationships, with the price mechanism at the center of coordination, nor on full integration within a firm, with hierarchy as the ultimate mean of coordination). Hybrids can be more rigorously defined as the organization of transactions among legally autonomous entities that keep strategic property rights separated but share significant decision rights because it is the best way to create added value: only joint usage of the relevant assets can deliver a surplus. Having acknowledged the existence and importance of hybrids in the organization of economic activities is in my view a major breakthrough in modern economics of organization.

#### Illustration: cooperatives

Cooperatives are illustrative of this type of organizational arrangements, with cooperators keeping full control over their specific assets while possibly sharing some of them (joint ownership) and above all sharing decision rights to a degree that in many cases is highly significant. Cooperatives play a very important role as a modality to organize transactions in developed market economies, which is somehow puzzling for standard economic theory. In some countries (e.g. Finland) it is even the dominant form that entirely structures the economy. At the sector level it may also play an important role. A fascinating case in that respect is the spectacular increase in the number of cooperatives in the German-energy sector over the last 10 years (Fig. 3).

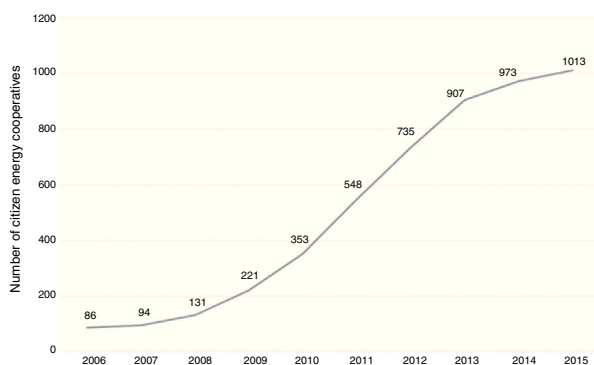


Fig. 3. The example of energy-cooperatives in Germany.

This case is fascinating in that this development connects to two crucial components of the NIE framework. Indeed, it is the result of: (1) changes in the nature and specificity of investments, coming out of technological changes, as is often the case: the emergence of new technologies, from solar panels to smart grids, allowing more decentralized organizations with less specific investments to deliver energy; (2) changes in institutional rules of the game, in this case changes in the German fiscal regime to facilitate ‘renewable energies’.

There are many other examples of HYBRIDS (Ménard, 2013, chap. 26; Ménard, 2014, 2018): (1) franchising, which now represents a ‘heavy weight’ in distribution (but not only!); (2) strategic alliances that now dominate the airline industry; (3) plural forms, characterizing firms that diversify the type of supplying arrangements on which they rely, as in the automobile industry – the so-called ‘Toyota’ model-, in agri-business, etc.

#### Some consequences for economic policies

This variety of organizational arrangements has important consequences for economic theory (the need to revisit the dualism of ‘markets’ and ‘firms’ also identified as hierarchies); but also for economic policies, e.g., revisiting competition rules (ex.: are strategic alliances falling under ‘collusion practices’?), fiscal regimes (as in the case of cooperatives), labor laws and ‘liability’ (in a franchising system what are the respective responsibilities of the franchisor and the franchisees?).

#### New frontiers in institutional analysis

These issues bring into the picture the other dimension of the New Institutional Economics research program: the institutional embeddedness of organizational arrangements into the judiciary, the polity, the administrative setting, and even underlying norms and beliefs.

#### Institutional embeddedness: guiding principles

In that respect the conceptual apparatus summarized above has allowed to go much further than simply stating that ‘institutions matter,’ which was already a non-negligible steps forward for most economists (do remember that the idea that institutions matter was long ignored in economic theory or considered not belonging to its domain). *First*, it is now accepted that organizational arrangements, including markets, are deeply *framed by and embedded in their institutional environment*. Indeed, the set of concepts that define the ‘golden triangle’ through which I have characterized organizations all have an institutional dimension. *Second*, it is increasingly acknowledged that this institutional environment is not a homogenous gelatin in which all transactions would be soaked, but that it is composed of *intricate layers*. Unfolding these layers is an important task on the research agenda of those of us who want to better understand how rules and norms actually operate. *Third*, recent developments suggest that the interactions among these institutional layers (and between these layers and technologies) involve the existence of ‘critical functions’. Critical functions are those requirements (i)



that some transactions must meet in order for economic activities to be sustainable; and (ii) that institutions must secure in order to maintain socio-economic cohesion.

### *Some consequences on our understanding of economic systems*

These achievements have important consequences if we want to better understand gaps, flaws, even crises in the running of economic systems. For example, properly identifying the critical functions might be decisive to adapt . . . or fail to adapt to changing circumstances such as those imposed by the ongoing technological revolution.

Let me illustrate very briefly with two examples. At the *micro-level*, consider the running of a railway system. In that sector, inter-operability is central to meet passengers' expectations . . . and to avoid crashes. On the technical side, there is the need to coordinate and properly maintain the signaling systems (for example, there are several signaling systems involved in the running of THALYS between Paris and Amsterdam); on the institutional side, there is the need to implement appropriate institutions to coordinate (for example, who is going to allocate the slots between Paris and Amsterdam and according to what criteria if competition is going to be introduced). Modalities of defining and allocating rights and of organizing transactions are critical for this apparently well-known and well-understood activity: running a railway system!

At the *macro-level*, there is also the risk of a mismatch between the general rules of the game and the actual organization of transactions by operators. For example the rules of the game in the energy sector, largely built in the context of centralized systems that prevailed in most countries until now are less and less adapted to the complex requirements of interdependent and technologically heterogeneous sources of energy (e.g., the coordination of wind farms, solar energy, hydro, etc.) which impose a different technological architecture.

There are two major consequences here. *First*, mismatches among institutional layers and/or between institutional rules and technologies (and the potential gaps in their mutual adjustment) can be the source of major disruptions in economic activities, up to the point of challenging societal cohesion. *Second*, if we refer to the distinction between property rights and decision rights, the mismatch between these two vectors of rights might generate major *political transaction costs*. Political transaction costs, a concept explicitly introduced by North (1990b) are the costs of reaching and stabilizing a coalition among constituencies with different, diverging, even conflicting interests. Illustrative are the difficulties faced by the adoption and implementation of the so-called 'public-private partnerships'.

The initial insights on these issues were largely provided by North (1981), North (1990a, 2004), North, Weingast, and Wallis (2009) and to a lesser degree of influence, by Ostrom (2005). Although proposing partially different approaches, the contributions of Aoki (2001), Greif (2006), Acemoglu and Robinson (2012) also go in this direction, in which the focus has been on a dyadic approach, looking at the interaction between what North called the 'institutional environment' (defining the 'rules of the game') and the 'institutional arrangements' (organizations and individual actors identified as 'the players of the game').

### *A general model of institutional interactions*

Building on the concepts of NIE, but also integrating other contributions (institutional design, system engineering), ongoing researches provide a more complex representation of what we call 'institutions'. Fig. 4 summarizes this complex netting of different institutional layers and their interactions.

It is out of question to comment this conceptual framework extensively in the short time allocated. Let me emphasize two aspects. *First*, the representation of this framework clearly emphasizes the role of the technological dimension and the need to take on board technologies in their interaction with

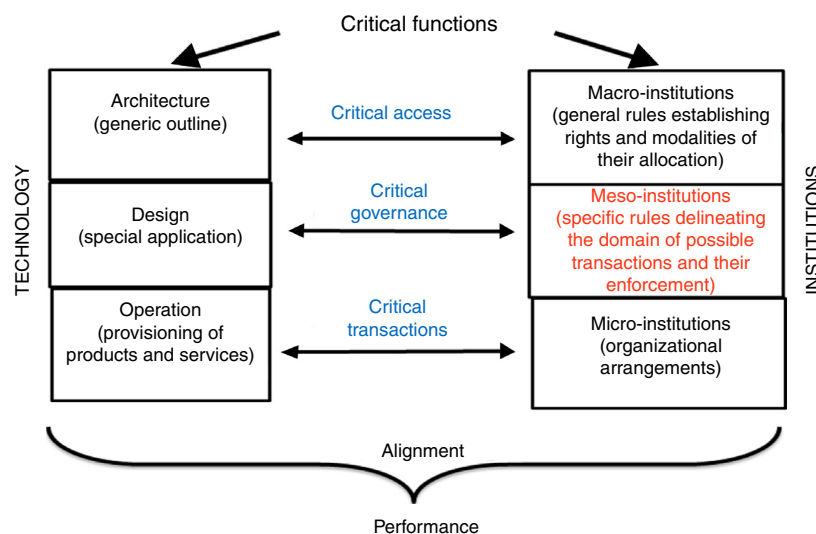


Fig. 4. A general institutional framework.  
(Source: Kunneke, Ménard, & Groenewegen, 2018).

institutions. If we have entered into a new ‘industrial revolution’ (and I think we have), there is the imperious necessity to look at how technological changes go hand in hand with institutional changes. However, this co-evolution never works smoothly, creating gaps and delays that generate distortions, maladaptation, and even more profound socio-economic crisis. *Second*, the representation above also suggests that these interactions proceed at different levels. In that perspective it is essential to disentangle the concept of institutions. In particular there is a layer that has long been ignored by institutionalists (whatever their approach and school of thought), which is the institutional intermediate between the level at which general rules and rights and the modalities of their allocation are defined, and the level of organizational arrangements (markets, firms, hybrids) through which transactions are actually implemented. I suggest identifying this intermediate layer as *meso-institutions*.

*The missing link: meso-institutions*

*Meso-institutions* are the set of devices and mechanisms through which specific rules (embedded in the general ones) are delineating the domain of transactions that are possible and allowed and the modalities of their enforcement. ‘Mechanisms’ are here understood as the procedures through which coordination and monitoring are processed, while ‘devices’ are the organizational modalities through which mechanisms operate. For example, a regulation is a mechanism; a regulatory agency is a device.

Illustrative of these meso-institutions are the following: (1) public bureaus, for example CALTRANS, the department of transportation in charge of organizing and monitoring the road system in California; (2) regulatory agencies, for example the French ARCEP, the authority in charge of regulating all electronic communications and postal services; (3) specialized courts, for example the Labor Courts of Israel, specializing in the implementation of labor law, thus impacting the allocation of decision rights in employment relationships; (4) arbitrating organizations, such as the Arbitration Institute of the Stockholm Chamber of Commerce specialized in international dispute resolution among private partners.

What these diverse institutional devices share is their central role in bridging the gap between the general rules of the game and the actors operating within these rules. Meso-institutions do so through three major modalities (Fig. 5).

First, meso-institutions *translate, adapt, and allocate* rights. For example, once the European Union has decided to introduce competition in rail transportation and that this has been trans-

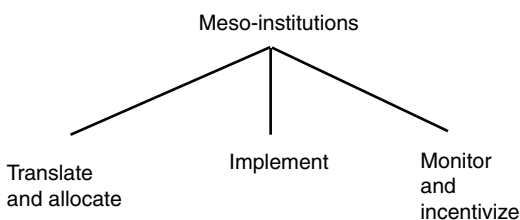


Fig. 5. Meso-institutions functions with respect to rules and rights.

lated into national laws (according to the so-called ‘subsidiarity principle’), there is the need to install entities, e.g., a bureau, an independent agency, etc., to allocate rights of access to the rail network, which requires competing companies to meet specific economic, financial, and technological norms and standards, and to allocate slots to the selected companies. *Second*, meso-institutions are a central node in the *implementation* of these specific rules and rights, for example in their capacity to impose penalties or even exclude from the market those not respecting the rules agreed upon. This centrality explains the importance of the properties of meso-institutions, which has been the source of an important literature regarding regulatory agencies, for example about their desirable degree of autonomy, their capacity to investigate, their right to penalize, etc. (Laffont, 2005). *Third*, meso-institutions play also a crucial role in *monitoring* the actual running of the system, for example checking that safety standards in the delivery of drinkable water are met, and providing adequate *incentives*, for example by adopting appropriate rights of access or tariff systems.

*Why meso-institutions matter*

Most examples above relate to public utilities because this is an area in which we have learned a lot over the last decades about the role of meso-institutions, while at the same time important aspects have been neglected, for example regarding the comparative transaction costs of alternative institutional arrangements, issues that can fruitfully be explored with the conceptual apparatus developed by new institutional economists. Let me illustrate (Fig. 6) with a simple model connecting the different status of public utilities (on the diagonal) with elements of the framework introduced above (the axes).

In this figure, the degree of autonomy of property rights with respect to public authorities is associated to different devices defining modalities of regulation and combined with the degree of autonomy of decision-making and the associated incentive mechanisms. This combination helps characterizing the variety of organizational arrangements that we can observe in the delivery of public utilities. One important issue that remains relatively underexplored and misunderstood concerns the characterization of the vertical axis, that is the different incentive mechanisms that

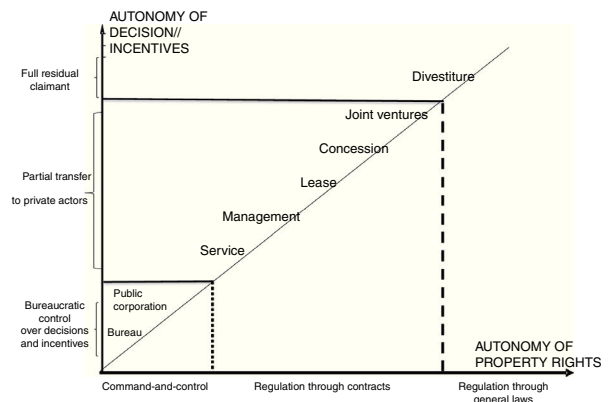


Fig. 6. The case of public Utilities.

operate according to different allocation of rights and that could explain the observable variety of outcomes (e.g., the success of publicly owned and controlled utilities in some institutional context and their failure in others). These issues are getting high (and rightly so) on the agenda of international organizations (e.g., the OECD) and of reputed academic researchers.

### What future for NIE?

Nothing remains ‘new’ forever! The name ‘NIE’ will likely leave way to other appellations. However, I submit that the conceptual apparatus introduced by Coase, North, Williamson, Ostrom and so many others will still pollinate research and remain relevant for policy-makers for years to come. Let me conclude by pointing out what I view as some particularly challenging issues that can benefit from the rich contributions of the New Institutional Economics research program.

#### *Bridging the gap*

In my view, a central contribution of NIE has been to identify and characterize the diversity of arrangements that provide the building blocks of our economies, and to have introduced a conceptual framework to initiate the analysis of these arrangements. I summarized these concepts under what I identified as the ‘golden triangle’ of NIE. And I have emphasized that among the diversity of arrangements, there is a particular need to build a satisfying theoretical approach to:

(1) The whole set of organizational arrangements, making room for hybrids, which have properties that overlap with markets and firms (‘hierarchies’) on some aspects but radically differ on some other aspects. As rightly emphasized by Ronald Coase, these arrangements might well be the prevalent form of doing business, so that economic theory must engage beyond the simplistic dichotomy between markets and firms.

(2) The complex netting of institutional arrangements, here identified as ‘meso-institutions’, that bridge the gap between the general rules and norms defined at the macro-institutional level, through the political system, the judiciary, the administration; and the actual operation of transactions implemented by entrepreneurs and actors. Again, this requires economic theory to go further than the already rich contributions of the founders of New Institutional Economics and their followers.

#### *Revisiting economic theory*

The main points I wanted to emphasize through the relatively abstract presentation of these issues is that it is in these intermediate layers (organizational as well as institutional) that a lot of action is happening; that it is to these intermediate layers that policy-makers are confronted most of the time (e.g., when regulating unfair trading practices); and that it is in this direction that economists and social scientists concerned with institutions may expect (or hope) substantial developments. If it is so, the consequence is that we need an in-depth revision of some *fundamental components of the existing economic theory*. Acknowledging the existence and importance of *hybrids*

requires revising organization theory, industrial organization, and, more substantially, micro-economic theory. Acknowledging the existence and importance of *meso-institutions* requires much more attention to a revised version of political economy (taking on board political transaction costs), law and economics, etc. And accepting that norms and beliefs are part of the framing of these dimensions requires revisiting the foundations of behavioral economics in order to better establish links between individual behavior and collective action.

#### *Impact for economic policies*

Although I am neither a policy-maker nor a specialist of public policies, I would also like to emphasize that if hybrid modes of organization and meso-institutions are significant components to the field in which *substantial part of economic actions happen*, this is very consequential when it comes to defining and choosing economic policies. For example, it likely requires an in-depth revision of competition laws and guidelines in order to make room for hybrid arrangements; or it imposes to better take into account the role of meso-institutions in adapting general rules to specific sectors, specific organizational arrangements, and specific technologies, e.g., allocating property rights and decision rights in public-private partnerships operating in a changing technological environment.

#### *Wrapping it up*

New Institutional Economics does not provide answers to all these complex issues nor all tools required to investigate them. But it has already delivered substantial means to go further in our exploration of these questions. It does so by:

- Providing **conceptual tools**, as summarized in the (simplifying) ‘golden triangle’.
- Providing a rich and **integrated framework** of analysis, as illustrated with the figures summarizing what we have learned about the diversity of organizational arrangements and the need to disentangle institutional layers.
- Delivering **results** through already substantial empirical contributions that allow raising new questions and indicating paths for future research.
- Opening a **progressive research agenda** that can hopefully attract an increasing number of researchers, particularly young ones.

Indeed, beside the necessity to continue enriching this theoretical framework, there is the need to face a major challenge that institutional as well as organizational theory faces and to which NIE and/or its paradigmatic successor(s) did not, do not escape: how to make progress from already very substantial conceptual developments toward measurement, an absolute requirement on which we lack behind.

### Conflicts of interest

The authors declare no conflicts of interest.

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<sup>4</sup> Only key references are provided here.