



Evaluating regulatory reform of network industries: a survey of empirical models based on categorical proxies

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ABSTRACT

Proxies for regulatory reforms based on categorical variables are increasingly used in empirical evaluation models. We surveyed 63 studies that rely on such indices to analyze the effects of entry liberalization, privatization, unbundling, and independent regulation of the electricity, natural gas, and telecommunications sectors. We highlight methodological issues related to the use of these proxies. Next, taking stock of the literature, we provide practical advice for the design of the empirical strategy and discuss the selection of control and instrumental variables to attenuate endogeneity problems undermining identification of the effects of regulatory reforms.

1. Introduction

At least since the 1980s, governments around the world have implemented wide regulatory reforms that have reshaped network industries such as energy, telecommunications, and transport. The empirical evaluation of the societal impacts of these reforms¹ is essential to guiding policymakers and regulators in the selection of the most appropriate measures. This process seems straightforward: reforms are desirable when they yield economic and social benefits that outweigh their costs (Coglianese, 2012). While this simple description is backed-up by a well-established theoretical literature in public economics (see Boadway, 2012 for a survey), empirical assessments of regulatory reforms by means of econometric analyses are complex (Jamash and Pollit, 2001). One of the main difficulties is how to build accurate empirical proxies for regulatory reforms and use them to identify their causal effects on key economic outcomes (Arndt and Oman, 2006; Knack, 2006). The recent controversy over the World Bank's competitiveness rankings, brought to the media's attention by former Chief Economist Paul Romer, exemplifies well the kind of criticisms to which extant proxies are subjected (Zumbrun and Talley, 2018).

This paper summarizes these criticalities focusing on entry liberalization, privatization, unbundling, and independent regulation of

the electricity, natural gas and telecommunications sectors. We surveyed 63 empirical analyses that rely on dichotomous or categorical variables to evaluate the effects of regulatory reforms across sectors, countries, and over time. These proxies for reform, such as the OECD “Indicators of regulation in energy, transport and communications” (ETCR) or the “ICT Regulatory Tracker”, recently released by the International Telecommunication Union, are based on a process that combines statistical data and subjective information from different sources (e.g., from surveys of business or experts). We discuss several issues involved in the measurement and assessment of regulatory reforms in network industries using categorical variables; next, taking stock of the literature, we provide recommendations to help researchers and policymakers avoid methodological pitfalls and errors in interpreting empirical results. First, since categorical variables summarize a variety of data, aggregation biases can be reduced relying, as far as possible, on the most disaggregated index. Second, given that conceptual errors involved in the construction of reform proxies are to some extent inevitable, re-coding categorical indices into dichotomous variables might mitigate the impact of this issue. Third, we recommend using alternative proxies as robustness checks of the results and to facilitate cross-country comparisons. Fourth, properly handling the dynamics of the econometric specification is

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¹ We use the term regulatory reforms to encompass any regulatory policy aiming to enhance the life of citizens and business; that is, any measure implemented by governments through legislative and non-legislative acts. In the literature, regulatory reforms are also referred to as structural reforms. See Section 2 for a more detailed discussion.

essential for capturing the forward-looking behavior of agents and to accurately describe the lags associated with the political process that leads to the implementation of reforms. Fifth, we review how to select appropriate control factors and valid instrumental variables to attenuate endogeneity problems that might undermine the identification of the effects of regulatory reforms.

Empirical studies of the effects of regulatory reforms can be divided into two distinct groups depending on whether the reform proxy enters the econometric specification as a dependent variable or as an explanatory variable. The first class of models, which we do not analyze, is representative of the political economy literature on the historical determinants, success, and failure of reforms (see Obinger et al., 2016; Duso and Seldeslachts, 2010; Guerriero, 2013; Belloc et al., 2014, among many others). We focus on the strand of the literature where reform proxies are fed into regression models as explanatory variables with the aim of estimating their effects on various economic outcomes, ranging from prices to customers' satisfaction. Studies that are related to our paper are Nicoletti and Pryor (2006), Jamasb et al. (2017), Parker and Kirkpatrick (2012), and Pollitt (2009a, 2009b). We depart from previous surveys along two lines. First, we do not focus on economic outcomes (i.e., dependent variables), but mostly on regulatory reform indicators as explanatory variables. Second, we do not concentrate on a single sector or country, but on four different reforms: entry liberalization, privatization, unbundling, and the establishment of an independent regulatory authority in the electricity, natural gas and telecommunications sectors. In this way, we provide some guidelines for practitioners and academic researchers.

The rest of the paper is organized as follows. Section 2 sets the conceptual framework and describes the difficulties of translating general definitions of regulatory reforms into empirical proxies; Section 3 discusses potential pitfalls and methodological issues related to the use of categorical proxies for regulatory reforms; Section 4 surveys the literature focusing on the measurement of different regulatory reforms with categorical proxies; Section 5 discusses how to selected appropriate control factors and valid instrumental variables to attenuate endogeneity problems; Section 6 concludes.

2. Taking the theory of regulatory reforms to the data

OECD (2012, p. 5) stated that regulatory policy aims at “(...) achieving government's objectives through the use of regulations, laws, and other instruments to deliver better economic and social outcomes and thus enhance the life of citizens and business.” This definition is broad enough to encompass most of the regulatory reforms implemented in network industries, including liberalization, privatization, unbundling, and the establishment of independent regulatory bodies. The OECD's definition also shows that theoretical models belonging to the “Ramsey-Samuelson-Guesnerie” tradition² can hardly be used to analyze them. In fact, within this framework, regulatory reforms are expected to change a “vector of signals”, defined as variables affecting the behavior and welfare of individuals and firms, such as prices, rations, taxes, transfers, and shareholding rights (see e.g., Diamond and Mirrlees, 1971; Drèze and Stern, 1990; Gruber and Saez, 2002; Saez et al., 2012; Barrell and Weale, 2009; Kosonen, 2015; Laubach, 2009). This framework is too narrow to represent a proper theoretical background for the array of reforms subsumed in the OECD's definition of regulatory policy.

In fact, regulatory reforms in network industries do not necessarily involve a marginal change to a vector of signals, such as tax rates or prices, nor an instantaneous variation in the social welfare function. Rather, they often imply a modification of the existing policy framework and are implemented with legislative packages that encompass a variety of instruments, such as primary laws, secondary regulations, subordinate rules, standards, administrative guidance and circulars,

with complex interactions³ (OECD, 2010; Goldberg, 1976).

While presenting a complete list of regulatory reforms is neither feasible, nor particularly informative, providing definitions of the four measures we analyze is useful to better illustrate the topics of the paper and the difficulties that emerge when these definitions need to be translated into quantitative or qualitative variables.

2.1. Regulatory reforms in network industries: definitions

We focus on liberalization, privatization, unbundling and the introduction of an independent regulatory body in electricity, natural gas and telecommunications sectors. Providing consistent definitions is not trivial in that these regulatory reforms are intertwined and their success depends on several factors including the order and the way in which they are implemented in different countries and sectors (e.g., Zhang et al., 2005).

Finding a precise definition of “liberalization” is problematic. In fact, this term is used to encompass several measures aimed at spurring competition. For instance, privatization and the unbundling of the network core facilities are often viewed as part of the liberalization process (see e.g., Erdogdu, 2013; Pompei, 2013; Nepal et al., 2016). To avoid definitional problems, we adopt a narrow definition and equate the term liberalization to “entry liberalization”, defined as the removal of barriers to entry (i.e., any factors hindering entry in a market and hence representing an obstacle to competition). Privatization is more easily defined either as the transfer of property rights from the public to the private sector or as the participation of the private sector in the management of public assets (Finger and Künneke, 2011), in this paper we focus on the first aspect only, the change of utility ownership.

We exclude from liberalization those obstacles faced by the incumbent firms when they entered the market in the first place, such as the sunk costs of building the network's core facilities. This exclusion allows for defining the concept of “unbundling” more precisely, although it remains intertwined with that of entry liberalization. The unbundling of network infrastructures aims at fostering competition in sectors where highly integrated firms operate (see Joskow, 1997). Integrated firms provide multiple services to exploit economies of scope that can derive from vertical integration (i.e., along different stages of the supply chain) or horizontal integration (i.e., the case of a multi-utility operating at a single stage of the production chain, but in different segments or sectors). Unbundling is thus the separation of the operation of network infrastructures from the stages of production and provision of services.⁴ A key dimension of structural reform is the degree of separation, from accounting to ownership separation. See Baldwin et al. (2012) for a discussion.

Although liberalization, privatization, and unbundling have the common goal of fostering competition, their success hinges on the existence of an authority supervising and enforcing the rules necessary for their implementation. The establishment of an independent regulator is the fourth regulatory reform analyzed in our study. An independent regulatory authority (IRA) is an agency that independently from the interests of firms and of policymakers and other stakeholders can issue binding decisions and impose penalties, so to enforce the rules necessary for the actual implementation of reforms (see e.g., Armstrong and Sappington, 2006; Bortolotti et al., 2013; Pollitt, 2009a; Larsen et al., 2006). The importance of the IRA for the effectiveness of entry

³ In the case of the European Union, regulation of network services involves the adoption of both legislative and non-legislative acts, the so-called “soft law”. Legislative acts (secondary law) comprise directives, regulations and decisions. Non-legislative acts include communications, green papers and white papers. “Soft laws” provide a correct interpretation of the primary and secondary laws. See Maresca (2013) and references therein.

⁴ An alternative view adopted by some scholars is to reserve the term “unbundling” for measures aimed at regulating utilities that operate at the same level of the production chain, and use the term “restructuring” for the vertical separation of functions (e.g., generation, transmission and distribution).

² See Ramsey (1927), Samuelson (1986) and Guesnerie (1977).

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