UNDERSTANDING THE CO-EVOLUTION OF ELECTRICITY MARKETS AND REGULATION

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Overview

Regulation aims to protect the customers and to ensure the intended functioning of the market. Developping appropriate regulation for a monopoly was not a straightforward task, and this task became even more challenging in the electricity context with the move from monopolies to liberalized markets. First, by their nature, electricity markets are complex and hard to interpret since they have long lead times, include feedbacks and involve environmental and policy concerns. Second, each market has its own characteristics, such as energy mix or reserve margin, that need to be taken into account when developing a regulatory framework. Furthermore, electricity markets are highly dynamic due to technological improvements and the behaviour of stakeholders. All these reasons pave the way for a mismatch between market and regulation. A regulatory framework that is not at the same level of maturity as the market will result in undesirable consequences; fixing these complications will be costly, difficult and requires a long time. An example of regulatory failure is the California electricity crisis where all the market participants were behaving as expected, but regulation was deficient and the regulatory body was not sufficiently pro-active to address the problems arising from this deficiency (Wolak, 2003). This crisis led to disconnections and resulted in major economic losses. Therefore, ensuring the co-evolution of regulation and market is crucial for a forward looking regulation.

To this end, this work proposes a behavioural regulatory framework in the electricity context that allows to consider idiosyncracies at national level while being generic at the same time. By introducing behavioral aspects, we seek to provide recommendations for the successful co-evolution of a market and its regulation. We discuss six main components a regulatory framework needs to be able to adapt as the market matures. We then discuss a number of cases to illustrate how the components of the framework can be used to explain regulatory failures and successes.

Methods

Based on an extensive literature review, we identify the main components of a behavioural regulation that is able to co-evolve with the market. We integrate these into a conceptual model. Then, we discuss several historical examples within the frame of our conceptual model.

Results

The conceptual model (Figure 1) presented here incorporates six main components of a behavioural regulatory framework, consisting of three interacting layers.

The innermost layer of our model consists of **soft drivers** and **stakeholders**. In the context of behavioural regulation, to be able to satisfactorily address market needs, regulation should take into account the variables that are not in line with purely economic goals. Examples include the NIMBY (“Not In My Back Yard”) effect, political concerns, fears and panics. We include these variables into our model as **soft drivers**.

Having a comprehensive view on market behaviour is only possible by considering all the main stakeholders, i.e., government, regulator, transmission and distribution companies, and final consumers. The interactions between different stakeholders create a need for regulatory change. Therefore, stakeholders are a main component of our behavioural regulatory framework.

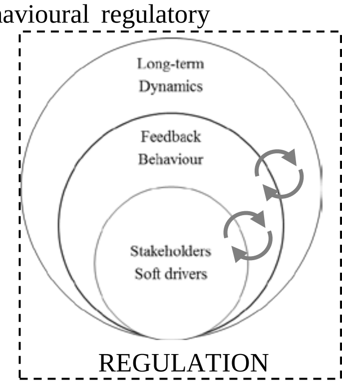

Figure 1: Conceptual model

The second layer of our model consists of **behaviour** and **feedback**. In the electricity context, reactions to incentives and political objectives, and self-interest of the stakeholders influence their decisions. All of these decisions have an impact on the evolution of the market, which generates the **behaviour** of the system. Also, **behaviour** is highly connected to **feedback.** Using feedback loops increases managerial understanding by allowing to anticipate the results of managerial actions, which helps avoiding undesirable consequences.

The outermost layer of the model consists of **dynamics** and **long-term horizon**. The regulation and the market evolve and interact over time. These interactions create pressure to adopt new regulatory mechanisms and this is referred to as **dynamics** in our model. The final component of our model is **long-term horizon**. Electricity is a context where facilities have long construction times and long life spans; therefore the consequences of regulatory changes are only visible over the long term.

In summary, soft drivers influence stakeholders and affect their decisions. These decisions create market behaviour and feedbacks. Feedbacks resulting from behavioural factors create the dynamics of the regulation, which affect the long-term performance of the system. For example, people agree on the use of wind power, but do not want to have wind farms nearby. This behaviour limits investments in wind energy (market behaviour) and consequently, the percentage of electricity generated using wind power remains low (long-term consequence).

The insights from this model can be observed in some illustrative cases. For instance, Germany is considered as a successful example since the country has dramatically increased its electricity production from renewables by introducing various policy mechanisms. However, while on the one hand these changes serve to increase the share of renewables, on the other hand they pose problems for security of supply, employement rates and competition among renewable energy producers (Frondel, Ritter, Schmidt, & Vance, 2010).

Another example is the England and Wales electricity market, where the regulatory regime had to be changed after 10 years of deregulation to create a more competitive market with lower prices: the original design was considered neither to provide the right price signals, nor to encourage sufficient competition (behaviour, dynamics) (Woo, Lloyd, & Tishler, 2003). This market also showed evidence of capacity cycles, a consequence of investment behaviour in a market characterized by long-term dynamics (Arango & Larsen, 2011).

These examples illustrate that a regulatory framework often will not yield the expected results; regulatory changes introduced to remedy certain problems can in turn create new disfunctionings of the market. Therefore, regulatory frameworks should be designed in a more comprehensive way that matches the market.

Conclusions

The presence of long lead times, continuous technological improvements and feedback loops make electricity markets complex and highly dynamic. These specifities make regulating electricity markets challenging because, in order to systematically address the market needs, regulation should be pro-active and in constant evolution with the market. However, experience has shown that this is not always the case, and a mismatch between market and regulation results in undesirable outcomes.

Our intention in this work is to provide a conceptual model to improve understanding of a behavioural regulatory approach which is capable of co-evolving with the market. With the six main components of our model, we can capture the idiosyncracies of different countries, but at the same time, we keep the model generic. Therefore, this model can help regulators identify cause and effect relationships between different variables and gain insight into future problems, allowing for an efficient structuring of regulatory frameworks.

A limitation of this model might be to define the main components for a specific example, for instance soft drivers are not straightforward to identify. While we focus on the electricity sector, the insights derived from this framework could be useful for other utilities as well. However, several modifications would be required in order to implement this framework in different contexts.

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