COMPLEXITY AND DIVERSITY OF REAL WORLD CAPACITY MECHANISMS: FATE OR TRANSITION?

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Overview

Capacity Remuneration Mechanisms (CRMs) have long been implemented all over the world in order to ensure security of supply. A quick look at contemporaneous designs reveals the diversity of tools regulators have to meet one common goal. This observation comes in direct opposition with the extended literature that points out how dominant some specific features are compared to others (Mastropietro et al. (2016), Pérez-Arriaga (2013), Pfeifenberger et al. (2009)). The abundance of such papers reflects the learning process that have occurred over the past decades. In this framework where designs should converge towards the identified features (Golub and Sadler (2016)), the high variance in designs is puzzling. Convinced that the international context seems at least as relevant as the national one to understand the evolution of CRM design (Bennett (2016), Correljé and DeVries (2008)), we hypothesize that the learning process is hindered both by local specifics and technological chocs.

We defend the idea that CRMs are composed of two types of features: the universal and the tuned ones. The design elements that do converge can seemingly be regarded as universal considering that all dominated alternatives tend to disappear from current CRMs. On the contrary, when the variance is high on some specific design features, it presumably means that they correspond to system specifics or to new regulatory challenges such as technical change. To highlight these dynamics, we build a framework of analysis where the broad variety of design elements available is reduced by the local institutional context: some are irrelevant due exogenous factors, and identified market failures, policy objectives and stakeholders' view also affect the final design. To analyze the options and choices in the design of CRMs, we thus build a conceptual framework and identify six main categories of features. We then apply the framework to CRM design evolution in 10 systems. System specific features mainly relate to the targeted level of reliability while diverging ones are often linked to new technologies: Are new technologies eligible to capacity remuneration? If yes, under which condition would they be? Finally, the identification of converging features builds up the future of CRM designs based on the current trajectory. The rate of adoption of those universal features gives insight on the inertia of the regulatory process that leads to boom and busts in the adoption process.

Methods

Using a blend of both capacity market rules publication and academic literature, we identify 27 features. Legal documents' architecture reflect how design features are organized from the regulators' perspective while scholars insist on specific features that might be either dominant or controversial. The key features are gathered in 6 main categories: high level design, contract (supply side), capacity demand, product, market and non conventional participation. It results a unified framework of analysis that we apply to 10 systems' regulations that are studied in details: PJM, ISO-NE, MISO, NYISO, the UK, France, Spain, Ireland, Italy and Colombia. Their successive implementations and re-designs lead to almost 20 different designs, giving clear insights on both spatial and geographical evolution of the regulation. The conceptual framework describes the adoption process: from the 27 elements, each system can only choose from a limited subset of tools to design its CRM. Some features might be irrelevant du to system specifics, maintaining heterogeneity in the designs implemented. The learning process consequently occurs in slightly different conditions, leading to a slower and partial convergence. The design to be implemented in a specific system emerges from numerous interactions that help rank the features based on their expected efficiency (learning from foreign experience and stakeholders intake) and contextual relevance (knowledge of local constraints).

The variance in feature implementation is a good indicator of convergence. Indeed, features that are system specific are likely to keep a high variance over time while an increasing variance in some features reflects the new challenges. A decreasing variance, on the contrary, is sign of convergence. Features can then be categorized according to the evolution of their variance over time. Out of the almost 30 features considered, we find more than half of them to be

increasingly chosen (i.e. converging) in CRM designs. This clearly suggests how future CRMs may be tailored and use it to set out the dynamics of adoption.

Results

The fact that the recent designs display common features reflects their universality and provides clues on the future of CRM design. The new converging design is likely to be a 3 year forward centralized market with a one year performance contract which frames the obligation either to produce or to be available at scarcity. To create a homogeneous product, criterion explicitly define eligible capacity and deratings are applied to installed capacity. Non compliance penalties are proportional to the clearing price and market power mitigation rules are included in the design. Regarding the demand side, a downward slopping demand curve is based on the net cost of new entry, the clearing occurs ex ante but adjustment auctions are planned to adjust for possible forecast errors.

The rate of adoption of those universal features enlightens both on the dynamics of convergence and on the learning process. Each phase of design lasts roughly a decade during which lessons are drawn from existing designs and new ones are tailored. They are then implemented around the same year in the different countries in the panel. The inertia of regulation is, however, seizing. If some systems are able improve their design almost constantly, others seem to prefer changing their regulation less often but more profoundly at once. Regarding non conventional capacity, however, very little convergence has emerged yet except for the explicit participation of interconnectors. Obviously, storage and demand response integration is too recent to provide lessons, but soon the most efficient features should be, in turn, identified and adopted.

Conclusions

The conceptual framework developed provides an original setting to analize the institutional drivers of CRM designs. While technical change and the experience from other CRMs do affect the pool of available features directly, exogenous factors and identified market failures define their relevance. In turn, policy objectives and the stakeholders affect the final choice of CRM design. Consequently, the 90s were caracterized by a broad range of designs: implementing features that resulted to be dominated has permitted the actors to draw comprehensive lessons. Thus, the CRM regulatory process does display signs of (social) learning where the most efficient features are increasingly adopted. This enables to uncover the probable future CRM design. However, the existence of local specifics prevents designs from fully converging. In addition, the increasing lobby for new technologies integration results from a shift in political concerns from affordability towards sustainability. Nonetheless, demand response and storage differ from conventional technology in that their net generation is still negative. This creates new challenges for the regulator in terms of reliability assessment and performance incentives. The continuous disruption in the electricity markets forces the regulation to adapt quickly, possibly even faster than learning occurs.

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