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Term Paper

The Need For Capacity Mechanisms And Their Limits At Solving Issues Of 'Energy-Only'–Markets

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1 Introduction

As many developed countries around the world have been liberalizing their wholesale electricity markets during the last three decades[1], even if to different extents, their governments, regulators and customers had to make the experience that not all the hoped for benefits of these steps did materialize[2]. Economic theory had predicted that competitive markets should lead to cheaper electricity as prices would eventually converge towards marginal production costs. The market mechanism was thought to provide the necessary price signals to give generators enough incentive to invest in new capacity so supply and demand could be matched in the future[3].

Alas, market designers didn't pay enough attention to intrinsic imperfections of electricity markets resulting in insufficient investments in generation capacity. Inelasticities on supply as well as demand side and the difficulty to store meaningful amounts of electricity for later use lead to high price volatility on the wholesale market[4]. Together with regulators' unwillingness to allow spot prices to climb too high for political reasons fearing that firms exercise market power new investments became unattractive to power companies thus leading to what became called the 'missing-money problem'[5].

This issue particularly concerns so-called peak power plants[6] whose short-

[1] Chile and UK were the first countries to abolish generation monopolies and opening up their markets to private companies introducing supply-side competition. Several US states and EU countries followed in the 1990s and 2000s

[2] see IEA (2002, 2003)

[3] Finon & Pignon (2006), p.3

[4] ibid (2006), p.9

[5] The 'missing-money problem' refers to the issue that so-called peak power plants which are in use only for a small part of the year (during peak demand periods) need high prices to cover their considerable fixed costs. If there are price caps in place, these prices will not come about which in turn results in under-investment in capacity.

[6] Böckers, Giesing, Haucap, Heimeshoff & Rösch (2012a) p.4

term response times to sudden increases in demand make them indispensable for the system operator to ensure system reliability avoiding involuntary rationing by shedding load.

Aggravating the situation is the increasing share of intermittent renewable sources most markedly in the German electricity market. Spot prices experience a downward pressure as renewables have marginal production costs near zero and their bids on the wholesale market have to be taken according to German legislation[7]. This development makes it even more difficult for peak power plants to recoup investment costs. As a result from the year 2020 on, several authors predict a scarcity of peak capacity[8].

Capacity adequacy regarding electricity, defined as supply security in the long-run, can arguably be considered a public good, being nonrival but also non-excludable[9]. Since a system failure caused by insufficient generation capacity imposes heavy losses on all market participants and supply security having characteristics of a public good meaning that free markets will not provide unless forced to, government intervention could be a solution to the problem of capacity shortages as explained above.

Serious market disruptions with recurring brown-outs and even black-out in the wake of California's electricity market reforms in the 1990s show that concern about how to guarantee future generation adequacy is not merely a theoretical thought experiment. This paper will at first present the causes of the problem of missing capacity as they have become manifest during and since the implementation of market liberalization[10].

[7] Matthes (2012), p.36

[8] ibid (2012), p.25 and Grave, Lindenberger & Paulus (2012)

[9] Finon & Pignon (2006), p.3

[10] The term liberalization refers here to reforms to national electricity markets that attempted to introduce competition. Measures taken included vertical unbundling by which incumbent energy firms had to separate different business activities along the value chain (generation, transmission, distribution to end-customers), granting access to monopoly network infrastructure to third parties and creation of independent regulators. Liberalization often went along with full or partial privatisation of state-owned electricity assets. Market liberalization has been implemented to varying degrees in different countries, and this paper will take the developments on Germany's electricity market as an illustration. Nonetheless the conclusion drawn should be applicable to a certain extent to any deregulated electricity market

2 Research Questions

This paper aims to look into the issue whether capacity instruments can solve the aforementioned 'missing-money problem' in the long-term. This has to remain largely a theoretical discussion as the unintended effects of market liberalization have become fully visible only during the past decade in most markets[1] and capacity mechanisms are a fairly new approach to the problem. Empirical data are rather thin, and Germany which is to provide some exemplary illustrations for the questions at hand does not have any capacity market to date.

Germany's generation parc for example has not run through a complete investment cycle since market deregulation[2] in the late 1990s and neither did other markets even if liberalization started earlier in some cases. So empirically no final judgment can be made whether 'energy-only'–markets[3] provide sufficient incentives for new generation or not. Some authors even express doubts over the existence of a 'missing-money problem'[4]. After an overview of some of the specific characteristics of electricity as a good the paper will describe the 'missing-money problem' and why liberalized ' nergy-only'–markets may not be able to guarantee sufficient inves ment in capacity for ensuring adequate supply in the future.

In the third part I will deal with certain specificities of Germany's decision to phase-out nuclear energy until 2022 along with the goal to switch from fossil fuels to renewables for its electricity generation. Having outlined

[1] see IEA (2002)

[2] The terms *deregulation* and *liberalization* will be used synonymously here, although deregulation, the removal of sector specific regulation, can be considered a subset of a more complex liberalization effort (see Sioshansi 2006a)

[3] On an *'energy-only'–market* solely electrical power is traded, generation and transmission capacity are not part of the transactions

[4] see Hogan (2005)

the nature of the 'missing-money problem' and its causes, a brief, in no way exhaustive overview of approaches to tackle investment shortfalls in 'energy-only'–markets shall follow. The aim of this paper is not to provide a comparison of the effectiveness of different capacity schemes, but rather highlight general shortcomings of this solution as well as flaws of specific dwhile scarcity of supply makes the available generation capacity very valuable due to high electricity prices, it renders it utterly valueless when the whole system collapses and no electricity can be sold anymore[5].

My paper will argue that capacity mechanisms will fail to address the deficiencies of 'energy-only'–markets if regulators inhibit the free functioning of market price mechanisms via upholding caps on spot prices. I will also attempt to show that the objectives of Germany's energy transformation (so-called 'Energiewende') towards renewables will make it more difficult to ensure supply adequacy while at the same time reaping the potential welfare gains of a deregulated market.

[5] Joskow & Tirole (2007), p.63

3 The Need For Capacity Mechanisms

3.1 Electricity As A Good Unlike Others

Electric power is unlike other goods or commodities in that it is expensive to store for later use. Given the current technology level only pump storage plants allow this on a large scale, geographic conditions permitting, which limits the feasibility of the approach to mountainous areas. Electricity markets thus require continuous and above all instantaneous balancing between supply and demand[1], as there is only a very limited amount of stored power available to make up for generation shortfalls.

Failure to balance supply and demand at any given time will put the system's stability at risk. This can result in disruptions for the entire electricity network due to involuntary load shedding as customers are forcibly cut off from power supplies by the system operator. As only in rare instances it is technically possible to suspend deliveries to specific end-consumers their willingness to pay higher prices to continue the service or else forego supply cannot be acknowledged by the market.

In addition most households have fixed-price contracts with utilities making them unresponsive to price spikes caused by supply scarcity[2]. This renders the demand side very inelastic in the short- as well as in the long-run. The 'traditional' function of market mechanisms to restore the equilibrium between demand and supply by price swings as classic economics would have it cannot be provided by the current market design.

On the supply side we also find short-term inelasticities since lead-times for the construction of new power plants are considerable, ranging from between

[1] Creti & Fabra (2007), p.259/260
[2] Hughes & Parece (2002), p.32

2-3 years for gas-fired installations to 10 years or more for nuclear reactors[3]. The lump-sum nature of investments in generation capacity with hefty upfront costs for new infrastructure also leads to slow decision-making processes by power companies. By implication the system operator has to estimate future demand for specific time frames and then make sure that sufficient capacity will be available during that period.

If capacity supply is inflexible and highlty used at a certain point in time, even small changes in available capacity or demand can result in huge price swings[4]. This inherent price volatility in the electricity sector is unwelcome to generation companies since it makes estimating future revenues from new capacity very tricky thus making these investments less likely to be undertaken.

While scarcity of supply makes the available generation capacity very valuable when wholesale prices are high, it renders it utterly valueless in case the whole system collapses and no electricity can be sold anymore[5]. The mere possibility of extreme cases where the system collapses under too much load or when the system operator resorts to involuntary load shedding to prevent this happening gives capacity adequacy the character of a public good. No customer can be excluded from the benefits of a functioning electricity system since it is nearly always impossible to cut off individual consumers. By implication providing the good 'supply security' is not a profitable business in itself and will thus not be made available by an 'energy-only'–market.

Joskow and Tirole deem regulatory action all the more warranted as a single power plant no supplying the contracted for amount of electricity could potential cause a system failure. This would impose a severe negative externality on all market participants[6] since they would all be immediately affected.

[3] CITATION NEEDED!!!
[4] Hughes & Parece (2002), p.32
[5] Joskow & Tirole (2007), p.63
[6] ibid (2007), p.78

3.2 Electric Power Markets And Their Specific Nature

To serve peak loads almost at any time there needs to be idle reserve capacity available, which does not earn any income when not supplying electricity to the system[7]. Therefore, peak power plants have to make high returns when called upon in order to recover not only marginal costs but also their long-term fixed costs which only high spot prices on the wholesale market could ensure. Operators that provide peak capacity will not bid their marginal costs as in that case the assets would not profitable[8] without additional capacity payments to fund their investment expenses.

At the same time most electricity markets feature caps for wholesale prices imposed by regulators. Market supervisors fear that high prices are less a signal of scarce supply but rather the result of strategic behaviour by energy firms using their market power. By withholding some of their capacity, artificial scarcity can be induced which would in turn lead to higher prices if the price mechanism was totally flexible and free.

As policy makers and regulators impose upper price limits on electricity, the chances of peak power plants becoming sufficiently profitable to give incentives for new investment[9] are significantly reduced. Thus peak power plants, although essential to ensure adequate generation capacity during periods of high demand, pose substantial investment risks for private actors[10]. Adding to that problematic situation, construction of new conventional power plants is rarely feasible in incremental small-scale steps. Lump-sum investments imply higher risks and by easing undersupply via extra capacity may paradoxically undercut their initial economic rationale[11]. *As long as generators cannot be certain to recover their fixed-costs, the prime objective of market liberalization, to drive down prices to marginal costs in the long-term will not be realized.*

[7] Hughes & Parece (2002), p.33
[8] Ni, Wen & Wu (2004), p.366
[9] Keller & Wild (2004): *"Investment only makes sense (i.e. is profitable) when the discounted value of revenues from sales of new [. . .] capacity exceeds investment and operation costs"*, p.244
[10] Finon & Pignon (2006), p.4
[11] Keller & Wild (2004), p.244

4 The Effects Of Renewable Energy Sources

The existing system of selecting supply offers according to the merit-order[1] gets disrupted as renewable energy sources (photovoltaics, wind & tidal power) increase their market share. These technologies combine high fixed-costs (in relation to the specific generation potential for an individual plant) with the advantage of very low marginal costs since their input factors are provided free by nature.

Bidding with very low offers renewable energy pushes all other generation capacity rightwards in the merit-order. Thus the previously most expensive conventional plants (regarding marginal costs) are not contracted for by the system operator anymore, leaving this capacity unused and thus unprofitable. In general, spot prices, reflecting only marginal prices, are pushed lower during non-peak times. All participating plants are affected by this structural shift in the wholesale price level. Final unique wholesales price are insufficient for expensive power plants to recover their fixed costs via the difference between their marginal costs and spot prices. Conventional capacity thus earn lower returns, making it more difficult to pay off investment expenses. Some plants will be rendered entirely unprofitable since they get called upon too rarely for their revenues to cover fixed costs[2]

[1] *Merit-Order:* Sorting of power plant types according to their marginal generation costs in increasing order

[2] Böckers, Giesing, Haucap, Heimeshoff & Rösch (2012b) p.10

5 Shortcomings Of Capacity Instruments

5.1 National Solutions In The Context Of European Market Integration

5.2 Regulatory Obstacles To Capacity Markets

6 Conclusion

Wie diese Arbeit zeigen wollte, sind in Lettland die Voraussetzungen vÃ¶llig andere als in den alten MitgliedslÃ?ndern der EuropÃ?ischen Union. Es kann daher kaum verwundern, dass die Politik auf die globale Finanzkrise anders reagierte. Ein Ende der Kopplung des Lats an den Euro stand und steht fÃ?r Lettland und seine baltischen Nachbarstaaten auÃŸer Frage[1]. Diese rigide WÃ?hrungsstrategie war der Grundpfeiler der Wirtschaftspolitik in den vergangenen 15 Jahren und sorgte bei auslÃ?ndischen Investoren fÃ?r Vertrauen. Eine Abkehr von festen Wechselkursen wÃ?rde nicht nur fÃ?r viele lettische Unternehmen, die Kredite in FremdwÃ?hrungen aufgenommen haben, den Bankrott bedeuten. Auch die Idee nationaler SouverÃ?nitÃ?t (symbolisiert durch eine stabile WÃ?hrung) trÃ?ge erheblichen Schaden davon. Der begrenzte Binnenmarkt bietet dem lettischen Staat nur wenig MÃ¶glichkeiten, fiskalische Impulse durch vermehrte Ausgaben zu setzen. Wie aufgezeigt, wÃ?ren solche MaÃŸnahmen aus Sicht der Wirtschaft Lettlands weitgehend ineffektiv, da sie nur beschrÃ?nkt von erhÃ¶hten Einkommen profitieren wÃ?rde, sofern sich diese Ã?berhaupt als gesteigerte Nachfrage materialisieren und nicht in Ersparnisse mÃ?nden. Die sogenannten Multiplikator-Effekte, auf welche der Keynesianische Ansatz vertraut, hÃ?tten somit kaum erzielt werden kÃ¶nnen.

Die unterschiedliche Art auf die Wirtschafts- & Finanzkrise zu reagieren, auf der einen Seite Keynesianische Konjunkturpolitik, und wie im Falle Lettlands pro-zyklische SparmaÃŸnahmen auf der anderen[2], bieten ein "natÃ?rliches Experiment" fÃ?r die GÃ?ltigkeit Ã¶konomischer Theorien zur BewÃ?ltigung einer Rezession. Ein fundiertes Urteil Ã?ber die Wirksamkeit der unterschiedlichen

[1]The Economist, 28. Februar 2009
[2]Blanchard, Das & Faruq (2010), S.267

AnsÃ?tze wird erst in ein paar Jahren gefÃ?llt werden kÃ¶nnen mit einer besseren Datenlage, die zum gegenwÃ?rtigen Zeitpunkt noch nicht vorhanden ist. Diese Arbeit hatte nicht die Ambition, diese Frage zu klÃ?ren, sondern will lediglich einen geeigneten Untersuchungsgegenstand vorstellen. Ebensowenig wird hier der Anspruch erhoben, eine Kausalkette zwischen den Ã¶konomischen Gegebenheiten und Handlungen der lettischen Regierung herzustellen. FÃ?r diesen Schritt wÃ?ren detailreichere Studien nÃ¶tig, um die Entscheidungswege nachzeichnen zu kÃ¶nnen. Offenkundig besteht weiterer Forschungsbedarf, sowohl hinsichtlich der empirischen ÃœberprÃ?fung des keynesianischen Ansatzes und seiner Alternativen, als auch der nicht betrachteten, aber nicht weniger relevanten politischen Dimension. Von einer genaueren Untersuchung polit-Ã¶konomischer Faktoren der Antwort Lettlands auf die Krise sind weitere AufschlÃ?sse Ã?ber die Interaktion zwischen Ã–konomie und Politik zu erwarten.

7 Sources

- **Böckers, Veit, Giesing, Leonie, Haucap, Justus, Heimeshoff, Ulrich & Rösch, Jürgen (2012a):** Braucht Deutschland einen Kapazitätsmarkt für Kraftwerke? Eine Analyse des deutschen Marktes für Stromerzeugung, in: *Ordnungspolitische Perspektiven*, Issue 24, Düsseldorf.
- **Böckers, Veit, Giesing, Leonie, Haucap, Justus, Heimeshoff, Ulrich & Rösch, Jürgen (2012b):** Vor- & Nachteile alternativer Kapazitätsmechanismen in Deutschland: Eine Untersuchung alternativer STrommarktsysteme im Kontext europäischer Marktkonvergenz und erneuerbarer Energien, *Study on behalf of RWE AG*, Düsseldorf.
- **Creti, Anna& Fabra, Natalia (2007):** Supply Security And Short-Run Capacity Markets For Electricity, in: *Energy Economics*, Vol.29, p.259-276.
- **Finon, Dominique & Pignon, Virginie (2006):** Electricity And Long Term Capacity Adequacy. The Quest Of Regulatory Mechanism Compatible With Electricity Market, *Working Paper No.2*, Laboratoire d'Analyse économique des Réseaux et Systèmes Energétiques, Paris.
- **Flinkerbusch, Kai & Scheffer, Fabian (2013):** Eine Bewertung verschiedener Kapazitätsmechanismen für den deutschen Strommarkt, in: *Zeitschrift für Energiewirtschaft*, Vol.37, p.13-25.
- **Hogan, William W. (2005):** On An 'Energy-Only' Electricity Market Design, Harvard University, Cambridge, MA (USA).
- **Hughes, William R. & Parece, Andrew (2002):** The Economics Of Price Spikes In Deregulated Power Markets, in: *The Electricity Journal*, July, p.31-44.

- **International Energy Agency (2002):** Security Of Supply In Electricity Markets: Evidence And Policy Issues, Paris.
- **International Energy Agency (2003):** Power Generation Investment In Electricity Markets, Paris.
- **Joskow, Paul L. (2008):** Capacity Payments In Imperfect Electricity Markets: Need And Design, in: *Utilities Policy*, Vol.16, p.159-170.
- **Marty, Frédéric (2007):** La Sécurité de l'approvisionnement électrique: Quels enjeux pour la régulation?, in: *Revue de l'OFCE*, Vol.2007/2, Issue 101, p.421-452.
- **Pollitt, Michael G. (2012):** The Role Of Policy In Energy Transitions: Lessons From The Energy Liberalisation Era, *Electricity Policy Research Group Working Paper No. 1208*, Cambridge, (UK).
- **Siegmeier, Jan (2011):** Kapazitätsinstrumente in einem von erneuerbaren Energien geprägten Stromsystem, *Electricity Markets Working Papers No.45*, TU Dresden.
- **Sioshansi, Fereidoon P. (2006a):** Electricity Market Reform: What Has The Experience Taught Us So Far?, in: *Utilities Policy*, Vol.24, p.63-75.
- **Sioshansi, Fereidoon P. (2006b):** Electricity Market Reform: What Have We Learned? What Have We Gained?, in: *The Electricity Journal*, Vol.29, Issue 9, p.70-83.