The promotion of regional integration of electricity markets: Lessons for developing countries

Musili O. Oseni, Michael G. Pollitt*

Energy Policy Research Group, Judge Business School, University of Cambridge, Cambridge CB2 1AG, United Kingdom

HIGHLIGHTS
• This paper focuses on how to promote regional electricity cooperation.
• We develop lessons based on comparison of four international case studies.
• The cases highlight both the potential and difficulty of power pools.
• We identify preconditions, institutional arrangements and timetabling.
• We conclude that the future prospects for regional power pools are good.

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ABSTRACT
This paper focuses on how to promote regional cooperation in electricity. We begin by discussing the theory of international trade cooperation in electricity, with a view to discussing what preconditions might be important in facilitating wide area trading across national borders.

We then develop lessons based on the comparison of four case studies. These include three regional developing country power pools – the Southern African Power pool (SAPP), West African Power pool (WAPP) and the Central American Power Market (MER). We contrast these with Northern Europe’s Nord Pool. These cases highlight both the potential and difficulty of having cross-jurisdictional power pools.

In the light of the theory and evidence we present, we draw key lessons in the areas of: preconditions for trading; necessary institutional arrangements; practicalities of timetabling; reasons to be hopeful about future prospects.

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1. Introduction

The problem of how to promote wide-area trade in electricity is a well-known one within individual countries. National electricity markets in advanced countries developed over time as initially local, vertically integrated distribution companies found that there were substantial cost and quality of service advantages to horizontal integration and interconnection between service territories. While some countries developed near monopoly generation utilities which made use of a national transmission system (e.g. France), other countries did develop (limited, but in some cases substantial) trading between continuing regionally vertically integrated utilities (e.g. Japan and the United States). The creation of a national or wide area electricity transmission system which is centrally dispatched has been key to the promotion of trade in electricity. 1 Such a system physically allows energy from different power stations to be directed towards supplying given electrical loads from a common ‘power pool’.

Clearly physical interconnection is necessary, because without it no electricity can flow across pre-existing electrical boundaries. Traditionally countries have been very reluctant to trade electricity across borders and hence have limited the construction of cross-border transmission lines. This is actually unusual in energy. For 2012, globally exports of electricity are around 3% of total production, in contrast to c.52% for oil (and Natural Gas Liquids), c.31% for gas and c.17% for coal (with the average for all goods and services being c.31%); 2 suggesting that there may be substantial scope

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1 See for example Foreman-Peck and Waterson (1985) who document the emergence of a national integrated transmission system in the England and Wales.
for increased trade in electricity across the world.

This paper will focus on the institutional arrangements for facilitating electricity cooperation. We have in mind the application of the lessons in the paper to other regions, such as the South Asia Region (SAR), namely Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. These countries are part of a free trade area – SAFTA (South Asian Free Trade Area, formed in 2006). The South Asia Region currently exhibits very little trade in electricity but exhibits significant potential for beneficial trade.

We begin by discussing the theory of international trade cooperation in electricity, with a view to discussing what preconditions might be important in facilitating wide area trading across national borders. Next we will introduce four case studies. Arguably, the most successful international power market in the world is Nord Pool (which includes Norway, Sweden, Finland and Denmark). We compare this with three regional developing country power pools – the Southern African Power pool (SAPP), West African Power pool (WAPP) and the Central American Power Market (MER). We will then go on to draw key general lessons on the promotion of electricity trade across borders based on the theory and experience.

2. The theory of cooperation and international trade applied to electricity

In thinking about the institutional arrangements that might facilitate increased cross border trade in electricity, it is useful to think about ideal electricity market design and institutions. Hogan (1995) suggests that a wholesale pool spot market and an independent system operator (ISO) should go together. This is because short term generator dispatch and short term transmission system operation are ‘two sides of the same coin’ (Hogan, 1995, p. 26). This suggests that power trading should be associated with an institution which is also responsible for the operation of the transmission system in real time. Hogan (1998) suggests that nodal pricing of the transmission system access is also desirable unless the networks are relatively simple. Thus the US Standard Market Design – which incorporates these ideas – may be the most sophisticated market design for wide area trading, but it may not be necessary for international trade in electricity.

Other designs may work, but the institutional design of markets is undoubtedly important. Stoft (1996) correctly predicted (prior to the California electricity crisis of 2001) that the institutional conflict between the California ISO and the California Power Exchange might decrease system reliability and lead to inefficient dispatch! Efficient market design is also about the participation of the demand side in the wholesale electricity market. This is increasing in importance in many of the most sophisticated markets, such as PJM and New York (see Walawalkar et al. (2010)). For many countries demand side response inside their own country might become equally dependent on the export revenue that such energy security risk is two – sided, as the exporting country might become equally dependent on the export revenue from electricity sales.3

Trade theory has become increasingly concerned with considering departures from the assumptions of the basic Heckscher–Ohlin model. Markusen (1981) showed that if markets were initially monopolised a large country opening up to trade might suffer a loss of welfare due to the competition from another monopolist in the other country in a two country trade model. However Lahiri and Ono (1996) show that this result does not hold if new firms enter. Trade liberalisation becomes beneficial again. The general result of Dixit and Norman (1986) emphasises that trade can always be made beneficial as long as consumption and income taxes can be used to compensate losers within an economy.

An important question in international trade theory is whether trade worsens the natural environment. This might be a concern for electricity trading where exploiting low cost resources might involve burning more coal in a low generation cost country. Antweiler et al. (2001) find that trade is generally good for the

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3 We discuss the dependence of Bhutan government revenue on electricity export income in the final section. This surely makes them a more reliable supplier of electricity than would otherwise be the case.
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<table>
<thead>
<tr>
<th>امکان دانلود نسخه تمام متن مقالات انگلیسی</th>
</tr>
</thead>
<tbody>
<tr>
<td>امکان دانلود نسخه ترجمه شده مقالات</td>
</tr>
<tr>
<td>پذیرش سفارش ترجمه تخصصی</td>
</tr>
<tr>
<td>امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله</td>
</tr>
<tr>
<td>امکان دانلود رایگان ۲ صفحه اول هر مقاله</td>
</tr>
<tr>
<td>امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب</td>
</tr>
<tr>
<td>دانلود فوری مقاله پس از پرداخت آنلاین</td>
</tr>
<tr>
<td>پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات</td>
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