Interconnections and Market Integration in the Irish Single Electricity Market (SEM)

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Some Remarks:

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Cautions:

- *This research is not a cost-benefit analysis (CBA) of interconnector in the Irish SEM. However, it can serve as an input for any policymaker undertaking a CBA of interconnection in SEM.*

- *We primarily assess the current degree of market integration between SEM against other large, mature and well-established electricity wholesale markets in Europe including Great Britain (GB) and determine the level of interconnection needed in SEM to meet the EU policy of increasing integration of electricity markets.*

Overview:

- Introduction
- Why interconnections?
- Data and Econometric Methodology
- Results and Discussions
- Conclusions

Introduction (I):

•A major quest of the EU: creation of a common and integrated market for electricity
- *Sustainability*
- *Affordability*
- *Security of supply*

• Directive 2003/54/EC: market opening and non-discriminatory access to third parties

•Directive 2009/72/EC: cross-border interconnections and reduce barriers to international electricity trade

• Creation of organized wholesale markets, expanding interconnections and increased cross-border electricity trade: modern means towards achieving market integration

Introduction (II):

- November 1, 2007: Joint regulation of SEM by NAIRU (Northern Ireland Authority for Utility Regulation) and CER (Commissions for Energy Regulation)
- Small market: 2.5 million customers, 1.8 million in the Republic of Ireland and 0.7 million in Northern Ireland
- SEM: Centralised gross mandatory pool
- Negative pricing regime in place like in EEX
- Highly concentrated: Two large incumbent groups, namely Electricity Supply Board (ESB) and Viridian
- Interconnected to GB via the Moyle interconnector: 4.7% of SEM's generation capacity

Introduction (III):

- Market Power: A major Concern

  - Allocative inefficiency
  - Productive inefficiency

- Interconnections: a feasible solution for smaller concentrated markets with limited number of participants

  - To promote competition
  - Enhance security of supply
  - To reap the benefits of a largely integrated market

Benefits of Interconnections:

•Economic benefits, security of supply benefits and benefits from increased competition (i.e. lower wholesale prices)

➢Improves market integration : integrated markets leads to the highest social welfare than if the markets were to remain separate (Neuhoff and Newbery, 2005; Hobbs et al. 2005; Ehrenmann and Neuhoff, 2009)

➢ Enhanced security of supply and a reduction in reserves needed to maintain any given level of system performance (Malaguzzi Valeri, 2009; de Nooij, 2011)

➢Lower reserves imply lower operating and capital costs as excess supply in one node can be utilized in other nodes (Charun and Morande, 1997; Turvey, 2006)

➢Market power mitigation: allows generating companies abroad to compete possibly with dominant domestic generators (Newbery, 2002; van Damme, 2004)

➢Create incentives for optimizing the size and timing of new investments (Brunekreeft and Newbery, 2006)

Benefits of interconnection (II): Not Always

•Security of Supply not always guaranteed:

➢Interconnections also expose the system to security of supply risks

➢Chances of 'ripple effect' being spread across the systems (Hammond and Waldron, 2008)

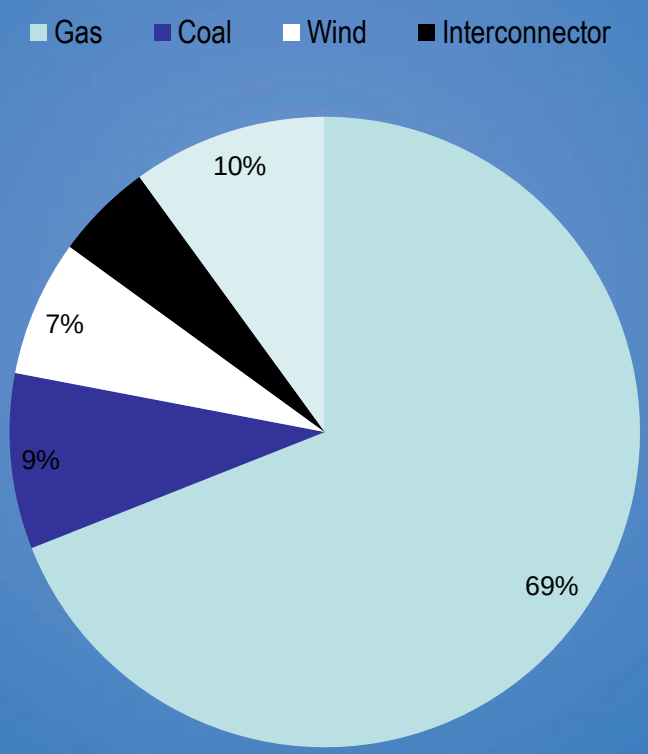
➢Interconnections can facilitate the occurrence of high-impact, low frequency events such as terrorist attacks, cyber attacks etc.

➢Therefore: we examine the role of interconnection in market integration by examining the degree of market integration between SEM and other large, mature and well-interconnected wholesale electricity markets in Europe by analysing the wholesale electricity prices.

Data: Power Exchanges

	Countries	Established	Currency	Spot market volume in 2009 (TWh)	Total Consumption in 2009 (TWh)	Spot market share (% of total consumption)
European Energy Exchange (EEX)	Germany	2002	EURO	203	581	35%
Belgian Power Exchange (BELPEX)	Belgium	2006	EURO	10.1	81.7	12.4%
Energy Exchange Austria (EXAA)	Austria	2002	EUR0	4.7	62.4	7.5%
Amsterdam Power Exchange (APX)	Netherlands	1999	EURO	29.1	122.8	23.7%
Nordpool Power Exchange (ELSPOT)	Scandinavia	2002	NOK	285.5	396.5	72%
Single Electricity Market (SEM)	Northern Ireland and Republic of Ireland	2007	Euro and Pound Sterling	34.6	36.2	95%
APX Power UK (former UKPX)	Great Britain	2000	Pound Sterling	10 (approx)	344.7	2.9%

Data: Scheduled Generation Fuel Mix in SEM (2009)



Source: UREGNI (2009)

Econometric Methodology:

$$P_{A,t} = \alpha_{A,B} + \beta_{AB,t} P_{B,t} + \varepsilon_t \quad (1)$$

$$\beta_{AB,t} = \beta_{AB,t-1} + \Theta_t \quad (2)$$

where ε_t and Θ_t are white noise processes.

- *Equation 1 is the signal or observation equation.*
- *Equation 2 is the state or transition equation.*
- *$\beta_{AB,t}$ captures the strength of market integration.*
- *If β_{AB}=0, no market integration and interconnection can integrate the markets (to some extent)*
- *If β_{AB}=1, full market integration*
- *However, it is necessary to specify the initial conditions. Hence, we calibrate the following:*
- *$E(\beta_0) = 1 \approx P_{A,1}/P_{B,1}$, $\sigma^2_\epsilon = 0.1 \approx Var(P_{A,t})$ and $\sigma^2_\Theta = \sigma^2_\epsilon/1000$*

Results (I): Descriptive Statistics (in levels)

Eur / MWh	APX	BELPEX	EEX	ELSPOT	EXAA	SEM	APX UK
Mean	52.181	51.487	49.702	44.469	50.110	59.336	68.177
Median	47.710	47.000	45.980	42.850	46.070	51.777	61.11
Maximum	500.000	500.00	494.260	300.030	248.270	695.785	1111.71
Minimum	0.010	0.010	-500.020	0.000	0.010	-26.025	0.000
Std. Dev.	26.223	24.522	24.452	14.907	23.406	33.846	35.58
Skewness	1.834	1.852	0.693	1.948	1.238	3.143	4.80
Kurtosis	16.791	16.438	22.751	19.017	6.202	24.855	58.332
Observations	35064	35064	35064	35064	35064	35064	35064

Results (II): Unit Root Tests

Electricity hourly day-ahead Prices (log)		
Power Exchanges	ADF	KPSS
	Level	Level
APX	-4.786***	0.358*
Belpex	-7.607***	0.339
EEX	-23.032***	0.353*
Elspot	-2.253**	0.313
EXAA	-51.875***	0.423*
SEM	-37.463***	0.375*
APX UK	-33.42***	0.311*

Results (III): Correlation Results (in levels)

	APX	*BELPEX*	*EEX*	*ELSPOT*	*EXAA*	*SEM*
APX	1.000					
BELPEX	0.963	1.000				
EEX	0.883	0.855	1.000			
ELSPOT	0.398	0.397	0.422	1.000		
EXAA	0.923	0.893	0.927	0.435	1.000	
SEM	0.588	0.560	0.564	0.475	0.602	1.000

Results (IV): Market Integration (log prices)

Method: Maximum likelihood (Marquardt) Sample: 1/01/2008 to 12/31/2011	
Market Pairs	Final State of Market Integration
SEM-EEX	0.09 (0.069)
SEM-APX	0.18 (0.058)
SEM-Belpex	0.15 (0.058)
SEM-EXAA	0.14 (0.057)
SEM-Elspot	0.19*** (0.061)

Results (V): Market Integration (in levels)

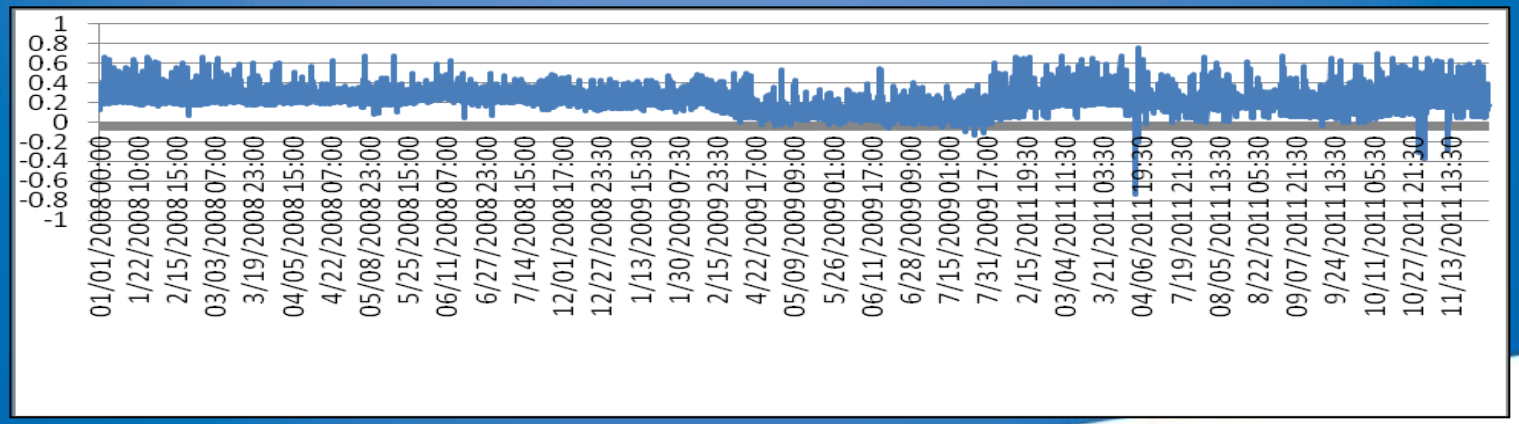
Method: Maximum likelihood (Marquardt) Sample: 1/01/2008 to 12/31/2011	
Market Pairs	Final State of Market Integration
SEM-EEX	0.29 (0.413)
SEM-APX	0.45 (0.460)
SEM-Belpex	0.44 (0.432)
SEM-EXAA	0.47 (0.464)
SEM-Elspot	0.27 (0.512)

Results (VI): Market Integration among mature markets

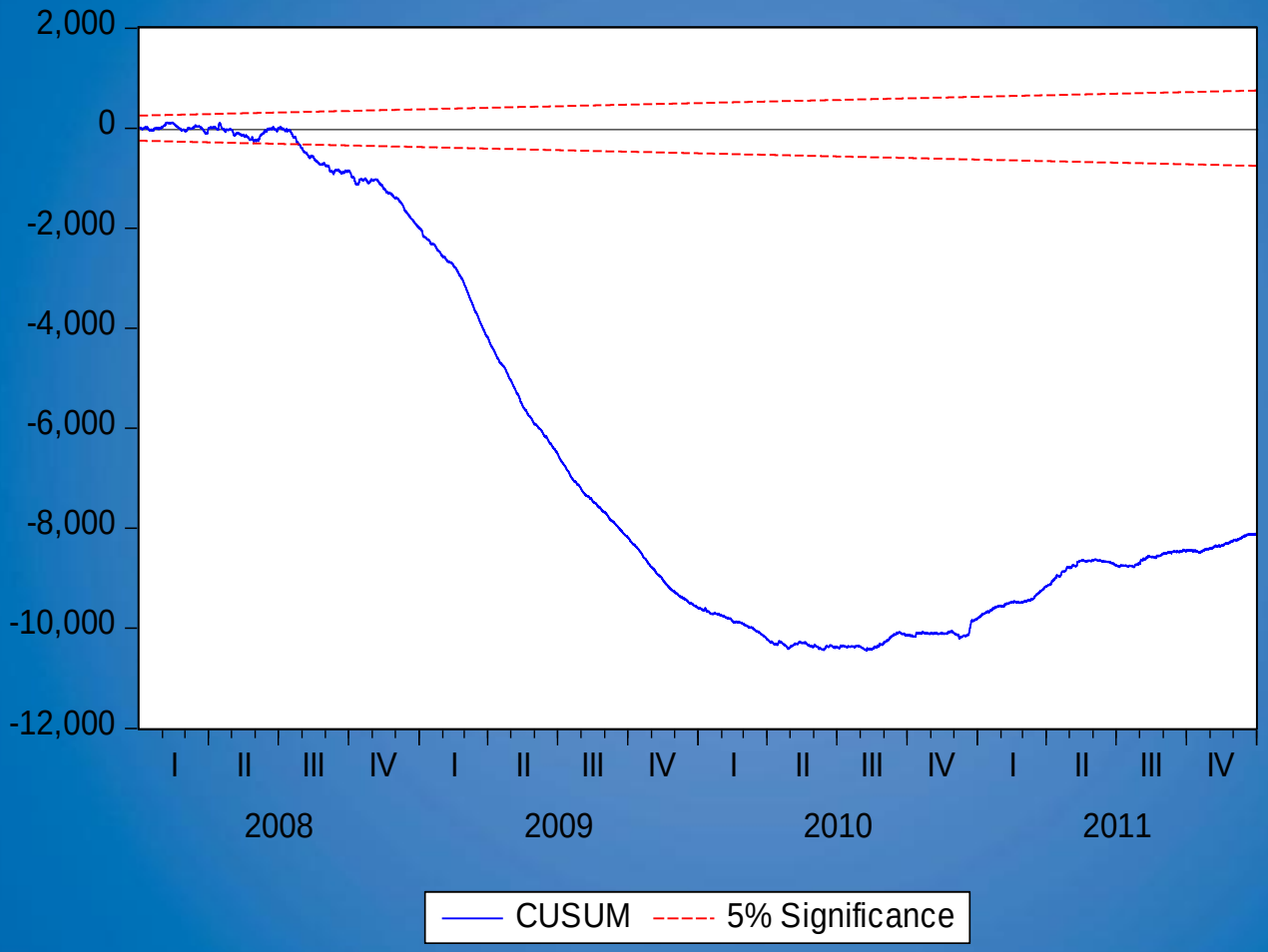
Method: Maximum likelihood (Marquardt) Sample: 1/01/2008 to 12/31/2011		Required level of interconnection in SEM (as a percentage of total generation capacity)	
Market Pairs	Final State of Market Integration		
APX-Belpex	0.77*** (0.008)	APX 19%	BELPEX 20.10%
EEX-APX	0.66*** (0.013)	EEX 25.9%	APX 16.33%
EXAA-APX	0.86*** (0.006)	EXAA 26.9%	APX 21.3%
EXAA-EEX	0.62*** (0.0110)	EXAA 19.42%	EEX 24.3%

Results (V): Market Integration (in log and levels)

Method: Maximum likelihood (Marquardt) Sample: 1/01/2008 to 12/31/2011	
Market Pairs	Final State of Market Integration
SEM-GB	0.17*** (0.04)
SEM-GB	-0.41 (0.460)



Results (VI): CUSUM plot



Conclusions and Policy Recommendations

•Expanding interconnections with GB desirable due to low market integration while interconnecting SEM with other markets requires a detailed CBA.

•Interconnections also requires investment in interconnector capacity as well as strong coordination's among the TSOs and market operators. How about rising end-user bills?

•It is necessary that available interconnector capacity is efficiently used. The proposal to couple France, GB and Ireland by 2014 seems a desirable one.

•Appropriate regulatory framework is necessary to ensure adequate participation and investments in networks.

• Institutional harmonisation necessary for market integration and remains a challenge.