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THE IMPACT OF POWER EXCHANGES ON THE ELECTRICITY PRICES IN THE WHOLESALE ELECTRICITY MARKET IN INDIA

Presentation by

and

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at

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on

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at

Indian Institute of Management , Bangalore

BACKGROUND

- Electricity Act, 2003
- National Electricity Policy in 2005
- Tariff policy in 2006
- Various initiatives by CERC to facilitate competition:
  - (ABT) in 2003, open access in inter-state transmission in 2004, regulations for grant of trading licence in 2004, guidelines for setting up and operation of PX in 2007 and approval to set up the power exchanges in 2008 to IEXL and PXIL.
- This paper examines short-term transactions during July 2008 to Sept 2009 to understand impact of PXs on the electricity prices in WEMI.

SUPPLY AND TRANSMISSION

- Five regional grids: Northern, Eastern, Western, Southern, North-eastern
- Inter-regional transfer capacity In Mar,2009 - 20750 MW and expected to increase 38,650 MW by 2012.
- ATC loss of 27% compared to 10-15% in developed countries.
- Substantial peak and energy shortages in 2008-09, also varied in regions.

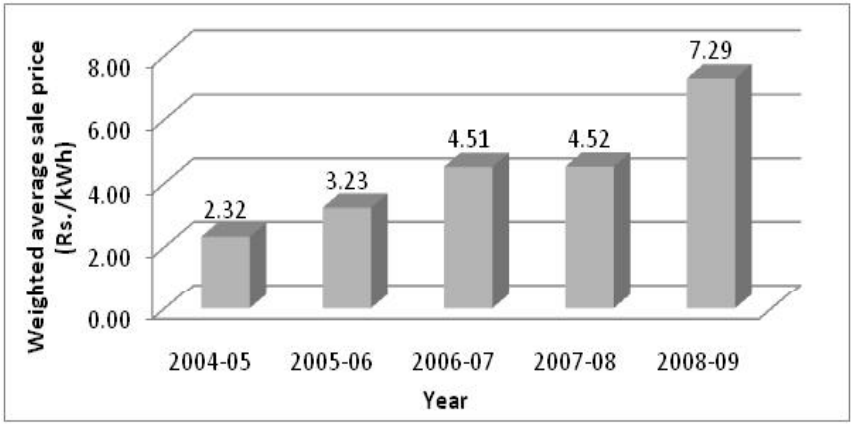
Region	Peak demand (GW)	Peak supply (GW)	Peak shortages		Energy demand (GWh)	Energy supply (GWh)	Energy shortages		Occurrence of peak
			(GW)	(%)			(GWh)	(%)	
Northern	33.034	29.504	3.530	10.69%	224,218	199,928	24,290	10.83%	June, July and August
Western	37.240	30.154	7.086	19.03%	254,486	213,724	40,762	16.02%	December
Southern	28.340	26.244	2.096	7.40%	204,086	188,865	15,221	7.46%	March and October
Eastern	12.901	11.689	1.212	9.39%	82,127	78,370	3,757	4.57%	March
North eastern	1.820	1.358	0.462	25.38%	9,407	8,134	1,273	13.53%	January
All India	109.809	96.685	13.124	11.95%	774,324	689,021	85,303	11.02%	March and October

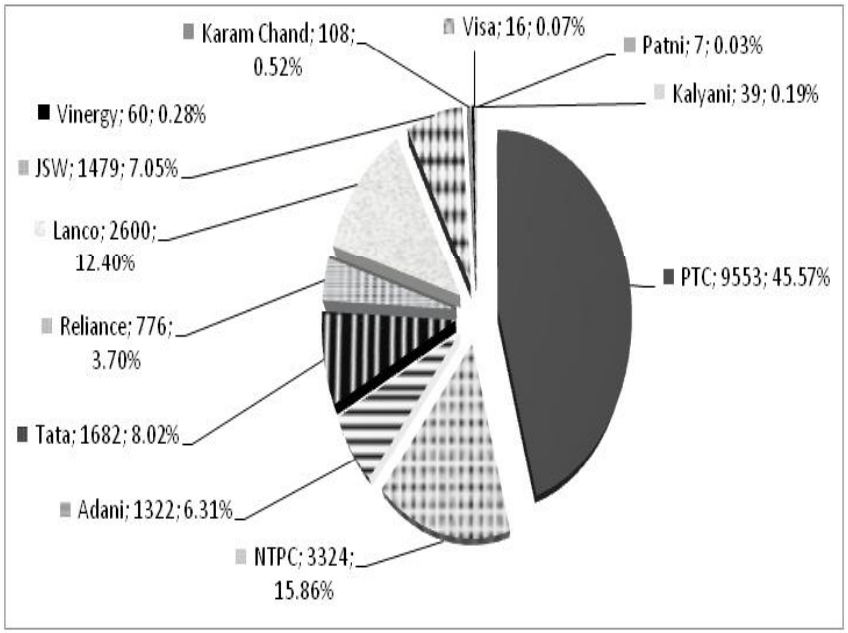
Source: Central Electricity Authority (2009)

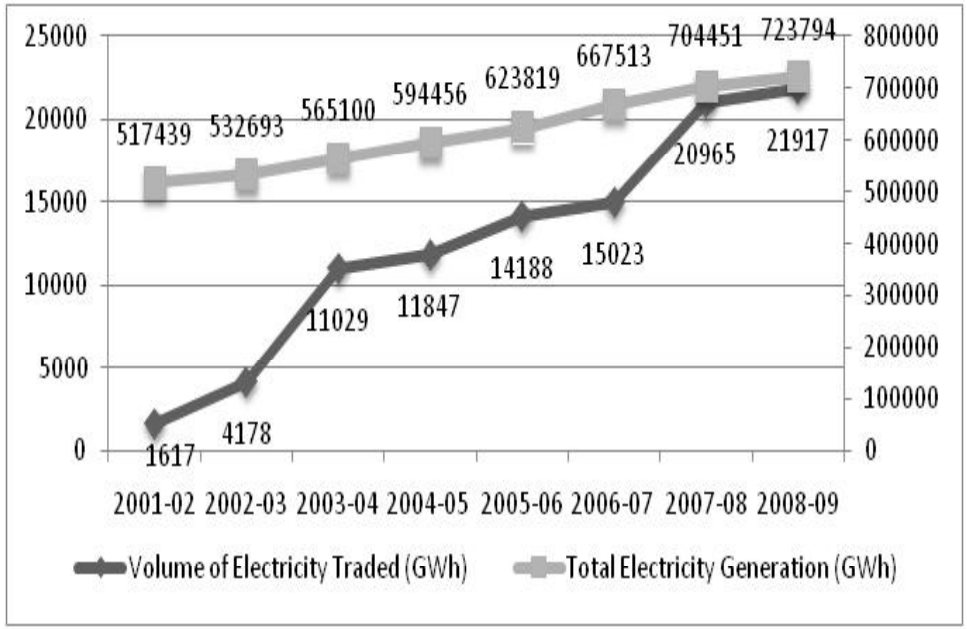
TRADING MECHANISM

- Long-term PPAs
- Short-term bilateral contracts
- Unscheduled interchange
- Power exchange
- During Sept. 2009, 91.15% were through long term PPAs, 8.85% were transacted through short-term, comprising 4.52% through bilateral followed by 3.50% through UI and 0.83% through PXs.

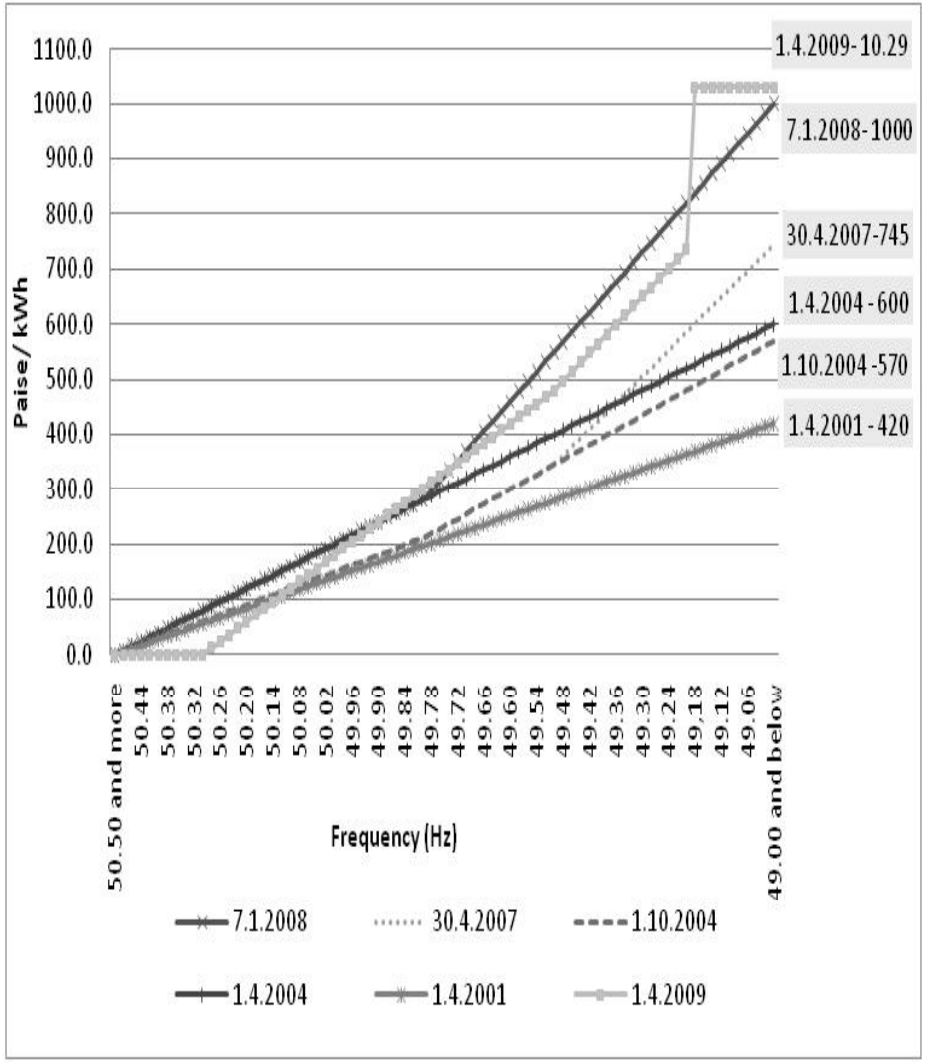
SHORT-TERM BILATERAL CONTRACTS







UNSCHEDULED INTERCHANGE (UI)



- For a generating station or seller is equal to its actual generation minus its scheduled generation.
- For a beneficiary or buyer is equal to its total actual drawl minus its total scheduled drawl.
- Energy metered is compared with scheduled energy in each 15-minute time block, and corresponding UI rate is determined by taking average frequency for same 15-minute time block.

POWER EXCHANGE (PX)

- IEXL and PXIL started operations on 27.6.2008 and 22.10.2008 .
- Price discovery through double side bidding and buyers and suppliers pay/ receive the uniform price,
- Market-splitting methodology for congestion management.
- Each electrical region divided in two bid-areas and In case of congestion, area prices differ in each region after splitting market.
- After power is scheduled, the deviation settled through UI.
- During August 2008 to Sept 2009, maximum electricity price was more than Rs.8.00/kWh in all the months and has touched Rs.17.00/kWh in IEXL and Rs.15.00/kWh in PXIL during August 2009.

IMPACT OF IEXL: ON ELECTRICITY PRICES THROUGH BILATERAL CONTRACTS

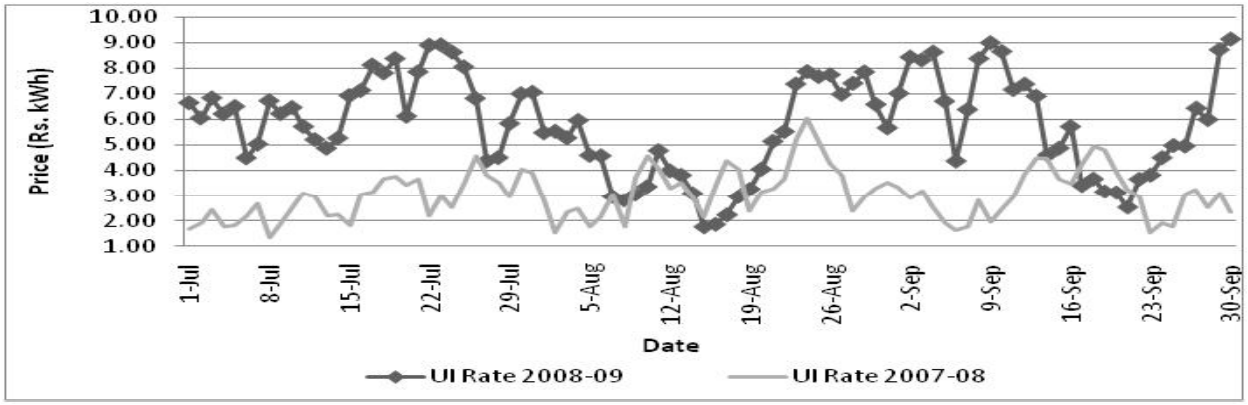
Comparison of electricity prices of trading through bilateral contracts

Details	July-September 2007	April-June 2008	July-September 2008	% Change from July-September 2007	% Change from April-June 2008
Volume	7226.51	4451.78	6274.22	-13%	41%
Weighted average price	3.37	7.20	6.91	105%	-4%

- Substantial increase by 105% in July-Sept 2008 as compared to the same quarter of 2007
- Gone down by 4% compared to the prices of the immediately preceding quarter, Apr-Jun, 2008.
- 27% reduction in July-Sept in 2007 as compared to 4% in 2008

IMPACT OF IEXL: ON UI RATE

UI rate of Jul-Sept 2008 and Jul-Sept 2007 in WR

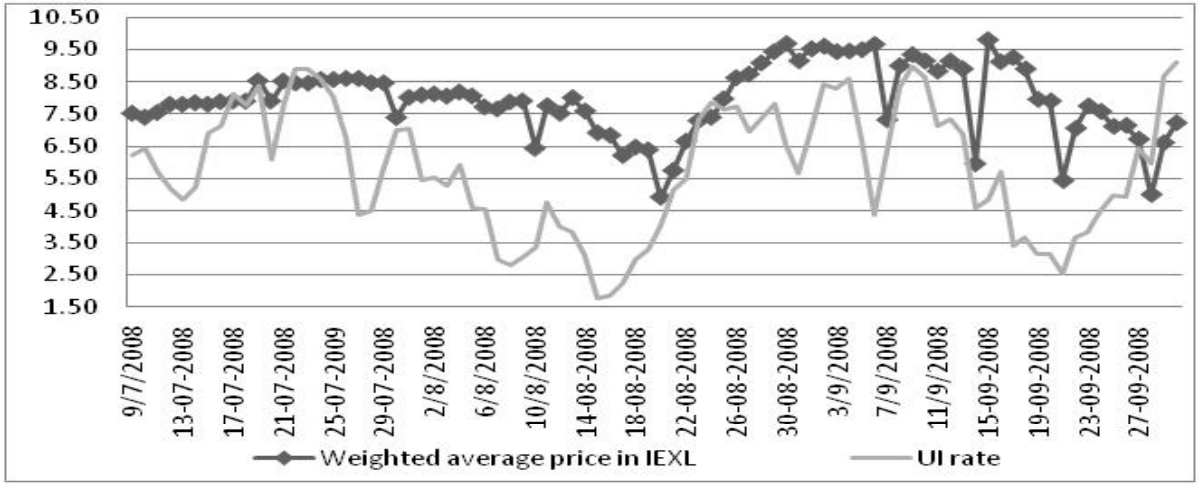


	July-September, 2007	April-June, 2008	July-September, 2008	%age change from July-September 2007	%age change from April-June 2008
Highest	6.03	9.25	9.12	51%	-1%
Lowest	1.53	1.60	1.76	15%	10%
Average	3.06	5.30	5.82	90%	10%
Weighted average	2.99	4.63	5.35	79%	16%
Standard deviation	**0.97**	**2.24**	**1.90**	96%	-15%

- Weighted average daily UI rate in Jul-Sept. 2008 is 79% higher than that in Jul-Sept. 2007.
- Higher SD in Jul-Sept. 2008 showing more volatility in the UI rate.
- Wghtd average daily UI rate in Jul-Sept,08 16% higher than that in Apr-Jun 08.

IMPACT OF IEXL: RELATIONSHIP OF UI RATE WITH ELECTRICITY PRICES IN IEXL

Prices in IEXL and UI rate in Jul-Sept 08 in WR



Particulars	Electricity prices in IEXL	UI rate	Higher price in power exchange (%)
Highest price	9.80	9.12	7%
Lowest price	4.92	1.76	180%
Average price	7.95	5.82	37%
Weighted average price	8.07	5.35	51%
Standard deviation	**1.09**	**1.98**	

- Electricity prices in IEXL higher than UI rate.
- Average and weighted average prices in IEXL higher by about 37% and 51% respectively than UI rate and lowest electricity price was higher by about 180%.
- Higher SD shows more fluctuation of grid frequency.

IMPACT OF IEXL: RELATIONSHIP OF UI RATE WITH ELECTRICITY PRICES IN IEXL

Correlation of prices in IEXL and UI rate during July-Sept 2008 in WR

CORREL IEXLt, UI(t)	**0.4329**		
CORREL IEXL(t-1), UI(t)	0.2481	CORREL IEXL(t+1), UI(t)	0.5274
CORREL IEXL(t-2), UI(t)	0.1382	CORREL IEXL(t+2), UI(t)	0.6270
CORREL IEXL(t-3), UI(t)	0.1326	CORREL IEXL(t+3), UI(t)	0.6478
CORREL IEXL(t-4), UI(t)	0.0637	CORREL IEXL(t+4), UI(t)	0.6505
CORREL IEXL(t-5), UI(t)	0.0048	CORREL IEXL(t+5), UI(t)	0.6268

Where IEXL=IEXL price, UI=UI rate, t=same day, $_{t+1}$=next day, $_{t+2}$=one day after next day and so on. Similarly $_{t-1}$=previous day, $_{t-2}$=one day previous to previous day and so on.

- Price formation in IEXL is positively linked to the UI rate.
- Correlation decreases with $IEXL_{t-1}$ and UI_t, $IEXL_{t-2}$ and UI_t, and $IEXL_{t-3}$ and UI_t and so on but increases with $IEXL_{t+1}$ and UI_t, $IEXL_{t+2}$ and UI_t and $IEXL_{t+3}$ and UI_t and so on upto $IEXL_{t+4}$.
- UI rate has impact on electricity prices in IEXL and that impact is more visible after 3-4 days.

IMPACT OF IEXL: RELATIONSHIP OF UI RATE WITH ELECTRICITY PRICES IN IEXL

Correlation of UI and net buy volume in IEXL in July-Sept. 08 in WR

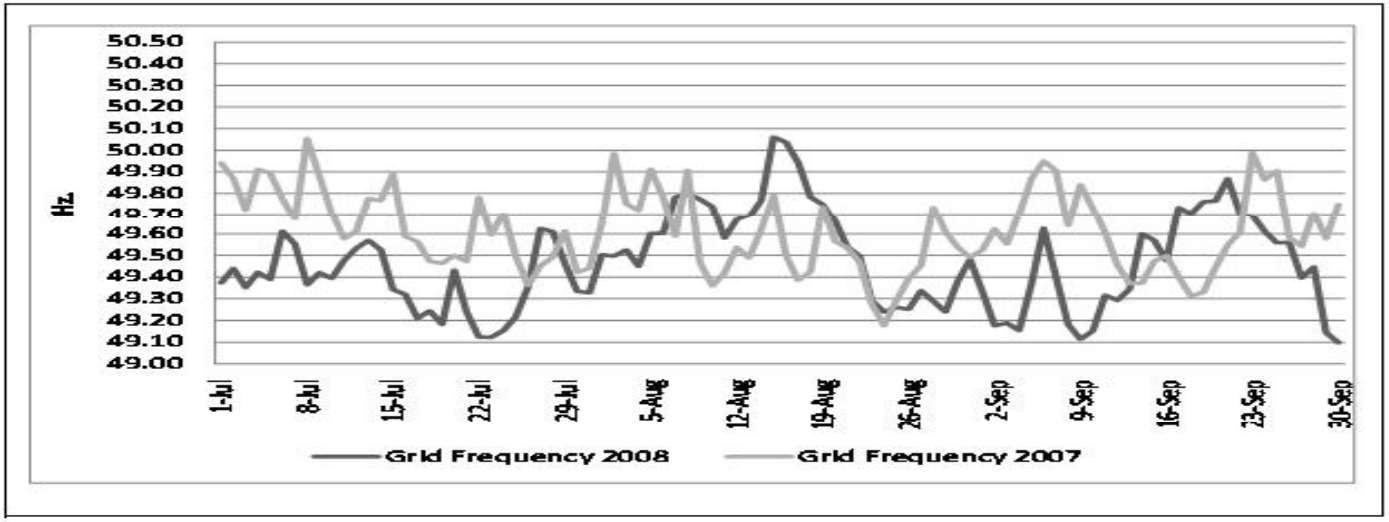
CORREL IEXLV(t), UIV(t)	-0.4049		
CORREL IEXLV(t-1), UIV(t)	-0.3423	CORREL IEXLV(t+1), UIV(t)	-0.4715
CORREL IEXLV(t-2), UIV(t)	-0.2788	CORREL IEXLV(t+2), UIV(t)	-0.5083
CORREL IEXLV(t-3), UIV(t)	-0.2046	CORREL IEXLV(t+3), UIV(t)	-0.4585
CORREL IEXLV(t-4), UIV(t)	-0.0963	CORREL IEXLV(t+4), UIV(t)	-0.3631
CORREL IEXLV(t-5), UIV(t)	-0.0595	CORREL IEXLV(t+5), UIV(t)	-0.2794

Where IEXLV=IEXL volume and UIV=UI and t=same day, $_{t+1}$=next day, $_{t+2}$=one day after next day and so on. Similarly $_{t-1}$=previous day, $_{t-2}$=one day previous to previous day and so on.

- Negative correlation of 0.4049 between volume of electricity traded in IEXL ($IEXLV_t$) and UI (UIV_t).
- Correlation decreases with $IEXLV_{t-1}$ & UIV_t, $IEXLV_{t-2}$ & UIV_t, $IEXLV_{t-3}$ & UIV_t and so on but increases with $IEXLV_{t+1}$ & UIV_t and $IEXLV_{t+2}$ & UIV_t.
- UI has impact on volume traded in IEXL, which is more visible after 2 days.

IMPACT OF IEXL: ON GRID FREQUENCY

Av. grid frequency in July-Sept. in 2008 and 2007 in WR

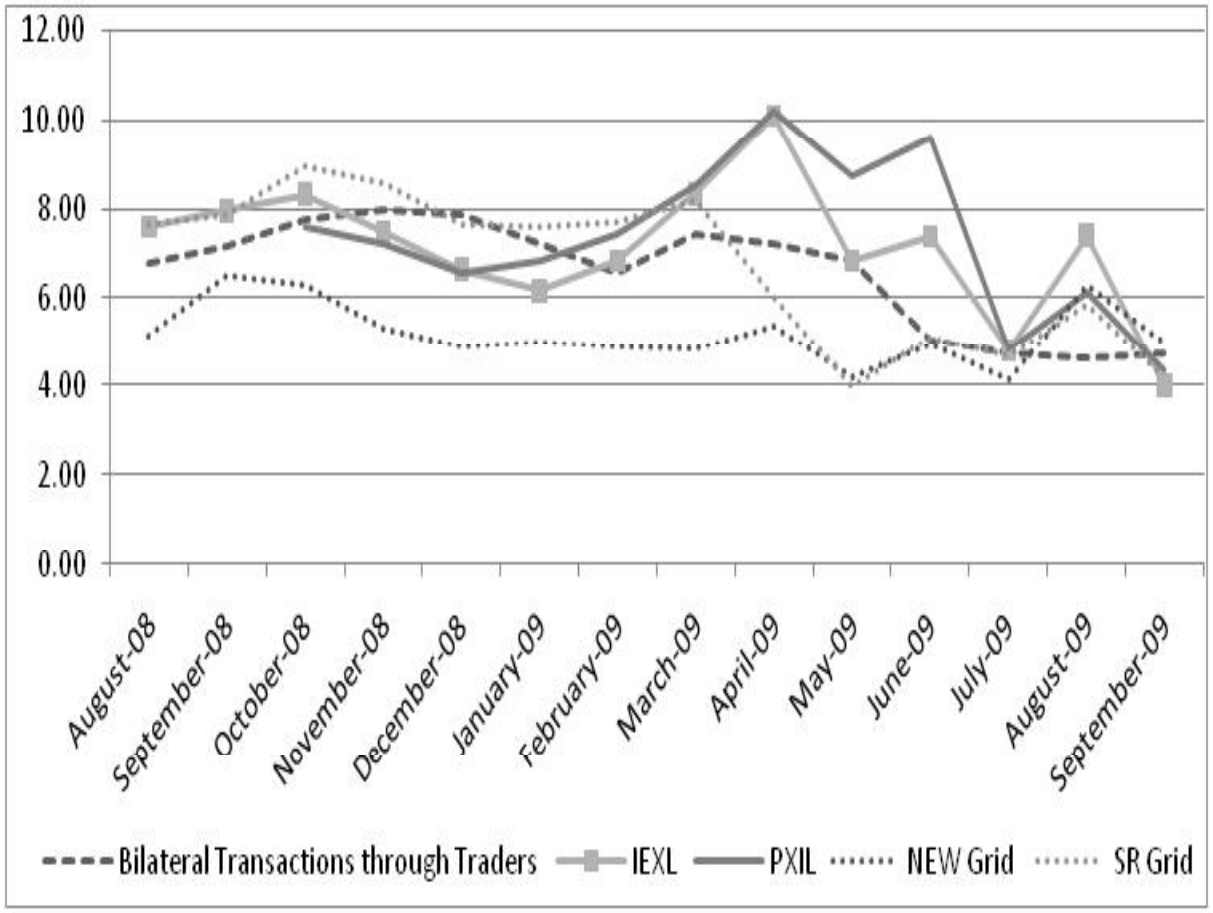


Month	Average grid frequency		Standard deviation	
	2007	2008	2007	2008
July	49.66	49.38	0.18	0.14
August	49.57	49.58	0.19	0.23
September	49.62	49.44	0.19	0.23
July-September	49.62	49.47	0.19	0.22

- Av. grid frequency in July-Sept 2008 lower at 49.47 Hz. compared to 49.62 Hz. in July-Sept 2007.
- SD in July-Sept 2008 also higher at 0.22 compared to 0.19 in July-Sept 2007 showing more fluctuations in grid frequency.

IMPACT OF PXIL: ON ELECTRICITY PRICES OF BILATERAL CONTRACTS AND UI RATE

Electricity prices in short-term transactions in WEMI during Aug 2008 to Sept 2009



- Electricity prices in IEXL and PXIL generally higher than UI rates and short-term bilateral transactions.
- Electricity prices in short-term bilateral transactions through traders and UI rates shown the downward trend.

IMPACT OF PXIL: ON ELECTRICITY PRICES OF BILATERAL CONTRACTS AND UI RATE

Correlation among short term transaction mechanisms in Aug 2008 to Sept 2009

Short Term Transaction Mechanisms		Bilateral	Power Exchanges		UI	
			IEXL	PXIL	New Grid	SR Grid
Bilateral		1.00	**0.54**	0.42	0.16	**0.76**
Power Exchanges	IEXL	**0.54**	1.00	**0.84**	0.46	0.47
	PXIL	0.42	**0.84**	1.00	0.04	0.15
UI	New Grid	0.16	0.46	0.04	1.00	0.49
	SR Grid	**0.76**	0.47	0.15	0.49	1.00

- Weighted av. prices in PXs show significant correlation of 0.84.
- Weighted av. monthly prices in bilateral transactions also show correlation with prices in IEXL and UI rates (SR), but no significant correlation is found between prices in other mechanisms.

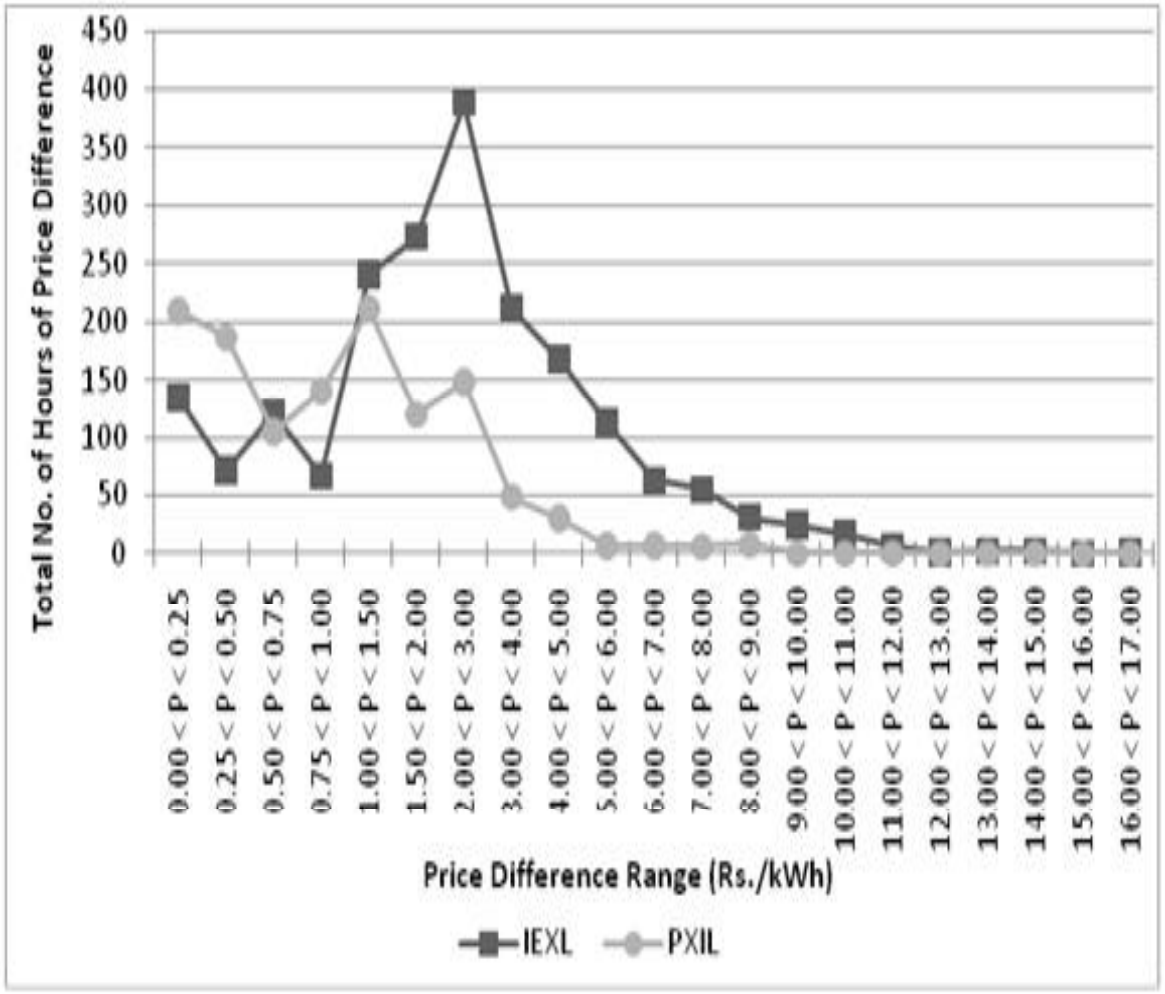
Correlation among PXs and UI rates during Aug 2008 to Sept 2009

Short Term Transaction Mechanisms		Power Exchanges		UI	
		IEXL	PXIL	New Grid	SR Grid
Power Exchanges	IEXL	1.00	0.69	0.43	0.40
	PXIL	0.69	1.00	0.27	0.17
UI	New Grid	0.43	0.27	1.00	0.47
	SR Grid	0.40	0.17	0.47	1.00

Similarly, Weighted av. daily prices in IEXL and PXIL show significant correlation of 0.69, but no significant correlation is found between the weighted average daily prices of electricity in PXs and UI rates.

IMPACT OF PXIL: ON THE BID AREA PRICES IN PXS

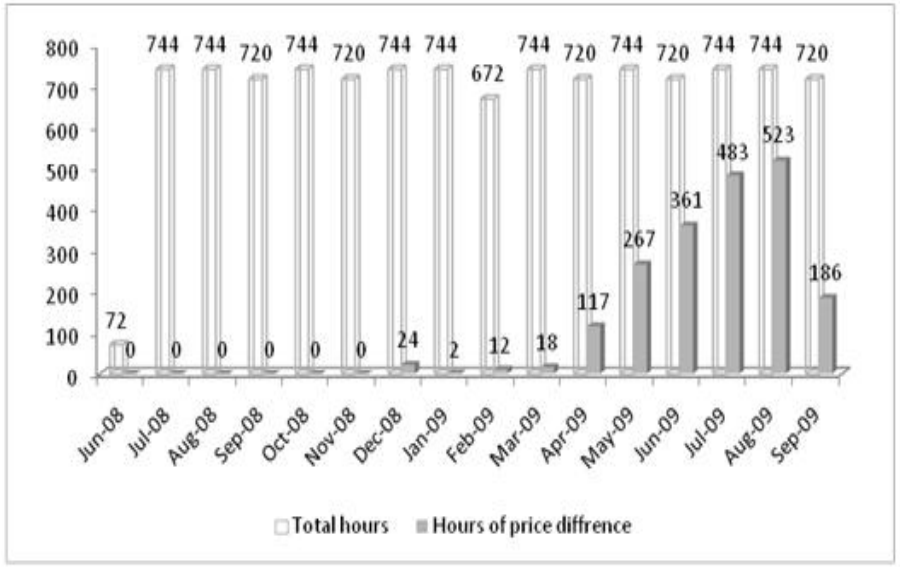
Hourly bid area prices in PXs



- Out of 11040 hours during 28.6.08 to 30.9.09, hourly bid area prices not same in all the bid areas during 1993 hours in IEXL.
- Similarly out of 8208 hours during 24.10.08 to 30.9.09, hourly bid area prices not same in all the bid areas during 1227 hours in PXIL.
- Highest area price difference Rs.16.12/kWh in IEXL and Rs.8.38/kWh in PXIL.

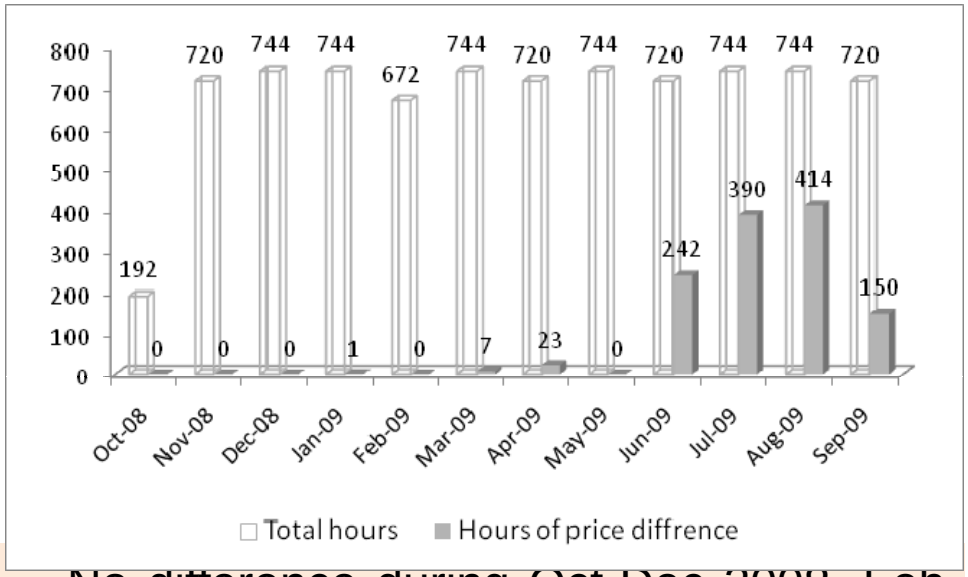
IMPACT OF PXIL: ON THE BID AREA PRICES IN PXS

Difference in hourly bid area prices in IEXL during Jun 2008 to Sept. 2009



- No difference till Nov 2008.
- During Dec 2008 to March 2009, in some of the hours.
- More prevalent during April-Sept 2009 and remained more than 50% of no.of hours in Jun, Jul and Aug 2009.

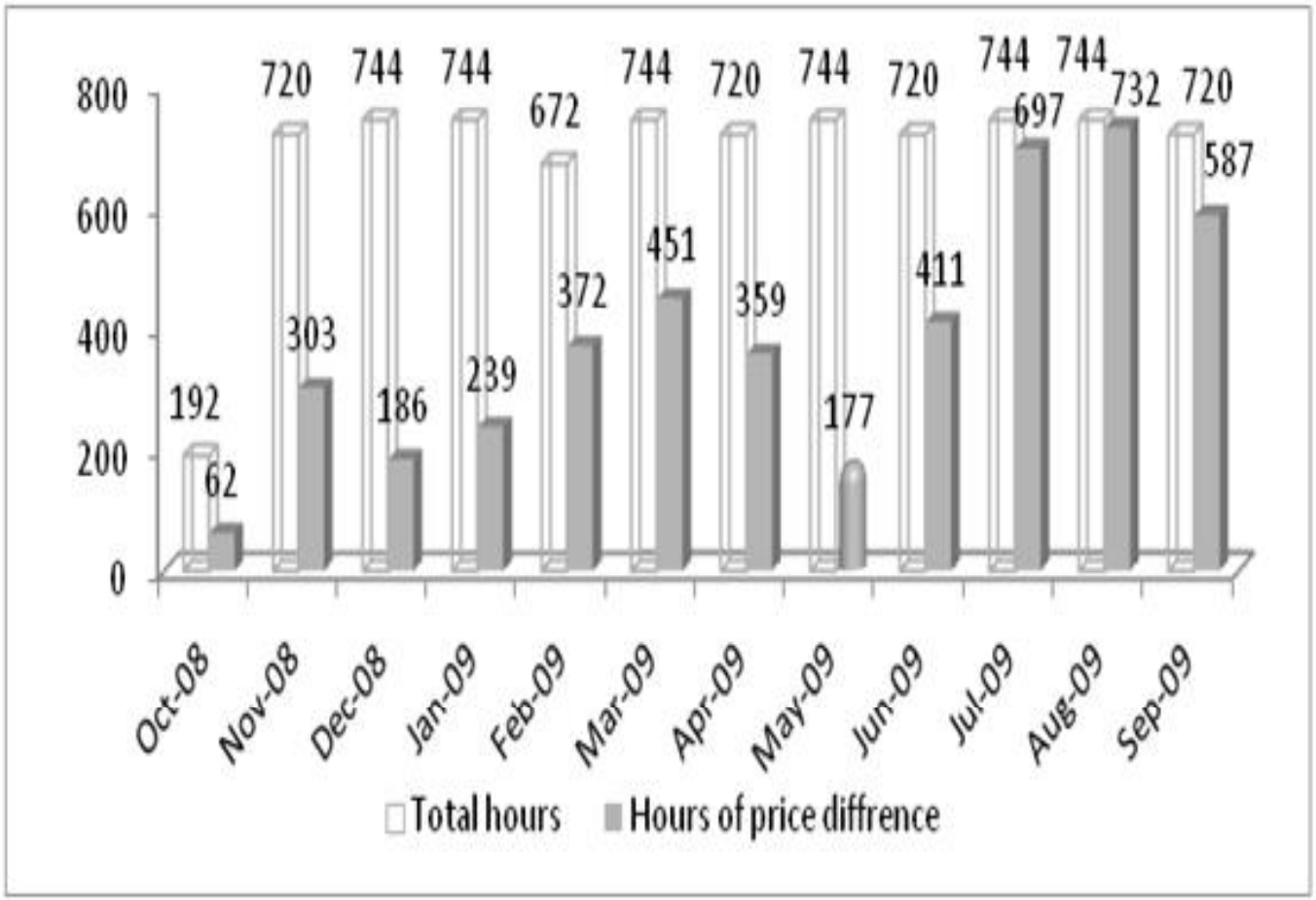
Difference in hourly bid area prices in PXIL during the period Oct 2008 to Sept 2009



- No difference during Oct-Dec 2008, Feb 2009 and May 2009.
- During Jan, Mar and Apr 2009, in some of the hours.
- More prevalent during June-Sept 2009 and remained more than 50% of the number of hours in July and Aug 2009.

IMPACT OF PXIL: ON MARKET CLEARING PRICES IN PXS

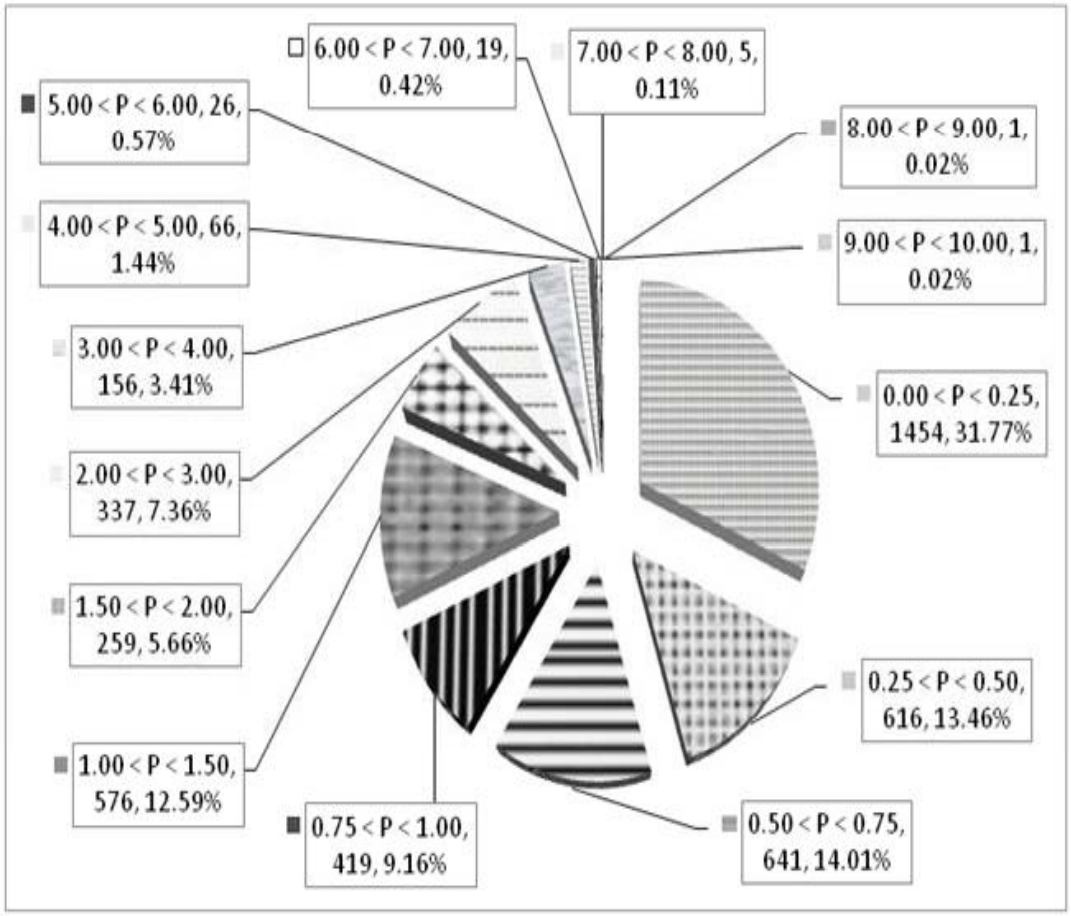
No. of hours of difference between PXs (IEXL and PXIL) during 24.10.2008 to 30.9.2009



- Difference in hourly bid area prices in all the months, but more prevalent during July, August and September 2009.

IMPACT OF PXIL: ON MARKET CLEARING PRICES IN PXS

Difference between two PXs (IEXL and PXIL) during 24.10.2008 to 30.9.2009



- Difference in hourly market clearing price between two PXs on more frequent occasions.
- Out of 8208 hours, difference in 4576 hours and highest price difference Rs.9.84/kWh. Similar trend in different regions.
- Price difference within Rs.1.00/kWh on 68.40% of the instances, price differences between Rs.1.0-1.5, Rs.1.5-2.0, Rs.2.0-3.0, Rs.3.0-4.00 and Rs.4.0-5.0 also on substantial no. of instances.

SUGGESTIONS: ADEQUATE TRANSMISSION CAPACITY

- Difference in hourly bid area prices in PXs indicates the constraints in transmission of electricity more particularly to northern region from other regions.
- Based on the projected capacity addition during 11th Plan, need to transfer the electricity between regions, particularly from eastern and north-eastern regions to other regions.
- More inter-regional transmission capacity for transfer of power from surplus regions to shortage regions may be developed.

SUGGESTIONS: FIXING THE MAXIMUM PRICE CAP

- Difference in hourly bid area prices in IEXL and PXIL and market clearing price between IEXL and PXIL indicate possibility of use of market power.
- To mitigate market power, price cap used in many efficient electricity markets in countries such as Australia, Singapore and UK and various studies also suggested price regulation and use of price cap.
- In view of power shortage in India, need to put adequate maximum price cap in all the trading mechanism.

SUGGESTIONS: REDUCING THE DEMAND-SUPPLY GAP

- Add new generation capacities
- Improve the efficiency of existing generation capacities,
- Reduce AT&C losses and adopt demand side management and energy conservation measures at the consumer end.

SUGGESTIONS: REGULATORY GOVERNANCE

- Felt in the World the need for effective regulation, as evidenced from the presidential address of Barack Obama quoted as below:

  "……..Nor is the question before us whether the market is a force for good or ill. Its power to generate wealth and expand freedom is unmatched, but this crisis has reminded us that without a watchful eye, the market can spin out of control – and that a nation cannot prosper long, when it favours only the prosperous……."

- Due to acute peak and energy shortages in India, the dependence only on market mechanism may not give desired results.
- Focus of the ERCs to bring competition through market mechanism and adequate attention not to protect consumers' interest.
- SERCs should prescribe the performance standards for the discoms so that discoms may sell only surplus electricity.

As a part of Mutual Learning Process, we welcome the Interaction

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