

14TH CCRP WORKSHOP

Flicking the Switch: Retail Demand-Side Response under Alternative Electricity Pricing Contracts

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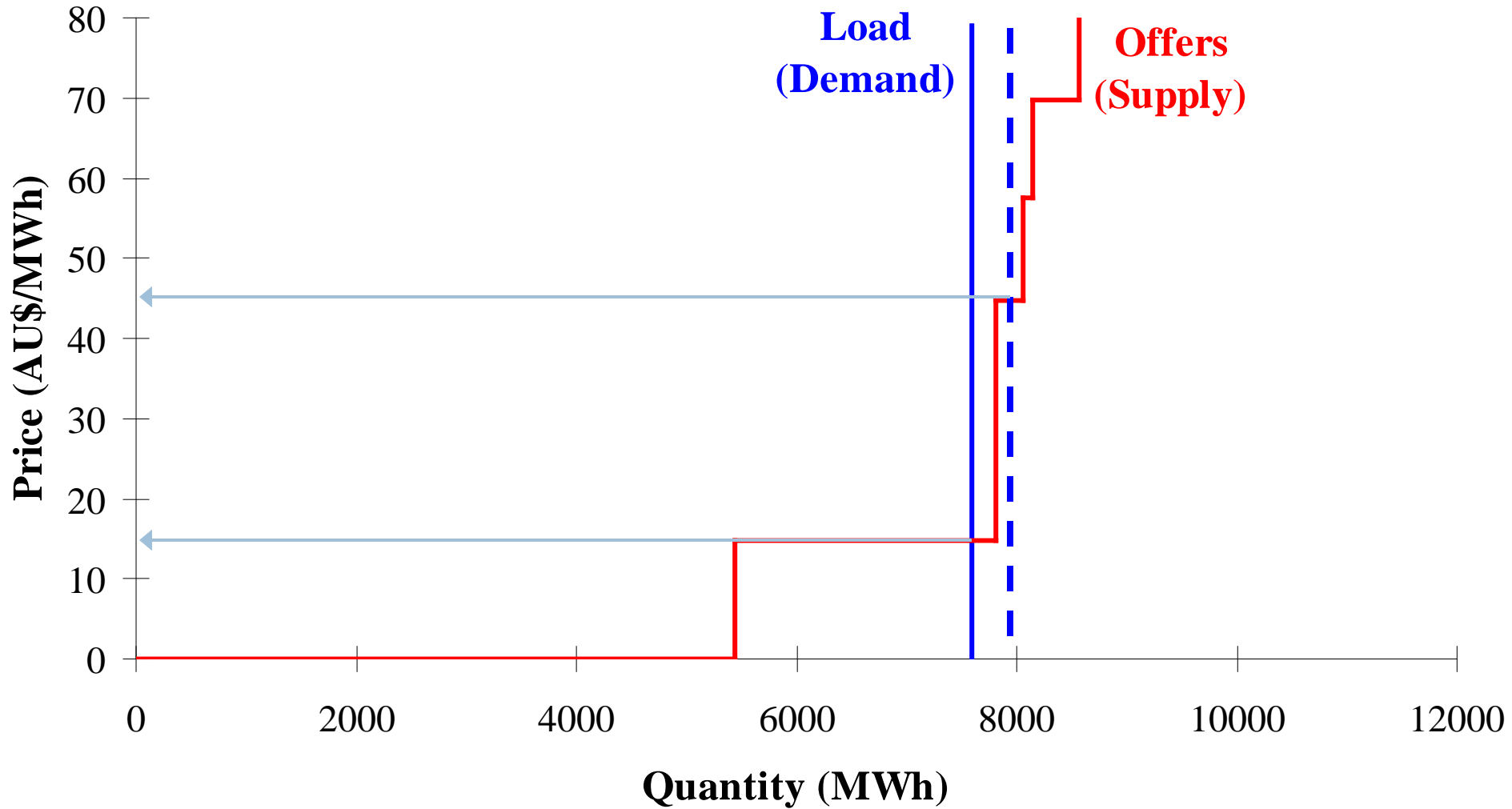
Taylor Smart '13
Gettysburg College

July 2012

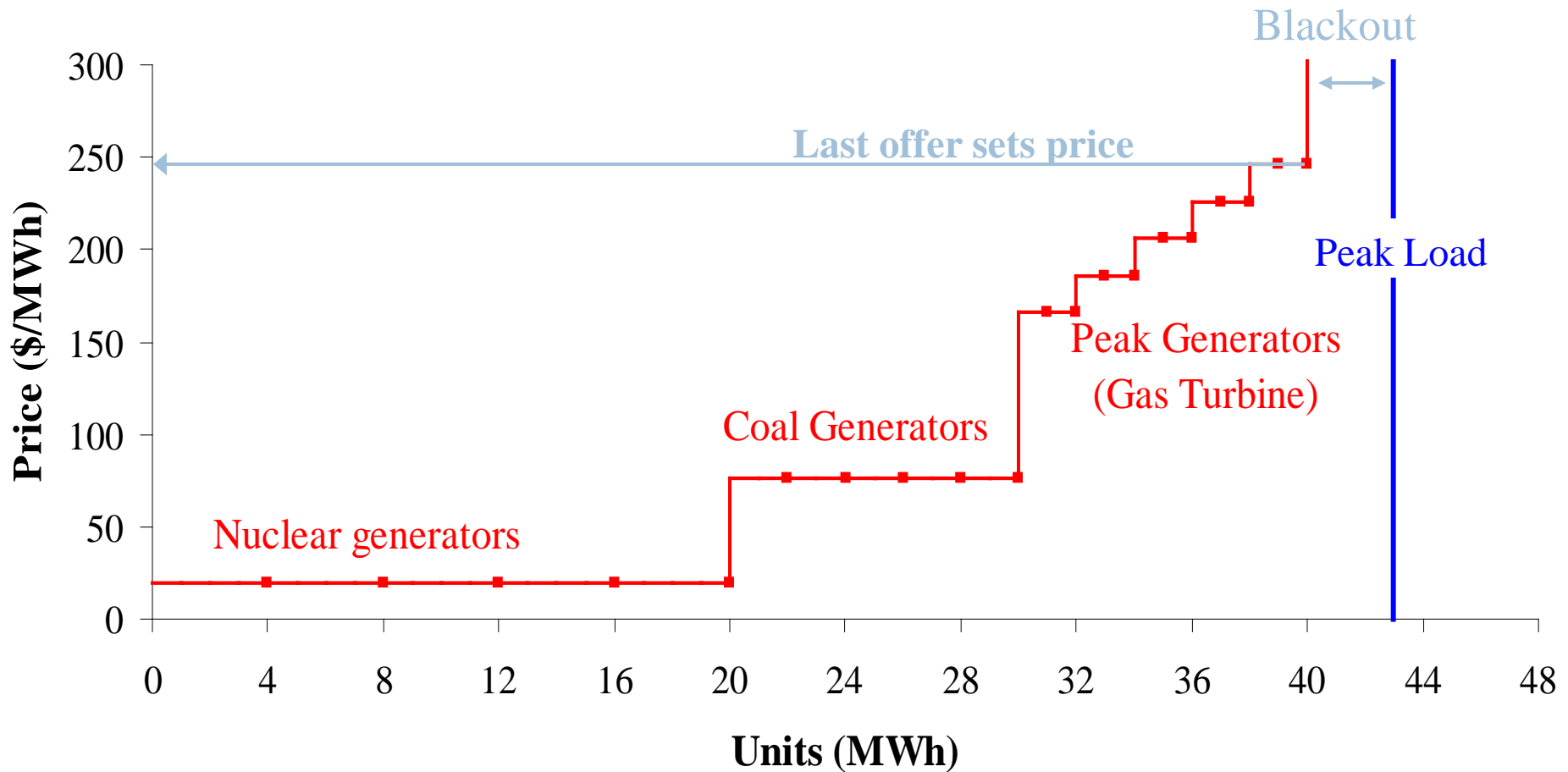
REEML

We thank the Australian Research Council under Linkage grant "Emissions trading and the design and operation of Australia's energy markets" in collaboration with the Australian Financial Markets Association. Acknowledgements are extended to Julie Weisz '12 for outstanding research assistance.

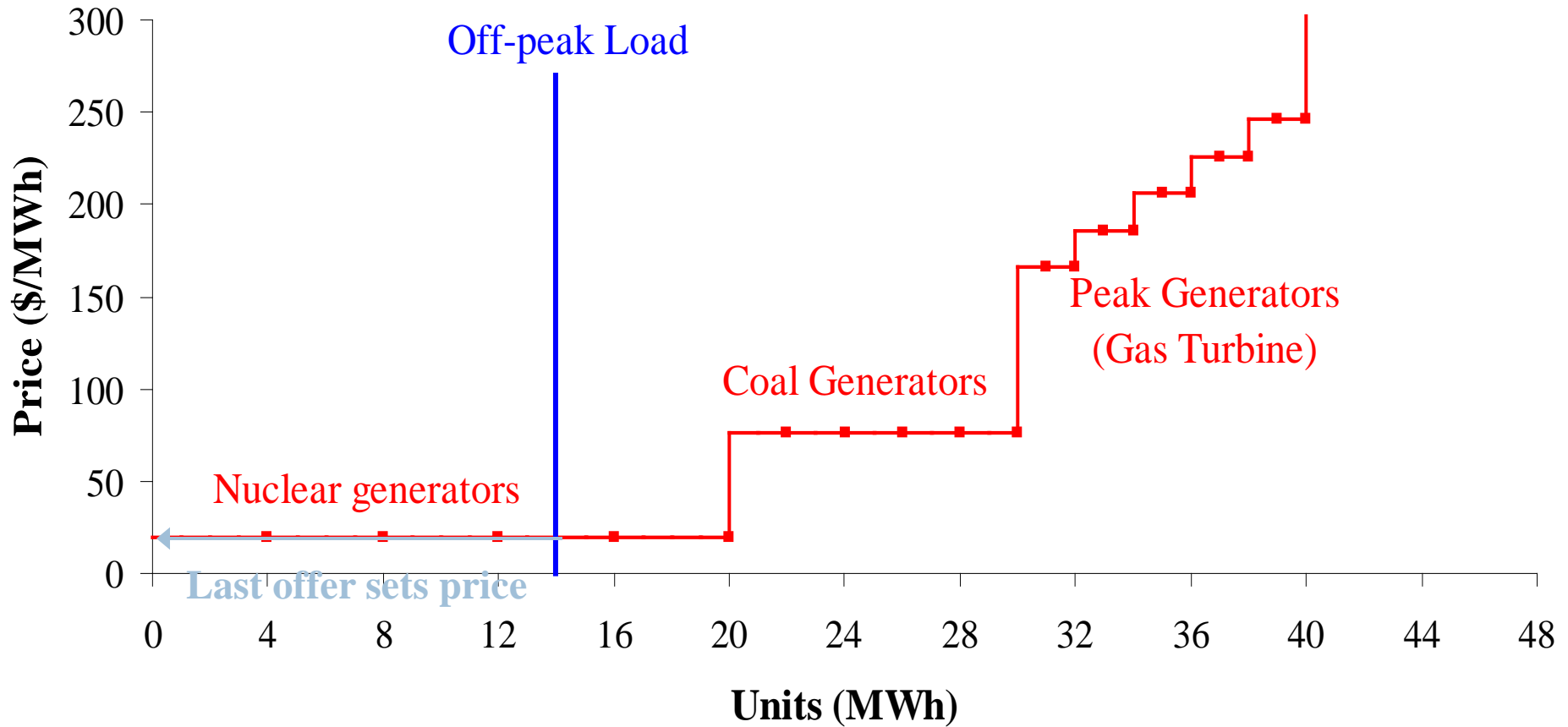
Price Determination in Australia



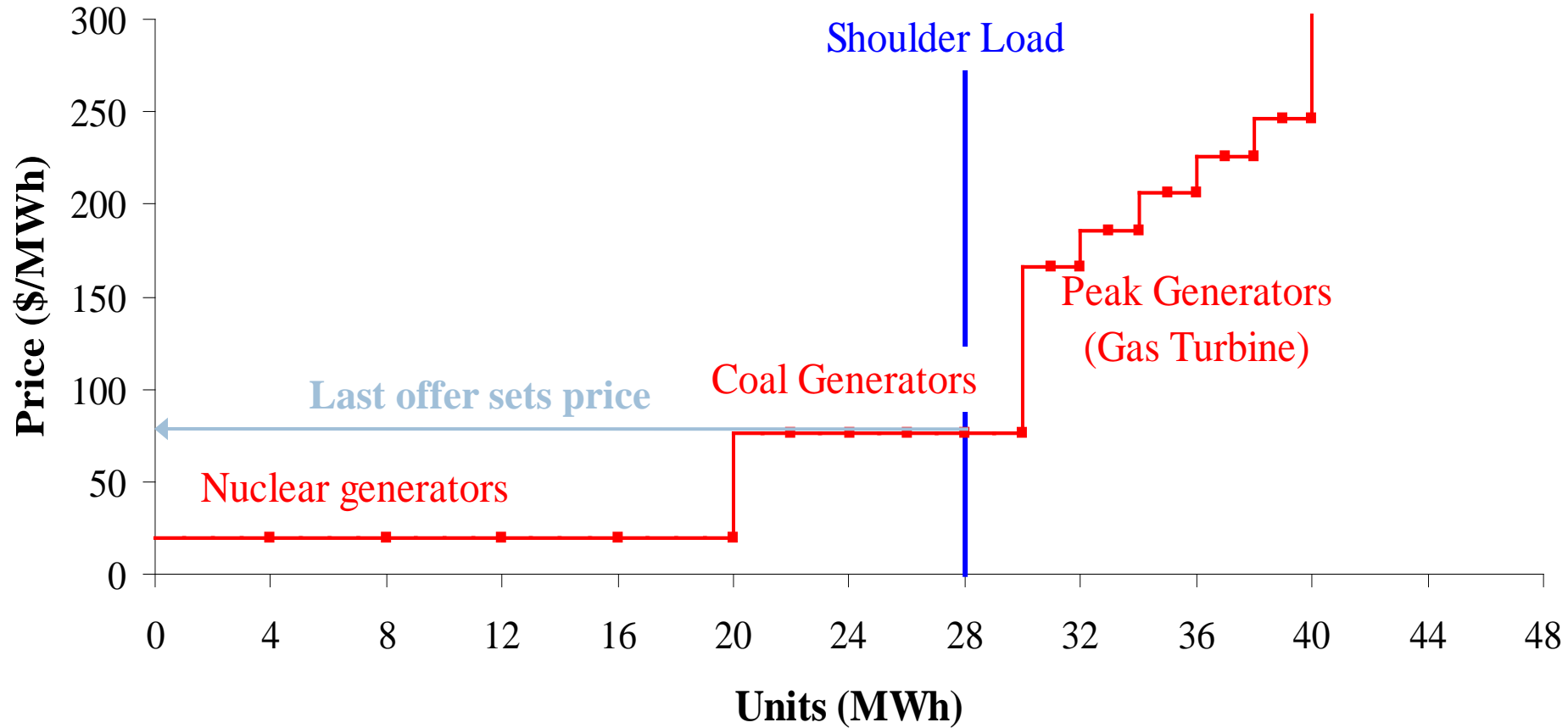
Electricity Market



Electricity Market

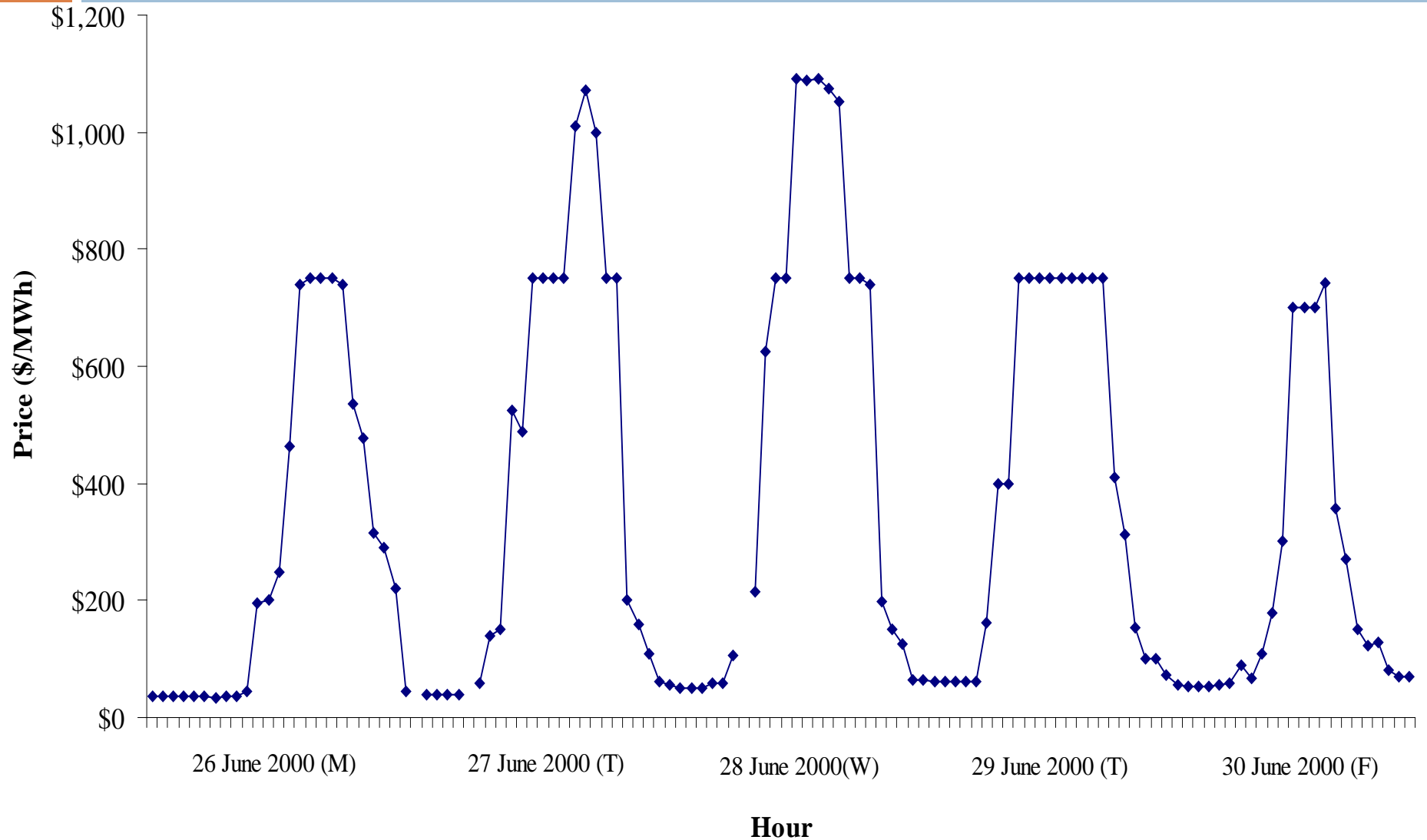


Electricity Market



California Power Exchange Prices

Unconstrained Day-Of/Hour-Ahead Market



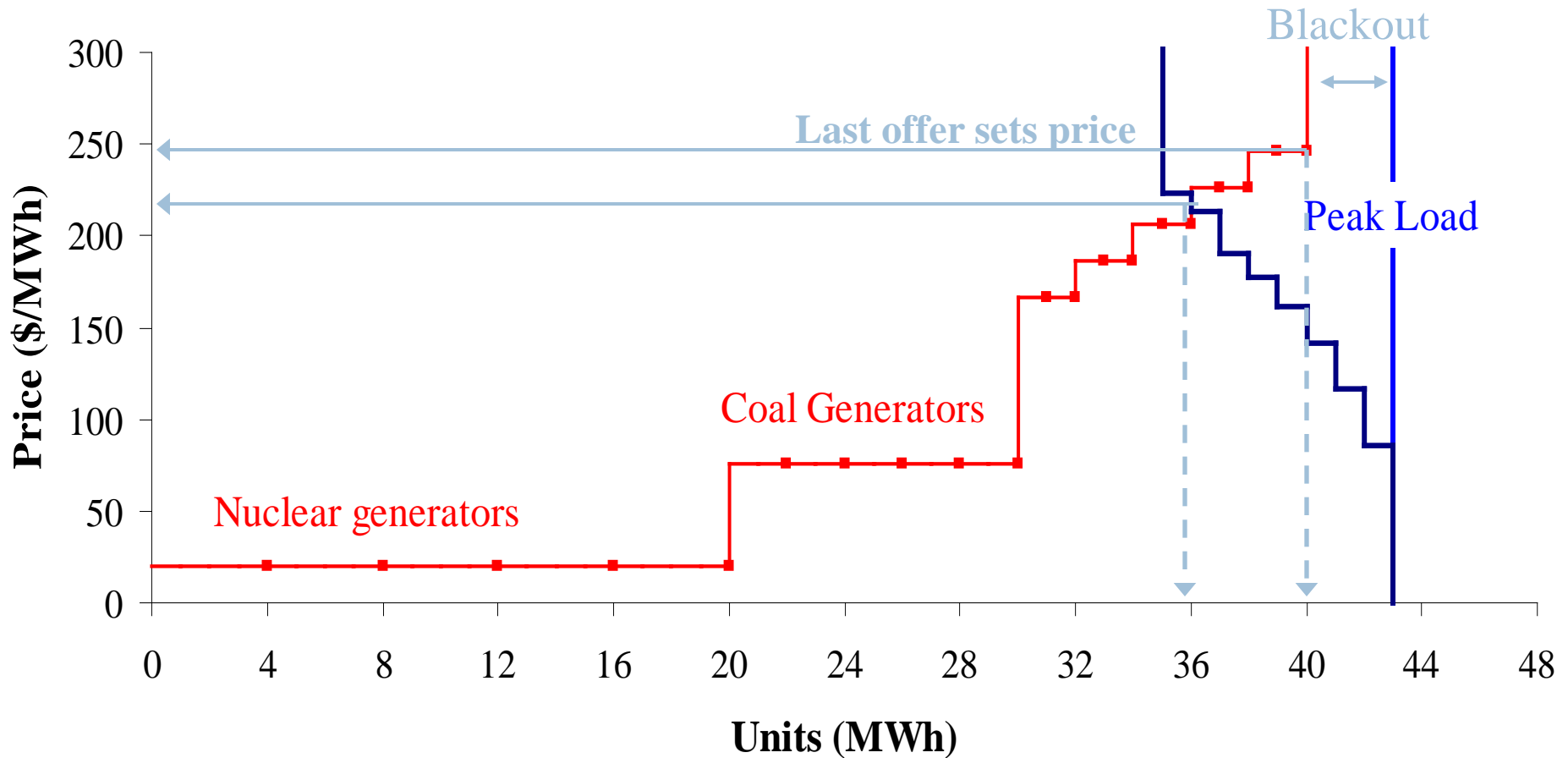
Electricity Market



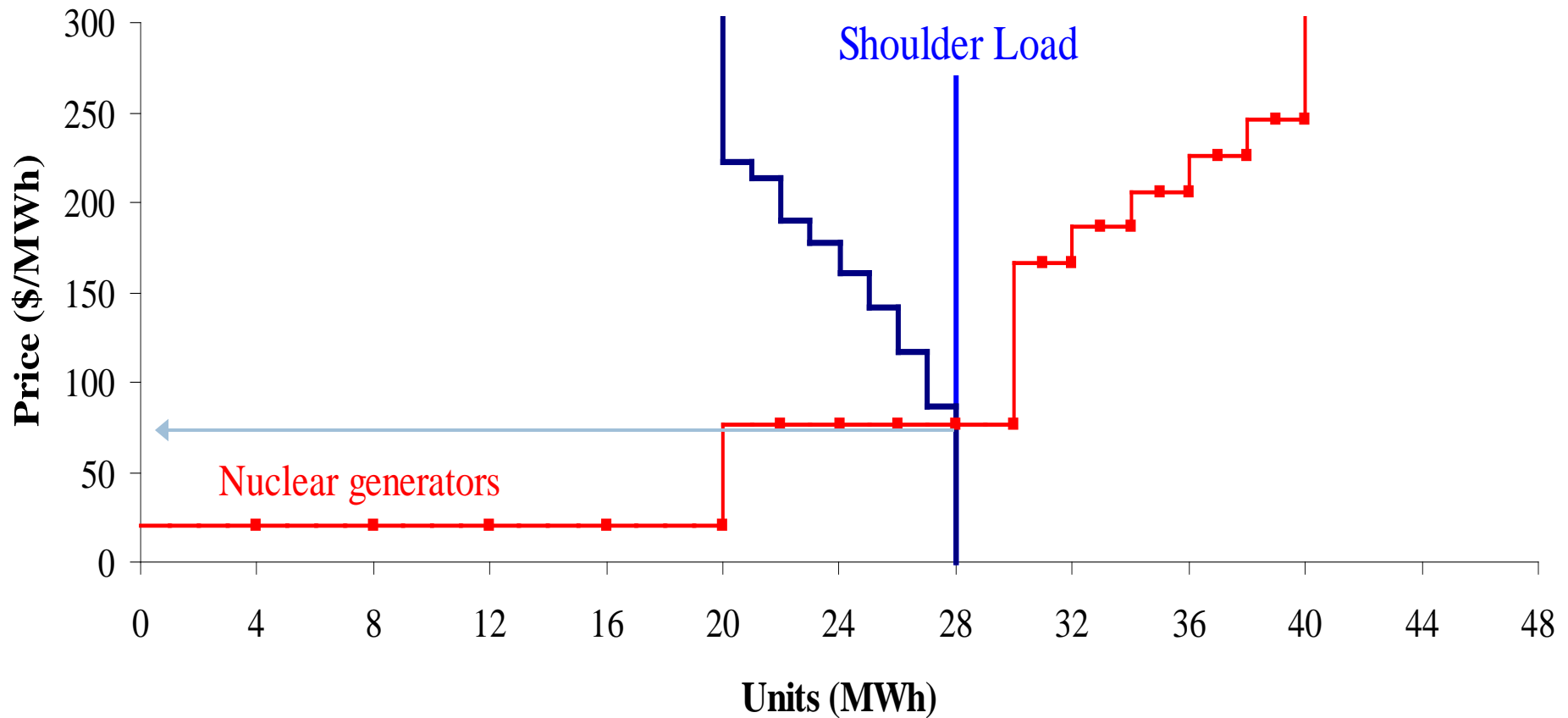
Rassenti, Smith & Wilson (2003):

- What is missing in this market?

A Responsive Demand on Peak



A Responsive Demand on Shoulder



A Question

- How exactly should we implement demand-side response into electricity markets?

Different Retail Electricity Pricing Contracts

- Flat rate pricing (FRP)
- Time of use pricing (TOU)
- Real time pricing (RTP)

California Statewide Pricing Pilot



Community Energy Cooperative's Energy-SmartPricing Plan



GridWise Olympic Peninsula Project



California Automated Demand Response System Pilot



Our Questions

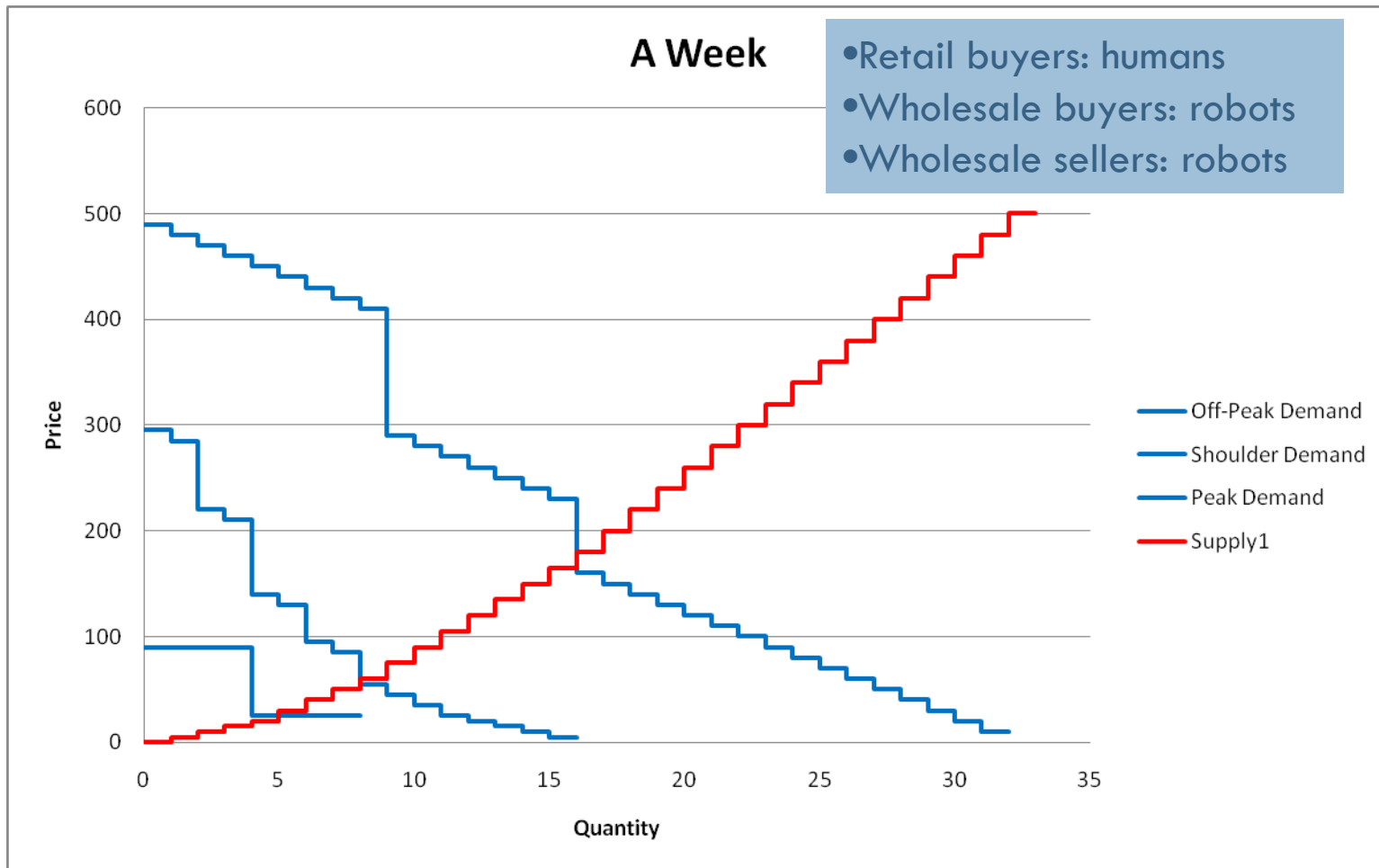
- 1) How do different retail electricity pricing contracts affect market allocative efficiency?
- 2) How good (bad?) are the consumers at responding to supply-side cost shocks under different pricing contracts?
- 3) How does the access to market information affect consumer behavior?

Laboratory Experimental (why?) Approach

We consider four types of pricing contracts:

- 1) FRP
- 2) TOU-L
- 4) TOU-H
- 3) RTP

Experimental Environment: Months 1-15



Experimental Treatments

		FRP	TOU-L	TOU-H	RTP
<i>Market Information Access</i>	<i>No</i>	(5; 33)	(5; 33)	(5; 33)	(5; 33)
	<i>Yes</i>				(5; 33)

- Total number of subjects: 100
- Average subject earnings: 33.03 AUD
- Participation fee: 10 AUD
- Recruitment: ORSEE
- Software: zTree

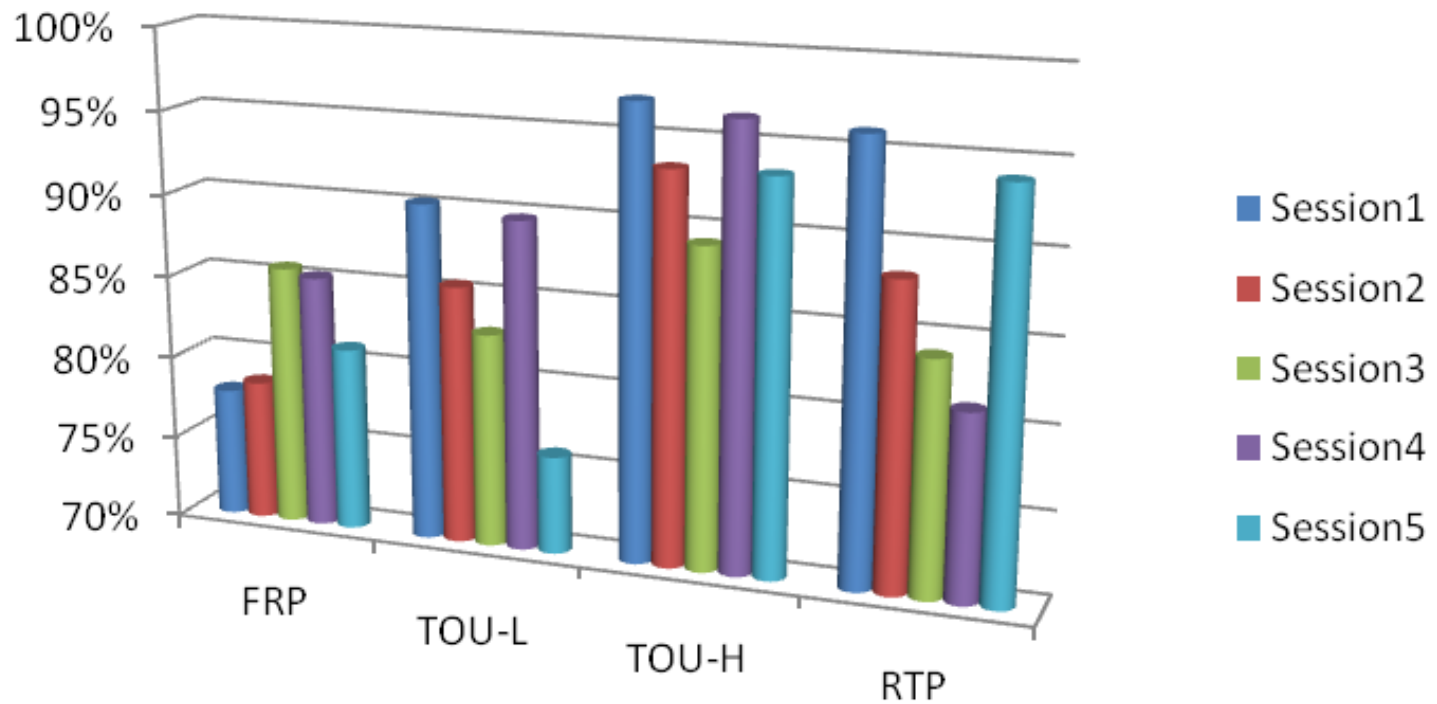
Predicted Efficiency Levels for Months 1-15

- Efficiency = (Realized Total Surplus / Maximum Total Surplus) * 100

	FRP	TOU-L	TOU-H	RTP
<i>Efficiency</i>	88%	92%	100%	100%

Results

Efficiency Months 1-15



A Behavioral Puzzle

- Why is RTP less efficient relatively to TOU-H?

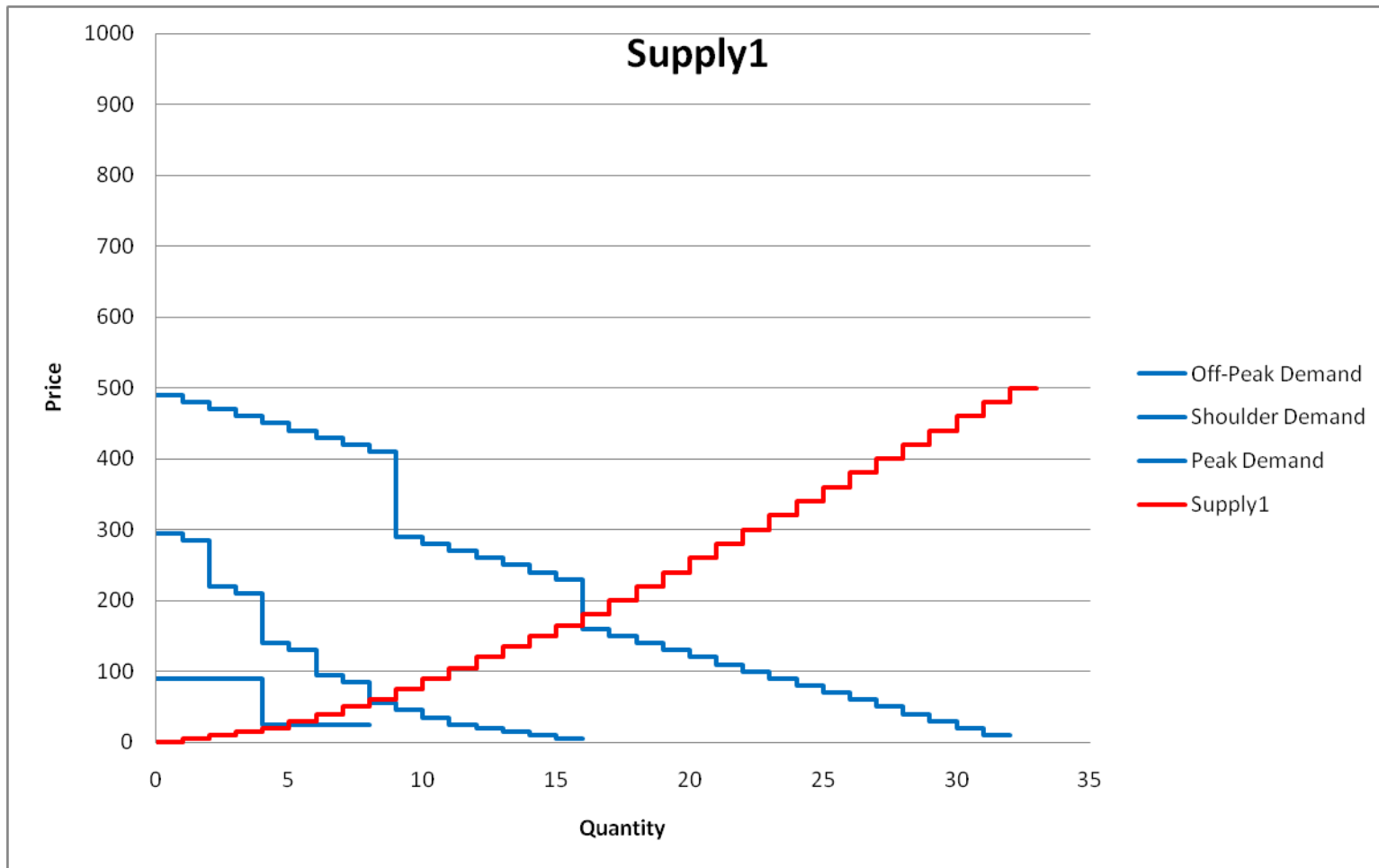
Varying Information

- Introducing instantaneous market information access
- Treatment RTP+

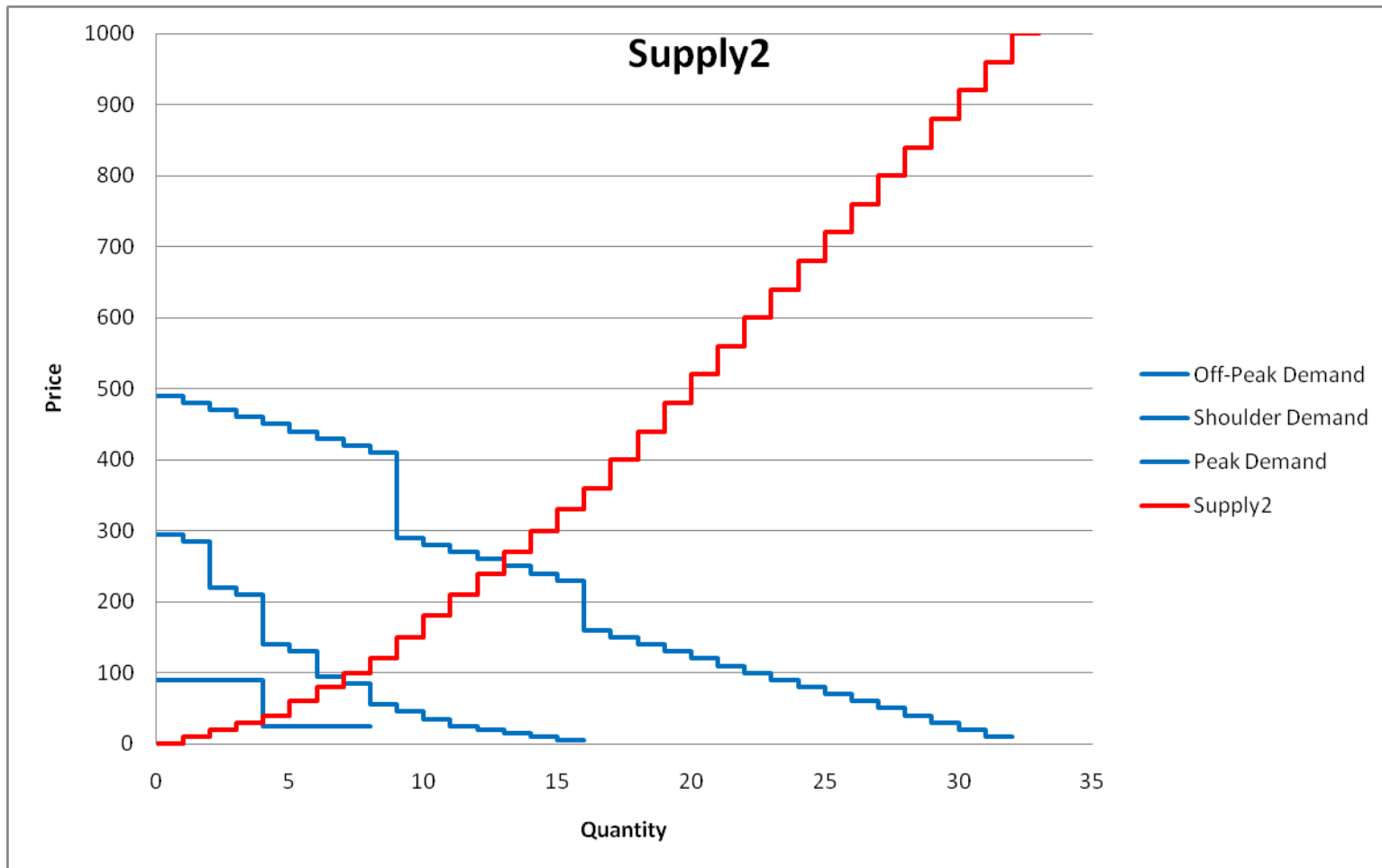
Results: Efficiency Levels for Months 1-15

	FRP	TOU-L	TOU-H	RTP	RTP+
<i>Predicted Efficiency</i>	88%	92%	100%	100%	100%
<i>Observed Efficiency</i>	82%	85%	94%	89%	98%

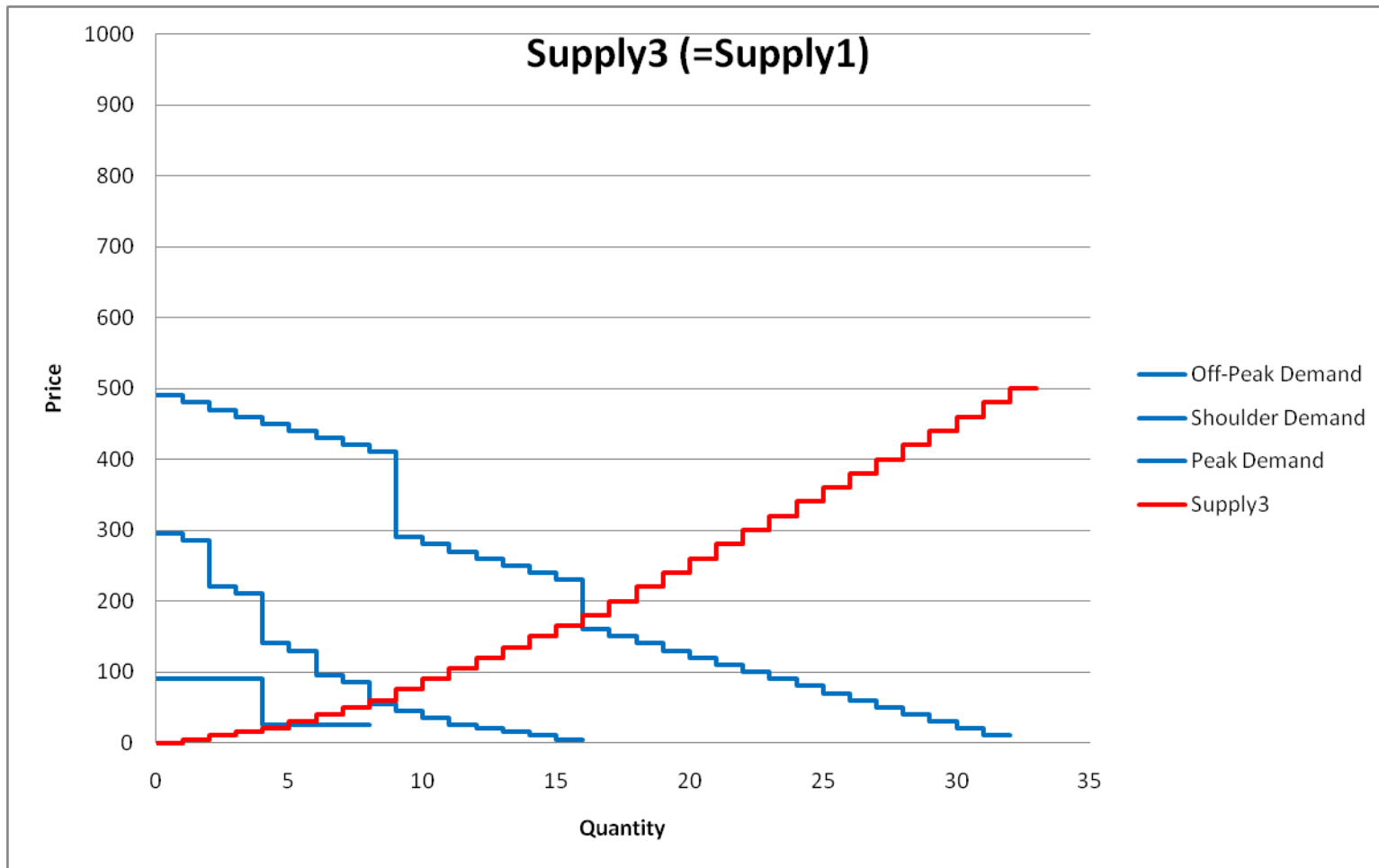
Experimental Environment: Months 1-15



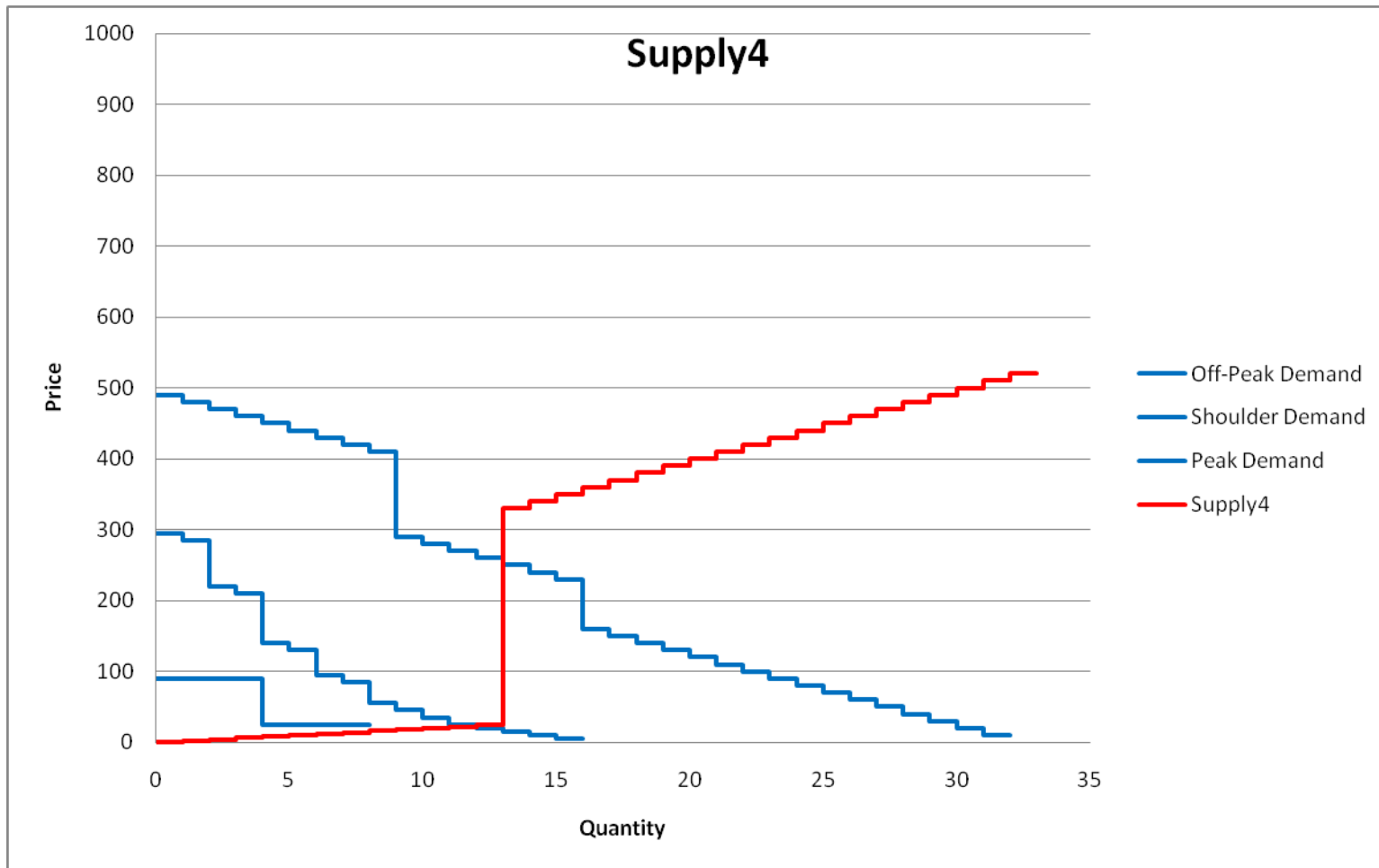
Experimental Environment: Months 16-21



Experimental Environment: Months 22-27



Experimental Environment: Months 28-33



Results

<i>Efficiency</i>		FRP	TOU-L	TOU-H	RTP
<i>Month 10-15</i>	<i>Predicted</i>	88%	92%	100%	100%
	<i>Observed</i>	84%	88%	98%	92%
<i>Month 16-21</i>	<i>Predicted</i>	78%	93%	95%	100%
	<i>Observed</i>	81%	86%	91%	89%
<i>Month 22-27</i>	<i>Predicted</i>	88%	92%	100%	100%
	<i>Observed</i>	74%	88%	91%	88%
<i>Month 28-33</i>	<i>Predicted</i>	72%	89%	98%	100%
	<i>Observed</i>	76%	78%	92%	90%

Varying Information

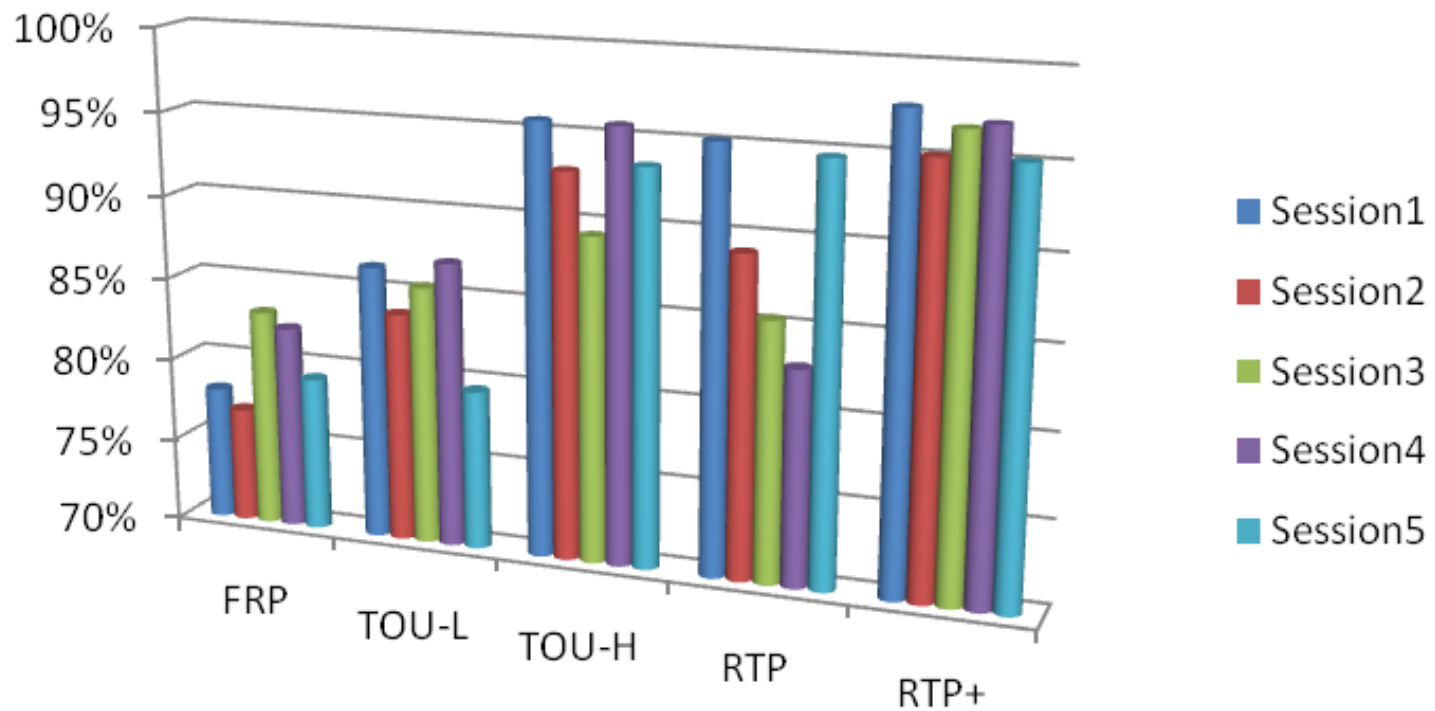
- Introducing instantaneous market information access
- Treatment RTP+

Results

<i>Efficiency</i>		FRP	TOU-L	TOU-H	RTP	RTP+
<i>Month 10-15</i>	<i>Predicted</i>	88%	92%	100%	100%	100%
	<i>Observed</i>	84%	88%	98%	92%	98%
<i>Month 16-21</i>	<i>Predicted</i>	78%	93%	95%	100%	100%
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	<i>Observed</i>	74%	88%	91%	88%	98%
<i>Month 28-33</i>	<i>Predicted</i>	72%	89%	98%	100%	100%
	<i>Observed</i>	76%	78%	92%	90%	95%

Results

Efficiency Months 1-33



Results

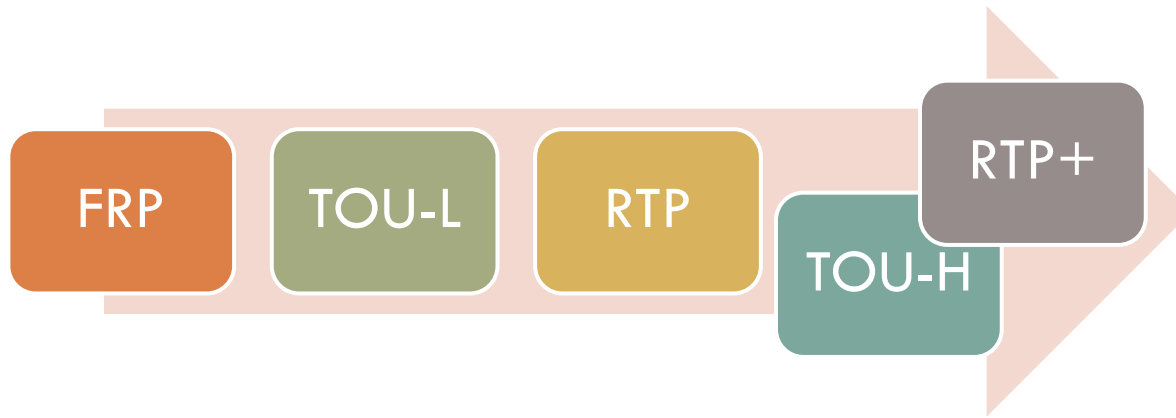
Estimates from Linear Mixed Effects Model (Months 1-33)^b

Treatment	Mean	Std. Error	df	95% Confidence Interval	
				Lower Bound	Upper Bound
FRP	79.876 ^a	.834	73.400	78.214	81.538
TOU-L	84.455 ^a	.834	73.400	82.792	86.117
RTP	89.480 ^a	.834	73.400	87.818	91.142
TOU-H	93.464 ^a	.834	73.400	91.801	95.126
RTP+	96.379 ^a	.834	73.400	94.717	98.041

a. Based on modified population marginal mean.

b. Dependent Variable: MonthlyEfficiency.

Conclusions



- 1) Contracts with simply more dynamic pricing do not necessarily increase allocative market efficiency: RTP produced relatively low efficiency when compared to TOU-H.

Conclusions

- 2) The type of TOU pricing matters.

Conclusions

- 3) Contracts with more dynamic pricing allow customers to respond to supply-side shocks better (?)

Conclusions

- 4) Providing an instantaneous access to market information significantly improves allocative efficiency with RTP contracts.



Thank You!