

Contents

1	Introduction	4
2	Literature	4
3	Data	4
3.1	Description of the Experiment	4
3.2	Description of the Data Sets from the Experiment	5
3.3	Description of the Weather Data Set	5
4	Empirical Analysis and Results	6
4.1	Empirical Strategy	6
4.2	Average Responses to Time-Of-Use Prices	6
4.2.1	Average Responses by Hour of Day	6
4.2.2	Average Responses in the Peak Period	6
4.3	Decomposition of Responses to Time-Of-Use Prices	7
4.3.1	Decomposition of Average Responses in the Peak Period	7
4.3.2	Decomposition of Responses in the Peak Period as a Linear Function of Unit Rate Changes	8
5	Time-Of-Use Prices with Higher Granularity	8
5.1	Time-Of-Use Prices with 2-Dimensional Dynamics	8
5.1.1	Time-Of-Use Prices with an Additional Dynamics in Heating Needs	8
5.1.2	Comparison to Alternative Dynamic Prices	8
5.2	Simulations	9
6	Conclusion	9
A	Appendix for Chapter 1	10
B	Appendix for Chapter 2	10
C	Appendix for Chapter 3	10

List of Tables

1	Treatment and Control Group Assignments	5
2	Summary Statistics and Differences in Means for Treatment and Control Groups	5
3	Summary Statistics and Differences in Means for Treatment and Baseline Periods	5
4	Correlations in Temperature for Major Cities in Ireland	5
5	Average Treatment Effects by Heating Degree Day	7
6	Treatment Effects as a Linear Function of Unit Rate Changes	8
7	Average Treatment Effects by Tariff and Stimulus	10
8	Average Treatment Effects by Heating Degree Days, Tariff, and Stimulus	10

List of Figures

1	Time-Of-Use Pricing Structures	4
2	Average Consumption by Hour of Day	5
3	Average Daily Temperature by Date	6
4	Distribution of Heating Degree Days by Rate Period	6
5	Average Treatment Effects by Hour of Day	6
6	Average Treatment Effects by Heating Degree Day	7
7	Average Treatment Effects by Heating Degree Days and Tariff	7
8	Average Treatment Effects by Heating Degree Days and Stimulus	7
9	Simulated Treatment Effects	9
10	Hourly Average Consumption by Rate Period	10

1 Introduction

(To be added...)



2 Literature

- (1. Literature on time-varying electricity prices)
 - (1.1. A common finding: reduction in electricity consumption)
 - (1.2. Brief discussion about the factors affecting the effectiveness of dynamic pricing)
 - (1.2.1. Information about consumption and prices)
 - (1.2.2. Inattention to electricity price and consumption information)
 - (1.2.3. The importance of automation technology, including default technology setting, with respect to adjustment costs)
 - (1.3. Papers that exploit the same data)
- (2. Literature on the relationship between temperature and consumption)
 - (2.1. In the context of climate change)
 - (2.2. TODO: Need to do additional review)
- (3. Limitation(s) in previous studies)

3 Data



3.1 Description of the Experiment

- (1. Description of the smart meter consumer behavior trial run by the Commission for Energy Regulation)
 - (1.1. The purpose of the trial)
 - (1.2. Construction of treatment and control groups)
 - (1.3. The time line of the trial)
 - (1.4. Four different pricing structures)
 - (1.5. Four different information stimuli)

Figure 1: Time-Of-Use Pricing Structures

3.2 Description of the Data Sets from the Experiment

- (1. Description of the data sets from the experiment)
 - (1.1. Overall description of the metering data set)
 - (1.2. Brief description of the survey data set)
- (2. Final sample)
 - (2.1. Description of how to construct the final sample)
 - (2.2. Brief discussion about treatment and control groups)

Table 1: Treatment and Control Group Assignments

Table 2: Summary Statistics and Differences in Means for Treatment and Control Groups

- (2.3. Brief discussion about treatment and Baseline periods)

Figure 2: Average Consumption by Hour of Day

Table 3: Summary Statistics and Differences in Means for Treatment and Baseline Periods

3.3 Description of the Weather Data Set

- (1. Description of weather data set)
 - (1.1. Overall description of weather data set)
 - (1.2. Representative data for average daily temperature)
 - (1.2.1. Description of the spatial distribution of temperature in Ireland)

Table 4: Correlations in Temperature for Major Cities in Ireland

- (1.2.2. Description of why/how to create average daily temperature data)

Figure 3: Average Daily Temperature by Date

(1.2.3. Description of why to drop observations for too hot/cold days)

Figure 4: Distribution of Heating Degree Days by Rate Period

4 Empirical Analysis and Results



4.1 Empirical Strategy

(1. Description of the Differences-In-Differences estimator)

(1.1. Assumptions)

(1.2. Threats to identification, with countermeasures)



4.2 Average Responses to Time-Of-Use Prices

4.2.1 Average Responses by Hour of Day

(1. Description of average responses by hour of day)

(1.1. Econometric model)

(...)

(1)

(1.2. Results, with implications)

(- Little evidence of load shifting)

Figure 5: Average Treatment Effects by Hour of Day

4.2.2 Average Responses in the Peak Period



(1. Description of average responses in the peak period: By Tariff/Stimulus)

(1.1. Econometric models)

(...) (2)

(...) (3)

(1.2. Results, with implications)

Table 5: Average Treatment Effects by Heating Degree Day

4.3 Decomposition of Responses to Time-Of-Use Prices

4.3.1 Decomposition of Average Responses in the Peak Period

(1. Description of average responses in the peak period: by HDDs)

(1.1. Econometric model)

(...) (4)

(1.2. Results, with implications)

Figure 6: Average Treatment Effects by Heating Degree Day

(2. Description of average responses in the peak period: by HDDs + Tariffs/Stimuli)

(2.1. Econometric model)

(...) (5)

(...) (6)

(2.2. Results, with implications)

Figure 7: Average Treatment Effects by Heating Degree Days and Tariff

Figure 8: Average Treatment Effects by Heating Degree Days and Stimulus



4.3.2 **Decomposition of Responses in the Peak Period as a Linear Function of Unit Rate Changes**

(1. Description of average responses in the peak period: linear function of changes in unit rate)

(1.1. Econometric model)

$$(\dots) \tag{7}$$

(1.2. Results, with implications)

Table 6: Treatment Effects as a Linear Function of Unit Rate Changes

5 Time-Of-Use Prices with Higher Granularity

5.1 Time-Of-Use Prices with 2-Dimensional Dynamics

5.1.1 Time-Of-Use Prices with an Additional Dynamics in Heating Needs

(1. Inefficiency of time-invariant prices)

(2. TOU prices with an additional dynamics)

(2.1. Description of TOU prices with an additional dynamics)

(2.2. Validity of TOU prices with an additional dynamics)

(2.2.1. Little evidence of load shifting, implying that consumption during the peak period is the key to reduction in electricity consumption)

(2.2.2. High demand for electricity on days with high HDDs)

5.1.2 Comparison to Alternative Dynamic Prices

(1. Key differences)

(1.1. From other dynamic prices, especially in terms of granularity)

(1.2. From TOU, especially in terms of the additional dynamics)

(2. Advantages of TOU prices with an additional dynamics)

(2.1. Less welfare loss on days with less HDDs)

(2.2. High efficiency on days with high HDDs, especially during the peak period)

5.2 Simulations

(1. Description of Simulations)

(2. Simulation results, with their implications)

Figure 9: Simulated Treatment Effects

6 Conclusion

(To be added...)

A Appendix for Chapter 1

B Appendix for Chapter 2

Figure 10: Hourly Average Consumption by Rate Period

Table 7: Average Treatment Effects by Tariff and Stimulus

Table 8: Average Treatment Effects by Heating Degree Days, Tariff, and Stimulus

C Appendix for Chapter 3

References