Consumer Reactions to Complex Pricing Schemes

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  - energy billing
  - income tax system
  - credit card interest charges and fees

- Such complexity and changes make it difficult, due to information gathering and cognitive costs, to easily understand marginal pricing, and hence to choose the right amount of consumption.
Research Questions

1. What factors determine whether consumers (re-)acquire exact pricing information at some point in time?
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2. If not obtaining the information, how do consumers update their beliefs about the pricing scheme based on observation of their total bill?
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  - Blocks 1-6: 12 periods per block

- In each period, subjects face an induced demand:

<table>
<thead>
<tr>
<th>Unit number</th>
<th>Marginal resale value</th>
<th>Cumulative resale value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.5</td>
<td>30.5</td>
</tr>
<tr>
<td>2</td>
<td>9.5</td>
<td>40.0</td>
</tr>
<tr>
<td>3</td>
<td>8.5</td>
<td>48.5</td>
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<tr>
<td>4</td>
<td>7.5</td>
<td>56.0</td>
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<td>5</td>
<td>6.5</td>
<td>62.5</td>
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<tr>
<td>6</td>
<td>5.5</td>
<td>68.0</td>
</tr>
<tr>
<td>7</td>
<td>4.5</td>
<td>72.5</td>
</tr>
<tr>
<td>8</td>
<td>3.5</td>
<td>76.0</td>
</tr>
<tr>
<td>9</td>
<td>2.5</td>
<td>78.5</td>
</tr>
<tr>
<td>10</td>
<td>1.5</td>
<td>80.0</td>
</tr>
</tbody>
</table>
Experimental Design (2)

In each period $t$, subjects face a two-part tariff price schedule

$$P_t(x) = F_t + p_t x_t,$$

(1)

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$$P_t(x) = F_t + p_t x_t,$$

where

1. $x_t$ is the purchased quantity
2. $P_t(x_t)$ is the total cost of the purchased quantity
3. $F_t$ is a fixed fee
4. $p_t$ is the per-unit price
In each period $t$, $F_t$ is drawn independently from the uniform distribution on 0,1,...,20.
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In period $t$, the per unit price $p_t$ is determined as follows:
Experimental Design (3)

- In each period $t$, $F_t$ is drawn independently from the uniform distribution on $0, 1, \ldots, 20$.

- In period $t$, the per unit price $p_t$ is determined as follows:
  1. $p_1$ is drawn from the uniform distribution on $1, 2, \ldots, 10$.  

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In period $t$, the per unit price $p_t$ is determined as follows:

1. $p_1$ is drawn from the uniform distribution on $1,2,...,10$.
2. If $t > 1$, then $p_t$ is determined as follows. Define $\hat{p}_t$ by

$$\hat{p}_t = \begin{cases} 
  p_{t-1} - 2 & \text{w.p. } 1/12 \\
  p_{t-1} - 1 & \text{w.p. } 1/6 \\
  p_{t-1} & \text{w.p. } 1/2 \\
  p_{t-1} + 1 & \text{w.p. } 1/6 \\
  p_{t-1} + 2 & \text{w.p. } 1/12 
\end{cases}$$

If $\hat{p}_t \in \{1,2,...,10\}$, then $p_t = \hat{p}_t$, otherwise $p_t = p_{t-1} - (\hat{p}_t - p_{t-1})$. That is, per-unit price jumps out of the range $\{1,2,...,10\}$ are reversed in sign.
In any period, a subject can acquire exact pricing information before making the purchase decision at a cost $c \in \{2, 4, 6, 8\}$. 
Experimental Design (4)

- In any period, a subject can acquire exact pricing information before making the purchase decision at a cost $c \in \{2, 4, 6, 8\}$.

- In 4 out of 6 blocks, the cost is fixed and known. In the other two blocks, it is drawn from the uniform distribution on $\{2, 4, 6, 8\}$ and the subject does not know the realization when deciding whether to acquire the pricing information. In one of these two blocks, subjects are told the distribution of the information cost ("risky" treatment) and in the other one they are not ("ambiguous" treatment).
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- Blocks are ordered randomly across subjects to control for order effects. The only exception is that the ambiguous treatment always comes before the risky treatment.
After deciding on the purchased quantity, subjects are asked how much they expect to pay in total for their purchase.
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At the end of each period, subjects are informed about how much they actually paid for their purchase (i.e., $P_t(x_t)$).
At the end of the experiment, a questionnaire is run that collects demographic data on:

- gender
- age
- country origin
- academic major
- highest achieved degree
- mobile phone provider
- plan name
- whether they exceed their calling time limit
- their estimates of over-the-limit and roaming per-minute charges
At the end of the experiment, a questionnaire is run that collects demographic data on:

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Additional questions include:

- mobile phone provider
- plan name
- whether they exceed their calling time limit
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At the end of the experiment, a questionnaire is run that collects demographic data on:

- gender
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We also ask each subject about his or her:

- mobile phone provider
- plan name
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Subjects are also asked to state their beliefs about the marginal tax rate on:

- one-time job contract
- regular job contract
- interest income
- consumption (i.e., the VAT rate)

Finally, subjects are also asked to comment on how they were deciding on:

- whether to buy information
- how many units to buy when knowing \( F_t \) and \( p_t \)
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- Average earnings: CZK 341 (EUR 14)
Theoretical Predictions: Quantity Demanded

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  where the expectation is taken with respect to subject beliefs.
- Reverse-engineering this result, if subjects do make optimal purchase decisions given their beliefs, then the mean of the belief about $p_t$ can be obtained as
  \[ x_t^* \equiv 11 - E(p_t). \]  \hspace{1cm} (5)
Depending on current subject beliefs about $p_t$, it is possible to compute the value of pricing information. The comparison of this value with (expected) cost of information then determines the optimal information demand.
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  1. Demand for pricing information decreases in (expected) cost of information.
  2. Demand for pricing information decreases with the number of periods left until the end of the block.
  3. Demand for pricing information increases with size of the surprise in the amount of the total bill, symmetrically so for positive and negative surprises.
Given beliefs about $p_t$ before observing the purchase bill, these beliefs are updated according to the Bayes rule based on observation of the purchase bill.
Theoretical Predictions: Belief Updating

- Given beliefs about $p_t$ before observing the purchase bill, these beliefs are updated according to the Bayes rule based on observation of the purchase bill.

- Comparative statics predictions: a higher (lower) than expected consumption bill increases (decreases) the mean of the posterior belief about $p_t$, and hence also $p_{t+1}$. The effect is quantitatively symmetric for positive and negative bill surprises.
Subjects buy information in about:

\[ \text{Quantity Demanded} \]

[:math: x_t = 11 - p_t \text{ in } 70\% \text{ of subject-periods}]

\[ |x_t - (11 - p_t)| \leq 1 \text{ in } 85\% \text{ of subject-periods} \]

These figures are about 3 p.p. higher in the second half of the experiment.

Message: It is reasonable to use the formula \( E(p_t) = 11 - x_t \) to infer the mean of beliefs of most of the subjects.
Results: Quantity Demanded

- Subjects buy information in about:
  - 93% of first subject-periods in the individual blocks

When having the exact pricing information, $x_t = 11 - p_t$ in 70% of subject-periods $|x_t - (11 - p_t)| \leq 1$ in 85% of subject-periods. These figures are about 3 p.p. higher in the second half of the experiment.

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Subjects buy information in about:
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- 35% of subject-periods over all
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- Message: it is reasonable to use the formula $E(p_t) = 11 - x_t$
  to infer the mean of beliefs of most of the subjects.
Because in what follows we will infer beliefs from purchasing decisions using the formula $E(p_t) = 11 - x_t$, in some specifications the sample will be restricted to subject-blocks for which there is a reasonable degree of evidence that this is a good assumption.
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Let $I$ be the set of periods within a given block in which a subject purchases pricing information. The use only those subject-blocks in which

$$\max_{t \in \{1,..,12\}} |x_t - (11 - p_t)| \leq 1$$

(6)
60 out of 107 subjects satisfy this condition in all blocks in which they purchase the information at least once. Among these subjects, however, there are 12 subject-blocks without any purchase of the pricing information. These data will be included in further analysis.

Among the remaining 47 subjects, 190 out of 282 subject-blocks will be used. Summary: 457 out of 642 subject-blocks, or about 71% of the data will be used in the subsequent analysis.
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Data Restriction (2)

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## Results: Demand for Information (LPM)

<table>
<thead>
<tr>
<th>Sample Surprise</th>
<th>(1) All Data Stated</th>
<th>(2) All Data Computed</th>
<th>(3) Restricted Stated</th>
<th>(4) Restricted Computed</th>
</tr>
</thead>
<tbody>
<tr>
<td>c=2</td>
<td>0.186*** (0.000)</td>
<td>0.193*** (0.000)</td>
<td>0.224*** (0.000)</td>
<td>0.228*** (0.000)</td>
</tr>
<tr>
<td>c=4</td>
<td>0.070*** (0.004)</td>
<td>0.073*** (0.003)</td>
<td>0.085*** (0.003)</td>
<td>0.086*** (0.003)</td>
</tr>
<tr>
<td>c=6</td>
<td>-0.037* (0.052)</td>
<td>-0.037* (0.063)</td>
<td>-0.035 (0.102)</td>
<td>-0.031 (0.154)</td>
</tr>
<tr>
<td>c=8</td>
<td>-0.109*** (0.000)</td>
<td>-0.110*** (0.000)</td>
<td>-0.110*** (0.000)</td>
<td>-0.104*** (0.000)</td>
</tr>
<tr>
<td>c risky</td>
<td>0.035* (0.058)</td>
<td>0.034* (0.070)</td>
<td>0.027 (0.190)</td>
<td>0.027 (0.197)</td>
</tr>
<tr>
<td>Period</td>
<td>-0.005*** (0.000)</td>
<td>-0.006*** (0.000)</td>
<td>-0.004** (0.019)</td>
<td>-0.005** (0.012)</td>
</tr>
<tr>
<td>−10 ≤ shock &lt; −5</td>
<td>0.001 (0.939)</td>
<td>-0.006 (0.728)</td>
<td>-0.001 (0.959)</td>
<td>-0.002 (0.913)</td>
</tr>
<tr>
<td>−5 ≤ shock &lt; 0</td>
<td>-0.035** (0.039)</td>
<td>-0.029 (0.111)</td>
<td>-0.033 (0.131)</td>
<td>-0.023 (0.320)</td>
</tr>
<tr>
<td>0 ≤ shock ≤ 5</td>
<td>0.005 (0.808)</td>
<td>-0.016 (0.397)</td>
<td>-0.010 (0.676)</td>
<td>-0.025 (0.269)</td>
</tr>
<tr>
<td>5 &lt; shock ≤ 10</td>
<td>0.070*** (0.002)</td>
<td>0.057** (0.015)</td>
<td>0.060** (0.025)</td>
<td>0.060** (0.039)</td>
</tr>
<tr>
<td>10 &lt; shock</td>
<td>0.144*** (0.000)</td>
<td>0.119*** (0.000)</td>
<td>0.128*** (0.000)</td>
<td>0.129*** (0.000)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.202*** (0.000)</td>
<td>0.216*** (0.000)</td>
<td>0.201*** (0.000)</td>
<td>0.207*** (0.000)</td>
</tr>
<tr>
<td>Observations</td>
<td>4,555</td>
<td>4,555</td>
<td>3,358</td>
<td>3,358</td>
</tr>
<tr>
<td>Number of Subject ID</td>
<td>107</td>
<td>107</td>
<td>95</td>
<td>95</td>
</tr>
</tbody>
</table>
**Results: Updating**

- Look at a period two periods after a subject bought information last time for evidence of updating.
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- Data are to a great extent consistent with Bayesian updating.
As theory predicts, demand for pricing information is increasing the cost of information, decreasing with the number of periods, and increasing with the size of a positive shock in the amount of the consumption bill. Contrary to theoretical predictions, demand for pricing information is insensitive to negative shocks in the amount of the consumption bill. In regards to updating, data are consistent with Bayesian updating.
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In regards to updating, data are consistent with Bayesian updating.