What Does a Deductible Do? The Impact of Cost-Sharing on Health Care Prices, Quantities, and Spending Dynamics

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Medical Care Price Responsiveness

- Price elasticity of demand for health care services (“moral hazard”) is a crucial input into many important policy decisions
  - Insurance menu offerings (e.g. ACA, large employer)
  - Design of payment structure within contract
  - National health system priorities / methods for cost control

Recent trends:
- 82% of employers offer HDHPs, 30% in 2015 will only offer an HDHP (up from 16% in 2014), and five year change in HDHP enrollment from 15% to 33% at employers
- Regulation of cost sharing on ACA exchanges
Our Environment

- Study health care utilization of 160,000 employees and dependents of large self-insured firm
  - Relatively high income (Median income $125,000-150,000)
  - Approx. 70% of employees in one state / location

- The firm discontinued primary health insurance option at end of 2012, forcing most employees into high-deductible plan (HDHP)
  - Shift motivated by (i) ACA Cadillac Tax (ii) Health spending trends
  - Shift from zero cost-sharing to HDHP
  - Income effect compensated for

- Use shift together with detailed data to study many aspects of consumer price responsiveness
Key Questions

Question 1: What are the effects of different marginal prices on health care spending?
  ▶ Forced HDHP switch causes 16.5% reduction in total spending for 2013 ($123 Million)
  ▶ Spending reductions from sickest quartile of consumers (ex ante)

Question 2: How do sick/well off consumers reduce spending?
  ▶ Provider price changes (+1.7%)
  ▶ Consumer price shopping (+4.3%)
  ▶ Consumer quantity reductions (-22.4%)

Question 3: Are sicker consumers responding to true expected marginal prices or spot prices (short-run)?
  ▶ Reductions from ex ante sick consumers when under deductible
  ▶ Consumers reduce under deductible spending by 27%, controlling for true end of year price
  ▶ Related work: Part D, broadband, electricity
Overview

1. Data & Environment
2. Impact on Utilization
3. Decomposition
4. Consumer Response to NL Contracts
5. Conclusion & Next Steps
Administrative Data

- Large firm with approximately 60,000 US employees (yearly) covering roughly 160,000 lives

- Detailed administrative data from both the insurer and HR department of the firm, covering the years 2009-2013
  - Insurance choices / design features
  - Demographic data
  - Health claims
  - Linked HR files (income, job description, etc.)
  - ACG medically relevant predictive metrics
  - Linked survey data for subset of consumers

- A lot of money at stake–firm’s total health care spending in 2012 over $750 million
Policy Change

From 2009-2012 the firm had two primary insurance options:

- **PPO:**
  - Broad provider network
  - *Zero employee cost-sharing*
  - 80-85% market share

- **HDHP:**
  - Same providers
  - Linked health savings account *with direct subsidy*
  - Non-linear cost-sharing contract: consumers pay 22% on average
  - 10-15% market share

The firm discontinued PPO option for 2013, effectively moving all employees enrolled in the PPO into the HDHP
  - First announcement October 2010, many subsequent
  - Handel & Kolstad (2015)
## Insurance Options

### Health Plan Characteristics

<table>
<thead>
<tr>
<th>Family Tier</th>
<th>PPO</th>
<th>HDHP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Premium</strong></td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Health Savings Account (HSA)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>HSA Subsidy</td>
<td>-</td>
<td>$3,750*</td>
</tr>
<tr>
<td>Max. HSA Contribution</td>
<td>-</td>
<td>$6,250**</td>
</tr>
<tr>
<td><strong>Deductible</strong></td>
<td>$0***</td>
<td>$3,750*</td>
</tr>
<tr>
<td>Coinsurance (IN)</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Coinsurance (OUT)</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>Out-of-Pocket Max.</td>
<td>$0***</td>
<td>$6,250*</td>
</tr>
</tbody>
</table>

* These values apply to the employee-only coverage tier. Employees with no (one) dependent have 0.4x (0.8x) the values given in this table.

**Single employees have a legal maximum contribution of $3,100. Employees over 55 can contribute an extra $1,000 in ‘catch-up’ contribution. This maximum includes the employer subsidy.

***For out-of-network spending, the PPO has a deductible of $100 per person (up to $300) and an out-of-pocket max. of $400 per person (up to $1200).
Primary Sample

- Primary sample uses employees and dependents present over entire five-year sample 2009-2013

- Includes only those who were (i) in PPO 2009-2012 (ii) in HDHP 2013

- Internal selection concerns very limited:
  - 85% in PPO in pre-period, more than 95% of expenses
  - Robustness to different pre-horizons removes duration selection
  - Limited differential attrition
  - Much of literature relies on structural assumptions to separate AS/MH

- Excludes those enrolled in HMO option (stable 4%)
### Primary Sample

<table>
<thead>
<tr>
<th></th>
<th>PPO or HDHP in 2012</th>
<th>PPO in 2012</th>
<th>Sample in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>N - Employees</td>
<td>52,445</td>
<td>44,711</td>
<td>31,293</td>
</tr>
<tr>
<td>N - Emp. &amp; Dep.</td>
<td>147,388</td>
<td>129,183</td>
<td>97,022</td>
</tr>
</tbody>
</table>

#### Age - Emp. & Dep.

<table>
<thead>
<tr>
<th></th>
<th>PPO or HDHP in 2012</th>
<th>PPO in 2012</th>
<th>Sample in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18</td>
<td>34.5%</td>
<td>35.3%</td>
<td>36.8%</td>
</tr>
<tr>
<td>18-29</td>
<td>12.3%</td>
<td>11.5%</td>
<td>9.8%</td>
</tr>
<tr>
<td>30-54</td>
<td>50.1%</td>
<td>50.1%</td>
<td>50.1%</td>
</tr>
<tr>
<td>≥ 55</td>
<td>3.1%</td>
<td>3.1%</td>
<td>3.3%</td>
</tr>
</tbody>
</table>

#### Income

<table>
<thead>
<tr>
<th>Tier</th>
<th>PPO or HDHP in 2012</th>
<th>PPO in 2012</th>
<th>Sample in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1 (&lt; $75K)</td>
<td>1.8%</td>
<td>1.8%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Tier 2 ($75K-$100K)</td>
<td>6.6%</td>
<td>6.4%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Tier 3 ($100K-$125K)</td>
<td>30.1%</td>
<td>29.8%</td>
<td>30.5%</td>
</tr>
<tr>
<td>Tier 4 ($125K-$150K)</td>
<td>34.9%</td>
<td>35.1%</td>
<td>35.3%</td>
</tr>
<tr>
<td>Tier 5 ($150K-$175K)</td>
<td>15.5%</td>
<td>15.6%</td>
<td>15.2%</td>
</tr>
<tr>
<td>Tier 6+ ($175K+)</td>
<td>11.2%</td>
<td>11.3%</td>
<td>10.8%</td>
</tr>
</tbody>
</table>

#### Family Size

<table>
<thead>
<tr>
<th></th>
<th>PPO or HDHP in 2012</th>
<th>PPO in 2012</th>
<th>Sample in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23.7%</td>
<td>21.4%</td>
<td>17.8%</td>
</tr>
<tr>
<td>2</td>
<td>19.6%</td>
<td>19.1%</td>
<td>18.3%</td>
</tr>
<tr>
<td>3+</td>
<td>56.7%</td>
<td>59.5%</td>
<td>64.0%</td>
</tr>
</tbody>
</table>

#### Individual Spending, 2012

<table>
<thead>
<tr>
<th>Percentile</th>
<th>PPO or HDHP in 2012</th>
<th>PPO in 2012</th>
<th>Sample in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>$5,020</td>
<td>$5,401</td>
<td>$5,811</td>
</tr>
<tr>
<td>25th Percentile</td>
<td>$609</td>
<td>$687</td>
<td>$722</td>
</tr>
<tr>
<td>Median</td>
<td>$1,678</td>
<td>$1,869</td>
<td>$1,978</td>
</tr>
<tr>
<td>75th Percentile</td>
<td>$4,601</td>
<td>$5,036</td>
<td>$5,219</td>
</tr>
<tr>
<td>95th Percentile</td>
<td>$18,256</td>
<td>$19,367</td>
<td>$20,201</td>
</tr>
<tr>
<td>99th Percentile</td>
<td>$49,803</td>
<td>$52,872</td>
<td>$56,624</td>
</tr>
</tbody>
</table>
Overview

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Spending Trends
19.6% drop in nominal spending, 22.9% drop in age and CPI adjusted spending

*Vertical line is for Dec 2012
Anticipatory Spending
Anticipatory intertemporal substitution of claims is apparent, even more apparent in member *median* spending.

*Vertical line is for Dec 2012*
Anticipatory Spending  
Correction for Causal Estimates

- Estimate model on months from January 2009 to December 2011:
  \[
  \bar{y}_t = \alpha + \beta t + \lambda_{\text{month}} + \bar{\epsilon}_t
  \]  

  (1)

- Measure anticipatory spending as deviation from predicted values
  \[
  (y_{\text{Nov2012}} - \hat{y}_{\text{Nov2012}}) + (y_{\text{Dec2012}} - \hat{y}_{\text{Dec2012}})
  \]  

  (2)

- Limited, insignificant excess mass in prior months
- Deviations from trend include anticipatory spending and idiosyncratic shock \( \bar{\epsilon} \)
- 95% CI for November-December 2012 'excess mass' of \([122.57,
  212.21]\), point estimate of \$167.38\)
### Treatment Effect of Policy Change

- Calculate ’treatment effect’ taking % change in mean spending between 2012 and 2013, with adjustments.
- Use treatment effect, extrapolated to whole firm, to compute % total medical savings from forced HDHP switch.

<table>
<thead>
<tr>
<th>HDHP Switch Spending Impact</th>
<th>(1)</th>
<th>(2)</th>
<th>Model</th>
<th>(3)</th>
<th>(4)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>CPI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>4372.54</td>
<td>4244.68</td>
<td>4244.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>4709.95</td>
<td>4273.05</td>
<td>4273.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>5159.41</td>
<td>4434.72</td>
<td>4434.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>5811.48</td>
<td>4764.97</td>
<td>4597.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>4671.73</td>
<td>3673.75</td>
<td>3841.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Decrease, 2012-2013</td>
<td>-19.61%</td>
<td>-22.90%</td>
<td>-16.45%</td>
<td>-20.12%</td>
<td></td>
</tr>
<tr>
<td>$ Impact (million)</td>
<td>-$147.09</td>
<td>-$171.76</td>
<td>-$123.40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Heterogeneity: Health Status

- Classify consumers into ex ante health status quartiles at beginning of each year
- Sickest consumers reduce spending by large magnitude (26%)
- Why do rich / sick consumers reduce spending?

![Graph showing spending by previous year's ACG Quartile]
## Heterogeneity: Medical Services

### Heterogeneous HDHP Spending Impact

<table>
<thead>
<tr>
<th>Group</th>
<th>Spending %</th>
<th>2012 Mean Spending</th>
<th>(1) Nominal Spending</th>
<th>(2) CPI</th>
<th>(3) Intertemp. Substitution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inpatient</td>
<td>19.20</td>
<td>1115.71</td>
<td>-0.14</td>
<td>-0.17</td>
<td>-0.09</td>
</tr>
<tr>
<td>Outpatient Hosp.</td>
<td>17.67</td>
<td>1026.84</td>
<td>-0.18</td>
<td>-0.22</td>
<td>-0.12</td>
</tr>
<tr>
<td>ER</td>
<td>2.92</td>
<td>169.41</td>
<td>-0.27</td>
<td>-0.30</td>
<td>-0.29</td>
</tr>
<tr>
<td>Office Visit</td>
<td>7.02</td>
<td>407.99</td>
<td>-0.19</td>
<td>-0.22</td>
<td>-0.17</td>
</tr>
<tr>
<td>RX</td>
<td>12.25</td>
<td>712.14</td>
<td>-0.22</td>
<td>-0.25</td>
<td>-0.22</td>
</tr>
<tr>
<td>RX-Brand</td>
<td>11.70</td>
<td>679.94</td>
<td>-0.20</td>
<td>-0.23</td>
<td>-0.20</td>
</tr>
<tr>
<td>RX-Generic</td>
<td>3.87</td>
<td>224.88</td>
<td>-0.19</td>
<td>-0.23</td>
<td>-0.21</td>
</tr>
<tr>
<td>Mental Health</td>
<td>9.02</td>
<td>524.21</td>
<td>-0.09</td>
<td>-0.13</td>
<td>-0.16</td>
</tr>
<tr>
<td>Preventive</td>
<td>8.87</td>
<td>515.32</td>
<td>-0.11</td>
<td>-0.15</td>
<td>-0.11</td>
</tr>
<tr>
<td>Other</td>
<td>23.06</td>
<td>1339.86</td>
<td>-0.31</td>
<td>-0.33</td>
<td>-0.24</td>
</tr>
</tbody>
</table>

- Relationship to income, dependants, chronic conditions
Overview

1. Data & Environment
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Prices vs. Quantities in Reduced Utilization

- Significant reduction in total utilization, especially for sick

- We analyze whether drop in utilization is from:
  - Providers reducing prices (potential equilibrium effects)
  - Price shopping by consumers
  - Quantity reductions by consumers

- Decompose different effects by holding prices or quantities constant (in the spirit of Oaxaca (1973), Blinder (1973))

- Analysis leverages detailed data on procedure-provider combinations to investigate
  - Over 15 observations in 2012 / 2013 (90% spending)

- Short-run analysis: 2014 coming as well
Provider Price Changes

- Compute mean price for provider-procedure combinations in 2012 and in 2013

- Compare the following statistics:
  - Total spending for 2012 choices at 2012 prices: $TS_{2012,2012}$
  - Total spending for 2012 choices at 2013 prices: $TS_{2013,2012}$

- Provider price changes equal:
  \[
  \frac{TS_{2013,2012} - TS_{2012,2012}}{TS_{2012,2012}}
  \]

- Not saying why prices changes happened, just that they did
The extent to which HDHPs induce price shopping is an important policy question [e.g. Lieber (2014)]

We compute this effect as follows:

\[
PS_{m,t+1,t} = \frac{P_{m,Q,t+1} \cdot C_{m,Q,t+1} - P_{m,Q,t+1} \cdot C_{m,Q,t}}{P_{m,Q,t+1} \cdot C_{m,Q,t}}
\]

\[
PS_{t+1,t} = \sum_{m=1}^{M} \frac{Y_{m,t}}{Y_t} PS_{m,t+1,t}
\]

- \( m\) is procedure, \( Q\) providers offering procedure
- First step is, for each class of procedures compare:
  - Mean provider-procedure prices for 2012 choices at 2013 prices
  - Mean provider-procedure prices for 2013 choices at 2013 prices
- Second step computes aggregate price-shopping effect across all procedures, holding procedure-specific revenue share constant
Approach nets out provider price changes and focuses on incremental sorting given 2013 prices
  ➤ If prices re-order over time, will bias coefficient towards more price shopping

Our approach is *conditional on procedure*

Could also do *conditional on episode of illness*

**Example:** in our case, substitution to different procedures, that are lower price, enters through quantity impact

With episode of illness, procedure substitution in price shopping

E.g. Surgery vs. management, brand vs. generic
Quantity Reductions

- We compute % decrease from quantity reductions as remainder of total effect taking out other two mechanisms

- Compute year to year % change in total spending as:

\[
\Delta TS_{t+1,t} = \frac{P_{t+1} \cdot C_{t+1} - P_t \cdot C_t}{P_t \cdot C_t}
\]

- Effect of quantity reduction:

\[
QE_{t+1,t} = \Delta TS_{t+1,t} - PPI_{t+1,t} - PS_{t+1,t}
\]

- Remember: this incorporates procedure substitution

- Also compute directly, with very similar results
Results Decomposition

- Change for 2013 is large departure from trend of increasing health expenditures, and increasing service quantities.

```
<table>
<thead>
<tr>
<th>Total Spending Change Decomposition</th>
<th>( \Delta TS_{t+1,t} )</th>
<th>( PPI_{t+1,t} )</th>
<th>( PS_{t+1,t} )</th>
<th>( QE_{t+1,t} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010</td>
<td>11.3%</td>
<td>3.7%</td>
<td>-0.8%</td>
<td>8.4%</td>
</tr>
<tr>
<td>2010-2011</td>
<td>11.9%</td>
<td>3.5%</td>
<td>2.2%</td>
<td>6.2%</td>
</tr>
<tr>
<td>2011-2012</td>
<td>10.2%</td>
<td>0.4%</td>
<td>0.0%</td>
<td>9.8%</td>
</tr>
<tr>
<td>2012-2013</td>
<td>-16.4%</td>
<td>1.7%</td>
<td>4.3%</td>
<td>-22.4%</td>
</tr>
</tbody>
</table>
```

- Also, for new employees (approx. 2,000):
  - Quantity reduction of 22.3%
  - Price index rises by 2.7%
  - Price shopping gives 1.7% higher spend
Surprising that sick and high income consumers reduce spending by quite a bit, and that all of reduction from reduced service quantities

### Specific Effects
#### Spending Decomposition

<table>
<thead>
<tr>
<th>% Tot. Spend</th>
<th>ΔTS$_{t+1,t}$</th>
<th>PPI$_{t+1,t}$</th>
<th>PS$_{t+1,t}$</th>
<th>QE$_{t+1,t}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sickest Quartile</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009-2010</td>
<td>52.1%</td>
<td>18.4%</td>
<td>3.9%</td>
<td>-1.4%</td>
</tr>
<tr>
<td>2010-2011</td>
<td>57.3%</td>
<td>25.1%</td>
<td>4.0%</td>
<td>1.1%</td>
</tr>
<tr>
<td>2011-2012</td>
<td>54.7%</td>
<td>-7.2%</td>
<td>-0.5%</td>
<td>-1.1%</td>
</tr>
<tr>
<td>2012-2013</td>
<td>47.3%</td>
<td>-23.1%</td>
<td>0.6%</td>
<td>5.1%</td>
</tr>
</tbody>
</table>
Decomposition: Imaging Services

Imaging services (e.g. MRIs / CT scans) thought to be one source of ‘moral hazard’

### Specific Effects

#### Spending Decomposition

<table>
<thead>
<tr>
<th></th>
<th>% Tot. Spend</th>
<th>$\Delta TS_{t+1,t}$</th>
<th>$PPI_{t+1,t}$</th>
<th>$PS_{t+1,t}$</th>
<th>$QE_{t+1,t}$</th>
</tr>
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<tbody>
<tr>
<td><strong>Imaging</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009-2010</td>
<td>10.5%</td>
<td>9.3%</td>
<td>5.8%</td>
<td>1.5%</td>
<td>2.0%</td>
</tr>
<tr>
<td>2010-2011</td>
<td>9.9%</td>
<td>6.2%</td>
<td>4.1%</td>
<td>-1.1%</td>
<td>3.2%</td>
</tr>
<tr>
<td>2011-2012</td>
<td>10.5%</td>
<td>12.0%</td>
<td>0.7%</td>
<td>1.7%</td>
<td>9.6%</td>
</tr>
<tr>
<td>2012-2013</td>
<td>11.5%</td>
<td>-20.6%</td>
<td>0.1%</td>
<td>0.9%</td>
<td>-21.6%</td>
</tr>
<tr>
<td><strong>Preventive Always</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009-2010</td>
<td>7.0%</td>
<td>5.9%</td>
<td>3.5%</td>
<td>-1.6%</td>
<td>4.0%</td>
</tr>
<tr>
<td>2010-2011</td>
<td>7.3%</td>
<td>5.0%</td>
<td>-1.8%</td>
<td>8.2%</td>
<td>-1.4%</td>
</tr>
<tr>
<td>2011-2012</td>
<td>7.5%</td>
<td>1.4%</td>
<td>6.7%</td>
<td>-2.6%</td>
<td>-2.7%</td>
</tr>
<tr>
<td>2012-2013</td>
<td>8.7%</td>
<td>-3.0%</td>
<td>8.6%</td>
<td>4.4%</td>
<td>-16.0%</td>
</tr>
</tbody>
</table>
Decomposition: Top 30 Procedures

- Reproduce decomposition analysis for:
  - 30 top procedures by revenue
  - 30 top procedures by count

- Substantial difference in changes for 2013 for these top 30 procedures, relative to earlier years

### Total Spending Change Decomposition

<table>
<thead>
<tr>
<th>High Spend Procedures</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>% Total Spend</th>
<th>$\Delta TS_{t+1,t}$</th>
<th>$PPI_{t+1,t}$</th>
<th>$PS_{t+1,t}$</th>
<th>$QE_{t+1,t}$</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>No. top 30 w/ Positive Value</th>
</tr>
</thead>
</table>

| 2010-2011 | - | 26 | 23 | 15 | 22 |
| 2011-2012 | - | 24 | 19 | 17 | 23 |
| 2012-2013 | - | 4  | 13 | 17 | 7  |
Overview

1. Data & Environment
2. Impact on Utilization
3. Decomposition
4. Consumer Response to NL Contracts
5. Conclusion & Next Steps
Consumer Responses to Non-Linear Contracts

Switching to the HDHP not only increases prices, but forces employees to respond to multi-part non-linear contract

Non-linear contracts are more complicated than typical price (e.g. Aaron-dine, et al., 2013). Are consumers responding to:
- Marginal price (expected EOY)
- Spot price
- Average price

<table>
<thead>
<tr>
<th>Coverage Tier</th>
<th>Avg. HDHP Price</th>
<th>% Under Deductible</th>
<th>% Over Ded., Under OOP Max.</th>
<th>% Over OOP Max.</th>
<th>Actuarial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Dependents</td>
<td>0.428</td>
<td>37.92%</td>
<td>49.16%</td>
<td>12.92%</td>
<td>78.31%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(&lt; $1,500)</td>
<td>($1,500 - $11,500)</td>
<td>(&gt; $11,500)</td>
<td></td>
</tr>
<tr>
<td>1 Dependent</td>
<td>0.293</td>
<td>23.22%</td>
<td>61.08%</td>
<td>15.70%</td>
<td>76.59%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(&lt; $3,000)</td>
<td>($3,000 - $23,000)</td>
<td>(&gt; $23,000)</td>
<td></td>
</tr>
<tr>
<td>2+ Dependents</td>
<td>0.201</td>
<td>13.30%</td>
<td>68.40%</td>
<td>18.30%</td>
<td>78.24%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(&lt; $3,750)</td>
<td>($3,750 - $28,750)</td>
<td>(&gt; $28,750)</td>
<td></td>
</tr>
<tr>
<td>All Tiers</td>
<td>0.249</td>
<td>18.42%</td>
<td>64.46%</td>
<td>17.12%</td>
<td>78.05%</td>
</tr>
</tbody>
</table>
Advantage of Our Setting

- Our setting is uniquely well-suited to answer this question:
  - Same large population of consumers over five years
  - First four years in free plan, last in non-linear contract

- **Key assumption:** Constant population health

\[ F_{2013}[s_t|H, X] = F_{2011}[s_t|H, X], \forall t = 1, \ldots, 12 \]

- \( H \) is ex ante health status, \( X \) is demographics, \( s_t \) is health status for month \( t \)

- **Key Feature:** Dynamics in health status from lower spending bias against incremental spending reductions for low spending consumers
  - Will bring in 2014 data to assess longer run
Approach

- Mapping from H to monthly spending at each point in time:
  \[ G[M_{t+1} - M_t|s_t, H, X, Ins_t] \]

- \( Ins_t \) can be decomposed into non-linear contract prices

- We observe everything except for \( s_t \)

- Consider distribution of incremental spending, based on observables, at date \( t \) for duration \( x \):
  \[ G(M_{t+x} - M_t|H, X, Ins_t) \]

- For any \((H, X)\), look at incremental behavior for people in given position in contract in month \( t \), and compare to incremental spending of associated quantiles in 2011
Prices
Spot vs. Marginal vs. Average

- Reduce contract position conditional on (H,X) to three prices
- Spot price $P^s_t$: Either 1, 0.1, or 0 depending on NLC arm
- Expected EOY price $P^e_t$: $E_t[P^s_t|M_{t-1}, H, X, Ins_t]$
- Average price $P^a_t$: Ex ante expectation of expected price at beginning of year, conditional on $(H, X)$
- Other things coming......
Expected EOY Marginal Price

- Use minimal assumptions to get expected EOY marginal price
  - Rational expectations is benchmark, in essence testing this

- **Step 1:** For each individual $i$ and each point in time $t$ define cell by triple $(H, X, M_{t-1})$

- **Step 2:** Form non-parametric distribution of EOY spending
  
  $f_i(M_{i,T} | H, X, M_{i,t-1})$

- **Step 3:** Combine individual distributions within family:

  $f_{J(i)}(M_T) = \sum_{M_{i,t}=M_T} \prod_i ^{J(i)} f_i(M_T)$ \hspace{1cm} (4)

- **Step 4:** Form expected EOY marginal price:

  $P_{j,t}^e = \int_{R_+^{J(i)}} P_{J(i)}^s (M_T) dF_{J(i)}(M_t)$
Incremental Spending Above OOP Max

Good test of average vs. combined margin and spot price

Charts for families
Very large and meaningful decrease in ROY spending, suggestive of dynamic effects of economizing now and then being under deductible later
Incremental Spending: Deductible Region
Spot vs. Expected EOY Price

- Average expected EOY marginal price in February is 0.09
- Average expected EOY marginal price in March is 0.10
Incremental Spending: Deductible Region
Spot vs. Expected EOY Price

Drop in ROY spending of approximately 20%, despite fact that they are very likely to spend a lot!
Contribution to ROY Spending Changes by Contract Arm

- Primary reduction due to individuals under the deductible, particularly early in the year.
NLC Analysis: Regressions Analysis

- Regressions that decompose effects of three potentially different prices that consumer respond to:

  \[ \log(Y_{i,t}) = \alpha_{2013} I_{2013} + \alpha_t I_t + [\theta_s P_{i,t}^s + \theta_e P_{i,t}^e] I_{2013} + 
  [\beta_s P_{i,t}^s + \beta_e P_{i,t}^e] + \gamma_h H_i + \gamma_x X_i + \gamma_L \log(Y_{i,t-1}) + \epsilon_{i,t} \]

- \( Y_{i,t} \): Log total incremental spending for next month

- Independent variables: Prices faced at beginning of month, health status, demographics, spending to date / recent spending

- Construct counterfactual prices for 2011 consumers to control for history dependent unobserved heterogeneity

- Current specification *for July only*. Coming:
  - Pooled regression over all months
  - ROY spending
### Impact of Specific Pricing Components

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Includes all Controls</th>
<th>(2) Excludes Previous Spending Controls</th>
<th>(3) Excludes Health Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>0.0562</td>
<td>0.0183</td>
<td>0.0434</td>
</tr>
<tr>
<td></td>
<td>(0.0936)</td>
<td>(0.0962)</td>
<td>(0.0966)</td>
</tr>
<tr>
<td>(Spot MP = 1) x 2013</td>
<td>-0.266**</td>
<td>-0.333**</td>
<td>-0.251*</td>
</tr>
<tr>
<td></td>
<td>(0.136)</td>
<td>(0.140)</td>
<td>(0.141)</td>
</tr>
<tr>
<td>(Spot MP = 0.1) x 2013</td>
<td>-0.137</td>
<td>-0.174</td>
<td>-0.148</td>
</tr>
<tr>
<td></td>
<td>(0.104)</td>
<td>(0.107)</td>
<td>(0.107)</td>
</tr>
<tr>
<td>2nd quantile E[EOY MP] x 2013</td>
<td>-0.113*</td>
<td>-0.167**</td>
<td>-0.169**</td>
</tr>
<tr>
<td></td>
<td>(0.0644)</td>
<td>(0.0661)</td>
<td>(0.0664)</td>
</tr>
<tr>
<td>3rd quantile E[EOY MP] x 2013</td>
<td>-0.104</td>
<td>-0.140</td>
<td>-0.195**</td>
</tr>
<tr>
<td></td>
<td>(0.0902)</td>
<td>(0.0926)</td>
<td>(0.0930)</td>
</tr>
<tr>
<td>4th quantile E[EOY MP] x 2013</td>
<td>-0.0568</td>
<td>-0.149</td>
<td>-0.196*</td>
</tr>
<tr>
<td></td>
<td>(0.110)</td>
<td>(0.113)</td>
<td>(0.113)</td>
</tr>
<tr>
<td>Top quantile E[EOY MP] x 2013</td>
<td>0.0220</td>
<td>-0.00252</td>
<td>-0.0511</td>
</tr>
<tr>
<td></td>
<td>(0.110)</td>
<td>(0.113)</td>
<td>(0.114)</td>
</tr>
<tr>
<td>Log Spending Last Month</td>
<td>0.170***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.00568)</td>
<td>(0.00686)</td>
<td>(0.00686)</td>
</tr>
<tr>
<td>Log Spending 2 Mths. Ago</td>
<td>0.123***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.00686)</td>
<td>(0.00686)</td>
<td>(0.00686)</td>
</tr>
<tr>
<td>Observations</td>
<td>60,407</td>
<td>60,408</td>
<td>60,408</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.368</td>
<td>0.333</td>
<td>0.326</td>
</tr>
</tbody>
</table>

Standard errors in parentheses  
*** p<0.01, ** p<0.05, * p<0.1

- Other controls have intuitive / predictive power / signs  
- Clear emphasis on spot prices
Overview

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Conclusion

- Overall causal impact of HDHP equal to 16.45% reduction in spending, off spending base of $750 Million
  - Important to account for anticipatory spending
  - Meaningful spending drop for for high income, compensated pop.
  - Sickest consumers reduce spending by over 20%

- Decomposition into quantity effects vs. price shopping
  - Large quantity implications, with potentially meaningful implications for welfare
  - Limited to no price shopping effect in short run (2014 coming)
  - Sickest consumers substantially reduce quantities

- Consumers substantially reduce spending when under deductible (30%), somewhat when in coinsurance arm, not at all above OOPMax
  - Sick consumers reduce spending a lot under deductible, even when expected EOY price is low!!
Next Steps

- Optimal menu design depending on:
  - Consumer price response heterogeneity
  - Heterogeneity in medical services responses
  - Dynamic responses to non-linear contracts
  - Leverage machine learning algorithms

- Welfare à la Baicker et al. (2015):
  - Informed consumers vs. uninformed consumers
  - Rational price responses
  - Categorization of services

- Mechanism underlying dynamic responses
  - Beliefs about health risk
  - Knowledge of contract
  - Myopia
  - Learning

- Long-term price shopping and offsets