Patient Cost-Sharing and Healthcare Utilization in Early Childhood: Evidence from a Regression Discontinuity Design

UBC
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Motivation

- Several recent studies suggested health conditions and medical treatments in early childhood have a positive impact on health and labour outcomes in adulthood
  - Bharadwaj et al. (2013)
  - Almond et al. (2011)
  - Currie (2009)
  - Almond (2006)

- Young children also bring about sizeable medical expenses to their parents since they are vulnerable to diseases
In light of that, some countries have subsidized medical care for young children by reducing cost-sharing

- United States: Having lower Medicaid eligibility requirement for young children (aged less than 6)
- Japan: reducing the copayment for young children (aged less than 6) by 50%
- South Korea: exempting copayment of inpatient care for the young children (aged less than 6)
- Taiwan: exempting the copayment of medical services for young children (aged less than 3)
To evaluate the effectiveness of these subsidy policies, understanding how young children’s healthcare demand respond to patient cost sharing is essential.

The existing literature has very little knowledge about the price elasticity of healthcare demand for young children.

Most estimates of price elasticity mainly focus on adult’s and the elderly’s healthcare demands.

- Shigeoka (2014)
- Chandra et al. (2014)
- Chandra et al. (2010)
- Rice and Matsuoka (2004)
- Selby et al. (1996)
- Cherkin et al. (1989)
We exploit a sharp increase in patient cost-sharing at the 3rd birthday in Taiwan that results from young children aging out of the cost sharing subsidy.

On average, turning age three leads to an increase in patient’s out-of-pocket cost per outpatient visit by more than 100% (from 59 to 123 NTD).

Patient’s out-of-pocket cost per inpatient admission dramatically rises from zero to 1300 NTD (40 USD).
This Paper

- Average out-of-pocket cost per outpatient visit at given age
This Paper

- Average out-of-pocket cost per inpatient admission at given age
The change in patient’s out-of-pocket cost at the 3rd birthday allows us to use a regression discontinuity design (RDD).

We examine the causal effect of patient cost sharing on young children's healthcare demand by comparing their healthcare use just before and after the 3rd birthday.
This Paper

- The number of outpatient visits per 10,000 children at given age
This Paper

- The number of inpatient admissions per 10,000 children at given age
Policy Background
Patient Cost Sharing: Outpatient care

Patient Cost Sharing for outpatient care:

1. Fixed copayment and registration fee
2. Its amount varies with respect to types of providers
3. In general, a better provider charges a higher copayment and registration fee
Policy Background

Patient Cost Sharing: Outpatient care

Table 1: Patient Cost-Sharing in Taiwan NHI

<table>
<thead>
<tr>
<th></th>
<th>Major Teaching Hospital</th>
<th>Minor Teaching Hospital</th>
<th>Community Hospital</th>
<th>Clinic</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHI copayment</td>
<td>360</td>
<td>240</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>Average register Fee</td>
<td>150</td>
<td>100</td>
<td>100</td>
<td>50</td>
</tr>
</tbody>
</table>

Panel A:
Outpatient service: copayment (NT$)

Panel B:
Inpatient service: coinsurance

<table>
<thead>
<tr>
<th></th>
<th>1-30 days</th>
<th>31-60 days</th>
<th>after 61 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td></td>
</tr>
</tbody>
</table>
Policy Background
Patient Cost Sharing: Outpatient care

- Patients in Taiwan (or other Asian countries) have no restriction on the choice of their healthcare providers.

- This design tries to guide patients to choose their healthcare providers based on the severity of an illness.

- The differential copayment across healthcare providers makes patients pay much larger share of medical costs when they visit better providers for non-serious diseases (e.g., cold).

- Curing a cold:
  - Major teaching hospital: pay 90% of total medical costs
  - Clinic: pay 25% of total medical costs

- NHI uses differential copayment to reduce unnecessary visits to teaching hospitals.
Policy Background
Patient Cost Sharing: Inpatient care

- Patient Cost Sharing for inpatient care:
  1. Fixed coinsurance rate
  2. The coinsurance rate depends on the length of stay, but not the types of health providers
  3. NHI has a annual maximum out-of-pocket cost (stop-loss) for inpatient admissions (52,000 NTD in 2012)
- No deductibles for NHI
Policy Background

Patient Cost Sharing: Inpatient care

Table 1: Patient Cost-Sharing in Taiwan NHI

<table>
<thead>
<tr>
<th>Panel A:</th>
<th>Patient Cost-Sharing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Major Teaching Hospital</td>
</tr>
<tr>
<td>Outpatient service: copayment (NT$)</td>
<td></td>
</tr>
<tr>
<td>NHI copayment</td>
<td>360</td>
</tr>
<tr>
<td>Average register Fee</td>
<td>150</td>
</tr>
</tbody>
</table>

Panel B:

Inpatient service: coinsurance

- 1-30 days: 10%
- 31-60 days: 20%
- after 61 days: 30%
In March 2002, the Taiwan Children Medical Subsidy Program (TWCMS) was implemented.

TWCMS each year spent NTD 1.8 billion for children under age 3 on cost sharing.

- It exempts NHI copayment for outpatient and emergency care (but not the registration fee).
- It exempts coinsurance rate for inpatient care.

A child is no longer eligible for this subsidy program once reaching his/her 3rd birthday.
Data

- We use claims data from Taiwan’s National Health Insurance Database (NHID)
  - NHI is compulsory so NHID covers all individuals in Taiwan
  - Detailed information about cost-sharing, health care use and medical expenditure
  - It records the exact date of outpatient visits, inpatient admissions, and children’s birthdays
- We can precisely measure children’s age (in days) to determine whether they are eligible for cost sharing subsidy
Sample

- Our sample restricts to children born between 2003 and 2004
- We track their health care use from the first day after 2nd birthday to the 4th birthday (2*365 days)
- We use NHID data between 2005 and 2008
- The final sample size is 410,517 children
Empirical Specification

- We estimate the following local linear regression:

  \[ Y_a = \beta_0 + \beta_1 \text{Age3} + \gamma_1 (a - 1096) + \gamma_2 \text{Age3}(a - 1096) + \varepsilon_a \]

- \( Y_a \) is the outcome of interest for the children at given age \( a \) (measured in days)
  - total expenditure on outpatient or inpatient care
  - total number of outpatient visits or inpatient admissions
  - expenditure per outpatient visit or inpatient admission

- \( \text{Age3} \) is an indicator equaling to one if age \( a \) is after 3rd birthday

- Bandwidth is 90 days before and after 3rd birthday

- \( \beta_1 \) represents the effect of 3rd birthday on children’s healthcare expenditure and use
### Table 5: Change at 3rd birthday in Outpatient Expenditure and Visits: before and after reform

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(1) Nonparametric Local linear</td>
<td>(2) Parametric Cubic spline</td>
</tr>
<tr>
<td>Visits rate at age 2 (per 10,000 person-years)</td>
<td>542</td>
<td>568</td>
</tr>
<tr>
<td>Bandwidth (days)</td>
<td>90</td>
<td>365</td>
</tr>
<tr>
<td><strong>Panel A:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(outpatient expenses)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 3rd birthday (X100)</td>
<td>-6.90***</td>
<td>-6.99***</td>
</tr>
<tr>
<td></td>
<td>[0.49]</td>
<td>[0.46]</td>
</tr>
<tr>
<td><strong>Panel B:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(number of visits)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 3rd birthday (X100)</td>
<td>-4.73**</td>
<td>-4.77**</td>
</tr>
<tr>
<td></td>
<td>[0.31]</td>
<td>[0.32]</td>
</tr>
<tr>
<td><strong>Panel C:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(outpatient expenses per visit)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 3rd birthday (X100)</td>
<td>-2.17**</td>
<td>-2.22**</td>
</tr>
<tr>
<td></td>
<td>[0.29]</td>
<td>[0.27]</td>
</tr>
</tbody>
</table>
Outpatient Visits and Expenditures

Summarized Results

- Our main result indicates that higher patient cost-sharing at the 3rd birthday causes overall outpatient expenditures to significantly decrease by 6.9%.

- The implied arc-elasticity of outpatient expenditure is around -0.1.

- The change in total outpatient expenditure comes from two margins:
  
  1. The number of visits (extensive margin) significantly decreases by 4.7% at the 3rd birthday.

  2. The outpatient expenditure per visit (intensive margin) significantly decreases by 2.2% at the 3rd birthday.
Outpatient Visits and Expenditures
Graphical Analysis

(a) Outpatient expenses per 10,000 person-years: 2005-2008
(b) Outpatient expenses per 10,000 person-years: 1997-2001
Outpatient Visits and Expenditures
Graphical Analysis

(c) Outpatient visits per 10,000 person-years: 2005-2008
(d) Outpatient visits per 10,000 person-years: 1997-2001
Outpatient Visits and Expenditures

Graphical Analysis

(e) Outpatient expenses per visit: 2005-2008

(f) Outpatient expenses per visit: 1997-2001
Outpatient Visits and Expenditures
By Healthcare Providers

- TWCMS exempts all NHI copayment of outpatient visit for children under age 3

- It gives us an unique opportunity to examine the impact of differential copayment on patient’s choice of providers and allocation of medical resource

- NHI copayments for teaching hospitals are much higher than community hospitals/clinics

- Turning age 3 leads larger increase in patient cost sharing for the visits to teaching hospitals
Outpatient Visits and Expenditures
By Healthcare Providers

(a) Major Teaching Hospital

(b) Minor Teaching Hospital

(c) Community Hospital

(d) Clinic
# Outpatient Visits and Expenditures

By Healthcare Providers

<table>
<thead>
<tr>
<th>Providers</th>
<th>(1) Major teaching hospital</th>
<th>(2) Minor teaching hospital</th>
<th>(3) Community hospital</th>
<th>(4) Clinic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visits rate at age 2 (per 10,000 person-years)</td>
<td>22</td>
<td>30</td>
<td>20</td>
<td>469</td>
</tr>
</tbody>
</table>

**Panel A:**

<table>
<thead>
<tr>
<th><strong>Log(number of visits)</strong></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>After 3rd birthday (X100)</td>
<td>-59.29***</td>
<td>-43.89***</td>
<td>17.71***</td>
<td>-1.73***</td>
</tr>
<tr>
<td></td>
<td>[1.96]</td>
<td>[1.65]</td>
<td>[1.64]</td>
<td>[0.32]</td>
</tr>
</tbody>
</table>

**Panel B:**

<table>
<thead>
<tr>
<th><strong>Log(outpatient expense per visit)</strong></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>After 3rd birthday (X100)</td>
<td>19.85***</td>
<td>5.76***</td>
<td>0.05</td>
<td>-0.19*</td>
</tr>
<tr>
<td></td>
<td>[2.24]</td>
<td>[1.77]</td>
<td>[1.67]</td>
<td>[0.10]</td>
</tr>
</tbody>
</table>
Outpatient Visits and Expenditures
By Healthcare Providers

- Turning age 3 substantially reduces outpatient visits to major and minor teaching hospitals by 59% and 44%, respectively.

- But outpatient visits to community hospitals increases by 18% and caseloads of clinics decrease slightly by 1.7%.

- The results reveal that patients can switch their providers easily.

- Most of the reduced visits to teaching hospitals at the 3rd birthday are actually for less severe diseases.

- Turning age 3 substantially increase medical cost per visit for major and minor teaching hospitals by 20% and 6%, respectively.
Inpatient Admissions and Expenditures

Regression Results

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>Nonparametric</td>
<td>Parametric</td>
</tr>
<tr>
<td></td>
<td>Local linear</td>
<td>Cubic spline</td>
</tr>
<tr>
<td>Visits rate at age 2</td>
<td>3.9</td>
<td>2.5</td>
</tr>
<tr>
<td>(per 10,000 person-years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bandwidth (days)</td>
<td>90</td>
<td>365</td>
</tr>
<tr>
<td>Panel A:</td>
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<tr>
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</tr>
<tr>
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<td>-0.89</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>[4.85]</td>
<td>[4.31]</td>
</tr>
<tr>
<td>Panel B:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(number of admission)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 3rd birthday (X100)</td>
<td>-0.18</td>
<td>-1.26</td>
</tr>
<tr>
<td></td>
<td>[2.82]</td>
<td>[2.56]</td>
</tr>
<tr>
<td>Panel C:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(inpatient expense per admission)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 3rd birthday (X100)</td>
<td>-0.71</td>
<td>1.72</td>
</tr>
<tr>
<td></td>
<td>[3.49]</td>
<td>[3.21]</td>
</tr>
</tbody>
</table>
Inpatient Admissions and Expenditures
Summarized Results

- Turning age 3 (losing cost sharing subsidy) reduces the total inpatient expenditure by 0.89% insignificantly
- The implied arc elasticity of inpatient expenditure is close to 0
- Most admissions for young children could be treated with bed rest and medication
- Previous studies (Card et al., 2008; Shigeoka, 2014) found these types of admissions are not price sensitive
Inpatient Admissions and Expenditures

Graphical Analysis

(a) Inpatient expenses per 10,000 person-years: 2005-2008

(b) Inpatient expenses per 10,000 person-years: 1997-2001
Inpatient Admissions and Expenditures

Graphical Analysis

(c) Inpatient admissions per 10,000 person-years: 2005-2008

(d) Inpatient admissions per 10,000 person years: 1997-2001
Inpatient Admissions and Expenditures

Graphical Analysis

(e) Inpatient expenses per admission: 2005-2008

(f) Inpatient expenses per admission: 1997-2001
Conclusion

- Many developed countries subsidize young children’s healthcare by providing this demographic group relatively low patient cost sharing in their public insurance programs.

- Yet the existing literature is very little known about how young children’s healthcare demand respond to patient cost sharing.

- We provide the convincing evidence on the price response of healthcare for young children by exploiting a sharp increase in patient cost-sharing at age 3 in Taiwan.
Conclusion

- Our results show:
  - The price elasticity for outpatient expenditure is about -0.1
  - Differential copayment for outpatient care in Taiwan reduces
    the visits to teaching hospitals by 50% and most of reduced
    visits are for less serious illness
  - The price elasticity for inpatient expenditure is very small,
    almost zero
  - Providing full insurance coverage of young children’s inpatient
    care should be welfare improving
  - Since it will not cause overuse of inpatient care but
    substantially reduce financial risk brought by inpatient
    admissions
Table 3:
SELECTED CHARACTERISTICS AT AGE THREE BEFORE AND AFTER SAMPLE SELECTION

<table>
<thead>
<tr>
<th></th>
<th>(1) Original Sample</th>
<th>(2) Continuous enrollment at age two and three</th>
<th>(3) Eliminating cost-sharing waiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.525</td>
<td>0.525</td>
<td>0.524</td>
</tr>
<tr>
<td>Birith year: 2003</td>
<td>0.510</td>
<td>0.509</td>
<td>0.509</td>
</tr>
<tr>
<td>Birith year: 2004</td>
<td>0.490</td>
<td>0.491</td>
<td>0.491</td>
</tr>
<tr>
<td>1st birth</td>
<td>0.519</td>
<td>0.520</td>
<td>0.520</td>
</tr>
<tr>
<td>2nd birth</td>
<td>0.368</td>
<td>0.370</td>
<td>0.370</td>
</tr>
<tr>
<td>3rd birth (above)</td>
<td>0.113</td>
<td>0.112</td>
<td>0.110</td>
</tr>
<tr>
<td>Number of siblings</td>
<td>1.761 (0.671)</td>
<td>1.760 (0.671)</td>
<td>1.759 (0.669)</td>
</tr>
<tr>
<td>Number of children</td>
<td>435,206</td>
<td>426,587</td>
<td>410,517</td>
</tr>
</tbody>
</table>
Results
Robustness Check

- Parents might anticipate the sharp increase in medical price after children’s 3rd birthday

- So children might visit doctors more in face of the ending of subsidy program

- We indeed find outpatient expenditures and visits suddenly rise at 20 days before the 3rd birthday

- Following Barreca et al (2011) and Shigeoka (2014), we conduct donut-type RDD by systematically excluding the outpatient expenditures and visits within 3-21 days before/after 3rd birthday
## Results

### Robustness Check

<table>
<thead>
<tr>
<th>Size of Donut around 3rd birthday</th>
<th>Log(outpatient expenditure)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
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<td>-4.73***</td>
</tr>
<tr>
<td></td>
<td>[0.38]</td>
</tr>
</tbody>
</table>