Motivation

▶ What determines demand and prices in the housing market?
  ▶ Recent debate about the origins of the current financial crisis

▶ Academic work has considered the impact of the cost of homeownership
  ▶ Real interest rates and other credit market conditions:
    Mian & Sufi 2009; Glaeser et al. 2010; Adelino et al. 2012
  ▶ Tax subsidies to housing:
    Poterba 1984, 1992; Rosen 1985; Poterba & Sinai 2008

▶ A policy that has been largely overlooked by academics
  ▶ **Transaction taxes** on the buying and selling of property
Context and Methodological Advantages

- UK property transaction tax: Stamp Duty Land Tax (SDLT)

- Large administrative dataset:
  - Universe of stamp duty tax returns in the UK from 2004-2012 (about 10 million property transactions)

- Quasi-experimental variation:
  - Tax schedule produces large price notches (discrete jumps in tax liability at cutoff prices)
  - Anticipated tax changes create time notches (discrete jumps in tax liability at cutoff dates)
  - Permanent reforms and stimulus programs affect houses in specific price ranges
More Literature

- Property transaction taxes (Besley et al. 2011; Slemrod et al. 2012; Kopczuk & Munroe 2013)

- Taxation of capital gains (Feldstein et al. 1980) and housing capital gains (Cunningham & Engelhardt 2008; Shan 2011)

- Micro studies of stimulus policy (Johnson et al. 2006; Agarwal et al. 2007; Mian & Sufi 2012)

- Taxable income literature and bunching approaches (Saez 2010; Chetty et al. 2011; Kleven & Waseem 2013)
Outline

Introduction

Stamp Duty Land Tax

Data

Results
  Static Notches: House Price Responses
  Moving Notches: Dynamics of House Price Responses
  Stimulus: Timing and Extensive Margin Effects

Conclusions
Outline

Introduction

Stamp Duty Land Tax

Data

Results
  Static Notches: House Price Responses
  Moving Notches: Dynamics of House Price Responses
  Stimulus: Timing and Extensive Margin Effects

Conclusions
UK Stamp Duty: Notches

- Tax on the total sale price of property; remitted by the buyer

<table>
<thead>
<tr>
<th>Price</th>
<th>Tax Liability</th>
</tr>
</thead>
<tbody>
<tr>
<td>£125K</td>
<td>0%</td>
</tr>
<tr>
<td>£250K</td>
<td>1%</td>
</tr>
<tr>
<td>£500K</td>
<td>3%</td>
</tr>
<tr>
<td>£1,000K</td>
<td>4%</td>
</tr>
<tr>
<td>£2,000K</td>
<td>5%</td>
</tr>
</tbody>
</table>

\[ \Delta T = \text{£1,250} \]
\[ \Delta T = \text{£5,000} \]
\[ \Delta T = \text{£5,000} \]
\[ \Delta T = \text{£10,000} \]
\[ \Delta T = \text{£40,000} \]

Tax Schedule in
Tax Year 2012-2013
## UK Stamp Duty: Reforms & Stimulus

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - £60K</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>£60K - £120K</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>£120K - £125K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>£125K - £175K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>£175K - £250K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>£250K - £500K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>£500K - £1000K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>£1000K - £2000K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>£2000K - ∞</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### UK Stamp Duty: Reforms & Stimulus

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>£0 - £60K</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>£60K - £120K</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>£120K - £125K</td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>£125K - £175K</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>£175K - £250K</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>£250K - £500K</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>£500K - £1000K</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>£1000K - £2000K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>£2000K - ∞</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

**Stimulus: Stamp Duty Holiday 3 Sep 2008 - 31 Dec 2009**

- First notch moved temporarily from £125K to £175K, eliminating taxes in a 50K range
- Beginning of holiday was unanticipated
- End of holiday was anticipated (time notch at New Year 2010)
Outline

Introduction

Stamp Duty Land Tax

Data

Results
  Static Notches: House Price Responses
  Moving Notches: Dynamics of House Price Responses
  Stimulus: Timing and Extensive Margin Effects

Conclusions
Data

- First-time access to administrative stamp duty records from Her Majesty’s Revenue and Customs (HMRC)

- Universe of stamp duty land tax returns (≈ all transactions) in the UK from 2004-2012

- About 10 million transactions

- Rich tax return information; no information outside the return
## Data Spanning the Collapse of the Housing Market

![Graph showing normalised number of transactions over time in London and UK](image)

<table>
<thead>
<tr>
<th>Month</th>
<th>London</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005m1</td>
<td>1.4</td>
<td>1.0</td>
</tr>
<tr>
<td>2006m1</td>
<td>1.2</td>
<td>0.8</td>
</tr>
<tr>
<td>2007m1</td>
<td>1.0</td>
<td>0.6</td>
</tr>
<tr>
<td>2008m1</td>
<td>0.8</td>
<td>0.4</td>
</tr>
<tr>
<td>2009m1</td>
<td>0.6</td>
<td>0.2</td>
</tr>
<tr>
<td>2010m1</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>2011m1</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>2012m1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2013m1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### Results

- The graph shows a significant decline in normalised number of transactions in both London and the UK, with London showing a more pronounced decrease.
- The data suggests a robust recovery post-2010 in both areas, with London recovering faster than the UK.

### Conclusions

- The housing market collapse had a profound impact on both London and the UK, with transactions significantly reduced.
- The recovery phase post-crisis highlights the resilience of the housing sector in both regions.
Prices Have Recovered in London, But Not the UK Overall

<table>
<thead>
<tr>
<th>Month</th>
<th>London</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005m1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006m1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007m1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008m1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009m1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010m1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011m1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012m1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013m1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Outline

Introduction

Stamp Duty Land Tax

Data

Results

Static Notches: House Price Responses
Moving Notches: Dynamics of House Price Responses
Stimulus: Timing and Extensive Margin Effects

Conclusions
House Price Responses to £250K Notch, 2004-2012

\[
b = 1.85 \ (0.340) \\
m = 2.21 \ (0.365) \\
m - b = 0.36 \ (0.694) \\
\]

\[
h_v = £10,000 \ (1,997.0) \\
\text{Tax} = £5,000 \\
v = 0.08 \ (0.032) \\
\]

Number of Property Transactions

<table>
<thead>
<tr>
<th>House Price</th>
<th>Actual Distribution</th>
<th>Counterfactual Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>200,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>225,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>275,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>325,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Method

- Conceptual
- Higher Prices

Introduction  Stamp Duty Land Tax  Data  Results  Conclusions
House Price Responses to £125K Notch, 2006-2008

- $b = 0.86 (0.144)$
- $m = 0.96 (0.186)$
- $m - b = 0.10 (0.320)$
- $h_v = £5,000 (534.0)$
- $\nu = 0.16 (0.034)$
- Tax = £1,250

Number of Property Transactions

- 75,000
- 100,000
- 125,000
- 150,000
- 175,000
- 200,000

House Price

- Actual Distribution
- Counterfactual Distribution

Method

Other Periods

Introduction  Stamp Duty  Land Tax  Data  Results  Conclusions
House Price Responses

Summary

- **Bunching and holes:**
  - Large and sharp bunching just below notches
  - Large holes above notches
  - Holes are (weakly) larger than bunching, which suggests extensive margin responses

- **House price responses:**
  - Average house price response $= 2-5 \times \text{tax jump}$
  - Largest house price response (end of hole) $\geq 5 \times \text{tax jump}$
  - Liquidity constraints are likely to play an important role
Outline

Introduction

Stamp Duty Land Tax

Data

Results

Static Notches: House Price Responses

Moving Notches: Dynamics of House Price Responses

Stimulus: Timing and Extensive Margin Effects

Conclusions
Dynamics of House Price Responses
Notch moving from £120,000 to £125,000

4/2005

Number of Property Transactions

House Price

- Counterfactual Distribution
- Actual Distribution

Introduction  Stamp Duty Land Tax  Data  Results  Conclusions
Dynamics of House Price Responses
Notch moving from £125,000 to £175,000 and back again
Dynamics of House Price Responses

Monthly Bunching Estimates Over Time

Introduction  Stamp Duty Land Tax  Data  Results  Conclusions
Dynamics of House Price Responses

Summary

▶ **Build-up of bunching** when notches are introduced
  ▶ Holiday start (unanticipated): bunching at £175K builds up in 3 months
  ▶ Holiday end (anticipated): bunching at £125K builds up in 1-2 months

▶ **Disappearance of bunching** when notches are removed
  ▶ Holiday start (unanticipated): bunching at £125K disappears in 4 months
  ▶ Holiday end (anticipated): bunching at £175K disappears immediately

▶ Little indication of optimization frictions
  ▶ With anticipation, almost zero inertia
  ▶ Without anticipation, small inertia $\approx$ contract completion lag
Outline

Introduction

Stamp Duty Land Tax

Data

Results

Static Notches: House Price Responses
Moving Notches: Dynamics of House Price Responses
Stimulus: Timing and Extensive Margin Effects

Conclusions
Stimulus: Timing and Extensive Margin Effects
Conceptual Framework

- The stamp duty holiday was an unanticipated stimulus program with a pre-announced end date

- Unanticipated stimulus in period $s$ has two conceptual effects on house purchases:
  - **Timing effect** by those initially close to indifference between buying in period $s$ and buying in a future period
  - **Extensive margin effect** by those initially close to indifference between buying in period $s$ and not buying at all

- Key macro questions:
  - What is the total stimulus effect?
  - How much of it is driven by timing?
  - How quick is reversal?
Empirical Approach

- Difference-in-differences approach

- Naive baseline:
  - Compare treated range 125K-175K to nearby control range
  - Treatment is endogenous to price responses to notches

- Dealing with endogeneity:
  - Widen treated range to include responding ranges on each side (intent-to-treat)
  - Adjust for price responses to notches using bunching estimates
Stimulus: Timing and Extensive Margin Effects

Raw Time Series

![Graph showing the normalised log number of transactions from 2007 to 2012. The graph indicates a decrease in transactions in 2008, with a sharp increase in 2009, followed by a steady increase until 2012. The transactions are categorized into £125K - £175K range.](image)
Stimulus: Timing and Extensive Margin Effects

Naive Diff-in-Diff

- Short Term Timing
Stimulus: Timing and Extensive Margin Effects

Diff-in-Diff Adjusting for Bunching Responses

Month

Wider Range

Short Term Timing

Results

Conclusions
Stimulus: Timing and Extensive Margin Effects

Diff-in-Diff Adjusting for Bunching Responses

- $H = 0.20$ (0.022)
- $R = -0.08$ (0.032)
- $P = -0.00$ (0.010)

**Short Term Timing**

Introduction
Stamp Duty Land Tax
Data
Results
Conclusions

- **£125K - £175K**
- **£175K - £225K**
Stimulus: Timing and Extensive Margin Effects

Diff-in-Diff Adjusting for Bunching Responses (Cumulative Effect)
Stimulus: Timing and Extensive Margin Effects

Reversal / Total Stimulus Effect (Sensitivity to Reversal End Date)

\[-\frac{12_R}{16_H} = 0.31 (0.124)\]

<table>
<thead>
<tr>
<th>Month</th>
<th>Reversal / Total Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010m1</td>
<td></td>
</tr>
<tr>
<td>2010m7</td>
<td></td>
</tr>
<tr>
<td>2011m1</td>
<td></td>
</tr>
<tr>
<td>2011m7</td>
<td></td>
</tr>
<tr>
<td>2012m1</td>
<td></td>
</tr>
</tbody>
</table>

Introduction  Stamp Duty Land Tax  Data  Results  Conclusions
Summary

- Housing stimulus increases activity during the 16 months of the program \(\text{(timing + extensive margin)}\) [20% per month]

- But reduces activity for about 12 months after the program \(\text{(timing)}\) [8% per month]

- Reversal is only 30-40% of stimulus effect

- These findings go against Mian and Sufi (2012):
  - **Length of program** is different: 16 months vs 1 month
  - **Market** being stimulated is different: houses vs cars
  - **Empirical approach** is also different
Outline

Introduction

Stamp Duty Land Tax

Data

Results
  Static Notches: House Price Responses
  Moving Notches: Dynamics of House Price Responses
  Stimulus: Timing and Extensive Margin Effects

Conclusions
Conclusions

- Property transaction taxes are widely used, but little studied

- We have benefitted from
  - Unique access to complete UK transaction tax records
  - Compelling variation from notches and stimulus

- We have found
  - Large house price responses to transaction taxes
  - Fast price adjustment to transaction tax changes
  - Sharp short-term timing effects to anticipated tax changes
  - Strong stimulus effects without complete reversal
  - Strong extensive responses to permanent tax reform
Thank You

m.c.best@lse.ac.uk
h.j.kleven@lse.ac.uk
Appendix Slides
Appendix

Estimating the Counterfactual Distribution

Use a flexible polynomial to estimate $g_0(h_v)$, excluding data around the notch:

$$c_i = \sum_{j=0}^{q} \beta_j (z_i)^j + \sum_{r \in R} \eta_r I \left\{ \frac{\bar{h}_v + z_i}{r} \in \mathbb{N} \right\} + \sum_{k=\bar{h}_v^-}^{\bar{h}_v^+} \gamma_k I \left\{ i = k \right\} + \mu_i$$

where $c_i$ is count of transactions in price bin $i$, $q$ is the order of the polynomial, $z_i$ is the distance between bin $i$ and the cutoff $\bar{h}_v$, $\bar{h}_v^-$ is the lower bound of the excluded range, $\bar{h}_v^+$ is the upper bound of the excluded range, $\mathbb{N}$ is the set of natural numbers, $R = \{500, 1000, 5000, 10000, 25000\}$ is a set of round numbers multiples, $I \{ \cdot \}$ is the indicator function, and $\mu_i$ is the error term.
Appendix

Estimates of the Counterfactual Distribution, Bunching, and Holes

▶ Estimate of counterfactual distribution:

\[
\hat{c}_i = \sum_{j=0}^{q} \hat{\beta}_j (z_i)^j + \sum_{r \in \mathcal{R}} \hat{\eta}_r I \left\{ \frac{\bar{h}_v + z_i}{r} \in \mathbb{N} \right\}
\]

▶ Estimates of excess bunching and hole (missing mass):

\[
\hat{B}(\bar{h}_v) = \sum_{i=\bar{h}_v^-}^{\bar{h}_v} (c_i - \hat{c}_i) \quad \text{and} \quad \hat{M}(\bar{h}_v) = \sum_{i>\bar{h}_v} (\hat{c}_i - c_i)
\]
Effect of Notch on House Price Distribution

Intensive & Extensive Responses

Density

Density under linear tax
Density under notched tax

Extensive Responses

Intensive Responses

Introduction  Stamp Duty Land Tax  Data  Results  Conclusions
House Price Responses to £500K Notch, 2004-2012

- $b = 1.64$ (0.510)
- $m = 2.27$ (0.387)
- $m - b = 0.63$ (0.855)
- $h_v = £10,000$ (3,808.7)
- $\nu = 0.04$ (0.031)
- Tax = £5,000

Number of Property Transactions:
- 450,000
- 475,000
- 500,000
- 525,000
- 550,000
- 575,000
House Price Responses to £1 Million Notch 2011-2012

- $b = 0.70$
- $h_v = £30,000$
- $\text{Tax} = £10,000$
- $e_v = 0.09$

### Graph Details

- **Density of Property Transactions**
- **House Price**
- **Actual Density**
- **Counterfactual Density**

- **Introduction Stamp Duty Land Tax Data Results Conclusions**
House Price Responses to £2 Million Notch 2012

- \( b = 1.26 \)
- \( h_v = £100,000 \)
- Tax = £40,000
- \( e_v = 0.13 \)

- Density of Property Transactions
- 1,400,000
- 1,600,000
- 1,800,000
- 2,000,000
- 2,200,000
- 2,400,000
- 2,600,000

- House Price
- 250K

Graph showing density of property transactions and house price responses.
Static Price Notches: Bunching and Holes
Notch at £60,000; 1 Nov 2004 - 16 Mar 2005

\[ b = 0.41 \ (0.132) \]
\[ m = 0.92 \ (0.318) \]
\[ m-b = 0.51 \ (0.446) \]

\[ h_v = £3,500 \ (1,026.1) \]
\[ \text{Tax} = £600 \]
\[ v = 0.34 \ (0.200) \]

Introduction Stamp Duty Land Tax Data Results Conclusions
Static Price Notches: Bunching and Holes
Notch at £120,000; 17 Mar 2005 - 22 Mar 2006

- $b = 0.70 \pm 0.068$
- $m = 0.83 \pm 0.226$
- $m - b = 0.13 \pm 0.292$
- $h_v = £5,000 \pm 282.2$
- $\nu = 0.17 \pm 0.020$
- $\text{Tax} = £1,200$

Number of Property Transactions

House Price

- Actual Distribution
- Counterfactual Distribution
Static Price Notches: Bunching and Holes
Notch at £175,000; 3 Sep 2008 - 31 Dec 2009

\[ b = 1.00 \ (0.270) \]
\[ m = 0.50 \ (0.267) \]
\[ m - b = -0.50 \ (0.520) \]
\[ h_v = £5,000 \ (1,981.8) \]
\[ \nu = 0.08 \ (0.065) \]

Tax = £1,750

Number of Property Transactions

Introduction Stamp Duty Land Tax Data Results Conclusions
Static Price Notches: Bunching and Holes
Notch at £125,000; 1 Jan 2010 - 31 Oct 2012

\[ b = 0.78 \ (0.121) \]
\[ m = 0.73 \ (0.179) \]
\[ m - b = -0.05 \ (0.288) \]
\[ h_v = £5,000 \ (274.6) \]
\[ \nu = 0.16 \ (0.018) \]

Number of Property Transactions

House Price

Actual Distribution

Counterfactual Distribution
Time Notch: Short-Term Timing Effects
Difference-in-Bunching with Price Range Counterfactuals

D-i-Bunching = 2.75 (.392)

Number of Transactions

Week

£75,000 - £125,000
£125,000 - £175,000
£175,000 - £225,000

Naive DiD
Bunching DiD
DiD Estimates

Introduction
Stamp Duty Land Tax
Data
Results
Conclusions
Time Notch: Short-Term Timing Effects

Difference-in-Bunching with Time Period Counterfactuals

D-i-Bunching = 3.44 (.381)

Number of Transactions

Week

1 Year Earlier

2 Years Earlier

Actual

Naive DiD

Bunching DiD

DiD Estimates

Introduction

Stamp Duty Land Tax

Data

Results

Conclusions
Placebo Difference-in-Bunching 1: Price Range Counterfactuals 1 Year Earlier

D-i-Bunching = .09 (.42)

Week

Number of Transactions

2008w27 2008w40 2009w1 2009w13 2009w26

£75,000 - £125,000
£125,000 - £175,000
£175,000 - £225,000

Introduction Stamp Duty Land Tax Data Results Conclusions
D-i-Bunching = -.03 (.241)

Naive DiD
Bunching DiD
DiD Estimates

Introduction
Stamp Duty Land Tax
Data
Results
Conclusions
Stimulus: Timing and Extensive Margin Effects

Diff-in-Diff with Wider Treatment Range

Normalised Log Number of Transactions

Month

£115K - £195K

£195K - £235K

Bunching-Adjusted DiD