Home production as a substitute to market consumption: Estimating the elasticity using houseprice shocks from the Great Recession

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Motivation

Analyses of *well-being* have relied on measures of income and spending.

- Becker’s 1965 theory on the allocation of time: Home production.
- Time can be used to increase consumption beyond market spending (Aguiar & Hurst 2005).
- Share of home production in consumption bundle depends on *relative price of time*.
- Shift to home production when the price of time drops.
Home production can smooth consumption in response to shocks in income (Hicks 2015):

- Home production and retirement (e.g. Aguiar & Hurst 2005).
- Home production and unemployed households (e.g. Guler & Taskin 2013).
- Home production and health (e.g. Halliday & Podor 2012).
- Home production and wealth (e.g. Kuehn 2015).
Identification strategies

- Transitory shocks in income.
  - Monetary- and Time-budget: substitution or time-endowment?
- Disputable instruments: lagged consumption (Rupert et al. 1995).
- Very specific subsample: EITC and single women (Gelber & Mitchell 2009).
- Permanent shocks in income: permanent income (Hicks 2015).
  - Identification from cross-sectional differences between poorer and richer persons.
**Contribution**

- **Intratemporal elasticity from within-person variation.**
- **Causal identification:**
  - Wealth-shocks only influence monetary-budget.
  - Large exogenous shock: *houseprices* in the Great Recession.
    - Consumption (Angrisani et al. 2014).
    - Home production (Kuehn 2015).
- **Panel data with detailed consumption spending and time-use information of persons in US households (HRS/CAMS).**
  - Consumption: *Retirement-Consumption "Puzzle"* literature.
  - Time-use: Burda & Hamermesh (2010); Aguiar et al. (2013).
HRS/CAMS

Health and Retirement Survey
- Representative 50+ population of the US.
- Longitudinal: 12 waves.
- 20,000 persons every two years (one wave).
- Detailed information on demographics, economic status, etc.

Consumption and Activities Mail Survey
- Supplementary study to HRS.
- Survey to subset of HRS respondents.
- 37 time-use categories, 39 spending categories.
- Information on both spouses within a household.
Definition of home production

Following Aguiar et al. (2013):

- House cleaning
- Washing, ironing or mending clothes (Laundry)
- Yard work or gardening (Gardening)
- Shopping or running errands (Shopping)
- Preparing meals and cleaning up afterwards (Cooking)
- Taking care of finances or investments, such as banking, paying bills, balancing the checkbook, doing taxes, etc. (Financial Management)
- Doing home improvements, including painting, redecorating, or making home repairs (Home maintenance)
- Working on, maintaining, or cleaning car(s) and vehicle(s) (Vehicle maintenance)
What can home production substitute?

"Home Production Substitutable Consumption":

- House cleaning ⇔ Housekeeping services
- Laundry ⇔ Housekeeping services, Washing/Drying machine
- Gardening ⇔ Gardening services
- Shopping ⇔ n.a.
- Cooking ⇔ Dining out, Dishwasher
- Financial Management ⇔ n.a.
- Home maintenance ⇔ Homerepair services
- Vehicle maintenance ⇔ Vehicle maintenance services
Consumption spending across Time ($/y)

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<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>Dining out</td>
<td>1,912</td>
<td>1,808</td>
<td>1,513</td>
<td>1,598</td>
</tr>
<tr>
<td>Housekeeping services</td>
<td>414</td>
<td>386</td>
<td>331</td>
<td>349</td>
</tr>
<tr>
<td>Gardening services</td>
<td>381</td>
<td>355</td>
<td>314</td>
<td>296</td>
</tr>
<tr>
<td>Homerepair services</td>
<td>1,347</td>
<td>1,465</td>
<td>1,068</td>
<td>1,006</td>
</tr>
<tr>
<td>Vehicle maintenance</td>
<td>649</td>
<td>614</td>
<td>618</td>
<td>598</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>23</td>
<td>27</td>
<td>19</td>
<td>15</td>
</tr>
<tr>
<td>Washing/Drying machine</td>
<td>63</td>
<td>76</td>
<td>68</td>
<td>53</td>
</tr>
<tr>
<td>Substitutable consumption</td>
<td>4,788</td>
<td>4,730</td>
<td>3,931</td>
<td>3,915</td>
</tr>
<tr>
<td>Substitutable consumption excl. durables</td>
<td>4,703</td>
<td>4,627</td>
<td>3,844</td>
<td>3,847</td>
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<tr>
<td>Substitutable consumption incl. suppl. mat.</td>
<td>6,487</td>
<td>6,387</td>
<td>5,342</td>
<td>5,382</td>
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<tr>
<td>Total consumption</td>
<td>40,558</td>
<td>39,904</td>
<td>37,515</td>
<td>36,359</td>
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</table>
## Home Production across Time (h/w)

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<tr>
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</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>House cleaning</td>
<td>4.7</td>
<td>4.8</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>Laundry</td>
<td>2.6</td>
<td>2.7</td>
<td>2.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Gardening</td>
<td>2.2</td>
<td>2.2</td>
<td>2.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Shopping</td>
<td>3.9</td>
<td>3.8</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Cooking</td>
<td>6.4</td>
<td>6.3</td>
<td>6.3</td>
<td>6.2</td>
</tr>
<tr>
<td>Financial management</td>
<td>1.0</td>
<td>1.0</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Home maintenance</td>
<td>1.0</td>
<td>0.8</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Vehicle maintenance</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Home production</strong></td>
<td><strong>22.2</strong></td>
<td><strong>21.8</strong></td>
<td><strong>21.5</strong></td>
<td><strong>21.6</strong></td>
</tr>
</tbody>
</table>
Life-Cycle Model with Home Production and Wealth Shocks

\[ U_{\tau} = \max E_{\tau} \left[ \sum_{t=\tau}^{T} (1+\delta)^{\tau-t} u(c_{mt}, c_{nt}(h_{nt}), l_{t})\psi(v_{t}) \right] \quad (1) \]

with

\[ c_{nt}(h_{nt}) = g_{t}(h_{nt}) \quad (2) \]

subject to

\[ h_{nt} = H - h_{mt} - l_{t} \quad (3) \]

\[ A_{t+1} = (1+r)(E_{t}[A_{t}] + (w_{t} \cdot (H - l_{t} - h_{nt})) + b_{t} - c_{mt}) \quad (4) \]

\[ E_{t}[A_{t}] = A_{t} + \xi_{t} \quad (5) \]
Euler Equations

**Market consumption** (e.g. Consumption spending):

$$u_{cmt}(c_{mt+1}, c_{nt+1}(h_{nt+1}), l_{t+1})\psi(v_{t+1}) =$$

$$\left(\frac{1 + \delta}{1 + r}\right) u_{cmt}(c_{mt}, c_{nt}(h_{nt}), l_{t})\psi(v_{t}) + \epsilon_{t+1} \quad (6)$$

**Market work** (e.g. Labor supply):

$$u_{hmt}(c_{mt+1}, c_{nt+1}(h_{nt+1}), l_{t+1})\psi(v_{t+1}) =$$

$$-w_{t} \left(\frac{1 + \delta}{1 + r}\right) u_{hmt}(c_{mt}, c_{nt}(h_{nt}), l_{t})\psi(v_{t}) + \epsilon_{t+1} \quad (7)$$

**Home work** (e.g. Home production):

$$u_{hnt}(c_{mt+1}, c_{nt+1}(h_{nt+1}), l_{t+1})\psi(v_{t+1}) =$$

$$w_{t} \left(\frac{1 + \delta}{1 + r}\right) u_{hnt}(c_{mt}, c_{nt}(h_{nt}), l_{t})\psi(v_{t}) + \epsilon_{t+1} \quad (8)$$
Parametric assumptions

Functional form:

\[ u(c_{mt}, c_{nt}(h_{nt}), l_t) = c^{\theta_{mt}}_{mt} + c_{nt}(h_{nt})^{\theta_{nt}} + l^\theta_{lt} \]  

(9)

\[ c_{nt}(h_{nt}) = g_t(h_{nt}) = \gamma_t h_{nt} \]  

(10)

Assumptions first-order approximation of Euler Equations:

▶ Time-constant \(r\) and \(\delta\) reduce to a constant \(\alpha\).

\[ \theta_{jt+1} = X_{t+1} + \eta_j \]  

(11)

\[ \psi_{t+1} = X_{t+1} + \eta_j \]  

(12)

\[ \gamma_{t+1} = X_{t+1} + \eta_j \]  

(13)

\[ w_t = X_{t+1} + \eta_j, j = m, n \]  

(14)
Empirical Euler Equations

**Market consumption** (e.g. Consumption spending):

\[
\Delta \ln(c_{imt+1}) = \Delta X_{it+1}\beta_c + \varepsilon_{ict+1}
\]

(15)

**Market work** (e.g. Labor supply):

\[
\Delta \ln(h_{imt+1}) = \Delta X_{it+1}\beta_m + \varepsilon_{imt+1}
\]

(16)

**Home work** (e.g. Home production):

\[
\Delta \ln(h_{int+1}) = \Delta X_{it+1}\beta_n + \varepsilon_{int+1}
\]

(17)

\(\varepsilon_{ijt+1}\) are distributed iid \(N(0, \sigma_j)\) and capture random error of:

- Recursive process of the marginal utility of wealth (including shocks).
- Equations (11)-(14).
- Equations (15)-(17).
Estimating the Elasticity

Interested in \( \frac{\Delta \ln(h_{int+1})}{\Delta \ln(c_{imt+1})} \):

- \( c_{imt+1} \), \( h_{int+1} \), (and \( h_{imt+1} \)) simultaneously determined.
- **Second-stage:**
  \[
  \Delta \ln(h_{int+1}) = \Delta X_{it+1}\beta_{n1} + \Delta \ln(c_{imt+1})\beta_{n2} + \varepsilon_{int+1} \quad (18)
  \]
- **First-stage:**
  \[
  \Delta \ln(c_{imt+1}) = \Delta X_{it+1}\beta_{c1} + D_{GR}\Delta \ln(W_{it})\beta_{c2} + \varepsilon_{ict+1} \quad (19)
  \]
- \( D_{GR}\Delta \ln(W_{it}) \) shock to monetary-budget, not to time-budget.
- Keep \((w_t \cdot (H - l_t - h_{nt})) + b_t \) constant in Equation (4).
Identification: Houseprice changes

![Graph showing mean reported house price change (1,000's of U.S. dollars) from 2003 to 2011. The graph shows a peak in 2007 and a decline in 2009.]

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## Estimation results

<table>
<thead>
<tr>
<th>Second-stage</th>
<th>$\Delta \ln(h_{int+1})$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coeff.</td>
<td>S.E.</td>
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<tr>
<td><strong>Elasticity</strong></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln(c_{int+1})$</td>
<td>-0.65* 0.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>First-stage</th>
<th>$\Delta \ln(c_{int+1})$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coeff.</td>
<td>S.E.</td>
</tr>
<tr>
<td><strong>Instrument</strong></td>
<td></td>
</tr>
<tr>
<td>$D_{GR}\Delta \ln(W_{it})$</td>
<td>0.14** 0.06</td>
</tr>
</tbody>
</table>

- Observations ($N \times T$): 2,500
- Hansens J statistic (p-value reported): 0.00
Interpretation

- $\beta_{n2} = \frac{\Delta \ln(h_{int+1})}{\Delta \ln(c_{imt+1})} = -0.65$.
- Less than perfect substitute.
- Bigger than elasticity between food preparation and dining out found by Hicks (2015): -0.031 (endogeneity/food/25-80).
- Average effect: drop in consumption of 40 dollars (p/y) increases home production by about 7.6 hours (p/y): shadow wage $5.30$.
- Reasonably lower than minimum wage in retirement (Ghez & Becker 1975).
Robustness

- Definitions of "home production substitutable consumption":
  - Excluding durables.
  - Including supplementary material.
- Equivalence scales of market consumption:
  - Full sharing.
  - Oxford equivalence scale.
  - OECD equivalence scale.
  - Square root equivalence scale.
- Single/couple household.
- Male/female respondents.
Heterogeneous elasticities

Elasticity primarily determined by:

- Drop in houseprice value.
- Relatively low houseprice value (absolute).
- Mortgage-free.
- Relatively high substitutable spending.
- Medium household income

Not by:

- Financial wealth.
Conclusion

- Decrease in market consumption after ‘shocks’.
- Increase in home production after ‘shocks’.
- Wealth shocks in the Great Recession avoid endogeneity problems.
- Small substitution effects \( \frac{\Delta \ln(h_{int+1})}{\Delta \ln(c_{imt+1})} = -0.65 \).
- Small scope for substituting market consumption (\( \approx 12\% \)).
- Increases in home production primarily due to ‘time-endowment’.
- Contrast to the high substitutability assumed in theoretical (macro) models (Campbell & Ludvigson 2001).