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

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

- ‘Time’ can be used to increase consumption beyond market spending (Aguiar & Hurst 2005).
- ‘Time’ can be a considerable endowment in low-income households.
- Becker’s 1965 theory of the allocation of time.
A theory of the allocation of time (Becker 1965)

- Consumption ‘produced’ by two inputs
  - Market expenditures.
  - Time.
- *Money-intensive* versus *Time-intensive goods*.
- Composition of consumption bundle depends on *relative price of time*.
- Shift in composition when the price of time changes.
Augmenting the standard classical model (Gronau, 1977)

$$\max_{c_{mt}, h_{mt}, h_{nt}} u(c_m, c_n(h_n), l)$$

with home production function

$$c_n(h_n) = g(h_n)$$

subject to a time- and monetary budget

$$H = h_m + h_n + l$$

$$c_m = w \cdot (H - l - h_n) + b$$
Shocks and Home Production

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.
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. 2015).
    - 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 $\iff$ Housekeeping services
- Laundry $\iff$ Housekeeping services, Washing/Drying machine
- Gardening $\iff$ Gardening services
- Shopping $\iff$ n.a.
- Cooking $\iff$ Dining out, Dishwasher
- Financial Management $\iff$ n.a.
- Home maintenance $\iff$ Homerepair services
- Vehicle maintenance $\iff$ Vehicle maintenance services
Consumption spending across Time ($/y)

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<thead>
<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>1,795</td>
<td>1,761</td>
<td>1,472</td>
<td>1,683</td>
</tr>
<tr>
<td>Housekeeping services</td>
<td>432</td>
<td>390</td>
<td>291</td>
<td>296</td>
</tr>
<tr>
<td>Gardening services</td>
<td>486</td>
<td>429</td>
<td>348</td>
<td>363</td>
</tr>
<tr>
<td>Homerepair services</td>
<td>1,403</td>
<td>1,412</td>
<td>1,176</td>
<td>1,059</td>
</tr>
<tr>
<td>Vehicle maintenance</td>
<td>632</td>
<td>558</td>
<td>556</td>
<td>545</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>21</td>
<td>82</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Washing/Drying machine</td>
<td>71</td>
<td>82</td>
<td>69</td>
<td>45</td>
</tr>
<tr>
<td>Substitutable consumption</td>
<td>4,841</td>
<td>4,656</td>
<td>3,930</td>
<td>4,009</td>
</tr>
<tr>
<td>Substitutable consumption excl. durables</td>
<td>4,749</td>
<td>4,549</td>
<td>3,843</td>
<td>3,946</td>
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<tr>
<td>Substitutable consumption incl. suppl. mat.</td>
<td>6,540</td>
<td>6,266</td>
<td>5,320</td>
<td>5,402</td>
</tr>
<tr>
<td>Total consumption</td>
<td>40,120</td>
<td>38,856</td>
<td>36,122</td>
<td>35,348</td>
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</table>
# Home Production across Time (h/w)

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<thead>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>House cleaning</td>
<td>4.5</td>
<td>5.2</td>
<td>5.0</td>
<td>4.8</td>
</tr>
<tr>
<td>Laundry</td>
<td>2.7</td>
<td>2.6</td>
<td>2.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Gardening</td>
<td>2.7</td>
<td>3.0</td>
<td>2.9</td>
<td>3.0</td>
</tr>
<tr>
<td>Shopping</td>
<td>4.1</td>
<td>3.9</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Cooking</td>
<td>7.0</td>
<td>7.0</td>
<td>6.8</td>
<td>7.1</td>
</tr>
<tr>
<td>Financial management</td>
<td>0.9</td>
<td>1.0</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Home maintenance</td>
<td>1.0</td>
<td>0.9</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Vehicle maintenance</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Home production</strong></td>
<td><strong>23.1</strong></td>
<td><strong>23.9</strong></td>
<td><strong>23.4</strong></td>
<td><strong>23.3</strong></td>
</tr>
</tbody>
</table>
Life-Cycle Model with Home Production and Wealth Shocks

\[ U_{\tau} = \max_{c_{mt}, h_{mt}, h_{nt}} \mathbb{E}_{\tau} \left[ \sum_{t=\tau}^{T} (1 + \delta)^{\tau-t} u(c_{mt}, c_{nt}(h_{nt}), l_t)\psi(v_t) \right] \]  

with

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

\[ c_{mt} = \{c^{s}_{mt}, c^{ns}_{mt}\} \]  

subject to

\[ h_{nt} = H - h_{mt} - l_t \]  

\[ A_{t+1} = (1 + r)(\mathbb{E}_t[A_t] + (w_t \cdot (H - l_t - h_{nt})) + b_t - c_{mt}) \]  

\[ \mathbb{E}_t[A_t] = A_t + \xi_t \]
Theoretical predictions

\[ u_{cmt}(c_{mt}, c_{nt}(h_{nt}), l_t)\psi(v_t) = \left( \frac{1 + r}{1 + \delta} \right) \mathbb{E}_t \left[ u_{cmt+1}(c_{mt+1}, c_{nt+1}(h_{nt+1}), l_{t+1})\psi(v_{t+1}) \right] \] (11)

\[ u_{hmt}(c_{mt}, c_{nt}(h_{nt}), l_t)\psi(v_t) = -w_t \left( \frac{1 + r}{1 + \delta} \right) \mathbb{E}_t \left[ u_{hmt+1}(c_{mt+1}, c_{nt+1}(h_{nt+1}), l_{t+1})\psi(v_{t+1}) \right] \] (12)

\[ u_{hnt}(c_{mt}, c_{nt}(h_{nt}), l_t)\psi(v_t) = w_t \left( \frac{1 + r}{1 + \delta} \right) \mathbb{E}_t \left[ u_{hnt+1}(c_{mt+1}, c_{nt+1}(h_{nt+1}), l_{t+1})\psi(v_{t+1}) \right] \] (13)
Empirical model

Estimating the elasticity:

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

(14)

where \( \beta_n = \frac{\Delta h_{nt+1}}{\Delta c_{smt+1}^s} \), using

\[ \Delta \ln(c_{smt+1}^s) = \Delta X_{it+1}\beta_{c1} + D_{GR} \Delta \ln(W_{it}) \beta_{c2} + \varepsilon_{ict+1} \]  

(15)

Keeping \((w_t \cdot (H - l_t - h_{nt})) + b_t\) constant.
Identification: House price changes

![Graph showing mean reported house price change (1,000's of U.S. dollars) from 2003 to 2011. The graph indicates a peak in 2007 followed by a sharp decline in 2009, with a slight recovery by 2011.]
Instrument: Validity & Relevance

Validity:

\[ h_{nt} = H - h_{mt} - l_t \]  

(16)

\[ A_{t+1} = (1 + r)(E_t[A_t] + (w_t \cdot (H - l_t - h_{nt})) + b_t - c_{mt}) \]  

(17)

Relevance:

- General: Case et al. (2005; 2013), Carroll et al. (2011).
### Results

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

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

F-statistic 5.6

Observations (\( N \times T \)) 2,500

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Home production as a substitute to market consumption
Interpretation

- $\beta_{n2} = \frac{\Delta \ln(h_{int+1})}{\Delta \ln(c_{int+1})} = -0.65$.
- Less than perfect substitute.
- Bigger than elasticity found by Hicks (2015): -0.03 (endogeneity/food).
- 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 to different definitions

<table>
<thead>
<tr>
<th>Definition</th>
<th>First-stage</th>
<th></th>
<th>Second-stage</th>
<th></th>
<th>Obs.</th>
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<tr>
<td></td>
<td>$\beta_{c2}$</td>
<td>$\sigma^2_{\beta_{c2}}$</td>
<td>$\beta_{n2}$</td>
<td>$\sigma^2_{\beta_{n2}}$</td>
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<tr>
<td>$\ln(c_{imt+1}^s)$</td>
<td>0.14**</td>
<td>0.06</td>
<td>-0.65*</td>
<td>0.37</td>
<td>2,500</td>
</tr>
<tr>
<td>$\ln(c_{imt+1}^s)$ excl. durables</td>
<td>0.12**</td>
<td>0.06</td>
<td>-0.71*</td>
<td>0.44</td>
<td>2,500</td>
</tr>
<tr>
<td>$\ln(c_{imt+1}^s)$ incl. suppl. material</td>
<td>0.14**</td>
<td>0.06</td>
<td>-0.61**</td>
<td>0.31</td>
<td>2,504</td>
</tr>
<tr>
<td>$\ln(c_{imt+1}^s)$ dining out only</td>
<td>0.30***</td>
<td>0.11</td>
<td>-0.29*</td>
<td>0.17</td>
<td>2,489</td>
</tr>
<tr>
<td>$\ln(c_{imt+1}^s)$ excl. homerepair services</td>
<td>0.12**</td>
<td>0.06</td>
<td>-0.74*</td>
<td>0.45</td>
<td>2,491</td>
</tr>
<tr>
<td>$\ln(c_{imt+1}^s)$ excl. homerepair/gardening services</td>
<td>0.12**</td>
<td>0.06</td>
<td>-0.74*</td>
<td>0.45</td>
<td>2,490</td>
</tr>
</tbody>
</table>
Heterogeneous elasticities

Elasticity primarily determined by:

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

Not by:

- Financial wealth.
- Indebtedness.
### Lower bound

<table>
<thead>
<tr>
<th></th>
<th>$h_n$</th>
<th></th>
<th>$c^s_m$</th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.E.</td>
<td>Mean</td>
<td>S.E.</td>
</tr>
<tr>
<td>Non-retired</td>
<td>19.8</td>
<td>0.26</td>
<td>5,177.5</td>
<td>103.4</td>
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<tr>
<td>Retired</td>
<td>23.2</td>
<td>0.23</td>
<td>3,747.8</td>
<td>64.0</td>
</tr>
<tr>
<td>$\Delta$</td>
<td>3.4***</td>
<td>0.35</td>
<td>-1,429.7***</td>
<td>115.3</td>
</tr>
<tr>
<td>Non-retired men</td>
<td>16.1</td>
<td>0.29</td>
<td>6,013.6</td>
<td>175.9</td>
</tr>
<tr>
<td>Retired men</td>
<td>19.1</td>
<td>0.23</td>
<td>3,992.8</td>
<td>96.3</td>
</tr>
<tr>
<td>$\Delta$</td>
<td>3.0***</td>
<td>0.50</td>
<td>-2,020.7***</td>
<td>194.9</td>
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<tr>
<td>Non-retired women</td>
<td>22.6</td>
<td>0.39</td>
<td>4,540.6</td>
<td>122.1</td>
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<tr>
<td>Retired women</td>
<td>25.2</td>
<td>0.28</td>
<td>3,624.5</td>
<td>83.0</td>
</tr>
<tr>
<td>$\Delta$</td>
<td>2.6***</td>
<td>0.47</td>
<td>-916.0***</td>
<td>143.1</td>
</tr>
<tr>
<td>Non-retired $&lt; 65$</td>
<td>19.4</td>
<td>0.27</td>
<td>5,247.1</td>
<td>133.6</td>
</tr>
<tr>
<td>Retired $&lt; 65$</td>
<td>23.6</td>
<td>0.47</td>
<td>3,766.0</td>
<td>126.9</td>
</tr>
<tr>
<td>$\Delta$</td>
<td>4.2***</td>
<td>0.51</td>
<td>-1,481.1***</td>
<td>199.2</td>
</tr>
<tr>
<td>Non-retired 65+</td>
<td>20.6</td>
<td>0.55</td>
<td>5,029.1</td>
<td>153.8</td>
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<tr>
<td>Retired 65+</td>
<td>23.0</td>
<td>0.27</td>
<td>3,740.8</td>
<td>73.9</td>
</tr>
<tr>
<td>$\Delta$</td>
<td>2.4***</td>
<td>0.58</td>
<td>-1,288.3***</td>
<td>158.6</td>
</tr>
</tbody>
</table>
Conclusion

- 'Small' substitution effects \( \frac{\Delta \ln(h_{int+1})}{\Delta \ln(c_{smt+1}^s)} = -0.65 \).
- Small scope for substituting \( c_{smt}^s \) (≈ 12%).
- High substitutability assumed in theoretical (macro) models (Campbell & Ludvigson 2001).
- Estimates are credible lower bound.
Importance for pensions

- Income and spending drop at retirement (*Retirement-Consumption Puzzle* literature).
- Drop in well-being likely to be smaller:
  - Substitute $c_{mt}^s$ for $c_{nt}$.
  - Considerably more non-work time available ($h_{mt} = 0$).
- Need for Pension Adequacy measures that go beyond income and spending.