Time Use and the Macroeconomy

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Broad Overview

Why is the allocation of time important to macroeconomists?

- Market work central to most business cycle and growth models.
- Shocks to productivity to the market sector a focal point in business cycle and growth models.
- Having a home sector can potentially make market labor supply more elastic.
- Shocks to the home sector can also generate time series (and business cycle?) variation in market work.
- Alternate uses of time are essential to understanding both lifecycle and business cycle patterns in expenditures.
- Many macro literatures focus on other uses of household time: shopping behavior, job search, human capital investment, leisure, etc.
Handbook Chapter Goals

- Express a simple model to illustrate many of the key features of the interaction between time use and expenditures.

- Show some stylized facts about the time series, life cycle and business cycle patterns in key time use categories: market work, child care, home production, and leisure.

- Throughout, highlight the importance of time use in recent macro literature.
Data - Part 1:
Time Series Patterns in Market Work
Key Outstanding Question

- What explains the time series patterns in market work for men and women of different skill?

- Changes in participation rates a key puzzle in recent years.

- We still do not have a good grasp on changes in hours worked among sub-groups over the past 50 years.

- Part of our goal is to set the stage for future research with time series trends in market work.
Setting the Stage: Trends in Market Work

Sample: CPS Data, Men, Age 21-75
Setting the Stage: Trends in Market Work

Sample: CPS Data, Women, Age 21-75
Setting the Stage: Trends in Market Work

Sample: CPS Data, Men by Skill, Age 21-75
Setting the Stage: Trends in Market Work

Sample: CPS Data, Women by Skill, Age 21-75
Setting the Stage: Trends in Market Work (Hours Per Week)

Sample: CPS Data, Higher Skilled Men by Age
Setting the Stage: Trends in Market Work (Hours Per Week)

Sample: CPS Data, Lower Skilled Men by Age
Setting the Stage: Trends in Market Work (Hours Per Week)

Sample: CPS Data, Higher Skilled Women by Age
Setting the Stage: Trends in Market Work (Hours Per Week)

Sample: CPS Data, Lower Skilled Women by Age
Summary of Trends in Market Work

- **Key Take-Aways**
  - Trend down in market hours for men of all skill.
  - Increase in employment inequality across men by skill.
  - The decline in employment for higher skilled men much larger for ages \( \geq 55 \) (until recently)
  - Younger and older lower skilled men have consistently experienced declines in market hours.
  - Trend up in market hours for women until mid-1990 for all skill.
  - Women hours are declining over the last 15 years.
  - Patterns similar by skill levels for women.
  - Men and women market hours are converging
Summary of Trends in Market Work

- **Some questions....**
  - What is driving the downward trend in male labor supply? It is not just wages as high skilled men experienced wage increases and labor supply declines.
  - Why relatively large drop for less skilled men in 1970s to early 1980s, then relative stability until Great Recession?
  - Why does upward trend in women stop/reverse in mid-1990s?
  - Why has participation fallen so much during the decade for all groups (particularly the young)?
  - Can time use allocated away from the market sector help us to understand the time series and lifecycle patterns?
A Beckerian Model of Expenditure: Theory and Implications
Ghez and Becker (1975);

\[ V(a, \psi, t) = \max U(C_i, \ldots, C_I) + \beta E^t V(a', \psi', t + 1) \]

subject to:
\[ C_i = F_i(H_i, X_i), \ i = 1, \ldots, I \]
\[ \sum_i H_i + L = 1 \]
\[ a' = (1 + r)a + (1 - \tau)wL + T - \sum_i p_i X_i \]
\[ L \geq 0, \ a' \geq a. \]

Let \( \mu, \lambda, \theta, \) and \( \kappa \) be the respective multipliers on the time budget constraint, the money budget constraint, the positive hours constraint and the positive assets constraint.

Assume \( U(.) \) is additively separable across time and across goods.

\( \psi = \) is vector of wages, commodity prices (\( p \)), taxes and transfers
First Order Conditions

\[ X_i : \frac{\partial U}{\partial C_i} \frac{\partial F_i}{\partial X_i} = \lambda p_i, \quad \forall i \]

\[ H_i : \frac{\partial U}{\partial C_i} \frac{\partial F_i}{\partial H_i} = \mu = \lambda \omega, \quad \forall i \]

\[ L : \lambda w + \theta = \mu \]

If \( \theta = 0 \) (\( L > 0 \)), price of time (in permanent income units) \( (\mu/\lambda = w) \)

More generally (given \( L \) often = 0), \( \mu/\lambda = \omega \)
First Order Conditions

Intra-period tradeoff between time and goods:

\[
\frac{\partial F_i}{\partial H_i} / \frac{\partial F_i}{\partial X_i} = \frac{\omega}{p_i} = \frac{w}{p_i} \quad (\text{if } L > 0) \quad (1)
\]

Marginal rate of transformation between time and goods in production of \( i \) is equated to the relative price of time.
First Order Conditions

A few additional assumptions:

- $F_i$ is constant elasticity of substitution ($\sigma_i$)
- $p_i$’s are constant over time

Some algebra

$$\frac{d \ln \left( \frac{X_i}{H_i} \right)}{d \ln \left( \frac{\partial F_i}{\partial H_i} / \frac{\partial F_i}{\partial X_i} \right)} = \sigma_i \tag{2}$$

$$\frac{d \ln \left( \frac{X_i}{H_i} \right)}{d \ln (\omega)} = \sigma_i \tag{3}$$

Note: To get (3), sub (2) into (1)
Static First Order Condition

The static F.O.C. pins down expenditure relative to time inputs.

If we know $\sigma$ and the change in the opportunity cost of time, we should be able to pin down the relative movement in expenditures relative to time.

\[ \%\Delta X_i - \%\Delta H_i = \sigma_i \%\Delta \omega \]

Notice, this equation does not require us to make any assumptions about borrowing or lending, perfect foresight, etc.
Home Production vs. Leisure

- Work of Aguiar and Hurst make distinction based on commodity production functions.

- “Home Produced Goods”:
  - Goods where $\sigma_i > 1$
  - Examples – meals; cleaning services; etc.

- “Leisure Goods”:
  - Goods where $\sigma_i < 1$
  - Examples – entertainment goods.
Estimating $\sigma$’s

\[
\%\Delta X_i - \%\Delta H_i = \sigma_i \%\Delta \omega
\]

• Insight from this equation has been critical to literature estimating $\sigma_i$.

• Rupert, Rogerson, Wright (1995) – Use PSID data to estimate $\sigma$ for home production. Do this for different groups (sex*marital status). Estimates of $\sigma$ for all groups (highest for married women).

• Aguiar and Hurst (2007) – Use data from ATUS, CEX and shopping data (to infer opportunity cost of time) to estimate $\sigma$ for home production. Estimates of $\sigma \sim 1.8$.

• Can use this insight to estimate $\sigma$ for other consumption commodities.
Some Further Assumptions/Definitions

- Constant Intertemporal Elasticity of Substitution (good specific):

  \[ \gamma_i = -\frac{\partial U / \partial C_i}{C_i (\partial^2 U / \partial C_i^2)} \]

- Share of Time in Commodity Production

  \[ S^H_i = \frac{H_i \frac{\partial F_i}{\partial H_i}}{C_i} \]

- Separability Across Consumption Goods
Expenditure Elasticity With Cost of Time

\[
\frac{d \ln X_i}{d \ln \omega} \bigg|_{\sigma = 0} = s^H \left( \sigma_i - \gamma_i \right)
\]

- The elasticity of expenditure on category \( i \) with respect to changes in the opportunity cost of time can be positive, negative or zero.

- If home production time is not important (\( s^H = 0 \)), the elasticity is zero.

- The elasticity increases as \( \sigma_i \) increases. If time and goods are substitutes in the commodity production (\textit{home produced goods}), more willing to substitute towards expenditures as time gets expensive.

- The elasticity falls as \( \gamma_i \) increases. As the price of time increases raises the cost of consuming today (relative to tomorrow) – reducing both \( X_i \) and \( H_i \). The extent of the substitution is governed by \( \gamma_i \).
Expenditure Elasticity With Marginal Utility of Wealth

Differentiate FOC for \( x^n \) with respect to \( \omega \) holding \( \lambda \) constant. Get:

\[
\frac{d \ln c^n}{d \ln \lambda} \bigg|_{d \omega=0} = \gamma_i
\]

- Spending should fall the most (with declines in the marginal value of wealth) for goods that have high elasticities of substitution (high income elasticities).

- Spending should fall more for luxuries (e.g. entertainment) rather than necessities (e.g. food).

- Some common explanations for spending declines with age (retirement).
Predictions: Lifecycle Movements

- **Standard Lifecycle Consumption Models (Gourinchas and Parker, 2002; Blundell et al 2001)**
  - Luxuries (entertainment) should decline more late in life relative to necessities (food)
  - No importance of changing opportunity cost of time over lifecycle

- **Beckerian Model**
  - Goods for which home production is important can move over the lifecycle in ways that are different than goods for which expenditure and time are complements.
  - If opportunity cost of time declines after middle age, food may decline more than entertainment later in life.
Aguiar and Hurst (2005, 2007b, and 2013)

- Show that home production is an important reason that expenditure falls after middle age.

- As households leave labor force, they allocate more time to home production – reducing expenditures on high $\sigma$ goods and increasing expenditures on low $\sigma$ goods.

- Show that food expenditures fall sharply after middle age while entertainment expenditures continue increasing after middle age.

- Use Beckerian model to explain lifecycle profiles of expenditure, Deaton-Paxon facts, and the retirement consumption puzzle.

- Show that insights from the Beckerian model are important for estimates of the amount of risk household face and preference parameters.
Non-Market Time Elasticity With Cost of Time

\[ \left. \frac{d \ln H_i}{d \ln \omega} \right|_{d \lambda = 0} = -\sigma_i \left( 1 - s_h^i \right) - \gamma_i s_h^i \]

- The elasticity of home production time in category i with respect to changes in the opportunity cost of time is unambiguously negative.

- As price of time increases, will shift away from home production to market expenditures in the production of the good.

- As price of time increases, will shift away from consumption today vs. tomorrow.

- **Implication:** As opportunity cost of time increases, home production time should fall (holding lifetime resources fixed).
Market Time Elasticity With Cost of Time

- Weighted average of the non-market time elasticities.
- Labor supply elasticity depends on what you do with your time outside of the market sector.
- If outside time is spent on high $\sigma$ activities (home production), labor supply is more elastic.
- **Women spend more time in home production then men – so they should have more elastic labor supply (Mincer 1962).**
- As home production times of men and women have been converging (a fact we highlight below), labor supply elasticities should be converging.
Additional Model Elements

- Can set the model in general equilibrium
  
  Can endogenize wage movements (market productivity shocks).
  Can allow for shocks to the home production and leisure sectors.

- Explore the business cycle implications (Benhabib, Rogerson, and Wright (1991); Greenwood and Hercowitz (1991)).
  o Generate higher labor supply elasticities at business cycle frequencies.

- Explore implications of innovations in the home production sector (Greenwood and Seshadri (2005), Greenwood et al. (2005)).
  o Generate increasing market hours and declining home hours for women.
Shopping Time

- Detailed time use data combined with price data has allowed researchers to estimate shopping functions.

- Aguiar and Hurst (2007) – first to use scanner data to estimate shopping function parameters (the trade off between time investments and prices).

- Lifecycle Implications – Aguiar and Hurst (2007)

- Business Cycle Implications – Kaplan and Menzio (2014)
  Coibion et al (2015)
  Rios-Rull and Huo (2013)
  Nevo and Wong (2014)

Consensus: Shopping time is an important margin of substitution in explaining prices, employment, consumption, mark-ups, etc.
More Data:
Time Series, Business Cycle and Life Cycle Patterns in Time Use
Data

- All based on 24-hour time diaries.
- **Market Work** – All time working on all paid jobs, time spent commuting to work, any time spent on work related meals and activities.
- **Non-Market Work** – All time in (1) core home production (cooking, cleaning, ironing, dusting, vehicle maintenance, etc.), (2) home ownership activities (painting rooms, repairing roof, mowing lawn, gardening), (3) shopping and obtaining goods and services, and (4) adult care.
- **Child Care** – All time spent caring for, educating, and playing with children (not for pay).
- **Leisure** – All time spent on leisure activities (TV watching, socializing, going to movies, exercising, computer time, eating meals, sleeping, etc.)
- **Other** – Everything else (own health care, education, civic obligations, etc.)
Lifecycle Profile of Market Work

Sample: ATUS Data, Pooled 2003-3007, Fitted 4th Order Polynomial
Lifecycle Profile of Non-Market Work

Sample: ATUS Data, Pooled 2003-3007, Fitted 4th Order Polynomial
Lifecycle Profile of Child Care

Sample: ATUS Data, Pooled 2003-3007, Fitted 4th Order Polynomial
Sample: ATUS Data, Pooled 2003-3007, Fitted 4th Order Polynomial
Can We Identify Business Cycle Effects in Another Way

- Exploit cross-state variation during the recession (Aguiar, Hurst and Karabarbounis 2013).

- For each state pool data over two or three years:
  - 2007 and 2008
  - 2009 and 2010
  - 2011, 2012, and 2013

- Take changes in time use for all individuals within the state between successive pooled year pairs.

- Regress change in time use in state k during period t against change in market work hours in state k during period t.

- 102 state*time pairs.
Sample: ATUS, Ages 21-75, Change in Non Market Work, $\beta = -0.36 (0.04)$
Sample: ATUS, Ages 21-75, Change in Leisure, $\beta = -0.44 \ (0.06)$
Sample: ATUS, Ages 21-75, Change in Job Search, $\beta = -0.018 \ (0.014)$
## Time Use of the Unemployed: Men

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</tr>
<tr>
<td>Child Care</td>
<td>2.63</td>
<td>3.74</td>
<td>2.49</td>
<td>1.21</td>
</tr>
<tr>
<td>Other</td>
<td>2.72</td>
<td>4.59</td>
<td>8.71</td>
<td>5.31</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>22,319</td>
<td>1,625</td>
<td>3,603</td>
<td>3,399</td>
</tr>
</tbody>
</table>
Time Use By Unemployment Duration

- We explore whether the allocation of time changes with the duration of unemployment.

- Hard to do with ATUS data (need to merge to the CPS but there is a gap in measurement).

- Found no evidence of changes in time use by unemployment duration. However, power is an issue.

- Would be interesting to see if people do change the allocation of their time (job search, home production, child care, etc.) the longer they remained unemployed. Selection? Duration?
Conclusions/Next Steps

- A Beckerian model of time use is quite powerful in explaining in life cycle, business cycle, and time series trends in both labor supply and expenditure.

- With the advent of new data, new opportunities are opening up to explore even more questions.
  - Job search
  - Shopping
  - Home production
  - Child care
  - Human Capital
  - Travel times

- It is an exciting time to thinking about the relationship between time use and macroeconomics.