Flexible Work Arrangements and Precautionary Behavior: Theory and Experimental Evidence

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Basel, Oct 09, 2018
Research Question

- Well known fact that labor supply can be transformed into consumption/saving intratemporally

- But are saving and labor supply substitutes intertemporally?
  
  → Could solve (part of) precautionary saving puzzle
  
  → Could explain negative Frisch elasticity
  
  → Saving behavior has strong effects on economic growth
  
  → Practical importance: How should firms or governments regulate work arrangements?
How should firms or governments regulate work arrangements?

BBC Is it the end of the 9 to 5 working day?

HUFFPOST Working 9 'Til 5? Only 6% Of Us Now Have A Traditional Working Day

The Atlantic Walmart's Future Workforce: Robots and Freelancers

Forbes The Future Of Work: Flexible Work Arrangements

CNBC Uber will require US drivers to take six-hour breaks between long shifts
Evidence for precautionary behavior is mixed

There is evidence for precautionary labor supply

**Definition**

**Precautionary Labor Supply.** Difference between hours supplied in the presence of risk and hours under certainty (Flodén, 2006).

- 4.5% of weekly work hours of self-employed are precautionary (e.g. Jessen, Rostam-Afschar, and Schmitz, 2017)

- Precautionary labor supply should show up in savings
Reduction in Hours if Risk becomes Minimal

The graph shows the distribution of hours of work with three categories: Long-Run, Short-Run, and Actual. The x-axis represents the hours of work, while the y-axis represents the fraction of the hours distribution.
"I sleep in my office"

Étienne Gillig, 64, is a freelance artist and earns only 100 euros, but sometimes more than 6,000 euros a month. What's left, goes to the tax office.

By Felicitas Wilke, December 10, 2017, 15:55 / 208 comments

"If things get really tight, there are four times 50 cents on my window sill, four times one euro and four times two euros, which I can then use," says Étienne Gillig. © Simon Koy for TIME ONLINE
Precautionary Saving Puzzle

- But, no evidence for precautionary savings with survey data (e.g. Fossen and Rostam-Afschar, 2013; Lusardi, 1998, 1997)

- \( \log(\text{Savings})_{it} = \beta_0 + \beta_1 \text{Risk}_{it} + \beta_2 \log(\text{Income in absence of shocks})_{it} + Z_{it}\beta_3 + \varepsilon_{it} \)

  Why do regressions of this type not work?

- If intertemporal substitution not via savings, paradox is resolved

  \( \rightarrow \) We formulate a model that allows income shifting by time allocation
Why an experimental study with students may be useful

- **Drawbacks**
  - only qualitative results (but no point looking at quantities if qualitatives wrong)
  - external validity (like in natural experiments)

- **Usual problem in labor economics:**
  Is it preferences, frictions or measurement error?

  **In the lab**
  - Control preferences, wage risk, frictions
  - No measurement error:
    wage risk and effort observed without error
  - Direct test of theory:
    see which part of theory fails under ideal conditions

- **Falk and Heckman (2009):**
  
  “many recent objections against lab experiments are misguided and [] even more lab experiments should be conducted.”
Definition: Labor Supply

Definition

**Supply of Effort.** Effort is total cost incurred during given duration.

Definition

**Supply of Work-Shift Time.** A work-shift is calendar time spent working with continuous effort. Work-shift ends with valuation of total work net of total effort costs accumulated during work-shift.

- We show why work-shift choice (shifting) is equivalent to saving choice (consumption/leisure cuts, extra effort)
Findings of Our Experiment

- On the aggregate level, the model describes subjects’ behavior well
- Extended model with shifting can predict behavior better
- Some who follow the intertemporal model and others who follow the static model coexist
- Combination of extended model and static model works best
- Precautionary saving exists for 82% to 94% of subjects
- Precautionary shifting exists for 40% to 66% of subjects
- Shifting and saving are substitutes, though not perfect substitutes

If governments or labor unions decide to promote variable work arrangements (flexible hours or days) as an alternative to the traditional fixed, 40-hour work week, saving and thus economic growth may be reduced.
The Standard Model

- Work-Shift 1 = Period 1 with wage $w_1$
- Work-Shift 2 = Period 2 with wage $w_2$

- Wage (piece rate) in period 1 certain, uncertain in period 2
- Effort translates into quantity via $q(e_i)$, costs of effort $v(e_i)$ are deducted
- After-tax consumption in each shift $c(y_i)$
- All decisions taken before uncertainty is resolved
- Two scenarios: Hand-to-mouth and Precautionary Saving
- Savings allow to smooth consumption
Our Extension to the Standard Model

We now distinguish between:

- period: time for which a (certain or uncertain) wage is paid,
- work-shift: time of uninterrupted work, income enters \( c(y_i) \),
- round: a round consists of two periods and two shifts.

\[
\text{Work-Shift 1, } w_1 < \quad \text{Period 1, } w_1 \\
\quad 0 \quad 0.2 \times T \\
\quad 0.3 \times T \\
\quad 0.5 \times T \\
\quad 0.7 \times T \\
\quad 0.8 \times T \\
\quad T
\]

\[
\text{Work-Shift 2, } w_1 \text{ and } w_2 > \quad \text{Period 2, } w_2 \\
\quad 0 \quad 0.2 \times T \\
\quad 0.3 \times T \\
\quad 0.5 \times T \\
\quad 0.7 \times T \\
\quad 0.8 \times T \\
\quad T
\]

- Now the worker can (also) adjust the time spent in the work-shifts (total time fixed at \( T \))
- Again, two scenarios: Precautionary Labor Supply and Precautionary Labor Supply and Saving
- Labor supply can also be used to smooth consumption
- Labor supply and saving are perfect substitutes
### Definition of Treatments and Decision Variables

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Standard Model</th>
<th>Extended Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I Hand-to-Mouth</td>
<td>II Saving</td>
</tr>
<tr>
<td>Effort</td>
<td>Allowed</td>
<td>Allowed</td>
</tr>
<tr>
<td>Saving</td>
<td>Not Allowed</td>
<td>Allowed</td>
</tr>
<tr>
<td>Time Allocation</td>
<td>Not Allowed</td>
<td>Not Allowed</td>
</tr>
</tbody>
</table>

#### Choices

<table>
<thead>
<tr>
<th>Effort</th>
<th>Saving</th>
<th>Time Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$e_1, e_2$</td>
<td>$s$</td>
<td>$t$</td>
</tr>
</tbody>
</table>

**Note:** The table above outlines the different treatments and decision variables with their respective allowed options in both the standard and extended models.
Real Effort Task
(Gächter, Huang, and Sefton, 2016)

Periode: 1
Schicht: 1

Gefangene Bälle: 11
Bewegungen: 0

Verdienst/Ball: 100
Verdienst: 1100
Euro-Verdienst: 0.01

Kosten/n. Bew.: 0
Gesamtkosten: 0

Verbleibende Zeit: 05:13
Induced shift-separable CRRA payoff function:

\[ c(y_i) = 4 \log(y_i) - 4 \times 7. \]

Coefficient of relative risk aversion (Pratt, 1964)

\[ -y_i \frac{c''}{c'} = \tau = 1 \]

Coefficient of relative prudence (Kimball, 1990) is

\[ -y_i \frac{c'''}{c''} = \tau + 1 = 2 \]
Payoff Maximization Problem

\[ \max_{y_1, y_2} C = c(y_1) + E[E(c(y_2))]. \] (1)

- **Budget in shift 1 with share of time spent in first work-shift** \( t \)

\[ y_1 = \begin{cases} 
  y_1(t, w_1, e_1, s) & \text{if } t < 0.5 \\
  y_1(0.5, w_1, e_1, s) & \text{if } t = 0.5 \\
  y_1(t, w_1, e_1, w_2, e_2, s) & \text{if } t > 0.5 
\end{cases} \] (2)

- **Budget in shift 2**

\[ y_2 = \begin{cases} 
  y_2(t, w_1, e_1, w_2, e_2, s) & \text{if } t < 0.5 \\
  y_2(0.5, w_2, e_2, s) & \text{if } t = 0.5 \\
  y_2(t, w_2, e_2, s) & \text{if } t > 0.5 
\end{cases} \] (3)

- **First period wage** \( w_1 = 100 \)

- **Second period wage** stochastic i.i.d. \( w_2 = w_1 + \varepsilon \) with \( \varepsilon = \pm 80 \) 20 or 180 with equal probability in second period

- \( e_1 \) and \( e_2 \) denote **effort** in shifts 1 and 2, \( s \) **savings**
How is $y_i$ Determined?

- Costly production: induced quadratic effort costs

Ability function estimated from real effort task:

\[
\text{balls}(\text{moves}) = \beta_0 + \beta_1 \times \sqrt{\text{moves}} + \beta_2 \times \text{moves}^2
\]
Lagrangians in the Standard Model

Treatment I (Hand-to-Mouth):

\[ \mathcal{L}^{I}_i = E_\varepsilon[c(y_i, e_i)] + \mu^I(E_\varepsilon[w_i \times q(e_i) - v(e_i) - y_i]) \] (4)

Treatment II (Precautionary Saving):

\[ \mathcal{L}^{II} = c(y_1, e_1) + E_\varepsilon[c(y_2, e_2)] + \mu^{II}(E_\varepsilon[w_1 \times q(e_2) + w_2 \times q(e_2) - v(e_1) - v(e_2) - y_1 - y_2]) \] (5)
Lagrangians in the Extended Model

Treatment III (Precautionary Labor Supply) + Treatment IV (both):

\[ \mathcal{L}^{\text{III/IV}} = c(y_1, e_1) + E_\varepsilon[c(y_2, e_2)] + \mu^{\text{III/IV}} \left\{ \right. \]

\[ + \mathbb{I}_{\{t=0.5\}} \times \left[ 2 \times t[w_1 \times q(e_1) - v(e_1)] - y_1 ight. \]

\[ + \left. 2 \times (1-t)E_\varepsilon[w_2 \times q(e_2) - v(e_2)] - y_2 \right\} \]

\[ + \left( 1 - \mathbb{I}_{\{t=0.5\}} \right) \mathbb{I}_{\{t<0.5\}} \times \left[ 2 \times t[w_1 \times q(e_1) - v(e_1)] - y_1 \right. \]

\[ + \left. 2 \times (0.5-t)[w_1 \times q(e_1) - v(e_1)] \right. \]

\[ + \left. 2 \times 0.5E_\varepsilon[w_2 \times q(e_2) - v(e_2)] - y_2 \right\} \]

\[ + \left( 1 - \mathbb{I}_{\{t=0.5\}} \right) \left( 1 - \mathbb{I}_{\{t<0.5\}} \right) \times \left[ 2 \times 0.5[w_1 \times q(e_1) - v(e_1)] \right. \]

\[ + \left. 2 \times (t-0.5)E_\varepsilon[w_2 \times q(e_2) - v(e_2)] - y_1 \right. \]

\[ + \left. 2 \times (1-t)E_\varepsilon[w_2 \times q(e_2) - v(e_2)] - y_2 \right\} \]
Optimality Conditions

Treatment I:

\[ c_{y_1}(w_1 q_{e_1} - v_{e_1}) = -c_{e_1}, \]  \hspace{1cm} (7)

\[ E\varepsilon[c_{y_2}(w_2 q_{e_2} - v_{e_2})] = -E\varepsilon[c_{e_2}]. \]  \hspace{1cm} (8)

Income and effort can be traded at a rate equal to the difference between valued marginal production and marginal costs.

Treatment II/III/IV:

\[ c_{y_1}(w_1 q_{e_1} - v_{e_1}) = -c_{e_1}, \]  \hspace{1cm} (9)

\[ E\varepsilon[c_{y_2}(w_2 q_{e_2} - v_{e_2})] = -E\varepsilon[c_{e_2}], \]  \hspace{1cm} (10)

\[ c_{y_1} = E\varepsilon[c_{y_2}]. \]  \hspace{1cm} (11)

Standard consumption Euler equation
Experimental Design

- Within-subject design (with 192 subjects)
- No interest, no discounting
- 3 trial periods and 4 treatment rounds with 2 periods for each subject
- In each of the 7 periods/rounds subjects complete real effort task
- In treatment round 2, 3, 4 subjects additionally make choices
  - Round 2: savings choice
  - Round 3: work-shift allocation
  - Round 4: both
- Elicitation of risk aversion: 12 binary choices between lotteries
- Subjects were invited using ORSEE (Greiner, 2015)
- Experiments were run on z-Tree (Fischbacher, 2007) at PLEX (Uni Potsdam) in November and December 2017
- Subjects were paid according to result of
  - one randomly chosen trial period,
  - one of the four treatment rounds,
  - with 5% chance of the risk aversion questions.
- Payoffs revealed only at the very end of the experiment
- Average duration 90 minutes, average 15 Euro, min 0, max 66
Ball Catching Task for Treatment III
(Gächter, Huang, and Sefton, 2016)
In Schicht 1 haben Sie 3727 Punkte verdient. Jetzt haben Sie die Möglichkeit zu sparen.


Bitte nutzen Sie den Schieber in der Box, um die hypothetischen Konsequenzen von unterschiedlichen Sparbeträgen auf Ihre Auszahlungen zu ermitteln.

Geben Sie dann Ihren Sparbetrag in dem Feld in der zweiten Box ein und bestätigen Sie Ihre Eingabe mit dem OK-Button.

<table>
<thead>
<tr>
<th>Ersparnis in Punkten:</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verdienst - Ersparnis in Schicht 1:</td>
<td>1706</td>
</tr>
<tr>
<td>Neuer Euro-Verdienst für Schicht 1:</td>
<td>1.88</td>
</tr>
</tbody>
</table>

Bitte geben Sie hier Ihren Sparbetrag in Punkten ein!

Ihre Ersparnis: [Eingabefeld]
Dies ist die erste Entscheidung. Wählen Sie die Option, die Sie besser finden. Bitte entscheiden Sie sich zwischen "Option L" und "Option R"! (Nach dem Klick auf Ihre Wahl geht es direkt weiter zur nächsten Entscheidung.)

<table>
<thead>
<tr>
<th>Option L:</th>
<th>Option R:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>4, 5, 6</td>
<td>4, 5, 6</td>
</tr>
<tr>
<td>20 Euro</td>
<td>5 Euro</td>
</tr>
</tbody>
</table>

Von den beiden Optionen bevorzuge ich: Option L
Option R
Hypotheses 1 to 4

- Hypothesis 1 (Direct reduction of effort by risk).

- Hypothesis 2 (Precautionary saving and effort):
  - i (Existence of precautionary motive).
  - ii (Absence of precautionary effort).

- Hypothesis 3 (Precautionary shifting):
  - i (Existence of precautionary shifting).

- Hypothesis 4 (Equivalence of saving and shifting).
Theoretically, Work-Shift Choice and Saving Choice Substitutes
The Work-Shift-Savings-Payoff Space in **GRAPH3D for Stata**
The Work-Shift-Savings-Payoff Space in GRAPH3D for Stata
Behavior in T4 After 10 Seconds

![Graph showing the relationship between movements and payoff in Euro. The graph includes data points for Payoff with 3 Balls per Movement, with separate markers for Shift 1 (red circles) and Shift 2 (blue diamonds).]
Behavior in T4 After 20 Seconds

Payoff with 3 Balls per Movement

- Payoff in Euro
- Movements

- Payoff with 3 Balls per Movement
  - Shift 1
  - Shift 2
Behavior in T4 After 30 Seconds

![Graph showing the relationship between movements and payoff in Euro. The graph indicates the payoff with 3 balls per movement, with two shifts labeled as Shift 1 (orange dots) and Shift 2 (blue diamonds).]
Behavior in T4 After 40 Seconds

The graph shows the behavior of subjects in T4 after 40 seconds, with payoffs measured in Euros. The data is plotted against movements, with payoffs ranging from -15 to 15 Euros and movements ranging from 0 to 60.

The graph includes two shifts: Shift 1 (circles) and Shift 2 (diamonds). The payoffs are higher with 3 balls per movement compared to 1 or 2 balls per movement.
Behavior in T4 After 50 Seconds

Payoff with 3 Balls per Movement

- Shift 1
- Shift 2
Behavior in T4 After 60 Seconds

Payoff in Euro

Movements

Payoff with 3 Balls per Movement

- Shift 1
- Shift 2
Behavior in T4 After 70 Seconds

![Graph showing behavior in T4 after 70 seconds. The x-axis represents movements, and the y-axis represents payoff in Euro. The graph includes data for two shifts, with 'Shift 1' represented by orange circles and 'Shift 2' by blue diamonds. The legend indicates 'Payoff with 3 Balls per Movement'.]
Behavior in T4 After 80 Seconds

Payoff with 3 Balls per Movement

Shift 1
Shift 2
Behavior in T4 After 90 Seconds

![Plot showing behavior in T4 after 90 seconds with data points for Payoff with 3 Balls per Movement for Shift 1 and Shift 2. The x-axis represents Movements, and the y-axis represents Payoff in Euro. The plot includes a line indicating the Payoff with 3 Balls per Movement.]
Behavior in T4 After 100 Seconds

Payoff in Euro

Movements

Payoff with 3 Balls per Movement
- Shift 1
- Shift 2
Behavior in T4 After 110 Seconds

Payoff with 3 Balls per Movement

- Shift 1
- Shift 2

Movements

Payoff in Euro
Behavior in T4 After 120 Seconds

Payoff in Euro

Movements

Payoff with 3 Balls per Movement

Shift 1

Shift 2
Behavior in T4 After 130 Seconds

![Behavior Diagram]

- **Payoff in Euro**

- **Movements**

- **Payoff with 3 Balls per Movement**

  - **Shift 1**
  - **Shift 2**
Behavior in T4 After 140 Seconds

Payoff with 3 Balls per Movement

- Shift 1
- Shift 2
Behavior in T4 After 150 Seconds

Payoff in Euro

Movements

Payoff with 3 Balls per Movement
- Shift 1
- Shift 2
Behavior in T4 After 160 Seconds

Payoff with 3 Balls per Movement
- Shift 1
- Shift 2
Behavior in T4 After 170 Seconds

![Behavior in T4 After 170 Seconds](image-url)

- **Payoff in Euro**
  - 0 10 20 30 40 50 60
- **Movements**
  - -15 -10 -5 0 5 10 15

**Graph Details**
- **Payoff with 3 Balls per Movement**
  - Orange dots: Shift 1
  - Blue diamonds: Shift 2
Behavior in T4 After 180 Seconds

![Graph showing movements and payoffs for different shifts.](image-url)

- **Payoff with 3 Balls per Movement**
  - **Shift 1**: Orange dots
  - **Shift 2**: Blue squares

The graph illustrates the behavior of participants in T4 after 180 seconds, focusing on movements and payoffs with 3 balls per movement. The data points are color-coded to distinguish between Shift 1 and Shift 2.
End of first period

Now wage can be either high or low
Behavior in T4 After 200 Seconds

Payoff in Euro

Movements

Wage Payoff 3 Balls/Move Wage Payoff 3 Balls/Move Wage Shift 1 Wage Shift 1 Wage Shift 2 Wage Shift 2
Behavior in T4 After 220 Seconds

The diagram shows the relationship between movements and payoff in Euros for different shifts and wages. The data is color-coded by wage and shift (Shift 1 and Shift 2).

- **Payoff 3 Balls/Move**
- **Wage**
  - Shift 1
  - Shift 2

The graph illustrates how different wage levels affect the payoffs over the course of 220 seconds, with movements on the x-axis and payoff in Euros on the y-axis.
Behavior in T4 After 230 Seconds

The graph shows the behavior of participants in a payoffs experiment, with data points representing different shifts and movement payoffs. The x-axis represents movements, while the y-axis represents payoffs in Euros. The graph includes data for two shifts, with different symbols indicating wage payoffs and movement payoffs per ball. The data points are color-coded to distinguish between shifts and payoffs.
Behavior in T4 After 250 Seconds

The graph shows the relationship between movements and payoff in Euro for different shifts and wage conditions. The x-axis represents movements, while the y-axis represents the payoff in Euro. Different symbols and colors are used to indicate different shifts and wage conditions.

- Shift 1: Red circles for Wage and blue diamonds for Payoff 3 Balls/Move.
- Shift 2: Orange circles for Wage and gray diamonds for Payoff 3 Balls/Move.

The data suggests that there is a positive correlation between movements and payoff, with higher movements generally associated with higher payoffs.
Behavior in T4 After 260 Seconds

-15 -10 -5 0 5 10 15

Payoff in Euro

Movements

Wage

Payoff 3 Balls/Move

Wage

Shift 1

Wage

Shift 2

Wage

Shift 1

Wage

Shift 2
Behavior in T4 After 270 Seconds

The graph shows the behavior of subjects in two shifts (Shift 1 and Shift 2) over movements ranging from 0 to 60. The y-axis represents the payoff in Euro, ranging from -15 to 60. The x-axis represents the number of movements. The data points are color-coded to indicate wage levels, with different symbols for each shift. The graph compares the payoffs for moving 3 balls per move between the two shifts.
Behavior in T4 After 290 Seconds

![Graph showing behavior in T4 after 290 seconds. The x-axis represents movements, and the y-axis represents payoff in Euro. The graph includes data points for different shifts and wage levels.]

-15 -10 -5 0 5 10 15
Payoff in Euro
0 10 20 30 40 50 60
Movements
Wage Payoff 3 Balls/Move Wage Payoff 3 Balls/Move Wage Shift 1 Wage Shift 1 Wage Shift 2 Wage Shift 2

58
Behavior in T4 After 300 Seconds
Behavior in T4 After 310 Seconds

Payoff in Euro vs. Movements for Wage and Payoff 3 Balls/Move for Shift 1 and Shift 2.
Behavior in T4 After 320 Seconds

The diagram shows the relationship between movements and payoff in Euros. The data is split into two shifts: Shift 1 and Shift 2. The payoffs are colored differently for each wage rate:

- **Wage**: Light blue squares and orange circles for Shift 1 and Shift 2, respectively.
- **Payoff 3 Balls/Move**: Black diamonds for Shift 1 and blue diamonds for Shift 2.

The movements range from 0 to 60, and the payoffs range from -15 to 15 Euros.
Behavior in T4 After 330 Seconds

![Graph showing behavior in T4 after 330 seconds. The graph plots movements against payoffs in euros, with different symbols representing wage levels and shifts.](image-url)
Behavior in T4 After 340 Seconds
Behavior in T4 After 350 Seconds

![Graph showing behavior in T4 after 350 seconds. The x-axis represents movements, and the y-axis represents payoff in Euro. The graph includes data for Wage Shift 1 and Wage Shift 2, with different symbols for Payoff 3 Balls/Move.](image)
End of second period
H1: Effort Smaller in Second Work-Shift than in First Work-Shift
H2i: Precautionary Savings are Positive for Most
H2ii: Absence of Precautionary Effort (Higher First Shift Effort)
H3i: Work-Shift 1 is Shorter Than Work-Shift 2 for Most
Saving vs Shifting

- **T1**: Only Saving Choice
- **T4**: Shifting and Saving

---

**Top Graph**
- Frequency on y-axis
- % of Income Saved on x-axis
- Data points for T2 and T4

**Bottom Graph**
- Frequency on y-axis
- % Income Shifted on x-axis
- Data points for T3 and T4
H4i: Less Savings if Work-Shift Choice Allowed
Longer First Work-Shift if Saving Allowed
Shifting as a Substitute for Savings

The diagram illustrates the relationship between the percentage of income saved and the percentage of income shifted in T4. The data points are color-coded to represent different categories:

- Teal (Theoretical)
- Pink (Substituter)
- Blue (Standard-Model)
- Green (Other)

The scatter plot shows a trend where a higher percentage of income saved is associated with a lower percentage of income shifted, and vice versa. The theoretical line indicates the expected relationship based on the model, whereas the actual data points show the observed behavior.
Longer First Work-Shift if Saving Allowed

% of Income Shifted in T4

% of Income Shifted in T3

Substituter in T4
Standard-Model in T4
Other in T4
45 Degree
Less Savings if Work-Shift Choice Allowed
## Statistical and Economic Significance

<table>
<thead>
<tr>
<th>H1: Effort Smaller in Second Work-Shift than in First Work-Shift</th>
<th>T1 Shift 1</th>
<th>T1 Shift 2</th>
<th>Difference 95% Conf. Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movements</td>
<td>32.71</td>
<td>26.54</td>
<td>4.61-7.75</td>
</tr>
<tr>
<td>Log Effort Cost</td>
<td>6.66</td>
<td>5.99</td>
<td>0.52-0.83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H2i: Proportion With Savings Higher than 100 Points</th>
<th>T2</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (%)</td>
<td>89.58</td>
<td>86.98</td>
</tr>
<tr>
<td>Std. Err. (%)</td>
<td>(2.20)</td>
<td>(2.43)</td>
</tr>
<tr>
<td>95% Conf. Interval</td>
<td>85.26-93.90</td>
<td>82.22-91.74</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H2ii: Absence of Precautionary Effort (Higher First Shift Effort)</th>
<th>T1 Shift 1</th>
<th>T2 Shift 1</th>
<th>Difference 95% Conf. Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movements</td>
<td>32.70</td>
<td>30.73</td>
<td>-3.59 to -0.37</td>
</tr>
<tr>
<td>Log Effort Cost</td>
<td>6.66</td>
<td>6.46</td>
<td>-0.35 to -0.05</td>
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<table>
<thead>
<tr>
<th>H3i: Proportion With Work Shift 1 Shorter than 180 Seconds</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (%)</td>
<td>58.85</td>
<td>47.40</td>
</tr>
<tr>
<td>Std. Err. (%)</td>
<td>(3.55)</td>
<td>(3.60)</td>
</tr>
<tr>
<td>95% Conf. Interval</td>
<td>51.89-65.81</td>
<td>40.33-54.46</td>
</tr>
</tbody>
</table>
Are Shifting and Saving Perfect Substitutes?

<table>
<thead>
<tr>
<th></th>
<th>Expected Euro earnings</th>
<th>Low Euro earnings</th>
<th>High Euro earnings</th>
</tr>
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Robust standard errors clustered at subject level.
Significantly different from zero at the 1%-level: ***, 5%-level: **.
Significantly different from Treatment II’s coefficient at the 1%-level: a, from Treatment III’s: b, from Treatment IV’s: c.

Source: Own calculations.
## Differences in Treatments: H2i, H3i, H4

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|                         |          |              |                  |            |              |                  |                  |
| Treatment II-IV         | 500***   (82.2) |              |                  | -106       (153.7) | -431***       |                  |                  |
| Treatment III-IV        | -5       (4.7)   | -8***       | -1183***         | (153.8)    | -420***      |                  |                  |
| Constant (IV)           | 1511*** (41.1) | 171***      | 126***           | 2118*** (87.5) | 2668***      |                  |                  |
| Subject FE              | ✓       | ✓            | ✓                | ✓          | ✓            | ✓                 |                  |
| Observations            | 384     | 384          | 205              | 576        | 451          |                  |
Ability to Catch Balls and Prediction

Ability function estimated from real effort task ($R^2 : 0.77$):

$$\text{balls(moves)} = 63.337 + 12.491 \times \sqrt{\text{moves}} - 0.001 \times \text{moves}^2$$
### Differences in Treatments and Predictions: H2i, H3i, H4

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<th>II</th>
<th>III</th>
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<td>(11.1)</td>
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<td>33***</td>
<td>32***</td>
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<td>171</td>
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### Behavioral Strategies

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<tr>
<td>(1) Hand-to-Mouth</td>
<td>(2) Saving</td>
<td>(3) Shifting</td>
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<td>TII</td>
<td>8.3%</td>
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<td>TIII</td>
<td>17.7%</td>
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<tr>
<td>TIV</td>
<td>4.2%</td>
<td>41.7%</td>
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**Notes:**
- TI, TII, TIII, TIV represent different time periods or conditions.
- The table shows the percentage distribution across the specified models and their combined outcomes.
Conclusions

- Overall, the model predicts actual behavior quite well
- Precautionary saving exists for 82% to 94% of subjects
- Precautionary shifting exists for 40% to 66% of subjects
- Shifting and saving are substitutes, though not perfect substitutes
- Behavioral strategies and effect of flexible work time on savings identifiable with data on shifts and shift- and period-specific wages
Thanks for your attention!

davud.rostam-afschar@uni-hohenheim.de


Kimball, M. S. (1990): “Precautionary saving in the small and in the large,” *Econometrica*, 84


<table>
<thead>
<tr>
<th>Study</th>
<th>Data Set</th>
<th>Data Period</th>
<th>Measures of Risk</th>
<th>Precautionary Saving</th>
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<tr>
<td>Lab experiment</td>
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<td>Meissner and Rostam-Afschar (2017)</td>
<td>Students at TU-Berlin</td>
<td>Eight life cycles à 25 periods</td>
<td>35% of expected value with probability 0.5</td>
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<td>Brown, Chua, and Camerer (2009)</td>
<td>Students at National University of Singapore and California Institute of Technology</td>
<td>Seven life cycles à 30 periods</td>
<td>Log-normally distributed</td>
<td>Undersaving</td>
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<td>Ballinger, Palumbo, and Wilcox (2003)</td>
<td>Students at University of Houston and Stephen F. Austin State University</td>
<td>One life cycle à 60 periods</td>
<td>Two treatments: 3 francs (5%) or 5 francs (5%); otherwise, 4 francs, 50% 8 francs and 50% 0 francs</td>
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<td>Hey and Dardanoni (1988)</td>
<td>Students at University of York</td>
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<td>1993-2008</td>
<td>Subjective earnings variance, second income earner</td>
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<td>Lusardi (1997)</td>
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<td>1989</td>
<td>Self-reported</td>
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<td>Guiso, Jappelli, and Terlizzese (1992)</td>
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<td>UK Family Expenditure Survey</td>
<td>1984</td>
<td>Variance of labor income</td>
<td>&gt; 60%</td>
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Table continued on next page.
<table>
<thead>
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<td>2001-2012</td>
<td>Standard deviation of past detrended log wages</td>
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<td>Jessen, Rostam-Afschar, and Schmitz (2017)</td>
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<td>Parker, Belghitar, and Barmby (2005)</td>
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<td>Broadway and Haisken-DeNew (2017)</td>
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<td>1993;1995</td>
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<td>Ventura and Eisenhauer (2006)</td>
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<td>1972-1973</td>
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<td>Dynan (1993)</td>
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<td>Skinner (1988)</td>
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<td>Cagetti (2003)</td>
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<td>Caballero (1991)</td>
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<td>&gt; 60%</td>
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Notes: Importance figure is sometimes calculated from several sources in the respective paper, please read the paper for details. Datasets are De Nederlandsche Bank household survey (DHS), German Socio-Economic Panel (SOEP), Italian Survey of Household Income and Wealth (SHIW), Household, Income and Labour Dynamics in Australia (HILDA), Consumer Attitudes, Sentiments and Expectations (CASIE), British Household Panel Survey (BHPS), National Longitudinal Survey (NLS), Health and Retirement Study (HRS), Consumer Expenditure Survey (CEX), Survey of Consumer Finances (SCF), Panel Study of Income Dynamics (PSID).
## Characteristics

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*Source: Authors’ calculations.*
Pairwise correlations of balls per movement in the two work-shifts

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<th>T2, shift 1</th>
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<th>T3, shift 1</th>
<th>T3, shift 2</th>
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<td>0.605***</td>
<td>0.521***</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T3, shift 2</td>
<td>0.547***</td>
<td>0.474***</td>
<td>0.586***</td>
<td>0.421***</td>
<td>0.564***</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>T4, shift 1</td>
<td>0.550***</td>
<td>0.462***</td>
<td>0.615***</td>
<td>0.477***</td>
<td>0.729***</td>
<td>0.512***</td>
<td>1</td>
</tr>
<tr>
<td>T4, shift 2</td>
<td>0.553***</td>
<td>0.570***</td>
<td>0.597***</td>
<td>0.429***</td>
<td>0.533***</td>
<td>0.626***</td>
<td>0.620***</td>
</tr>
</tbody>
</table>
Means and kernel density distributions of balls per movement
Ability to Catch Balls and Prediction

Period 1 ($R^2 : 0.65$):

$$\text{balls(moves)} = 43.8091 + 6.3099 \times \sqrt{\text{moves}} - 0.0001 \times \text{moves}^2$$

Period 2 ($R^2 : 0.73$):

$$\text{balls(moves)} = 40.8174 + 6.9724 \times \sqrt{\text{moves}} - 0.0010 \times \text{moves}^2$$