III. Reference-Dependent Preferences and Labor Supply

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Motivation

Labor supply is at the heart of a fundamental problem facing the employer:

- Elicit optimal labor supply (effort) from workers, even though effort is difficult to monitor.

Firms care **how much effort** employees exert, and also **when**.

- High average level of effort is important.
- But firms also want workers to save their greatest effort for times when the MRP of effort is highest (e.g., on days when customers are rushing into the shop)
Labor Supply and Incentives

Standard model makes a clear prediction

• Workers will work harder when monetary incentives (wages) are high

Suggests a solution for the employer:

• Use appropriate monetary incentives to elicit effort, e.g. link earnings to output, which is more-easily observed

• This type of “piece rate” compensation creates an incentive to work hard at times when demand for output is especially high, because high demand implies a higher hourly wage under piece rates
But there are competing intuitions…

• Effort is costly
  
  Inelastic MC of effort may prevent response of effort to incentives

• Monetary incentives are not the only motive for exerting effort
  
  People have reference-dependent preferences, i.e. strong preference for not falling short of a personal reference level, or goal.

  ➢ A higher wage can even reduce daily effort, by causing a worker to reach a daily income goal earlier in the day and removing this important source of motivation for the rest of the day.
Old Literature on Labor Supply

Tests how effort responds to transitory wage changes

Basic stylized fact: little support for standard prediction…

- Small and insignificant, or even negative impact
  (Mankiw et al., 1985; Pencavel, 1986; Altonji, 1986; Blundell, 1994; Card, 1994; Blundell and MaCurdy, 1999)

But difficult to interpret this evidence due to data limitations:
- Main limitation: not clear that institutional setting allows flexibility in the choice of labor supply
- Other limitations: Are wage changes anticipated? Transitory or permanent?
New literature on labor supply

We will discuss a new literature that tests the response of effort to incentives in “neoclassical” work environments

Work settings without rules and institutions limiting the flexibility of effort, i.e. piece-rate jobs

But direct link between daily effort and earnings means individuals are likely to have daily income goals, which may interact in important ways with monetary incentives

Despite the possibility to adjust effort, these studies find:

- Effort is unchanged, or even falls, after a wage increase
- Consistent with RDP and a daily income goal
  (Camerer et al, 1997; Shearer, 2002; Chou, 2003; Farber, 2003; Treble, 2003; Fehr and Goette, 2006; Goette and Huffman, 2006)
Empirical Obstacles

- In some cases, unclear whether wage variation is truly exogenous
  (Camerer et al, 1997; Chou, 2003; Farber, 2003)

- In most cases, evidence is consistent with two possible explanations
  - Effort costs limit response to incentives
  - RDP, or goal-motivated behavior leads to perverse effect of incentives

  The most recent paper, Goette and Huffman (2006), tries to disentangle fatigue and RDP explanations
Main Literature


Theory
Consider an individual who maximizes the following time-separable utility function:

$$U_o = \sum_{t=0}^{T} \beta^t u (c_t, e_t)$$  \hspace{1cm} (1)$$

where lifetime utility is the sum of $T$ one-period utility functions, $u(.,.)$, and $\beta < 1$ denotes the discount factor. $c_t$ denotes consumption, and $e_t$ is effort in period $t$.

Utility is increasing in $c_t$, and decreasing in $e_t$. 
The usual lifetime budget constraint applies, i.e. the PDV of expenditure over the lifetime must not exceed the PDV of labor and non-labor income.

\[ \sum_{t=0}^{T} p_t c_t (1+\rho)^{-t} = \sum_{t=0}^{T} (w_t e_t + y_t) (1+\rho)^{-t} \]  

(2)

\( p_t \): price of the consumption good  
\( w_t \): the period \( t \) wage per unit of \( e_t \) 
\( y_t \): non-labor income  
Interest rate \( \rho \) is constant and that there is no uncertainty regarding the time path of prices and wages
Differentiating the associated Lagrange function with respect to $c_t$ and $e_t$ yields the following two first order conditions:

\[ u_c(c_t, e_t) = \lambda \hat{p}_t \]  
\[ -u_e(c_t, e_t) = \lambda \hat{w}_t \]  

- $\hat{p}_t$ is defined as $p_t/((\beta (1 + \rho))^t$ and can be interpreted as the discounted price.
- $w_t$ is defined analogously.
- $\lambda$: Lagrange multiplier for the life-time budget constraint, i.e., $\lambda$ represents the marginal utility of life-time wealth.
A simpler, but equivalent representation of the previous choice problem is the following static utility function:

\[ V(e_t) = \lambda (\hat{w}_t e_t - y_t) - g(e_t, \lambda \hat{p}_t) \]  

(5)

- \( \lambda \hat{w}_t e_t \) is the discounted utility of income arising from effort in period \( t \), and \( \lambda y_t \) is discounted utility from non-labor income
- \( g(e_t, \lambda) \) is a convex, money-metric cost function of effort
- (5) focuses attention on the optimal effort choice in period \( t \), as a function of income, but the condition restricts the consumption decision to be optimal in period \( t \) as well.
F.O.C.: \[ g'(e_t) = \lambda \hat{w}_t \]

This simple FOC makes two key implications transparent:

- An **anticipated** wage increase leads to higher effort in the standard model
  \( (\lambda \text{ is constant when an anticipated wage change occurs}) \)

- The curvature of \( g'(\) limits the response of effort to the wage change. So zero response could be optimal…

What about income-effects, i.e. the impact of wage changes on \( \lambda \)?
The key point is that income-effects are linked to the timing of information, not to the timing of wage changes *per se*.

The optimal paths for $e_t$ and $c_t$ are chosen so that $\lambda$ is constant over time. In this calculation, the impact of *Anticipated* wage changes on lifetime income have been taken into account, so $\lambda$ remains *constant* at the time when these wage changes eventually occur.

New information, about an *unanticipated* wage increase, can have an income-effect, reducing $\lambda$ in the instant the information arrives. Thereafter, however, $\lambda$ is again constant.

- Income-effects occur when new information arrives.
- When anticipated wage increases eventually occur, only the intertemporal substitution effect is relevant, and so effort must increase at that time.
Reference-Dependent Preferences

Evidence from psychology suggests that the standard model leaves out a fundamental aspect of human preferences: reference-dependence.

– Standard model assumes that the valuation of a given change in income depends only on the impact on the level of income

– In fact, the valuation typically depends crucially on whether the change is viewed as a gain or a loss, relative to some reference level

– Intuitively, how painful it is to lose 1 euro depends on how your current income compares to a reference level, say, the level you are used to, or the level you expected.
Example 1:

Suppose I offer you the following choice, in euros:

A: Win 5 with probability \( \frac{1}{2} \), Lose 3 with probability \( \frac{1}{2} \).
B: Receive nothing

Will you choose A or B?

- Majority of people reject lottery A, even though EV>0  
  (N=72, Fehr and Goette, 2003)
- For risk aversion to explain rejection, necessary to assume wildly-implausible curvature of utility function for lifetime wealth (see Rabin, 2000)
- People are simply **loss averse**. They do not want to fall below the reference level, which is zero in this choice experiment.
Example 2 [N=73]:

Charles and David both follow workout plans that usually involve doing 25 sit-ups [they are equally fit].

One day, Charles sets a goal of performing 30 sit-ups. He finds himself very tired after performing 34 sit-ups and, at most, has the energy to perform 1 more.

David sets a goal of performing 40 sit-ups. He finds himself very tired after 34 sit-ups and, at most, has the energy to perform 1 more.

Who will work harder to perform the 35th sit-up?

(Heath, Larrick, and Wu, 1999)

- Charles (28%)  David (82%)
- David places greater value on an additional sit-up
- Consistent with LA when below a personal goal
A Descriptive Theory of RDP

Kahneman and Tversky (1979) were the first to highlight a body of evidence lending strong support to RDP.

- They proposed a function $v()$, now known as the “KT value function,” which describes the two key properties of RDP.
  
  1. Loss aversion (LA): people dislike losses about twice as much as they like gains of the same size
  
  2. Diminishing sensitivity (DMS): decrease in the marginal valuation of an outcome to as distance from the r-point increases.

- The function $v()$ will be the basis of our model of labor supply that incorporates RDP.
Figure 1: The Kahneman-Tversky Value Function

- Gain: Outcome > Reference Point
- Loss: Outcome < Reference Point

Valuation of Revenues vs. Outcome
K&T (1979) identify two steps in decision-making with RDP:

1. **A framing or editing phase**, strongly influenced by vivid cues from the individual’s environment, which determines the reference level perceived by the individual.

2. **An evaluation phase**, in which the individual makes the comparison to the reference level and LA and DMS come into play.

**Relevant for daily labor supply…**

If we take this evidence seriously, and then consider individuals who are free to choose effort and who are paid a piece rate, it seems likely that these workers end up with a **daily reference point for earnings in the framing phase**.

- Vivid link between daily effort and daily earnings,
- Clear division of work into day-long periods,
Evidence on the Sources of RDP

• Growing evidence that human decision making involves a tension: long-term considerations vs. temptation to act impulsively in the moment (Cohen, 2005).
• Evidence from neuroscience points to emotion, or affect, as the source of short-sighted impulses.
  – Affective brain regions more active when choosing immediate rewards, or rejecting unfair offers.
  – Cognitive areas more active when people act like homo economicus (choose patiently, accept unfair offers).
  – Brain lesions in affective regions reduce impulsiveness.
  – People can consciously enlist cognitive areas of the brain to counteract activation of affective regions.
• Overall: suggests cognitive system similar to homo economicus struggling to control impulsive affective system.
Evidence on the Sources of RDP

- Can the role of affect in decision making explain RDP?
- Loss aversion appears to be linked to affect:
  - Loss aversion disappears in patients with brain lesions in regions related to affect.
  - Loss aversion is present in monkeys, who share our affective system but have a more limited cognitive system.
  - People predict that individuals experience more emotion if they fall short of a goal or reference point.
    - In the sit-ups study discussed earlier, people predict that David, who has done 30 sit-ups and is below his goal, is experiencing more emotion than Charles who has done 30 but is above his goal.
Evidence on Sources of RDP

• Affect also seems to be linked to a pattern similar to diminishing sensitivity:
  – Monkeys working towards a goal show increased activation in the affective system as the goal draws near (Shidara and Richmond, 2002).
  – They work faster, and make fewer mistakes, as visual cues signal increased proximity of the goal.
  – This suggests a role of the affective system in producing motivation to reach a reward or goal.
  – Increased emotional arousal as a goal draws near leads to a “goal gradient” in effort.
    • A goal gradient has been documented in many animal studies.
    • Also in experiments with humans (college athletes..).
Labor Supply, This Time with More Feeling

• A “dual-process” model in the spirit of O’Donoghue and Loewenstein (2005), from Goette and Huffman (2006).

• Consider a workday $k$, divided into $m$ work episodes of length $\Delta$. Work episode $t$ lasts until $t + \Delta$.

• The individual maximizes a two-part objective function.

• The first corresponds to the cognitive system, and is the same as the standard model.

$$ (1) \quad w_t e_t - c(e_t) $$

• The second part corresponds to the affective system, and incorporates evidence on emotion.
Labor Supply, This Time with More Feeling

\[(2) \quad v(w_t e_t - r) - c(e_t)\]

- Assume the worker has a daily earnings goal \( r \) in mind.
- The affective system cares about changes in income during the day, relative to this goal.
- Assume \( v() \) convex below the goal, concave above.
  - I.e., affective system’s valuation of another dollar is increasing as approach goal from below, decreasing as move farther above the goal.
  - Corresponds to goal gradient, and diminishing sensitivity
- Assume kink in \( v() \) at the goal.
  - Affective system cares more about another dollar when below the goal by amount \( X \) than when above the goal by the same amount.
  - Corresponds to loss aversion
Labor Supply, This Time with More Feeling

- Combine the two parts into one objective function.
- Assume two time periods: morning and afternoon.
- The cognitive system maximizes its objective function, but must pay a willpower cost if it chooses an effort level different from the one preferred by the affective system.

\[
\text{Max } Q_t = we_1 + we_2 - c(e_1) - c(e_2)
\]

\[
- h[v(we_1^A - r) - c(e_1^A) - (v(we_1 - r) - c(e_1))]
\]

\[
- h[v(w(e_1 + e_2^A) - r) - c(e_2^A) - (v(w(e_1 + e_2) - r) - c(e_2))]
\]

- Willpower costs \( h \) increase linearly in deviations from the effort level \( e^A \) that maximizes the affective system’s objective function.
Predictions

• Suppose worker below the goal for first two periods of the day, and above the goal in the last period.
  – Effort is increasing from period 1 to period 2, and then decreases in period 3.

• What happens if there is a wage increase?
  – Under certain conditions on the curvature of $v()$, effort increases in early periods, and decreases in periods in the end of the day.
  – Intuitively, the wage increase causes the worker to start closer to the goal at the beginning of the day.
    • Goal gradient reinforces financial incentives early in the day.
    • The wage increase further decreases the affective system’s valuation of income later in the day, when the goal is already achieved, and thus effort can drop if willpower costs are high.
Empirical Evidence
The Labor Supply of Cabdrivers

• Cabdrivers are potentially good subjects for studying the response of effort to wages

• They face wages that fluctuate on a daily basis due to demand shocks (weather, holidays, conventions)
  – Rates per mile set by law
  – But spend less time searching for customers on busy days, yielding a higher hourly wage

• Relatively free to choose effort
  – Rent or own cab, free to drive for as many hours as they like during a shift (typically a 12 hour shift in NYC)
Empirical Strategy in Cabdriver Studies

Data: total hours and total daily earnings for individuals

Typical regression: \( \ln(h_{it}) = \gamma \ln(w_{it}) + \text{controls} + e_{it} \)

Hourly wage for day \( t \) calculated as \( \frac{y_{it}}{h_{it}} \)

- Daily fluctuations in \( w \) have no income effect (even if unanticipated) because transitory.
- \( \gamma \) is the intertemporal elasticity of substitution and must be positive
- IV estimate (e.g. average wage of other cab drivers) to correct for measurement error in hours, \( h \), which could bias elasticity downward.
Estimates of the intertemporal elasticity of substitution

<table>
<thead>
<tr>
<th>Study</th>
<th>OLS estimate</th>
<th>IV estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camerer et al. (1997)</td>
<td>-0.62***</td>
<td>-0.93***</td>
</tr>
<tr>
<td>Chou (2001)</td>
<td>-0.51***</td>
<td>-0.85***</td>
</tr>
<tr>
<td>Farber (2003)</td>
<td>-0.64***</td>
<td>NA</td>
</tr>
</tbody>
</table>

- Contrary to standard prediction
- Consistent with RDP and daily income target
Problems with this approach

• Where does the variation in wages come from?

Camerer et al. (1997) and Chou (2001) claim:
Shifts in demand for cabs

But: There might be strong supply-side shifts that affect labor supply and wages

Example:
Wages are very high during rush hour, and just as rush hour peaks, many of cabdrivers quit
  – Is this because high demand during rush hour typically causes them to surpass their income target?
  – Is this because of supply-side shifts? (drivers quit because they need to have dinner, return cab)
Other Issues

• Fatigue on high-wage days?
  – Not clear why fatigue would make it optimal to work fewer hours on high wage days
  – Camerer et al argue that it is actually more tiring on low-wage days because drivers must search harder for customers

• Credit constraints?
  – Camerer et al: Cabdrivers who pay for a license worth $130,000 are not credit constrained, but exhibit same behavior

• Long hours on low-wage days explained by more breaks?
  – Camerer et al show that eliminating long breaks from data does not change the result of longer hours on low-wage days.

• Does experience eliminate the behavior?
  – Camerer et al conclude that it does
  – Actually, their evidence is not overwhelming: 1 out of 3 estimates is significant and has the wrong sign. Only 1 out of 3 is significant and has the right sign.