Intertemporal Preferences with Consumption Indivisibility

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Abstract

When expenditures are indivisible, consumers must choose between discrete alternatives that deviate from their optimal consumption plan. We show in a two-period model that they not only care about the absolute deviation from the optimal plan but also about how asymmetric the deviation is. Consumers who are averse to negatively skewed deviations, a preference order related to the third derivative of utility, tend to postpone the purchase of the indivisible good.

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1 Introduction

Some categories of consumption are indivisible or lumpy: they cannot be purchased in arbitrarily small units but require a threshold expenditure (e.g., buying

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a car, a house, durable or luxury goods). Indivisible goods are the most expensive ones and occupy a significant share of consumer's intertemporal resources. Durable goods (vehicles, appliances, electronics, etc.) accounted for 12.4% of total personal consumption expenditures in the U.S. in 2022 (BEA, 2024). This feature alters the shape of indirect utility over wealth, often leading to non-concavities.

The consequences of indivisibility for consumption/saving decisions are studied in an otherwise standard discounted time-separable intertemporal model. We show that consumers not only care about second-order effects (the absolute deviation from the optimal plan), but also about third-order effects (how asymmetric the deviation is). Three novel concepts, two behavioral patterns and one statistical measure, are pivotal for the analysis. *Deviation aversion*, related to the second derivative of the utility function, measures how much individuals dislike consuming less or more than the optimal plan. *Deviation skewness* measures the direction and intensity of the temporal asymmetry of deviations. It is positive if the discounted excess consumption at one of the two periods is larger than the discounted deficit of consumption the other period, and negative in the contrary case. *Aversion to negative deviation skewness*, related to the third derivative of the utility function, measures individuals' preference for positive deviation skewness.

For small deviations, second-order effects dominate, leading consumers to choose the plan closest to the optimal one. Third-order effects become significant for larger deviations especially when deviation aversion is weak, aversion to negative skewness is strong, the interest rate is high or first period deviations are symmetric around the optimal level. Consumers may no longer choose the smallest deviation but the positively skewed consumption profile. This type of preference is shown to introduce a bias toward postponing the purchase of the indivisible good.

Indivisibility captures a wide class of frictions, like adjustment costs, fixed commitments or borrowing constraints, that force individuals to consume away from their optimal plan. It has long been identified as a major feature of consumption. Browning and Crossley (2001), in their review of life-cycle consumption models, highlight indivisibility as a crucial departure from the benchmark model that helps explain empirical anomalies such as excess smoothness and sensitivity of nondurable consumption. A number of important macroeconomic implications have been outlined in the literature. Grossman and Laroque (1990) model consumption of durable goods by assuming non-convex adjustment costs, leading to intervals of inaction punctuated by large purchases. Caballero (1993) shows that consumers adjust only when the deviation between desired and actual stock levels is sufficiently large, which helps explain the observed slow adjustment of durable consumption. Eberly (1994), using micro data on automobile purchases, provides empirical support for such lumpy adjustment patterns. Building on these insights, Attanasio (2000) estimates aggregated (S,s) rules for automobile purchases and shows that indivisible durable expenditures help account for the persistence and inertia in household spending. Chetty (2004) shows how fixed commitments (e.g. housing) alter risk attitudes and savings. Chetty and Szeidl (2007) formalize how commitments make households effectively more risk averse and less flexible in reallocating consumption. Deaton (1991) demonstrates how borrowing limits prevent attainment of the frictionless optimum. Chetty (2004) and Guiso and Pistaferri (2002) show that households accumulate buffer-stock savings to insure against income shocks precisely because they cannot easily downscale committed consumption in the short run.

Our framework does not model how individuals dynamically adjust their level of indivisible expenditures but demonstrates how a preference for temporally skewed consumption profiles naturally arises in riskless standard consumption/saving models with indivisibility. Aversion to negatively skewed deviations is shown to be consistent with excess saving which contributes to explaining why households tend to postpone the purchase of indivisible goods even in absence of uncertainty about future incomes.

Finally, two parallels can be drawn with classical results in the consumption/saving literature. First, in smooth optimization problems, the elasticity of intertemporal substitution captures the extent to which individuals resist consumption reallocation in response to interest rate changes. In our model, deviation aversion, also linked to the second derivative of utility, captures the extent to which individuals with a preference for positive skewness resist the appeal of interest rate increase and positive deviation skewness. Second, just as prudence makes the agent sensitive to downside risk and induces precautionary saving that truncates the worst states of consumption (Kimball, 1990), individuals averse to negatively skewed deviations tend to favor oversaving to limit the downside of borrowing. Our results provide a deterministic analogue to prudence.

The remainder of the paper is organized as follows. Section 2 introduces the model of consumption indivisibility. Section 3 presents the third-order Taylor expansion of utility differences of oversaving and overspending and derives the main analytical results. Section 4 proposes thought experiments allowing to disentangle deviation aversion from aversion to negative skewness. Section 5 concludes.

2 Intertemporal preference properties

2.1 Model

Consider a two-period model in which agents consume c_1 and c_2 funded by a recurring endowment w:

$$c_1 - w + \frac{c_2 - w}{1+r} = 0$$

with $r > -1$ the interest rate. They maximize a time-separable intertemporal utility:

$$U = u(c_1) + \frac{1}{1+\rho} u(c_2)$$

with u increasing, concave and C^4, and $\rho > -1$ their subjective discount rate. Optimal consumptions c_1^* and c_2^* are derived from the Euler condition:

$$\frac{u'(c_1^*)}{u'(c_2^*)} = \frac{1+r}{1+\rho} \tag{1}$$

which hinges on the critical assumption that small units of goods can be transferred from one period to the other.

With indivisibility, the optimal plan (c_1^*, c_2^*) may not be implementable. Suppose individuals have to decide whether to spend a fixed amount of indivisible good I. Let $\delta = c_1 - c_1^*$ and $\delta' = c_1' - c_1^*$ represent two deviations from both side of the optimal level, where the fixed spending is the sum of the two deviations: $A = |\delta| + |\delta'|$. Indirect intertemporal utility, expressed in terms of consumption deviation, is:

$$U(\delta) = u(c_1^* + \delta) + \frac{1}{1+\rho} u(c_2^* - (1+r)\delta)$$

Consumers oversave if $\delta < 0$ and overspend if $\delta > 0$.

3 Third-Order Expansion of Utility Differences

This section develops a general framework for analyzing consumption choices under indivisibility constraint. A third-order Taylor expansion of utility differences is derived which reveals how multiple preference orders interact to determine optimal deviations.

Proposition 1 *Let u satisfy the standing assumptions. The Euler equation is assumed to hold at the optimum. For any two feasible deviations δ, $\delta' \in \Delta = [-c_1^*, c_2^*/(1+r)]$ (possibly of opposite sign),*

$$\begin{aligned} U(\delta) - U(\delta') = u'(c_1^*)\Big[&-\frac{1}{2}(\delta^2 - \delta'^2)\Big(A(c_1^*) + (1+r)A(c_2^*)\Big) \\ &+ \frac{1}{6}(\delta^3 - \delta'^3)\Big(S(c_1^*) - (1+r)^2 S(c_2^*)\Big)\Big] \ + \ R(\delta, \delta'), \end{aligned} \tag{2}$$

where $A(c) \equiv -\frac{u''(c)}{u'(c)}$, $S(c) \equiv \frac{u'''(c)}{u'(c)}$ *and* $R(\delta, \delta') = O(|\delta|^4 + |\delta'|^4)$ *as* $(\delta, \delta') \to (0, 0)$.

Proof Write

$$U(\delta) = u(c_1^* + \delta) + \frac{1}{1+\rho} u\Big(c_2^* - (1+r)\delta\Big).$$

Third-order Taylor expansions with remainder give $u(c_1^* + \delta) = u(c_1^*) + u'(c_1^*)\delta + \frac{1}{2}u''(c_1^*)\delta^2 + \frac{1}{6}u'''(c_1^*)\delta^3 + O(\delta^4)$ and $u(c_2^* - (1+r)\delta) = u(c_2^*) - (1+r)u'(c_2^*)\delta + \frac{1}{2}(1+r)^2 u''(c_2^*)\delta^2 - \frac{1}{6}(1+r)^3 u'''(c_2^*)\delta^3 + O(\delta^4)$, with analogous formulas for δ'. Subtracting $U(\delta')$ from $U(\delta)$, the linear term $\Big[u'(c_1^*) - \frac{1+r}{1+\rho}u'(c_2^*)\Big](\delta - \delta')$ vanishes by the Euler equation. Collecting quadratic and cubic terms and using $u'' = -Au'$ and $u''' = Su'$, together with $u'(c_2^*) = \frac{1+\rho}{1+r}u'(c_1^*)$, yields (2). The remainder equals $O(\delta^4) - O(\delta'^4) = O(|\delta|^4 + |\delta'|^4)$. $\square$

The third-order expansion reveals how consumption choices under indivisibility depend on the interaction of two preference orders: deviation aversion, measured by $A(c)$ and aversion to negative skewness, measured by $S(c)$.

From expression (2), the second order preferences are reflected in

$$-\Big[A(c_1^*) + (1+r)A(c_2^*)\Big] \frac{\delta^2 - \delta'^2}{2}$$

Since $A(c)$ is positive by assumption, δ is preferred to δ' if $|\delta| < |\delta'|$ everything else equal, which indicates a preference for the minimal deviation regardless of the degree of utility curvature and of whether this corresponds to oversaving or overspending.

The third-order preferences

$$[S(c_1^*) - (1+r)^2 S(c_2^*)] \frac{\delta^3 - \delta'^3}{6}$$

reflects preferences over consumption asymmetry. Deviation δ is preferred to δ' if the product of the two terms is positive which happens under the main scenario if the two factors are negative. The second factor $\delta^3 - \delta'^3$ is negative if consumers oversave ($\delta < 0$). Assuming aversion to negative skewness ($S(c) > 0$), the first term is also negative if $S(c_1^*)$ is close to $S(c_2^*)$ or the compound interest rate is high enough to compensate the discrepancy. In this scenario, the higher interest rate, the stronger the appeal of oversaving. Conversely, a low interest rate or a negative interest rate may induce consumers to overspend and purchase the indivisible good.

4 Separating deviation aversion from aversion to negative skewness

The previous analysis does not strictly separate the two preference orders, deviation aversion and aversion to negative skewness, which leaves open questions. Can the two preference orders be disentangled? What does deviation skewness precisely mean? How to identify consumers averse to negative deviation skewness?

4.1 Disentangling the two preference orders

Proposition 2 shows how to characterize deviation aversion based on the choice of a specific consumption plan.

Proposition 2 (Local deviation aversion) *Assuming the standing assumptions in Proposition 1 and that (w, w) is optimal under $r = 0$, then there exists $\varepsilon > 0$ such that, for all δ, δ' with $|\delta|, |\delta'| < \varepsilon$, the third-order Taylor expansion of lifetime utility around (w, w) ranks $(w + \delta, w - \delta) \succ (w + \delta', w - \delta')$ if and only if $|\delta| < |\delta'|$.*

Proof From Proposition 1, setting $r = 0$ and $c_1^* = c_2^* = w$, the third-order Taylor expansion of lifetime utility around (w, w) yields

$$U(\delta) - U(\delta') \;\approx\; -\Big(\delta^2 - \delta'^2\Big) A(w), \tag{3}$$

up to higher-order remainder terms. $A(w) = -u''(w)/u'(w)$ is positive by assumption. Therefore (3) is positive if and only if $|\delta| < |\delta'|$. $\square$

The proposition makes precise in which environment preference for the closest deviation is always preferred. It isolates the second-order motive due to the symmetry of the deviation plan around a flat optimal consumption profile (w, w). Under those additional assumptions, consumers are deviation averse if and only if they prefer the consumption plan that deviates the least from the optimal plan.

Proposition 3 indicates which conditions allow to identify consumers averse to negative skewness.

Proposition 3 (Local aversion to negative skewness) *Assume the standing assumptions in Proposition 1 and that* (w, w) *is optimal. The following are equivalent: (i)* $S(c) > 0$ *for all* $c > 0$*; (ii) for all* $w > 0$, $r > 0$, *and* $\delta \in \Delta^+ = [0,\, w/(1+r)]$, *the third-order Taylor expansion around* (w, w) *ranks* $(w - \delta,\, w + (1+r)\delta) \succ (w + \delta,\, w - (1+r)\delta)$.

Proof From Proposition 1, with $r > 0$ and $c_1^* = c_2^* = w$, the third-order expansion gives

$$U(\delta) - U(-\delta) \;\approx\; \delta\Big(1 - (1+r)^2\Big)\, S(w),$$

up to higher-order terms. If $S(w) > 0$ and $\delta > 0$, then $1 - (1+r)^2 < 0$ implies $U(\delta) - U(-\delta) < 0$, hence $U(-\delta) > U(\delta)$, establishing (ii). Conversely, if (ii) holds for all $w > 0$ and $\delta \in \Delta^+$, then for small $\delta > 0$ we must have $U(-\delta) - U(\delta) > 0$, which forces $S(w) > 0$ because $1 - (1+r)^2 < 0$. Since w is arbitrary, $S(c) > 0$ for all $c > 0$. $\square$

The second-order term of the Taylor expansion vanishes because the deviations are antisymmetric around the first-period optimum ($\delta' = -\delta$). As a result, the ranking is entirely driven by the third-order term. In this scenario, consumers are averse to negative skewness if they prefer to oversave when the interest rate is positive. Conversely, consumers averse to negative skewness prefer to oversave when the interest rate is positive.

4.2 Deviation skewness and aversion to negative skewness

To interpret further third-order aversion to negative skewness, the concept of deviation skewness is formally defined.

Definition 1 (Deviation skewness) *Let (c_1^*, c_2^*) be an optimal consumption plan. Deviation skewness K associated with plan (c_1, c_2) is defined as:*

$$K(c_1, c_2) = (c_1 - c_1^*)^3 + \frac{(c_2 - c_2^*)^3}{1+r}$$

Deviation skewness measures how asymmetrically discounted consumption is distributed around the optimal consumption profile. The skew is positive if deviations are stretched toward excess consumption and negative if they are stretched toward consumption loss. Expressed in terms of deviations and taking into account the budget constraint:

$$K(\delta) = \delta^3 + (1+r)^2(-\delta)^3 \tag{4}$$

For a positive interest rate, oversaving ($\delta < 0$) positively skews the deviation plan: the first period negative deviation is less in absolute terms than the extra consumption the second period thanks to interest rate income. The higher the interest rate the higher the skewness. Conversely, overspending ($\delta > 0$) is associated with a negative skew: the second period negative deviation is higher in absolute terms than the extra consumption obtained the first period. The pattern is reversed if the interest rate is negative.

The utility difference can then be written as the product of two terms: aversion to negative deviation skewness $S(w)$ and deviation skewness as measured in Definition (1):

$$3\,\frac{U(\delta) - U(-\delta)}{u'(c_1^*)} \;\approx\; K(\delta)\,S(w)$$

We have seen that the combination of a positive interest rate and oversaving positively skews the deviation profile ($K(\delta) > 0$ if $\delta > 0$). As a result, consumers who are averse to negative skewness ($S(w) > 0$) prefer to oversave. The magnitude of the utility difference is proportional to the extent of positive skewness and to the strength of aversion to negative skewness.

5 Conclusion

This paper highlights a novel aspect of intertemporal preferences when expenditures are indivisible. Within a two-period deterministic framework, we show that consumers care not only about the absolute deviation from their optimal consumption plan but also about the temporal asymmetry of this deviation. Aversion to negatively skewed deviations, linked to the third derivative of utility, represents a preference for positively skewed consumption profiles which may lead individuals to postpone the purchase of indivisible goods. This tendency is more likely when individuals are mildly averse to consumption deviations, first period deviations are large or symmetric around the optimal level. It is also more likey when the asymmetry of the deviation temporal profile is strong, which is reinforced by a high interest rate. The positive relationship between interest rate and saving does not come from the classical substitution effect but from an enhancement of deviation skew. Even in the absence of uncertainty about future income, the combination of indivisibility and a preference for positive deviation skewness provides a deterministic rationale for excess saving and delayed durable expenditures. Future extensions could study interactions with income uncertainty, analyze longer time horizons, or explore the implications of these preferences for aggregate consumption and saving dynamics.

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