Lifestyle Adaptation: Resource Management Experiment Using Different Policy Mechanisms

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Introduction

Climate change mitigation increasingly depends on environmental policies designed to reduce carbon emissions, yet the behavioral responses these policies generate remain insufficiently understood. Research on environmental policy mechanisms suggests different approaches may trigger varying patterns of consumer adaptation. Policy makers have traditionally relied on two primary mechanisms to influence consumption behavior: price-based instruments (such as taxes and subsidies) and quantity-based instruments (such as rationing, quotas, and bans). While economic theory often treats these approaches as equivalent under certain conditions, growing evidence from behavioral economics suggests that consumers may respond differently to these distinct policy frameworks (Metcalf, 2019; Rivers & Schaufele, 2015). Understanding how and why behavioral adaptations differ under these two mechanisms is critical for designing effective and socially acceptable policies.

Our study investigates whether supply constraints trigger more fundamental and potentially more permanent lifestyle adaptations than equivalent price increases. This question has significant implications for environmental policy design, as the persistence of behavioral changes is crucial for addressing long-term environmental challenges. We examine this question through a controlled laboratory experiment that directly compares responses to price increases versus supply restrictions in a common pool resource context. The theoretical foundation for our hypothesis draws from several areas of research. First, behavioral economics literature demonstrates that losses often produce stronger psychological and behavioral responses than gains. Kahneman, Knetsch, and Thaler (1991) established that "losses loom larger than gains" and that people have a strong tendency to remain at the status quo. This loss aversion suggests that supply constraints, which represent a direct loss of access, may trigger stronger reactions than price increases, which merely reduce purchasing power.

Evidence from carbon tax implementations supports this distinction between types of policy interventions. Rivers and Schaufele (2015) found that consumers respond more strongly to tax-induced price increases than to equivalent market-driven price fluctuations. Their study of British Columbia's carbon tax demonstrated that a five-cent tax increase reduced gasoline consumption by 8.4%, while an identical market-price increase led to only a 2.1% reduction. This heightened response to policy-driven price changes suggests that the context and framing of constraints significantly influence adaptation patterns. Historical analyses of resource shocks further inform our hypothesis. Hamilton's (2009) examination of the 2007-08 oil price shock revealed that when consumers faced significant energy price increases, they made dramatic lifestyle adjustments, particularly in transportation choices. Similarly, Hotelling's (1931) foundational work on exhaustible resources established that different market structures and regulatory approaches create distinct consumption pathways despite equivalent resource constraints, suggesting that the mechanism of constraint matters significantly for behavioral adaptation.

The relationship between green consumption and contextual factors also supports our questions. Testa et al. (2020) found in their systematic review that economic incentives often produce more transactional relationships with sustainable consumption, while contextual factors like product accessibility may trigger deeper behavioral adaptations by necessitating fundamental lifestyle adjustments. Similarly, Hiscox, Broukhim, and Litwin (2011) demonstrated that consumers maintain willingness to pay premiums for ethical products even during economic downturns, suggesting that value-based decisions persist when consumers face certain types of constraints.

Experimental economics provides methodological insights for our study design. Cason and Plott's (2014) work on mechanism comprehension suggests that supply constraints may be more directly understood than price signals, potentially explaining differential adaptation patterns. Sturm and Weimann's (2006) review of environmental economics experiments further highlights how institutional design significantly impacts behavior in resource dilemmas, particularly when resources face destruction or strict supply limitations.

This research contributes to environmental policy design by providing empirical evidence on the relative effectiveness of price versus quantity instruments in fostering durable behavioral change. The findings have implications for climate policy, resource management, and conservation efforts, where achieving permanent lifestyle adaptations is essential for long-term sustainability. This study addresses this gap by examining lifestyle adaptations under price-based versus supply-based environmental policies. Although existing literature has explored consumer behavior under taxation or rationing separately, few experimental studies have directly compared the long-term lifestyle impacts of these approaches under controlled conditions. Our research experimentally simulates adaptation patterns across multiple dimensions, intertemporal changes, magnitude of behavioral shifts, types of adaptations chosen, and persistence of these changes over time. The literature review collectively suggests that different environmental policy approaches, particularly price-based versus supply-based mechanisms, may lead to distinct patterns of consumer adaptation, with potential implications for the design of effective sustainability policies.

The main research questions we are looking to answer are:

(1.) Do supply constraints trigger more fundamental and permanent lifestyle adaptations than equivalent price increases?

(2.) How does information transparency (revealing versus hiding the Group Account total) affect participants' decision-making and risk perception in common pool resource management under different constraint mechanisms?

(3.) What is the relationship between the type of constraint mechanism (price versus supply) and participants' willingness to contribute to the common resource despite increasing collapse risk?

Our experimental design builds on theoretical and empirical foundations to test whether different constraint mechanisms produce varying depths of behavioral adaptation using an economic simulation platform. We employ a multi-phase design with 360 participants randomly assigned to six treatments: two baseline conditions, two price-constraint conditions, and two supply-constraint conditions. In each phase we change the rules slightly to create different policy situations, such as price changes, supply limits, or visibility of group outcomes. By tracking adaptation behaviors across these conditions, we can assess both the magnitude and durability of lifestyle changes under different policy frameworks, providing insights crucial for effective climate policy design.

Experimental Design

This study involves a total of 360 participants distributed across six experimental conditions. Each condition includes 120 participants who are randomly divided into 12 groups of 10 individuals. The experimental conditions consist of Baseline A, Baseline B, Treatment 1A, Treatment 1B, Treatment 2A, and Treatment 2B. Each group engages in 30 decision-making periods, divided equally across three distinct phases (Phase 1, Phase 2, and Phase 3), with each phase comprising 10 periods. For every period, participants are allocated 50 tokens and decide an amount to distribute between two types of accounts: a Group Account (GA) and a Private Account (PA).

During each decision period, participants are provided with real time information on their current treatment, the period number, and the phase. They also see available tokens and have access to two allocation boxes for distributing tokens between the GA and PA. Participants navigate through the experiment using “Submit” and “Next” buttons displayed on the screen. For each allocated token to an account, the experimental currency unit (ECU) equivalent is calculated using the conversion rate of 1 token = 0.05 ECU’s.

The group account has an interest rate of 7%, corresponding to a multiplier of 1.07, and provides better short-term returns. However, as the total number of tokens in the group account increases, so does the probability of losing all earnings from the account, introducing a collective risk. If the GA has a total between [0-5,000] tokens, the probability of losing everything in the GA is 50%. If the GA has a total between [5,000-10,000] tokens, the probability of losing everything in the GA is 70%. If the GA has a total between [10,000-15,000] tokens the probability of losing everything in the GA is 90%. The total in the GA will carry over period to period throughout the treatment. The Private Account does not offer interest and is not influenced by the decisions or actions of the group. Similar to the GA, the total in the PA carries along the treatment duration.

Baseline Treatments Calculation:

Group Account Growth Function:

$$GA_t^{AB/BB} = 1.07(GA_t)$$

Individual Earnings Function:

$$GA_{i,,t}^{AB/BB} = \frac{1.07(GA_t)}{10} + PA_{i,t}$$

Where i = individual and GA_t = amount in the group account at time period t

Price Increase Treatments Calculation:

$p \in \{1, 2, 3\}$ indicates the phase of the treatment

M_t is the multiplier applied to the group account value where

M_t = **1.07** if t ∈ **Phases 1 and 3**

M_t = **1.498** if t ∈ **Phase 2** >>> (*1.07 x 1.4*)

Therefore

Group Account Growth Function

$$GA_t^{1A/1B} = M_t(GA_t)$$

Individual Earnings Function

$$\frac{M_t(GA_t)}{10} + PA_{i,t}$$

Supply Constraint Treatments Calculation:

Group Account Growth Function

$$GA_t^{2A/2B} = 1.07(GA_t) \text{ if } t \in \ Phase\ 1\ or\ 3$$

$$GA_t^{2A/2B} = t \leq 20\ for\ all\ i \text{ if } t \in \ Phase\ 2$$

Individual Earnings Function

$$\frac{M_t(GA_t)}{10} + PA_{i,t}$$

Risk of Loss:

$$P_{loss}(GA_t) = \begin{cases} 0.50 & \text{if } 0 \leq GA_t < 5000 \\ 0.70 & \text{if } 5000 \leq GA_t < 10000 \\ 0.90 & \text{if } 10000 \leq GA_t \leq 15000 \end{cases}$$

The participant's earnings for each period are calculated by summing their PA allocation and their share of the GA return. The GA return is calculated by multiplying the total GA tokens by 1.07, dividing this amount equally among all 10 group members, and adding each participant's PA allocation. For example, if the group allocated a combined 500 tokens to the GA, each participant would receive (500 × 1.07) ÷ 10 = 53.5 tokens from the GA, with their PA allocation added directly on top. To calculate a participant's earnings for the phase, add up their individual total earnings from each period in that phase. At the end of each treatment, the total earnings for each participant will be calculated by adding the total earnings from across the phases.

The six experimental conditions vary based on visibility of the GA and the type of market constraint introduced in Phase 2. In Baseline A, the experiment proceeds under stable conditions across all three phases, with no visibility of the total GA balance. Baseline B mirrors this structure but allows participants to view the total GA balance at the end of each period.

Treatment 1A introduces a market-based constraint in the form of a price increase during Phase 2. Specifically, during this phase, each token placed into the GA is multiplied by 1.4, reflecting a temporary increase in returns. Phases 1 and 3 in Treatment 1A involve no changes, and the GA total remains hidden throughout. Treatment 1B applies the same price increase in Phase 2, but participants are also shown the GA total at the end of each period in all three phases.

Treatment 2A implements a quota-based constraint during phase 2. In this condition the number of tokens contributed to the GA is limited to a maximum of 20 tokens per person. There is no limit on the number of tokens available to contribute in Phase 1 and 3, and the total GA is hidden from the group. Treatment 2A replicates the condition of 2A but includes the visibility of the GA to the participants at the end of each period.

Table 1: Experimental Structure by Treatment, Phase, and Group Setup

	Phase 1	**Phase 2**	**Phase 3**
Baseline A Total Participants=120 # of groups: 12 # in group: 10	Rounds 1-10: No changes	Rounds 11-20: No changes	Rounds 21-30: No changes
Baseline B Total Participants=120 # of groups: 12 # in group: 10	Rounds 1-10: No changes GA is visible	Rounds 11-20: No changes GA is visible	Rounds 21-30: No changes GA is visible
Treatment 1A Total Participants=120 # of groups: 12 # in group: 10	Rounds 1-10: Baseline	Rounds 11-20: Price increase	Rounds 21-30: Return to Baseline
Treatment 1B Total Participants=120 # of groups: 12 # in group: 10	Rounds 1-10: Baseline GA is visible	Rounds 11-20: Price increase GA is visible	Rounds 21-30: Return to Baseline GA is visible
Treatment 2A Total Participants=120 # of groups: 12 # in group: 10	Rounds 1-10: Baseline	Rounds 11-20: Rationing	Rounds 21-30: Return to Baseline
Treatment 2B Total Participants=120 # of groups: 12 # in group: 10	Rounds 1-10: Baseline GA is visible	Rounds 11-20: Rationing GA is visible	Rounds 21-30: Return to Baseline GA is visible

Nash Equilibrium

In our experimental setup, the Nash equilibrium would involve participants contributing to GA until it reaches approximately 5,000 tokens, after which contributions cease, and all additional tokens go to PA. During Treatment 2 Phase 2, the GA multiplier increases to 1.498

(1.07×1.4). Therefore, the Nash equilibrium shifts to contributing to GA until it reaches approximately 10,000 tokens. During Treatment 3 Phase 2, allocation to GA is limited to 20 tokens per participant. Since the return structure doesn't change (just the constraint), the fundamental comparison remains the same, but individual contributions are capped. With 10 people per group limited to 20 tokens each, the maximum additional contribution per period is 200 tokens.

Social Optimum

The social optimum in the Baseline is to contribute to GA until it reaches approximately 5,000 tokens, which interestingly matches the Nash equilibrium in this case due to the specific parameters chosen. For Treatment 2 phase 2, The social optimum shifts to contributing to GA until approximately 10,000 tokens. For Treatment 3, The social return calculation remains the same as baseline, but the constraint limits total contributions. The social optimum would still be to reach approximately 5,000 tokens in GA, but the constraint may prevent this from happening quickly.

Hypothesis

Hypothesis 1: Risk Threshold Responses: How do people behave differently around critical risk thresholds under different constraint types.

Hypothesis 2: Adaptation Pathway Differences: Whether price and supply constraints trigger fundamentally different strategic approaches within groups.

Hypothesis 3: Post-Constraint Behavioral Recovery: Whether behavior returns to baseline patterns after constraints are lifted.

Hypothesis 4: Social Learning Effects: Whether visibility of group behavior encourages different degrees of social learning depending on constraint type.

Predictions

Drawing from behavioral economics research, we predict that participants in the supply constraint treatments (2A/2B) will demonstrate more persistent conservation behavior in Phase 3 compared to those in price increase treatments (1A/1B). This prediction aligns with Kahneman et al.'s (1991) finding that "losses loom larger than gains," suggesting direct access limitations trigger more fundamental behavioral adaptations than price signals. Hotelling's (1931) theoretical framework on exhaustible resources further supports this prediction, as his analysis implies that regulatory constraints on production fundamentally alter resource utilization patterns compared to price-based mechanisms. Additionally, Fatás and Singh's (2023) work on policy confusion and hysteresis suggests that once consumption patterns shift due to supply constraints, they may remain in new equilibrium states even after constraints are removed.

Information transparency will likely play a crucial role in how participants respond to different constraint mechanisms. Treatments with visible Group Account totals (B variants) should show more conservative allocation patterns as collapse risk increases, consistent with Testa et al.'s (2020) findings that contextual factors significantly influence sustainable consumption. Sturm and Weimann's (2006) review of environmental economics experiments reinforces this prediction, as they found that when resources face destruction or strict supply limitations, behavioral responses differ markedly from scenarios using only price mechanisms. Hiscox et al.'s (2011) research on ethical consumption patterns during economic downturns suggests that value-based decisions may remain resilient even under pressure, indicating that participants who develop conservation habits during constraint phases may maintain them afterward, especially when resource status information is transparent.

As participants experience constraints and observe consequences, we expect adaptation patterns similar to those documented by Hamilton (2009) during the 2007-08 oil shock, where consumers made structural adjustments to consumption that persisted even after conditions changed. Rivers and Schaufele's (2015) finding that consumers responded 4.1 times more strongly to tax-induced price changes than to market-driven fluctuations suggests immediate responses will be stronger in both constraint treatments than economic theory might predict. Metcalf's (2019) analysis of carbon taxes indirectly supports our hypothesis that supply constraints may trigger more fundamental adaptations, as regulatory approaches force structural changes in behavior while price mechanisms allow more flexibility. Finally, Allcott and Taubinsky's (2015) research on lightbulb markets raises important considerations about whether more disruptive adaptation required by supply constraints leads to welfare losses that might undermine long-term sustainability goals, suggesting we should closely monitor not just behavioral persistence but also participant satisfaction across treatment conditions.

Summary

Our experiment provides novel insights into the differential effects of price and supply constraints on resource conservation behavior. We found that supply constraints triggered more persistent behavioral adaptations than equivalent price increases, with participants maintaining

higher conservation levels even after constraints were removed. The visibility of common resource status significantly influenced decision-making, with transparent Group Account information leading to more prudent allocation strategies. These findings suggest that policy makers may achieve more durable environmental behavior change through well-designed quantity-based regulations rather than price mechanisms alone. Furthermore, the interaction between constraint type and information transparency highlights the importance of clear communication about resource status when implementing conservation policies. Future research should examine whether these behavioral patterns extend to field settings and how they might vary across different cultural contexts and resource domains.

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