Price Distortions and Hoarding: An experiment

Edgar Castro[*]

Cesar Martinelli[†]

September 11, 2023

Abstract

In a two-period model featuring durable goods, we explore the implications of anticipated price distortions in the context of available storage. Rationing serves as our primary mechanism to rationalize hoarding behavior. We empirically validate our model using three experimental setups: i) a free market without hoarding incentives, ii) a price-capped market where hoarding is anticipated due to potential rationing in the second period, and iii) a market with an impending supply shock, where hoarding is expected but not rationing. Our experimental results reveal a prevalent trend of excessive hoarding among participants, leading to market inefficiencies greater than our theoretical predictions.

Keywords: price controls, price distortions, hoarding, lab experiments.

JEL Classification: D41, C92

[*]Interdisciplinary Center for Economic Science, ecastrom@gmu.edu

[†]George Mason University, cmarti33@gmu.edu.

1 Introduction

We propose a model and examine the theoretical predictions of price distortions in a two-period market with durable goods, where goods can be reserved from one period to the next at a small cost. We allowed price distortions to occur only in the second period and are anticipated by market participants. The main mechanism in our model is the uncertainty that results from rationing -when there is an excess of demand at the imposed market price. Crucially, our framework is versatile and applicable to studying price distortions from various sources, including government interventions and naturally occurring price rigidities, among others.

We validate our core findings across three experimental settings: a baseline free market, a market with a price cap, and one experiencing a supply shock. Our investigation particularly focuses on the implications of price controls on durable goods that have storage potential.

Prices act as mechanisms to facilitate cooperation and relay information among economic actors. When price controls intervene, they can distort these mechanisms, leading to misallocated resources and coordination issues. Laboratory experiments suggest that the inefficiencies caused by price controls exceed predictions from standard partial equilibrium models. Specifically, lower-surplus consumers can potentially crowd out those with greater surpluses (Smith and Williams, 1981; Isaac and Plott, 1981; Coursey and Smith, 1983). Additionally, even when price controls aren't directly restrictive, they can still distort the price discovery process, affecting consumer welfare.

Though price controls aim for fairness, they can yield unfair results by denying goods to those most in need, as posited by Schmidtz (2016). Such controls can push agents to expend resources avoiding exclusion or prompt adjustments in areas beyond price, like quality or location (Finley et al., 2019; Hatfield et al., 2016; Brekke et al., 2006).

During and post-World War II, price controls were prevalent, affecting various markets from labor to finance, resulting in supply-demand imbalances and associated issues like shortages (Rockoff, 1981). These controls have had far-reaching impacts: UK rent controls from 1918 to 1988 precipitated a housing crisis (Coleman, 1988), pharmaceutical controls influenced global supplies and delayed drug access (Kyle, 2007), and in energy and vice markets, they deterred investments and encouraged risky behaviors and black markets, affecting overall efficiency and welfare (Morton, 2001; Coyne and Coyne, 2015).

Research suggests that voters gravitate towards policies with immediate benefits, neglecting wider equilibrium repercussions (Dal Bó et al., 2018). Price controls are notably prevalent in developing countries, especially when governed by populist leaders (Ádám, 2019). Although some market anomalies warrant regulation, hastily-deployed price controls often amplify existing problems. As highlighted by Finley et al. (2019) and Hatfield et al. (2016), these controls can induce rent-seeking and non-price competition. Subsidies or price discrimination, being less intrusive, may serve as better alternatives.

Our model predicts that in a storage market, the sum of the initial price and storage costs matches the price in the second period. When price distortions arise, we term the equilibrium "rationing equilibrium" due to an optimal level of rationing, even when hoarding goods is viable. In such an equilibrium, high-reservation buyers store goods during the first period, whereas low-reservation buyers purchase at the second period's price ceiling. The combined costs in the first period surpass this price ceiling. Furthermore, the first-period price is no less than its competitive counterpart, and the quantity stored under rationing often equals or exceeds that in a competitive framework.

Our experiments showed that participants consistently hoarded too much. Efficiency in the baseline was only 59% of what we expected, and it was remarkably similar to the price-capped market. This matches Dal Bó et al. (2018)'s findings, where people did not fully understand the overall impact of their choices on the equilibrium outcomes. Unlike Dal Bó et al. (2018), our study had salient direct costs for not sticking to the competitive equilibrium, but these costs were insufficient to prevent excessive hoarding.

Among the three scenarios, only the supply-shocked market approached the price and quantities expected in the competitive equilibrium, but with persistent uncertainties, many high-valuation buyers were left out of the market due to excess demand. The market only performed at a 50% of the expected surplus.

Drèze (1975) offer proof of general equilibrium in the presence of price rigidities and rationing. Dreze's model, in particular, is sufficiently general to uphold equilibrium within dynamic contexts.

The rest of the paper is organized as follows. In Section 2, we offer a comprehensive description of the model and present a theorem summarizing the theoretical findings. The experimental design and hypotheses are detailed in Section 3. Section 4 describes the results of the experiment. And Section 5 concludes. For supplementary graphs, experimental instructions, and related materials, please refer to the online appendix.

2 Conceptual framework

2.1 An economy with storage

We propose a simple model to explore the effects of price controls when storage is available. We consider an economy with two goods, "money" and a traded good that is available only in indivisible units. There is a large number of traders represented by the continuum [0,1], n_B is the fraction of buyers, and n_S is the fraction of sellers. $n_B + n_S \leq 1$. All individuals live for two periods $t = 1, 2$.

The utility function of buyer $i \in B$ is

$$u_i(q_{i1}, q_{i2}, m_i) = r_i(q_{i1} + q_{i2}) + m_i,$$

where $r_i > 0$ is a parameter representing the buyer's reservation value for the traded good, $q_{it} \in \{0, 1\}$ is the buyer's consumption of the traded good in period t, and $m_i \in \mathbb{R}$ is the buyer's (final) money holding. Buyers enjoy consuming at most one unit of the traded good per period, but they can store one unit in period 1 for consumption in period 2 at a (monetary) cost of $s > 0$. Note that we allow for negative money holdings; we normalize the endowment of money of all individuals to zero. We assume without loss of generality that buyers are ordered by their reservations, that is $r_1 \geq r_2 \geq \cdots \geq r_{|B|}$.

Similarly, the utility function of seller $j \in S$ is

$$u_i(y_{j1}, y_{j2}, m_j) = -c_{j1}y_{j1} - c_{j2}y_{j2} + m_j,$$

where $c_{jt} > 0$ is a parameter representing the seller's cost of production in period t, $y_{jt} \in \{0, 1\}$ is the seller's production of the traded good in period t, and $m_j \in \mathbb{R}$ is the seller's (final) money holding. Note that each seller's production in each period is capped at one. We allow for changes in the cost of production so as to represent supply shocks.

2.2 Competitive equilibrium

We first consider a situation in which individuals may trade freely at market prices. We let x_{i1} and x_{i2} be the quantity of the traded good acquired by buyer i in period 1 and in period 2. Since a buyer can consume at most one unit in period 1 but can store one unit for later consumption, choosing $x_{i1} = 2$ allows the individual to consume $q_{i1} = q_{i2} = 1$ at a monetary cost of $2p_1 + s$. Given prices $p_1 \geq 0$ and $p_2 \geq 0$ in periods 1 and 2, respectively, the problem of buyer i is then

$$\max_{x_{i1} \in \{0,1,2\}, x_{i2} \in \{0,1\}} r_i(x_{i1} + x_{i2}) - p_1 x_{i1} - p_2 x_{i2} - s \max\{x_{i1} - 1, 0\},$$

and the problem of seller j is

$$\max_{y_{j1}, y_{j2} \in \{0,1\}} (p_1 - c_{j1})y_{j1} + (p_2 - c_{j2})y_{j2}.$$

Market clearing conditions are given by

$$\int_{i \in B} x_{i1} di = \int_{j \in S} y_{j1} dj \quad \text{and} \quad \int_{i \in B} x_{i2} di = \int_{j \in S} y_{j2} dj.$$

A <u>competitive equilibrium</u> is a demand vector (x_{i1}, x_{i2}) for each buyer $i \in B$, a supply vector (y_{j1}, y_{j2}) for each seller $j \in S$, and a price vector (p_1, p_2) such that buyers' demand and sellers' supply solve their respective problems, and markets clear.

To find competitive equilibria, we start by analyzing each market separately. As usual, we let the supply and demand functions in each period $t = 1, 2$ be given by

$$S_t(p) \equiv c_t^{-1}(p) \text{ and } D_t(p) \equiv r^{-1}(p).$$

We refer to prices p_1 and p_2 such that $0 = S_1(p_1) - D(p_1)$ and $0 = S_2(p_2) - D(p_2)$ as "myopic" since they occur when buyers ignore the possibility of storage. Graphically, these are represented by crossing the familiar supply and demand schedules in each period. Any pair of myopic prices p_1 and p_2 such that $p_1 + s \geq p_2$ are competitive prices, since buyers would not gain by storing in period 1 (see Figure 1).

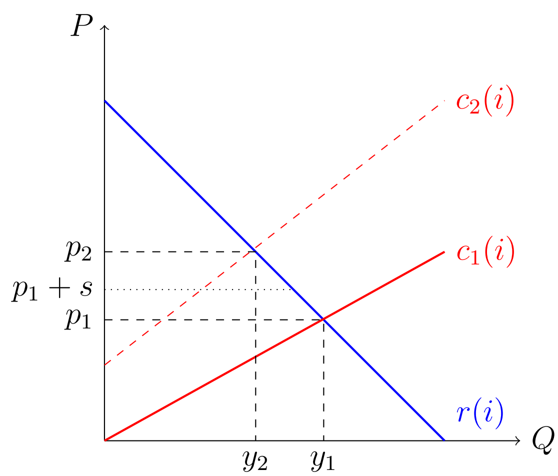


Figure 1: Myopic prices

If for every pair of myopic prices p_1 and p_2 we have $p_1 + s < p_2$, we can find competitive equilibria by considering a market for stored goods as follows. Let

$$\tilde{S}(p_1) = S_1(p_1) - D(p_1) \quad \text{and} \quad \tilde{D}(p_1) = D(p_1 + s) - S_2(p_1 + s)$$

be respectively the supply and demand correspondence for consumption in period 2.

The competitive prices p_1^* and $p_2^* = p_1^* + s$ are determined by any value of p_1 such that $0 = \tilde{S}(p_1) - \tilde{D}(p_1)$, representing the intersection of the supply and demand schedules for consumption in period 2. As an illustration, we graphically represent the competitive equilibrium by depicting the excess of supply ($\tilde{S(p_1)}$) and the demand for storage ($\tilde{D(p_1)}$) in period 1 when $p_2 > p_1 + s$. It is worth noting that the equilibrium price is greater than what the myopic equilibrium price would have predicted. The quantities for storage, denoted as α_c, are determined by this equilibrium.

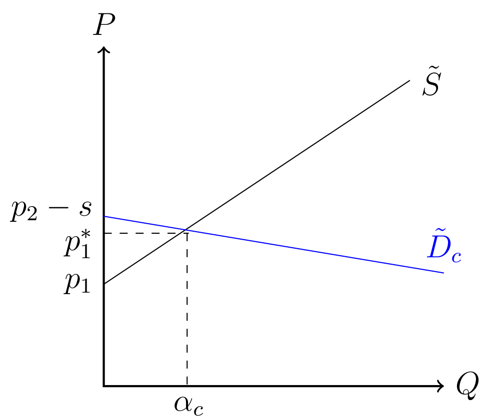


Figure 2: Competitive equilibrium

2.3 Rationing equilibrium

We consider now a situation in which the price in period 2 is capped at some $\overline{p}_2 > 0$; if demand exceeds supply at $\overline{p}_2$, then the available supply is distributed randomly between those demanding the good, with equal probability. Given prices $p_1 \geq 0$ and $0 \leq p_2 \leq \overline{p}_2$ in periods 1 and 2, respectively, and a rationing probability ρ, the problem of buyer i is

$$\max_{x_{i1} \in \{0,1,2\}, x_{i2} \in \{0,1\}} r_i(x_{i1} + \rho x_{i2}) - p_1 x_{i1} - p_2 \rho x_{i2} - s \max\{x_{i1} - 1, 0\},$$

and the problem of seller j is, as before,

$$\max_{y_{j1}, y_{j2} \in \{0,1\}} (p_1 - c_{j1}) y_{j1} + (p_2 - c_{j2}) y_{j2}.$$

The market clearing and rationing conditions are

$$\int_{i\in B} x_{i1}di = \int_{j\in S} y_{j1}dj,$$
$$\int_{i\in B} x_{i2}di \geq \int_{j\in S} y_{j2}dj \ \text{ with equality if } \ p_2 \leq \overline{p}_2,$$
$$\frac{\int_{j\in S} y_{j2}dj}{\int_{i\in B} x_{i2}di + 1} \leq \rho \leq \frac{\int_{j\in S} y_{j2}dj}{\int_{i\in B} x_{i2}di} \text{ if } p_2 = \overline{p}_2 \text{ and } \int_{i\in B} x_{i2}di > 0, \ \text{ and } \rho = 1 \text{ otherwise.}$$

A rationing equilibrium is a demand vector (x_{i1}, x_{i2}) for each buyer $i \in B$, a supply vector (y_{j1}, y_{j2}) for each seller $j \in S$, a price vector (p_1, p_2) with $p_2 \leq \overline{p}_2$, and a rationing probability ρ such that buyers' demand and sellers' supply solve their respective problems, and the market clearing and rationing conditions hold.

In the spirit of competitive equilibrium, we treat the probability ρ with which a buyer expects to be able to buy the good in period 2 if demanding the good as constant from the viewpoint of all buyers and equal for all buyers.

We have:

Theorem 1 *The existence of at least one rationing equilibrium is established. Moreover, when the price ceiling is binding in a rationing equilibrium:*

i) The supply in period 2 is weakly below the maximum competitive supply.

ii) Effective rationing occurs, with the rationing probability strictly below 1.

iii) Only buyers with the highest reservations store in period 1, and only buyers with the lowest reservations equal to or above $\overline{p_2}$ buy in period 2. In contrast, in a competitive equilibrium, buyers are either indifferent between storing in period 1 or buying in period 2 or prefer not to store.

iv) The price in period 1, along with the cost of storage, is strictly higher than the price ceiling in period 2. Conversely, in a competitive equilibrium, the price in period 1 plus the cost of storage is equal to the price in period 2 whenever there is storage.

v) If there is storage under some competitive equilibrium, and the price ceiling in period 2 is greater than or equal to the competitive price in period 1, then in a rationing equilibrium, the price in period 1 is larger than or equal to the competitive price in period 1, and the quantity stored is larger than or equal to that in the competitive equilibrium.

Proof. Let's begin by considering different cases to establish the existence of rationing equilibrium when the price ceiling is binding.

Case 1: Suppose a competitive equilibrium exists with a price in period 2 that is less than or equal to the ceiling $\overline{p_2}$. In this scenario, it is evident that this competitive equilibrium is also a rationing equilibrium (with $\rho = 1$) after the ceiling is imposed.

Case 2: Now, assume the price ceiling $\overline{p_2}$ is below every competitive equilibrium price in period 2, which implies $\overline{p_2} < \overline{p_1} + s$. In a rationing equilibrium, the supply in period 2 must be weakly below the maximum competitive supply. Additionally, $\rho < 1$ must hold in every rationing equilibrium; otherwise, the rationing equilibrium would also be a competitive equilibrium. This completes the proof for parts (i) and (ii) of the proposition.

Part (iii): We establish that in a rationing equilibrium, only those buyers with the highest reservations store goods. A buyer weakly prefers to store rather than buy in period 2 if the expected utility from storing is higher than the utility from immediate consumption. The condition for this preference is given by

$$r_i - (p_1 + s) \geq \rho(r_i - \overline{p_2})$$

, or equivalently,

$$r_i \geq \frac{p_1 + s}{1 - \rho} - \frac{\rho}{1 - \rho}\overline{p_2}.$$

This preference holds strictly if the inequality is strict. Thus, buyers with higher reservations are incentivized to store in a rationing equilibrium.

Part (iv): Since the price ceiling is binding, we must have $\rho < 1$. However, if $\overline{p_2} \geq p_1 + s$, it is strictly better for buyers to buy and store in period 1 rather than waiting to buy in period 2. Therefore, there cannot be excess demand in period 2, which contradicts the assumption of a binding ceiling.

Part (v): let us consider a competitive equilibrium with prices p_1' and p_2', in which storage exists, and a rationing equilibrium with price p_1 and rationing probability $\rho < 1$ (due to the binding price ceiling).

First, we claim that the quantity stored under rationing cannot be smaller. Let us proceed by contradiction. Suppose the quantity stored is smaller under rationing, which implies $p_1 \leq p_1'$ due to the monotonicity of $\tilde{S}$. Moreover, there must be a buyer who buys to store in the competitive equilibrium but does not store in the rationing equilibrium. For this buyer, $r_i - p_1 \leq \rho(r_i - \overline{p_2})$, which leads to $\overline{p_2} < p_1$. Since by assumption $\overline{p_2} \geq p_1'$, we get $p_1 > \overline{p_2} \geq p_1' \geq p_1$, a contradiction.

A similar argument can be applied to show that the price in period 1 under rationing cannot be smaller than in the competitive equilibrium. If the price in period 1 is smaller under rationing, then the monotonicity of $\tilde{S}$ implies that the quantity stored is smaller than or equal to that under the competitive equilibrium. Therefore, there must be a buyer who buys to store under the competitive equilibrium but is either indifferent or prefers not to store under the rationing equilibrium. For this particular buyer, $r_i - p_1 \leq \rho(r_i - \overline{p}_2)$, which implies $\overline{p}_2 < p_1$. However, by assumption, $\overline{p}_2 \geq p_1'$, leading to the conclusion that $p_1 > \overline{p}_2 \geq p_1' \geq p_1$, which creates a contradiction.

Existence of rationing equilibrium: To demonstrate the existence of a rationing equilibrium when the price ceiling is binding, let us define $\overline{y_2}$ as the supply voluntarily offered, and $\overline{x_2}$ as the demand in period 2 at the capped price. Since the price ceiling is binding, we have $0 \leq \overline{y_2} < \overline{x_2}$.

For $k \in (0, n_B]$, where n_B represents the total number of buyers, we introduce ρ_k as follows: if $k < \overline{x_2} - \overline{y_2}$, then $\rho_k = \overline{y_2}/(\overline{x_2} - k)$; otherwise, $\rho_k = 1$. Intuitively, ρ_k represents the probability of successfully trading in period 2 for those buyers who decide to store instead of buying in period 2, given that k buyers choose to store. Notably, ρ_k is increasing in k by definition.

For $p_1 \geq \overline{p}_1$, we define the supply correspondence as $\tilde{S}(p_1)$ as before, and the demand correspondence for stored goods under rationing as

$$\hat{D}(p_1) = \int_{i \in B} z_i(p_1) d_i, \tag{1}$$

where $z_i(p_1) = 1$ if

$$r_i - (p_1 + s) \geq \max\{\rho_i(r_i - \bar{p_2}), 0\},$$

and $z_i(p_1) = 0$ otherwise. This definition represents the buyer's optimal response which consists in buying to store only if it is best to pay $p_1 + s$ and get the good for certainty rather than paying a lower $\bar{p_2}$ but only having a probability ρ_i of getting good.

We claim that any p_1 such that $\tilde{S}(p_1) = \hat{D}(p_1)$ must be a rationing equilibrium price in period 1. To see this, suppose first that $\hat{D}(p_1) = \tilde{S}(p_1) = 0$. This implies $p_1 = \overline{p}_1$ and

$$r_1 \leq \frac{\overline{p}_1 + s}{1 - \rho_0} - \frac{\rho_0}{1 - \rho_0}\overline{p}_2.$$

In this case we have a rationing equilibrium with zero storage for $p_1 = \overline{p}_1$ and $\rho = \rho_0$.

Next suppose $\hat{D}(p_1) = \tilde{S}(p_1) = x$ for some $1 \leq x < \overline{x}_2 - \overline{y}_2$. This implies $p_1 > \overline{p}_1$ and

$$r_x - (p_1 + s) = \rho_x(r_x - \overline{p}_2)$$

In this case, we have an equilibrium for p_1 and $\rho = (r_x - (p_1 + s))/(r_x - \overline{p}_2)$.

Lastly, suppose there exists a value $x \geq \overline{x_2} - \overline{y_2}$ such that $\hat{D}(p_1) = \tilde{S}(p_1) = x$. This implies that $p_1 > \overline{p_1}$, and using the definition of $\hat{D}(p_1)$, we find that $\overline{p_2} \geq p_1 + s > \overline{p_1} + s$, which leads to a contradiction with the assumption that the price ceiling is binding.

Finally, we claim that there exists some $p_1 \geq \overline{p_1}$ such that $\tilde{S}(p_1) = \hat{D}(p_1)$. To see this, consider two cases:

If $r_0 \leq (\overline{p_1} + s - \rho_0 \overline{p_2})/(1 - \rho_0)$, then we have $\hat{D}(\overline{p_1}) = \tilde{S}(\overline{p_1}) = 0$.

If instead $r_0 > (\overline{p_1} + s - \rho_0 \overline{p_2})/(1 - \rho_0)$, then we have $\hat{D}(\overline{p_1}) > 0$, which implies $\hat{D}(\overline{p_1}) - \tilde{S}(\overline{p_1}) > 0$.

Since the excess demand $\hat{D}(p) - \tilde{S}(p)$ is a descending schedule and takes negative values for large enough p, there must exist some $p \geq \overline{p_1}$ such that $\hat{D}(p) = \tilde{S}(p)$. ■

In regard to part (iv) of the theorem, it is important to highlight that when the price ceiling is in effect, the difference between the price in period 1 and the capped price in period 2 is strictly greater than the difference in any competitive equilibrium with storage. However, it is possible that the price level in period 1 under rationing could be lower than the competitive price level, and the storage quantity may also be lower under rationing. Intuitively, the price ceiling in period 2 may serve as a collusive device for buyers, enabling them to obtain goods at a more favorable price.

2.3.1 Example

Figure 3 illustrates a rationing equilibrium using the same parameters as the graphic example in Figure 2, but this time incorporating a price ceiling at $\bar{p_2}$. The line labeled as $\tilde{D}$ represents the resulting demand when agents fully anticipate the possibility of a shortage in the second period. This indicates a higher willingness to pay for additional widgets in the first period, as determined by ρ, which represents the probability of securing a unit of the good in the second period, given the level of shortage in the market. As more agents buy in advance, the probability of being left out of the market in the second period reduces. Consequently, the point where the mismatch of supplied and demanded quantities at the price cap, denoted by $(\bar{x_2} - \bar{y_2})$, is completely satisfied, $\tilde{D}$ is zero. We use this example to highlight that additional storage occurs when compared with the competitive equilibrium ($\alpha_r > \alpha_c$), yet a certain level of shortage still remains ($\alpha_r < \bar{x_2} - \bar{y_2}$).[1]

[1]It is important to note that, for the sake of simplicity, we have omitted the impact of agents' risk aversion in both the example and the underlying model.

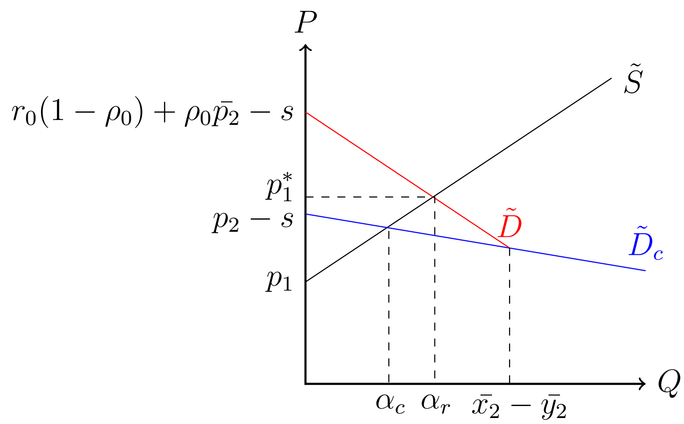


Figure 3: Rationing equilibrium

3 Experimental Design

3.1 Hypotheses

This section outlines hypotheses from our previous theoretical framework. We will test these through our lab experiment, examining market outcomes and the effects of price controls and forward-looking behavior.

Hypothesis 1 *In a competitive market with storage, when storage is an option, buyers see no difference between storing a good initially and buying it in the second period. In other words, the first period's price, combined with storage costs, matches the second period's price.*

Hypothesis 2 *In a rationing equilibrium, the following conditions hold:*

a) high-reservation buyers store in period 1, while low-reservation buyers purchase the good in period 2 at the price ceiling $\overline{p_2}$.

b) The price in period one, when added to the cost of storage, is strictly larger than the price ceiling in period 2.

c) The price in period 1 is larger than or equal to the competitive price in period 1.

d) The quantity of goods stored in the rationing equilibrium is larger than or equal to the quantity stored in the competitive equilibrium.

3.2 Experiment

The experiment consists of trading a durable good over two periods. In the initial period, buyers can opt to store goods at a certain cost for use in the subsequent period. Those who acquired an extra unit of the good in the first period are not permitted to partake in the second period's market. We administer this experiment using an online platform developed in Otree (Chen et al., 2016). At George Mason University, we organized 9 sessions, each involving 8 or 16 undergraduate students, all acting as buyers. Of the 128 total participants, 66 are male, 43 are female, and 19 chose not to reveal their gender. Notably, a significant portion of these participants belong to graduate STEM programs. Table 8 details the results of our post-experiment demographic survey.

We utilize a between-subjects approach, randomly assigning different treatments to participants across sessions. Each participant receives a budget of 200 lab currency units. We assigned valuations randomly to ensure equal expected earnings for everyone throughout the experiment.

In terms of structure, each session forms groups of eight participants, and the entire experiment covers 10 rounds. Each round includes two trading periods, consistent with our experimental model. For our analysis, we treat pairs of group rounds as a single market. In each market, there are eight human buyers and an equal number of "robot" sellers. These robot sellers are programmed to adhere to equilibrium strategies. Their inclusion allows us to focus on buyer behavior, reducing anomalies, and effectively handling logistical and budget constraints. A detailed set of instructions and experiment materials are available in the online appendix.

3.3 Market institution

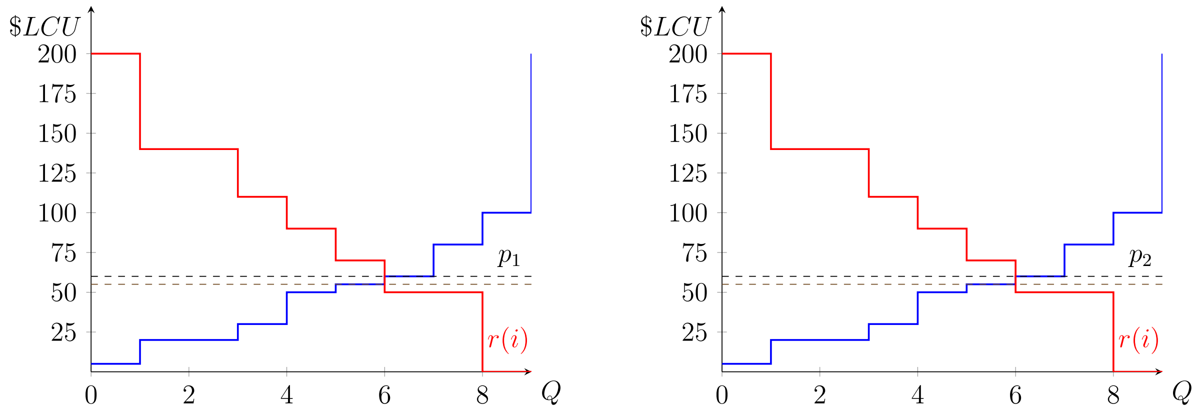
We use a single call market (SCM) institution. SCM asks each buyer i to submit their maximum acceptable price, bid b_i, and to each seller to submit their minimum acceptable sale price, ask a_j. The market is cleared at a single equilibrium price p^*. This particular market institution reduces behavioral noise, guarantees a unique equilibrium price, and human subjects seem to behave more efficiently when interacting with automated agents (Cason and Friedman, 1997).

3.4 Implementation of the model

We utilize three different treatments for this experiment.

1. **Baseline case**: In this market setting, Buyers' valuations are represented as $r(i) = [50, 50, 70, 90, 110, 140, 40, 200]$, while the seller's reservation costs in both periods are given by $c(i) = [5, 20, 20, 30, 50, 55, 60, 80, 100]$. We allow the possibility for buyers to buy up to two units of the good in the first period. The first purchased unit is used for consumption in the first period, while the second is put into storage to be consumed in the second period. Storage cost is \$10 and must be paid in the first period.

   In equilibrium, there is no storage, so the myopic solution is also competitive. The quantity traded is $q = 6$ in both periods, and the corresponding price falls within the range of $[55, 60]$.



(a) Period 1 (b) Period 2

Figure 4: Baseline market

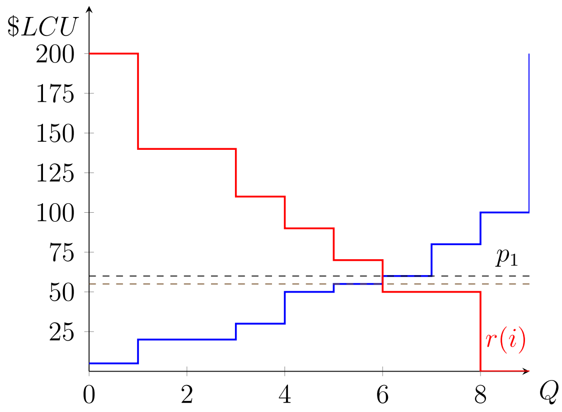
2. **Price cap case**: In this scenario, supply and demand parameters remain the same as in the previous case. However, we introduce a price cap regulation. Both buyers' valuations and sellers' costs are the same in both periods.

   Demand: $r(i) = [50, 50, 70, 90, 110, 140, 140, 200]$

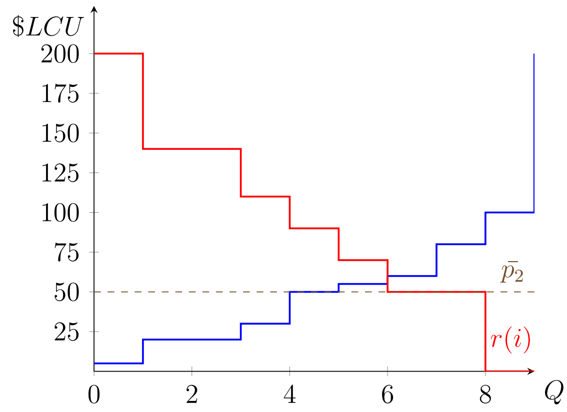
   Supply: $c_1(i) = c_2(i) = [5, 20, 20, 30, 50, 55, 60, 80, 100]$

   The price ceiling, $\bar{p}_2$, is set at 50 in period 2, and it is binding, resulting in a shortage during that period. This shortage leads to uncertainty and triggers a demand for storage with a cost of $s = 10$. As a result, the demand for storage is given by $\tilde{D} = [97.25, 96.25, 65.71, 55]$, while the supply for storage is $\tilde{S} = [60, 70, 80, 90, 100, 110, 140, 140, 200]$. Therefore, the predicted market equilibrium is as follows:

   - Equilibrium probability of acquiring a good in period 2 is $\rho \simeq 0.71$
   - In the rationing equilibrium, the quantity traded in the first period is $q_1^* = 7$, among them $\alpha^* = 1$ is put in storage, with the corresponding price p_1^* falling within the range $[65.71, 70]$. In the second period, the traded quantities are $q_2^* = 5$, with the corresponding price $p_2^* = \bar{p}_2 = 50$.



(a) Period 1



(b) Period 2

Figure 5: Price cap market

3. **A case with increasing prices**: In this market scenario, buyers' valuations remain constant across both periods, while sellers' costs are four times greater in the second period. The demand function is represented as

$$r(i) = [50, 50, 70, 90, 110, 140, 140, 200]$$

, and the seller's reservation costs in the first period are given by

$$c_1(i) = [5, 20, 20, 30, 50, 55, 60, 80, 100]$$

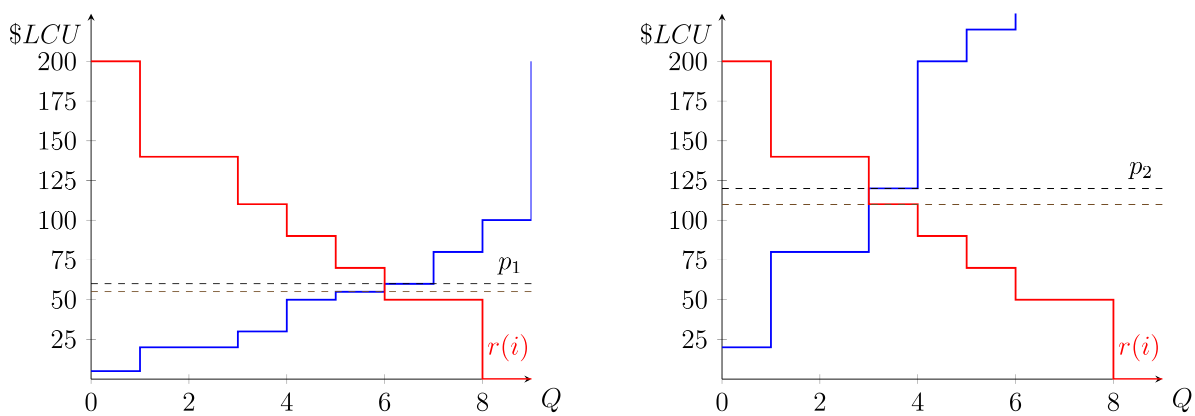
, while in the second period, they are

$$c_2(i) = [20, 80, 80, 120, 200, 220, 240, 320, 400].$$

In the myopic equilibrium, the quantity traded in the first period is $q_1 = 6$, with the corresponding price falling within the range of $[55, 60]$. Similarly, the equilibrium quantity traded in the second period is $q_2 = 3$, and the corresponding price is in the range of $p_2 \in [110, 120]$.

Notice that $p_2 > p_1 + s$ indicates an incentive to store goods in period 1. As a result, the predicted competitive equilibrium leads to the following outcomes:

- Equilibrium probability: $\rho = 1$ (no rationing in equilibrium).
- Demand for storage: $\tilde{D} = [50, 70, 70, 70, 80, 110]$
- Supply for storage: $\tilde{S} = [60, 70, 80, 90, 100, 110, 140, 140, 200]$
- In the competitive equilibrium, the quantity traded in the first period can be either $q_1^* = 7$ or $q_1^* = 8$, with the corresponding price falling within the $[70, 80]$ range. $\alpha^* = 2$ units are put in storage. For the second period, the equilibrium quantity traded is $q_2^* = 3$, and the corresponding price is in the range of $[80, 90]$.



(a) Period 1

(b) Period 2

Figure 6: Supply shock market

4 Experimental Results

4.1 Overview

H1: *the first period's price, combined with storage costs, is equal to the second period's price.*

Results: In the baseline scenario, the optimal strategy was to wait until the second period to buy. However, many buyers purchased multiple units early, causing first-period prices to rise above equilibrium. In the second period, prices were slightly below equilibrium due to earlier purchases by high-valuation buyers.

In contrast, in the supply shock case, the optimal strategy for some buyers was to buy earlier, given that the price was expected to increase in the second period. Here, the trading prices during the experiment coincide with the competitive equilibrium. It's worth noting that no significant price difference was observed between the baseline and the supply shock treatments. This suggests that participants employed similar strategies in both contexts, regardless of the optimal dynamic solution.

In summary, our findings are inconclusive, and we do not have sufficient evidence to confirm the initial hypothesis. In the baseline, the condition $p_1 + s = p_2$ does not hold. but it does for the supply shock treatment.

H2a: *high-reservation buyers store in period 1, while low-reservation buyers purchase the good in period 2 at the price ceiling* $\overline{p_2}$.

Results: We found no statistical difference in the valuations between participants who chose to buy and store goods in the first period and those who did not. This pattern was consistent in all treatments. Players did not appear to base their storage decisions on their valuations, so we cannot confirm the hypothesis.

H2b: *The price in period one, when added to the cost of storage, is strictly larger than the price ceiling in period 2.*

Results: This hypothesis is supported. With the introduction of price cap regulation, the average price for goods in the initial period was notably higher than in the price ceiling set for the subsequent period. Nonetheless, this difference surpassed theoretical predictions. Also, fewer goods were traded in the second period than the rationing equilibrium suggested.

H2c: *The price in period 1 is larger than or equal to the competitive price in period 1.*

Results: We found evidence suggesting that the price in the first period was higher under the price cap compared to the second period. Yet, this difference isn't statistically significant when accounting for clustered standard errors at the market level. More data observations may be necessary to confirm the hypothesis.

H2d: *The quantity of goods stored in the rationing equilibrium is larger than or equal to the quantity stored in the competitive equilibrium.*

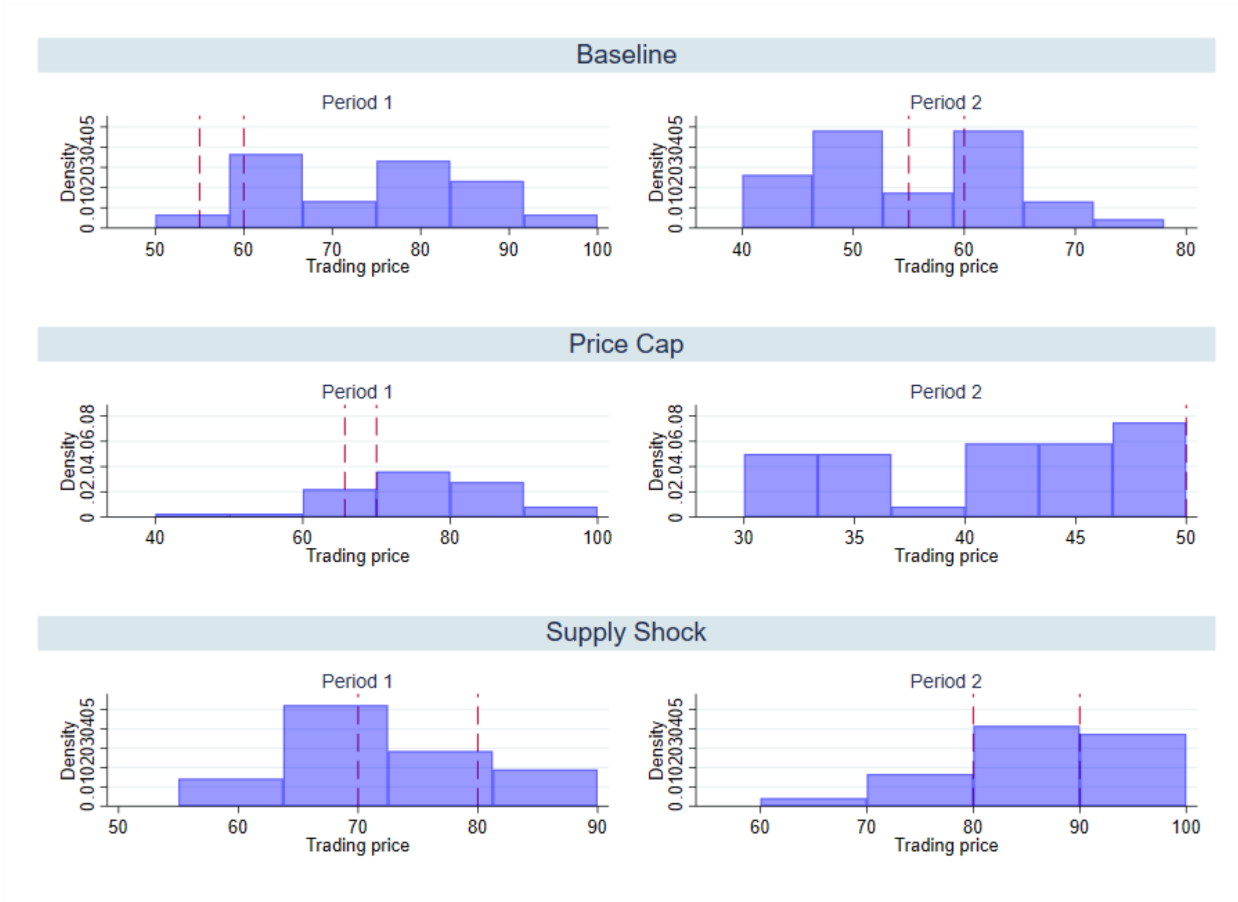
Results: In the baseline scenario, a larger number of buyers opted to purchase and store goods than what theory predicted. As a result, we lack sufficient evidence to assert that the quantity of goods stored during the rationing equilibrium exceeds or equals the quantity stored in the competitive equilibrium.

4.2 Prices

Table 1 presents the average trading price per market across different treatments and trading periods. In the baseline scenario, we inform all players that valuations and production costs would be constant in both periods. Nonetheless, many buyers were unable to accurately forecast the equilibrium prices for the second period, storing more goods than optimal, and causing the prices in the first period to exceed the equilibrium. Prices in the second period are slightly below the competitive benchmark. Similarly, in the price cap scenario, prices were also above competitive prices, and marginally above the baseline case scenario. In the supply shock treatment, trading prices on average convinced with the competitive equilibrium.

Table 1: Market Price

Treatment	Period	num. markets	Av. price	se	95% conf. interval	Competitive price
Baseline	1	60	69.72	1.84	[66.11, 73.32]	[55.00, 60.00]
	2	60	53.82	1.24	[51.39, 56.24]	[55.00, 60.00]
Price Cap	1	60	73.27	1.65	[70.04, 76.49]	[65.71, 70.00]
	2	60	39.15	0.92	[37.35, 40.95]	50.00
Supply Shock	1	40	69.18	2.11	[65.03, 73.32]	[70.00, 80.00]
	2	40	86.70	3.24	[80.36, 93.04]	[80.00, 90.00]



Note: The dashed vertical lines represent the competitive equilibrium for the baseline and supply shock treatments. For the price cap treatment, they indicate the rationing equilibrium.

Figure 7: Trading prices, last 5 rounds

Figure 7 illustrates the distribution of trading prices for each treatment and trading period over the final 5 rounds, typically representing the end of the learning phase. Interestingly, most markets do not consistently align with the competitive price bracket. However, the most frequent price, or mode, tends to be proximate to or within the optimal pricing range. Throughout the experiment, deviations from optimal prices remain evident.

Regarding hypothesis H1, we lack sufficient evidence to assert that the price under control exceeds the price in a free market during the first period. Although Table 2 shows a positive difference between treatments in the first period's price, consistent with theoretical predictions, this difference is not statistically significant.

It is worth noting that we do not observe a prolonged learning trend or convergence path to equilibrium for the baseline results. Figures 12, 13, and 14 depict the progression of average trading prices across experiment rounds, revealing that learning took place between the first two rounds and remains nearly stagnant for the rest of the experiment. Furthermore, table 3 confirms that the quantity of goods procured remains stable between the initial and concluding 5 rounds. And this is true for all treatments.

Table 2: Differences in market price and stored goods

	Baseline	Price Cap	Two sided T-Test	Wilcoxon-Mann-Whitney Test
Num. Markets	60	60	-	-
Price	69.72 (1.840)	73.27 (1.646)	-1.4380 Pr = 0.1531	-1.5875 Pr = 0.1124
Stored Goods	2.03 (0.111)	2.05 (0.124)	-0.0998 Pr = 0.9207	-0.0250 Pr = 0.9800

Notes: the T-Tests and the Wilcoxon-Mann-Whitney tests report two sided p-values with the alternative hypothesis that the baseline scenario is significantly different than the price cap scenario.

Table 3: Sold widgets distribution by treatment and rounds

Number of widgets acquired in period 1	**Round 1-5**	**Round 6-10**	**Total**	**Pearson's Chi-2 Test**	**Wilcoxon Mann Whitney Test**
Baseline					
0	106	87	193	4.0583 Pr = 0.131	-1.1944 Pr = 0.232
1	73	92	165		
2	61	61	122		
Price Cap					
0	105	97	202	0.5513 Pr = 0.759	-0.6490 Pr = 0.516
1	75	80	155		
2	60	63	123		
Supply Shock					
0	84	69	153	2.8623 Pr = 0.239	-1.4955 Pr = 0.135
1	33	41	74		
2	43	50	93		

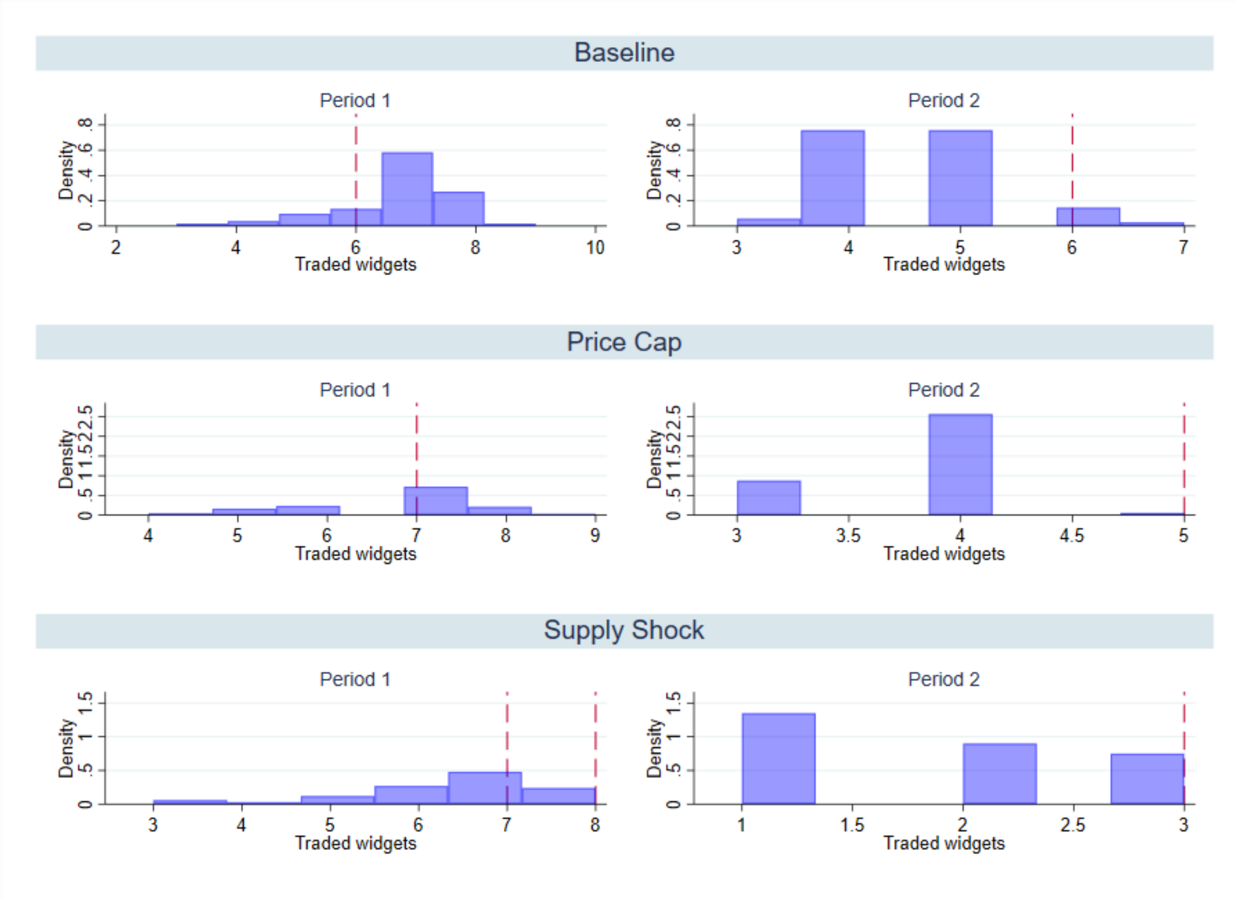
Notes: The table's second and third columns display the distribution of widgets acquired during the first trading period for the initial and final five rounds of the session, respectively. The last two columns compare the distribution between these two sets of rounds, indicating the level of statistical significance of the difference.

4.3 Consumption and Hoarding

Table 4 outlines the average quantities traded in each market, differentiated by treatments and trading periods. As previously noted, buyers in the baseline case often misjudged the equilibrium outcomes, leading to an over-storage of goods in the initial period. This had repercussions on the quantities traded: in the first period, they exceeded equilibrium, while in the second period, they fell below the competitive equilibrium. In the price cap scenario, traded quantities didn't meet the competitive mark and were somewhat below the baseline. In contrast, in the supply shock treatment, the traded quantities, on average, aligned with the competitive equilibrium.

Table 4: Market Quantities

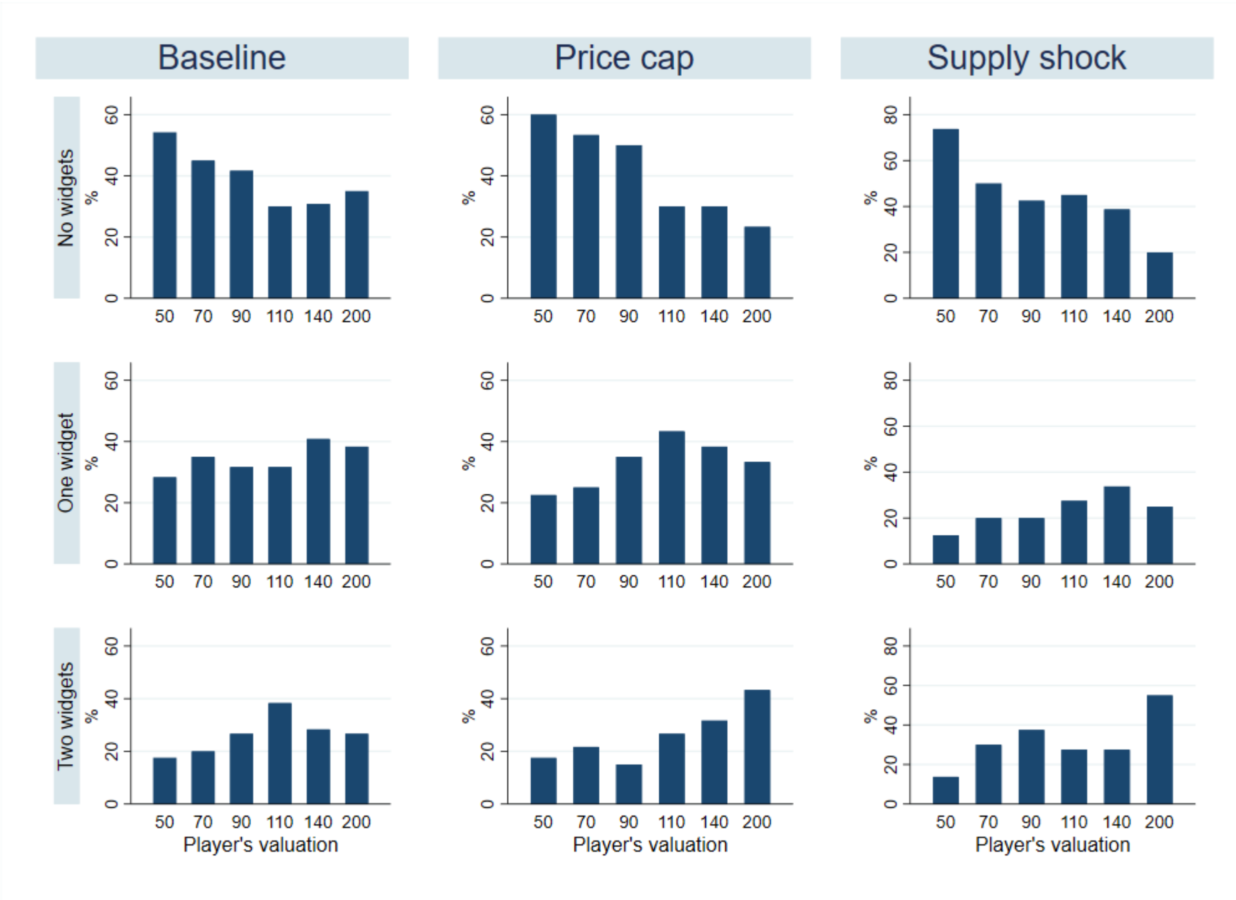
Treatment	Period	num. markets	Q	se	95% conf. interval	Competitive price
Baseline	1	60	6.82	0.15	[6.53, 7.11]	[6.00, 6.00]
	2	60	4.62	0.10	[4.42, 4.81]	[6.00, 6.00]
Price Cap	1	60	6.68	0.13	[6.42, 6.94]	[7.00, 7.00]
	2	60	3.77	0.06	[3.65, 3.88]	[5.00, 5.00]
Supply Shock	1	40	6.50	0.20	[6.10, 6.90]	[7.00, 8.00]
	2	40	1.80	0.13	[1.55, 2.05]	[3.00, 3.00]



Note: The dashed vertical lines represent the competitive equilibrium for the baseline and supply shock treatments. For the price cap treatment, they indicate the rationing equilibrium.

Figure 8: Traded quantities, last 5 rounds

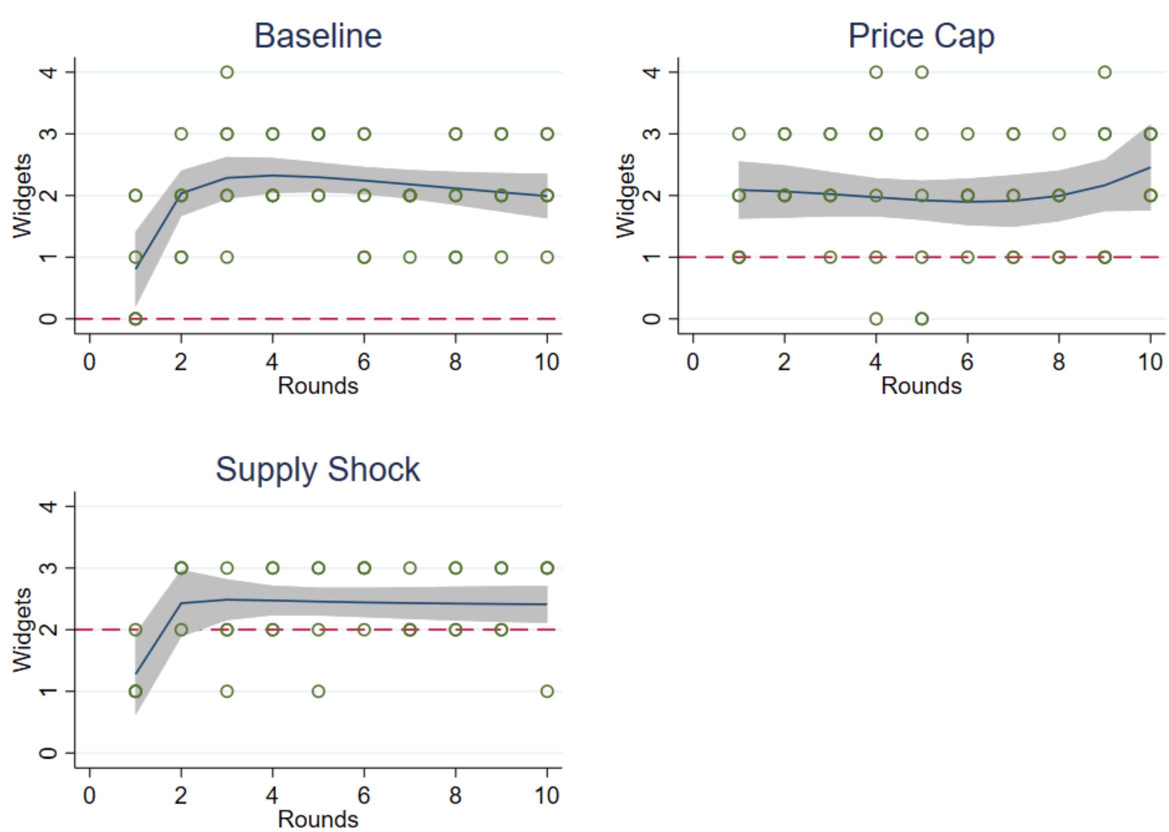
Figure 8 presents the distribution of quantities traded in the last 5 rounds of the experiment. Most traded quantities do not correspond with the competitive equilibrium range. For the baseline scenario, the mode of distribution exceeds the market equilibrium but aligns with the competitive equilibrium in other treatments. In the second period, the traded quantities significantly deviate below the market equilibrium, largely due to over-purchases in the first period and sub-optimal bidding choices. A deeper examination of these bidding strategies will be discussed later. Notably, while buyers appear to prioritize the price levels in their bids, they often neglect the broader market equilibrium implications when selecting quantities. Additionally, figure 9 indicates that the valuation was frequently not the primary factor influencing demand choices. Although those with lower valuations were often sidelined from the market, there's considerable variability in behavior. Surprisingly, certain submarginal buyers obtained goods even when they provided no discernible advantage.



Notes: The figure presents the distribution of players based on the number of widgets acquired in period 1 across all rounds, categorized according to their valuation.

Figure 9: Acquired widgets in period 1 by player's valuation and treatment

Figure 10 shows the number of goods stored in the first period. This picture brings together our earlier findings. We see that the stored amount is often too high, and there isn't much change through the experiment's rounds. There's no clear move toward the competitive equilibrium for the baseline and price cap treatments.



Notes: The figure shows the number of widgets stored in each round for the three treatments in the experiment. The dashed line represents the theoretical prediction for each market.

Figure 10: Storage Market in all Treatments

4.4 Bidding strategy

Due to a software glitch, we could not save the bidding prices submitted by buyers in half of the data we collected (the data we have so far). As a result, our analysis in this section will focus solely on market outcomes based on the valuations provided to each buyer. This section will be properly expanded once the data collection is completed.

Figure 5 displays the distribution of valuations assigned to each player based on the number of widgets they acquired in period 1 for all treatments. The table's test examines if there is a difference in the buyers' valuations who acquire 0, 1, or 2 widgets. Our findings suggest that players who did not secure any widgets typically held lower valuations. Interestingly, there is no discernible difference in the valuations between those who purchased 1 widget and those who bought 2. These outcomes point to a significant excess of demand, leading to seemingly random allocations of widgets. Consequently, valuations appear not to play a pivotal role in the final widget counts each player achieved.

Table 5: Widget value distribution comparison by treatment and amount acquired

Player's valuation	0 sold widgets in P1	1 sold widgets in P1	Total	Wilcoxon MannWhitney Test
Baseline				
50	65	34	99	
70	27	21	48	
90	25	19	44	-3.0668
110	18	19	37	Pr = 0.002
140	37	49	86	
200	21	23	44	
Price Cap				
50	72	27	99	
70	32	15	47	
90	30	21	51	-4.8337
110	18	26	44	Pr = 0.000
140	36	46	82	
200	14	20	34	
Supply Shock				
50	59	10	69	
70	20	8	28	
90	17	8	25	-4.4863
110	18	11	29	Pr = 0.000
140	31	27	58	
200	8	10	18	

Notes: The second and third columns of the table illustrate the distribution of widgets obtained during the first trading period, specifically for participants who managed to secure either 0 or 1 widget. The last column makes a comparison between these two groups of buyers in terms of their assigned valuations, indicating the statistical significance of the disparity between them.

Table 5: Widget value distribution comparison by treatment and amount acquired (continued)

Player's valuation	1 sold widgets in P1	2 sold widgets in P1	Total	Wilcoxon MannWhitney Test
Baseline				
50	34	21	55	
70	21	12	33	
90	19	16	35	-0.3370
110	19	23	42	Pr = 0.736
140	49	34	83	
200	23	16	39	
Price Cap				
50	27	21	48	
70	15	13	28	
90	21	9	30	-1.4033
110	26	16	42	Pr = 0.161
140	46	38	84	
200	20	26	46	
Supply Shock				
50	10	11	21	
70	8	12	20	
90	8	15	23	-0.2878
110	11	11	22	Pr = 0.773
140	27	22	49	
200	10	22	32	

Notes: The second and third columns of the table illustrate the distribution of widgets obtained during the first trading period, specifically for participants who managed to secure either 1 or 2 widget. The last column makes a comparison between these two groups of buyers in terms of their assigned valuations, indicating the statistical significance of the disparity between them.

4.5 Efficiency

To analyze efficiency in our experiment, we contrast the consumer surplus with two benchmarks. The first benchmark involves comparing the total realized surplus over the two trading periods with the theoretical prediction for a free market scenario. We define the efficiency ratio κ for market m formally as:

$$\kappa_m = \frac{\sum_{j \in B} u_i(y_{mj1}, y_{mj2}, p_{m1}, p_{m2})}{\sum_{j \in B} u_i(y^*_{mj1}, y^*_{mj2}, p^*_{m1}, p^*_{m2})}$$

Here, u_i represents the net payoff of buyer j, and $y_{jt} \in \{0, 1, 2\}$ denotes the purchases made in period $t \in \{1, 2\}$, with p_t being the transaction price. The parameters marked with * represent the optimal values in a free market scenario. We compare the results from the price cap treatment with the maximum theoretical prediction of the baseline market. As there are no market interventions in the other treatments, the counterfactual for the baseline and supply shock cases is their respective theoretical maximum surplus.

Additionally, we compare the actual market surplus with its maximum theoretical prediction for each period individually. This ratio aids in pinpointing where the majority of the inefficiencies are and gauging the accuracy of our theoretical predictions within the experiment.

Table 6 presents the estimated mean for κ_m for each treatment. Surprisingly, there is not much difference between the price cap case and the baseline case. Both exhibit an efficiency ratio of about 60% with respect to the free market benchmark.

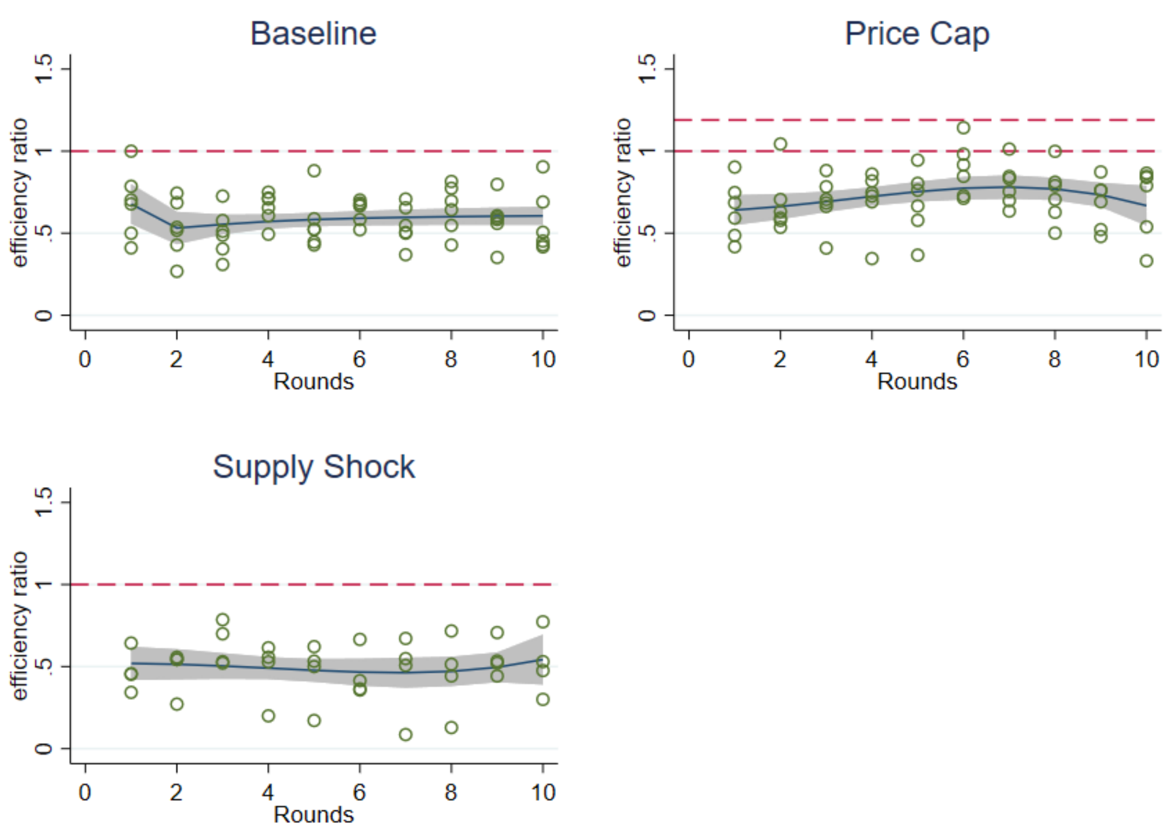
Table 6: Efficiency Ratio Compared to Free Market Benchmark

Treatment	Num. markets	Efficiency ratio	se	95% conf. interval
Baseline	60	0.59	0.019	[0.55, 0.63]
Price Cap	60	0.61	0.019	[0.57, 0.65]
Supply Shock	40	0.49	0.026	[0.44, 0.55]

Table 7 shows the efficiency ratio when the realized market surplus is compared to the theoretical predictions of the competitive equilibrium (for the baseline and supply shock cases) and in relation to the rationing equilibrium (for the price cap case). It's evident that most inefficiencies arise from decisions made in the first market period. Interestingly, the theoretical prediction aligns more closely with the experimental results for the price cap market, even though many markets in this treatment did not achieve the market equilibrium price.

Table 7: Efficiency Ratio Relative to Theoretical Predictions

Treatment	Period	Num. markets	Efficiency ratio	se	95% conf. interval
Baseline	1	60	0.42	0.030	[0.37, 0.48]
	2	60	0.76	0.020	[0.72, 0.80]
Price Cap	1	60	0.53	0.030	[0.47, 0.59]
	2	60	0.90	0.027	[0.85, 0.96]
Supply Shock	1	40	0.44	0.025	[0.39, 0.50]
	2	40	0.57	0.042	[0.49, 0.65]



Notes: The graphs represent the ratio of observed market surplus to expected theoretical surplus for all treatments throughout the experiment's rounds. The dashed line marks the predicted maximum surplus. In the price cap scenario, the uppermost dashed line references the free market efficiency benchmark.

Figure 11: Ratio of realized efficiency vs expected theoretical efficiency

Lastly, figure 11 depicts the progression of efficiency outcomes across the experiment's rounds. Efficiency remained notably consistent throughout the experiment, reinforcing the observation of a stagnant learning trajectory noted earlier.

5 Conclusions

In our research, we developed a model to explore price distortions in a two-period market with durable goods, where hoarding goods between periods incur a minor cost. We tested this model across three experimental settings: a baseline free market, a market with a price cap, and a market facing a supply shock.

Our experimental results deviated from theoretical predictions, largely due to buyers' inclination to hoard goods, despite clear costs. This trend persisted in all treatments, especially noticeable in the baseline where hoarding offers no benefits.

This result is consistent with Dal Bó et al. (2018), which showed that participants often failed to anticipate the broader equilibrium effects of their actions. Unlike Dal Bó et al. (2018), our study introduced direct costs associated with deviations from the equilibrium. However, they did not effectively curb the widespread hoarding behavior.

Introducing a price cap resulted in the first-period prices being larger than in the free economy as predicted. However, the difference was too small to be statistically significant. Moreover, the average efficiency in both scenarios was remarkably similar, 59% in the baseline case and 61% for the price cap.

We found no significant difference in early storage decisions between high and low-reservation buyers across all treatments, indicating that choices weren't consistently based on their valuations.

In the supply shock scenario, the competitive equilibrium predicted that buyers would have no preference between purchasing immediately or waiting until the second period. Throughout the experiment, while trading prices roughly matched the competitive equilibrium, surprisingly high excess demand excluded many high-valuation buyers. Consequently, the efficiency achieved only half of its theoretical benchmark.

Interestingly, storage quantities in all treatments showed no significant difference, indicating participants used similar strategies, regardless of the incentives.

In conclusion, our study reveals a tendency to hoard consistently across different market scenarios. As further research explores these behaviors, policymakers and stakeholders should consider both theory and real-world data when addressing the implementation of price distortions as a policy.

A Additional Tables and Figures

Table 8: Participants per treatment

	Baseline	**Price Cap**	**Supply Shock**
No. of participants	48	48	32
Gender			
Man	33%	54%	75%
Woman	31%	44%	22%
Non-binary	2%	2%	3%
No response	33%	0%	0%
Major			
STEM	54%	79%	81%
Non-STEM	4%	6%	3%
Economics	2%	0%	3%
No response	40%	15%	13%
Level of studies			
Graduate	40%	56%	75%
Undergraduate	29%	44%	22%
No response	31%	0%	3%

Notes: The table presents an overview of the demographic characteristics of the participants involved in the experiment.

Table 9: Sold widget's value distribution by treatment and rounds

Player's valuation	Round 1-5	Round 6-10	Total	Pearson's Chi-2 Test
Baseline				
Acquired widgets in P1 = 0				
50	34	31	65	
70	13	14	27	
90	14	11	25	2.1513
110	11	7	18	Pr = 0.828
140	20	17	37	
200	14	7	21	
Acquired widgets in P1 = 1				
50	15	19	34	
70	10	11	21	
90	9	10	19	0.6083
110	7	12	19	Pr = 0.988
140	22	27	49	
200	10	13	23	
Acquired widgets in P1 = 2				
50	11	10	21	
70	7	5	12	
90	7	9	16	1.7921
110	12	11	23	Pr = 0.877
140	18	16	34	
200	6	10	16	

Notes: The table's second and third columns show the distribution of widgets obtained during the first trading period for the initial and final five rounds of the session, respectively. The last column contrasts the distributions between these two round sets, indicating the statistical significance of the difference.

Table 9: Sold widget's value distribution by treatment and rounds (continued)

Player's valuation	Round 1-5	Round 6-10	Total	Pearson's Chi-2 Test
Price Cap				
Acquired widgets in P1 = 0				
50	39	33	72	
70	13	19	32	
90	12	18	30	5.5486
110	11	7	18	Pr = 0.353
140	21	15	36	
200	9	5	14	
Acquired widgets in P1 = 1				
50	12	15	27	
70	7	8	15	
90	10	11	21	0.5739
110	13	13	26	Pr = 0.989
140	22	24	46	
200	11	9	20	
Acquired widgets in P1 = 2				
50	9	12	21	
70	10	3	13	
90	8	1	9	12.3821
110	6	10	16	Pr = 0.030
140	17	21	38	
200	10	16	26	

Notes: The table's second and third columns show the distribution of widgets obtained during the first trading period for the initial and final five rounds of the session, respectively. The last column contrasts the distributions between these two round sets, indicating the statistical significance of the difference.

Table 9: Sold widget's value distribution by treatment and rounds (continued)

Player's valuation	**Round 1-5**	**Round 6-10**	**Total**	**Pearson's Chi-2 Test**
Supply Shock				
Acquired widgets in P1 = 0				
50	31	28	59	
70	12	8	20	
90	8	9	17	2.5347
110	11	7	18	Pr = 0.771
140	19	12	31	
200	3	5	8	
Acquired widgets in P1 = 1				
50	5	5	10	
70	2	6	8	
90	5	3	8	2.9245
110	4	7	11	Pr = 0.712
140	13	14	27	
200	4	6	10	
Acquired widgets in P1 = 2				
50	4	7	11	
70	6	6	12	
90	7	8	15	2.8285
110	5	6	11	Pr = 0.726
140	8	14	22	
200	13	9	22	

Notes: The table's second and third columns show the distribution of widgets obtained during the first trading period for the initial and final five rounds of the session, respectively. The last column contrasts the distributions between these two round sets, indicating the statistical significance of the difference.

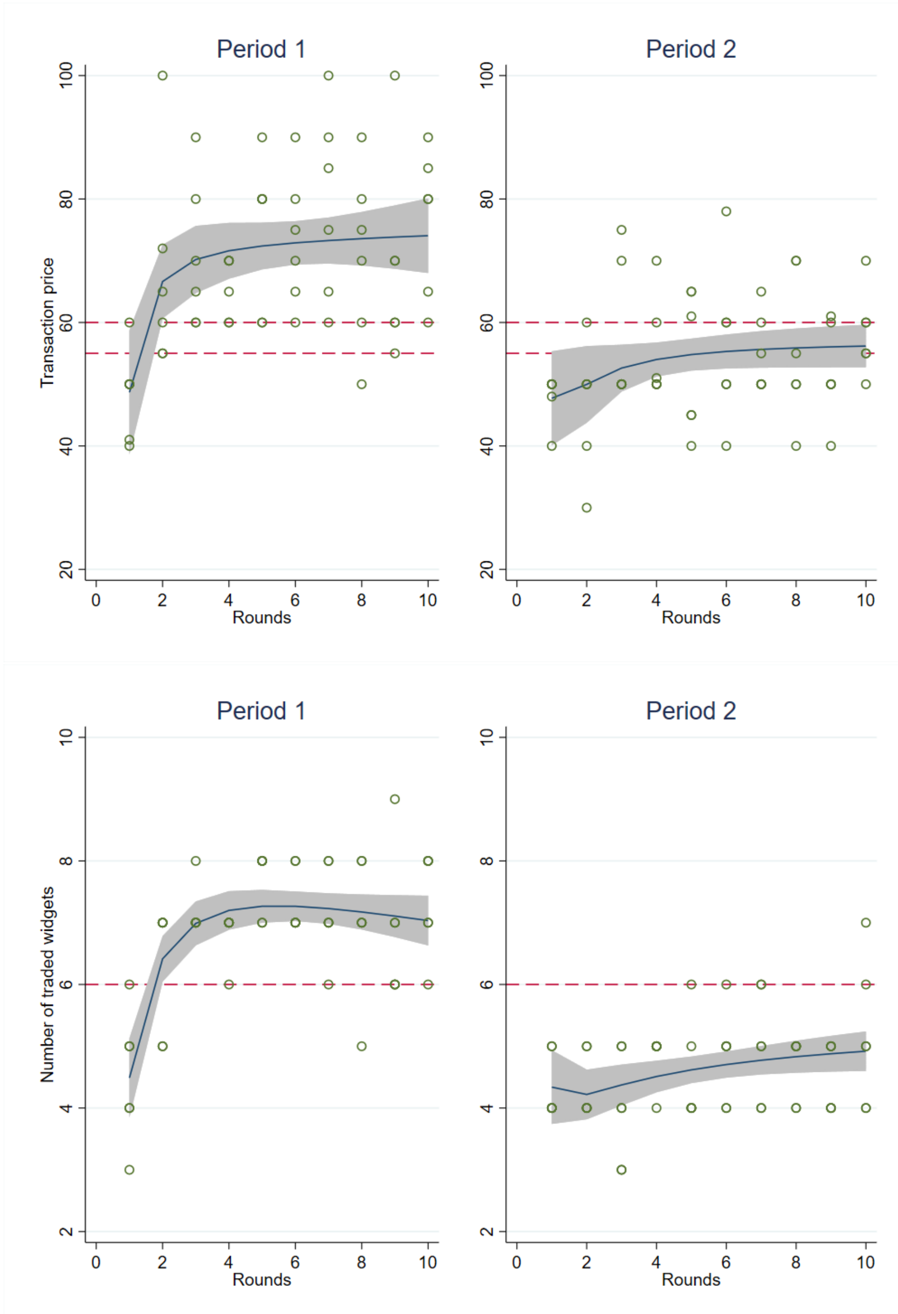


Figure 12: Baseline Market Outcomes

Notes: The figure illustrates the market outcomes for the indicated treatment. The first row displays the market price in each period, while the second row shows the quantities. The dashed horizontal line represents the theoretical prediction for each dimension. In cases where two lines are present, they indicate the upper and lower limits of the equilibrium values, respectively.

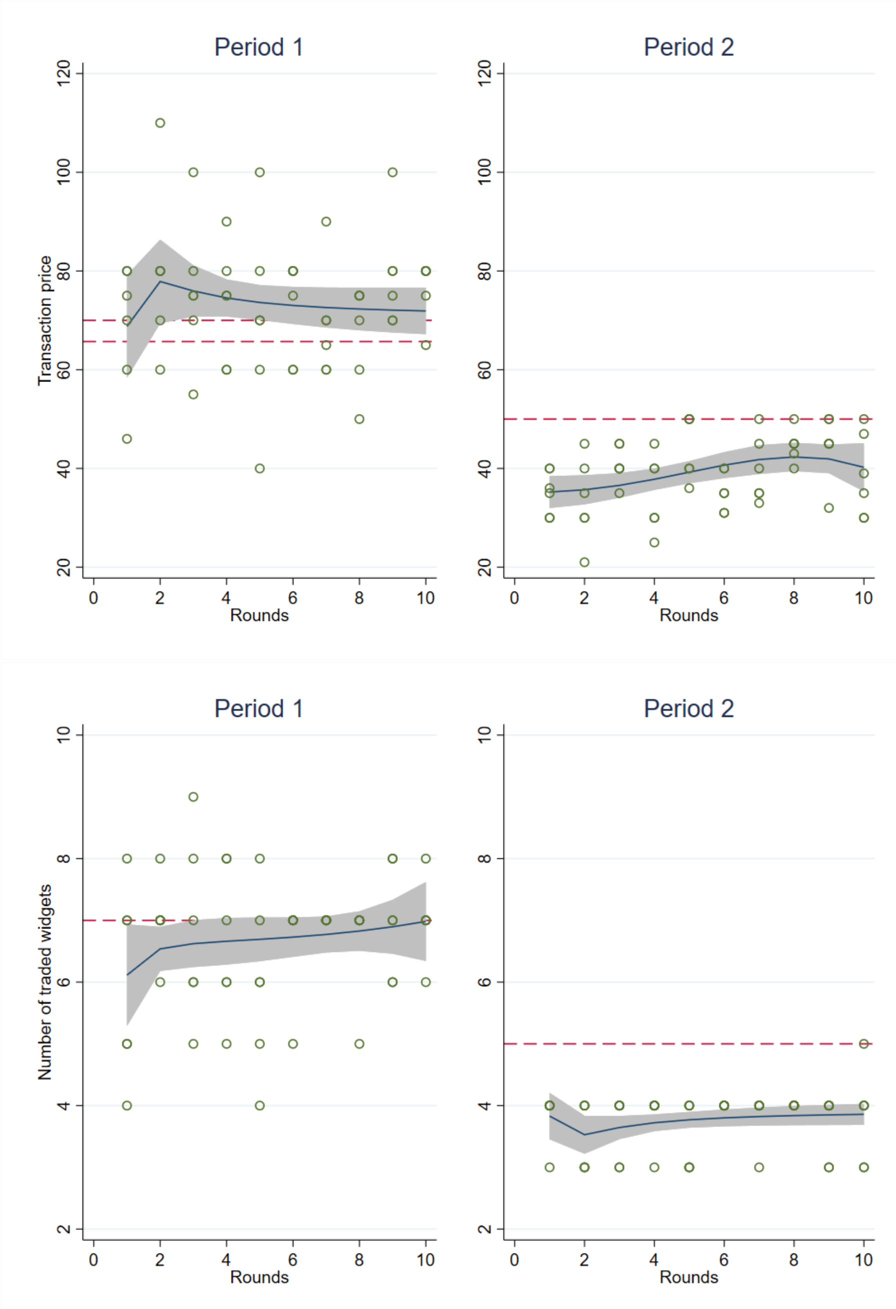


Figure 13: Price Cap Market Outcomes

Notes: The figure illustrates the market outcomes for the indicated treatment. The first row displays the market price in each period, while the second row shows the quantities. The dashed horizontal line represents the theoretical prediction for each dimension. In cases where two lines are present, they indicate the upper and lower limits of the equilibrium values, respectively.

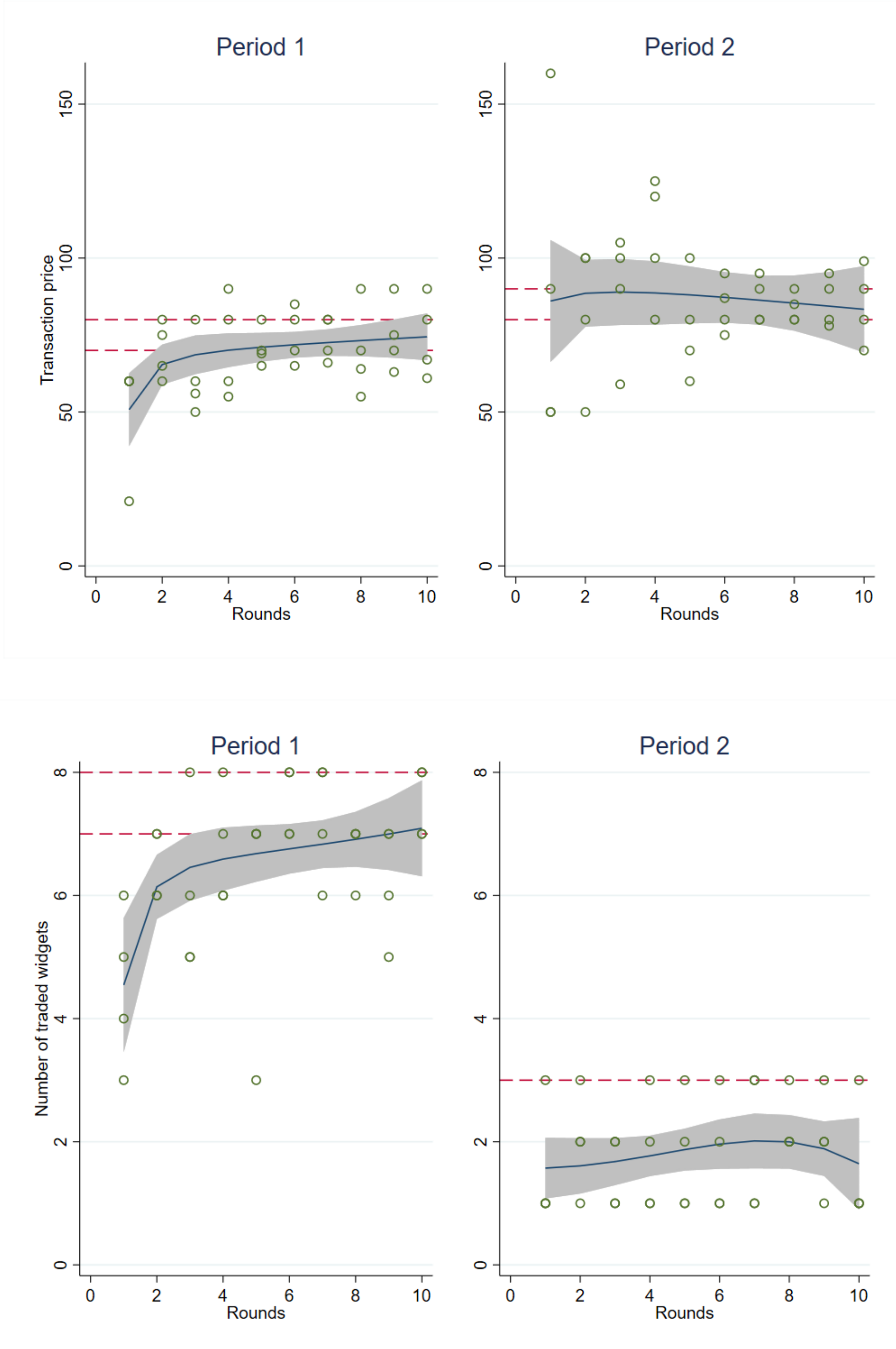


Figure 14: Supply Shock Market Outcomes

Notes: The figure illustrates the market outcomes for the indicated treatment. The first row displays the market price in each period, while the second row shows the quantities. The dashed horizontal line represents the theoretical prediction for each dimension. In cases where two lines are present, they indicate the upper and lower limits of the equilibrium values, respectively.

References

Brekke, K. R., Nuscheler, R., and Rune Straume, O. (2006). Quality and location choices under price regulation. Journal of Economics & Management Strategy, 15(1):207–227.

Cason, T. N. and Friedman, D. (1997). Price formation in single call markets. Econometrica, 65(2):311–345.

Chen, D. L., Schonger, M., and Wickens, C. (2016). otree—an open-source platform for laboratory, online, and field experiments. Journal of Behavioral and Experimental Finance, 9:88–97.

Coleman, D. (1988). Rent control: The british experience and policy response. The Journal of Real Estate Finance and Economics, page 233–255.

Coursey, D. L. and Smith, V. L. (1983). Price controls in a posted offer market. The American Economic Review, 73(1):218–221.

Coyne, C. and Coyne, R. (2015). Flaws and ceilings : price controls and the damage they cause. Institute of Economic Affairs, London, UK.

Dal Bó, E., Dal Bó, P., and Eyster, E. (2018). The demand for bad policy when voters underappreciate equilibrium effects. Review of Economic Studies, 85(2):964–998.

Drèze, J. H. (1975). Existence of an exchange equilibrium under price rigidities. International Economic Review, 16(2):301–320.

Finley, G., Holt, C., and Snow, E. (2019). The welfare costs of price controls and rent seeking in a class experiment. Experimental Economics, 22(3):753–771.

Hatfield, J. W., Plott, C. R., and Tanaka, T. (2016). Price controls, non-price quality competition, and the nonexistence of competitive equilibrium. Games and Economic Behavior, 99:134–163.

Isaac, R. M. and Plott, C. R. (1981). Price controls and the behavior of auction markets: An experimental examination. The American Economic Review, 71(3):448–459.

Kyle, M. K. (2007). Pharmaceutical Price Controls and Entry Strategies. The Review of Economics and Statistics, 89(1):88–99.

Morton, F. M. S. (2001). The Problems of Price Controls. Regulation, 24.

Rockoff, H. (1981). Price and wage controls in four wartime periods. The Journal of Economic History, 41(2):381–401.

Schmidtz, D. (2016). Are Price Controls Fair? Supreme Court Economic Review, 23(1):221–233.

Smith, V. L. and Williams, A. W. (1981). On Nonbinding Price Controls in a Competitive Market. American Economic Review, 71(3):467–474.

Ádám, Z. (2019). Explaining orbán: A political transaction cost theory of authoritarian populism. Problems of Post-Communism, 66(6):385–401.