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Information, Prices and Buyer Entry

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Abstract

Conventional wisdom suggests that information transparency about prices lowers prices and markups by intensifying seller competition. However, in markets with costly buyer entry, price transparency also draws in more buyers, increasing demand-side competition and putting upward pressure on prices. We show that this buyer entry effect may dominate, and prices and markups may rise with information transparency.

Research themes: Models and tools – Economic models
JEL codes: D40; D83; L11

Résumé

Il semble communément admis que la transparence des prix fait baisser les prix et les marges bénéficiaires en intensifiant la concurrence entre vendeurs. Toutefois, sur les marchés dont le coût d’entrée est élevé pour les acheteurs, cette transparence attire d’autres acheteurs, ce qui accroît la rivalité du côté de la demande et exerce une pression à la hausse sur les prix. Nous montrons que cet effet d’attraction des acheteurs peut l’emporter, et que les prix et les marges peuvent ainsi augmenter avec la transparence des prix.

Sujets : Modèles et outils – Modèles économiques
Codes JEL : D40; D83; L11

1 Introduction

A standard result in consumer search theory is that greater information transparency leads to lower prices. The intuition is simple: as buyers become more informed about the prices posted by sellers, sellers compete by lowering their prices to attract buyers. Consequently, greater transparency about prices should promote competition among sellers and reduce their market power.

We investigate whether this conventional wisdom is robust in markets where buyers incur non-trivial costs to participate. For instance, tourists often incur substantial travel costs to visit unfamiliar destinations, and face uncertainty about market prices during their stays.[1] In those markets, buyer's participation decisions, together with informational uncertainty, jointly determine the equilibrium price distribution. Technological advances, such as widespread internet and smartphone access, alleviate (but do not eliminate) information frictions by helping tourists to identify and locate sellers that offer better terms of trade. We analyze how such changes affect equilibrium prices while taking into consideration the buyer's participation decision. We find that in this setup, greater information transparency may lead to higher prices and markups, overturning the conventional wisdom.

In our model, each seller has one unit of a good to sell, and each buyer wants to consume one unit of that good. Buyers and sellers play a two-stage game. First, sellers post prices. Second, observing the price distribution, buyers decide whether to enter the market by incurring a cost. Upon entry, each buyer becomes informed with probability λ. *Informed buyers* observe the prices posted by sellers and can direct their search toward those offering the most favorable terms of trade. By contrast, *uninformed buyers* know only the price distribution but cannot identify individual prices and thus engage in an undirected search.

Greater information transparency, represented by a higher λ, has two opposing effects. On one hand, it intensifies competition among sellers, exerting downward pressure on prices and markups, a mechanism we refer to as the *seller competition effect*, consistent with the conventional view. On the other hand, transparency also encourages additional

[1] Besides the markets in tourist destinations, many other markets also feature non-trivial participation costs. In monetary models, such entry costs are typically represented by the cost of holding money. The participation costs may also take the form of annual fees or the expense of acquiring a necessary device. To trade on an online platform, consumers must often pay a subscription fee. In the market for music lessons, potential students must invest in musical instruments before taking the lessons. To purchase e-books, one must invest in an e-reader. To purchase video games, one must invest in a game console.

buyer entry, which heightens competition among buyers. This *buyer competition effect* exerts upward pressure on prices and markups. We show that, under free entry of buyers, the buyer competition effect dominates, implying that the posted price rises with greater information transparency.

In addition to the standard specification of buyer free entry, we explore two alternative entry specifications that capture the characteristics of different market environments. The first imposes a participation cap on buyers, reflecting situations in which buyer entry is limited by factors such as capacity limits or institutional restrictions; in this setup, information transparency has a non-monotone effect on posted prices (the price first increases, then decreases and finally becomes flat in response to transparency). In the second specification—seller free entry—we show that information transparency leaves the posted price unchanged. These alternative specifications clarify how entry mechanisms mediate the impact of information on market outcomes: although the seller competition effect persists in all cases, its effect is offset by endogenous entry decisions. Overall, the relationship between information transparency and prices or markups depends crucially on the market's entry structure, and once entry costs and decisions are incorporated, the conventional wisdom that greater transparency lowers prices may no longer hold.

Our paper is most closely related to Lester (2011). Similar to our findings, Lester (2011) shows that information transparency can increase competition among buyers such that it dominates the traditional seller competition effect. When sellers have capacity constraints, the limited availability of goods at each seller induces buyers to compete for low-priced goods. As more buyers become informed, congestion worsens at low-price sellers, prompting each informed buyer to become more willing to pay a higher price in exchange for a lower probability of being rationed. Such willingness provides incentives for sellers to set higher prices and may dominate the seller competition effect in a small economy. However, the result is not robust in a large economy, where informed buyers distribute themselves efficiently across sellers, effectively reducing congestion so that the seller competition effect dominates and information transparency reduces the posted price, consistent with the conventional wisdom.

We introduce free entry by buyers to the large economy in Lester (2011). When the fraction of informed buyers is below a threshold, greater information transparency leads more sellers to post non-predatory prices. This induces more uninformed buyers to enter the market and increases the queue length and competition among buyers. As a response, sellers post higher non-predatory prices. Hence, with the buyer-entry channel, transparency can raise prices even in a large economy with a continuum of buyers and sellers, whereas the capacity-constraint mechanism emphasized by Lester (2011) delivers this result only in a small economy. We also study welfare—an issue not addressed by Lester (2011)—and show that extra buyer entry lengthens queues, increases trading volume, and raises sellers' profits and total welfare (with free buyer entry, the buyer's trading surplus is fully dissipated by entry cost).

Our paper is also related to Bethune et al. (2020). They analyze a monetary model with a mix of informed and uninformed buyers and highlight a new channel that affects the welfare cost of inflation. Inflation taxes high-price sellers more heavily—sellers that inefficiently profit from exploiting the uninformed, which reduces the welfare cost of inflation. We can introduce money into our model following the framework in Lagos and Wright (2005) and Rocheteau and Wright (2005). The buyer's entry cost is naturally embedded as the cost of carrying money balances. The relationship between information transparency and prices and the buyer competition effect that we identify in our paper will carry through to monetary models and could affect the analysis of money demand and the welfare cost of inflation.

More generally, our paper is related to the literature on the effect of competition on prices. Some papers suggest that the conventional wisdom that more (seller) competition leads to lower equilibrium prices and markup may not hold (Satterhwaite 1979; Rosenthal 1980; Chen and Riordan 2008; and Mangin 2024). We highlight another nonconventional wisdom: greater information transparency could lead to higher prices and markups.

The paper proceeds as follows. Section 2 describes the environment. We solve the equilibrium in Section 3. In Section 4, we examine the effect of information transparency on prices. Section 5 investigates the welfare implications of information transparency. Section 6 analyzes the effect of information transparency on prices in two alternative models, one under buyer entry with a participation cap and the other under seller entry. Section 7 concludes.

2 Environment

The environment extends the large-economy framework of Lester (2011). The key innovation lies in allowing buyers to make endogenous entry decisions, whereas the measure of buyers is exogenously fixed in Lester (2011). There are two types of agents: a measure 1 of sellers and a large measure of buyers. Each seller is endowed with one unit of an indivisible and homogeneous good. Buyers derive one unit of utility from consuming one unit of the good.

Sellers and buyers play a one-time two-stage sequential game. In stage one, each seller posts and commits to a price p. Let $F(p)$ denote the c.d.f. of the price p posted by sellers. In stage two, buyers observe the distribution of prices (which captures the overall price condition) and decide whether to incur an entry cost $k \in (0,1)$ to participate in the market. After entry, a buyer becomes an informed buyer with probability λ and an uninformed buyer with probability $1-\lambda$. Being informed means the buyer can locate the sellers and therefore a particular price p. This information structure implies that informed buyers can conduct a directed search and choose the seller promising the maximum expected utility, while uninformed buyers engage in an undirected search and choose a seller at random.

Given the search strategies by buyers, the expected queue length at a particular seller is denoted by Q, which determines the matching probabilities for buyers and sellers. As formalized by Burdett et al. (2001), the matching probability for a seller $\mu(Q) = 1 - e^{-Q}$ is the probability that at least one buyer visits a particular seller. For a buyer, the probability of being served is $\eta(Q) = \mu(Q)/Q$, which decreases in Q. Once a buyer and a seller are matched, the pair trades according to the posted price p. The seller derives a surplus p and the buyer derives a surplus $1-p$ from the trade. Given that sellers are endowed with the indivisible good, p is also the markup sellers receive.

3 Equilibrium

We use the backward induction technique to construct a subgame perfect Nash equilibrium. We first determine the optimal entry decisions for buyers and define the symmetric equilibrium in the second stage subgame taking the price distribution, $F(p)$, as given. Then we characterize the equilibrium price distribution in stage one, taking the equilibrium strategies of buyers in stage two into account.

Consider the second stage subgame. Given any distribution of prices $F(p)$ posted by sellers, a buyer decides to incur the cost k and participate in the market if and only if the expected gain is no less than the entry cost. They become informed with an exogenous probability $\lambda \in [0,1]$ upon entry. If uninformed, they simply visit a seller at random, and if informed, they direct the search to the seller that promises the maximum expected utility.

Formally, let V_I and V_U be the expected values for informed and uninformed buyers, respectively, conditional on having entered the market. The free entry condition is

$$\lambda V_I + (1-\lambda)V_U \leq k, \text{with} = \text{iff } b > 0, \tag{1}$$

which determines an endogenous measure of buyers b (it will be clear later that V_I and V_U depend on b).

Since both informed and uninformed buyers could arrive at a particular seller, the expected queue length at a seller with price p is given by

$$Q(p) = q(p) + (1-\lambda)b, \tag{2}$$

where $q(p)$ is the measure of informed buyers and $Q(p)$ is the measure of all buyers at a price p. Denote the set of sellers that receive informed buyers as $\mathcal{S}_I$ and the set of sellers that do not have any informed buyers as $\mathcal{S}_U$. Therefore, $q(p) = 0$ for a seller in $\mathcal{S}_U$ and $q(p) > 0$ for a seller in $\mathcal{S}_I$.

As informed buyers conduct a directed search, they will visit a seller with price p' and expected queue length Q' only if the expected payoff $\eta(Q')(1-p')$ is weakly higher than the maximum expected payoff from choosing other sellers. As a result, from visiting any seller in $\mathcal{S}_I$, all informed buyers should receive the same expected payoff V_I, or V_I is unique for any given $F(p)$. This implies that the price posted by a seller in $\mathcal{S}_I$ satisfies

$$\eta[q(p) + (1-\lambda)b](1-p) = V_I. \tag{3}$$

From (3), the queue length Q at a seller in $\mathcal{S}_I$ is strictly decreasing in p for any given V_I because $\eta(Q)$ is a decreasing function of Q: buyers are willing to pay a higher price to be in a shorter queue. As the measure of uninformed buyers, $(1-\lambda)b$, does not depend on the particular price posted by the seller, $q(p)$ strictly decreases in p; i.e., a larger measure of informed buyers visit a seller that posts a lower price. Since $q(p) \geq 0$, the price posted by a seller in $\mathcal{S}_I$ should not exceed any price posted by a seller in S_U; intuitively, a seller intending to attract informed buyers should not post a price higher than the price posted by sellers that cater to only uninformed buyers. Given V_I, there exists a critical price $\hat{p}$ which solves

$$\eta[(1-\lambda)b](1-\hat{p}) = V_I. \tag{4}$$

Sellers that post $p < \hat{p}$ will receive informed buyers and $q(p) > 0$, whereas sellers that post $p \geq \hat{p}$ will receive only uninformed buyers and $q(p) = 0$. It must be true that $\eta[(1-\lambda)b](1-p) < V_I$ for $p > \hat{p}$ and

$$V_U = \int_{p<\hat{p}} V_I dF(p) + \int_{p\geq\hat{p}} \eta[(1-\lambda)b](1-p) dF(p). \tag{5}$$

A direct implication from (5) is that $V_U \leq V_I$. Naturally, informed buyers enjoy at least as high an expected value as uninformed buyers.

Next, we define the equilibrium of the stage two game. Following Lester (2011), we focus on symmetric equilibria, in which all agents of the same type use identical strategies, and the equilibrium conditions are satisfied given those strategies.

Definition 1 *Given any price distribution $F(p)$, a symmetric equilibrium in stage two is a list of $(q(p), Q(p), \hat{p}, V_I, V_U, b)$ that satisfies (1) – (5) and $\int Q(p)dF(p) = b$.*

We can show that for any given price distribution and parameter values, there exists a unique subgame equilibrium. The proof of uniqueness is as follows. First, note that when V_I and b are unique, the rest of the endogenous variables must be unique. Second, V_I is unique because informed buyers direct themselves to sellers that offer the highest surplus. Third, given V_I is unique, we can prove by contradiction that b must be unique. If there exist multiple solutions of b with $b_1 > b_2$ in (4) for a given V_I, the corresponding $\hat{p}$ must be $\hat{p}_1 < \hat{p}_2$. Fewer sellers offer V_I when it is easier to meet an uninformed buyer. From (5), we must have $V_{U,1} < V_{U,2}$. As b increases, uninformed buyers get a lower surplus because fewer sellers offer V_I and the queue length at sellers that offer less than V_I increases. Having $V_{U,1} < V_{U,2}$ contradicts the uniqueness of V_U, which follows from (1) and the uniqueness of V_I.

Knowing the buyers' entry decisions and search strategies in stage two, sellers post prices to maximize their expected profits in stage one. At an arbitrary price p, a seller's profit is given by $\pi(p) = \mu[Q(p)]\,p$, where $Q(p)$ is the queue length at price p. Each seller thus solves

$$\Pi = \max_{p\in[0,1]} \{\pi(p) = \mu[Q(p)]\,p\}.$$

Definition 2 *An equilibrium in stage one is a list of $(q(p), Q(p), V_I, V_U, b)$ and a distribution of prices $F(p)$ such that (i) $\pi(p) = \Pi$ for all p with $dF(p) > 0$ and $\pi(p) < \Pi$ for all p with $dF(p) = 0$; and (ii) $(q(p), Q(p), V_I, V_U, b)$ constitute a symmetric subgame equilibrium given $F(p)$.*

We are now ready to characterize the equilibrium price distribution. On one hand, if a seller posts a price $p \geq \hat{p}$, the seller receives only uninformed buyers with the expected queue length $(1-\lambda)\,b$. The expected profit is $\mu\left[(1-\lambda)\,b\right]p$, which increases in p. So it is optimal for the seller to post $p = 1$. On the other hand, if a seller posts a price $p < \hat{p}$, the seller serves both informed and uninformed buyers. In this case, the seller takes the market value of informed buyers V_I as given and chooses the price to maximize the expected profit

$$\max_{p \in [0,\hat{p}]} \quad p(1-e^{-Q}) \quad \text{st. } \frac{1-e^{-Q}}{Q}(1-p) = V_I. \tag{6}$$

As shown in Lester (2011), this optimization problem has a unique solution. As a result, there are at most two equilibrium prices; we label $p_H = 1$ as the high price and the solution to (6) p_L as the low price. Using the constraint in (6) to substitute p into the objective function, we then take the first order condition with respect to Q: $e^{-Q_L} = V_I$. Notice that the solution gives Q_L, the queue length at the low price p_L. Then p_L can be found from the constraint in (6), which yields $p_L = \left(1 - e^{-Q_L} - Q_L e^{-Q_L}\right)/(1-e^{-Q_L})$.

The expected profits from posting (p_H, p_L) are therefore $\pi_H = p_H \mu\left(Q_H\right) = 1 - e^{-Q_H}$ and $\pi_L = p_L \mu\left(Q_L\right) = 1 - e^{-Q_L} - Q_L e^{-Q_L}$. Sellers choose to post p_H if $\pi_H > \pi_L$ and post p_L if $\pi_H < \pi_L$. When $\pi_H = \pi_L$, sellers randomize between p_H and p_L. Notice that a seller posting p_H serves only uninformed buyers, while a seller posting p_L serves both informed and uninformed buyers. Let α denote the fraction of sellers posting p_L. Formally,

$$\begin{cases} \alpha = 0 & \text{if } \pi_H > \pi_L \\ \alpha \in [0,1] & \text{if } \pi_H = \pi_L \\ \alpha = 1 & \text{if } \pi_H < \pi_L. \end{cases}$$

With at most two prices in equilibrium and $p_H = 1$, (5) reduces to $V_U = \alpha V_I$. The associated expected queue lengths at (p_H, p_L) are $Q_H = (1-\lambda)b$ and $Q_L = \lambda b/\alpha + (1-\lambda)b$.

Using the equilibrium conditions, we find two types of equilibria depending on the values of λ and k. In Case 1, all sellers post the same non-predatory price $p < 1$. In Case 2, some sellers post the predatory price $p_H = 1$, and the rest cater to informed buyers and post $p_L < 1$. In the following, we fully characterize each type of equilibrium and the conditions under which it arises.

Lemma 1 ***(Case 1: one-price equilibrium).*** *If* $\lambda \geq -\ln(1-\ln k)/\ln k \equiv \lambda_0(k)$, *all sell-*

ers post the non-predatory price $p < 1$, and the equilibrium values of $(\alpha, V_I, V_U, p, \pi, Q, b)$ are characterized by $\alpha = 1$, $V_I = V_U = k$, $Q = b = -\ln k$, $p = 1 + k \ln k/(1-k)$ and $\pi = 1 - k + k \ln k$.

Proof. The condition $\lambda \geq \lambda_0$ ensures that no sellers want to deviate by posting $p_H = 1$, or

$$\pi_H = 1 - e^{-(1-\lambda)b} < 1 - e^{-b} - be^{-b} = \pi_L.$$

In addition, $k < 1$ guarantees that some buyers enter, or $b > 0$. ■

When λ is high, predatory sellers capture only a small fraction of buyers, and it is not profitable to post the high price $p = 1$. Posting the non-predatory price allows sellers to enjoy a larger customer base and a higher profit.

Lemma 2 ***(Case 2: two-price equilibrium).*** *If $k < \lambda < \lambda_0(k)$, some sellers post $p_L < 1$ and others post $p_H = 1$. The equilibrium values of $(Q_H, Q_L, \alpha, V_I, V_U, p_L, \pi, b)$ are determined by*

$$k = [\lambda + (1-\lambda)\alpha] V_I \tag{7}$$

$$Q_L = \frac{\lambda b}{\alpha} + (1-\lambda) b \tag{8}$$

$$Q_H = (1-\lambda) b \tag{9}$$

$$\pi = 1 - e^{-Q_H} = 1 - e^{-Q_L} - Q_L e^{-Q_L} \tag{10}$$

$$V_U = \alpha V_I \tag{11}$$

$$V_I = e^{-Q_L} \tag{12}$$

$$p_L = \frac{1 - e^{-Q_L} - Q_L e^{-Q_L}}{1 - e^{-Q_L}}. \tag{13}$$

Proof. We first prove the uniqueness of Q_L, and the uniqueness of other variables follows. Combine the equilibrium conditions to generate two equations that determine (Q_L, b):

$$Q_L(k - \lambda e^{-Q_L}) = (1-\lambda) bk$$
$$e^{-Q_L}(1 + Q_L) = e^{-(1-\lambda)b}.$$

We can solve Q_L as a function of λ from

$$g(Q_L) \equiv \frac{e^{Q_L} \ln(1 + Q_L)}{Q_L} = \frac{\lambda}{k}. \tag{14}$$

The derivative of $g(Q_L)$ is

$$g'(Q_L) = e^{Q_L} \frac{-\ln(1+Q_L) + Q_L \left[\ln(1+Q_L) + \frac{1}{1+Q_L}\right]}{Q_L^2}.$$

The sign of $g'(Q_L)$ depends on the sign of

$$h(Q_L) \equiv Q_L \ln(1+Q_L) - \ln(1+Q_L) + \frac{Q_L}{1+Q_L}.$$

Notice that $h(0) = 0$ and

$$h'(Q_L) = \ln(1+Q_L) + \frac{Q_L^2}{(1+Q_L)^2} > 0$$

for $Q_L > 0$. It follows that $h(Q_L) > 0$ for any $Q_L > 0$. Then we have $g'(Q_L) > 0$ for any $Q_L > 0$. When $Q_L = 0$, $g(Q_L) = 1$, or $g(Q_L)$ has a vertical intercept of 1. Given that $g(Q_L)$ is monotonically increasing in Q_L and $g(0) = 1$, a unique solution of Q_L exists when $\lambda/k > 1$.

Given that Q_L is unique, it is straightforward that V_I, π and p_L are unique because they are functions of Q_L. Given π is unique, Q_H is unique from (10). Given Q_H is unique, b is unique from (9). Given Q_b and b are unique, α is unique from (8). ■

The two-price equilibrium exists when $k < \lambda < \lambda_0(k)$. Some sellers can post the predatory high price and serve only uninformed buyers because there are enough uninformed buyers for these sellers to make profits. Sellers that post the non-predatory low price receive both informed and uninformed buyers. In equilibrium, all sellers make the same profits. When λ is too small, or $\lambda < k$, buyers do not enter the market because the expected value from entry is not enough to cover the cost of entry.

Proposition 1 ***(Equilibrium).*** *A unique equilibrium with $b > 0$ exists if $\lambda > k$. Depending on the values of (k, λ), there are two types of equilibria.*

Case 1: *If $\lambda \geq \lambda_0(k)$, all sellers post the same price $p < 1$. The equilibrium values of $(\alpha, V_I, V_U, p, \pi, Q, b)$ are characterized by $\alpha = 1$, $V_I = V_U = k$, $Q = b = -\ln k$, $p = 1 + k \ln k/(1-k)$ and $\pi = 1 - k + k \ln k$.*

Case 2: *If $\lambda_0(k) > \lambda > k$, some sellers post $p_L < 1$ and others post $p_H = 1$. The equilibrium values of $(Q_H, Q_L, \alpha, b, V_I, V_U, p_L, \pi)$ are determined by* (7) *to* (13).

As an illustration, we plot the topology of equilibrium in the (k, λ) space in Figure 1. When $\lambda \leq k$, although there are gains from trade ($k < 1$), the market breaks down and $b = 0$. Because λ is low, (some) sellers are tempted to post predatory prices, and buyers do not obtain enough trading surplus to justify the high entry cost. From the equilibrium conditions, when $Q_L = 0$, $\alpha = 0$ and $V_I = 1$, so the ex ante surplus for buyers is $[\lambda + (1-\lambda)\alpha]V_I = \lambda$. To ensure an equilibrium with $b > 0$ exists, we must have $\lambda > k$.

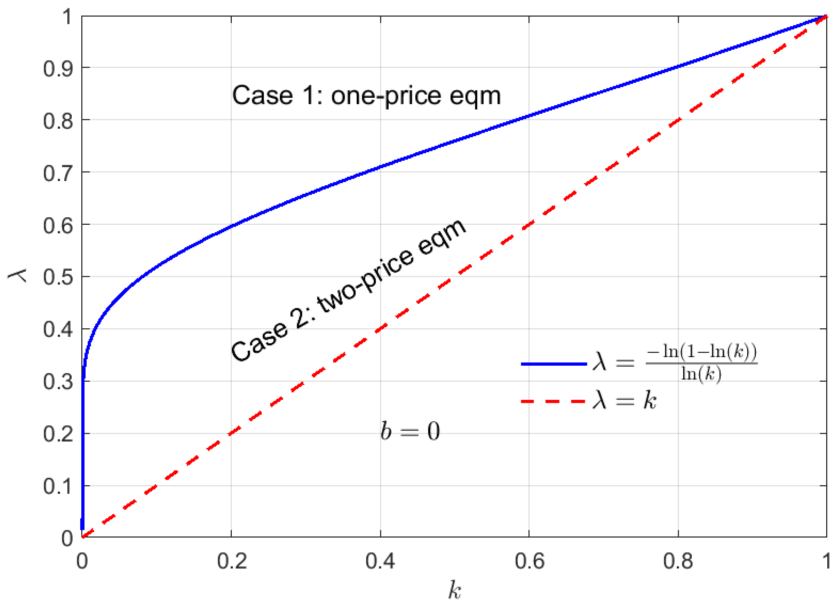

Figure 1: Types of equilibria

4 Information and Prices

In this section, we analyze how information transparency, measured by λ, affects prices and markups. In Case 1, all sellers post the same non-predatory price and the price does not change with λ. Proposition 2 shows the effect of λ in a two-price equilibrium.

Proposition 2 ***(Effects of information transparency in a two-price equilibrium).*** *In a two-price equilibrium, as the fraction of informed buyers (λ) increases, the queue length at the informed buyers Q_L increases ($\partial Q_L/\partial\lambda > 0$), which implies that p_L also increases ($\partial p_L/\partial\lambda > 0$). In addition,*

$$\frac{\partial \pi_H}{\partial \lambda}, \frac{\partial \pi_L}{\partial \lambda}, \frac{\partial Q_H}{\partial \lambda}, \frac{\partial b}{\partial \lambda}, \frac{\partial \alpha}{\partial \lambda} > 0; \frac{\partial V_I}{\partial \lambda} < 0.$$

Proof. From (14) and $g'(Q_L) > 0$, we have $\partial Q_L/\partial\lambda = 1/kg'(Q_L) > 0$. Then we use (13) to derive

$$\frac{\partial p_L}{\partial Q_L} = \frac{e^{-Q_L}(Q_L - 1 + e^{-Q_L})}{(1 - e^{-Q_L})^2} > 0. \tag{15}$$

As a result, $\partial p_L/\partial\lambda > 0$. Using (12), $\partial V_I/\partial Q_L < 0$, and therefore $\partial V_I/\partial\lambda < 0$.

From (10), $\partial\pi/\partial Q_L = Q_L e^{-Q_L} > 0$. It follows that $\partial\pi/\partial\lambda > 0$ and $\partial Q_H/\partial\lambda > 0$. We use the equilibrium conditions to express b and α as functions of (Q_L, λ):

$$b = \frac{Q_L - \ln(1 + Q_L)}{1 - \lambda} \tag{16}$$

$$\alpha = \frac{\lambda}{1 - \lambda}\left[\frac{Q_L}{\ln(1 + Q_L)} - 1\right]. \tag{17}$$

Since the numerator of b in (17) increases in Q_L, and the denominator decreases in λ, we have $\partial b/\partial\lambda > 0$. Let

$$A(\lambda) \equiv \frac{\lambda}{1 - \lambda} \qquad \text{and} \qquad B(Q_L) \equiv \frac{Q_L}{\ln(1 + Q_L)} - 1,$$

so that $\alpha = AB$. Note that for $Q_L > 0$, $B(Q_L) > 0$, $A'(\lambda) = 1/(1 - \lambda)^2 > 0$ and

$$B'(Q_L) = \frac{\ln(1 + Q_L) - \dfrac{Q_L}{1 + Q_L}}{[\ln(1 + Q_L)]^2} > 0.$$

We have $\partial\alpha/\partial\lambda = A'B + AB'(Q_L)\partial Q_L/\partial\lambda > 0$. ■

As a numerical example, Figure 2 shows the comparative statics of key variables with respect to λ for $k = 0.5$. In the region where $\lambda < \lambda_0 = 0.76$, some sellers post $p_L < 1$ and others post $p_H = 1$. As λ increases, more buyers enter, and the queue lengths at both prices increase. The increased queue length intensifies competition among buyers, leading to an increase in p_L. Sellers that post either p_L or p_H both enjoy higher probabilities of sales. Those who post the non-predatory price p_L also sell at a higher price. Hence, both π_L and π_H increase. For informed buyers, their expected value V_I decreases due to the lower trading probability and the higher price p_L. Uninformed buyers enjoy a higher V_U since more sellers post the non-predatory price p_L. Once λ exceeds λ_0, all sellers post the same price $p < 1$, and λ does not affect the economy anymore.

Our results suggest that information transparency induces the posted price p_L to in-

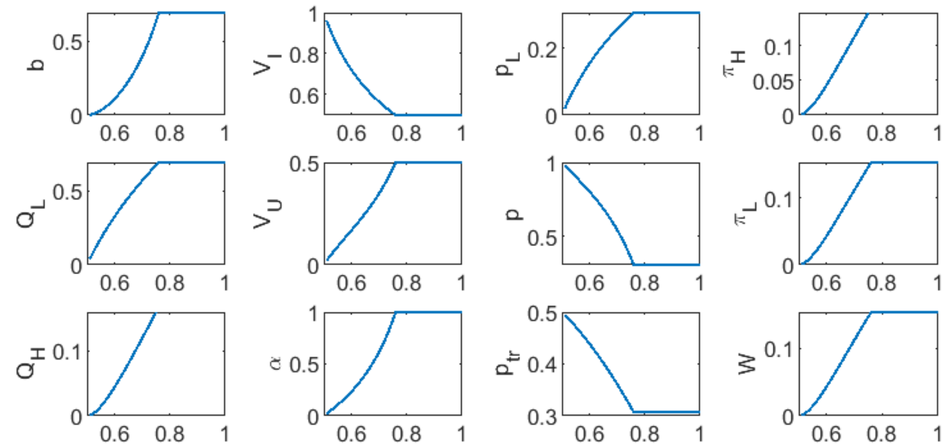

Figure 2: Effect of λ

Notes. The figure shows the effect of λ for $\lambda > k = 0.5$. The implied λ_0 is 0.76.

crease in the two-price equilibrium. This might appear to be counter-intuitive as information transparency about prices is often perceived as reducing sellers' market power. Lester (2011) obtains a similar result by assuming small markets where there are finite numbers of buyers and sellers. However, in his large economy, information transparency monotonically lowers p_L in a two-price equilibrium.

We examine in detail the mechanisms through which information transparency affects p_L and compare them with those in the large-economy setting of Lester (2011). First note that our model and Lester's large economy model share the same positive relationship between p_L and Q_L, characterized by (13). Intuitively, a longer queue means a higher demand (relative to supply) and the seller can charge a higher price. As a result, we can analyze the effect of λ on p_L by analyzing the effect on Q_L. Next, we decompose the effects of λ on Q_L into three terms, using $Q_L = \lambda b/\alpha + (1-\lambda)b$.

$$\frac{\partial Q_L}{\partial \lambda} = b\left(\frac{1}{\alpha}-1\right) - \frac{\lambda b}{\alpha^2}\frac{\partial \alpha}{\partial \lambda} + \left[\lambda\left(\frac{1}{\alpha}-1\right)+1\right]\frac{\partial b}{\partial \lambda}.$$

The first term is the direct effect of λ on Q_L. In any two-price equilibrium ($\alpha < 1$), since informed buyers visit only sellers posting the low price, having more informed buyers increases the queue length at those sellers. This direct effect tends to push up the low price.

The second term represents the indirect effect of λ on Q_L through its impact on α. In both our model and Lester's model, the presence of more informed buyers induces more sellers to post the low price. As a result, each seller that posts the low price attracts fewer buyers, which mitigates the upward pressure on Q_L.

These two effects exist in Lester (2011). In the large economy, the indirect effect through α dominates the direct effect so that the overall effect of λ on Q_L is negative, implying that p_L decreases as λ increases, consistent with the conventional wisdom.

Our model introduces a third effect, an indirect effect of λ on Q_L through buyer entry b. Knowing that the probability of being an informed buyer is higher, more buyers choose to enter the market. The buyer entry effect strengthens the direct effect and leads to a higher Q_L and a higher p_L. The inclusion of the buyer entry effect therefore overturns the effect of λ on Q_L in the large economy and highlights that buyer entry margin is critical when evaluating the effect of information transparency on prices.

We next present a concrete example to demonstrate the effect of information transparency in the presence of buyer entry. Consider shopping in a tourist destination. Tourists (buyers) incur non-trivial transportation and accommodation costs traveling and staying at the destination (k). After arrival, tourists learn about prices (for example, by reading the ads in local newspapers or chatting with hotel workers in the old days before widespread internet access or by browsing the internet or smartphones today) with some probability. Facing a mix of informed and uninformed buyers, some shops (sellers) offer low prices (p_L) to attract the informed visitors, while others charge inflated prices (p_H), targeting uninformed visitors. The advent of internet and then smartphones have greatly increased the probability of acquiring price information (higher λ). As a result, more shops begin to offer reasonable prices (α increases). This makes the tourist destination desirable (the trading surplus increases) because the probability of being overcharged is lower and more visitors will be drawn to the city (b increases). It implies that all shops receive more buyers (Q_H and Q_L increase). Shops offering lower prices tend to increase their prices (p_L) in response to this higher demand from buyers.

Our analysis above so far focuses on the posted price—in particular, on p_L because p_H is fixed at 1. In cases where two prices are posted (Case 2), it is useful to analyze the aggregate prices. We consider two aggregate prices: the average posted price and the average traded price. The average posted price is expressed as the weighted average of p_H and p_L: $\bar{p} = \alpha p_L + (1-\alpha)$. The average traded price is expressed as the weighted average of prices from materialized trades

$$\bar{p}_{tr} = \frac{\alpha(1-e^{-Q_L})p_L + (1-\alpha)(1-e^{-Q_H})}{N},$$

where $N = \left(1 - e^{-Q_L}\right)\alpha + \left(1 - e^{-Q_H}\right)(1-\alpha)$ is the trading volume.

In Case 1, all buyers participate in the market, all sellers post and trade at p_L, and p_L remains constant against λ. As a result, $\bar{p} = \bar{p}_{tr} = p_L$ and do not respond to λ.

In Case 2, a change in λ produces both an intensive margin and an extensive margin effect on the average posted price $\bar{p}$. On the intensive margin, a higher λ leads to a higher p_L due to increased buyer competition. On the extensive margin, a higher λ encourages more sellers to post p_L. The intensive margin and extensive margin work in opposite directions, but the extensive margin dominates and $\bar{p}$ decreases with λ (Appendix A.1 shows the proof). Similarly for $\bar{p}_{tr}$, p_L increases but the fraction of materialized trades at p_L is higher. As shown in Appendix A.2, $\bar{p}_{tr}$ is also decreasing in λ, indicating that the aggregate prices are lower with greater information transparency. Figure 2 illustrates the effects of λ on $\bar{p}$ and $\bar{p}_{tr}$ with a numerical example.

5 Information and Welfare

In this section, we analyze the welfare implications of greater information transparency. We define welfare $\mathcal{W}$ as the total trading surplus (which is equal to N since goods are indivisible and the surplus of each transaction is 1) minus the total entry cost:

$$\mathcal{W} = \left(1 - e^{-Q_L}\right)\alpha + \left(1 - e^{-Q_H}\right)(1-\alpha) - bk.$$

In a one-price equilibrium, information transparency does not affect the equilibrium allocation. Hence, λ does not affect welfare. In a two-price equilibrium, we use (7), (8), and (10) to simplify $\mathcal{W}$ as $\mathcal{W} = 1 - e^{-Q_H} + Q_L e^{-Q_L} - bk = \pi$.

Intuitively, buyers have free entry and their expected trading surplus is equal to the entry cost, so the welfare is equal to the sellers' expected profit, π. Since the seller's profit increases in λ, we have $\partial\mathcal{W}/\partial\lambda > 0$. In any two-price equilibrium, greater information transparency improves welfare (see also the numerical example in Figure 2).

6 Alternative Entry Specifications

Our main model features buyer free entry. In this section, we consider two alternative entry structures: (i) buyer entry with a participation cap, and (ii) seller free entry.

6.1 Buyer Entry with a Participation Cap

Our main model assumes that an infinite number of buyers can enter the market, with entry determined endogenously through a standard free-entry condition that equates the expected value of entry to the entry cost. This assumption may be too strong in environments where participation is capacity constrained. For example, in a tourist city, the number of potential visitors is not unlimited. In the housing market, the number of potential buyers is also unlikely to be infinite. To capture such situations, we introduce a buyer participation cap. Formally, we assume that the pool of potential buyers is limited to $\bar{b}$. When $\bar{b} \geq -\ln k$, buyer entry is not constrained as the maximum measure of buyers entering into the market is $-\ln k$ in the main model. In this subsection, we focus on the case $\bar{b} < -\ln k$ and investigate how the introduction of the participation cap affects the equilibrium outcome.

Under this modification, buyers continue to incur an entry cost, and the equilibrium measure of entrants remains endogenously determined, subject to the cap. For any $\bar{b} < -\ln k$, three types of equilibria with $b > 0$ may arise, depending on whether participation is constrained and on sellers' pricing strategies.

Let

$$\lambda_1(\bar{b}) = \frac{\ln(1+\bar{b})}{\bar{b}},$$

which solves $1 - e^{-\bar{b}} - \bar{b}e^{-\bar{b}} = 1 - e^{-(1-\lambda_1)\bar{b}}$. Let $\lambda_2(k, \bar{b})$ solve (14) and (16) jointly with Q_L, which we rewrite as:

$$\frac{e^{Q_L}\ln(1+Q_L)}{Q_L} = \frac{\lambda_2}{k}$$
$$\frac{Q_L - \ln(1+Q_L)}{1-\lambda_2} = \bar{b}.$$

Proposition 3 summarizes the different cases of equilibria and the effect of information transparency on p_L with a buyer entry cap.

Proposition 3 ***(Equilibrium with a buyer entry cap).*** *A unique equilibrium with $b > 0$ exists if $\lambda \geq k$ and $\bar{b} < -\ln k$. Depending on the values of (k, λ), there are three types of equilibria.*

Case 1: full participation one-price equilibrium. *If $\lambda \geq \lambda_1(\bar{b})$, buyer entry is constrainted at $b = \bar{b}$ and all sellers post the same price, $p < 1$. The equilibrium values of $(\alpha, V_I, V_U, p, \pi, Q)$*

are determined by $\alpha = 1$, $Q = \bar{b}$, $V_I = V_U = e^{\bar{b}}$,

$$p = \frac{1 - e^{-\bar{b}} - \bar{b}e^{-\bar{b}}}{1 - e^{-\bar{b}}} \qquad \textit{and} \qquad \pi = 1 - e^{-\bar{b}} - \bar{b}e^{-\bar{b}}.$$

Case 2a: full participation two-price equilibrium. *If $\lambda_2(k, \bar{b}) \leq \lambda < \lambda_1(\bar{b})$, buyer entry is constrained at $b = \bar{b}$. Some sellers post $p_L < 1$ and others post $p_H = 1$. The equilibrium values of $(Q_H, Q_L, \alpha, V_I, V_U, p_L, \pi)$ are determined by* (8) *to* (13) *with $b = \bar{b}$.*

Case 2b: partial participation two-price equilibrium. *If $k < \lambda < \lambda_2(k, \bar{b})$, the equilibrium b is unconstrained $b < \bar{b}$. Some sellers post $p_L < 1$ and others post $p_H = 1$. The equilibrium values of $(Q_H, Q_L, \alpha, b, V_I, V_U, p_L, \pi)$ are determined by* (7) *to* (13)*.*

As λ increases from k, the economy transitions from case 2b with $\partial p_L / \partial \lambda > 0$, to case 2a with $\partial p_L / \partial \lambda < 0$, and finally to case 1 with $\partial p_L / \partial \lambda = 0$.

Case 1 occurs if $\lambda \geq \lambda_1(\bar{b})$, which guarantees it is more profitable to post $p_L < 1$ than to post $p_H = 1$, or $1 - e^{-Q_H} \leq 1 - e^{-Q_L} - Q_L e^{-Q_L}$. Note that $\bar{b} < -\ln k$ implies that $V_I = V_U > k$ and the participation cap binds. In this case, information transparency does not affect the economy.

When $\lambda_2(k, \bar{b}) \leq \lambda < \lambda_1(\bar{b})$, some sellers post $p_H = 1$, the participation cap binds, and the economy is Case 2a. Using the equilibrium conditions, we solve for $Q_L(\lambda)$ from

$$e^{-Q_L}(1 + Q_L) = e^{-(1-\lambda)\bar{b}}. \tag{18}$$

Since the LHS in (18) decreases in Q_L and the RHS increases in λ, we have $\partial Q_L / \partial \lambda < 0$. It then follows that $\partial p_L / \partial \lambda < 0$. This result is consistent with the conventional wisdom that greater information transparency leads to lower prices. In this case, the expected value from entry for buyers is $V = \lambda V_I + (1 - \lambda)\alpha V_I$, which must be greater than k for b to be constrained. We can show that V increases in λ as $\partial \alpha / \partial \lambda > 0$ and $\partial Q_L / \partial \lambda < 0$. If follows that $V > k$ if $\lambda > \lambda_2(k)$ (and $V = k$ if $\lambda = \lambda_2(k)$).

If $\lambda < \lambda_2(k)$, then $V < k$ at $b = \bar{b}$, and the economy is in Case 2b. In this case, not all buyers enter, and the free entry condition holds with equality as in (7). This equilibrium corresponds to Case 2 in our main model. Greater information transparency drives up p_L because of competition among buyers through buyer entry.

Figure 3 illustrates the topology of the above cases. Figure 4 provides a numerical example, showing how selected endogenous variables respond to information transparency

λ in the model of buyer entry with the participation cap.

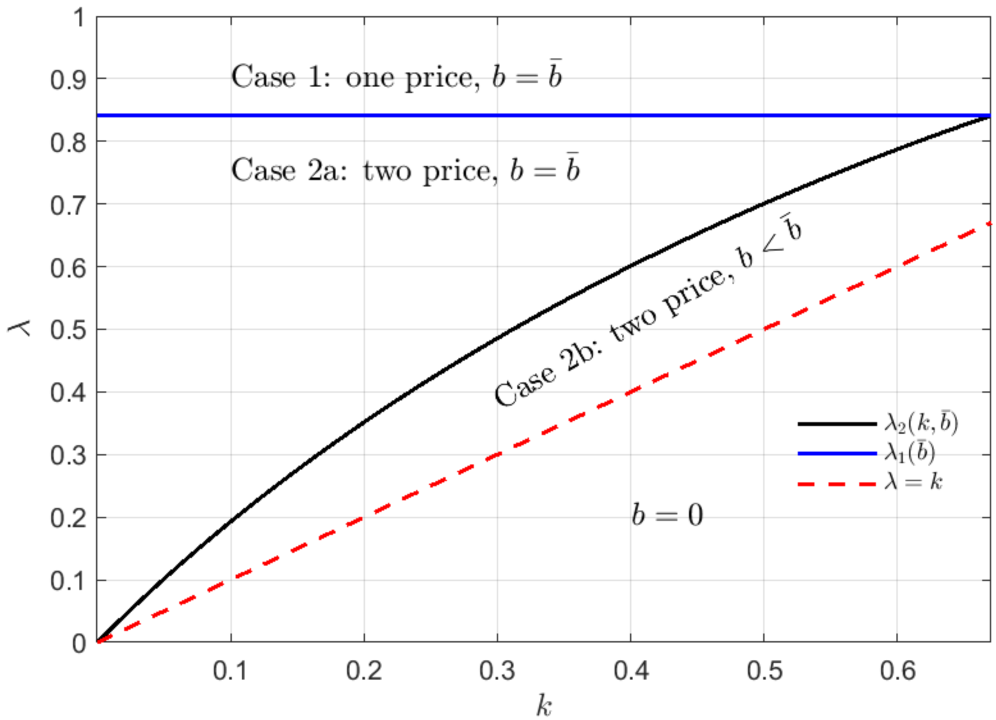

Figure 3: Types of equilibria under buyer entry with the participation cap

Notes. This figure shows the regions of the different types of equilibria for $\bar{b} = 0.4$.

Case 1 and Case 2a are observed in the large economy in Lester (2011), where the buyer entry effect is absent. In Case 2b, the mass of buyers adjusts in response to λ, and the buyer entry effect is active. In the two-price equilibrium, in the absence of buyer entry effect (Case 2a), the seller competition dominates, and information transparency reduces p_L, consistent with the conventional wisdom. In Case 2b, the buyer entry effect strengthens competition among buyers so that it becomes the dominant force. As a result, the conventional wisdom is overturned.

6.2 Seller Entry

Our analysis so far considers entry on the buyer side. In some markets, free entry by sellers can be more relevant. We use this subsection to consider free entry by sellers,

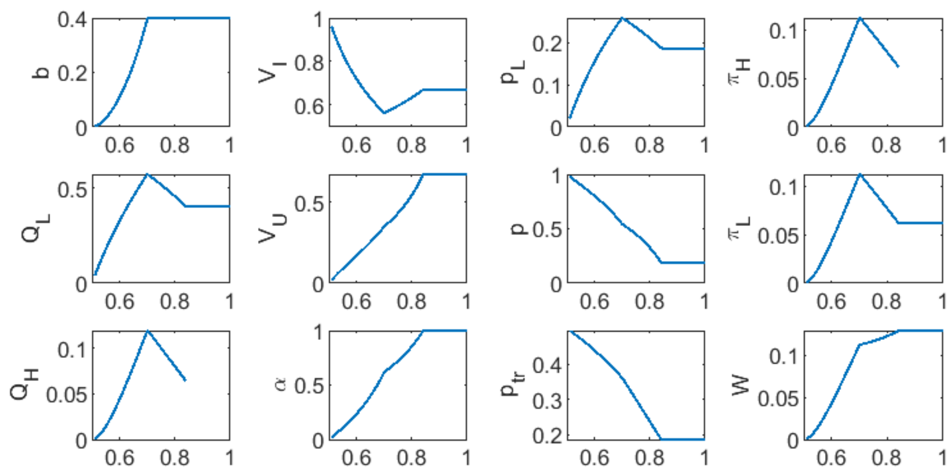

Figure 4: Effect of λ with the buyer entry cap

Notes. The figure shows the effect of λ for $\lambda > k = 0.5$ and $\bar{b} = 0.4$.

while fixing the measure of buyer to 1.[2] We modify the main model as follows. In the first stage, sellers decide on entry as well as the price to post (now k denotes the entry cost incurred by a seller). In the second stage, informed buyers (fraction λ) choose which seller to visit, while uninformed buyers (fraction $1-\lambda$) engage in a random search.

Under seller entry, the expected queue length at a seller with price p differs from the main model and is given by

$$Q(p) = q(p) + (1-\lambda)/s,$$

where $q(p)$ is the mass of informed buyers, s is the total measure of entering sellers, and $(1-\lambda)/s$ is the mass of uninformed buyers at each seller (uninformed buyers are uniformly distributed across all sellers).

It can be shown that, similar to the main model, there are at most two prices: $p_H = 1$ and $p_L < 1$ in equilibrium. Let s_H and s_L denote the measure of sellers posting $p_H = 1$ and $p_L < 1$, respectively. The free-entry condition implies that the expected profits from posting (p_H, p_L) satisfy

$$\begin{cases} \pi_H \leq k, & \text{with "=" if } s_H > 0, \\ \pi_L \leq k, & \text{with "=" if } s_L > 0. \end{cases}$$

[2]We cannot allow both the buyer and the seller free entry simultaneously, as each free entry condition determines the market tightness. With only one tightness variable, two free-entry conditions would overdetermine the equilibrium.

The queue lengths are given by:

$$Q_H = \frac{1-\lambda}{s_H + s_L}, \tag{19}$$

$$Q_L = \frac{\lambda}{s_L} + \frac{1-\lambda}{s_H + s_L} = \frac{\lambda}{s_L} + Q_H. \tag{20}$$

Similar to the main model, the price posted by a seller that attracts informed buyers satisfies (13), or $p_L(Q_L) = \left(1 - e^{-Q_L} - Q_L e^{-Q_L}\right)/(1 - e^{-Q_L})$.

In this environment, depending on (λ, k), there also exist two types of equilibria: one-price equilibrium and two-price equilibrium. Let $Q(k)$ solve $1 - e^{-Q} - Qe^{-Q} = k$, and define $\hat{\lambda}(k) = 1 + s(k)\ln(1-k)$, where $s(k) = 1/Q(k)$.

Proposition 4 ***(Equilibrium with free entry by sellers)****. A unique equilibrium with $s > 0$ exists for $k < 1$. Depending on the values of (λ, k), there are two types of equilibria.*

Case 1: one-price equilibrium. *If $\lambda \geq \hat{\lambda}(k)$, all sellers post the non-predatory price $p < 1$. The equilibrium values of (p, Q, s) are characterized by $Q = Q(k), s = s(k)$ and*

$$p(k) = \frac{1 - e^{-Q(k)} - Q(k)e^{-Q(k)}}{1 - e^{-Q(k)}}.$$

Case 2: two-price equilibrium. *If $\lambda < \hat{\lambda}(k)$, some sellers post $p_L < 1$, and others post $p_H = 1$. The equilibrium values of (Q_H, Q_L, s_H, s_L) are determined by* (19), (20), *and*

$$1 - e^{-Q_H} = k \tag{21}$$

$$1 - e^{-Q_L} - Q_L e^{-Q_L} = k, \tag{22}$$

and p_L is given by (13).

In Case 1, when λ is high, there are not many uninformed buyers so that predatory sellers capture only a small fraction of buyers. It is more profitable to post the non-predatory price to enjoy a larger customer base. When all sellers post $p(k)$, deviating to post $p_H = 1$ generates $\pi_H = 1 - e^{-(1-\lambda)/s}$. Since s is independent of λ, π_H is a decreasing function of λ. To ensure that no sellers want to deviate, we require $\pi_H \leq k$, which is equivalent to $\lambda \geq \hat{\lambda}(k)$. In addition, $k < 1$ guarantees that some sellers enter, or $s > 0$. In this case, having more informed buyers does not change the equilibrium allocation.

In Case 2, some sellers post $p_H = 1$, and some post $p_L < 1$. Interestingly, λ does not affect the equilibrium values of (p_L, Q_L, Q_H) in the two-price equilibrium. The seller's free-entry condition determines the seller's profit, which in turn pins down Q_H in (21) and Q_L in (22). It follows that p_L does not depend on λ either by (13). To understand this result, it is useful to decompose the effect of a higher λ on Q_L and therefore p_L, similar to the decomposition exercise in Section 4 under buyer entry. From (19) and (20), we can rewrite Q_L as $Q_L = (\lambda/\alpha + 1 - \lambda)/s$, where $\alpha = s_L/(s_H + s_L)$ is the fraction of sellers that post the low price, and $s = s_H + s_L$ is the total measure of sellers. We have

$$\frac{\partial Q_L}{\partial \lambda} = \left(\frac{1}{\alpha} - 1\right)\frac{1}{s} - \frac{\lambda}{s\alpha^2}\frac{\partial \alpha}{\partial \lambda} - \left(\frac{\lambda}{\alpha} + 1 - \lambda\right)\frac{1}{s^2}\frac{\partial s}{\partial \lambda}. \tag{23}$$

The first term in (23) is positive and reflects the direct effect that a higher λ induces a longer queue and more competition among buyers at p_L, raising p_L. The second term indicates that a higher λ induces a larger fraction of sellers posting p_L ($\partial\alpha/\partial\lambda > 0$) and more competition among sellers, reducing p_L. Again, these two effects exist in the large economy in Lester (2011). The third term is the new effect through seller entry. Fixing seller entry, a higher λ reduces sellers' profits. Some sellers exit the market ($\partial s/\partial\lambda < 0$), increasing p_L.[3] Without seller entry, the second effect dominates the first effect and p_L decreases with λ, consistent with the conventional wisdom. Allowing seller entry introduces the third effect, which together with the first effect, completely offsets the second effect so that information transparency does not affect p_L. Modelling seller entry therefore also overturns the conventional wisdom, albeit to a lesser extent than modelling buyer entry (which implies more information transparency could raise p_L).[4]

These extensions demonstrate that the relationship between information transparency and prices depends critically on the market structure and market frictions. Without entry, the conventional wisdom holds in a large economy. Entry generates an indirect effect of information transparency on prices. Under buyer entry, greater transparency attracts additional buyers, intensifying demand-side competition and pushing prices up. Under seller entry, transparency prompts some sellers to exit, weakening supply-side competition and again exerting upward pressure on prices. Thus, allowing entry on either side overturns the conventional wisdom that transparency lowers prices.

[3] From (19), we have $\partial s/\partial\lambda < 0$. From (20), we have $\partial s_L/\partial\lambda > 0$. It then follows $\partial\alpha/\partial\lambda > 0$.

[4] We also investigate how the average posted price and the average traded price depend on λ in the model under seller entry. The average posted price is $\bar{p} = (s_L p_L + s_H)/s$. As λ increases, s_H decreases, and s_L increases, so $\bar{p}$ decreases. We also calculate the average traded price. From the buyer's perspective, the matching probability is $\eta(Q)$. The average traded price is $p_{tr} = \eta(Q_H) + \eta(Q_L)P_L$. As the queue length does not depend on λ, the average traded price does not vary with λ.

7 Conclusion

We challenge the conventional wisdom that greater information transparency encourages competition among sellers, thereby reducing their market power and equilibrium prices. We show that the relationship between information and market prices or markups depends critically on the underlying market structure. In particular, when entry costs and decisions are taken into account, the conventional wisdom that greater information transparency leads to lower prices and markups may break down.

Our main model features endogenous buyer entry. Information transparency has two opposing effects on prices. The first is the seller competition effect, a conventional wisdom, where increased information transparency induces sellers to compete more aggressively, cutting prices and lowering markups. The second is the buyer competition effect, where greater information transparency induces more buyers to enter the market and pushes prices upward. We show that the buyer entry effect dominates and having more informed buyers leads some sellers to raise prices. Total welfare still increases with expanded trading volume.

We also explore free entry by sellers, and find the conventional wisdom breaks down in that setup too. Information transparency reduces sellers' profits, causing some sellers to exit the market, which offsets the pressure to reduce the price. In equilibrium, information transparency does not affect the price or markup. We thus expand the result in Lester (2011), who shows information transparency may increase prices in a small and finite economy. We show that incorporating entry overturns the conventional wisdom in a large economy, and we highlight the significance of entry costs and decisions in shaping the relationship between information and market prices.

Recently, Menzio (2024) has argued that search-theoretic models of imperfect competition are viable alternatives for analyzing market power in macroeconomics. The mechanisms we discover from our simple consumer search model could be embedded into macroeconomic models to examine the effects of macroeconomic policy on competition and markup.

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A Omitted Proofs

A.1 Proof of $\partial\bar{p}/\partial\lambda > 0$

The average posted price is $\bar{p} = \alpha(p_L - 1) + 1$. Define $C = 1 - p_L = Q_L/(e^{Q_L} - 1) > 0$. Proving $\bar{p}$ decreases in λ is equivalent to proving αC increases in λ. Recall $\alpha = AB$, where $A = \lambda/(1-\lambda), B = [Q_L - \ln(1+Q_L)]/[\ln(1+Q_L)]$, and both terms increase in λ. Below, we prove that AC increases in λ, which is more stringent than proving αC increases in λ. $\partial(AC)/\partial\lambda = A'C + AC' = A'C + AC_{Q_L}Q_L'$, which has the same sign as

$$S(\lambda) = \frac{A'}{A} + \frac{C_{Q_L}}{C}Q_L'.$$

From (14), we get

$$
\begin{aligned}
Q_L' &= \frac{1}{ke^{Q_L}} \frac{Q_L^2}{(Q_L-1)\ln(1+Q_L) + \frac{Q_L}{1+Q_L}} \\
&= \frac{Q_L \ln(1+Q_L)}{\lambda[\ln(1+Q_L)(Q_L-1) + Q_L/(1+Q_L]} > 0. \qquad (24)
\end{aligned}
$$

Combine with

$$
\begin{aligned}
\frac{A'}{A} &= \frac{1}{\lambda(1-\lambda)} > 0 \\
\frac{C_{Q_L}}{C} &= \frac{e^{Q_L}(1-Q_L)-1}{Q_L(e^{Q_L}-1)} < 0,
\end{aligned}
$$

and (24), and we have

$$
S(\lambda) = \frac{1}{\lambda}\left\{\frac{1}{1-\lambda} - f(Q_L)\right\},
$$

where

$$
f(Q_L) = \frac{1-e^{Q_L}(1-Q_L)}{e^{Q_L}-1} \frac{\ln(1+Q_L)}{(Q_L-1)\ln(1+Q_L) + \frac{Q_L}{1+Q_L}} > 0.
$$

Given that $1/(1-\lambda) > 1$, we can prove $s(\lambda) > 0$ by showing $f(Q_L) < 1$. Rewrite $f(Q_L)$ as

$$
\begin{aligned}
f(Q_L) &= \frac{(e^{Q_L}-1)(Q_L-1)+Q_L}{e^{Q_L}-1} \frac{\ln(1+Q_L)}{(Q_L-1)\ln(1+Q_L) + \frac{Q_L}{1+Q_L}} \\
&= \left(Q_L - 1 + \frac{Q_L}{e^{Q_L}-1}\right) \frac{\ln(1+Q_L)}{(Q_L-1)\ln(1+Q_L) + \frac{Q_L}{1+Q_L}} \\
&= \frac{(Q_L-1)\ln(1+Q_L) + \frac{Q_L}{e^{Q_L}-1}\ln(1+Q_L)}{(Q_L-1)\ln(1+Q_L) + \frac{Q_L}{1+Q_L}}.
\end{aligned}
$$

From (24), we know that the denominator of (24) is greater than 0. Since $f(Q_L) > 0$, showing $f(Q_L) < 1$ is equivalent to showing

$$
(Q_L-1)\ln(1+Q_L) + \frac{Q_L}{e^{Q_L}-1}\ln(1+Q_L) < (Q_L-1)\ln(1+Q_L) + \frac{Q_L}{1+Q_L},
$$

which is equivalent to

$$
\frac{\ln(1+Q_L)}{e^{Q_L}-1} < \frac{1}{1+Q_L},
$$

or

$$e^{Q_L} - 1 - (1 + Q_L)\ln(1 + Q_L) > 0.$$

Define $\Psi(Q_L) = e^{Q_L} - 1 - (1 + Q_L)\ln(1 + Q_L)$. We can derive

$$\begin{aligned}
\Psi'(Q_L) &= e^{Q_L} - 1 - \ln(1 + Q_L) \\
\Psi''(Q_L) &= e^{Q_L} - \frac{1}{1 + Q_L} \\
\Psi'''(Q_L) &= e^{Q_L} + \frac{1}{(1 + Q_L)^2} > 0.
\end{aligned}$$

Since $\Psi''(Q_L = 0) = 0$ and $\Psi'''(Q_L) > 0$, we know that $\Psi''(Q_L) > 0$ for $Q_L > 0$. Moreover, $\Psi'(Q_L = 0) = 0$. It follows that $\Psi'(Q_L) > 0$ for $Q_L > 0$. Finally, $\Psi(Q_L = 0) = 0$ implies that $\Psi(Q_L) > 0$ for any $Q_L > 0$. Then we have $f(Q_L) < 1$ and $S(\lambda) > 0$.

The term AC increases in λ, which means that $\bar{p}$ decreases in λ. The average posted price decreases as the fraction of informed buyers increases.

A.2 Proof of $\partial p_{tr}/\partial\lambda > 0$

Using (10) and (13),

$$\begin{aligned}
\bar{p}_{tr} &= \frac{\alpha(1 - e^{-Q_L})p_L + (1 - \alpha)(1 - e^{-Q_H})}{\alpha(1 - e^{-Q_L}) + (1 - \alpha)(1 - e^{-Q_H})} \\
&= \frac{1 - e^{-Q_L} - Q_L e^{-Q_L}}{\alpha(1 - e^{-Q_L}) + (1 - \alpha)(1 - e^{-Q_L} - Q_L e^{-Q_L})}.
\end{aligned}$$

We can express the inverse of $\bar{p}_{tr}$ as

$$\frac{1}{\bar{p}_{tr}} = 1 + \alpha \frac{Q_L e^{-Q_L}}{1 - e^{-Q_L} - Q_L e^{-Q_L}} \equiv 1 + \alpha D(Q_L).$$

From (17), we can rewrite

$$\alpha D(Q_L) = \frac{\lambda}{1 - \lambda}\left[\frac{Q_L}{\ln(1 + Q_L)} - 1\right] \frac{Q_L e^{-Q_L}}{1 - e^{-Q_L} - Q_L e^{-Q_L}} = AB(Q_L)D(Q_L),$$

where A and $B(Q_L)$ are the same as previously defined. The sign of $\partial\bar{p}_{tr}/\partial\lambda$ is the opposite of the sign of $\partial(ABD)/\partial\lambda$. Since $B(Q_L)$ and $D(Q_L)$ are both positive for $Q_L > 0$, we

can derive
$$\frac{\partial(ABD)}{\partial\lambda}\frac{1}{ABD} = \frac{1}{\lambda(1-\lambda)} + \left(\frac{\partial B/\partial Q_L}{B} + \frac{\partial D/\partial Q_L}{D}\right) Q_L'.$$

From the definition of A, B, and D, we have

$$\begin{aligned}
\frac{\partial B}{\partial Q_L} &= \frac{\ln(1+Q_L) - \frac{Q_L}{1+Q_L}}{[\ln(1+Q_L)]^2}, \\
\frac{\partial D}{\partial Q_L} &= \frac{e^{Q_L} - 1 - Q_L e^{Q_L}}{(e^{Q_L} - 1 - Q_L)^2}.
\end{aligned}$$

It follows that

$$\frac{\partial(ABD)}{\partial\lambda}\frac{1}{ABD} = \frac{1}{\lambda(1-\lambda)} + \left\{\frac{\ln(1+Q_L) - \frac{Q_L}{1+Q_L}}{\ln(1+Q_L)[Q_L - \ln(1+Q_L)]} + \frac{e^{Q_L} - 1 - Q_L e^{Q_L}}{Q_L(e^{Q_L} - 1 - Q_L)}\right\} Q_L'.$$

Using (24), we have
$$\frac{\partial(ABD)}{\partial\lambda}\frac{1}{ABD} = \frac{1}{\lambda}\left[\frac{1}{1-\lambda} - E(Q_L)\right],$$

where we define

$$\begin{aligned}
E(Q_L) &\equiv \left\{\frac{\frac{Q_L}{1+Q_L} - \ln(1+Q_L)}{\ln(1+Q_L)[Q_L - \ln(1+Q_L)]} + \frac{1 + Q_L e^{Q_L} - e^{Q_L}}{Q_L(e^{Q_L} - 1 - Q_L)}\right\} \frac{Q_L \ln(1+Q_L)}{(Q_L - 1)\ln(1+Q_L) + \frac{Q_L}{1+Q_L}} \\
&= \frac{Q_L^2(e^{Q_L} - 1 - Q_L)\left[\frac{Q_L}{1+Q_L} - \ln(1+Q_L)\right] + Q_L \ln(1+Q_L)[Q_L - \ln(1+Q_L)](1 + Q_L e^{Q_L} - e^{Q_L})}{[Q_L - \ln(1+Q_L)]Q_L(e^{Q_L} - 1 - Q_L)\left[(Q_L - 1)\ln(1+Q_L) + \frac{Q_L}{1+Q_L}\right]}
\end{aligned}$$

Next, we show that $E(Q_L) < 1$, which is equivalent to $1 - E(Q_L) > 0$. We can write

$$1 - E(Q_L) = \frac{\frac{Q_L^3 \ln(1+Q_L)}{1+Q_L}\left[e^{Q_L} - (1+Q_L)^2 + (1+Q_L)\ln(1+Q_L)\right]}{[Q_L - \ln(1+Q_L)]Q_L(e^{Q_L} - 1 - Q_L)\left[(Q_L - 1)\ln(1+Q_L) + \frac{Q_L}{1+Q_L}\right]}.$$

Notice that the denominator is always positive. We define the term in the square brackets in the numerator as

$$\Phi(Q_L) \equiv e^{Q_L} - (1+Q_L)^2 + (1+Q_L)\ln(1+Q_L).$$

We can show that $\Phi(0) = 0$ and

$$\Phi'(Q_L) = e^{Q_L} - 2(1 + Q_L) + 1 + \ln(1 + Q_L).$$

Moreover, $\Phi'(0) = 0$ and

$$\Phi''(Q_L) = e^{Q_L} - 2 + \frac{1}{1 + Q_L}.$$

We have $\Phi''(0) = 0$ and

$$\Phi'''(Q_L) = e^{Q_L} - \frac{1}{(1 + Q_L)^2}.$$

For any $Q_L > 0$, it must be true that $e^{Q_L} > 1$ and $1/(1 + Q_L)^2 < 1$. Therefore, we have $\Phi''(Q_L) > 0$. Together with $\Phi'(0) = 0$, we have $\Phi'(0) > 0$. As $\Phi(0) = 0$, we show $\Phi(Q_L) > 0$ for any $Q_L > 0$. It follows that $1 - E(Q_L) > 0$ and $E(Q_L) < 1$, which imply $\partial(ABD)/\partial\lambda > 0$ and $\partial\bar{p}_{tr}/\partial\lambda < 0$.