Firm Prominence and Price Framing*

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January 2026

Abstract

This paper explores the strategic use of price framing in a duopoly where firms differ in their prominence and where both frame differentiation and frame complexity are sources of consumer confusion. It analyzes the interaction between the relative effectiveness of the two sources of consumer confusion and firms' prominence levels, and its impact on equilibrium outcomes. A parametric condition on firms' prominence delineates different equilibrium outcomes and synthesizes the interaction between firm prominence and consumer confusion. In equilibrium, firms do not always coordinate on the most effective source of confusion. The impact of consumer protection policy on market outcomes, especially consumer surplus, depends crucially on underlying market conditions, and can be ineffective or even detrimental to consumers.

JEL Classification: D18; D43; D91; L13

Keywords: Firm prominence, Consumer confusion, Price framing, Price complexity, Consumer protection policy

*This paper expands part of our working paper 'Endogenous Prominence, Maximal Obfuscation, and Consumer Policy'. We thank the associate editor and the anonymous referees for their helpful comments for their valuable comments, which significantly improved the paper. We are grateful to Sandro Shelegia for a comment that prompted this analysis, and to Renaud Foucart, Ruochen Li, Jaimie Lien, Jie Zheng, Jidong Zhou, and participants at various seminars and conferences for their feedback. Yiquan Gu gratefully acknowledges support from the British Academy through the Innovation Fellowships Scheme, reference IF24RBDS2\240112.

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1 Introduction

In retail banking, financial services, and energy markets, firms often use complex prices (e.g., partitioned tariffs, different price disclosure methods, and technical jargon) even when the price format is the same. In grocery and online retail markets, firms often use differentiated price formats or frames (e.g., discount methods, measurement units, or tariff structures).[1] The use of complex or differentiated price (or product) presentation formats hinders price comparability and may lead to consumer confusion. Potentially misleading price framing has come under the scrutiny of competition authorities and remains a pervasive practice.[2]

Framing is partly the by-product of intrinsic product or market complexity. However, it is also a strategic device that can be used to exploit consumer biases and create confusion. Many markets where firms use price or product framing are also characterized by differences in firms' prominence, a feature that is likely to affect confused consumers' choices. Prominence can stem from strong brand recognition (e.g., pioneer or incumbent products, or those heavily advertised), recommendations by experts, agents, or peers, salient placement (like top positions in online search results), loyalty to familiar products, or perceptions of quality. For instance, mortgage or insurance buyers may favor their current bank, while consumers in formerly monopolized energy markets may lean towards the familiar regional incumbent over new entrants.

In this paper, we analyze how prominence affects firms' equilibrium price frames, and so the level of consumer confusion, and examine the effect of different consumer protection policies. We consider a homogeneous product duopoly in which firms differ in their prominence, i.e., they are asymmetric in their ability to attract confused consumers, and compete in prices and price frames. In the first stage, firms simultaneously and independently choose a price frame from two available formats. One format is simple (e.g., an all-inclusive price), while the other may be complex (e.g., a partitioned price). Consumers may get confused when comparing prices in different frames or prices in a common but complex frame. In the second stage, after observing the realized frame profile, the firms set prices. Then, consumers make decisions, and profits are realized.[3]

Confused consumers cannot compare firms' prices and shop at random, but are more likely to purchase from the prominent firm. Moreover, the more prominent a firm is, the more likely confused consumers are to choose it. The core idea is that when consumers are confused

[1] For further discussion and examples, see Carlin (2009), Piccione and Spiegler (2012), Chioveanu and Zhou (2013), and Spiegler (2016).

[2] A multibuy promotion is an example of a potentially misleading price frame. Smithers (2013) reports that "[i]n one case *Which?* found, shoppers at Asda buying two packs of Müller Light Greek style yoghurt during a promotion paid £1 more than if they had bought them at the normal price." See also the BBC article "Stop 'misleading' special offers, supermarkets told" (BBC News, 2019).

[3] As firms choose frames before prices, framing can be related here to either price or product presentation.

and cannot compare prices, their decisions are influenced by other characteristics such as firm prominence. For example, they may choose a product that is displayed in a prominent position or a salient brand. Prominence may give a firm a competitive advantage when some consumers are confused.[4]

As both frame complexity and frame differentiation are sources of consumer confusion, we distinguish between two scenarios. If the share of confused consumers is larger when firms use different frames than when they use a common but complex frame, then *frame differentiation* is the more effective source of confusion. In contrast, if the share of confused consumers is larger when firms use a common but complex frame, then *frame complexity* is the more effective source of confusion.

In the pricing stage, firms' strategies depend on the frame profile. If both firms choose the simple frame, all consumers can compare prices (i.e., there is no confusion) and firms compete à la Bertrand. For any other frame profile, firms face both consumers who choose the cheapest price and consumers who are confused and so are captive to one of the firms. In the unique equilibrium, firms randomize on prices from a common interval (Varian, 1980 and Narasimhan, 1988) and there is price dispersion.

While the prominent firm's expected profit in the pricing stage increases in both prominence and confusion levels, its rival's expected profit is non-monotonic in both. A higher level of confusion has a positive effect on the less prominent firm as it increases its share of captives and relaxes price competition. However, it also has a negative effect as it reduces the share of savvy consumers, who are a relatively more attractive target for this firm due to its smaller captive base. Competing with a more prominent firm may hurt the less prominent rival as it reduces its share of confused consumers, but it also has a positive effect as a more prominent firm is relatively less aggressive when targeting savvy consumers.

The equilibrium analysis of the framing game shows that, when frame differentiation is a more effective source of confusion, firms coordinate on choosing different frames and so the share of confused consumers takes the higher of the two available values. In contrast, when frame complexity is a more effective source of confusion, it is a dominant strategy for the prominent firm to choose the complex frame, whereas the rival chooses the simple frame for relatively high prominence levels and it chooses the complex frame otherwise. So, in this case, the firms choose different frames when they are sufficiently asymmetric, and the same complex frame when they are relatively symmetric. Hence, when frame complexity is a more effective confusion source, if the prominence level is high enough, the equilibrium share of confused consumers is determined by frame differentiation and takes the lower of

[4]In this analysis we focus on exogenous prominence only. In practice, prominence may be exogenous (an incumbent is likely to be more prominent than a new entrant and an established bank is likely to be more prominent than a fintech start-up) or it may be determined endogenously by firm strategic investments, such as advertising or product location.

the two available values. We derive a condition on the prominence level that maps different equilibrium outcomes in the parametric frame differentiation and frame complexity space and synthesizes the interaction between prominence and confusion.

Our policy analysis highlights the importance of identifying the equilibrium source of consumer confusion and understanding the role of prominence. Intervention that fails to recognize the underlying market conditions might be ineffectual or it may even backfire.

A policy that standardizes the price frame reduces confusion due to frame differentiation and benefits consumers when frame differentiation is the more effective source of confusion. However, when frame complexity is the more effective source of confusion, it may harm consumers as it narrows the range of prominence levels where the share of confused consumers takes the lower value (that is, where firms choose different frames in equilibrium). If after the intervention, the less prominent firm chooses the more complex frame in equilibrium, then there is confusion due to frame complexity and so a larger share of consumers get confused than before the intervention.

A policy that reduces confusion due to frame complexity (for instance, a limitation on the use of technical jargon) may also harm consumers. When frame complexity is the more effective source of confusion, there are cases where the intervention makes the less prominent firm switch from choosing the simple frame to choosing the complex frame in equilibrium. In these cases, the share of confused is higher after the intervention as the more effective source of confusion prevails in equilibrium.

Moreover, both frame standardization and a reduction in frame complexity can be completely ineffective when they target the source of confusion that does not prevail in equilibrium and fail to induce a post-intervention change in the equilibrium source of confusion.

Policies that aim to level the playing field by reducing the prominence level (e.g., consumer awareness programs) can be effective so long as they do not change the equilibrium source of confusion. However, when the policy modifies the equilibrium source of confusion, its impact on consumer surplus is ambiguous. Our policy analysis stresses the importance of understanding the underlying market conditions when designing consumer policy instruments in markets where firm prominence interacts with price framing.

To clarify the model and its policy implications, consider retail financial markets, where individuals access products like banking, investments, and retirement savings. In these markets, imperfections in consumer decision-making have been well-documented (Campbell, 2006; Calvet et al., 2009; Stango and Zinman, 2009, 2011). Moreover, both frame complexity and frame differentiation may be sources of consumer confusion.

Financial products are often complex, and firms may deliberately increase complexity to reduce price comparability and competition. Price complexity may stem from the use

of technical jargon or intricate price structures like multi-part interest rates. Price frame differentiation reflects variation in price presentation formats or disclosure methods, despite product similarity.[5] To simplify the analysis, we use a canonical model with two price frames (one simple and another that may be complex), which allows us to model both sources of confusion.

In retail financial markets, firm prominence plays an important role in consumer choice. Empirical evidence supports this, showing that well-known providers capture a larger share of consumers, even when they charge higher fees. For instance, the UK's Financial Conduct Authority (2018) documented that prominent banks maintain substantial market shares despite offering less competitive savings rates, a finding consistent with our model.

Policy interventions in retail financial markets reflect the challenges identified in our framework. For instance, the EU's European Standardised Information Sheet and the US's "Know Before You Owe" rules mainly target frame differentiation and frame complexity, respectively.[6] These examples align with Section 4, where we explore the impact of consumer protection interventions that target either source of confusion on market outcomes. Our theoretical analysis indicates that such policies may have limited impact on consumer welfare, underscoring the importance of targeting the right source of confusion and understanding the role of prominence. Several recent empirical studies of interventions aimed at protecting consumers in financial markets show that they have at best only small effects. See, Seira et al. (2017), Willis (2017), Adams et al. (2021), and European Commission (2021).

We provide a theoretical framework for the assessment of policy interventions that shows why they may be ineffectual or even backfire. Contextualized within the setting of retail financial markets, our analysis demonstrates that policy effectiveness hinges on correctly identifying the specific source of consumer confusion and, critically, accounting for the impact of other market characteristics, like firm prominence.

Related Literature

Our analysis contributes to a broad theoretical literature that examines bounded rationality in industrial organization.[7] Carlin (2009), Piccione and Spiegler (2012), and Chioveanu and Zhou (2013) propose models of competition in prices and price frames in homogeneous product markets. These analyses predict equilibrium dispersion in both prices and price frames and show that the strategic use of price framing allows firms to eschew Bertrand

[5] See Choi et al. (2010); Henderson and Pearson (2011); Célérier and Vallée (2017) for related evidence.

[6] The EU's Mortgage Credit Directive introduced the European Standardised Information Sheet (ESIS) in 2016 and the US Consumer Financial Protection Bureau standardized mortgage disclosure rules in 2013. For more information, see Financial Conduct Authority (2025) and Consumer Financial Protection Bureau (2025).

[7] See Huck and Zhou (2011), Grubb (2015a,b), Spiegler (2016), and Heidhues and Kőszegi (2018) for reviews. Madrian and Shea (2001), Thaler and Benartzi (2004), Hastings et al. (2017), Ko and Williams (2017), and Kosfeld and Schüwer (2017) present related policy analyses.

competition and obtain strictly positive expected profits. They consider markets where firms are symmetric, that is, equally prominent.

We modify the framework in Chioveanu and Zhou (2013) that accommodates both frame differentiation and frame complexity as sources of consumer confusion to study the role of prominence. We relate prominence to an asymmetry in firms' ability to attract confused consumers and show that it matters for the share of confused consumers and firms' strategies in equilibrium. For low prominence levels (including the limiting case of symmetric firms), regardless of the source of confusion, the equilibrium share of confused consumers takes the highest available value. In contrast, when one firm is sufficiently prominent, this is no longer the case when frame complexity is the main source of consumer confusion.

Firm prominence plays an important role in many markets.[8] In their seminal work on prominence, Armstrong et al. (2009) consider a search market where consumers always sample the salient firm first. They show that the welfare impact of prominence depends on product quality differences. Other theoretical analyses of prominence in sequential search markets include Armstrong and Zhou (2011), Chen and He (2011), Haan and Moraga-Gonzalez (2011), and Rhodes (2011).

We complement this research by exploring the role of prominence in a simultaneous search market with consumer confusion. We show that the welfare effect of a change in prominence depends on market conditions (the source of consumer confusion and the initial prominence level). The empirical analyses of retail energy markets in Giulietti et al. (2014) and Hortacsu et al. (2017) and private social security in Hastings et al. (2017) support the role of prominence in markets with consumer imperfections (e.g., inertia or inattention).

Related work focuses on the role of prominence in markets where only price complexity is a source of consumer confusion. In Gu and Wenzel (2014), where firms first choose price complexity levels and then compete in prices, consumer protection policy may not be effective when the less prominent firm is obfuscating below full capacity. In Chioveanu (2019), where price and complexity choices are simultaneous, consumer surplus is non-monotonic in the degree of prominence and policies that level the playing field may backfire. Mamadehussene (2020) shows that price comparison platforms exercise their market power by implementing a prominent position and accommodating a high obfuscation level.

The current analysis considers both frame complexity and frame differentiation as sources of consumer confusion, and focuses on their interaction with prominence and the implications of this interaction for consumer protection policy. However, when frame complexity is more effective than frame differentiation as a source of consumer confusion, as in Gu and

[8] McDevitt (2014) finds that firms whose names start with an "A" or a number, charge higher prices, and about 21% of plumbing firms choose names with these characteristics. Prominence plays a role as firms whose names start with an "A" or a number are prominently displayed in their Yellow Pages category.

Wenzel (2014) and Chioveanu (2019), a reduction in the share of confused consumers or in the level of prominence may harm consumers by making the less prominent firm use the more complex frame instead of the simple frame.

The rest of the paper proceeds as follows. Section 2 introduces the model and Section 3 presents equilibrium analysis. Section 4 discusses the implications of consumer policy. Section 5 explores several robustness extensions of our baseline model. Section 6 presents the final conclusions.

2 The model

Consider a market where two risk neutral firms ($i = 1, 2$) supply a homogeneous product to a unit mass of consumers. Each consumer buys at most one unit of the product and has a willingness to pay v, normalized to one. Firms' marginal costs of production are constant and normalized to zero. Without loss of generality, let firm 1 be more prominent than firm 2. To focus on consumer confusion and prominence, we analyze the following two-stage game.

In the first stage, firms simultaneously and independently select price presentation formats (or frames), z_1 and z_2. Each firm chooses one of two available frames: $z_i \in \{A, B\}$, $i = 1, 2$. Frame A is a simple format (e.g., an all-inclusive price) and frame B is a different and possibly more complex frame (e.g., a partitioned price). In the second stage, after observing the frames, firms simultaneously and independently set prices, p_1 and p_2, where $p_i \in [0, 1]$, using the price frame each selected in the first stage. The timing of the game reflects the focus on markets where frame adjustments take some time whereas prices can be changed relatively easily.

Motivated by observations in markets such as retail finance and groceries, we model price framing as a source of consumer confusion. If the firms choose different frames, a share $\alpha(A, B) = \alpha_1 \in (0, 1)$ of the consumers are confused, i.e., they cannot compare the two prices, while a share $(1 - \alpha_1)$ of the consumers accurately compare the prices and buy the cheaper product. If both firms choose frame A, then all consumers make accurate price comparisons and buy from the cheaper firm. In this case, the share of confused consumers is $\alpha(A, A) = 0$. If both firms choose frame B, a fraction $\alpha(B, B) = \alpha_2 \in (0, 1)$ of the consumers are confused (and so cannot compare the two prices). A share $(1 - \alpha_2)$ of the consumers choose the cheaper product.

While (simple) frame A can cause confusion only when it is combined with frame B (which is a different format), frame B is confusing in itself and can obstruct price comparisons even if both firms adopt it. Therefore, this model accommodates two sources of consumer confusion, frame differentiation and frame complexity. If $\alpha_1 > \alpha_2 > 0$ frame differentiation is more

confusing (or more effective) than frame complexity. If $\alpha_2 > \alpha_1 > 0$ frame complexity is more effective than frame differentiation.

When some consumers get confused by price framing, they shop at random and their decisions are influenced by firms' prominence. Consumers' decisions are affected by prominence when they are confused (i.e., when they cannot compare prices) or when they can compare the prices but are indifferent between the offers (i.e., when the firms charge the same price). Savvy consumers purchase the cheaper product regardless of prominence. Our analysis focuses on the effect of prominence on price framing and consumer confusion. Firm 1's share of confused consumers is $\sigma\alpha(z_1, z_2)$, while firm 2's share is $(1-\sigma)\alpha(z_1, z_2)$, where $\sigma \in [1/2, 1]$ measures firm 1's prominence. We also refer to σ as the 'degree of prominence' or the 'prominence level' in the market.

In our benchmark model, prominence is unrelated to product characteristics (the firms offer homogeneous products). A bank may be more prominent than a rival because of its size, (global) network, historical legacy, or marketing efforts. Alternatively, firm prominence may stem from (real or perceived) vertical product differentiation: the prominent firm offers a higher quality product (at the same marginal cost), so consumers' valuation for its product is $1 + \theta$ for some $\theta > 0$.[9] In Section 5.1 we show that our results are qualitatively robust in this modified model when θ is small enough to guarantee competitive interaction. Our benchmark model can then be interpreted as a limiting case where $\theta \to 0$.

We assume that confused consumers do not pay more than their valuation. This would be the case when consumers realize at checkout if a product's price exceeds their valuation and decline to buy or when they are eligible for a full refund if they cancel their contracts, e.g., during the 'cooling-off' period, upon discovering paying above their valuation. In Section 5.2 we explore a modified model where confused consumers are not only unable to compare the firms' prices but also unable to assess if a firm's price exceeds their valuation.

3 Equilibrium analysis

We solve for the subgame perfect Nash equilibrium of the two-stage game by backward induction.

[9] From this perspective, our model can be related to research on deceptive advertising. This line of work studies firms' use of false or misleading information to distort consumers' beliefs about product value and related regulatory intervention. See, for instance, Glaeser and Ujhelyi (2010), Rhodes and Wilson (2018), Piccolo et al. (2018) or, more recently, Colombo et al. (2026).

3.1 Price competition

In the second stage, the share of confused consumers is determined by firms' first stage frame choices, $\alpha \equiv \alpha(z_1, z_2) \in \{0, \alpha_1, \alpha_2\}$. Firm 1's expected profit is

$$\pi_1(p_1, p_2) = \begin{cases} p_1 [\sigma\alpha + (1-\alpha)] & \text{if } p_1 < p_2 \\ p_1 [\sigma\alpha + \sigma(1-\alpha)] & \text{if } p_1 = p_2 \\ p_1 \sigma\alpha & \text{if } p_1 > p_2 \end{cases}$$

and firm 2's expected profit is given below.

$$\pi_2(p_1, p_2) = \begin{cases} p_2(1-\sigma)\alpha & \text{if } p_1 < p_2 \\ p_2 [(1-\sigma)\alpha + (1-\sigma)(1-\alpha)] & \text{if } p_1 = p_2 \\ p_2 [(1-\sigma)\alpha + (1-\alpha)] & \text{if } p_1 > p_2 \end{cases}$$

Standard Bertrand competition arguments underpin the next result.

Lemma 1. If $(z_1, z_2) = (A, A)$, then in the second stage all consumers are savvy, and in unique price equilibrium, both firms choose prices equal to the marginal cost and make zero profits.

If in the first stage both firms choose frame B, then there are $(1-\alpha_2)$ savvy consumers and α_2 confused consumers. If one firm chooses frame A and the rival chooses frame B, there are $(1-\alpha_1)$ savvy consumers and α_1 confused consumers. In either case, firm 1 serves a share σ of the confused consumers, while firm 2 serves a share $(1-\sigma)$ of the confused consumers. In these cases, there is a conflict between the incentive to fully exploit confused consumers and the incentive to compete for savvy consumers, which leads to the non-existence of pure strategy price equilibria. The proof of the next result is standard and therefore omitted; see Narasimhan (1988).

Lemma 2. If $(z_1, z_2) \in \{(B, B), (A, B), (B, A)\}$, then in the second stage $\alpha > 0$ and in the unique pricing equilibrium, both firms randomize on prices from a common support $\left[\frac{\sigma\alpha}{1-(1-\sigma)\alpha}, 1\right]$ according to the following cumulative distribution functions.

$$F_1(p) = 1 + \frac{(1-\sigma)\alpha}{1-\alpha} - \frac{\sigma\alpha(1-\sigma\alpha)}{[1-(1-\sigma)\alpha](1-\alpha)p} \equiv F_1^{z_1 z_2}$$
$$F_2(p) = 1 + \frac{\sigma\alpha}{1-\alpha} - \frac{\sigma\alpha}{(1-\alpha)p} \equiv F_2^{z_1 z_2}$$

In this unique mixed-strategy equilibrium, firm 1's price c.d.f. is continuous on $\left[\frac{\sigma\alpha}{1-(1-\sigma)\alpha}, 1\right)$ but has a mass point at the upper bound, while firm 2's c.d.f. is continuous everywhere.

Firms' expected profits are as follows.

$$\pi_1 = \sigma\alpha \text{ and } \pi_2 = \frac{\sigma\alpha(1-\sigma\alpha)}{1-(1-\sigma)\alpha}. \tag{1}$$

These results are related to the properties of 'Varian-Narasimhan' price competition models (Varian, 1980; Narasimhan, 1988), where some consumers are savvy and others are captive. Both firms have incentives to soften price competition by creating consumer confusion through price framing, since otherwise they would compete head-to-head in a Bertrand-type market. On the other hand, prominence and the associated asymmetry in firms' shares of confused consumers give firms incentives to segment the market: the more prominent firm has a stronger incentive to focus on its confused consumers, while the less prominent firm has a stronger incentive to target savvy consumers.

It is useful to understand the effects of consumer confusion and firm prominence on firms' second stage equilibrium profits. Corollary 1 below follows immediately from the equilibrium profits in (1) in Lemma 2.

Corollary 1. In the second stage price equilibrium, firm 1's expected profit and expected industry profit are increasing in both σ and α. Firm 2's expected profit is strictly concave in both σ and α, and so non-monotonic in both.

Proof: See Appendix A.1. *Q.E.D.*

The more prominent firm benefits both from an increase in σ and from an increase in α, as either increases this firm's captive consumer group and, as a result, this firm's expected profit. In contrast, the less prominent firm faces trade-offs. An increase in the share of confused consumers softens competition but reduces the share of savvy consumers that this firm could target. This tension is magnified at higher prominence levels, where this firm's share of confused consumers is relatively small. At relatively low levels of prominence (i.e., when firms are relatively more symmetric), the less prominent firm has a relatively stronger incentive to focus on its share of confused consumers and compete less aggressively. These trade-offs underlie the non-monotonicity of the less prominent firm's expected profit in both the share of confused consumers and the prominence level and play an important role in the analysis of frame competition.

3.2 Frame choice

This section analyzes the first stage of the game where firms independently and simultaneously choose a price frame from two available formats, A and B. Using the results in

		Firm 2	
		A	B
Firm 1	A	$0,\ 0$	$\sigma\alpha_1,\ \frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1}$
	B	$\sigma\alpha_1,\ \frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1}$	$\sigma\alpha_2,\ \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2}$

Table 1: The normal form of the framing game

Lemmas 1 and 2, Table 1 presents the normal form of the reduced-form price framing game.

Depending on which source of consumer confusion is more effective, there are two scenarios: (i) frame differentiation is more confusing than frame complexity ($\alpha_1 > \alpha_2$) and (ii) frame complexity is more confusing than frame differentiation ($\alpha_2 > \alpha_1$). As we shall show, a notable feature of the latter case is that the prominent firm has a dominant strategy in the first stage.

3.2.1 Frame differentiation is more confusing than frame complexity

When frame differentiation is more confusing than frame complexity, i.e., $\alpha_1 > \alpha_2$, firm 1's best response is to choose a different frame than firm 2, for any frame choice by firm 2. It is straightforward to verify that (A, B) is a Nash equilibrium, regardless of the level of prominence. Moreover, (B, A) is another equilibrium *iff* firm 2 is better off when frame differentiation is the equilibrium source of confusion, that is, if $\frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1} > \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2}$. To facilitate this payoff comparison, let

$$\hat{\sigma} := \frac{\sqrt{(\alpha_1+\alpha_2-\alpha_1\alpha_2)^2+4\alpha_1\alpha_2}-(\alpha_1+\alpha_2-\alpha_1\alpha_2)}{2\alpha_1\alpha_2}. \tag{2}$$

Proposition 1. Let $\alpha_1 > \alpha_2$. If $\sigma > \hat{\sigma}$, $(z_1^*, z_2^*) = (A, B)$ is the unique Nash equilibrium of the price framing game. If $\sigma < \hat{\sigma}$, there are two pure strategy Nash equilibria $(z_1^*, z_2^*) = (A, B)$ and $(z_1^*, z_2^*) = (B, A)$ in the price framing game.

Proof: See Appendix A.2. *Q.E.D.*

Intuitively, firm 1 prefers an equilibrium where the rival uses a different price frame so that frame differentiation is the equilibrium source of confusion, as it is more effective in this case (i.e., $\alpha_1 > \alpha_2$). On the other hand, given the trade-offs it faces and the non-monotonicity of its expected profit in the share of confused, firm 2 may be better off if frame complexity is the

equilibrium source of confusion (although this is less effective than frame differentiation). This is the case when its expected profit is higher in the presence of more savvy consumers and the effect is stronger at higher levels of prominence as discussed below Corollary 1.

On the other hand, firm 2 has incentives to avoid all-out competition in a market where there is no confusion (i.e., all consumers are savvy). When choosing frame A, firm 1 knows that it is rational for firm 2 to choose frame B in response and avoid Bertrand competition. However, when firm 1 chooses frame B, the best response of firm 2 depends on the level of prominence. When prominence is low enough (i.e., $\sigma < \hat{\sigma}$), (B, A) is also a Nash equilibrium. In this case, the firms are relatively symmetric, and their incentives are more aligned. However, when prominence is relatively high (i.e., $\sigma > \hat{\sigma}$), if firm 1 chooses B, the two firms are relatively asymmetric, and firm 2's best response is to choose B, so that frame complexity is the prevailing source of confusion (although this is less effective than frame differentiation). But this cannot be part of equilibrium as firm 1 has a unilateral incentive to deviate to frame A, so that frame differentiation is the prevailing source of confusion. Therefore, (B, A) is an equilibrium iff prominence is low enough.

To summarize, when frame differentiation is more confusing than frame complexity ($\alpha_1 > \alpha_2$), in equilibrium, firms choose different frames and the share of confused consumers in the market is α_1.

3.2.2 Frame complexity is more confusing than frame differentiation

When frame complexity is more confusing than frame differentiation, i.e., $\alpha_2 > \alpha_1$, choosing frame B is a strictly dominating strategy for firm 1, and hence the unique equilibrium depends on firm 2's best response, that is, on which source of confusion the less prominent firm prefers. If firm 2 is better off when frame differentiation is the source of confusion (i.e., when there are α_1 confused consumers), then (B, A) is the unique equilibrium. If firm 2 is better off when frame complexity is the source of confusion (i.e., when there are α_2 confused consumers), then (B, B) is the unique equilibrium. A comparison of firm 2's expected profits when choosing either A or B leads to the next result.

Proposition 2. Let $\alpha_2 > \alpha_1$ and consider the first stage. If $\sigma > \hat{\sigma}$, $(z_1^*, z_2^*) = (B, A)$ is the unique Nash equilibrium. If $\sigma < \hat{\sigma}$, $(z_1^*, z_2^*) = (B, B)$ is the unique Nash equilibrium.

Proof: See Appendix A.3. *Q.E.D.*

If $\sigma < \hat{\sigma}$, the two firms are relatively symmetric and their incentives are more aligned. In this case, firm 2 prefers B over A as this results in α_2 confused consumers rather than $\alpha_1 (< \alpha_2)$. In contrast, if $\sigma > \hat{\sigma}$, the two firms are rather asymmetric and their incentives are more

divergent. Firm 2, unlike firm 1, is better off when the share of confused consumers is lower, and hence it chooses A over B, as this results in α_1 confused consumers.

When frame complexity is more confusing than frame differentiation ($\alpha_2 > \alpha_1$), the equilibrium share of confused consumers is not necessarily α_2. The non-monotonicity of firm 2's expected profit in the share of confused consumers underpins this result. Firm 2's frame choice determines the equilibrium share of confused consumers and this depends on the prominence level. Notably, the equilibrium share of confused consumers is α_2 iff $\sigma < \hat{\sigma}$. Otherwise, the equilibrium share of confused consumers is α_1.

3.3 Equilibrium outcome

Combining the analyses in Sections 3.1, 3.2.1 and 3.2.2, the next result follows. We highlight the equilibrium share of confused consumers, as this is of interest for the policy analysis in Section 4.

Proposition 3. The subgame perfect Nash equilibrium of the two-stage game is

$$\left((z_1^*, z_2^*); (F_1^{z_1 z_2}, F_2^{z_1 z_2})\right),$$

where the frame profile (z_1^*, z_2^*) is given in Propositions 1 and 2, the price distribution $F_i^{z_1 z_2}$ is characterized in Lemma 2 for $(z_1, z_2) \neq (A, A)$, and F_i^{AA} is degenerate at marginal cost with $i \in \{1, 2\}$. Using $\hat{\sigma}$ given by (2), the equilibrium share of confused consumers (α^*) is given below.

$$\alpha^* = \begin{cases} \alpha_1 & \text{if } \alpha_1 > \alpha_2 \\ \alpha_1 & \text{if } \alpha_2 > \alpha_1 \text{ and } \sigma > \hat{\sigma} \\ \alpha_2 & \text{if } \alpha_2 > \alpha_1 \text{ and } \sigma < \hat{\sigma} \end{cases}.$$

In equilibrium, the share of confused consumers is strictly positive. Moreover, unless $\alpha_2 > \alpha_1$ and $\sigma > \hat{\sigma}$, the equilibrium share of confused consumers is determined by the more effective source of confusion. Despite product homogeneity, strategic price framing allows firms to make strictly positive profits in equilibrium and, compared to a Bertrand competition benchmark, is detrimental to consumers. This provides a rationale for exploring the impact of consumer protection interventions in this market.

When frame complexity is more effective than frame differentiation ($\alpha_2 > \alpha_1$), the threshold prominence level $\hat{\sigma}$ plays an important role in determining the equilibrium share of confused consumers. Intuitively, $\hat{\sigma}$ measures the critical degree of prominence above which the two firms' obfuscation incentives are sufficiently different and below which the two firms'

obfuscation incentives are relatively aligned. Next we explore the properties of $\hat{\sigma}$ as a function of α_1 and α_2.

Lemma 3. The threshold prominence level $\hat{\sigma}$ given in (2) has the following properties.

(i) $\hat{\sigma} < 1 \iff \alpha_1 + \alpha_2 > 1$.

(ii) $\hat{\sigma}$ decreases in α_1 and α_2: $\frac{\partial \hat{\sigma}}{\partial \alpha_1} < 0$ and $\frac{\partial \hat{\sigma}}{\partial \alpha_2} < 0$.

(iii) $\hat{\sigma}$ reaches its minimum value of $\frac{\sqrt{5}-1}{2} \approx 0.618$ when $\alpha_1 = \alpha_2 = 1$.

Proof: See Appendix A.4. *Q.E.D.*

As $\hat{\sigma}$ has an impact on the equilibrium share of confused consumers when $\alpha_2 > \alpha_1$, we discuss these properties focusing on the case where frame complexity is more effective than frame differentiation.

(i) When the two sources of confusion are highly effective so that $\alpha_1 + \alpha_2 > 1$, there exists a non-trivial range of prominence levels where firms' incentives are sufficiently divergent and the equilibrium source of confusion is frame differentiation (the less effective source). However, if both confusion sources are relatively ineffective so that $\alpha_1 + \alpha_2 < 1$, then $\hat{\sigma} > 1$ and hence, $\sigma < \hat{\sigma}$ for sure. In this case, firms' incentives are sufficiently aligned and the equilibrium source of confusion is frame complexity (the more effective one).

(ii) As the effectiveness of either source of confusion increases, $\hat{\sigma}$ decreases and this makes it more likely for firm 2 to prefer a less effective source of confusion. Intuitively, consider $\sigma = \hat{\sigma}$ so that firm 2 is indifferent between the two sources of confusion. If either confusion source becomes marginally more effective, firm 2 loses out on savvy consumers, whom it can compete for, and it will strictly prefer the less effective confusion source.

(iii) The threshold prominence level $\hat{\sigma}$ reaches its minimum value of $\frac{\sqrt{5}-1}{2} \approx 0.618$ as both α_1 and α_2 approach their upper bounds equal to 1. This implies that if firm 1's prominence level is below 0.618, the two firms always agree on the more effective source of confusion, irrespective of the values of α_1 and α_2. In these cases, the insights are consistent with those in a symmetric model (i.e., $\sigma = 0.5$). However, when firm 1 is prominent enough (i.e., $\sigma > 0.618$), prominence plays a crucial role in determining the equilibrium level of confusion.

Drawing on the insights from Lemma 3, we can delineate the equilibrium regions in the (α_1, α_2) space. Figure 1 illustrates equilibrium outcomes for $\sigma = 0.8 > 0.618$. The dotted 45° line represents the equality $\alpha_1 = \alpha_2$ and separates the region where frame differentiation is

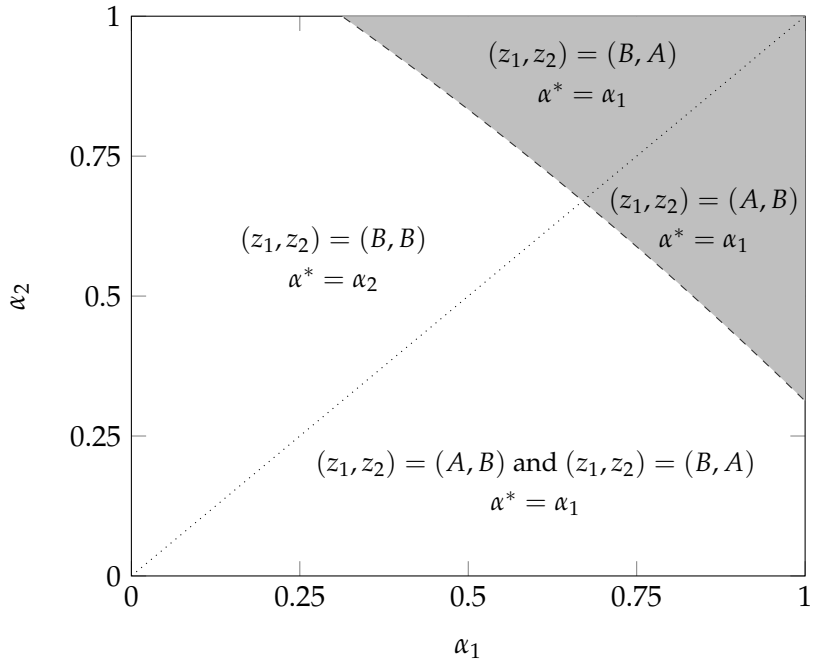

Figure 1: Equilibrium outcome for $\sigma = 0.8$

more effective from the region where frame complexity is more effective. The dashed curve represents $\alpha_2 = \frac{5/4-\alpha_1}{1-1/5\alpha_1}$, and is the locus where $\hat{\sigma} = 0.8$ in the (α_1, α_2) space.

The shading represents the region where the two firms have divergent incentives and where the less effective source of confusion prevails in equilibrium for $\alpha_2 > \alpha_1$. In contrast, the more effective source of confusion prevails in equilibrium for $\alpha_1 > \alpha_2$ where firm 1 can support (A, B) as in equilibrium. This is because $\hat{\sigma}$ decreases in both α_1 and α_2 and hence, $\sigma = 0.8 > \hat{\sigma}$ in the area to the north-east of the dashed line. In the non-shaded region, the two firms' incentives are aligned and the more effective source of confusion prevails in equilibrium.

Moreover, by Lemma 3(ii), as σ decreases, the shaded area diminishes, and it disappears completely once $\sigma < 0.618$. When σ increases (for $\sigma > 0.618$), the shaded area expands and the dashed curve reaches the limit of $\alpha_2 = 1 - \alpha_1$ as $\sigma \to 1$. The area to the south-west of $\alpha_2 = 1 - \alpha_1$ will always be non-shaded; see Lemma 3(i).

4 Policy implications

The equilibrium analysis highlights the role played by the degree of prominence and the relative effectiveness of the two sources of confusion in determining market outcomes. As

the equilibrium level of confusion is strictly positive, this section explores the impact of policies designed to mitigate consumer confusion (i.e., the effectiveness of price framing as a source of confusion) and policies that aim to reduce the impact of firm prominence.

In the model, total welfare is fixed but expected industry profit and consumer surplus depend on the prominence level (σ) and the equilibrium share of confused consumers (α^*). Below we assess the impact of policy intervention through firms' expected profits as any reduction (increase) in expected industry profit boosts (decreases) expected consumer surplus.

While in our stylized model the welfare-maximizing policy would mandate the use of the simple frame, this approach faces practical limitations. Consumer confusion may persist due to differences in consumers' financial literacy and behavioral biases. Despite rules promoting price transparency, firms often circumvent regulations by using spurious differentiation or multi-unit promotions. From a regulatory perspective, defining the 'simplest' frame is challenging, especially in complex markets like retail finance. Closely related regulations, such as standardized disclosures, have had limited success in fully eliminating confusion or frame differentiation. Moreover, regulators must balance market transparency and consumer protection against the risk of interventions that stifle innovation and reduce efficiency. Our model provides a flexible framework to evaluate realistic policy interventions targeting frame complexity, frame differentiation, and prominence.

4.1 Frame standardization

Frame standardization is a policy tool that facilitates price comparisons. In our model, it is an intervention that reduces the share of consumers confused by frame differentiation. It has a direct effect on market outcomes when the equilibrium source of confusion is frame differentiation. However, if the equilibrium source of confusion is frame complexity, the impact of frame standardization is not straightforward.

Policy Implication 1 (Frame standardization)**.** A reduction in the share of consumers confused by frame differentiation, from α_1 to $\alpha_1' (< \alpha_1)$, will have either of the following effects.

(i) If post-intervention the equilibrium source of confusion remains frame differentiation, then the equilibrium share of confused consumers decreases from α_1 to α_1'. Expected industry profit decreases and expected consumer surplus increases.

(ii) If pre-intervention the equilibrium source of consumer confusion is frame differentiation and post-intervention the equilibrium source of consumer confusion becomes frame complexity, then:

- when frame differentiation is the more effective source of confusion, the equilibrium share of confused consumers decreases from α_1 to α_2; expected industry profit decreases and expected consumer surplus increases;
- when frame complexity is the more effective source of confusion, the equilibrium share of confused consumers *increases* from α_1 to α_2; expected industry profit *increases* and expected consumer surplus *decreases*.

(iii) If post-intervention the equilibrium source of consumer confusion remains frame complexity, then the equilibrium share of confused consumers remains α_2. Expected industry profit and consumer surplus *do not change*.

These policy effects can be illustrated by considering different scenarios in the (α_1, α_2) space, using the example in Figure 1 where $\sigma = 0.8$. Starting from any point in the (α_1, α_2) space, a decrease in the share of consumers confused by frame differentiation (α_1) corresponds to a horizontal shift to the left.

Implication 1(i) summarizes all the cases where both the start and the end of the horizontal shift to the left are contained in the area where $\alpha^* = \alpha_1$. In these cases, the policy is effective and expected consumer surplus increases.

Implication 1(ii) covers cases where the starting point of the horizontal move is in an area where $\alpha^* = \alpha_1$ and the end point is in the area where $\alpha^* = \alpha_2$. If the starting point is above (below) the dotted 45° line, frame standardization policy increases (decreases) the equilibrium share of confused consumers and hence decreases (increases) expected consumer surplus. The unintended consequence of the policy intervention is related to the prominence threshold $\hat{\sigma}$. Consider a case where $\alpha_2 > \alpha_1$ and $\sigma > \hat{\sigma}(\alpha_1, \alpha_2)$. As frame standardization reduces α_1, $\hat{\sigma}$ increases. If α_1' is such that $\sigma < \hat{\sigma}(\alpha_1', \alpha_2)$, the two firms' incentives are more aligned and α_2 becomes the equilibrium share of confused consumers. In this case, frame standardization *harms* consumers.

Implication 1(iii) demonstrates that frame standardization has no effect on expected consumer surplus when the equilibrium source of confusion is frame complexity both before and after the intervention. Given the properties of $\hat{\sigma}$ in Lemma 3 and using Figure 1, it is easy to verify that frame standardization cannot change the equilibrium source of confusion from frame complexity to frame differentiation.

These implications cover all possible scenarios in the (α_1, α_2) space when $\sigma > 0.618$.

When $\sigma < 0.618$, Implication 1(ii) does not apply and it is not possible for the policy intervention to backfire. Nevertheless, Implication 1(iii) applies and so it is possible for the policy to be inconsequential.

In EU mortgage markets, the European Standardised Information Sheet (ESIS) harmonizes the way contract attributes are presented and is an example of frame standardization intervention. Through the lens of our model, it is an intervention that reduces confusion due to frame differentiation (i.e., α_1). If frame differentiation is indeed the equilibrium source of confusion ($\alpha^* = \alpha_1$) both before and after the intervention, Policy Implication 1(i) predicts that it will lower the share of confused consumers and boost consumer surplus.

However, our findings also indicate that such interventions might fail to improve market outcomes. If in equilibrium consumer confusion stems from contractual complexity - technical jargon or fine print clauses - (so that $\alpha^* = \alpha_2$) rather than from format differentiation, an intervention like ESIS would leave α^* unchanged and be ineffective; see Policy Implication 1(iii). Moreover, our results show that such interventions could backfire and worsen outcomes if they result in firms adopting comparable, but more complex contracts; see Policy Implication 1(ii).

4.2 Complexity regulation

Next, we examine complexity regulation measures such as limitations on the use of fine print terms and conditions. This intervention reduces the effectiveness of frame complexity and therefore leads to a reduction in the share of consumers confused by frame complexity.

Policy Implication 2 (Complexity regulation)**.** A reduction in the share of consumers confused by frame complexity, from α_2 to α_2', will have either of the following effects.

(i) If the equilibrium source of confusion remains frame complexity, then the equilibrium share of confused consumers decreases from α_2 to α_2'. Expected industry profit decreases and expected consumer surplus increases.

(ii) If the decrease from α_2 to α_2' changes the equilibrium source of confusion from frame complexity to frame differentiation, then the equilibrium share of confused consumers decreases from α_2 to α_1. Expected industry profit decreases and expected consumer surplus increases.

(iii) If the decrease from α_2 to α_2' changes the equilibrium source of confusion from frame differentiation to frame complexity (i.e., $\alpha_2 > \alpha_2' > \alpha_1$ and $\hat{\sigma}$ increases such that $\sigma > \hat{\sigma}$ no longer holds), then the equilibrium share of confused consumers *increases* from α_1 to α_2'. Expected industry profit *increases* and expected consumer surplus *decreases*.

(iv) If the equilibrium source of confusion remains frame differentiation, then the equilibrium share of confused consumers remains α_1. Expected industry profit and expected consumer surplus *do not change*.

As in the case of frame standardization, the effects of complexity regulation can also be analyzed by considering different scenarios in the (α_1, α_2) space. Consider the example in Figure 1 where $\sigma = 0.8$. Starting from any point in the (α_1, α_2) space, a decrease in frame complexity α_2 corresponds to a vertical shift downwards.

Implication 2(i) summarizes all the cases where both the start point and the end point of the vertical shift are contained in the area where $\alpha^* = \alpha_2$. Implication 2(ii) covers cases where the start point of the vertical shift is in the area where $\alpha^* = \alpha_2$ and the end point is in the area where $\alpha^* = \alpha_1$. As these changes can only happen when moving from a point above the 45° line to a point below it, the equilibrium share of confused consumers decreases from α_2 to α_1.

Noteworthy, complexity regulation can be counterproductive. Starting from a point above the 45° line in the area where $\alpha^* = \alpha_1$, a vertical shift downward may change the equilibrium source of confusion from frame differentiation to frame complexity. In this case, the equilibrium share of confused consumers increases from α_1 to α_2', because the endpoint is still above the 45° line, and hence expected consumer surplus decreases. Implication 2(iii) collects these cases.

Implication 2(iv) shows that complexity regulation is ineffective when the equilibrium source of confusion remains frame differentiation.

These implications cover all possible scenarios in the (α_1, α_2) space for $\sigma > 0.618$. For $\sigma < 0.618$, Implication 2(iii) does not apply, while the other policy insights carry over.

An example of complexity regulation is the *Know Before You Owe* mortgage disclosure rule introduced by the Consumer Financial Protection Bureau in the US. This is "intended to make mortgage disclosure forms clearer, simpler and easier to understand for homebuyers by combining several forms and statutory disclosure requirements into two forms – the Loan Estimate form and the Closing Disclosure" (Stroud, Willink & Howard, LLC, 2015).

In our model, this is an intervention that reduces confusion due to frame complexity (i.e., α_2). If frame complexity is indeed the equilibrium source of confusion ($\alpha^* = \alpha_2$) both before and after the intervention, Policy Implication 2(i) shows that it will lower the share of confused consumers and boost consumer surplus. If post-intervention the equilibrium source of confusion changes from frame complexity to frame differentiation, Policy Implication 2(ii) also predicts a lower share of confused consumers and higher consumer surplus.

However, our findings show that such interventions might fail to improve market outcomes. If confusion stems from frame differentiation (α_1) rather than from frame complexity, such intervention would leave α^* unchanged and be ineffective; see Policy Implication 2(iv). Moreover, our results show the intervention could backfire if it results in firms adopting more complex contracts; see Policy Implication 2(iii).

4.3 Prominence reduction

When one firm is more prominent, policies that raise the awareness of the less prominent firm's product may be regarded as pro-competitive. In our model, such intervention would reduce the prominence level (σ) and make the two firms more symmetric. Indeed, as Corollary 1 demonstrates, the fact that expected industry profit is an increasing function of σ lends theoretical support to a prominence reduction policy.

However, changes in σ may alter the less prominent firm's best response and, ultimately, the equilibrium share of confused consumers. This suggests that the intervention may have unintended effects. The following policy implication summarizes the effects of a reduction in the level of prominence.

Policy Implication 3 (Prominence reduction)**.** A decrease in the prominence level from σ to σ' will have either of the following effects.

(i) If $\alpha_1 > \alpha_2$ or, if $\alpha_2 > \alpha_1$ and $\sigma < \hat{\sigma}(\alpha_1, \alpha_2)$, the intervention does not affect the equilibrium share of confused consumers. Expected industry profit decreases and expected consumer surplus increases.

(ii) Suppose that $\alpha_2 > \alpha_1$ and $\sigma > \hat{\sigma}(\alpha_1, \alpha_2)$.

- If $\sigma' > \hat{\sigma}(\alpha_1, \alpha_2)$, the equilibrium share of confused consumers remains α_1. Expected industry profit decreases and expected consumer surplus increases.
- If $\sigma' < \hat{\sigma}(\alpha_1, \alpha_2)$, the equilibrium share of confused consumers increases from α_1 to α_2. The effect of the intervention on expected industry profit and expected consumer surplus is *ambiguous*.

Implication 3(i) covers cases where a reduction in prominence does not change the less prominent firm's best response, which is the case if either$\alpha_1 > \alpha_2$ or if $\alpha_2 > \alpha_1$ and $\sigma < \hat{\sigma}(\alpha_1, \alpha_2)$. In the latter case, where frame complexity is more effective, the firms' incentives are already aligned, and a reduction in relative prominence strengthens this alignment. Using Figure 1, take a point above the 45° line and in the non-shaded area. As σ decreases, the shaded area diminishes and so the point remains in the non-shaded area. In these cases, a product awareness policy that reduces the prominence level is effective and boosts expected consumer surplus.

Implication 3(ii) summarizes scenarios where a prominence reduction may change the less prominent firm's best response and so the equilibrium level of confusion. Take a point above the 45° line and in the shaded area in Figure 1, that is, in the region where $\alpha_2 > \alpha_1$

and $\sigma > \hat{\sigma}(\alpha_1, \alpha_2)$. In this case, where frame complexity is more effective and prominence is relatively high, firms' incentives are divergent, and the less prominent firm is better off choosing frame A so that frame differentiation is the equilibrium source of confusion (associated with the lower share of confused α_1). A marginal reduction in prominence would not diminish the shaded area too much, so the point remains in this area. Thus, the less prominent firm still prefers α_1 to α_2. The policy in this case is effective.

In contrast, a larger reduction in prominence may diminish the shaded area so that post-intervention the point is located in the non-shaded area. In this scenario, firms' incentives are more aligned after the policy and the less prominent firm's best response is B so that the equilibrium share of confused is α_2. The effect of the reduction in prominence is ambiguous because even though σ is reduced, the equilibrium share of confused α^* has increased.

Both these implications are relevant when $\sigma > 0.618$. However, when $\sigma < 0.618$, Implication 3(ii) does not apply.

Account portability regulations in retail banking, like UK's Current Account Switching Service and switching rules under EU's Payment Accounts Directive, are examples of interventions that can reduce dominant firms' prominence. Open banking regulations provide another example. In its 2016 investigation of the UK retail banking industry, the Competition Market Authority (CMA) found that big banks dominated the market and consumers would benefit from increased competition (Competition and Markets Authority, 2022). As a result, the largest banks were required to implement common standards for open banking that facilitate consumer switching.

In our model, such interventions that reduce prominence may indeed foster competition and enhance consumer welfare; see Policy Implication 3(i). However, our results also show that a reduction in prominence may interact with equilibrium sources of consumer confusion in ways that prompt firms to adopt more complex pricing frames, and have ambiguous welfare effects; see Policy Implication 3(ii).

4.4 Equilibrium source of confusion

An overarching insight from sections 4.1, 4.2, and 4.3 is that for a policy to be effective, it is important to identify the correct source of consumer confusion in equilibrium. Consider first policy tools that aim to reduce the effectiveness of frame complexity and frame differentiation as sources of consumer confusion. For example, regulatory intervention can standardize the price format or reduce contract complexity by limiting the use of fine print clauses. The former reduces the effectiveness of frame differentiation, while the latter reduces the effectiveness of frame complexity. A policy that fails to target or change the equilibrium source of confusion, may not make a difference to consumer outcomes. On the other hand, a

policy that changes the equilibrium source of confusion, may have unintended consequences and be detrimental to consumers.

Policy Implication 4. To ensure the effectiveness of consumer protection policy and avoid unintended consequences, it is crucial to identify the equilibrium source of consumer confusion and assess how it is affected by intervention.

4.5 Multifaceted policies

Policy measures may affect both frame complexity and frame differentiation. For example, EU's ESIS can simultaneously reduce frame differentiation and frame complexity by standardizing the format in which financial products are presented and requiring the use of simple wording to convey key pricing attributes.[10] Our framework allows for the analysis of multifaceted interventions, with Figure 1 providing a useful assessment tool.

Consider a policy intervention that changes the parameters from (α_1, α_2) to (α_1', α_2'), where $\alpha_1' < \alpha_1$ and $\alpha_2' < \alpha_2$. Intuitively, by reducing confusion along both dimensions, such an intervention is more likely to be effective compared to a policy that targets only one source of confusion. For example, if the equilibrium source of confusion remains unchanged after the intervention, this policy improves the outcomes, while a one-dimensional intervention that fails to target the equilibrium source of confusion would not.

However, multifaceted intervention may also backfire. Consider the case where $\alpha_1' < \alpha_1 < \alpha_2' < \alpha_2$ and $\hat{\sigma} < \sigma < \hat{\sigma}'$. In this case, the intervention shifts the framing equilibrium from $\{B, A\}$ to $\{B, B\}$, leading to an increase in the level of consumer confusion from α_1 to α_2'. Rather than reducing confusion and protecting consumers, this policy leads to increased consumer confusion, benefits the industry, and harms consumers.

5 Extensions

5.1 Correlated prominence and quality

In this section, we extend the baseline model by introducing a positive correlation between a firm's prominence and the quality of its product or service. Specifically, a firm may become more prominent because it consistently offers higher quality. Confused consumers, unable to assess prices or net surplus, may use prominence as a proxy for quality and are more likely

[10] However, such regulations may still be circumvented through the introduction of spurious complexity in other dimensions of the financial product.

to choose the more prominent firm. However, confused consumers may choose a higher quality firm that offers a worse deal in terms of net surplus.

Consider the baseline model except that now the prominent firm 1 offers a higher quality product with no extra cost.[11] Consumers value firm 1's product more highly than firm 2's by an amount $\theta > 0$. Thus, when consumers are able to compare prices, their utility from purchasing from firm 1 is $1 + \theta - p_1$, while their utility from purchasing from firm 2 is $1 - p_2$. Firm 1's pricing strategy space is $[0, 1 + \theta]$ while firm 2's is $[0, 1]$. We assume that the quality difference, θ, is sufficiently small to ensure that the higher quality firm does not easily monopolize the market: $\theta < \frac{\alpha(2\sigma-1)}{1-\sigma\alpha}$.

For completeness and clarity, in the pricing stage firm 1's expected profit is

$$\pi_1(p_1, p_2) = \begin{cases} p_1 [\sigma\alpha + (1-\alpha)] & \text{if } p_1 < p_2 + \theta \\ p_1 [\sigma\alpha + \sigma(1-\alpha)] & \text{if } p_1 = p_2 + \theta \\ p_1 \sigma\alpha & \text{if } p_1 > p_2 + \theta \end{cases}$$

and firm 2's expected profit is

$$\pi_2(p_1, p_2) = \begin{cases} p_2(1-\sigma)\alpha & \text{if } p_1 < p_2 + \theta \\ p_2 [(1-\sigma)\alpha + (1-\sigma)(1-\alpha)] & \text{if } p_1 = p_2 + \theta \\ p_2 [(1-\sigma)\alpha + (1-\alpha)] & \text{if } p_1 > p_2 + \theta \end{cases}.$$

Using the analytical approach for equilibrium characterization in Narasimhan (1988) and assuming that firms compete in the utility space à la Armstrong and Vickers (2001) and Shelegia and Wilson (2021), firms' equilibrium profits in the pricing stage are given below.

Proposition 4. Let $\alpha > 0$ and $\theta < \frac{\alpha(2\sigma-1)}{1-\sigma\alpha}$. The expected profits in the pricing stage with a share of α confused consumers are as follows.

$$\pi_1 = (1+\theta)\sigma\alpha \text{ and } \pi_2 = \frac{(1-\sigma\alpha)[\sigma\alpha - \theta(1-\alpha)]}{1-(1-\sigma)\alpha}. \tag{3}$$

Proof: See Appendix A.5. *Q.E.D.*

The expected profits in (3) extend those in (1) by incorporating the quality advantage θ of the more prominent firm. This advantage strengthens the prominent firm's position in price competition while disadvantaging the less prominent firm. As in the baseline model, it is evident that the prominent firm benefits from a higher equilibrium share of confused consumers. In contrast, the less prominent firm's preference for consumer confusion depends on whether α_1 or α_2 yields a higher expected profit.

[11] This quality advantage may stem from an earlier successful innovation by firm 1 that is not modelled here.

		Firm 2: A	Firm 2: B
Firm 1	A	$\theta,\ 0$	$(1+\theta)\sigma\alpha_1,\ \frac{(1-\sigma\alpha_1)[\sigma\alpha-\theta(1-\alpha_1)]}{1-(1-\sigma)\alpha_1}$
	B	$(1+\theta)\sigma\alpha_1,\ \frac{(1-\sigma\alpha_1)[\sigma\alpha-\theta(1-\alpha_1)]}{1-(1-\sigma)\alpha_1}$	$(1+\theta)\sigma\alpha_2,\ \frac{(1-\sigma\alpha_2)[\sigma\alpha-\theta(1-\alpha_2)]}{1-(1-\sigma)\alpha_2}$

Table 2: The normal form of the framing game with correlated prominence and quality

To understand the framing equilibrium in the first stage, we begin by examining the payoffs in Table 2. The profits in a fully transparent market with entirely savvy consumers, resulting from the frame choices $\{A, A\}$, are derived using standard arguments. By assumption, $\theta < \frac{\alpha_1(2\sigma-1)}{1-\sigma\alpha_1}$ and because $\frac{\alpha_1(2\sigma-1)}{1-\sigma\alpha_1} < \frac{\sigma\alpha_1}{1-\sigma\alpha_1}$, it follows that $\theta < (1+\theta)\sigma\alpha_1$. Therefore, Propositions 1 and 2 continue to hold, with a single modification: the prominence threshold $\hat{\sigma}$ in (2) is replaced by

$$\hat{\sigma} := \frac{\sqrt{[\alpha_1+\alpha_2-(1+\theta)\alpha_1\alpha_2]^2+4(1+2\theta)\alpha_1\alpha_2}-[\alpha_1+\alpha_2-(1-\theta)\alpha_1\alpha_2]}{2\alpha_1\alpha_2} \tag{4}$$

As in the baseline model, $\hat{\sigma}$ is derived by comparing the less prominent firm's expected profits when consumer confusion arises from frame differentiation (α_1) versus when it arises from frame complexity (α_2). Note that $\hat{\sigma}$ coincides with $\hat{\sigma}$ in (2) in the special case of $\theta = 0$.

Proposition 5. Let $\hat{\sigma}$ be as defined in (4). When the more prominent firm 1 offers a higher quality product than firm 2, with a quality differential $0 < \theta < \min\left\{\frac{\alpha_1(2\sigma-1)}{1-\sigma\alpha_1}, \frac{\alpha_2(2\sigma-1)}{1-\sigma\alpha_2}\right\}$, the following results hold.[12]

(i) Suppose $\alpha_1 > \alpha_2$. If $\sigma > \hat{\sigma}$, (A, B) is the unique Nash equilibrium of the price framing game. If $\sigma < \hat{\sigma}$, there are two pure strategy Nash equilibria (A, B) and (B, A).

(ii) Suppose $\alpha_2 > \alpha_1$. If $\sigma > \hat{\sigma}$, (B, A) is the unique Nash equilibrium of the price framing game. If $\sigma < \hat{\sigma}$, (B, B) is the unique Nash equilibrium.

Proposition 5 indicates that the policy results in Section 4 are qualitatively robust when the prominent firm offers a higher quality. In particular, policy may be ineffective or even backfire if it does not take into account the equilibrium source of confusion.

The following lemma provides a new insight into how the more prominent firm's higher quality affects the incentive alignment in the frame choice stage between the two firms.

[12]The proof is omitted as it parallels the procedure used to establish Propositions 1 and 2.

Lemma 4. The threshold prominence level $\hat{\sigma}$ given in (4) increases in θ, $\frac{\partial \hat{\sigma}}{\partial \theta} > 0$.

Proof: See Appendix A.6. *Q.E.D.*

For a given prominence level σ, an increase in the quality difference θ raises the threshold $\hat{\sigma}$. As a result, condition $\sigma < \hat{\sigma}$ is more likely to hold, and therefore it is more likely that firms' preferences over the equilibrium share of confused consumers are aligned. Intuitively, as the quality difference increases, the less prominent firm loses its relative advantage in competing for savvy consumers, and may therefore prefer a larger share of confused consumers. This suggests that a correlation between prominence and quality reduces the likelihood of unintended policy outcomes.

5.2 Pricing above valuation

In this part, we consider the possibility that confused consumers are not only unable to compare firms' prices, but also unable to assess if a firm's price is below their reservation value. We extend the baseline model to allow firms to charge prices above the consumers' reservation value. Firms can choose prices up to $\bar{r} > 1$. Consumers would make negative surplus if buying at a price in $(1, \bar{r}]$. Therefore, savvy consumers will not buy at this price, but confused consumers may buy as they do not realize that the price is above their valuation. Drawing on the equilibrium characterization in Gu and Wenzel (2014), equilibrium profits in the pricing stage are given in the following proposition.

Proposition 6. Let $\bar{\alpha} = [\bar{r}(1-\sigma)+\sigma]^{-1}$ and $\underline{\alpha} = [\bar{r}\sigma + (1-\sigma)]^{-1}$. The expected profits in the pricing stage with a share of α confused consumers are as follows.

(i) Suppose $\alpha \geq \bar{\alpha}$. Then:
$$\pi_1 = \sigma\alpha\bar{r} \text{ and } \pi_2 = (1-\sigma)\alpha\bar{r}.$$

(ii) Suppose $\underline{\alpha} \leq \alpha < \bar{\alpha}$. Then:
$$\pi_1 = \sigma\alpha\bar{r} \text{ and } \pi_2 = 1-\sigma\alpha.$$

(iii) Suppose $\alpha < \underline{\alpha}$. Then:
$$\pi_1 = \sigma\alpha \text{ and } \pi_2 = \frac{\sigma\alpha(1-\sigma\alpha)}{1-(1-\sigma)\alpha}.$$

In contrast to the baseline model, equilibrium pricing now consists of three regimes, depending on the share of confused consumers. Case (iii) covers the case when there are relatively few confused consumers ($\alpha < \underline{\alpha}$), corresponding to the outcome in the baseline model.

Cases (i) and (ii) are the new elements. Here, when the number of confused consumers is sufficiently large, at least one firm only sells to confused consumers and charges a price above their reservation value. In case (i), both firms charge a price of $\bar{r}$ so that only confused consumers purchase while savvy consumers are not served. Note that, in this regime, both firms' profits are strictly increasing in the share of confused consumers. In case (ii), market segmentation arises where the more prominent firm sells to confused consumers by charging a price of $\bar{r}$ while firm 2 sells to its share of confused consumers and all savvy consumers by charging a price of 1 (equal to the reservation value). In this regime, there are conflicting preferences regarding the level of consumer confusion. Indeed, while the more prominent firm prefers a larger share of confused consumers, the less prominent benefits from more savvy consumers.

Below we focus on the new cases, that is, situations where $\alpha_1, \alpha_2 > \underline{\alpha}$. Hence, the discussion centres on scenarios where a large share of consumers are confused. The next proposition presents firms' equilibrium frame choices.[13]

Proposition 7. Suppose $\alpha_1, \alpha_2 > \underline{\alpha}$ and define the following two critical levels $\bar{\sigma}_1 = \frac{\alpha_1 \bar{r} - 1}{\alpha_1 \bar{r} - \alpha_2}$ and $\bar{\sigma}_2 = \frac{\alpha_2 \bar{r} - 1}{\alpha_2 \bar{r} - \alpha_1}$. Then, the following equilibrium frame choices emerge.

(i) For $\alpha_1 > \alpha_2$:

- Suppose that $\alpha_1, \alpha_2 \geq \bar{\alpha}$. Then, there are two pure strategy Nash equilibria (A, B) and (B, A).
- Suppose that $\alpha_1 \geq \bar{\alpha} > \alpha_2 \geq \underline{\alpha}$. If $\sigma < \bar{\sigma}_1$, there are two pure strategy Nash equilibria (A, B) and (B, A). If $\sigma > \bar{\sigma}_1$, then (A, B) is the unique Nash equilibrium.
- Suppose that $\bar{\alpha} > \alpha_1 > \alpha_2 \geq \underline{\alpha}$, then (A, B) is the unique Nash equilibrium.

(ii) For $\alpha_2 > \alpha_1$:

- Suppose that $\alpha_1, \alpha_2 \geq \bar{\alpha}$. Then (B, B) is the unique Nash equilibrium.
- Suppose that $\alpha_2 \geq \bar{\alpha} > \alpha_1 \geq \underline{\alpha}$. If $\sigma < \bar{\sigma}_2$, (B, B) is the unique Nash equilibrium of the price framing game. If $\sigma > \bar{\sigma}_2$, (B, A) is the unique Nash equilibrium.
- Suppose that $\bar{\alpha} > \alpha_2 > \alpha_1 \geq \underline{\alpha}$. Then, (B, A) is the unique Nash equilibrium.

The equilibrium structure is similar to the one in the baseline model. In particular, when frame differentiation dominates ($\alpha_1 > \alpha_2$), equilibrium confusion level is $\alpha^* = \alpha_1$. Moreover, when frame complexity dominates ($\alpha_2 > \alpha_1$), the equilibrium confusion level can be either α_1 or α_2, depending on the degree of prominence.

[13] The proof is omitted as it parallels the procedure used to establish Propositions 1 and 2.

		Firm 2		
		A	B	C
Firm 1	A	$0,\ 0$	$\sigma\alpha_1,\ \frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1}$	$\sigma\alpha_3,\ \frac{\sigma\alpha_3(1-\sigma\alpha_3)}{1-(1-\sigma)\alpha_3}$
	B	$\sigma\alpha_1,\ \frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1}$	$\sigma\alpha_2,\ \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2}$	$\sigma\alpha_4,\ \frac{\sigma\alpha_4(1-\sigma\alpha_4)}{1-(1-\sigma)\alpha_4}$

Table 3: The normal form of the framing game with three price frames for Firm 2

When revisiting the policy analysis, however, the following points are worth noting.

First, in contrast to the baseline model, policies that reduce complexity or standardize the price frame cannot backfire, although they may still be ineffective when they target the source of confusion that does not prevail in equilibrium. Whenever policies induce a change in the equilibrium level of confusion, they increase consumer surplus.[14]

Second, policies are more effective in the sense they can raise consumer surplus to a greater extent and can also increase total welfare. For instance, a policy that reduces confusion from a level $\alpha^* > \bar{\alpha}$ to a lower level of $\bar{\alpha} > \alpha^* > \underline{\alpha}$ raises consumer surplus as confused consumers who choose the less prominent firm no longer end up with a negative surplus (while those captive to the more prominent firm keep on receiving a negative surplus). Moreover, total welfare increases as savvy consumers are now also served.

Overall, the analysis here suggests that in markets where consumer confusion is a major concern (e.g. where both α and $\bar{r}$ are high) policies that tackle obfuscation are relatively more effective than in the baseline model and potential adverse effects from regulation are of lesser importance. However, policies that level the playing field by reducing prominence can still have unintended consequences.

5.3 More than two price frames

In this section, we extend the baseline model to allow the less prominent firm, firm 2, to choose from an expanded set of price frames. Specifically, we replicate the structure of the model in Section 2, with the modification that, in the first stage, firm 2 can now select from the set A, B, C, where C represents a price frame that is distinct from both A and B. We assume that the share of confused consumers is given by $\alpha_3 \in (0, 1)$ when firm 2 chooses

[14] However, as in the baseline model, policies that reduce the level of prominence (σ) may still backfire. When σ decreases, the less prominent firm benefits more from a higher level of confusion and therefore firms' incentives are better aligned. Specifically, for $\alpha_2 > \alpha_1$, reducing prominence can lead to a shift to an equilibrium with a higher level of confusion (α_2 instead of α_1).

frame C while firm 1 chooses A, and by $\alpha_4 \in (0,1)$ when frame C is paired with B. Table 3 presents the normal form representation of the framing stage in this extended model.

An examination of the payoffs in Table 3 reveals that, with an appropriate combination of model parameters, any strategy profile except $\{A, A\}$ can emerge as an equilibrium. For example, $\{B, B\}$ is an equilibrium if

$$\alpha_2 > \alpha_1 \text{ and } \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2} > \max\left\{\frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1}, \frac{\sigma\alpha_4(1-\sigma\alpha_4)}{1-(1-\sigma)\alpha_4}\right\}.$$

On the other hand, $\{B, C\}$ is an equilibrium if

$$\alpha_4 > \alpha_3 \text{ and } \frac{\sigma\alpha_4(1-\sigma\alpha_4)}{1-(1-\sigma)\alpha_4} > \max\left\{\frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1}, \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2}\right\}.$$

The conditions under which other strategy profiles constitute an equilibrium can be derived in a similar manner. Consequently, the equilibrium share of confused consumers may take any value from the set $\{\alpha_1, \alpha_2, \alpha_3, \alpha_4\}$, depending on the parameter values.

This straightforward extension to more than two price frames illustrates the robustness of our central policy insight. Regulatory interventions aimed at altering the level of consumer confusion must account for the underlying equilibrium sources of consumer confusion, both before and after the intervention. As in the baseline model, such policies may succeed in enhancing consumer surplus, but they can also prove ineffective or even detrimental to consumer welfare, depending on the strategic responses of firms. Importantly, the relative prominence of firms continues to play a critical role in shaping the equilibrium source of confusion. Consequently, regulators may need to exercise caution when implementing seemingly simple policy measures, especially in markets with more price frames).

6 Conclusion

This paper examines the interplay between firm prominence and consumer confusion and its implications for market outcomes and consumer protection policy. In a homogeneous product duopoly where one firm is more prominent than its rival, firms choose price frames before competing in prices. Both price frame complexity and price frame differentiation limit price comparability and are sources of consumer confusion.

The equilibrium price frame profile depends both on the degree of prominence and on the relative effectiveness of frame differentiation and frame complexity as sources of consumer confusion. In particular, the alignment or divergence of firms' incentives plays a crucial role in determining the equilibrium share of confused consumers. A parametric condition on firm prominence delineates different equilibrium outcomes and synthesizes the interplay between prominence and confusion.

The analysis assesses the impact of price format standardization, frame complexity reduction, or prominence reduction interventions. Price frame standardization reduces the effectiveness of frame differentiation as a source of consumer confusion. Complexity reduction (e.g., limitation on the use of contractual fine print) reduces the effectiveness of frame complexity as a source of consumer confusion. Prominence reduction (e.g., product awareness campaigns) levels the playing field and increase competitive pressure. The assessment of different policies shows that the effects of intervention on expected consumer surplus and industry profit depend crucially on underlying market conditions. While all these policies may be effective, conditions are presented where the outcome may be ambiguous, ineffective, or even detrimental to consumers.

A Appendix

A.1 Proof of Corollary 1

(i) The claim is straightforward with respect to firm 1's expected profit. Industry profit is

$$\Pi := \pi_1 + \pi_2 = \frac{(2-\alpha)\sigma\alpha}{1-(1-\sigma)\alpha}.$$

Investigating the partial derivatives of Π with respect to σ and α yields

$$\frac{\partial \Pi}{\partial \sigma} = \frac{\alpha(2-\alpha)(1-\alpha)}{[1-(1-\sigma)\alpha]^2} > 0,$$
$$\frac{\partial \Pi}{\partial \alpha} = \frac{\sigma[2(1-\alpha)+(1-\sigma)\alpha^2]}{[1-(1-\sigma)\alpha]^2} > 0.$$

It follows that expected industry profit is increasing in σ and α.

(ii) Taking firm 2's expected profit in (1), the first order derivatives with respect to σ and α are

$$\frac{\partial \pi_2}{\partial \sigma} = -\alpha + \frac{\alpha(2-\alpha)(1-\alpha)}{[1-(1-\sigma)\alpha]^2},$$
$$\frac{\partial \pi_2}{\partial \alpha} = \frac{\sigma\left[1-\sigma\alpha(2-\alpha+\sigma\alpha)\right]}{[1-(1-\sigma)\alpha]^2}.$$

While the signs of the first order derivatives can be either strictly positive or strictly negative, depending on the exact values of $\sigma \in (1/2, 1)$ and $\alpha \in (0, 1)$, the second order derivatives are both negative:

$$\frac{\partial^2 \pi_2}{\partial \sigma^2} = -\frac{2\alpha(1-\alpha)(2-\alpha)}{[1-(1-\sigma)\alpha]^3} < 0,$$
$$\frac{\partial^2 \pi_2}{\partial \alpha^2} = -\frac{2\sigma(1-\alpha)(2-\alpha)}{[1-(1-\sigma)\alpha]^3} < 0.$$

Thus, firm 2's expected profit is concave in both σ and α, and so non-monotonic.

A.2 Proof of Proposition 1

Let $\alpha_1 > \alpha_2$. It is straightforward that (A, B) is a Nash equilibrium. On the other hand, (B, A) is an equilibrium if and only if $\frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1} > \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2}$. Since

$$\frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1} - \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2} = \frac{\sigma(\alpha_1-\alpha_2)[1-\sigma\alpha_1-\sigma\alpha_2+\sigma(1-\sigma)\alpha_1\alpha_2]}{[1-(1-\sigma)\alpha_1][1-(1-\sigma)\alpha_2]},$$

then

$$\frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1} > \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2} \iff 1-\sigma\alpha_1-\sigma\alpha_2+\sigma(1-\sigma)\alpha_1\alpha_2 > 0.$$

Solving $1-\sigma\alpha_1-\sigma\alpha_2+\sigma(1-\sigma)\alpha_1\alpha_2 = 0$ yields $\hat{\sigma}$ in (2). It is easy to check that $1-\sigma\alpha_1-\sigma\alpha_2+\sigma(1-\sigma)\alpha_1\alpha_2 > 0 \iff \sigma < \hat{\sigma}$. Hence, (B, A) is an equilibrium if and only if $\sigma < \hat{\sigma}$.

There are no other pure strategy equilibria in the first stage.

A.3 Proof of Proposition 2

Let $\alpha_2 > \alpha_1$. Following the discussion in the text, if $\frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1} > \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2}$, (B, A) is the unique Nash equilibrium in the first stage. Otherwise, (B, B) is the unique Nash equilibrium.

Using the same approach as in Section A.2 and noting that $\alpha_2 > \alpha_1$,

$$\frac{\sigma\alpha_1(1-\sigma\alpha_1)}{1-(1-\sigma)\alpha_1} > \frac{\sigma\alpha_2(1-\sigma\alpha_2)}{1-(1-\sigma)\alpha_2} \iff 1-\sigma\alpha_1-\sigma\alpha_2+\sigma(1-\sigma)\alpha_1\alpha_2 < 0.$$

Hence, (B, A) is the unique Nash equilibrium if $\sigma > \hat{\sigma}$ and (B, B) is the unique Nash equilibrium if $\sigma < \hat{\sigma}$.

A.4 Proof of Lemma 3

(i) The following steps establish the result.

$$\begin{aligned}
\hat{\sigma} < 1 &\iff \sqrt{(\alpha_1+\alpha_2-\alpha_1\alpha_2)^2+4\alpha_1\alpha_2} - (\alpha_1+\alpha_2-\alpha_1\alpha_2) < 2\alpha_1\alpha_2 \\
&\iff \sqrt{(\alpha_1+\alpha_2-\alpha_1\alpha_2)^2+4\alpha_1\alpha_2} < 2\alpha_1\alpha_2 + (\alpha_1+\alpha_2-\alpha_1\alpha_2) \\
&\iff (\alpha_1+\alpha_2-\alpha_1\alpha_2)^2+4\alpha_1\alpha_2 < (\alpha_1+\alpha_2+\alpha_1\alpha_2)^2 \\
&\iff 4\alpha_1\alpha_2 < 4(\alpha_1+\alpha_2)\alpha_1\alpha_2 \\
&\iff 1 < \alpha_1+\alpha_2.
\end{aligned}$$

(ii) The following steps and the observation that $\alpha_2 \in (0, 1)$ establish that $\frac{\partial\hat{\sigma}}{\partial\alpha_1} < 0$.

$$\frac{\partial\hat{\sigma}}{\partial\alpha_1} = \frac{\alpha_1\alpha_2 - 3\alpha_1 - \alpha_2 + \sqrt{\alpha_1^2\alpha_2^2 - 2\alpha_1^2\alpha_2 + \alpha_1^2 - 2\alpha_1\alpha_2^2 + 6\alpha_1\alpha_2 + \alpha_2^2}}{2\alpha_1^2\sqrt{\alpha_1^2\alpha_2^2 - 2\alpha_1^2\alpha_2 + \alpha_1^2 - 2\alpha_1\alpha_2^2 + 6\alpha_1\alpha_2 + \alpha_2^2}} < 0$$

$$\iff \alpha_1\alpha_2 - 3\alpha_1 - \alpha_2 + \sqrt{\alpha_1^2\alpha_2^2 - 2\alpha_1^2\alpha_2 + \alpha_1^2 - 2\alpha_1\alpha_2^2 + 6\alpha_1\alpha_2 + \alpha_2^2} < 0$$
$$\iff \sqrt{\alpha_1^2\alpha_2^2 - 2\alpha_1^2\alpha_2 + \alpha_1^2 - 2\alpha_1\alpha_2^2 + 6\alpha_1\alpha_2 + \alpha_2^2} < 3\alpha_1 + \alpha_2 - \alpha_1\alpha_2$$
$$\iff \alpha_1^2\alpha_2^2 - 2\alpha_1^2\alpha_2 + \alpha_1^2 - 2\alpha_1\alpha_2^2 + 6\alpha_1\alpha_2 + \alpha_2^2 < (3\alpha_1 + \alpha_2 - \alpha_1\alpha_2)^2$$
$$\iff 4\alpha_1^2(\alpha_2 - 2) < 0$$

Since $\hat{\sigma}$ is symmetric in α_1 and α_2, the same approach establishes that $\frac{\partial\hat{\sigma}}{\partial\alpha_2} < 0$.

(iii) Given the results in Lemma 3(ii), $\hat{\sigma}$ reaches its minimum value when both α_1 and α_2 approach the limit of 1. Substituting these values into $\hat{\sigma}$, the minimum is $\frac{\sqrt{5}-1}{2}$.

A.5 Proof of Proposition 4

Consider the following pricing strategies for the two firms. Firm 1 randomizes its price on $\left[\frac{(1+\theta)\sigma\alpha}{1-(1-\sigma)\alpha}, 1+\theta\right]$ and firm 2 on $\left[\frac{\sigma\alpha-(1-\alpha)\theta}{1-(1-\sigma)\alpha}, 1\right]$ according to the following respective cumulative distribution functions:

$$F_1(p) = 1 + \frac{(1-\sigma)\alpha}{1-\alpha} - \frac{[\sigma\alpha-(1-\alpha)\theta](1-\sigma\alpha)}{[1-(1-\sigma)\alpha](1-\alpha)(p-\theta)}$$
$$F_2(p) = 1 - \frac{\sigma\alpha(1-p)}{(1-\alpha)(p+\theta)}.$$

In this unique mixed-strategy equilibrium, firm 1's price c.d.f. is continuous on $\left[\frac{(1+\theta)\sigma\alpha}{1-(1-\sigma)\alpha}, 1+\theta\right)$ but has a mass point at the upper bound, while firm 2's c.d.f. is continuous on $\left[\frac{\sigma\alpha-(1-\alpha)\theta}{1-(1-\sigma)\alpha}, 1\right]$. Under the assumption that $\theta < \frac{\alpha(2\sigma-1)}{1-\sigma\alpha}$, one can verify that these c.d.f.s constitute a mixed-strategy Nash equilibrium of the pricing stage with an α share of confused consumers.[15] The firms' respective expected profits can then be confirmed to match those presented in Proposition 4.

A.6 Proof of Lemma 4

The following steps and the observation that $\alpha \in (0,1)$ establish that $\frac{\partial\hat{\sigma}}{\partial\theta} > 0$.

$$\frac{\partial\hat{\sigma}}{\partial\theta} = -\frac{1}{2} + \frac{4 - [\alpha_1+\alpha_2-(1+\theta)\alpha_1\alpha_2]}{2\sqrt{[\alpha_1+\alpha_2-(1+\theta)\alpha_1\alpha_2]^2 + 4(1+2\theta)\alpha_1\alpha_2}} > 0$$
$$\iff 4 - [\alpha_1+\alpha_2-(1+\theta)\alpha_1\alpha_2] > \sqrt{[\alpha_1+\alpha_2-(1+\theta)\alpha_1\alpha_2]^2 + 4(1+2\theta)\alpha_1\alpha_2}$$
$$\iff 4[\alpha_1\alpha_2(4\theta+3) + 2(1-\alpha_1) + 2(1-\alpha_2)] > 0$$

[15] This assumption on θ can be derived either by combining the equilibrium conditions of this mixed-strategy profile or by following the general procedure outlined in Online Appendix C1 of Shelegia and Wilson (2021).

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