02/23

ARBEIDSNOTAT
WORKING PAPER

Multidimensional information and firm strategies

Malin Arve
Heiko Karle
Markus Reisinger

SNF

Samfunns- og næringslivsforskning AS
Centre for Applied Research at NHH

SNF
SAMFUNNS- OG NÆRINGSLIVSFORSKNING AS

- er et selskap i NHH-miljøet med oppgave å initiere, organisere og utføre ekstern-finansiert forskning. Norges Handelshøyskole og Stiftelsen SNF er aksjonærer. Virksomheten drives med basis i egen stab og fagmiljøene ved NHH.

SNF er ett av Norges ledende forskningsmiljø innen anvendt økonomisk-administrativ forskning, og har gode samarbeidsrelasjoner til andre forskningsmiljøer i Norge og utlandet. SNF utfører forskning og forskningsbaserte utredninger for sentrale beslutningstakere i privat og offentlig sektor. Forskningen organiseres i program-mer og prosjekter av langsiktig og mer kortsiktig karakter. Alle publikasjoner er offentlig tilgjengelig.

SNF
CENTRE FOR APPLIED RESEARCH AT NHH

- is a company within the NHH group. Its objective is to initiate, organize and conduct externally financed research. The company shareholders are the Norwegian School of Economics (NHH) and the SNF Foundation. Research is carried out by SNF's own staff as well as faculty members at NHH.

SNF is one of Norway's leading research environment within applied economic administrative research. It has excellent working relations with other research environments in Norway as well as abroad. SNF conducts research and prepares research-based reports for major decision-makers both in the private and the public sector. Research is organized in programmes and projects on a long-term as well as a short-term basis. All our publications are publicly available.

SNF Working Paper No. 02/23

Multidimensional information and firm strategies

Malin Arve
Heiko Karle
Markus Reisinger

SNF Project No. 10052:
Media competition and media policy

The project is financed by the Research Council of Norway

CENTRE FOR APPLIED RESEARCH AT NHH
BERGEN, JANUARY 2023
ISSN 2704-0380 (Online)

Multidimensional information and firm strategies

Malin Arve[*], Heiko Karle[†] and Markus Reisinger[‡]

Abstract

In this paper we study how firms consider the multi-dimensionality of information when choosing their communication strategy. We study firm strategies for reacting to consumer- and profit-relevant information in several dimensions. We show that there is a trade-off between adapting the firm strategy to the information that is likely to be the most profitable and differentiating to reduce competitive pressure. The interplay between these forces can lead to both firms advertising in the same dimension, if competition is not particularly fierce, or one firm choosing the dimension that is not the most profitable one, or sending a general message, to strategically escape competition. In the latter case – i.e., when firms only react partially to the received information – doubling of information is avoided, which implies that the consumer receives messages that are of interest to her with a higher probability. However, she does not benefit from competition in the market.

[*]NHH Norwegian School of Economics. Also affiliated with SNF and CESifo. E-mail: malin.arve@nhh.no.
Financial support from NFR/Kulmedia

[†]Frankfurt School of Finance and Management. Also affiliated with CEPR and CESifo. E-mail: h.karle@fs.de.

[‡]Frankfurt School of Finance and Management. Also affiliated with CEPR and CESifo. E-mail: m.reisinger@fs.de.

1 Introduction

In today's digital world, firms have access to an abundance of information about both the market and consumers. But a lot of information can also lead to information overload. In addition, different pieces of information may have different managerial or strategic implications for the firm. In this paper, we explore the implications of firms having access to what we term as multidimensional information, i.e., information that contains several independent sub-elements that could be more or less valuable for the firm. We study how firms' react to such information in equilibrium.

An example of such multidimensional information is when a consumer searches for a particular book in an online bookstore or platform. The search might be for a particular book by a particular author. Beyond showing its offer for this particular book, the consumer search gives the store or platform information about the tastes of that particular consumer. However, the information is multidimensional. From the search it is unclear whether the consumer is mainly interested in the particular author of the book she searched for, or whether she is interested in the (sub-)genre that this book belongs to. There is of course some overlap between these dimensions. However, the platform needs to make a choice regarding which other items it should advertise or highlight to the consumer. If the book happens to be about the history of football in Europe, it is even less clear whether the consumer is interested in football, sports more generally, or even the evolution of leisure activities, in Europe or more generally. By advertising the *right* alternatives, the firm can increase its sales, reputation and profitability. The *wrong* choice could have a negative effect on the firm's performance and reputation.

For online news-sites, this is also relevant. What part of an initial news article is the reader drawn to? Is it the topic (politics, sports) or type of article (short news update, opinion piece, or in-depth analysis)? Or the different pieces of information could simply relate to the readerships' general political preferences. In this setting, we study how firms should optimally react to such information and whether this could contribute to more media bias, polarization and diversity. An

aim in this setting is to understand whether this could help explain the common belief that there is a bias in news reporting (see e.g., Mullainathan and Shleifer, 2005, Baron, 2006, Gentzkow and Shapiro, 2006).

The novelty of this paper is to explicitly take into account the multi-dimensionality of information. Instead of assuming that firms receive signals about what is the (one-dimensional) relevant state of the world (Baron, 2006), we assume that the firms receive (certain) information about the true state of the world in each dimension, but there is uncertainty related to which dimension is most relevant. Furthermore, we also allow firms not to react to the information and keep the status quo/neutrality.

For this purpose, we consider a simple model with two firms that can send advertising messages to potential consumers. Before doing so, the firms receive information about the consumer's interests. However, this information is two-dimensional, whereby a consumer's true interest lies only in one of the two dimensions, and firms do not know with certainty which dimension that is. The firms must then choose whether to react to this information or not, and if yes, how. In particular, a firm can send an advertising message to the consumer in the dimension that is more likely to be of interest to the consumer, the other dimension, which is the less likely one, or just send a general message. If both firms send messages to the consumer in the same dimension, they are in competition to each other, which lowers their payoffs. Instead, if firms send messages in different dimensions, the firm who's message has caught the consumer's interest, receives the monopoly profit.

The main trade-off a firm experiences is as follows: When sending a message in the dimension that is more likely to be the one that interests the consumer, it obtains a positive payoff with greater probability. However, if the other firm also chooses this dimension, competition gets fiercer, which dampens the firm's payoff. The interplay between these two effects can therefore lead to both firms advertising in the same dimension, if competition is not particularly fierce, or one firm choosing the less likely dimension, or sending a general message, to

strategically escape competition. In the latter case—i.e., when firms only react partially to the received information—doubling of information is avoided, which implies that the consumer receives messages that are of interest to her with a higher probability. However, she does not benefit from competition in the market.

We provide a characterization of the different equilibrium regions. Interestingly, we show that the range in which one firm reacts to information and sends a message in the dimension that it most likely of interest to the consumer, whereas the other firm only sends a general message, arises even if competition between firms is only weak. The reason is that the profit from a general message can be relatively high, which implies that a firm may choose this way to strategically differentiate from the rival.

The rest of the paper is organized as follows: Section 2 relates our paper to existing literature. Section 3 sets out the model, and Section 4 presents the analysis and results. Finally, Section 5 gives a short discussion and concludes.

2 Literature review

Our paper is related to several strands of literature. The first one is the literature on how firms decide which consumers to target. This literature has found that targeting certain consumer groups is beneficial to firms for several reasons. Concentrating advertising effort on consumers that are most receptive to it increases the probability that the ad is successful and may also reduce a firm's total advertising expenditure (see e.g., Roy, 2000; Esteban, Gil and Hernandez, 2001; Iyer, Soberman and Villas-Boas, 2005; Gal-Or et al., 2006; Galeotti and Moraga-Gonzalez, 2008; Chandra, 2009). However, targeted advertising can also lead to more fierce price competition on online portals or price search engines when consumers search more intensively after receiving more precise ads, see de Cornière (2016). Search engines may then have incentives to provide a suboptimal quality of sponsored links, i.e. reduce the degree of targeting. Karle

and Reisinger (2019) consider competition between advertising firms when the success probability of reaching a consumer of the targeted consumer group is lower than one. They show that depending on whether the success probability is high or low, the possibility to use targeted ads reduces or intensives competition. The reason is that firms either target different consumers groups when targeting is likely to be successful or compete for the same consumer group when targeting is sufficiently imprecise. This mechanism is similar to the one in this paper but builds on firms' choice of a targeted consumer group rather than that of a dimension how to advertise to a consumer.

The second one is strategic differentiation between firms. There are several papers, particularly in the platform literature, showing that firms follow heterogeneous selling strategies to reduce competition. For example, Gehrig (1998); Dudey (1990); Ellison and Fudenberg (2003) consider firms' choices on which platform or market place to become active. If firms choose the same platform, they attract more buyers which increases their demand, but at the same time such behavior spurs competition between them, which lowers their profits. Karle, Peitz and Reisinger (2020) show how these strategic incentives affect fee setting of platforms and the market structure in platform markets. We add to this literature by considering heterogeneous advertising strategies that depend on multi-dimensional information received by firms, which leads to new aspects compared to firms' decisions where to sell their products.

3 The model

There are two firms (or platforms), $i = 1, 2$ that receive payoff relevant information about their consumers. The information they receive is two-dimensional. However, a firm can only react to (maximum) one dimension. We denote the dimensions by $\omega = a, b$. In terms of payoff, one dimension yields a higher payoff than the other, but there is uncertainty related to which of the

two dimensions that is. We assume that $\alpha = \text{Proba}(\omega = a) > \frac{1}{2}$.[1]

If a firm reacts to the most valuable dimension, it obtains a payoff of $\bar{\pi} + \Delta$ if it is the only firm to react in this dimension and $\bar{\pi}$ if both firms react in this dimension. Similarity if a firm reacts in the less valuable dimension, it obtains a payoff of $\underline{\pi} + \Delta$ if it is the only firm to react in this dimension and $\underline{\pi}$ if both firms react in this dimension. The parameter $\Delta \geq 0$ can be interpreted as capturing the competitiveness of the market and the value of differentiation.

This information and payoff structure represents in a simple way that firms are uncertain of which dimension is the more important one for a consumer. If the firm sends a message to the consumers in her preferred dimension (i.e., reacts to the dimension the consumer is interested in), the consumers is willing to pay a higher price for the firm's offer, which leads to a higher payoff for firms.

The firm can also not to react to any information, in which case it obtains the payoff $\pi^0 < \bar{\pi}$. We also impose that in the best scenario (when only one firm reacts in the most valuable dimension), it is indeed profitable to do so, i.e.,

$$\alpha(\bar{\pi} + \Delta) + (1 - \alpha)(\underline{\pi} + \Delta) > \pi^0. \tag{1}$$

The possible actions of each firm (a, b or no reaction, which we denote by 0) and the associated payoffs of the two firms are summarized in the following table:

		Firm 2		
		a	b	0
Firm 1	a	$\alpha\bar{\pi} + (1-\alpha)\underline{\pi}$; $\alpha\bar{\pi} + (1-\alpha)\underline{\pi}$	$\alpha(\bar{\pi} + \Delta) + (1-\alpha)(\underline{\pi} + \Delta)$; $\alpha(\underline{\pi} + \Delta) + (1-\alpha)(\bar{\pi} + \Delta)$	$\alpha(\bar{\pi} + \Delta) + (1-\alpha)(\underline{\pi} + \Delta)$; π^0
	b	$\alpha(\underline{\pi} + \Delta) + (1-\alpha)(\bar{\pi} + \Delta)$; $\alpha(\bar{\pi} + \Delta) + (1-\alpha)(\underline{\pi} + \Delta)$	$\alpha\underline{\pi} + (1-\alpha)\bar{\pi}$; $\alpha\underline{\pi} + (1-\alpha)\bar{\pi}$	$\alpha(\underline{\pi} + \Delta) + (1-\alpha)(\bar{\pi} + \Delta)$; π^0
	0	π^0; $\alpha(\bar{\pi} + \Delta) + (1-\alpha)(\underline{\pi} + \Delta)$	π^0; $\alpha(\underline{\pi} + \Delta) + (1-\alpha)(\bar{\pi} + \Delta)$	π^0; π^0

[1] If $\alpha = \frac{1}{2}$, none of the two dimensions yields a higher payoff in expectations. As we will show below, firms will then always choose to react to different dimensions.

We focus the analysis on pure strategy Nash equilibria.

4 Results

4.1 Preliminary observations

Before studying which strategies are equilibrium strategies and under what conditions, we start by excluding some strategies.

First, it is straightforward to show that both firms playing b can never be an equilibrium. In fact, if firm j plays b, then firm i prefers a to b:

$$\alpha\underline{\pi} + (1-\alpha)\bar{\pi} < \alpha(\bar{\pi}+\Delta) + (1-\alpha)(\underline{\pi}+\Delta) \tag{2}$$

$$\Leftrightarrow (2\alpha - 1)(\bar{\pi} - \underline{\pi}) > 0. \tag{3}$$

The latter is always true. Intuitively, if faced with a firm playing b, it makes sense to differentiate and play the more valuable option a.

Second and for similar reasons as for (b, b), (b, x) is never an equilibrium. If firm j plays x, then firm i prefers a to b:

$$\alpha(\underline{\pi}+\Delta) + (1-\alpha)(\bar{\pi}+\Delta) < \alpha(\bar{\pi}+\Delta) + (1-\alpha)(\underline{\pi}+\Delta) \tag{4}$$

$$\Leftrightarrow (2\alpha - 1)(\bar{\pi} - \underline{\pi}) > 0. \tag{5}$$

The latter is always true. Thus, for the same reasons as for (b, b), (x, b) cannot be an equilibrium either.

Finally, under the assumption in equation (1), (x, x) cannot be an equilibrium either. It is then more profitable for one of the firms to choose a, as this gives a strictly higher payoff in expectations.

4.2 Main results

Our preliminary observations, allow us to reduce the number of types of equilibrium candidates to three:

1. Information reaction and conformity: (a, a)
2. Information reaction and differentiation: (a, b) and (b, a)
3. Partial information reaction and differentiation: (a, x) and (x, a)

Conditions for (a, a) to be an equilibrium: For (a, a) to constitute an equilibrium, both players need to prefer strategy a to both b and x, given that the other firms plays a. This implies the two following conditions on model parameters:

$$\alpha\bar{\pi} + (1-\alpha)\underline{\pi} \geq \alpha(\underline{\pi} + \Delta) + (1-\alpha)(\bar{\pi} + \Delta), \text{ and} \tag{6}$$

$$\alpha\bar{\pi} + (1-\alpha)\underline{\pi} \geq \pi^0. \tag{7}$$

Notice that the latter is always true if $\underline{\pi} \geq \pi^0$. Regardless, the two inequalities can be rewritten as

$$(2\alpha - 1)(\bar{\pi} - \underline{\pi}) \geq \Delta, \text{ and} \tag{8}$$

$$\pi^0 - \underline{\pi} - \alpha(\bar{\pi} - \underline{\pi}) \leq 0. \tag{9}$$

Intuitively, an equilibrium with conformity, that is, both firms react in the same dimension can only occur if competition is not too intense. This implies that Δ needs to be sufficiently small, which is represented by (8). Firms can only enjoy the additional benefit from avoiding competition by reacting in different dimensions, which does not occur in an equilibrium with (a, a). In addition, if firms are certain enough about the consumer's preferred dimension, that is,

if α is large, the (a, a) equilibrium becomes more likely. Although it leads to competition, deviating from choosing a reduces a firm's profit considerably, which implies that such a deviation is not profitable. This second effect is amplified if $\bar{\pi}$ is large, is choosing the right dimension is then more valuable, which makes the choice of a more attractive, given that α is already large.

We next turn to potential equilibria in which firms choose differentiation.

Conditions for (a, b) to be an equilibrium: For (a, b) to constitute an equilibrium, first, a player facing a competitor playing b needs to prefer a to both b and x. From our preliminary observations, we can conclude that this is always true. Furthermore, a player facing a competitor playing a needs to prefer b to both a and x. This can be translated into the following two conditions:

$$\alpha(\underline{\pi} + \Delta) + (1 - \alpha)(\bar{\pi} + \Delta) \geq \alpha\bar{\pi} + (1 - \alpha)\underline{\pi}, \text{ and} \tag{10}$$

$$\alpha(\underline{\pi} + \Delta) + (1 - \alpha)(\bar{\pi} + \Delta) \geq \pi^0. \tag{11}$$

Notice that the latter is always true if $\underline{\pi} \geq \pi^0$. Regardless, the two inequalities can be rewritten as

$$(2\alpha - 1)(\bar{\pi} - \underline{\pi}) \leq \Delta, \text{ and} \tag{12}$$

$$\pi^0 - \underline{\pi} - (1 - \alpha)(\bar{\pi} - \underline{\pi}) \leq \Delta. \tag{13}$$

It is easy to see that (12) is the reverse inequality to (8). In particular, choosing nonconformity to the other firm's strategy is only profitable if the value of differentiation—i.e., Δ—is large enough. This effect is also underlying (13). Given that the other firm chooses a, a firm has two ways to induce differentiation. One is to choose b and the other one is to choose a general message. The general message leads to a payoff that is independent of the value of differentiation. It is therefore not affected by competition, as the payoff is always π^0. As a

consequence, Δ must also be large relative to π^0 for an equilibrium with (a, b) to be sustainable.

Conditions for (a, x) **to be an equilibrium:** Finally, for (a, x) to constitute an equilibrium, first, a player facing a competitor playing x needs to prefer a to both b and x. From our preliminary observations, we can conclude that this is always true. Furthermore, a player facing a competitor playing a needs to prefer x to both a and b. This can be translated into the following two conditions:

$$\pi^0 \geq \alpha\bar{\pi} + (1-\alpha)\underline{\pi}, \text{ and} \tag{14}$$

$$\pi^0 \geq \alpha(\underline{\pi} + \Delta) + (1-\alpha)(\bar{\pi} + \Delta). \tag{15}$$

Notice that these inequalities never hold if $\underline{\pi} \geq \pi^0$.Thus, this cannot constitute an equilibrium if $\underline{\pi} \geq \pi^0$. For the opposite case, the two inequalities remain relevant and can be rewritten as

$$\pi^0 - \underline{\pi} - \alpha(\bar{\pi} - \underline{\pi}) \geq 0, \text{ and} \tag{16}$$

$$\pi^0 - \underline{\pi} - (1-\alpha)(\bar{\pi} - \underline{\pi}) \geq \Delta. \tag{17}$$

As explained above, an equilibrium in which one firm chooses a general message can only occur if the general message is sufficiently valuable relative to, first, the high payoff obtained when choosing the consumer's preferred dimension, and, second, the value of differentiation. (16) and (17) represent these two conditions: (16) implies that uncertainty must be sufficiently large (i.e., α sufficiently close to 1/2) to ensure that the general message is preferred to conformity. (17) implies that the value of avoiding competition (i.e., Δ) is sufficiently small, as only then the general message is preferred over differentiation.

For the illustration of the equilibrium for any set of (relevant) parameters, it is useful to

define the following three functions:

$$\Delta^1 = (2\alpha - 1)(\bar{\pi} - \underline{\pi}), \tag{18}$$

$$\Delta^2 = \pi^0 - \underline{\pi} - (1 - \alpha)(\bar{\pi} - \underline{\pi}) \text{ and} \tag{19}$$

$$\Delta^3 = \pi^0 - \underline{\pi} - (1 - \alpha)(\bar{\pi} - \underline{\pi}). \tag{20}$$

Notice that since $\alpha > \frac{1}{2}$, $\Delta^3 < \Delta^2$ for all possible parameter values. For the illustration of the equilbrium outcome, we will present the analyses for $\pi^0 \leq \underline{\pi}$ and $\pi^0 > \underline{\pi}$ separately.

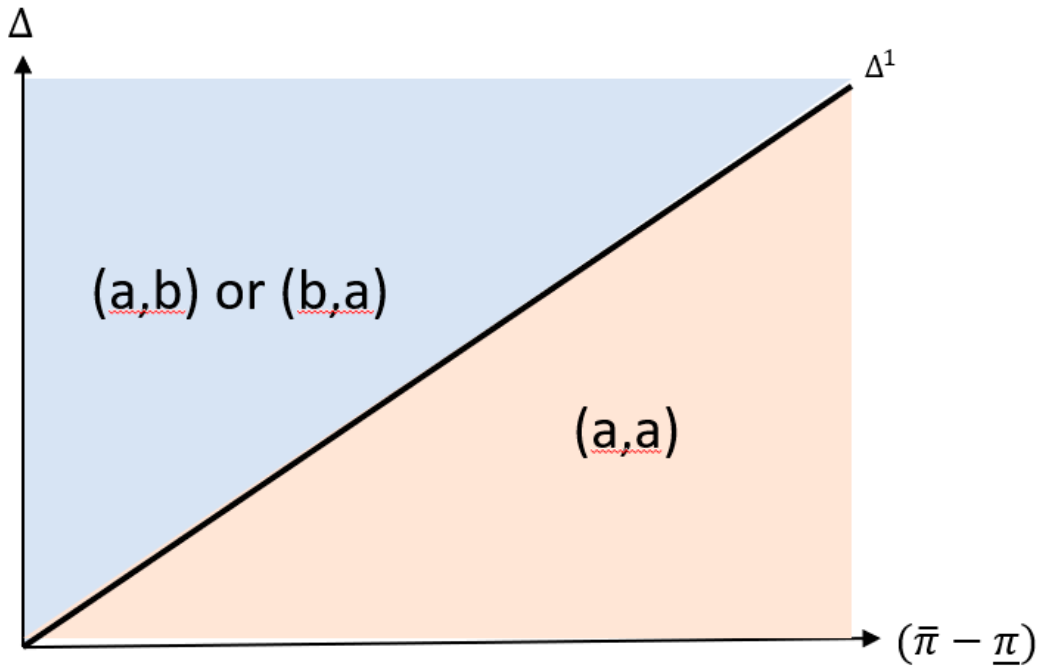

Figure 1: Equilibria for $\pi^0 \leq \underline{\pi}$

Equilibrium analysis for $\pi^0 \leq \underline{\pi}$: In this case (as noted when presenting the conditions for the various equilibrium candidates), only Δ^1 is relevant. In particular, for $\pi^0 \leq \underline{\pi}$, the general message leads to payoff that is low enough so that it it strictly dominated by either choosing *a* or *b*. Therefore, π^0 does not play a role. As shown in Figure 1, information reaction and

differentiation is the unique equilibrium if Δ is high enough relative to $\bar{\pi} - \underline{\pi}$ (the difference between reacting to the "right" and "wrong" information dimension). Instead, information reaction and conformity is the unique equilibrium if the reverse holds true. Due to the linearity of profits in these variables, the dividing line is a straight line.

Equilibrium analysis for $\pi^0 > \underline{\pi}$: In this case, all Δ^i, $i = 1, 2, 3$ are relevant. Notice that if the parameters are such that $\Delta \leq \Delta^3$, then we are outside the parameters of the model (the assumption in (1) is violated).

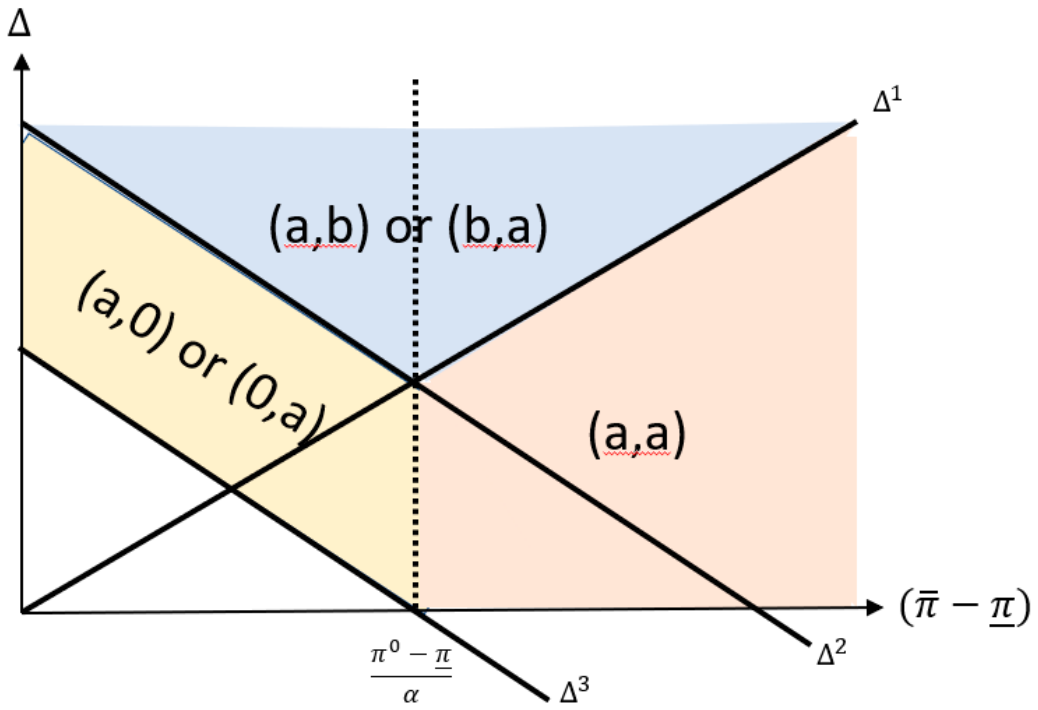

Figure 2: Equilibria for $\pi^0 > \underline{\pi}$

One way of comparing the figures, is to notice that Figure 1 is the upper right corner of Figure 2. Figure 2 shows that for $\pi^0 > \underline{\pi}$, partial information reaction can also be an equilibrium. The firms then prefer to strategically differentiate via one firm choosing a general message and the other the a message that is in the dimension that is most likely of interest to the consumer.

This occurs although the value of differentiation (i.e., Δ) is relatively large. The reason is that the value of having a match to the consumer's preference can be rather low (i.e., the difference between $\bar{\pi}$ and $\underline{\pi}$ is small), which implies that it is optimal to react only partially to information instead of choosing message *a* or *b*.

5 Discussion and conclusion

In this paper, we have presented a simple two-firm model where firms can send advertising messages to potential consumers. Before doing so, the firms receive information about the consumers' interests. The originality of the paper lies in considering that this information is two-dimensional. The firms must then choose whether to react to this information or not, and if yes, how. The main trade-off a firm experiences is as follows: When sending a message in the dimension that is more likely to be the one that interests the consumer, it obtains a positive payoff with greater probability. However, if the other firm also chooses this dimension, competition gets fiercer, which dampens the firm's payoff. The interplay between these two effects can therefore lead to both firms advertising in the same dimension, if competition is not particularly fierce, or one firm choosing the less likely dimension, or sending a general message, to strategically escape competition. In the latter case—i.e., when firms only react partially to the received information—doubling of information is avoided, which implies that the consumer receives messages that are of interest to her with a higher probability.

These results have implications for variety and diversity of media firms and platforms. Even if different firms have access to the same information about consumers (users or viewers), they will choose to differentiate, thus offering different values or experiences to consumers. This occurs foremost if uniqueness of positions is important, which can be due, for instance, the competitiveness of the environment. Consumer then obtain diverse views, which is valuable, but do not benefit from competition between firms. However, if uniqueness of positioning or

competition is not so important, then the equilibrium outcome leads to less media diversity.

The results in this paper open up for several interesting future avenues of research. One is related to information acquisition. In the current model, firms passively receive information about the consumer's interest. However, a media firm has a constant information flow to updated its beliefs about consumers' preferences. In a more sophisticated environment, it would be interesting to explore incentives to acquire information, keeping in mind the originality of the current research, i.e., that there are different dimensions in which a firm could choose to invest in information acquisition. How much new information would different media platforms choose to acquire? And, perhaps more importantly, how will they choose to acquire information? Does the trade-off between differentiation and value to consumers in terms of firm strategy identified in this paper also influence the choice of information acquisition?

Another question future research may address is the role of online intermediaries in providing information to firms about a consumer's preferred dimension. This is highly relevant for media economics. In which platform business model is it beneficial for intermediaries to acquire more precise consumer information and pass it on to firms active on the portal? What are the implications for consumer surplus and overall welfare?

A relevant consequence of media firms' choice between conformity and differentiation is how the efficiency of the voting decision is affected through it in an electoral campaign. Such a study would bridge a gap between media economics and political economics that has become more important in a digital world.

References

Baron, D.P. 2006. "Persistent Media Bias." *Journal of Public Economics*, 90(1-2): 1–36.

Chandra, Ambarish. 2009. "Targeted Advertising: The Role of Subscriber Characteristics in Media Markets." *Journal of Industrial Economics*, 57(1): 58–84.

de Cornière, Alexandre. 2016. "Search Advertising." *American Economic Journal: Microeconomics*, 8(3): 156–88.

Dudey, Marc. 1990. "Competition by Choice: The Effect of Consumer Search on Firm Location Decisions." *American Economic Review*, 80(5): 1092–1104.

Ellison, Glenn, and Drew Fudenberg. 2003. "Knife-Edge or Plateau: When Do Market Models Tip?" *The Quarterly Journal of Economics*, 118(4): 1249–1278.

Esteban, L., A. Gil, and J. M. Hernandez. 2001. "Informative Advertising and Optimal Targeting in Monopoly." *Journal of Industrial Economics*, 49: 161–180.

Galeotti, Andrea, and José Luis Moraga-Gonzalez. 2008. "Segmentation, Advertising and Prices." *International Journal of Industrial Organization*, 26: 353–372.

Gal-Or, Esther, Mordechai Gal-Or, Jerrold H. May, and William E. Spangler. 2006. "Targeted Advertising Strategies on Television." *Management Science*, 52(5): 713–725.

Gehrig, Thomas. 1998. "Competing markets." *European Economic Review*, 42(2): 277–310.

Gentzkow, Matthew, and Jesse M. Shapiro. 2006. "Media Bias and Reputation." *Journal of Political Economy*, 114(2): 280–316.

Iyer, Ganesh, David Soberman, and J. Miguel Villas-Boas. 2005. "The Targeting of Advertising." *Marketing Science*, 24(3): 461–476.

Karle, Heiko, and Markus Reisinger. 2019. "Excessive Targeting." *Working Paper*.

Karle, Heiko, Martin Peitz, and Markus Reisinger. 2020. "Segmentation versus agglomeration: Competition between platforms with competitive sellers." *Journal of Political Economy*, 128(6): 2329–2374.

Mullainathan, Sendhil, and Andrei Shleifer. 2005. "The Market for News." *The American*

Economic Review, 95(4): 1031–1053.

Roy, Santanu. 2000. "Strategic Segmentation of a Market." *International Journal of Industrial Organization*, 18(8): 1279 – 1290.

In this paper we study how firms consider the multi-dimensionality of information when choosing their communication strategy. We study firm strategies for reacting to consumer- and profit-relevant information in several dimensions. We show that there is a trade-off between adapting the firm strategy to the information that is likely to be the most profitable and differentiating to reduce competitive pressure. The interplay between these forces can lead to both firms advertising in the same dimension, if competition is not particularly fierce, or one firm choosing the dimension that is not the most profitable one, or sending a general message, to strategically escape competition. In the latter case – i.e., when firms only react partially to the received information – doubling of information is avoided, which implies that the consumer receives messages that are of interest to her with a higher probability. However, she does not benefit from competition in the market.

SNF

Samfunns- og næringslivsforskning AS
Centre for Applied Research at NHH

Helleveien 30
NO-5045 Bergen
Norway

P +47 55 95 95 00
E snf@snf.no
W snf.no

Trykk: Allkopi Bergen