Attention costs, economies of scale and markets for information

Tommaso Denti Kristoffer Nimark

Cornell University

Motivation

From events to decisions with information intermediation by news media

Firms ("newspapers")

1. Gather information about state of the world
2. Decide what to report
3. Disseminate message

Agents ("readers")

4. Choose which newspaper to read
5. Receive message
6. Take action

How do economies of scale, preference heterogeneity, and attention costs interact to determine market structure and information provision?

Contribution

Study structure of information markets with attention costs

- Contestable equilibrium
- Decouple attention costs from informativeness of message

In this talk: General set up + simple examples

Related literature

Rational inattention

- Studies vertically integrated informational Yeoman farmers
- Sims 03, Matejka and McKay 15, Caplin, Dean, and Leahy 21, ...

Markets for (consumer) information

- Studies information intermediaries in market for consumer characteristics data
- Bergemann and Bonatti 19, Galperti, Levkun, and Perego 21, ...

Economics of news media

- Market structure with preference externalities—media is a direct consumption good, e.g. music
- Political media slant – voting behavior
- Gentzkow and Shapiro 06, Anderson, Stromberg, and Waldfogel 15, ...

Model

Set up

States

- Nature draws state vector $\theta \in \Theta$ according to $\pi \in \Delta(\Theta)$

Firms

- Firms indexed by $j \in J$ produce information $P_j : \Theta \to \Delta(X_j)$
- Information structure P_j generates message x_j

Agents

- Agents indexed by $i \in I$ choose (ex ante) which firm j to get information from
- Agent i takes (ex post) action $a_i \in A_i$ to maximize $E[u_i(a_i, \theta) \mid x_j]$

Firms cost and revenue

Cost of information gathering

Firm j incurs a cost $K(P_j) \in [0, \infty]$ to gather information that makes P_j feasible

Assumption

If P_j is informative, then $K(P_j) \geq k > 0$

Revenue

Firm revenue $R(S_j) \in [0, \infty)$ depends on readership S_j

- $S_j \subseteq I$: set of agents i who gets information from j

Attention costs

Cost of attention Agent i incurs attention cost $C_i(P, x) \in [0, \infty]$ which depends on the information structure P and the realized message x

Example 1

- $C_i(P, x) = C_i(P)$ depends on the informativeness of P only

Example 2

- x is a vector of real numbers
- $C_i(P, x) = C_i(x)$ is the dimension of x

Value of information The (ex ante) value of information P for agent i is

$$V_i(P) = E\left[\max_{a_i} E[u_i(a_i, \theta)|x]\right] - E[C_i(P, x)]$$

Equilibrium in market for information provision

Contestable market equilibrium (Baumol, Bailey and Willig 1977)

- A firm will enter if it can attract a readership that is large enough to cover its cost
- New entrants replace incumbent firms if it is profitable to do so

Natural competitive benchmark for markets with fixed costs and free entry (e.g., Acemoglu and Azar 20)

Contestable equilibrium

Industry configuration An industry configuration $(P_j, S_j)_{j \in J^a}$ describes a set $J^a \subseteq J$ of active firms and, for every $j \in J^a$, an information structure P_j and a readership $S_j \subseteq I$.

Feasible configuration An industry configuration $(P_j, S_j)_{j \in J^a}$ is feasible if, for all $j \in J^a$, $R(S_j) \geq K(P_j)$.

Agent-optimal configuration An industry configuration $(P_j, S_j)_{j \in J^a}$ is agent-optimal if, for all $j, j' \in J^a$ and $i \in S_j$, $V_i(P_j) \geq V_i(P_{j'})$ and $V_i(P_j) \geq \max_{a_i} E[u_i(a_i, \theta)]$.

Sustainable configuration An industry configuration $(P_j, S_j)_{j \in J^a}$ is sustainable if there is no information structure $P_{j'}$, with $j' \notin J^a$, and associated readership $S_{j'}$ such that (i) $V_i(P_{j'}) > V_i(P_j)$ for all $i \in S_{j'}$ and all $j \in J^a$, and (ii) $R(S_{j'}) > K(P_{j'})$.

Equilibrium configuration An industry configuration is an equilibrium if it is feasible, agent-optimal, and sustainable.

Examples

Common structure in examples

Agents, actions, and states

$$I = \{1, 2, 3\} \text{ and } a_i, \theta \in \mathbb{R}^3, \qquad \text{with } \theta \sim N(0, I)$$

Utility

$$u_i(a_i, \theta) = -\sum_{d=1}^{3} \lambda_{id} \left(a_{id} - \theta_d\right)^2, \qquad \text{with } \sum_{d=1}^{3} \lambda_{id} = 1$$

Attention costs

$$C_i(P, x) = c \dim(x), \qquad \text{with } c > 0$$

Cost of information gathering

$$K(P) = \begin{cases} k & \text{if } P \text{ is informative} \\ 0 & \text{otherwise,} \end{cases} \qquad \text{with } k > 0$$

Economies of scale with homogeneous preferences

All agents care only about θ_1:

$$\lambda_1 = (1, 0, 0), \lambda_2 = (1, 0, 0), \lambda_3 = (1, 0, 0)$$

$\Rightarrow$ **All agents want the same information**

Feasible and agent-optimal for a single firm to report $x = \theta_1$ if

- $k \leq R(\{1, 2, 3\})$ (profits are positive)
- $c \leq 1$ (attention cost smaller than benefit)

There is scope for economies of scale.

Economies of scale and preference heterogeneity

Agent i cares only about θ_i:

$$\lambda_1 = (1, 0, 0), \lambda_2 = (0, 1, 0), \lambda_3 = (0, 0, 1)$$

Can economies of scale still be exploited?

- **Yes:** For $c \leq 1/3$ and $k \leq R(\{1, 2, 3\})$, it is feasible and agent-optimal for a single firm to report $x = (\theta_1, \theta_2, \theta_3)$
- **No:** For $c \geq 1$ and $k > R(\{i\})$, there is no feasible and agent-optimal configuration that produces information

Attention costs decrease the scope for economies of scale to be exploited.

Economies of scale and market provision of information

When a feasible and agent-optimal configuration that exploits economies of scale exists, will market outcomes always allow for it to be exploited?

Examples:

1. "Ring-preferences":

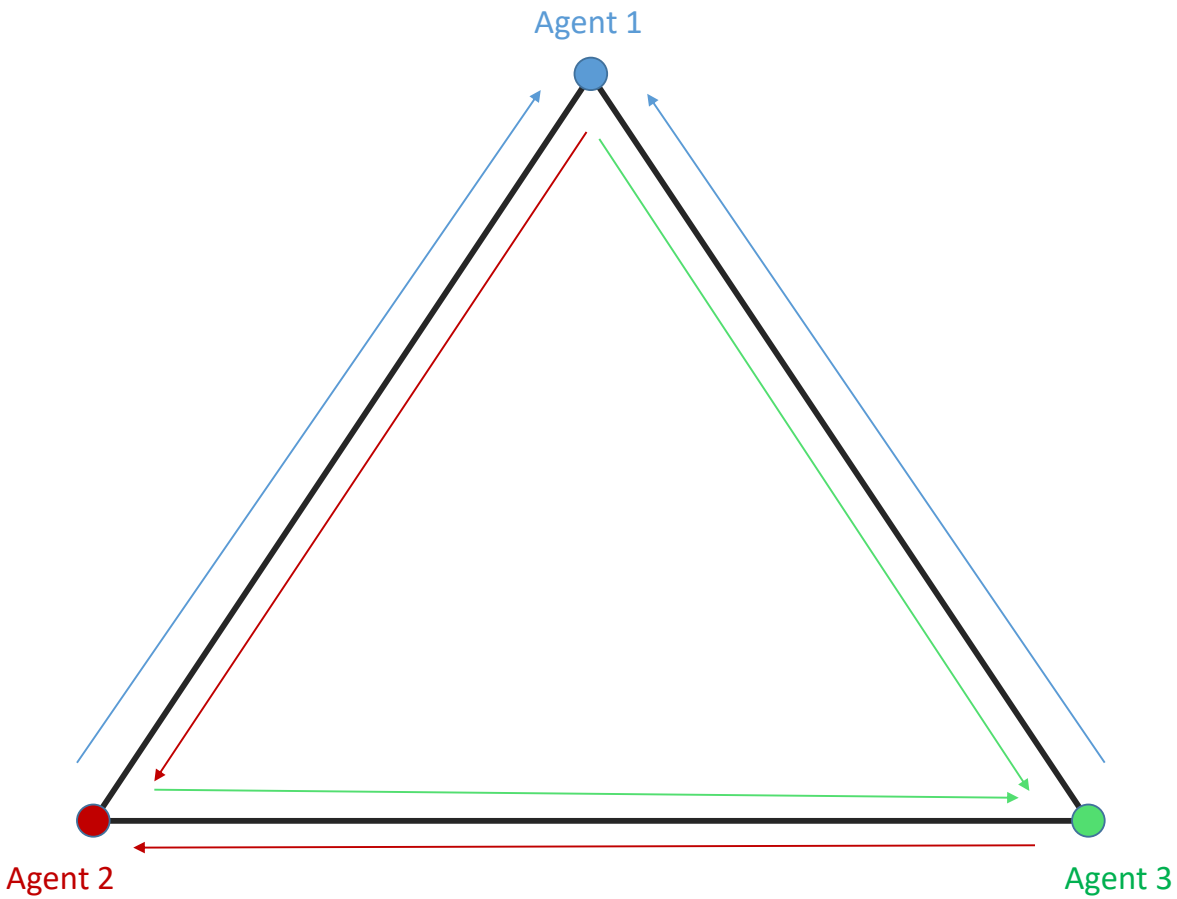
$$\lambda_1 = \left(\frac{3}{4}, \frac{1}{4}, 0\right), \lambda_2 = \left(0, \frac{3}{4}, \frac{1}{4}\right), \lambda_3 = \left(\frac{1}{4}, 0, \frac{3}{4}\right)$$

2. "Line-preferences":

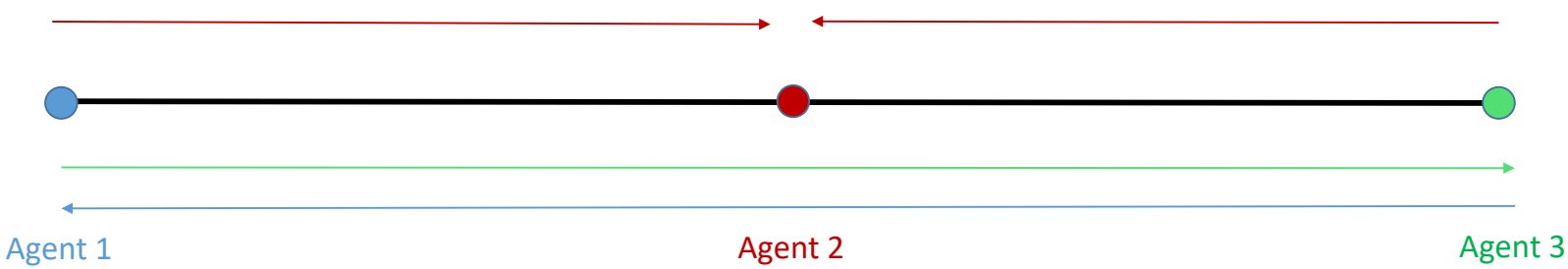
$$\lambda_1 = \left(\frac{3}{4}, \frac{1}{4}, 0\right), \lambda_2 = \left(\frac{1}{4}, \frac{1}{2}, \frac{1}{4}\right), \lambda_3 = \left(0, \frac{1}{4}, \frac{3}{4}\right)$$

$c > 1/2$ and $k > R(\{i\})$: there is no feasible and agent-optimal configuration where two agents are both at their bliss point.

Agents living on a ring $\Rightarrow$ No equilibrium provision



Agents living on a line $\Rightarrow$ Equilibrium provision



Four useful definitions

Better-than autarky set $\mathcal{B}_i$ is the set of all information structures P that make agent i better off than in autarky.

Feasible set $\mathcal{P}_S$ is the set of all information structures P such that $R(S) \geq K(P)$.

Pareto set $\mathcal{P}_S^*$ is the set of information structures $P \in P_S$ that are Pareto optimal with respect to S.

Central agent Agent i is central if, for any two $P, P' \in \mathcal{P}_I^*$ such that $V_i(P) > V_i(P')$, either $V_j(P) > V_j(P')$ or $V_k(P) > V_k(P')$

Sufficient conditions for sustainable economies of scale

Proposition

Economies of scale can be exploited in equilibrium if

(i) There exists a central agent (labeled i).

(ii) The set $\mathcal{B}_i$ is compact.

(iii) There exists a $P \in P^*_{\{i,j\}}$ that makes both agent i and j strictly better off than in autarky.

The proof uses that a monotone mapping on a compact set converges.

Advice vs information

Simple actions

An action is **simple** if it is of lower dimension than the states that enter utility function, i.e. if $\dim(a_i) < \sum_{d=1}^{3} \mathbb{I}(\lambda_{id} \neq 0)$

- With simple actions, attention cost of advice is lower than equally useful information about the state
- However, with heterogeneous readership, information may allow for exploiting economies of scale.

Example 1: New York Times endorsing a presidential candidate is equally useful for a liberal and conservative reader and is less costly than listing every quality of every candidate

Example 2: A newspaper covering both fixed income and stock markets attracts a larger readership than giving a single portfolio recommendation if population have different risk tolerances

Attention costs and equilibrium profits

An information structure P_j with readership S_j may be sustainable in equilibrium even if there exists a P' such that

1. $U_i(P') > U_i(P_j)$ for every $i \in S_j$
2. $K(P_j) < K(P') \leq R(S_j)$

since $U_i(P') > U_i(P_j)$ does not imply $V_i(P') > V_i(P_j)$

- Quality of information good inherently linked to its cost of consumption.
- Attention costs may prevent inactive firms from entering and providing a strictly more informative and feasible P'.
- In regular markets, firm can compete on price until profits are zero.

Summing up

- Attention cost reduces the scope for exploiting economies of scale in information markets if preferences are heterogenous
- Contestable markets do not guarantee that existing economies of scale will be exploited in equilibrium
- Attention costs of information imply that profits may exist in equilibrium in contestable markets with free entry