Privacy, Economics, and Regulation

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Privacy concerns do not have solid economic grounds

Free online services would not be possible without increasing collection of consumer data

Sharing personal data is an economic win-win

Loss of privacy is the price to pay for the benefits of big data

How much

To what degree should consumer privacy be protected?

How

And, how do we achieve that degree of protection?

How much

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And, how do we achieve that degree of protection?

Solitude

Seclusion

Anonymity

Right to be left alone

Control over information

Privacy

Obscurity

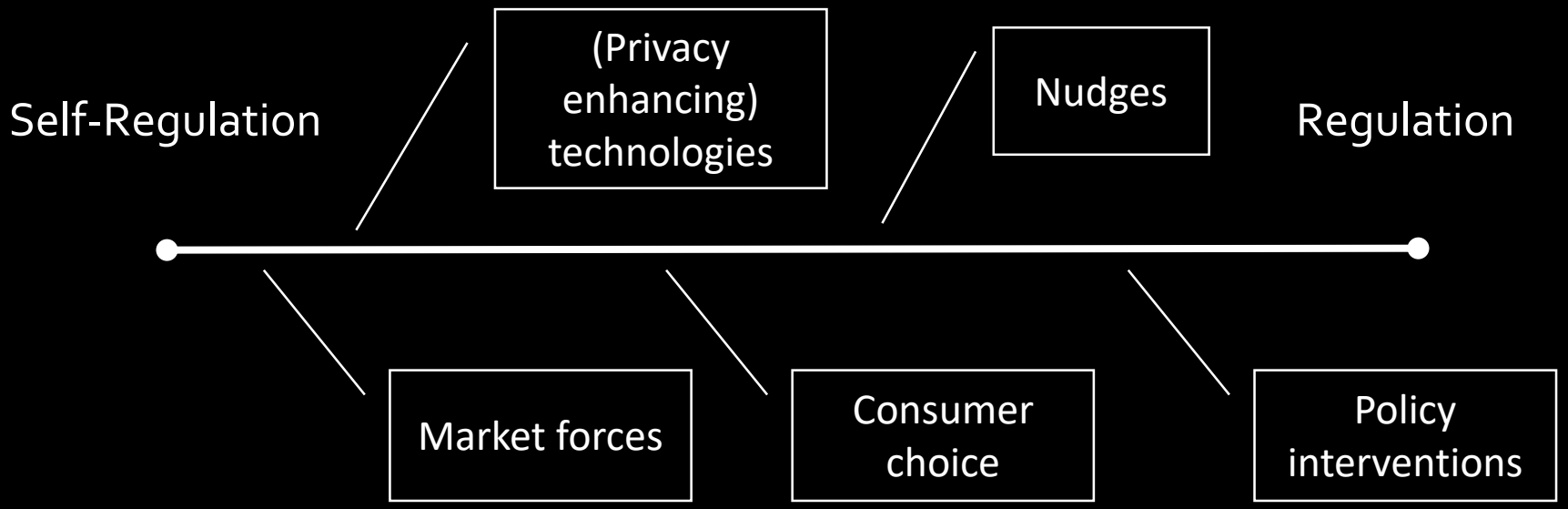
Disguise

Information security

Confidentiality

Autonomy

Secrecy


Self-Regulation
(Privacy enhancing) technologies
Nudges
Regulation
Market forces
Consumer choice
Policy interventions

The evolution of the economics of privacy

- Early 1980s
  - The Chicago School
- Mid 1990s
  - The IT revolution
- 2000s and onward
  - Expansion and fragmentation

The early days: Posner

- Privacy as concealment of information
  - Individuals with negative traits (e.g., low quality employees) have interest in hiding them
  - Individuals with positive traits have interest in showing them
  - Reducing information available to “buyers” in the market (e.g., employers) reduces efficiency
- Costs of concealment borne by others
  - E.g., when privacy of sex-offenders is protected
- Extends argument to non-market behavior
  - E.g., marriage

The early days: Stigler

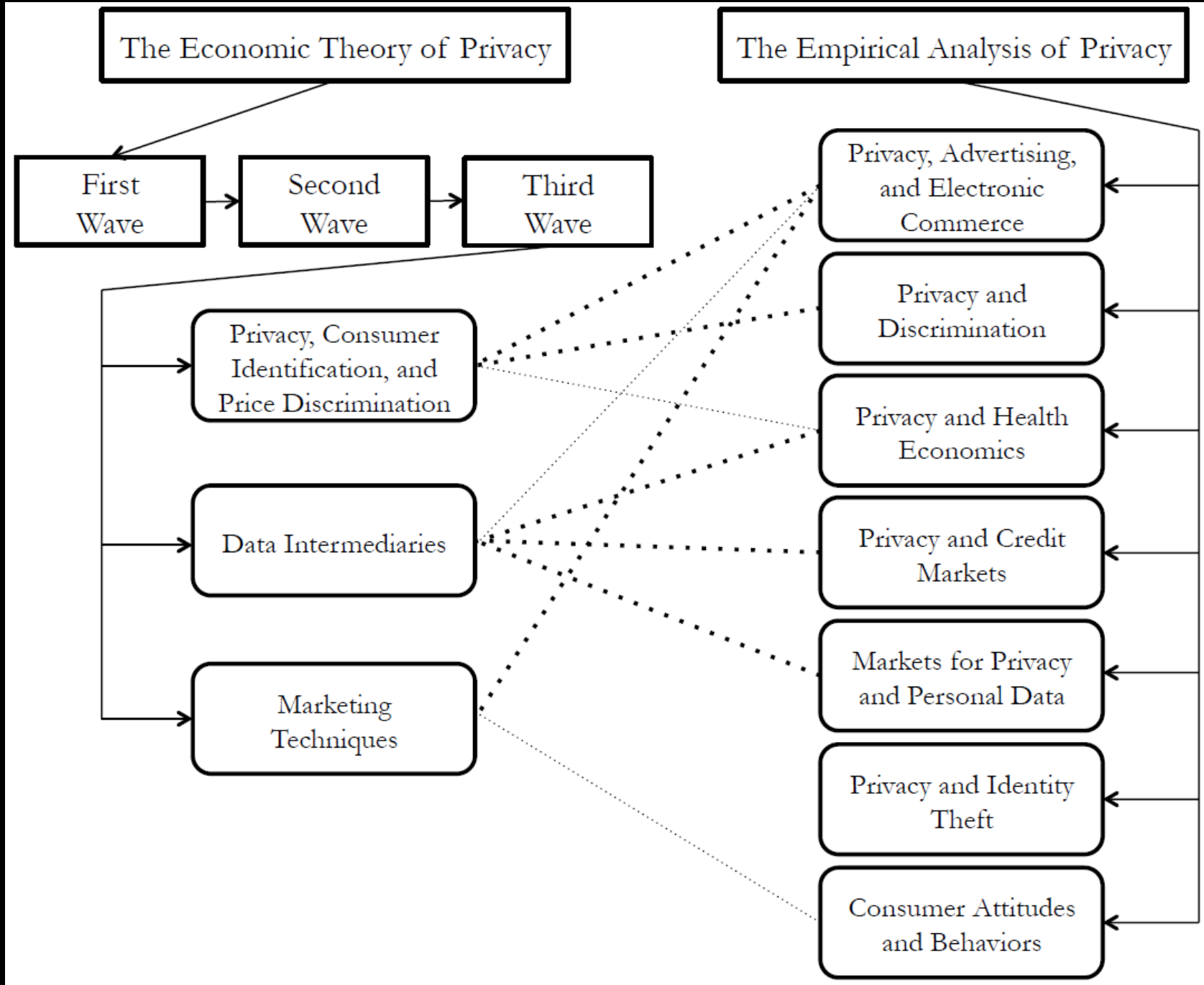
- Exchange of information will lead to desirable economic outcomes independently of ownership of data
  - E.g.: If I am a “good” debtor, I want this information to be known; if I am a “bad” debtor, I want to keep it secret
  - Suppose I am a bad debtor: then, whether I hide information or information about me is reported, I will pay higher rates (no information == bad information)

The mid 1990s: Varian

- Externalities (positive and negative) arise due to the secondary use of information
- Digitization of information creates novel challenges: collapsing MCs render semi-private information fully public
- Proposal: define property rights in private information in ways that allow consumers to retain control over how information about them is used
  - E.g., make it costly to access certain digital information

2000s and onwards

- Expansion and fragmentation
  - Increased modeling sophistication
  - Diversification of focus
  - Emergence of empirical analyses
  - Emergence of applied behavioral economic research


The Economic Theory of Privacy
The Empirical Analysis of Privacy
First Wave
Second Wave
Third Wave
Privacy, Consumer Identification, and Price Discrimination
Data Intermediaries
Marketing Techniques
Privacy, Advertising, and Electronic Commerce
Privacy and Discrimination
Privacy and Health Economics
Privacy and Credit Markets
Markets for Privacy and Personal Data
Privacy and Identity Theft
Consumer Attitudes and Behaviors

Privacy is redistributive

Posner (1978, 1981), Stigler (1980)

Privacy is about hiding negative information. Thus, privacy protection interferes with economic transactions: it causes a transfer of wealth from potential data holders to data subjects

… but so is the lack of privacy

Varian (1996)

Consumers would rationally want telemarketers to know what products they are interested in, but not how much they are interested in those products

Acquisti and Varian (2005) (as well as *Taylor 2004*)

Under tracking, myopic customers get price discriminated in intertemporal dynamic pricing model

I.e., in absence of privacy protection, consumers are worse off (perfect price discrimination)

Privacy is inefficient

Obstacles to data sharing create economic inefficiencies

Posner (1978, 1981); Stigler (1980)

… but so can be data collection too

Competition pushes firms to invest more than socially optimal amount in gathering consumer data

Competitive pressure leads to divergence between private and social marginal benefits of information acquisition

Hirshleifer (1971); Taylor (2008); Burke, Taylor, Wagman (2011); Hermalin and Katz (2006)

In fact: absence of privacy protection can decrease not just consumer but aggregate welfare

Empirics: Data sharing and EMR

Adoption of advanced EMR leads to a 27% decline in patient safety events

Hydari, Telang, Marella (2015)

Adoption of advanced EMR increases outpatient charges by 12%

Romanosky, Adjerid, Weber (2015)

Empirics: Privacy and innovation

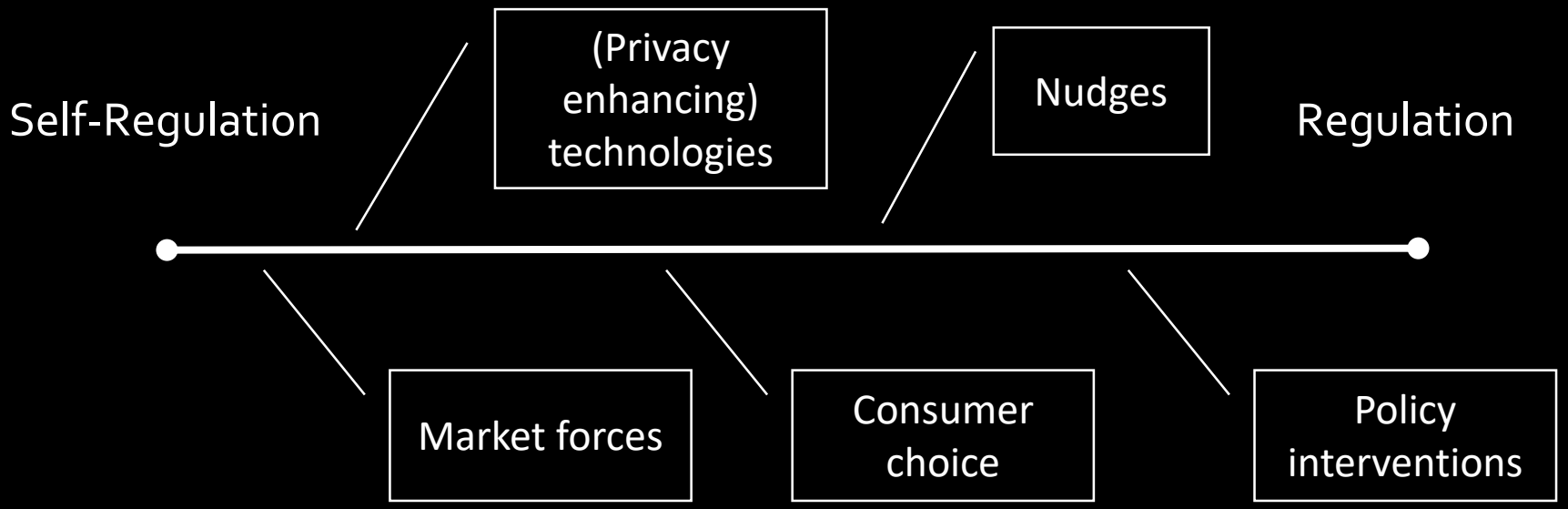
Privacy regulation reduces technology adoption/innovation

Miller and Tucker (2009, …)

Privacy regulation increases technology adoption/innovation

Adjerid, Acquisti, Telang, Padman, Adler-Minstein (2015)

The key seems to be *what type* of regulation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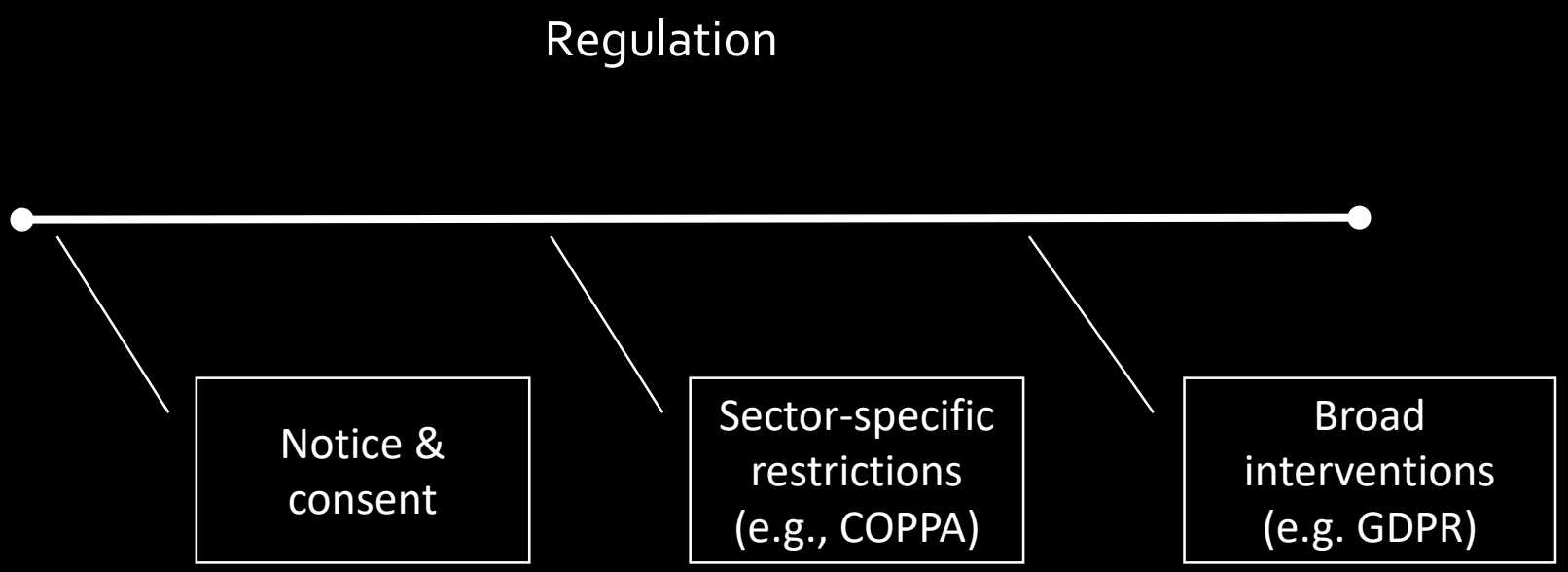
Regulation
Notice & consent
Sector-specific restrictions (e.g., COPPA)
Broad interventions (e.g. GDPR)

A few conclusions

- At the micro level ("first-order" consumer welfare), rational (self-interested) economic arguments for privacy protection (including via regulatory interventions)
- At the macro level (aggregate welfare, second-order effects), impact much more nuanced
- In fact, and importantly: Positive, negative, indeterminate effects all possible - depending on context
  - Effects nuanced and context dependent
  - Depend on type of regulation (among other things)
  - Still, we should dispel myth that privacy protection inherently depressing welfare / innovation / growth (this result is solid in both theoretical and empirical research)

Also: What most studies (inevitably) abstract from

- Multiple possible objective functions
- Interests of stakeholders often not aligned
- Second-order, long-term effects
- Heterogeneous effects
- The key role for privacy enhancing technologies (i.e. privacy as *non* binary)
- Non-economic dimensions
  - *Privacy is also about self-expression, intimacy, civility, human dignity, autonomy, freedom, …*
- Many studies heroically assume transparency
  - *In reality, information asymmetries abound*
- Many studies heroically assume economically rational consumers
  - *In reality, heuristics and biases are pervasive*

How much

To what degree should consumer privacy be protected?

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And, how do we achieve that degree of protection?

How much

To what degree should consumer privacy be protected?

How

~~*And, how do we achieve that degree of protection?*~~

And, how do we achieve any arbitrary degree of protection?

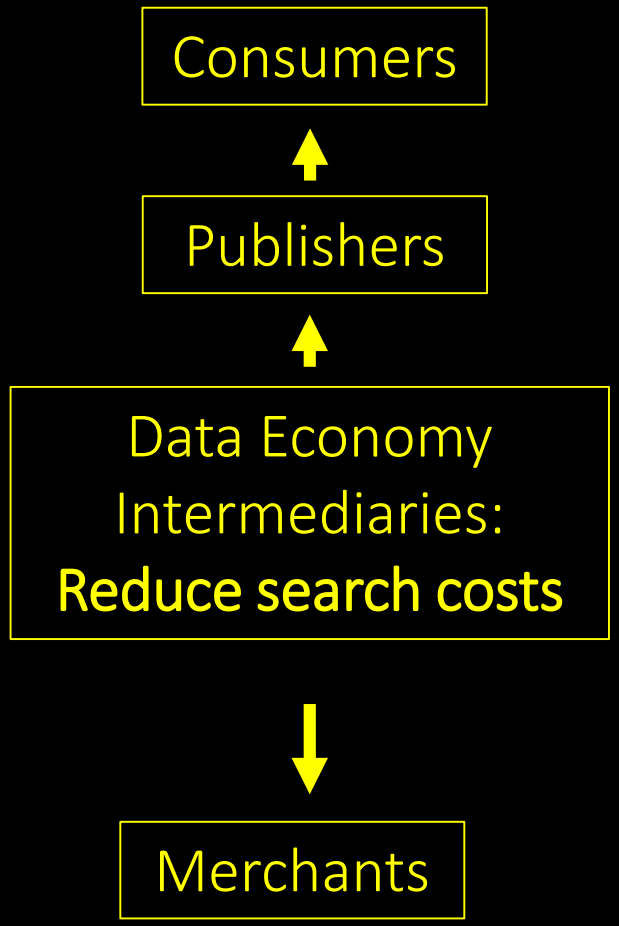
"Targeting is not only good for consumers [...] it's a rare win for everyone. [...] It ensures that ad placements display content that you might be interested in rather than ads that are irrelevant and uninteresting. [...] Advertisers achieve [...] a greater chance of selling the product. Publishers also win as [...] behavioral targeting increases the value of the ad placements."

“[Privacy] regulation imposed on a medium like the Internet that is changing so rapidly would have unpredictable consequences. […] Regulation would limit the flow of information and make it more expensive. This could create market failures where none now exist.”

If economic surplus is being generated by increasing (and increasingly sophisticated) consumer tracking, how is that surplus allocated? Who is extracting that surplus? And therefore, what will happen if policy makers regulate that space?

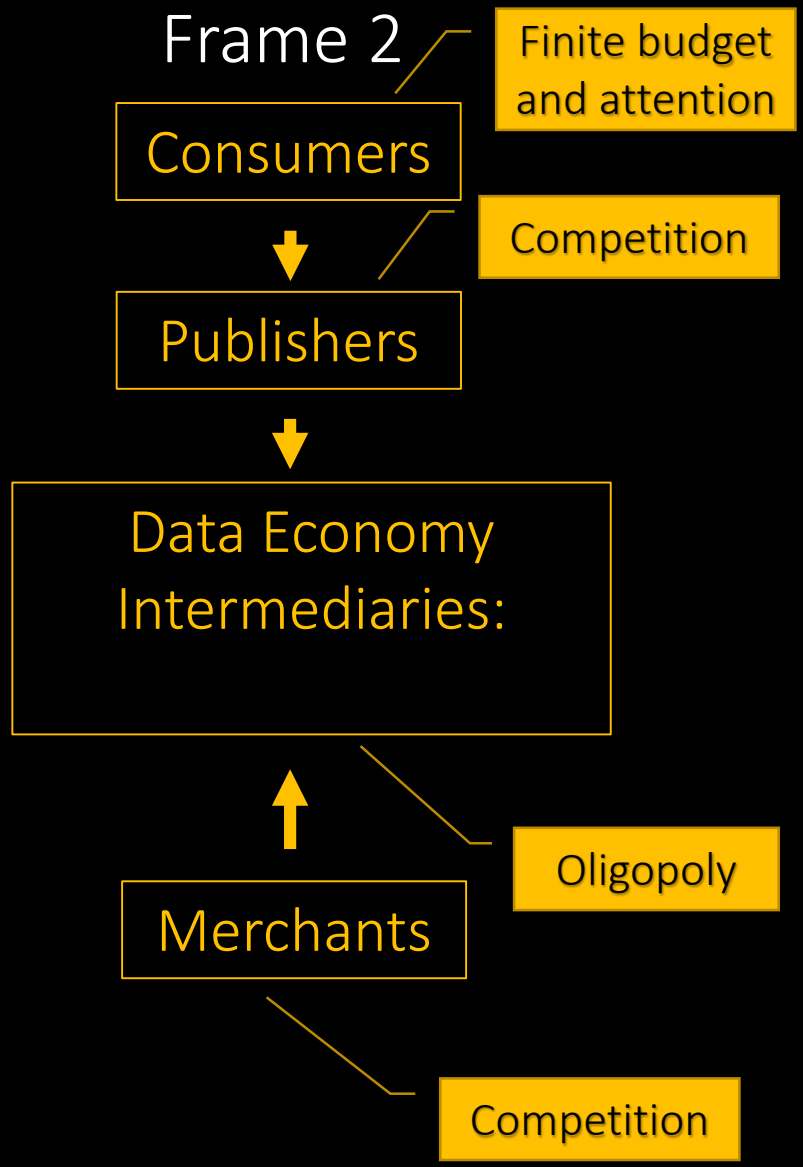
Online advertising:

Frame 1



Online advertising:

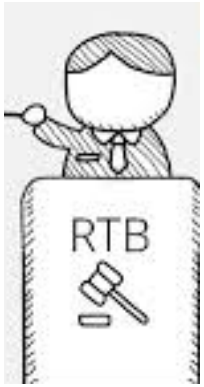
Frame 2



What Are the Welfare Implications of Targeted Advertising?

Veronica Marotta, Kaifu Zhang, Alessandro Acquisti

Ad Exchange



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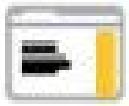
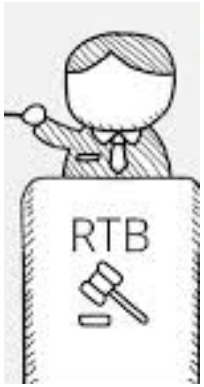
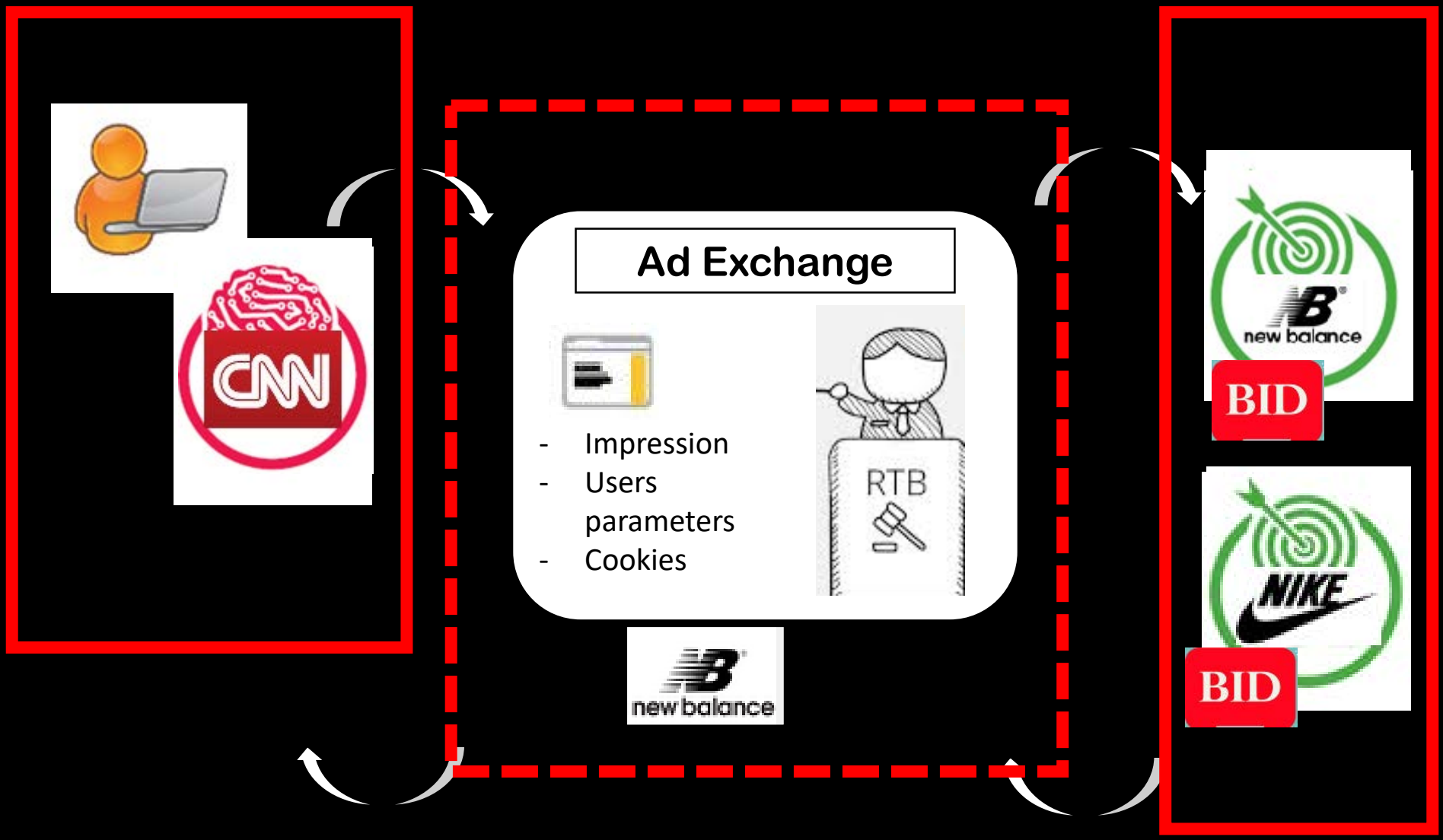


- Impression
- Users parameters
- Cookies




CNN
Ad Exchange
- Impression
- Users parameters
- Cookies
RTB
new balance
new balance
BID
NIKE
BID

- Multi-stage, 3-player game modeling online targeted advertising via “Real-Time Bidding” (RBT)
  - Consumers, Advertising merchants, Ad Exchange

- Compare welfare outcomes of informational scenarios that differ in the type and amount of consumer’s data available during the targeting process
  - No information
  - Limited Information (vertical/horizontal)
  - Complete information

Consumers' Preference	Advertisers' Preference	Intermediary's Preference	Aggregate Welfare Maximized
Indifferent	Complete Information	Vertical Information	Complete Information
Vertical Information	Complete Information	Vertical Information	Complete Information
Horizontal Information	Complete Information	Vertical Information	Horizontal Information

Preferred information regime for advertisers and intermediary,
given consumers' preference

Online Tracking and Publishers' Revenues: An Empirical Analysis

Veronica Marotta,
Vibhanshu Abhishek, and Alessandro Acquisti

By how much do publishers' revenues from selling ad space increase when the ads they display are behaviorally targeted?

- Advertisers' willingness to pay increases if they can target audiences (Chen and Stallert, 2014; Board, 2009)
- Ad price increases, publisher's revenue increases

- When targeting audiences, advertisers reach narrow markets with reduced competition (Levin and Milgrom, 2010; Hummel and McAfee, 2016)
- Ad price decreases, publisher's revenue decreases

We leverage a large data set shared by a media conglomerate, owner of a large number of online publishers

We estimate revenue changes when website visitors' cookies are, or are not, available (and therefore behavioral targeting of display ads is, or is not, possible)

- 2 million advertising transactions, over 60 different websites
  - Date and time
  - Ad's features (size, type, ...)
  - Urls where ads shown
  - Advertisers' names
  - Visitors' geo-location and device features
  - Publishers' revenues
  - Cookie's information (or absence)
  - ...

Augmented Inverse Probability Weighting (Robins et al., 1994)

1. Estimate Probability Model: Probability that user has a cookie associated

$$Prob_i(Cookie) = F(\beta_1 Demographics_i + \beta_2 Device_i + \beta 3 Location_i + \beta_4 X_i)$$

Where:

- X: vector of any other included features
- F : Logit function

2. Estimate two outcome models, one for transactions with cookies, one for transactions without

$$Y_i(t) = \beta_0 + \alpha Ad\_feat_i + \theta Website\_feat_i + \gamma User\_feat_i$$
$$+\delta Advertisers\_feat_i + \eta X_i + \epsilon_i, t = (0, 1)$$

Where:

- Y_i: Publisher Revenue for transaction i
- Ad Features: Vector of ad level features
- Website Features: Vector of website level features
- User Features: Vector of user level features
- Advertisers Features: Vector of advertisers' features
- X: Vector of any additional covariate

3. Compute weighted means of treatment-specific predicted outcomes
4. Compute average treatment effect

- $Prob(Cookie|X) = \hat{c}_i$
- $m_1 = E(Y|T = 1, X), m_0 = E(Y|T = 0, X)$

$$\Delta_{DR} = \frac{1}{n}\sum_i \frac{T_i Y_i - (T_i - \hat{c}_i)m_1}{\hat{c}_i} - \frac{1}{n}\sum_i \frac{(1 - T_i)Y_i + (T_i - \hat{c}_i)m_0}{(1 - \hat{c}_i)}$$

- *Double-robustness:* only needs either the probability model or outcome models to be correctly specified for the estimate to be consistent

Average increase in revenue when cookie is available is about 4%

Or, $0.00008 per ad

Is the increase *economically* significant?

- The increase in revenue obtained through the use of cookies comes at a cost for the publisher: infrastructure costs, data management costs, fees, costs imposed by data regulations...
- And, it comes at the cost of users' privacy
- Furthermore:

Google is also planning a policy change that would severely undermine news gathering. The company is **reportedly considering restricting third-party cookies** in its Chrome web browser, which it could announce as soon as its annual conference on May 7. Cookies are the largely unseen infrastructure on which the online marketplace runs. Cookies allow websites that provide free content to also collect anonymized data on users' interests, giving advertisers critical information about the market for their products. This value exchange is necessary to support nearly every site on the internet, but it is the lifeblood of digital journalism. An online advertisement without a third-party cookie sells for just 2 percent of the cost of the same ad with the cookie.

Laura Bassett, The American Prospect, May 6, 2019

Journal of Economic Literature 2016, 54(2), 1–53
http://dx.doi.org/10.1257/jel.54.2.1

The Economics of Privacy†

ALESSANDRO ACQUISTI, CURTIS TAYLOR, AND LIAD WAGMAN*

This article summarizes and draws connections among diverse streams of theoretical and empirical research on the economics of privacy. We focus on the economic value and consequences of protecting and disclosing personal information, and on consumers' understanding and decisions regarding the trade-offs associated with the privacy and the sharing of personal data. We highlight how the economic analysis of privacy evolved over time, as advancements in information technology raised increasingly nuanced and complex issues associated with the protection and sharing of personal information. We find and highlight three themes that connect diverse insights from the literature. First, characterizing a single unifying economic theory of privacy is hard, because privacy issues of economic relevance arise in widely diverse contexts. Second, there are theoretical and empirical situations where the protection of privacy can both enhance and detract from individual and societal welfare. Third, in digital economies, consumers' ability to make informed decisions about their privacy is severely hindered because consumers are often in a position of imperfect or asymmetric information regarding when their data is collected, for what purposes, and with what consequences. We conclude the article by highlighting some of the ongoing issues in the privacy debate of interest to economists. (*JEL* D82, D83, G20, I10, L13, M31, M37)

1. *Why an Economics of Privacy*

The value and regulation of information assets have been among the most interesting areas of economic research since Friedrich Hayek's 1945 treatise on the use of knowledge in society. Contributions to what has become known as the field of *information economics* have been among the most influential, insightful, and intriguing in the

"The Economics of Privacy," Acquisti, Taylor, and Wagman, *Journal of Economic Literature*, 2016

REVIEW

Privacy and human behavior in the age of information

Alessandro Acquisti,[1]* Laura Brandimarte,[1] George Loewenstein[2]

This Review summarizes and draws connections between diverse streams of empirical research on privacy behavior. We use three themes to connect insights from social and behavioral sciences: people's uncertainty about the consequences of privacy-related behaviors and their own preferences over those consequences; the context-dependence of people's concern, or lack thereof, about privacy; and the degree to which privacy concerns are malleable—manipulable by commercial and governmental interests. Organizing our discussion by these themes, we offer observations concerning the role of public policy in the protection of privacy in the information age.

If this is the age of information, then privacy is the issue of our times. Activities that were once private or shared with the few now leave trails of data that expose our interests, traits, beliefs, and intentions. We communicate using e-mails, texts, and social media; find partners on dating sites; learn via online courses; seek responses to mundane and sensitive questions using search engines; read news and books in the cloud; navigate streets with geotracking systems; and celebrate our newborns, and mourn our dead, on social media profiles. Through these and other activities, we reveal information—both knowingly and unwittingly—to one another, to commercial entities, and to our governments. The monitoring of personal information is ubiquitous; its storage is so durable as to render one's past indelectable

decisions about information disclosing and withholding. Those holding this view tend to see regulatory protection of privacy as interfering with the fundamentally benign trajectory of information technologies and the benefits such technologies may unlock (*7*). Others are concerned about the ability of individuals to manage privacy amid increasingly complex trade-offs. Traditional tools for privacy decision-making such as choice and consent, according to this perspective, no longer provide adequate protection (*8*). Instead of individual responsibility, regulatory intervention may be needed to balance the interests of the subjects of data against the power of commercial entities and governments holding that data.

Are individuals up to the challenge of navigat-

influence by those possessing greater insight into their determinants. Although most individuals are probably unaware of the diverse influences on their concern about privacy, entities whose interests depend on information revelation by others are not. The manipulation of subtle factors that activate or suppress privacy concern can be seen in myriad realms—such as the choice of sharing defaults on social networks, or the provision of greater control on social media—which creates an illusion of safety and encourages greater sharing.

Uncertainty, context-dependence, and malleability are closely connected. Context-dependence is amplified by uncertainty. Because people are often "at sea" when it comes to the consequences of, and their feelings about, privacy, they cast around for cues to guide their behavior. Privacy preferences and behaviors are, in turn, malleable and subject to influence in large part because they are context-dependent and because those with an interest in information divulgence are able to manipulate context to their advantage.

Uncertainty

Individuals manage the boundaries between their private and public spheres in numerous ways: via separateness, reserve, or anonymity (*10*); by protecting personal information; but also through deception and dissimulation (*11*). People establish such boundaries for many reasons, including the need for intimacy and psychological respite and the desire for protection from social influence and control (*12*). Sometimes, these motivations are so visceral and primal that privacy

"Privacy and Human Behavior in the Age of Information," Acquisti, Brandimarte, and Loewenstein, *Science*, 2015

For more information

1. "The Economics of Privacy," Acquisti, Taylor, and Wagman, *Journal of Economic Literature*, (2016)

2. "Privacy and Human Behavior in the Age of Information", Acquisti, Brandimarte, and Loewenstein, *Science*, (2015)

3. http://www.heinz.cmu.edu/~acquisti/
(or google/bing "economics privacy")