

The Economics of Privacy

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Onassis Foundation Science Lecture Series

June/July 2010

What is privacy, anyway?

- Right to be left alone...
 - Warren and Brandeis 1890
- An aspect of human dignity...
 - Bloustein 1964: "inviolable personality"
- Informational privacy...
 - Westin 1967: "Privacy is the claim of individuals, groups or institutions to determine for themselves when, how, and to what extent information about them is communicated to others"
- Solove 2006's taxonomy...
 - Information collection, processing, dissemination; and invasion

What is privacy, anyway?

- Many – even contradictory - definitions
- Ultimately, privacy relates to the negotiation/harmonization of private and public spheres:
 - Noam 1996: “Privacy is an interaction, in which the information rights of different parties collide. The issue is of control over information flow by parties that have different preferences over ‘information permeability’.”

Why an economics of privacy

- Privacy is about trade-offs: pros & cons of revealing & accessing personal information
 - For data subjects
 - For data holders
- ... and trade-offs are the realm of economics
- Hence, privacy is an economic problem...
 - ... even when privacy issues may not have straightforward monetary interpretation
 - ... even when the entities involved may not be aware that they are, in fact, facing/accepting trade-offs

The economics of privacy

- ...studies the incentives and the trade-offs that emerge from the dynamics between public and private spheres
- ...studies what conditions and what trade-offs maximize social and individual welfare
- ...studies how to attain those conditions. Through the market? Through self-regulation? Through technology? Through legislation?

Privacy *in* the economy: Examples

- American census, 1799
- Warren and Brandeis, 1890
- “Franklin Mills Flour” girl, 1901
- SSNs & AMKA (USA & Greece) (see: Gessiou, Labrinidis, Ioannidis 2009)
- Amazon’s price discrimination experiment, 2001
- Google Street View, Google Buzz, 2007-2009

Many open questions...

- What are the costs of privacy intrusions?
- What are the costs of privacy protection?
- How do people value privacy?
- What explains the privacy attitudes vs. behavior dichotomy?
- Who should protect your privacy?
 - Yourself, through technology and choice?
 - The government, through regulation?
 - The market, through self-regulation?
- ...

Agenda

1. The market for personal data and the market for privacy
2. The economics of privacy
3. The empirics of privacy



1. The market for personal data
and the market for privacy

Definitions and Economics

- Posner 1980
 - Privacy as concealment of information
 - Privacy as quiet
 - Privacy as freedom

Definitions and Economics

- Posner 1980
 - Privacy as concealment of information
 - *Privacy as quiet*
 - *Privacy as freedom*

Definitions and Economics

- Now:
 - Privacy as concealment of information
 - Privacy as quiet
 - Privacy as freedom
 - Even when privacy intrusions have no immediate economic relevance, immaterial dimensions of privacy still impact the well-being of the individual
 - (Economics of happiness and well-being studies)

The Two Markets of Privacy

- Privacy issues actually originate from two different markets
 - Market for personal information
 - Market for privacy
- Related, but not identical
- Confusion leads to inconsistencies
 - Different rules, attitudes, considerations
 - Public vs. private
 - Selling vs. buying
 - Specific vs. generic
 - Value for other people vs. damage to oneself
 - Lump sum vs. negative annuity

Market for privacy

- Companies that offer privacy enhancing technologies
- Companies that promise to keep their customers information protected and private
- Consumers who adopt privacy enhancing technologies and/or strategies
 - Price of identity theft insurance? ~\$40/year
 - Price of “Freedom Network” (anonymous browsing) when it still existed: ~40 \$
 - Number of users: some thousands, but not enough to cover fixed costs
 - Price of Tor, now: free (but slow)
 - Number of users : unclear. Hundreds of thousands?

Market for personal data

- Companies that deal with customers data, infomediaries, credit bureaus
- Companies that want to know more about consumers
- Consumers who willingly or unknowingly reveal personal information
 - Value of email addresses: ~few dollars for 100,000/1,000,000s
 - Value of your computer as a slave in a botnet: few cents
 - Value of US SSNs in the grey market: \$5-\$40?
 - Value of US SSNs in the black market: 50c to \$20?
 - See Perrig *et al* 2007 on the underground economy
 - Cost to access your credit history *for consumer*? Used to be \$20+, not free (but does not contain the credit score)
 - Cost to access your credit history+score *for other companies*: much less (with bulk purchases)

Personal Information as a (peculiar) Economic Good

- Subjective
- Ex-post
- Context-dependent
- Asymmetric

How to value privacy?

- Valuations may alternatively be anchored by the
 - Expected price in the marketplace if data could be sold there?
 - Expected loss if data were compromised?
 - Expected cost of protecting data?
 - Expected profit for data holder from exploiting data?

The costs of privacy

- Costs of protection
 - For data subjects
 - E.g., opportunity costs (missed opportunities), investments in protective technologies, privacy “externality,” ...
 - For data holders
 - E.g., adapt legacy technology, train workforce, forfeit marketing opportunities, ...
- Costs of invasion
 - For data subjects
 - E.g., monetary costs (e.g. from identity theft), spam, discrimination, price discrimination, psychological, intangible costs
 - For data holders
 - E.g., liabilities, negative, PR, loss of trust/customers...
- Note: for each cost there may be a corresponding benefit

The costs of privacy

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Microsoft Bing Cashback Not Always A Bargain

Microsoft's search rebate program inflates some prices for online shoppers, claims a competitor.

By [Thomas Claburn](#)
InformationWeek
November 23, 2009 9:50 PM

Having already drawn the ire of Microsoft (NASDAQ: [MSFT](#)) for posting information about a way to exploit the company's Bing cashback rewards program, Samir Meghani, co-founder of price-comparison search engine Bounti.com, now claims that Bing's cashback rebates can make some products more expensive.

Bing cashback, he says in a [blog post](#) published on Monday, has "a hidden feature" that I'm calling "negative cashback."

More Internet Insights

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Reports

- HTML 5 Starts Looking Real (Dr. Dobbs)
- Hybrid Clouds

Videos

San Francisco look: Obama's pledge of open and transparent government seriously, and launched data2net.org -- its attempt to give the city's data back to its citizens. Developers and users have embraced it, and the city's mayor is already looking ahead.

Bing cashback is a search marketing program that provides a cash rebate credit for the purchase of certain items found via search. The program lets merchants specify the amount of promotional funds paid to Microsoft as a sales commission. Microsoft, which operates the program to promote Bing, then passes 100% of the commission to shoppers after a 60-day waiting period.

Meghani says that the program can in some cases lead to higher rather than lower prices. As an example, he cites a visit to [butterflyphoto.com](#) to purchase a Canon (NYSE: [CAJ](#)) Vixia HV40 camcorder.

"If I go directly to [butterflyphoto.com](#), I pay \$699 with 0% cashback," he said in his post. "If I use Bing Cashback, I pay \$758 with 2% cashback, or \$742.84. Using Bing cashback has actually cost me \$43.84, giving an effective cashback rate of -6.27%. Yes, negative cashback is this legal? False advertising? I don't know, but it's pretty sketchy."

Meghani claims that the problem is compounded by a cookie that "taints" his browser. He says that because he followed a Bing link to Butterfly Photo, that site set a cookie identifying Bing as the referring site. The cookie, he says, lasts three months and will ensure that he is presented with the higher Bing price during subsequent visits to Butterfly Photo while the cookie is active.

"Just clicking a Bing link means three months of potentially negative cashback, without me ever realizing it," he writes.

In an e-mail, Meghani said that he's heard from others who have experienced this issue. "My very rough estimate is that about 5% of the listings from Butterfly Photo had inflated prices on Bing when I was looking into it," he said. "I know of at least one other store on Bing that does this kind of thing."

Two weeks ago, Meghani, at the insistence of Microsoft, removed information he had posted about a technical flaw that allowed Bing cashback participants to accumulate rebate cash without making purchases.

In an e-mailed statement, a Microsoft spokesperson said, "With more than 1,000 retailers and 1.7 million product offers, the Bing cashback program aims to ensure Bing customers get the best available deal on the Web. 100% of the cashback is passed on to the customer, and the rebate is calculated on the lowest available price."

- <http://www.informationweek.com/news/internet/search/showArticle.jhtml?articleID=221900811>

The benefits of privacy

- Benefits of protection
 - For data subjects
 - E.g., psychological effects, ability to compete, ...
 - For data holders
 - E.g., cast “customer friendly” appearance, ...
- Benefits of revelation
 - For data subjects
 - E.g., personalization, positive price discrimination, ...
 - For data holders
 - E.g., price discrimination, customer targeting, loyalty programs, behavioral targeting, ...

The privacy debate

- Gellman 2001:
 - Costs incurred by both **business** and **individuals** due to incomplete or insufficient privacy protections are huge
 - Tens of billions of dollars every year
 - Hence, we need regulation
- Rubin and Lenard 2001:
 - Market failures due to lack of privacy protection? No way, say Rubin and Lenard!
 - Regulation would limit flow of information and make it more expensive, reducing innovation
 - “This could create market failures where none exist”



2. The economics of privacy

The evolution of the economics of privacy

- Early 1980s
 - The Chicago school approach
- Mid 1990s
 - IT explosion: Varian, Noam, Laudon, Clarke
- After 2000
 - A “new” economics of privacy
 - ...and an economics of Information Security (WEIS, ...)
- And more recently
 - Behavioral economics of privacy/security (SHB, ...)
 - Privacy usability/security (SOUPS, ...)

The early days: Posner

- Privacy as concealment of information
 - Individuals with bad traits (e.g., poor employees) have interest in hiding them
 - Individuals with good traits have interest in showing them
 - Reducing information available to “buyers” in this market (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
- Privacy is re-distributive and reduces efficiency

The early days: Stigler

- Free exchange of information will lead to desirable results regardless of ownership of data
 - 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 do not reveal information or information about me is reported, I will pay higher rates
- Also, Stigler believes in a peculiar relation between “ownership” and privacy
 - Information about somebody may have been costly acquired by other people – hence it may rightly “belong” to that somebody

The mid 1990s: Noam

- If no transaction costs in trading or negotiation, initial assignment of privacy rights is arbitrary from viewpoint of economic efficiency
 - Encryption
 - “The existence of encryption may largely determine who has to pay whom, not whether something will happen”
 - In fact, encryption at most makes parties other than the data subject pay. Hence, it redistributes wealth to consumers
- Acknowledged difficulties
 - Incomplete information
 - Human right
 - Burden on poor

The mid 1990s: Varian

- Consumers rationally want certain kinds of information to be available to producers, not other kinds
 - E.g., consumer wants seller to know what goods she likes, but not *how* much she likes them
- Annoyances comes from *too little* information
 - E.g., tele-marketers offering products I do not want
- *Externalities* connected to secondary use of information
- Define property rights in private information in ways that allow consumers to retain control over how information about them is used
 - E.g., timed contracts
 - E.g., make it costly to access certain digital information

After 2000: A new economics of privacy

- Microeconomic, formal models
- Themes
 - Price discrimination
 - Spam
 - Hiring decisions
 - ...

Summarizing the results...

- Allowing firms to use cookies *can* make customers and society better off...
- Sharing information between sellers reduces “distortions”...
- With “strategic” customers, firms better off respecting customer’s privacy...
- So, economic modeling shows that free flow of *certain* information is good, and that market forces may tend towards optimal equilibrium
- *So: all privacy problems solved by the free market?*



3. The empirics of privacy

So many questions, so little time

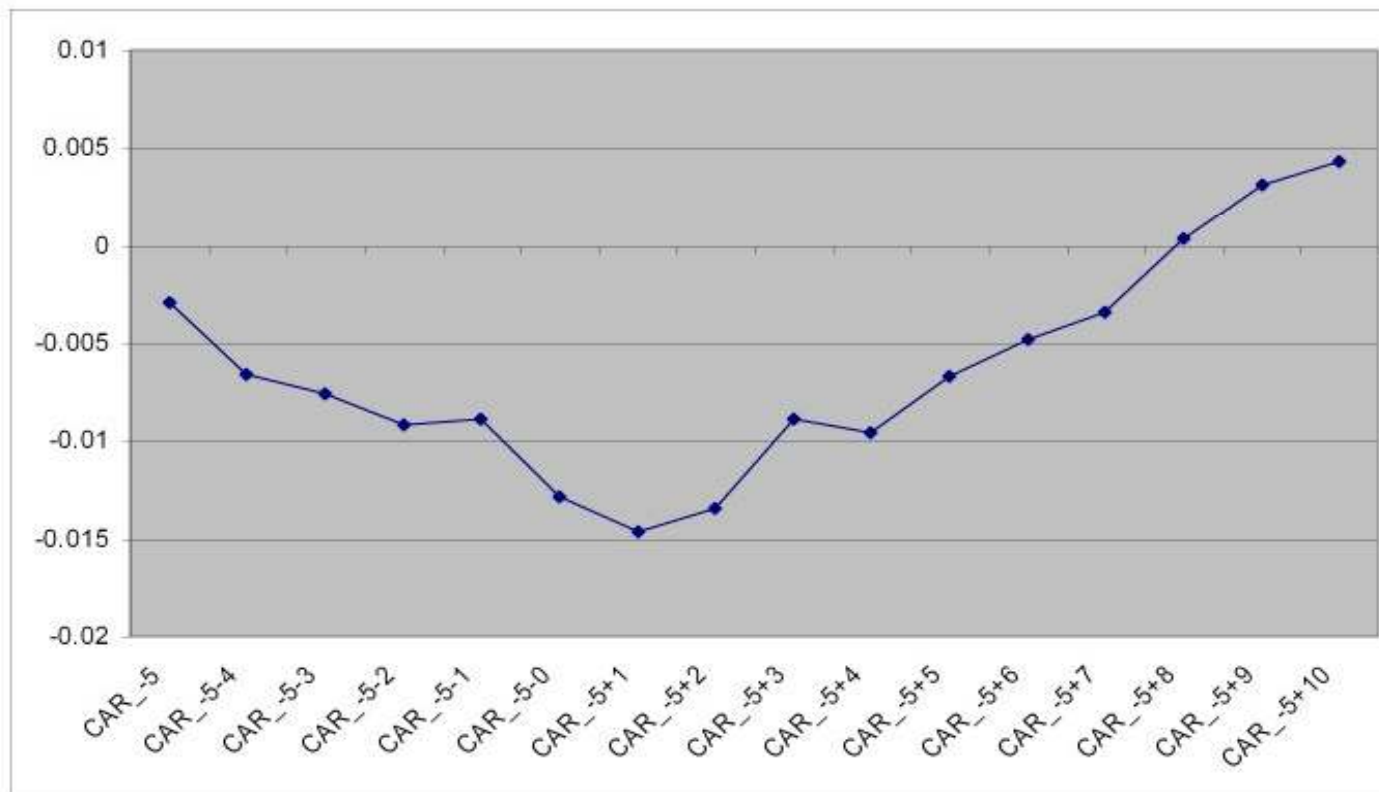
- ... what is the cost of privacy invasions – specifically, *privacy breaches*?
- ... what is the impact of *breach notification laws*?
- what is the impact of stronger privacy regulation?
- what is the impact of encryption on consumers' data protection?
- ... how much consumers *really* value privacy?
- ...

The cost of privacy breaches

- We mined US national and local media, newsgroups, mailing lists, blogs, and other surveys for privacy incidents reports
 - E.g., WSJ, Lexis Nexis, IP list, Attrition.org's Dataloss list, Privacy Rights Clearinghouse
 - 2000-2007 data
- Ran event study analysis
 - Focusing on data breach events that met the following criteria:
 - Publicly traded company
 - No compounding media reports of event
 - No conflicting/alternative major events during event window
 - Calculated “CAR” (cumulative abnormal return)

The cost of privacy breaches

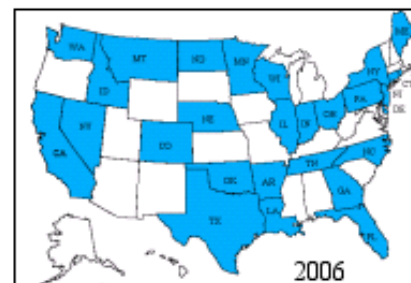
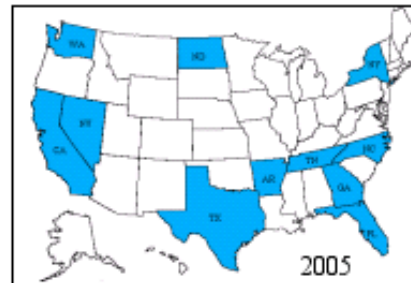
- CAR calculations show only a lukewarm response by the marketplace



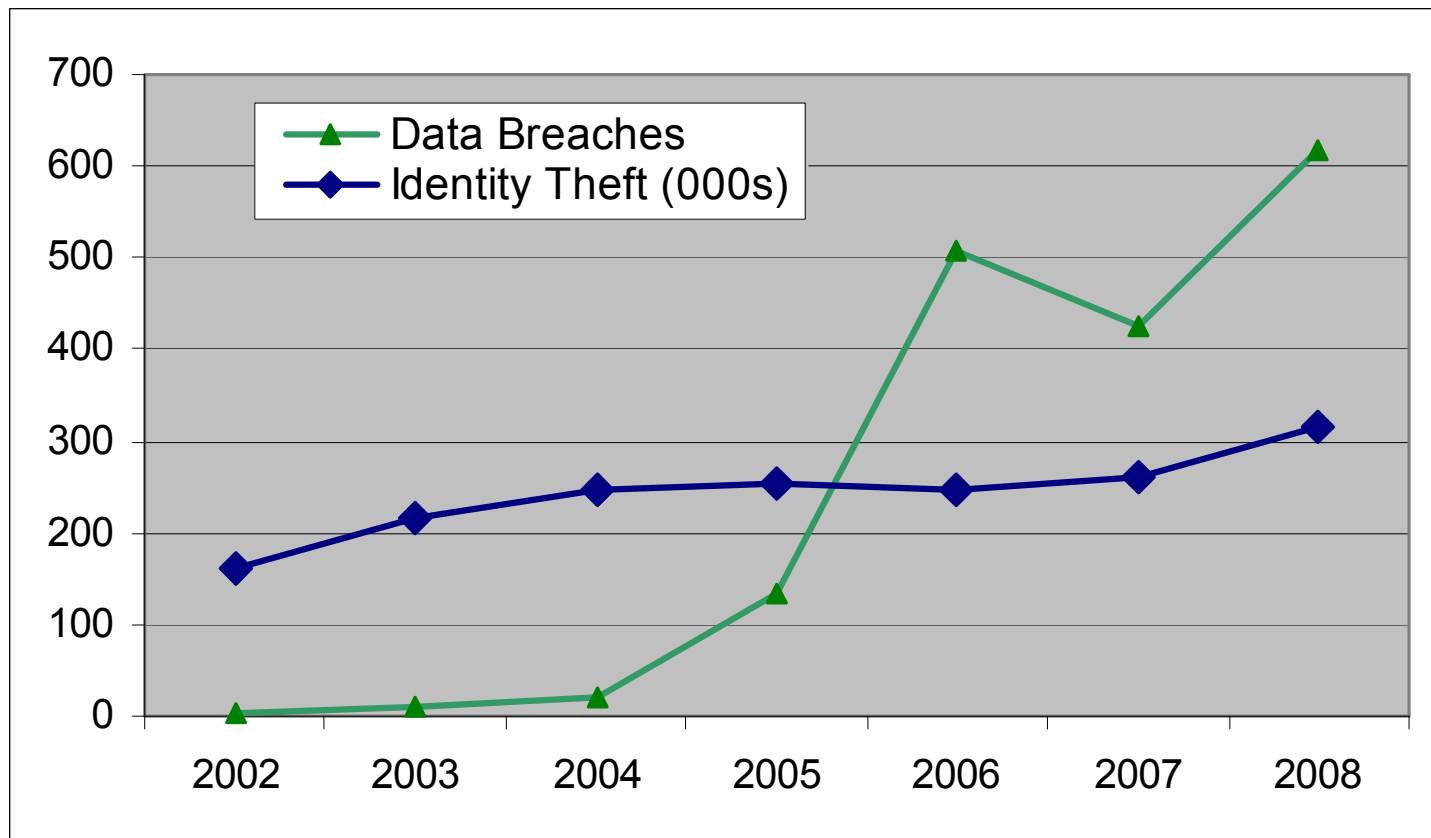
Do data breach disclosure laws reduce identity theft?

- The EU has been discussing enacting data breach disclosure laws similar to the ones enacted by many states in the US
- Such laws require that firms notify consumers when their PII has been lost or stolen
- This should have 2 effects:
 - Create incentives for firms to improve their practices
 - Empower consumers to mitigate risk of becoming victims of identity theft
- Together, these forces should help reduce # of breaches and identity theft
 - We used breach and ID theft data to test whether that was the case

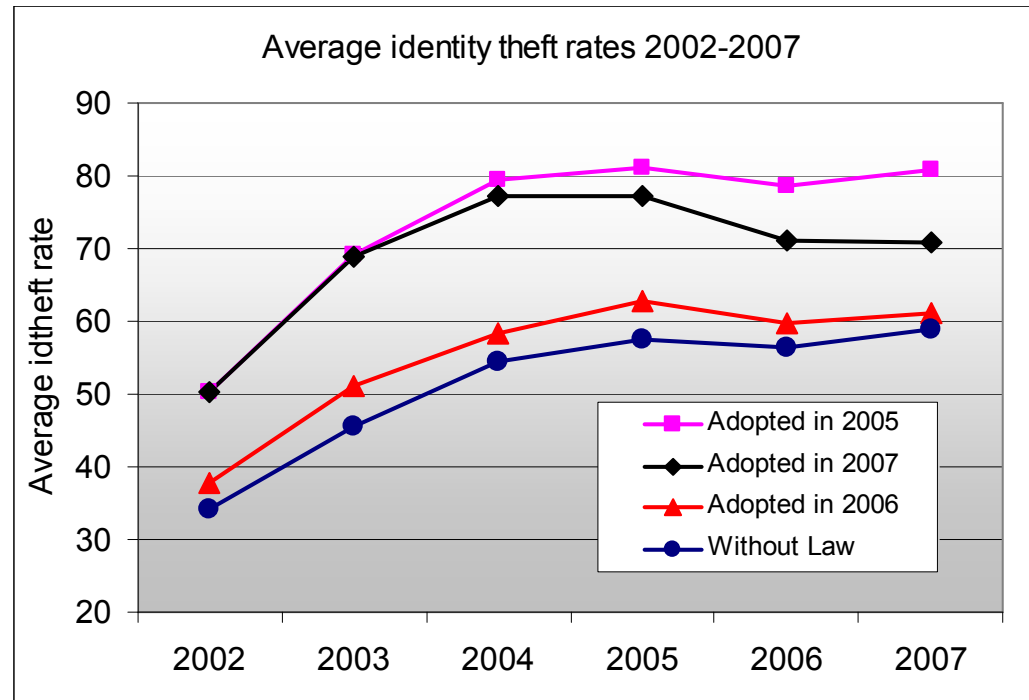
Progression of data breach notification laws across states



Both breaches and identity theft crimes are increasing



Results



Idtheft rate: number of crimes per 100,000 people

- Id theft for states *with* and *without* law appear to follow same trend
- Our panel data regressions indicate that data breach notification laws reduced id theft due to breaches **by only 1.8%**

The impact of regulation and encryption

- Tucker and Miller 2008:
 - Stronger privacy laws decrease innovation in the EMR (electronic medical records) sector
- Miller and Tucker 2010:
 - When organizations adopt encryption software, there is no evidence of a decrease in publicized instances of data loss.
 - Instead, there are actually increases in the cases of publicized data loss due to internal fraud or loss of computer equipment.

Do people really care for privacy?

A privacy dichotomy

- Attitudes about privacy
 - (Ostensibly,) top reason for not going online... (Harris Interactive)
 - Billions in lost e-tail sales... (Jupiter Research)
 - Significant reason for Internet users to avoid Ecommerce... (P&AB)
- Actual behavior
 - Dichotomy between privacy attitudes and privacy behavior
 - Spiekermann *et al.* 2001, Acquisti & Gross 2006's Facebook study

Do people really care for privacy?

- Well:
 - Few people even read privacy policies
 - Most PETs have been unsuccessful in the marketplace
 - Most people give away personal data for small rewards
 - Success of Facebook, Twitter, blogs and in general Web 2.0 suggests preference for information sharing over information protection...

Do people really care for privacy?

- On **NetWorthIQ**, individuals publicly report in great details earnings, assets, and debts – sometimes anonymously, sometimes under real names – so that they can be ranked against the “net worth” of other individuals.
- On **Blippy**, consumers broadcast updates of anything they just purchased to the rest of the world.
- On **Formspring.me**, users invite friends or strangers to anonymously ask (sometimes very) personal questions, and then publish their answers on (often identified) Facebook or Twitter profiles (the site received 50 million unique visitors in a single month).

How much do people value privacy?

- **Huberman et al. (2006)**: second-price auction
- **Wathieu and Friedman (2005)**: survey participants comfortable with an institution's sharing their personal information if they had been shown the economic benefits of doing so
- **Cvrcek et al. (2006)**: significant differences in the price EU citizens would accept to reveal their mobile phone location data, depending on their country of residence
- **Hui et al. (2007)**: used a field experiment in Singapore to study the value of various privacy assurance measures, finding that privacy statements and monetary incentives could induce individuals to disclose personal information (estimate value of protection at ~\$37)
- **Varian et al. (2005) and Png (2007)**: tried to estimate the implicit price that US consumers would pay for the protection from telemarketers using the do-not-call list, and found values ranging from a few cents to slightly more than \$30
- [...]

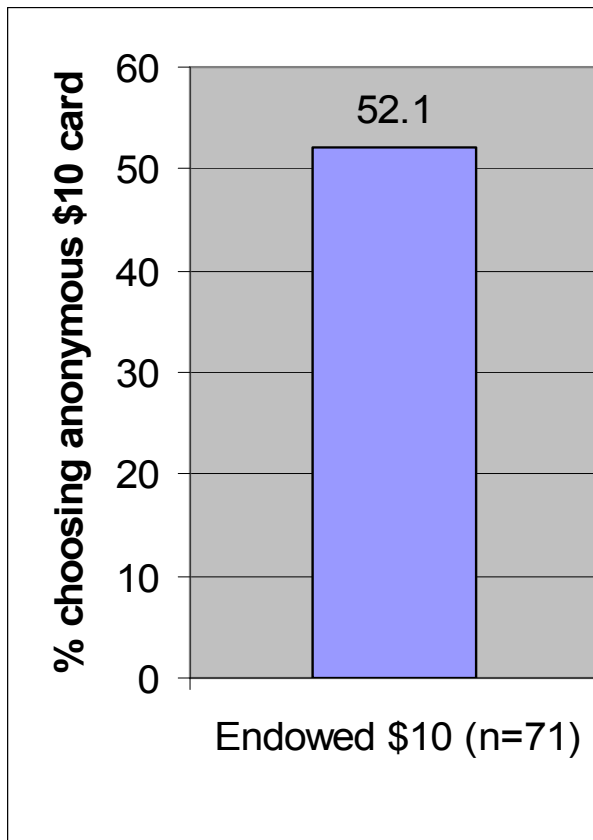
How much do people value privacy?

- Problems:
 - Many studies...
 - ... and many valuations
 - Confusion among WTP (willingness to pay) and WTA (willingness to accept)

Willingness to pay to protect privacy vs. willingness to accept to give data

- Mall patrons asked to participated in a study. Offered compensation in the form of gift card(s)
 - We manipulated trade-offs between privacy protection and value of cards
- Endowed with either:
 - **\$10 Anonymous gift card.** *"Your name will not be linked to the transactions completed with the card, and its usage will not be tracked by the researchers."*
 - **\$12 Trackable, identified gift card.** *"Your name will be linked to the transactions completed with the card, and its usage will be tracked by the researchers."*
- Then, asked whether they'd like to switch cards
 - From \$10 Anonymous to \$12 Trackable (WTA)
 - From \$12 Trackable to \$10 Anonymous (WTP)

WTP vs. WTA: Results



So: Will consumers ever pay for privacy?

- The impact of privacy information on shopping behavior (Tsai, Egelmann, Cranor, and Acquisti 2007)
 - Experiment in the lab with human subjects
 - Goal: to test whether provision of salient privacy information would affect purchase behavior
 - Participants given information sheet on shopping online – experiment group told about “Privacy Finder”
 - Participants asked to complete two online shopping transactions:



The impact of privacy information on shopping behavior

- Participants were asked to search for products using our “new” search engine
- Participants in different experimental conditions were provided different information about the merchants in the search results
 - No info about privacy practices
 - Icons ranking handicap accessibility (i.e., irrelevant information)
 - Icons ranking privacy practices

Condition 1

No information



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Condition 2

Irrelevant information



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Condition 3

Privacy information



Duracell AA batteries 8-pack

Search

Privacy premium:
\$0.69 4.8%

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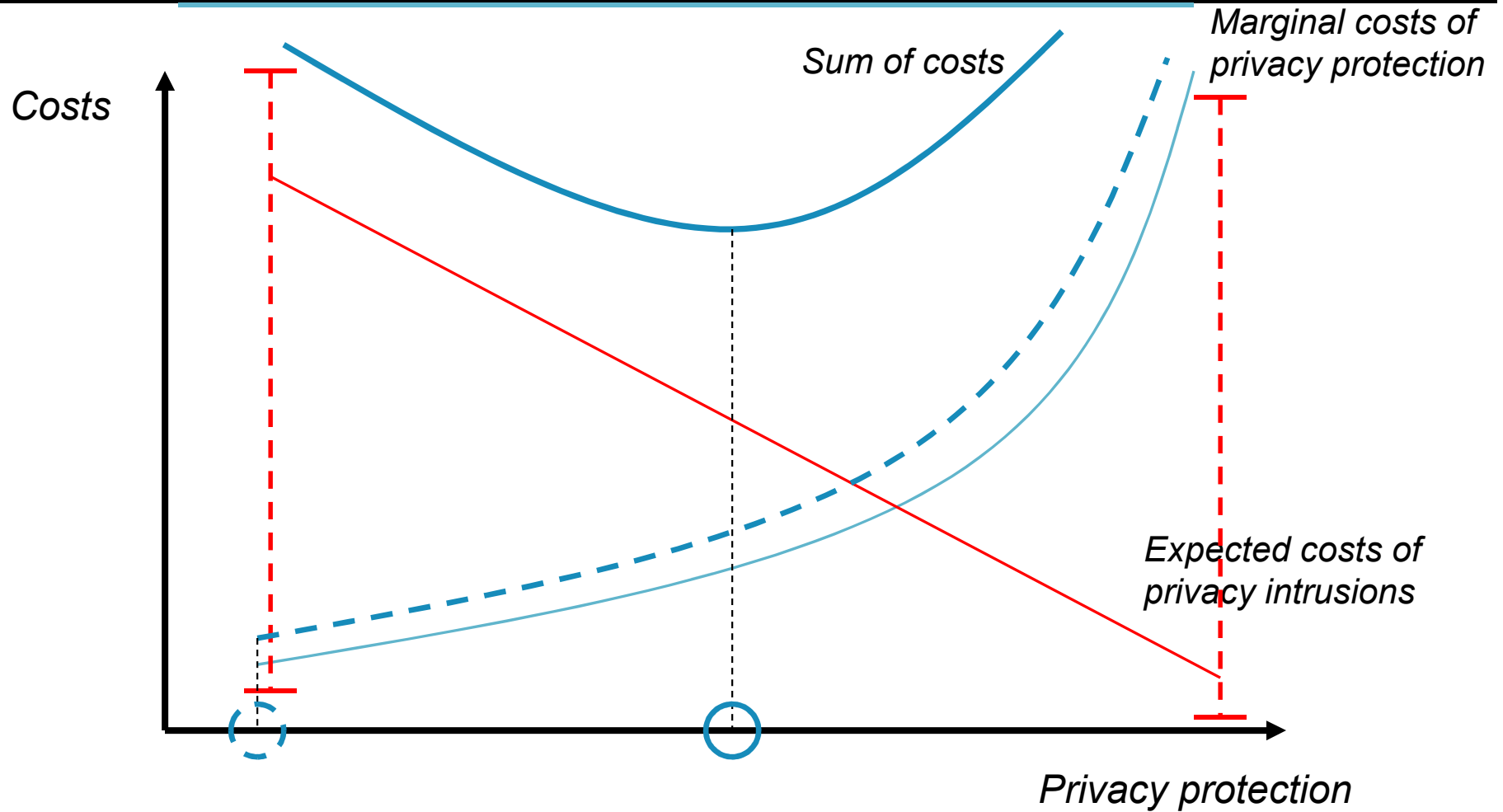


\$15.14 (w/shipping)

The impact of privacy information on shopping behavior

- Participants purchased the privacy sensitive item (condoms) from **more costly merchants** who had privacy policies compatible with their preferences
- Participants did **not** purchase the non-privacy sensitive item (surge protector) from the more costly merchants
- In other words, not always consumers trade-off privacy for monetary benefits!

The big picture



For more info

- Google: [economics privacy](#)
- Visit: <http://www.heinz.cmu.edu/~acquisti/economics-privacy.htm>
- Email: acquisti@andrew.cmu.edu