Computer Mediated Transactions

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Outline

• Waves of innovation and their implications
  - Combinatorial innovation
  - Mechanical, electrical, electronics, software

• Computer mediated transactions
  - Enforce new contracts
  - Better align incentives
  - Enable for data extraction and analysis
  - Enable controlled experimentation
  - Enable personalization and customization

• Collaborative computing
  - Optimizing workflow for knowledge workers
  - Micromultinationals
Waves of innovation

- Huge innovation on web in the last 15 years
  - Web pages, search engines, wikis, databases, etc
    - Why has there been so much innovation?
    - Why has it been so rapid?
- Examples of combinatorial innovation
  - Set of component technologies that can be combined and recombined to create new innovations
    - 1800: Interchangeable parts
    - 1900: Gasoline engine
    - 1960: Integrated circuits
    - 1995-now: Internet
  - Often process takes years, or decades to play itself out
But this time…

- Component parts are all bits!
  - Protocols: TCP/IP, HTTP, CGI, SQL
  - Languages: HTML, XML, Java, Python, Perl...
- Bits/protocols/languages can be combined to make…
  - Web pages, intranets, chat rooms, auctions, exchanges, video streaming, VOIP, search engines…
  - Note: no time-to-manufacture, no inventory problems, no delivery problems
  - Bits can be shipped around the world in seconds, and innovators can work in parallel
- Result: extremely rapid evolution and technological progress
- Question: what are implications for commerce?
Computer mediated transactions

- A computer is now involved in almost every transaction
  - Even cash registers are just PCs with a special interface
  - Web-based transactions are even more powerful since they directly connect to a database
  - Original intent was just accounting
  - But the record of transactions has other uses
  - How does the presence of computer-mediated transactions affect economic activity?
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One result: better contracts

- Contracts are fundamental to commerce
  - Simplest form: “I will do X if you will do Y”
    - Exchange of goods, services, labor, etc.
  - Major problem: monitoring the contract
    - Sometimes observe performance
    - Quality of goods, service, actions, effort may not be observed
- Where do computers come in?
  - Historically advances in technology have enabled better measurement and monitoring
  - Computers move this capability to a new level
Computer as accountant

- Since the computer serves as intermediary it can not only make record of transactions, but also verify contractual performance
- Allows us to structure more elaborate contracts and improve economic efficiency
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Francesco di Marco Datini
Better monitoring makes for better contracts

- Mediterranean shipping 3000 BC
- Cash registers 1883
- Semi trucks 1990s
- Video stores 1990s
- Online advertising 2000s
Mediterranean shipping 3000 BC

How do you ensure that your full shipment is received at other end of voyage...with no written language?

Answer

- Match clay tokens (bullae) to jars of oil loaded on ship
- Seal tokens in clay envelope, stamp clay with seal
- Bake bullae in kiln, send with shipment
- At other end of journey, recipient breaks open the envelope and compares tokens to jars on ship
- Later, inscribe marks on bullae as check, which may have led to writing
Examples of bullae 3300 BC
How do you ensure employees don't steal?

• From cash register
  - Answer: put a bell on it
  - 1883 patent to James Ritty and John Birch for the "Incorruptible Cashier"
  - Paper tape + bell recorded transactions

• From truck
  - Put a "vehicular monitoring system" on it
  - Improves gas mileage, logistics, and honesty!
Video store rentals

- Originally store purchased videos from studio, rented to customers
  - But price was high, so only bought a few
  - Much unhappiness among all parties

- Revenue sharing model
  - Distributor *gives* videos to store
  - Each time one is rented, revenue is shared according to pre-specified formula

- But need verifiable way to count the transactions
  - Use bar codes, computers, and network
  - Each side of the transaction can verify correctness on a daily basis
Rental cars

Car insurance for auto renters would cost less if drivers drove more slowly.
Drivers would be willing to drive more slowly if they paid lower rental prices.
Contract can't be made since speed is not observed.

But now it can be observed, so contracts can be more efficient.
Align incentives in online advertising

• Publisher has space for ad impression on page, wants to sell it to the highest bidder
• Advertiser doesn't care about ad impression, wants clicks = visitors and sales
• Answer
  – Value per impression = value per click x clicks per impression = VPC x CTR
  – If we can estimate CTR, we can convert one to the other
  – Huge statistical/machine learning problem
  – Aligns incentives between publisher, advertiser and user
• Revenue sharing
  – Publisher and search engine can share revenue from click
Computer mediated transactions
align incentives

- A purchase can be linked back to a click or an impression, making advertising accountable
  - ...at least on a statistical basis
  - Advertiser and publishers can run experiments with different treatments to see what works

- Cases
  - Search advertising
  - Display advertising
  - Mobile advertising
  - TV, radio, print, etc.
Assembly line for marketing

- Records of transactions allows for optimization of buying process from ad to sale
  - Advertising effectiveness
  - Debugging purchase process
  - Estimation of useful marketing relationships

- Assembly line for marketing which can be fine tuned on a piece-by-piece basis
  - Venice: 14\textsuperscript{th} century
  - Detroit: 1909
Assembly lines for manufacture: 14\textsuperscript{th} century Venice to 20\textsuperscript{th} century Michigan
Data extraction and analysis

• Since online transactions are computer mediated, can study data for patterns
  – Which converts better [diamond] or [diamonds]?
  – How do clicks vary over time of day?
  – What keywords perform best?
  – What advertiser characteristics predict success?

• Build predictive and causal models
  – Formulate hypotheses
  – Build models

• But you don't stop there...
Controlled experimentation

- Data from computer mediated transactions allows for measurement
  - But it takes controlled experimentation to determine causality
  - One of the critical reasons for Google's success is experimentation and continuous improvement
  - Experimentation should be available in every web environment
  - Data vs HiPPO
Customization and personalization

- Computer mediated transactions allow for “mass customization” whereby transactions can be optimized for individuals
- Purchases on Amazon, searches on Google
- Challenges
  - Informed consent
  - Benefits of personalization v privacy
  - Primary issues are trust, security and transparency
  - Intended v unintended use
But advertising is just the beginning...

- Computer mediated transactions make advertising accountable

- But computer mediated transactions also allows for other kinds of optimization
  - Logistics
  - Customer feedback
  - Product design and evolution
  - Recommender systems

- Improves business processes across the board
“The computer and the dynamo”

• Paul David on the productivity of electricity
  – In early 1800s waterwheels powered plants
  – All machinery connected to central shaft
  – Clustered machinery by type as in model
Improvements in power

– Steam and then electric motors used same design
– Miniaturization of electric motor made it possible to power each machine separately
– Allowed for rearrangement of production...but no onetook advantage. "We've always done it this way."
– Henry Ford and the assembly line broke the mold
– Allowed for dramatic increases in productivity
Henry Ford and mass production

• Ford realized that he could rearrange production and assembly in an optimized way
• Put the machines where they were needed, not where they “had always been”
Knowledge workflow

• Assembly of mechanical parts
  - Assembly lines: optimize the flow of physical product through factory in 1908

• Assembly of ideas
  - Collaborative computing: optimize the flow of ideas through the organization in 2008
    • Separation, distribution and optimization of tasks
    • Multiauthored documents and easy collaboration
    • Version tracking and control
    • Experimentation and fine tuning
    • Overcome barriers of distance
      • Outsourcing the details - McKinsey
      • Micromultinationals - see below
Enabled by “cloud computing”

- Evolution of computing
  - Mainframe
    - Data was in one place but access was controlled
  - Networked workstation
    - Data in many places, access open
  - Personal computer
    - Open access, data mostly on single computer or LAN
  - Cloud computing
    - Open access, data in one place
    - Store once, read everywhere via the Web
    - Access from any device any time by any authorized user
    - Facilitates both teamwork and maintenance
Infrastructure for rent

- Barriers to entry for online businesses are falling fast
  - Can purchase space in data center, storage on demand, development environment from Google, Amazon, and others
  - Allows you to scale your business to meet customer growth
  - Pushes “combinatorial innovation” to a new level
    - Not only innovation, but now actual deployment!
    - Fosters a huge burst of creative activity
Micromultinationals

• Cheap communications
  – Email, webpages, wikis, VOIP, wireless, collaborative computing, cloud computing
  – Opens doors to small business around the world
  – SMEs can have access to technology that only the mega-multinationals could afford a decade ago

• Combinatorial innovation
  – Businesses can be born international
  – Huge parallel innovation in technology and commerce
  – This is only the beginning
Appendix

• Various unused slides below
Early attempt to optimize knowledge work with hypertext...
Disassembly line