Credit and Identity Theft

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The Background

- Outgrowth of Kahn-McAndrews-Roberds "Money is Privacy" (*IER*, 2005)
- Idea of KMR: Credit arrangements require recordkeeping ("memory")
- Some types of money (cash, some proposed internet arrangements) preserve privacy in transactions
- Privacy can be socially valuable because it precludes ex-post opportunism

Limitation of Previous Paper

- The form of ex-post opportunism modeled:

Theft of purchased goods

—Imperfect stand-in for more important form of ex-post opportunism:

Identity theft

Purpose of this Paper

- Develop a model of identity theft in the context of payments
- Use it to understand the role of ID cards in credit arrangements (credit cards/cheque guarantee cards)
- Eventually, use it to understand relative social and private costs of different forms of identity theft ("new account fraud" vs. "existing account fraud"; "friendly fraud")

Modeling identity

- Usually modeled as history of agents' actions
- We must go further: problem is to *link* a particular history with individual making a current transaction

Modeling identity

- Individual's identity will be denoted by a unique (infinite) sequence of ones and zeros.
- We will describe technology for distinguishing an individual from an impersonator

Modeling identity

- In his role as a producer an individual's identity is unproblematic
- The difficulty is to link the production history with a particular attempt at consumption

The framework (from KMR)

- *N* agents, infinitely lived, risk neutral, with common discount factor δ'
- Each agent identified with a "location" where he can produce a unique, specialized, non-storable good at a cost *s*

The framework (from KMR)

- Each period one agent wakes up “hungry” for the good of a particular producer
- Consumption of that good by that agent provides him utility *u*; any other consumption in the period gives the consumer 0 utility

The framework (from KMR)

- Note: no double coincidence of wants
- Therefore no possibility of barter (if $s > 0$)
- Some arrangement needed for intertemporal trade

The framework

- The value of u is common to all agents.
- The value of s is distributed in the population with distribution F.

$$0 < F(u) < 1$$

- A producer's value of s (his "type") is unchanging over time, and is private information to the producer.

The framework

- The hungry agent can travel to the location of his preferred supplier
- The hungry agent's identity (i.e. his own location as a supplier) is not automatically revealed
- The refusal of an agent to supply a good is observable

Limiting Assumptions

- Continuous Time
- N large
- $N\delta'$ approaches δ

Timing

- At time 0, agents learn their own costs, and have the opportunity to form club (binding commitment)
- π denotes fraction of population in club

Enforcement

- Agreements can be enforced by court: assume has power to punish *one* individual up to an amount *X* (large), *provided he can be identified*
- Thus “fraud risk” but no “credit risk”

Events within a period

- Hungry agent and supplier randomly chosen
- Hungry agent journeys to supplier's location
- Hungry agent's identity is verified
- If verification successful, trade occurs

Baseline: Costless Identification

- Provided $X \geq u$, all individuals with $s \leq u$ join club $(\pi = F(u))$
- A member's expected utility is

$$V(s) = \delta^{-1}\,\pi\,(u - s)$$

- Constrained efficient (cross-subsidy not allowed)

Verification technology

- Examine a sample of n bits of individual's identity at cost k per bit sampled
- No type I error; probability of a false match of z^n
- Optimal sampling increases with s and falls with k, z, or π

Equilibrium

- Find the cutoff level of supply cost for membership such that
  - all members join voluntarily and are willing to supply
  - each chooses his preferred monitoring sample
  - all non-members prefer to remain outside the club (and attempt impersonation)

Credit club equilibrium

- If $X \geq u$

For small k, equilibria exist with $\pi < F(u)$.

As k shrinks, π approaches $F(u)$.

Credit card technology

- The credit card is a manufactured “pseudo-identity”: a string of bits, verifiable at lower cost than the identity itself.
- The credit card club makes an initial check of identity, then issues the member a card
- Subsequent suppliers verify the card (rather than the person).

Equilibrium

Analogous definition. Given club rules for monitoring, agents voluntarily choose between:

- joining the club (being monitored initially, and supplying to all card holders after monitoring their cards)
- not joining (not supplying, instead attempting credit card fraud)

Types of fraud

- Either the card or the person can be imitated: “old account” vs. “new account” fraud

A special case

- For the moment: assume costs of creating and verifying cards is zero
- In other words, cards are not counterfeitable (no “old account fraud”)
- Equilibria exist under same condition as before ($X \geq u$, small k)

Comparison of equilibria

- If agents are sufficiently patient, then for any independent verification equilibrium, there is a credit card equilibrium with a more extensive club.
- If in addition k is sufficiently small, members of the credit card club unanimously prefer the credit card equilibrium.

Sources of benefit

- Club's initial monitoring substitutes for monitoring by members
- Initial monitoring is more valuable; more frauds are excluded
- Size of club expands
- Additional individual monitoring redundant

Counterfeitable cards

- Analogous results, provided credit card creation and verification not too expensive
- Both kinds of fraud occur:
- Old account fraud has more limited benefits to fraudster, but is more likely to succeed (Assume cardholders given incentive to report misuse of their card)

- New account fraud arises because cost of establishing and verifying accounts is low relative to cost of initial identity verification
- As costs of new accounts falls, use of credit increases, but limited by the fact that new account fraud becomes more tempting

Extensions:

- Money vs. Credit
- Friendly fraud

Money v. Credit

- Add Kiyotaki Wright (1989) money to non-counterfeitable card model
- Money less flexible than credit (it is subject to stocking-out)
- Simplification: potential set of impersonators of fixed size

Money v. Credit

- Money has the advantage of not being tied to a purchaser's identity
- Money and credit can co-exist: agents with high costs of joining the club will find money cheaper to use
- Money's importance increases as the cost of verifying "things" (money, cards) falls relative to the cost of identifying people.

“Friendly Fraud”

- Occurs when a consumer fraudulently claims that a transaction was fraudulent.
- Only a feature in a world with credit constraints—in our initial model consumers have infinite lines of credit
- So we build a second model with this feature.
- Important to explain secondary identity verifications (signatures) and other constraints on cardholders

Model (from unpublished version)

- Overlapping generations, 3-period lives, types private information
- “Producers” vs. “Drones”: production in third period, only by producers.
- “Early consumers” (only value first period consumption) vs. “Late consumers” (value both first and second period consumption)

Model

- Late consumers place higher value on second period consumption; thus inefficient for late consumers to consume early
- Punishment technology effective only if the guilty party can be identified

Details

- Large number of locations L ("islands"), each with different good produced.
- Large number of agents N (all agents have distinct identities) $N >> L$
- Time discrete.
- For producers, disutility of producing y units is y.

Details

- All agents each period learn of a set of I islands at which they wish to consume. Locational shocks serially independent and independent across agents.
- In addition productive agents learn whether they have early or late preferences, each with probability 1/2. (Drones are always early consumers)

Schizophrenia

- Early consumers split into I buyers who visit the islands whose good is desired. Consumption x_t^t is equal to

$$I \min_i \{x_{t\,i}^t\}$$

where the buyer on island i purchases $x_{t\,i.}^t$

These complications are to keep aggregate behavior certain, and to make compatible with monetary models; they can probably be simplified.

Utility

- Early consumers:

$$w(x_t^t) - y^t_{t+2}$$

- Drones:

$$w(x_t^t)$$

- Late consumers:

$$\theta\, x_t^t + w(x^t_{t+1}) - y^t_{t+2}$$

where $0 < \theta < 1$ and w is "well behaved."

Timeline

- Young agents send buyers to islands; old agents produce on islands; goods are given to young by old in equal shares.
- In a market clearing equilibrium this is what would happen, but here, unless agents can be identified there can be no trade.
- Does money help?

Costless Enforcement

- Suppose costless identification and costless record keeping for transactions
  - In each generation, agents learn their production type and decide whether to join club
  - Reveal identities to the center, agree to consume in one period only, in return for third period production.
  - Center can impose disutility X on defaulters.

Costless Enforcement

- "Constrained efficient" allocation;
  - Only productive individuals join club
  - Hungry individuals consume in appropriate period of youth, where $w'(x^*) = 1$.
  - Club members supply x^* in old age
  - Preference shocks do not need to be observed if agents' consumption histories observable: agents who "exceed their credit limit" are punished.

Extreme cases

- If agents identifiable but consumption histories cannot be recorded
  - Late consumers also consume early (credit risk)
  - For some parameter values club collapses (autarky preferable to bearing the cost of double consumption by late consumers)

Model results

- Costly, imperfect verification of identity
  - Credit cards issued (entitles to consumption in one period, but not both)
  - Some drones succeed in impersonation

Model results

- Desirable to insure late consumers against risk of impersonation
- Result: temptation for “friendly fraud”
  - Late consumer consumes early
  - Claims identify theft

Remedy

- A second identification sample ("signature")
  - Enables detection of friendly fraud
  - Cost of collection but only costly to verify if dispute arises
  - In this simple environment, disputes do not arise because the signature acts as deterrent.

Policy Implications

- Popular notion is sometimes advanced that more sophisticated cards can "solve the problem" of ID theft—
- But more sophisticated cards may actually contribute to the problem by making credit card payment more prevalent, increasing incentives for existing account fraud.

Policy Implications

- Proposed privacy legislation may also fail to curb ID theft—
- By constraining ID samples, such legislation may encourage new account fraud ("impersonation" in the model)

Policy Implications

- Ultimately society may have to decide how much new account fraud it is willing to tolerate
  - New account fraud could be reduced by more extensive monitoring (attaching GPS device to everyone at birth)
  - But such intensive monitoring may violate social norms of privacy

Comparison to literature

- Pure anonymity (Kiyotaki-Wright)
- Public identities and histories (Kocherlakota)
- Both extremes (Cavalcanti-Wallace)

Comparison to literature

- Credit clubs: Corbae-Ritter (2004), Martin, Orlando and Skeie (2006)
- Fraud and credit: Camera and Li(2003), Kahn, McAndrews and Roberds (2005)
- Counterfeiting: Green and Weber (1996), Kultti (1996), Monnet (2005), Williamson (2002), Nosal and Wallace (2004)

Comparison to literature

- Externalities of verification: LoPucki (2001,3), Solove (2003)
- Identity: Clarke (1994) “knowledge-based” vs. token-based”

Summary

- The paper has developed a payments model which can be used to analyze identity theft
- Made a preliminary analysis of clubs with identification technologies comparable to credit card systems

Still To Do

- Lots and Lots
  - Externalities and cross subsidization for members
  - Competition among card systems
  - Detailed analysis of technological changes