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Privacy and Information Markets: An Experimental Study

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Abstract

In this paper we create an experimental 'information market' where consumers can trade in potentially useful personal information. We study how a market where trade in information takes place compares experimentally with a market where there is no trade in information. We test the impact of trading in information and the impact of stricter privacy laws on consumers and sellers, and also the impact from a social perspective. Total surplus was found to be significantly higher in a higher privacy regime than in a lower privacy regime. Although our theoretical predictions showed that sellers would be better off in a higher privacy regime, the results from the experiment did not support it significantly. Consumers were found to be better off in the higher privacy regime although, the theoretical results made no such predictions. There was partial support for the efficiency being higher in a higher privacy regime.

Keywords: Privacy, information markets, experiment.

1. Introduction.

Companies such as Lumeria (www.lumeria.com) are creating technologies that will allow consumers to create their own profiles, which they can share with marketers for the right price. This business model places personal data under the auspices of the individual, which can then be used as a new form of currency to enable the Identity Commerce (I-Commerce) marketplace. In the future, consumers will be able to share useful information - credit information with lenders, genetic information with insurance firms etc – for the right benefits. This will lead to an 'information market' where consumers can trade in potentially useful personal information (Laudon 1996, Sovern 1999). Sharing information however is associated with a loss of privacy for the consumer. The loss comes from losing control over the information revealed and the inherent risk of secondary use of that information.

In the United States collection of information, and its use by firms, is more self regulatory in nature. To ensure privacy of the collected information, the Federal Trade Commission has developed five fair information practice principles that would protect consumers in the collection, use and dissemination of their information. However as noted in the FTC report on self-regulation and privacy online (FTC 1999), only 10% of the organization web sites studied, practice all of the fair information practices of notice, choice, access, security and redress.

In contrast in the European Union (EU) collection of information and its use are regulated by strict privacy laws. The EU directive, takes a more consumer oriented focus than US companies do, and is structured, in when, and how a company can collect and use consumer information. The FTC recently recommended that the Congress enact laws to codify the Fair Information Practices – however the congress hasn't acted on it yet (Turow

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2003). In light of the fact that self regulation is not working in the US and because of increasing pressure from privacy protection groups, it is important to study the effect of privacy laws on information markets.

We create an experimental market where sellers are represented by human subjects and buyers are computers agents. The sellers set the price of two version of a good - one where information is collected and the other where information is not collected. All players know the cost (privacy losses) and benefits of revealing personal information. Different parameters simulate the different treatments (privacy regimes), and the impact of stricter privacy laws on overall efficiency is studied. The research questions we look at are: How does a market where trade in information takes place compare experimentally with a market where there is no trade in information? Are sellers/consumers better off in a higher privacy regime? Are stricter privacy laws better from a social perspective? Do the experimental results match the theoretical predictions?

The rest of the paper is organized as follows: the background literature is covered in Section 2, the environment that is studied and the theoretical predictions are explained in section 3. Section 4 covers the experimental design, while the results and discussion are in sections 5 and 6 respectively.

2. Background Literature.

Laudon (1996) in his paper 'Markets and Privacy' proposed a National Information Market (NIM), where information about individuals can be bought and sold at a market clearing price. The basic idea in the market is that institutions, which function as brokers, collect personal information (insurance information, medical records etc) from individuals, and then sell them as baskets of information to buyers (companies, government, private individuals etc). Market forces decide the market-clearing price and the cash flow takes place from the buyer to the individual through the broker. The buyers thus accept a price for their personal information, or for their privacy. Our work is motivated by this proposal, and provides an experimental test of such a market by testing predictions on prices and efficiency under different privacy regimes.

Revealing information to firms constitutes a loss of privacy because of the loss of control over the information. This falls in line with Coase's and Westin's (Coase 1960, Westin 1967) definition of privacy, as *the right of the individuals to control the flow of information about themselves*. Smith et al (1996) have broken down the privacy construct along four dimensions: improper collection, error, secondary use and improper access. Hann et al (2002) conduct a conjoint analysis to explore individuals' tradeoffs between the benefits and costs, of providing personal information to websites. Secondary use of information is any other use of the information, other than the primary purpose for which it was collected. For example use of information on hobbies, collected by a marketer, to better target consumers with personalized products and services, if used for job screening, is a secondary use of the collected information. Many researchers (Novak and Phelps 1995, Goodwin 1991) have pointed out that consumers tend to be unconcerned about privacy if information is used only for the purpose of the original transaction. Other studies have pointed out that other dimensions that could influence privacy concerns include: how sensitive the person considers the information (Jones 1991), how familiar the person is with the entity collecting the information (Wang and Petrison 1993), and what compensation is offered in exchange for the information (Goodwin 1991).

Tam et al (2002) offer a framework of seven motivators that can induce consumers to disclose their personal information. These include monetary savings, time savings and pleasure. They find that although all seven motivators are generally desirable to consumers, the consumers may differ in terms of their inclination towards specific motivators.

3. Environment.

There are two set of agents in the market place: a firm that is capable of collecting information, and a set of consumers. The firm sells a product/service (zero marginal cost) which is equally valued by the consumers. Consider the firm to be a grocery store that can collect purchase information, at the point of sale or an Internet Service Provider (ISP) that can collect browsing information. All consumers have the same value for the product or service sold by the firm. The firm provides two options to the consumers, option one where the consumer buys the product and pays the posted price and option two where the consumer allows the firm to collect information (purchase history, browsing information etc) and receives a discount on the posted price. If the consumer chooses option two, then the firm can sell the collected information to other firms (third parties) which are interested in the consumer's information. Also if the consumers' information is useful to a third party then the consumer receives some value from revealing the information (from personalized products or services). The firm receives a rent (commission) from the third parties for enabling the matching between the consumers and the third parties. The consumer if she chooses option 2 faces a privacy loss due to revealing information to the firm. The consumers differ in the loss associated with revealing information (privacy valuation) and in the value of their information to a third party.

There are four types of consumers:

1) Type 1: HIGH valuation for privacy and LOW value of the consumer's information to a third party.
2) Type 2: HIGH valuation for privacy and HIGH value of the consumer's information to a third party.
3) Type 3: LOW valuation for privacy and HIGH value of the consumer's information to a third party.
4) Type 4: LOW valuation for privacy and LOW value of the consumer's information to a third party (LOW Information value).

LOW (HIGH) valuation for privacy means that the consumer faces a small (large) loss if the consumer allows the firm to collect information and then reveal it to the third parties. LOW (HIGH) value of information to third party means that the consumer's information is of low (high) value to the third party. For example if the third party is a firm that sells Jazz CD's, then consumers who listen to jazz have a HIGH value of information (i.e. would buy a personalized jazz CD and hence are of value to the third party) and consumers who do not listen to jazz have a LOW value of information to the third parties. The third parties would only be interested in consumers who have a HIGH value of information i.e. consumers who listen to jazz.

Common knowledge:

- Consumer's valuation v (reservation value) for the product or service sold by the firm.
- Distribution of the 4 types of consumers ($\lambda_1, \lambda_2, \lambda_3, \lambda_4$).
- Privacy losses of HIGH (LOW) privacy types: c_H (c_L).
- Value to consumers to revealing information: w i.e. the consumer who has a HIGH value of information gets a value w (in terms of personalized products or services) if she releases her information to the third party and the consumer who has a LOW value of information gets a value 0 if she reveals information.
- Commission (u) received by the collector of information from the third parties for enabling the matching.

Private knowledge:

- Only the consumers know their privacy valuation and the value of their information to a third party.

The consumers decision variable is whether to allow the firm to collect information $(k=1)$ or not $(k=0)$. The firms decision variable is the price to charge $p(k)$ contingent on the choice made by the consumer k. The firm has three possible strategies:

1. To sell the product only to consumers who choose to reveal information.
2. To sell the product only to consumers who choose not to reveal information.
3. Sell the product to consumers who reveal information as well as to consumers who don't.

Strategies 1 and 2 are pooling contracts since all consumer types are offered the same contract. Strategy 1 is called the pooling revealing contract (all consumers types have to reveal information if they choose to buy the product), while strategy 2 is called the pooling private contract (consumers types keep information private). Strategy 3 is a partial pooling contract since two or three types may end up choosing the same contract while the other types choose the other contract.

For ease of notation we introduce some other parameters: Ratio of privacy loss of HIGH privacy type to privacy loss of LOW type $r_{HL}=c_H/c_L$, the ratio of number of Type 3 consumers to Type 2 consumers $r_{32}=\lambda_3/\lambda_2$ and total gains from trade of a personalized product or service enabled by revelation of information $S=w+u$. Total gains S is the sum of the values to the firm (u) and to the consumer (w).

We summarize the notation used for our theoretical benchmark in Table1

Table1 Notation

Notation	Description
j	Index for each consumer type $j=1..4$.
v	Common reservation utility of all consumers for product or service sold by firm.
λ_j	Firm *B*'s prior on distribution of consumer type j
S	Total Gains from trade of a personalized product or service enabled by revelation of information.
w	Value to consumers who have a HIGH value of information from trade of a personalized product.
u	Commission received for enabling matching between third parties and consumers.
c_H	Privacy loss of consumer having a high valuation for privacy.
c_L	Privacy loss of consumer having a low valuation for privacy.
k	Consumer choice variable. $k=1$ Reveal information $k=0$ do not reveal information.
$p(k)$	Price charged for product based on consumer choice to reveal information or not.
r_{HL}	Ratio of privacy loss of HIGH privacy type to privacy loss of LOW type (c_H/c_L)
r_{32}	Ratio of number of Type 3 consumers to number of Type 2 consumers (λ_3/λ_2)

The optimal pricing strategies for the firm under different set of parameters are summarized in Table 2. Detailed proofs of the results are available in Jaisingh et. al (2003). We provide a brief description of how the results were obtained and how to interpret them. Three cases

were identified, each of which differ in the relative magnitude of the parameters: w, c_H and c_L. These are identified as Cases1-3 in Table 2. For each of the cases, the profits to the collector of information are compared under the different pooling and partial pooling strategies. Two of the strategies are partial pooling strategies and are identified as PP1 and PP2. In PP1 the prices that are set ($p(k)$)are such that all consumers who have a HIGH value of information would have an incentive to reveal information and are given a discount while in PP2 only the consumers who have a LOW value for privacy loss and a HIGH value of information have an incentive to reveal information, and are subsidized. The third strategy is a pooling strategy (P3) where information is not collected at all and all consumers buy at the reservation price of v. The strategy that gives the collector the highest profit is the optimal strategy and the conditions under which these strategies are optimal are given in Table 2.

Table 2 Theoretical Benchmark

	$S \le c_H$	$S > c_H$
Case 1 $c_L < w < c_H$	PP2*	PP1 if $S > c_L[r_{HL} + r_{32}(r_{HL} - 1)]$ PP2 if $S \le c_L[r_{HL} + r_{32}(r_{HL} - 1)]$
Case 2 $c_L < c_H < w$	NA	PP1 if $S > c_L[r_{HL} + r_{32}(r_{HL} - 1)]$ PP2 if $S \le c_L[r_{HL} + r_{32}(r_{HL} - 1)]$
Case 3 $w < c_L < c_H$	PP2* if $S > c_L$ P3* if $S \le c_L$	PP1 if $S > c_L[r_{HL} + r_{32}(r_{HL} - 1)]$ PP2 if $S \le c_L[r_{HL} + r_{32}(r_{HL} - 1)]$

Partial Pooling PP1: $\{(p(0) = v); (p(1) = v - c_H + w)\}$

Partial Pooling PP2: $\{(p(0) = v); (p(1) = v - c_L + w)\}$

Pooling Private P3: $(p(0) = v)$

* First Best

Note that in most cases a partial pooling contract (either PP1 or PP2) is optimal. PP1 and PP2 differ in the price charged for option 2 i.e. $p(1)$. Also they differ in which consumer types would eventually choose to reveal information. Collecting information from all types is non-optimal while a pooling strategy where information is not collected (P3) is optimal only under Case 3 when $S \le c_L$.

4. Experimental Design.

Human subjects act as sellers who are paired up with robot buyers[1]. These robot buyers follow simple rules for buying or not buying a product, and these rules are known by the seller. In each session there are 5-8 human subjects (all sellers), and a fixed number of robot buyers are assigned to each seller. Each session is broken up into four Stages: Stage I and III - 5 periods, Stage II and IV - 15 periods each. All sellers are endowed with 100 francs at the start of each stage. In Stage I and III we create a conventional market with no trade in personal information. In Stage II and IV we allow for trade in the consumers personal information. Stage II and Stage IV differ in terms of some parameters (privacy regime treatments explained later). Stage I is used as a practice round, and the data from this round are not used for analysis.

[1] The decision for the buyers is trivial, and in a pilot study with human subjects as buyers, we found that 87.7 % of the decisions made by the humans were the correct decision. Replicating buyer behavior through agents allows us to create a larger market and also reduces possible payments to subjects.

Stage I - Periods 5 periods:
Firm is not allowed to collect information. The firm posts the price of the product and the robot consumers either accept or reject the prices. The robot consumers buy if the reservation value of the product is greater than the price, otherwise they do not buy. The wealth of the firm changes as follows:
Period End Wealth = Beginning period Wealth + Price of the product × No. of robot consumers who buy.
Stage II - 15 periods
Firm is allowed to collect information and consumers have the choice of revealing information to the firm or not. The firm offers two versions of the same product: Version 1 where information is not collected and Version 2 where information is collected.
At the start of each period, a die toss determines the type of the robot consumer – Types 1-4. This determination of the type of the consumers is carried out by the computer. All sellers know the likelihood of a consumer being a certain type, however they cannot identify the type of a particular buyer. The market for the product or service sold by the firm is a posted offer market. The firm sets two prices – one for Version 1 and the other for Version 2. The consumers can either accept one of the two prices (for the two versions) or reject both of them. The robot consumers use the following rule to buy or not buy: the robot buyer accepts the pricing option that gives them the greater surplus. If both pricing options give them a non-positive surplus, they choose not to buy. If they get the same surplus from both version 1 and 2, they randomly choose between the two. The sellers receive a commission if buyers Types 2 or 3 choose to buy Version 2.
The wealth of the firm changes as follows:
Period End Wealth = Beginning period Wealth + Price of version 1 × No. of consumers who buy option 1+ Price of version 2 × No. of consumers who buy version 2 + Commission.
The wealth of each consumer changes as follows
Option 1:
Period End Wealth = Beginning period wealth + Reservation value(v) – Price of product ($p(0)$).
Option 2:
Period End Wealth = Beginning period wealth + Net Value of Product – Price of product($p(1)$).
The Net Value of Product for each type is determined as follows:
Net Value of Product = Reservation Value(v) – Privacy Loss(c_H or c_L) + Value from Personalized product or service (w or 0).
This Net Value of Product is different for all four types of consumers depending on whether the consumers has a HIGH or a LOW privacy loss and whether the consumer has a HIGH or a LOW value for information.
Stage III 5 periods:
Same as Stage I.
Stage IV 15 periods:
Same as Stage II except some parameters changed.
Treatments (3): The main treatment variable is the privacy regime. The privacy regimes are specified by the relative magnitude of privacy losses of HIGH and LOW privacy types and the utility to revealing information. (3 Possible privacy regimes – Low, Medium and High)

- LPR: $w < c_L < c_H$
- MPR: $c_L < w < c_H$
- HPR: $c_L < c_H < w$

LPR represents a lenient privacy regime, which does not place legal restrictions on the firms collecting information, regarding the possible ways in which they can use the information collected. As a result the privacy losses of both the HIGH privacy type and the LOW privacy type exceed the possible benefits to revealing information. MPR correspondingly represents a medium level privacy regime, and HPR represents a High Privacy regime.

Control Parameters (2):

Gains from Trade: Relative Magnitude of total gains from trade (S) and the privacy loss of the HIGH/LOW privacy valuation consumer.

- LG (Low Gains): $S \le c_H$
- HG (High Gains): $S > c_H$
- ELG (Extreme Low Gain): $S \le c_L$

Ratio: number of Type 3 Consumers to Type 2 Consumers r_{32}

- LR: $r_{32} = \frac{1}{4}$ (Low Ratio)
- HR: $r_{32} = 4$ (High Ratio)

Table3 Parameters used in treatments

ID	v	w	c_H	c_L	S	u	r_{32}	λ_1	λ_2	λ_3	λ_4
1	20	2	15	9	12	10	0.25	0.2	0.4	0.1	0.3
2	20	2	15	9	20	18	0.25	0.2	0.4	0.1	0.3
3	20	2	15	9	7	5	4	0.2	0.1	0.4	0.3
4	20	2	15	9	20	18	4	0.2	0.1	0.4	0.3
5	20	12	18	5	13	1	0.25	0.2	0.4	0.1	0.3
6	20	12	15	5	12	0	4	0.2	0.1	0.4	0.3
7	20	12	15	5	20	8	4	0.2	0.1	0.4	0.3
8	20	22	15	5	25	3	0.25	0.2	0.4	0.1	0.3

Table4 Treatment and surpluses for buyers and sellers

ID	Treatment Cell	Predicted Prices (p_1, p_2) #	Expected Seller Surplus+	Expected Consumer Surplus
1	{LPR,LG,LR}	(20,13)	406	0
2	{LPR,HG,LR}	(20,7)	450	12
3	{LPR,ELG,HR}	(20,_)[2]	400	0
4	{LPR,HG,HR}	(20,13)	488	0
5	{MPR,LG,LR}	(20,27)	416	0
6	{MPR,LG,HR}	(20,27)	456	0
7	{MPR,HG,HR}	(20,27)	520	0
8	{HPR,HG,LR}	(20,27)	500	10

(p_1, p_2) are the prices charged for Version 1 and Version 2

+ Expected Seller surplus assuming 20 consumers per seller and the given distribution of consumer types.

% For all 20 consumers

Treatment id 1 in Table4, {LPR,LG,LR} specifies that the privacy treatment is LPR (Low privacy regime) with control variables LG (Low gain) and LR.

[2] Version 2 should not be sold

Table5 Sessions and Treatments

Session ID	Date	Treatment Sequence	# Sellers
1	5/27/03	0,2,0,8††	5
2	5/28/03	0,1,0,5	5
3	5/29/03	0,4,0,7	5
4	6/02/03	0,3,0,6	5
5	6/03/03	0,8,0,2	5
6	6/04/03	0,5,0,1	6
7	6/05/03	0,7,0,4	8
8	6/09/03	0,6,0,3	7

†† Treatment 0 is the market with no trade in information.

Each session consists of four stages: The baseline case: no trade in information was run once at the start (Stage 1) and once between the two privacy regime treatments (Stage 3). Stage 2 and 4 are the privacy regime treatments. Moving from Stage 2 to Stage 4 involves a change in the privacy treatment{LPR,MPR, or HPR} keeping the control parameters fixed. For example the session on 5/27/03 (See Table5) has a treatment sequence (0,2,0,8) which means that the baseline case (0) was run in stage 1 followed by treatment Id 2 (LPR,HG,LR) (see Table4) in stage 2, followed by the baseline case (0) in stage 3 and then finally treatment Id 8 (HPR,HG,LR) in stage 4. Note that in moving from stage 2 to 4 the privacy treatment changed from LPR->HPR keeping the control parameters HG and LR constant. Also, in order to rule out incorrect conclusions as a result of the order in which the treatments were executed, a session with the reverse ordering (in this case (0,8,0,2) on 06/03/03) was also conducted. We tested for the following hypotheses:

Privacy regime:

H1: Overall efficiency is higher in a higher privacy regime than in a lower privacy regime.

H2: Total surplus is higher in a higher privacy regime than in a lower privacy regime.

H3: Seller surplus is higher in a higher privacy regime than in a lower privacy regime.

H4: Consumer surplus is higher in a higher privacy regime than in a lower privacy regime.

Information Market:

H5: Total Surplus is higher in a market with trade in personal information than in a market without trade in personal information.

H6: Seller surplus is higher in a market with trade in personal information than in a market without trade in personal information.

H7: Consumer surplus is higher in a market with trade in personal information than in a market without trade in personal information.

5. Results.

The experiments were conducted with undergraduate subjects at Purdue University during the period 27th May–9th June 2003. The subjects were recruited from undergraduate classes in introductory economics and OBHR. There were 5-8 human subjects in each session. The average payment for each subject was around $23 and the duration of each session ranged from 1hr 15 min to 1 hr 45 min. Before each session instructions for the experiment were read out loud to the subjects. After the subjects were comfortable with the instructions, they were given 5 minutes to familiarize themselves with the interface. There was one interface (seller screen) for stages 1 and 3 and another one for stages 2 and 4 (see Appendix).

To test the hypotheses we calculated the means of the prices, surpluses etc for each seller for each stage and then ran the privacy regime hypotheses tests. We found significant ordering effects, i.e. the total surplus, seller surplus, consumer surplus and efficiency in a privacy regime, depended on the order in which the regimes were run in the experiment. Human subjects learn every period and so this result is not surprising. In order to remove the impact of learning we tested on regimes across sessions, i.e. a LPR in stage 2 (LPR_2) of one session, was tested against a stage 2 MPR (MPR_2) or HPR (HPR_2) of another session keeping the control parameters fixed. Similarly a stage 4 LPR (LPR_4) was tested against a MPR_4 (stage 4 MPR) or a HPR_4(stage 4 HPR). The results for the privacy regime hypotheses tests appear in Table 6

Table 6 Results for privacy regime hypotheses tests

		LPR_2-HPR_2	HPR_4-LPR_4	LPR_2-MPR_2	MPR_4-LPR_4	LPR_2-MPR_2	MPR_4-LPR_4	LPR_2-MPR_2	MPR_4-LPR_4
H1	*t*	-0.184	4.020	-1.456	-0.330	-1.76	0.661	-0.662	0.313
	(*p*)	(0.43)	(0.00)	(0.09)	(0.62)	(0.05)	(0.26)	(0.26)	(0.38)
H2	*t*	-1.840	8.744	-2.734	1.196	-4.960	2.601	-4.708	3.469
	(*p*)	(0.06)	(0.00)	(0.01)	(0.13)	(0.00)	(0.01)	(0.00)	(0.00)
H3	*t*	-1.349	3.308	-0.024	0.616	-1.095	-0.632	-0.170	1.057
	(*p*)	(0.11)	(0.00)	(0.49)	(0.27)	(0.15)	(0.72)	(0.43)	(0.15)
H4	*t*	0.440	1.911	-0.837	-0.257	-0.405	1.820	-1.273	0.930
	(*p*)	(0.66)	(0.05)	(0.21)	(0.59)	(0.34)	(0.06)	(0.11)	(0.18)

As seen from the p-values H2 was supported and there was partial support for H1. There wasn't significant support for H3 although the theoretical predictions, (see Table4) show that seller surplus should be higher in a higher privacy regime. Although our theoretical results don't predict that consumer surplus should be higher in a higher privacy regime, we still tested for it (H4) and found some support for it.

Table 7 Results for information market hypotheses test

		All Sessions	1	2	3	4	5	6	7	8
H5	*t*	-5.951	-2.665	-0.009	-5.889	0.048	-1.464	0.215	-9.280	-0.066
	(*p*)	(0.00)	(0.01)	(0.49)	(0.00)	(0.51)	(0.08)	(0.58)	(0.00)	(0.47)
H6	*t*	-2.457	-1.641	-0.037	-2.245	0.160	-0.557	0.495	-4.507	1.456
	(*p*)	(0.00)	(0.06)	(0.48)	(0.01)	(0.56)	(0.29)	(0.68)	(0.00)	(0.91)
H7	*t*	-1.636	-0.344	0.054	-1.023	-0.141	-0.387	-0.447	-0.244	-1.475
	(*p*)	(0.05)	(0.36)	(0.52)	(0.16)	(0.44)	(0.35)	(0.32)	(0.40)	(0.07)

The information market hypotheses tests were run for each session and for all session together. Just as for the privacy regime hypotheses tests, the means for the surpluses, prices etc were taken for each seller for each stage. When the data was combined for all sessions, all three hypotheses (H5, H6 and H7) were supported (see Table 7). For individual sessions, there was partial support for H5 and H6 and practically no support for H7.

6. Discussion.

A social planner would be interested in knowing the impact of stricter privacy laws on trade in information. Stringent privacy laws reduce the privacy losses compared to the benefit to the consumer from revealing information. The relative magnitudes of the privacy losses are parameters that a social planner can control. By varying the relative magnitudes of privacy losses w.r.t the utility from personalized services, we tested for different settings of privacy regimes. We tested the impact of trading in information and the impact of stricter

privacy laws on consumers and sellers and also the impact from a social perspective. Total surplus was found to be significantly higher in a higher privacy regime than in a lower privacy regime. Although our theoretical predictions showed that sellers would be better off in a higher privacy regime, the results from the experiment did not support it significantly. Consumers were found to be better off in the higher privacy regime although, the theoretical results made no such predictions. There was partial support for the efficiency being higher in a higher privacy regime. Thus stricter privacy regimes are better from a social sense since total surplus was significantly higher and there was partial support of efficiency being higher.

By combining data from all the sessions, and comparing the data for information markets with markets where there is no trade in information, there was support for the hypotheses that total surplus, seller profits and consumer surplus were higher in information markets. Seller profits results were mixed: in some sessions the sellers did worse in information markets while in others they did better. On further inspection it was found that the sessions in which they did badly involved the privacy treatment where it was non-optimal for sellers to participate in an information market. Human subject acting as sellers did not figure the optimal pricing strategy in these sessions and as a result they did worse. In the hypotheses tests where means of the surplus were takes for each seller for each stage, there was no support for the consumer surplus being higher in information markets compared to markets with no trade in information. Consumers were better of participating in an information market.

The results that we obtain however depend on our definition of the privacy regime. It is conceivable that the privacy regime could be defined in other ways and results could be different from what we obtained. Note that we were limited by the size of the lab where we ran the experiments, and so could run each session with only 5-8 sellers. This drastically reduced the degrees of freedom of the hypotheses test that we ran after calculating the mean of the surpluses of each seller in each stage.

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APPENDIX

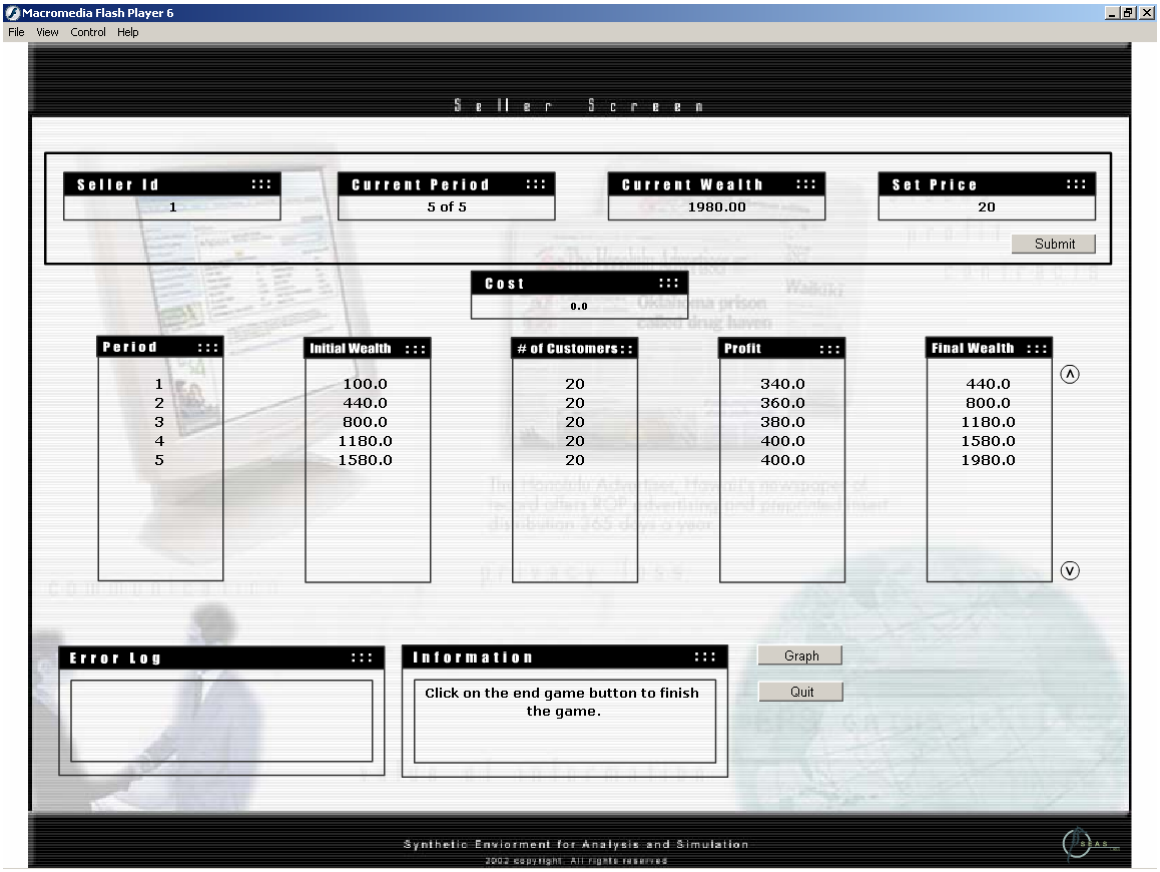

Figure .1 Seller screen stage 1 and 3

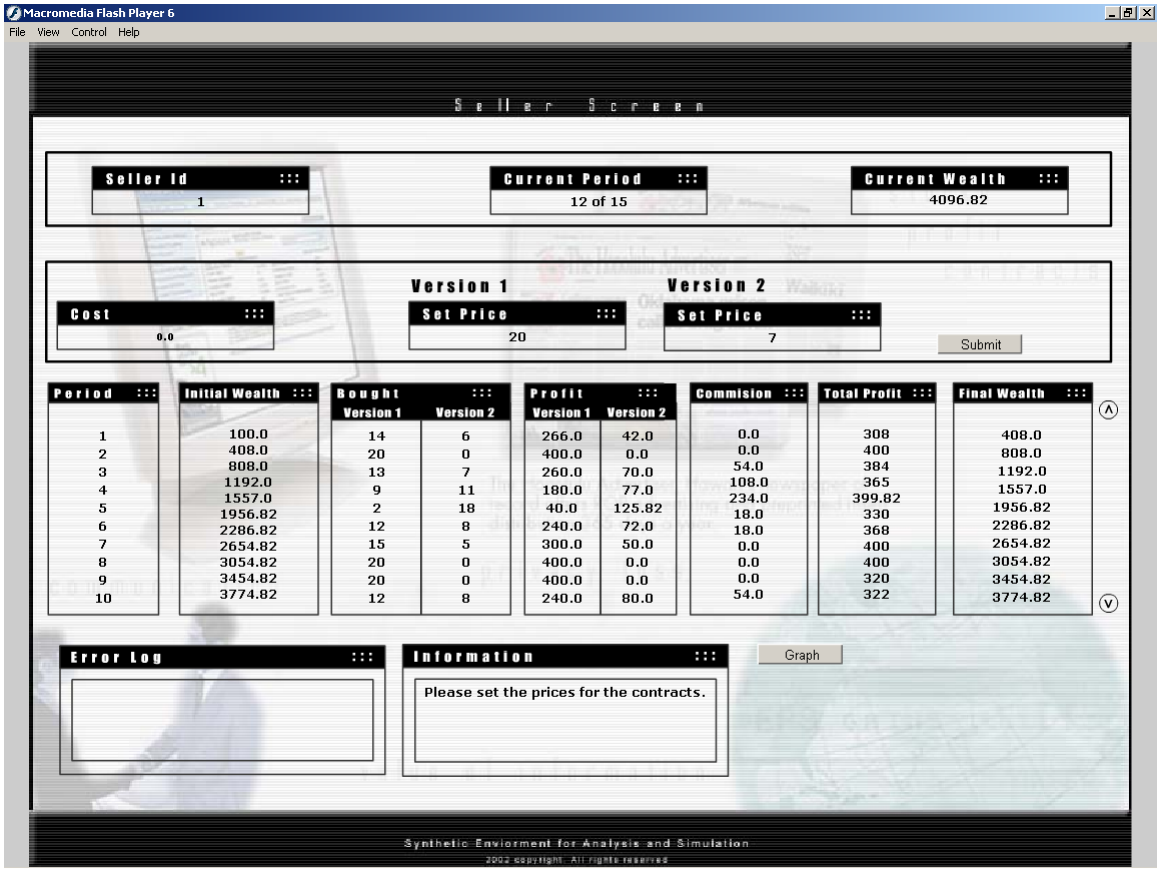

Figure.2 Seller screen stage 2 and 4