

EXTENSIONS TO THE THEORY OF MARKETS AND PRIVACY:
MECHANICS OF PRICING INFORMATION

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**Extensions to the Theory of Markets and Privacy:
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The theory of markets and privacy begins with the understanding that the current crisis in the privacy of personal information is a result of market failure and not “technological progress” alone. The market failure has occurred because of a poor social choice in the allocation of property rights. Under current law, the ownership right to personal information is given to the collector of that information, and not to the individual to whom the information refers. Individuals have no property rights in their own personal information. As a result, they cannot participate in the flourishing market for personal information, i.e., they receive no compensation for the uses of their personal information. As a further consequence, the price of personal information is so low that information-intensive industries become inefficient in its use. The price is low because the price of personal information does not reflect the true social costs of coping with personal information. The market is dominated by privacy-invading institutions. And as a further result, there is a disturbing growth in privacy invasion, an excessive and abusive disregard for the interests of many in keeping elements of their life private, or at least under their control.

These abuses of personal information are reflected in attitude surveys which over the last decade have recorded a growing public distrust in how major institutions use

personal information, a wide-spread feeling of frustration and hopelessness, and the belief that “individuals have lost all control over their personal information.” (Equifax, 1996). There is a growing anger in American public opinion over the loss of control over personal information.

Like other market failures, the personal information market failure results in enormous asymmetries in power and information. For many Fortune 500 firms, personal information is a strategic asset. As it turns out, privacy invasion pays handsome rewards. There is already today a lucrative market in personal information, but ordinary individuals cannot participate in the market (because they have no property interest), they are completely mystified about how their personal information is used in the market, and they have almost no tools to influence how major institutions use their information. The transaction costs for obtaining information by large institutions are small and falling, while the transaction costs which individuals incur in obtaining even a copy of their, say, medical record, are very high. In other words, the tools available to citizens to protect their information rights—as few as they are—are too costly to use! Contrast this situation to the average person’s understanding of the automobile market in the US: trading locations are known, seller and buyer rights are fairly clear, information about quality can be obtained, transaction costs for buyer and seller are more equal, and disposition of the asset is finally decided by the individual.

The Limits of Privacy Legislation

A second element to the crisis in privacy is the inability of the society to elaborate a set of concepts and policies to rectify the market failure. Over the last twenty years,

since the landmark report of the Privacy Commission in 1972, the societal response to privacy invasion has been a regulatory response driven from Washington and State capitals. In an effort to correct the market failure, political executives and legislators have passed more than twenty pieces of federal legislation, and hundreds of state statutes, which attempt to provide individuals with due process rights to their personal information, without at the same time, granting individuals ownership rights.

The regulatory efforts of the last twenty years have attempted to reduce the asymmetries in information and power which the market failure creates. Regulatory efforts have, for instance, tried to define due process rights for individuals vis-a-vis personal record systems. These efforts are informed by a doctrine called “fair information practices” developed in the late 1960s, an era when only a few large scale national institutions possessed national information databases.

There are two kinds of government regulation in response to market failure situations. One type affirms a “natural monopoly” and tries to regulate price and access. Public utilities and common carriers fall into this situation. The other kind of government regulation attempts to introduce competition, create a marketplace, and reduce the market power of large institutions. Unfortunately, privacy legislation of the last twenty years falls into the former camp: it reaffirms the market failure by securing the property interest in personal information for the gatherer, and denying ownership to individuals.

The current privacy legislation perpetuates a central dilemma of the information age: how can we live in a society where individuals can have as much information privacy as they want, and yet where the economic benefits of using personal information in commerce are optimized?

The Legal and Economic Foundations For Individual Ownership of Personal Information

An earlier paper attempted to lay the legal and economic foundation for a true marketplace for personal information (Laudon, 1996) In this marketplace, individuals would retain the ownership in their personal information and have the right, but not the obligation, to sell this information either to institutional users directly, or, more likely, to information intermediaries who would aggregate the information into useful tranches (e.g. blocks of one thousand individuals with known demographic characteristics) and sell these information baskets on a National Information Exchange.

Individual ownership of personal information can be anchored within British and American common law. The common law tort of appropriation protects the right of celebrities to own their images, likenesses, voices, and other elements of their persona. To appropriate personal images of celebrities for commercial purposes without consent or payment is recognized by the courts as an appropriation. Likewise, it is conceivable that courts and juries could be convinced to protect the personal “data images” of ordinary citizens. These data images have somewhat less resolution than a photographic image, but they are increasingly and profoundly descriptive and predictive of human behavior. As computers extend their powers, these data images will approach photographic resolutions.

The economic foundation for individual ownership of personal information can be found in the theory of markets (and related theories of governance) and the theory of externalities. Markets are likely the most efficient mechanisms for allocating scarce resources. Governments should intervene in markets only if markets fail. Markets do fail

under conditions of monopoly, asymmetries in power and information, and public goods. Governments should either seek to restore markets or regulate the activity. In the case of personal information, the market has failed because of asymmetries in power and information brought about by poor social choice in the allocation of property rights to information. The price of personal information is far too low, and therefore its abuse in the form of privacy invasion is far too cost beneficial to those institutions that dominate the market. The function of government here should be to restore the power of one class of participants in the market, namely individuals, by vesting ownership of personal information in the individual. A second function of government is to ensure the orderly functioning of a personal information marketplace.

The failure of the marketplace results in significant negative externalities for individuals. These externalities are experienced as excessive indirect and direct costs involved in “coping” with information. Coping costs include tangible costs like excessively large mail handling facilities (public and private), and loss of attention, to intangible costs like loss of serenity, privacy, and solitude. These negative externalities must be balanced against the positive externalities of nearly unlimited exploitation of personal information which results in enormous amounts of marketing information being delivered to consumers (whether they want it or not). However, it can no longer be blithely stated that these positive externalities fully compensate individuals or society for the negative costs of unlimited exploitation of personal information.

Adding Value Does Not Legitimize Appropriation

Information gathering institutions often argue that a personal name and address has zero value. In fact they argue, personal medical, credit and related information also has no value per se. The large institutions, for whom personal information is a strategic asset—or so they claim in their annual reports— argue that by collecting information on individuals from a variety of sources, and mixing this information with other information, they create the value in personal information, and therefore this value belongs all to them. In this argument, property results from the “sweat of the brow” expended by gathering institutions.

“Sweat of the brow” is only one element in the theory of property. Actually, the largest portion of wealth in America is inherited, not created. Surely “sweat of the brow” is a weak theory when it comes to personal information. For instance, if a thief steals your car, fixes the car, paints it, and mixes it with a fleet of stolen cars, then indeed the thief has added value to the car and the collection. But these actions by the thief do not therefore transfer ownership to the thief. To argue that information gathering institutions add value to my personal information by compiling, collating and mixing in a database, does not solve the question of ownership. To say information gathering institutions have exclusive property rights to my personal information because they have added value to the information simply begs the question of who owns my personal information. Whether or not my personal information appears in a collection, or was mixed with other information, is not decisive for the question of ownership.

I. Research on the Mechanics: How Will Personal Information be Priced?

The theory of markets and privacy raises many mechanical questions of implementation. Currently, with colleagues at New York University's Stern School of Business, we are planning research in a number of areas. Here are some interesting researchable questions raised by readers of an earlier theoretical paper:

What would individual citizens deposit in local depository institutions? Their "information" or their "information rights." How would these rights be transferred?

What would be included in these rights—the right to use only certain information, all information? For what period of time could these rights be sold?

How would depository institutions or traders on the National Information Market, price individual personal information?

How could people be compensated for the use of their information? How could any mechanism keep track of the uses of all this personal information over a period of a year?

I believe each of these questions has a sensible and practical answer. We are exploring answers in a forthcoming book called *Privacy and Markets*. In this paper, we sketch out two lines of on-going research which address the question of information pricing.

Finding the Price of Personal Information Baskets

It is amazing how little is known about the economics of personal information in an age when the trade in personal information has become so vital for the conduct of efficient markets and transaction systems. Currently we are pursuing two lines of research: (1) what are the economics of existing personal information markets, and (2) experimental simulation of market pricing mechanisms to test various formal models of pricing.

(1) the economics of existing personal information markets. In this “information economy” about 65% of the GDP is generated in the “information sector” and about 70% of the labor force is engaged in “information processing” activities (which does not include lower level service activities). The precise role of personal information in the information sector—as opposed to all other kinds of information on things and places—is not known but it can be assumed to play an important role. The FIRE (Finance, Insurance, Real-estate) industry is one of the largest generators and users of personal information, accounting for 1.1 trillion dollars in GDP, over 500,000 establishments and seven million employees. Even here, there is no accounting of the dollar amount of personal information trade. The Statistical Abstract of the United States does not have an index entry for “personal information,” or for “information.” How odd this all seems as we enter the “Age of information.”

Everyday trained professionals buy and sell enormous baskets of information on millions of individuals in the form of mailing lists, computer data files, demographic information, and locational information. We know that governments, credit granting institutions, insurance firms, and credit reporting agencies are the major sellers of personal

information, as well as the major purchasers. We know that this trade in personal information involves billions of dollars in trade. And yet we don't know the total size of this trade, how traders decide the purchase and selling prices, or even how much a driver record, medical insurance, or credit record is really "worth."

One line of our research is therefore is a series of interviews and questionnaires aimed at professional information brokers in the FIRE and marketing industries. The aim of this research will be to understand the size, structure and operation of the existing marketplace in personal information, and to understand the underlying pricing strategies of market participants.

**(2) Experimenting with the economics of future personal information markets:
finding the price of information**

On one Internet site, people are paid to read advertisements, and to reveal their personal preferences. More sites like this can be expected and are a harbinger of future information markets in which individuals are paid for revealing information about themselves. In fact, personal information markets are springing up all around us in response to the reticence which individuals feel about giving away personal information. In another unobtrusive information market, customers at supermarkets are given "discount cards" scanned at every purchase. The scanned information contains their personal name, as well as all purchase information. The information is then sold to marketers and manufacturers. Customers receive payments in the form of store discounts on selected items (which people truly want) and other "payments" in the form of product

promotions sent to their home, or unsolicited phone calls to their home (which most people do not want).

How do ordinary people decide the purchase and selling prices of their or other personal information? We will be pursuing answers this question at the Economics Laboratory at NYU's Department of Economics. Using student subjects, we will create a market place in which baskets of personal information having variable attributes of demography, accuracy, and currency can be traded by student subjects (See the article by Hal Varian 1996 in this collection). At the end of the experiment, subjects will be allowed to keep their trading profits, a nominal reward for participation.

Using this data we hope to test various formal models of information pricing. The pricing of personal information is probably no different from the pricing of other kinds of information. Students must answer this question every day: how much is the basket of information called a "college degree" really worth? My MBA students continually worry about this question: will I ever earn back the \$50,000 dollars which an MBA degree costs? What formal models do we have to answers this question, and to test in the laboratory or against real-world data?

(a) discounted cash flow methods with no learning. Students and experts tend to see the value of college degrees, and perhaps all baskets of information, as a rather linear return on investment problem, in which the worth of information today is equal to the discounted cash flows which the information will produce over a period of time. Or

$$NPV = -C_0 + \sum \frac{A_t}{(1+r)^t}$$

Where NPV = the net present value of information

C_0 = the cost of information at the start (t=0)

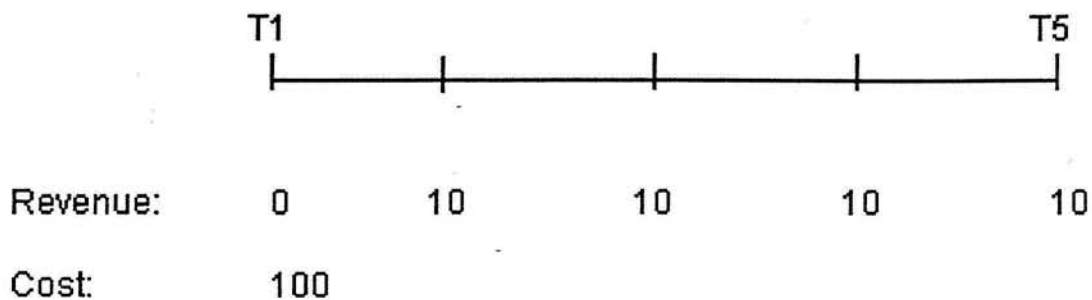
A_t = the cash flow at the end of the period t

T = the number of years we are calculating returns

r = the risk based discount rate based on the rate of return for investments with similar risk.

This model assumes the possession of information today does not really influence the possession of information in the future, and therefore it assumes a linear view of the information valuation and acquisition process (See Figure 1).

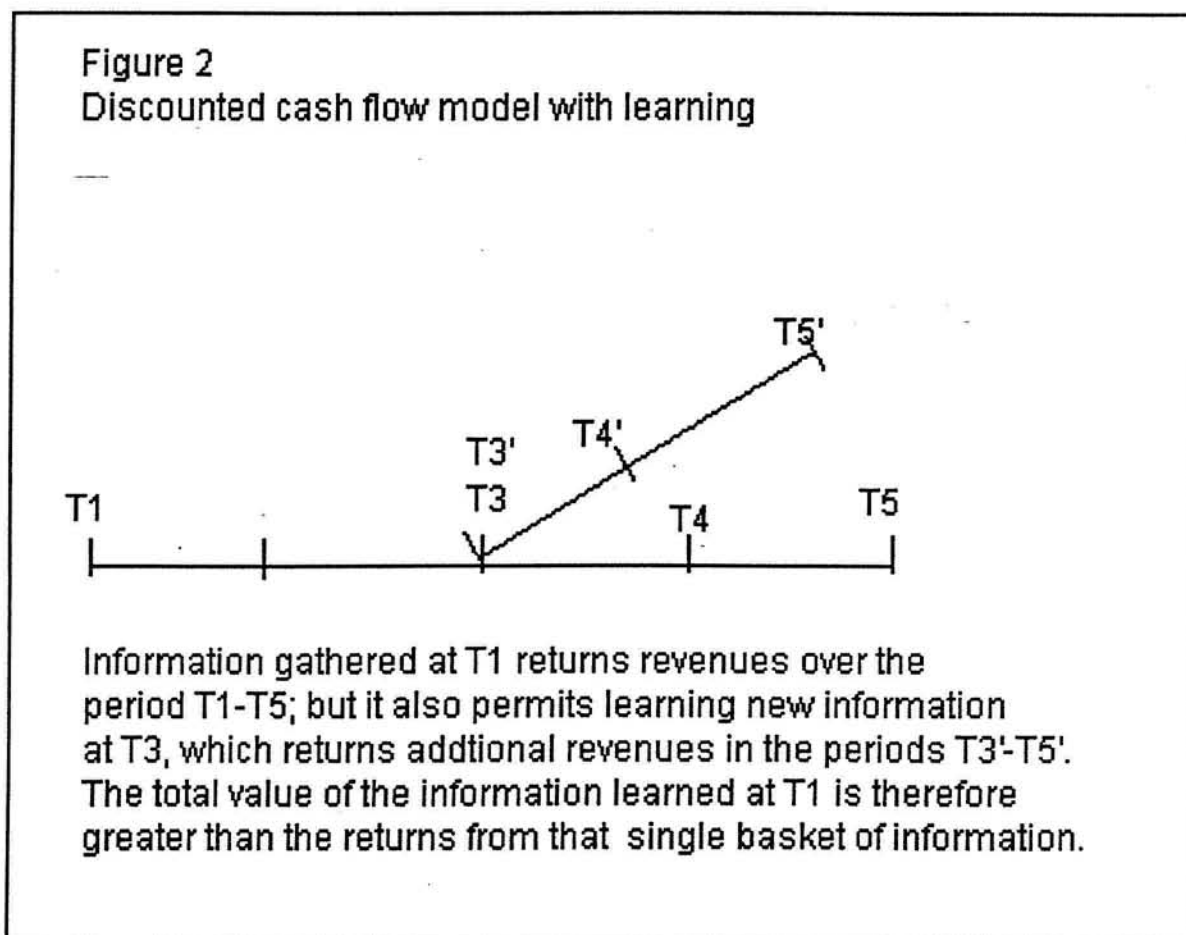
Figure 1
A simple discounted cash flow linear model of information value



Whenever people value a college degree in terms of its future income producing potential, they typically are using a discounted linear cash flow model. Similarly, information brokers in a marketplace might price information baskets based entirely on the expected future cash flows associated with the basket of information.

(b) discounted cash flow with "learning" effects. While the acquisition of knowledge and information can be serendipitous, abrupt, and unexpected, it is often cumulative. That is, learning a piece of information now will help you learn more information in the future.

See Figure 2.



People and organizations do learn sometimes, they accumulate information, store it in the form of learned routines, and occasionally act on what they have learned. This would suggest a branching problem in which the value of information today is actually much greater than the cash flows produced by that single basket of information. Instead, we need to increment the discounted value of a single basket by an amount equal to the value of future information that might be learned (and which could not be learned or acquired if the initial basket of information was not purchased). Dos Santos has suggested a two stage discounted cash flow model that could be useful in predicting how individuals value information baskets:

$$NPV = -C_f + B_f/(1+r) + E(V_{ssp})/(1+r)$$

Where $E(V_{ssp})$ = the expected value of second stage learning

$$\text{and } E(V_{ssp}) = p_1 (b_1/1+r) + p_2 (b_2/1+r) - C_s$$

Where:

p_i = probability that state i occurs

b_i = expected revenues generated from the information

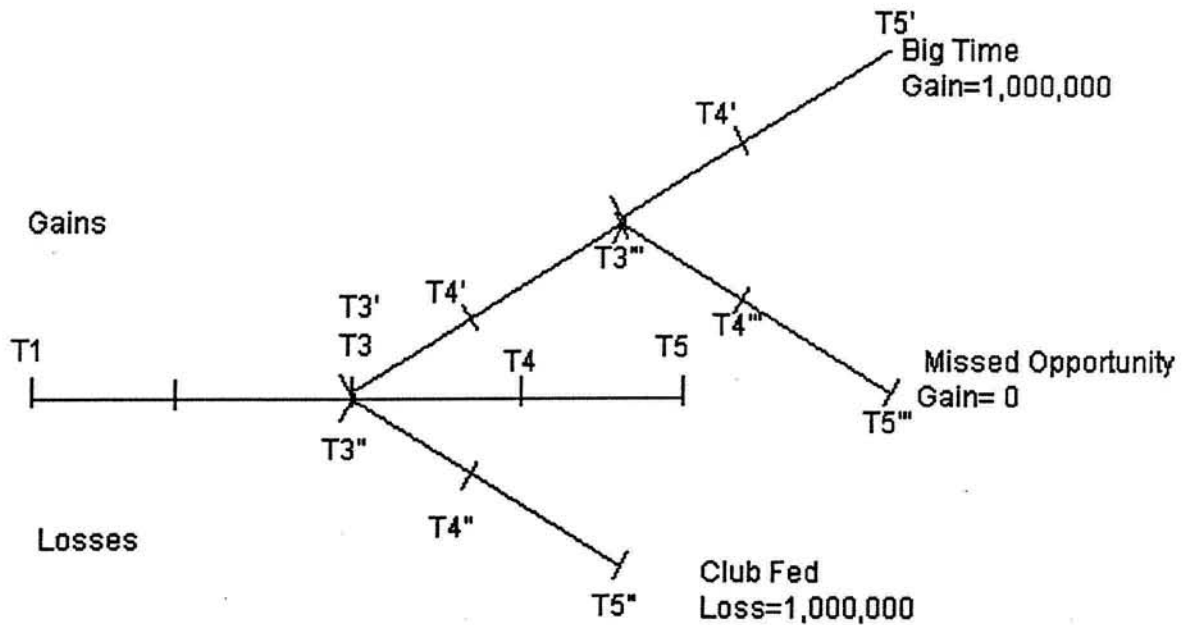
C_s = cost of obtaining the information in the second stage

In this instance, when students say “the finance course I take today will help me make a killing on stock options after I graduate....” they are using some sort of two-stage discounted cash flow model to establish the value of information. So also information brokers in a marketplace might pay a great deal more than net present value for information baskets based on returns from a single basket. Instead, brokers might pay a

“learning premium” in the belief that what personal information they buy today about individuals will allow them to learn even more about these same individuals in the future.

(c) *discounted cash flow with “learning” effects and “loss avoidance”*. So far we have assumed that individuals are forced to learn in the second stage. In fact, once people know a little information, they can decide whether or not to learn more and how much to spend on learning it. So, for instance, students will say “I don’t know if I should seek a position in Europe or the US. I will take some courses first, and then I’ll decide that when I “get there.” If I need additional courses to meet some requirement, I will take the courses when needed.” When students “get there” they may find that one option is worth 0, and another option is worth some positive number. They will choose the option with the highest benefits and avoid losses or zero benefits. See Figure 3.

Figure 3
Discounted cash flow model with learning and loss avoidance benefits



In this more complicated model, learning poses the prospect of both gains and losses. The price of today's information is not simply equal to its future revenues, but instead reflects both future revenues, additional learning, and loss avoidance.

Learning poses many hazards. One might learn the wrong thing, or put learning to the wrong ends. In teaching a course on business ethics, the faculty often point out to students that what they learn in business school could indeed lead to being in a position to make just the right decision at the right time, and to make a great deal of money. Or, alternatively, what they learn today could lead directly to Club Fed, that federal penitentiary system established for white collar felons. Sometimes, people learn the wrong things, or learn the right things but apply them to the wrong ends. The point of learning is in part to avoid future loss. People may pay a considerable amount to avoid a loss.

Dos Santos provided a modified version of two stage discounted cash flows by setting the revenues of the second stage learning to:

$$b^i = \text{Max}[0, (b_i/(1+r) - C_s)]$$

In this formulation, the value of information learned now is greater than merely the summation of discounted cash flows in the first two time periods. The value of information is greater by an amount equal to the value of avoiding a loss or a zero return on the cost of investing in new information. Information brokers in an information marketplace might pay a “loss avoidance” premium for information which they thought could help them avoid future losses. For instance, knowing the DNA information for a basket of individuals would be very useful and valuable for employers and insurers because it could great decrease future losses, or at least permit adjusting the cost of insurance to personal risk.

(d) Options models. Discounted cash flow models, no matter how modified, have limitations. All possible outcomes are assumed known, the probability of each outcome is known, and the value of each outcome is known. Also most troublesome is the selection of the discount rate which has a powerful effect on economic benefits. One is supposed to choose a discount rate of roughly equivalent market risk. The risk of buying various kinds of information is not well understood.

One possibility is to consider the price of a basket of information today as an option on future revenue streams which will come from the use of that information in the future. A call option gives the holder the right to purchase a share of stock for a set

exercise or strike price in the future. The real market price of the stock may be much higher than the stock price because it either pays dividends or simply has a current value greater than or equal to the exercise price. Of course, there's always the risk that the stock value will decline lower than the strike price, and hence the option will be worthless.

Likewise, buying a basket of information today is like buying an option on future uses of that information. Just like a stock option, the owner of an information basket may not exercise the option if, at the time of the exercise date, the expected revenues are less than the exercise price. So, for instance, when students say, "I don't know what will be 'hot' five years from now—investment banking or corporate finance—so I plan to take a wide variety of courses and be ready to move in either direction when the time comes," they are unconsciously invoking an options model to evaluate the "worth" of today's information. They are in effect buying an option (paying \$50,000 to purchase MBA courses) on an underlying asset (their future possible careers) in the belief that at some future point they will be able to make a judgment or decision which will produce returns of some sort.

Options models are useful to consider because (a) the price of options reflects the riskiness of the underlying security, and (b) they reflect the ability of individuals to make decisions about future information gathering costs over time. A model for pricing options as been developed by Black and Scholes, and a modification of that work by Margrabe offers the possibility to extend the original model to a situation where one risky asset (information gathering costs) for another risky asset (future revenues from baskets of information). These models are beyond the scope of this paper but are described in Dos

Santos. In options models, the price of the option is related to the underlying variance of the security or stock. The greater the variance, the greater the price of the option because the potential rewards are greater. This is opposite of the case with discounted cash flow models where variance of future revenues decreases today's value. Options models will probably overestimate the price of some personal information, but they may be quite accurate for other kinds of information. For instance, for certain types of information which does not change much—say for instance name and social security information—market brokers would probably pay little using an options model. However, for information which has great variance and where currency is important—like say medical condition—brokers might pay a lot.

(e) information and co-specialized information assets. The value of a basket of information is probably a non-linear function of the number of information dimensions which characterize the basket. This seems to defy the law of diminishing returns. Few things defy the law of diminishing returns. Networks may be one such phenomenon. It costs close to zero to add another person to a computer network, or telephone network, but the margin revenues or other gains are substantially greater than zero. Brands may follow a similar pattern: the more people who use Microsoft Windows the more valuable the operating system (and Microsoft) become.

Personal information baskets may have network features. We might think of information baskets as interconnected network nodes, and the more nodes we have the more valuable the whole package. A name and address, by itself, has little value. A name,

address, and occupation, has considerably more value; name, address, occupation, zip code, medical history, driver history, and credit record probably has a much higher market value. The more dimensions included in the basket, the greater the value by some exponent. At some point of course the cost of finding out more information exceeds the expected returns.

There are several implications. An individual person who sells rights to his/her information should charge considerably more for selling the “complete persona” than should be charged for, say, just a medical record, or credit history. A buyer of the complete persona should be willing to pay a great deal more than for small bits and pieces of the person, especially given the likely high gathering costs for small chunks of personal information which later must be collated with other information.

An interesting situation arises for holders of information assets. For instance, if an employer already holds job performance and psychological evaluation information on an employee, along with demographic data, how much would the employer be willing to pay for additional dimensions of employee persona like medical records, DNA records, credit, and so forth. Obviously the value of information on hand (co-specialized assets) would be greatly enhanced through the purchase of a few more pieces of information. But the sellers of personal information would not know this fact. In other words, holders of information are advantaged in the marketplace, and the buyers are better off than the sellers because the buyers total information value will greatly expand by purchasing just a few pieces of information and mixing it with information already on hand. The sellers will not know this. The best strategy for sellers will be to sell the “whole persona” rather than

sell bits and pieces. The best strategy for buyers will be to avoid buying the “whole persona” and instead to buy bits and pieces.

Conclusion

It is unclear at this time which of the four models (a-d) are most useful in characterizing how people evaluate the price of information, or which strategies will emerge in future information markets. As Tversky and Kahneman have discovered, people overestimate the risks of extremely rare events (shark attacks) and greatly underestimate the risk of likely events (having an accident on the way to the beach). Likewise, people may underestimate the future value of information gathered today relative to the value of its future uses, and overestimate the cost of today’s information gathered today relative to its future value. We simply don’t know how people in fact behave in information markets. If we to hope to understand privacy in our time, we will have to understand the market mechanisms which shape the flow of personal information.

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