MEASUREMENT
As a Contracting Problem[1]

A. Measurement is Costly & Potentially Wasteful

Whenever two parties trade, they must measure the thing that is transferred. When the trade is effected, there is an incentive for the buyer to deflate the quantity or quality recorded for the sale and for the seller to inflate these measures. Moreover, the buyer has an incentive to over measure and to reject components of the sale that represent less than the average value of the bundle.

Where quality is costly to measure, minimizing this cost while protecting the integrity of contracts is valuable. For instance, if a vendor offers lumber in a bin for sale at $1 per board foot, buyers have an incentive to pick through the bin to find the higher quality pieces. If the vendor sets the price of $1 based on the average quality of the lumber, then half of the lumber will be sold and the other half ignored until the price is reduced. If the vendor raises the price to, say, $1.5, a competitive disadvantage may result and only a fraction of the lumber will then look attractive to the consumer.

More precisely, the buyer's behavior can be decomposed into a two-step process. First, the buyer chooses the vendor based on the expected quality of the average unit and per-unit price offered. That is, the buyer searches across vendors on the basis of the expected quality/price ratio and chooses the vendor that offers the highest average value per dollar. Second, the buyer picks through the lot offered by the vendor, sorting to find pieces of higher than average quality. This sorting continues so long as the value of the marginal increase in quality exceeds the marginal cost of sorting.

Sorting of this sort is wasteful. If sorting is profitable, then nearly each item is sorted by each buyer in addition to the sorting performed by the seller. The full cost of the good is the posted per-unit price plus the cost of sorting. If the average item is sorted multiple times the average cost is raised by the multiple of the sorts. Costs can be lowered by stopping sorting by the buyer. One way that the vendor solves this problem is by making it costly for the buyer to pick through the stock. The vendor sells in lots, sight unseen. This leads to the rational suppression of information—selling a pig-in-a-poke.

Since sorting is profitable when variance is high, the seller can stop buyer sorting by reducing quality variations. If quality variations cannot be obliterated, then the seller can bundle goods so that the there is no variation across bundles in the average quality per bundle even though within each bundle the variation is large.

If the seller suppresses information about product quality in order to stop buyer sorting, the buyer may be uncertain about the average quality as well and, thus, uncertain about the choice of vendor. Brand names and reputation are a way to solve this problem. (Oscar Mayer bacon)

Sometimes buyers have a lower cost of sorting than do sellers. Even so, it is not necessarily efficient for buyers to sort before the purchase because multiple sorts may still be wasteful. If the quality dimensions are idiosyncratic to the buyers, then multiple sorts are efficient. If the dimensions are common, multiple sorts are inefficient. When buyers have the cost advantage in sorting on common dimensions, warranties are a way of stopping pre-purchase, multiple sorts.

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[1] Barzel, Yoram. "Measurement Cost and the Organization of Markets," *Journal of Law & Economics*, April 1982, 27-48.

B. Measurement Cost & the Structure of Contracts

Measurement cost can be used to explain the existence of the firm. The firm centers the sorting authority in the manager/owner. Otherwise, each resource supplier to the firm would have to measure the quality of the input by each other supplier. Multiple sorts are inefficient. This, however, does not add much to our understanding of the firm over and above Alchian & Demsetz/Coase.

Measurement cost can also be used to explain the nature of many contracts that we see between firms. A notable example is that of book publishers and writers. The standard contract involves a royalty rate between the publisher and the writer. The writer is paid a percentage of the sales of the book. Often this percentage increases as total sales grow. Also, it is common for the writer to receive an advance from the publisher in up-front cash against the future royalties. Why is this contract structured in this fashion?

It is not risk aversion. Measurement cost explains it. The writer has the most knowledge about the value of the book. This knowledge is most acute in the dimension of whether the book is a best seller or merely good. If the publisher has to pay for this value up front, then it must take measurements which are costly. Similarly, the activities of the publisher in bringing out the book affect the initial sales. These activities are similar across the many writers the publisher deals with. The cash advance is a way of paying the writer so that he does not need to measure these efforts. Cash is advanced against royalties as a way for the publish to get its money back if the book sales reach some minimum level. The prediction is seasoned authors of boiler plate books like murder mysteries will get big advances, possibly not against royalties, where as green authors will get all their money as royalties—they make money only if and when the sales roll in.

It is interesting to compare book writers to newspaper writers. News people are paid a straight salary. The news editor "measures" the value of the stories as they fit into the overall paper. There is no measurement reason to make the writers' pay dependent on the amount that they write. Moreover, it would induce excessive measurement on their part to try to make their pay dependent on the number of papers sold.

Co-authored books between high profile celebrities and parrot writers are predictably fashioned in the following way: The celebrity gets a check when the manuscript is finished. If the publisher signs the contract with the celebrity and then hires the parrot writer, this co-author gets paid like a newspaper writer, that is, a fixed payment. The publisher is the one with the market knowledge and can cheaply measure the value of the manuscript when it is turned in and during the revision stage. On the other hand, if the co-author puts the project together (that is, has the imagination about the project) then this write gets paid on a royalty basis.

The patent rights are similar. It is commonly the case that patent rights are leased on a royalty basis from the patent holder. For instance, an individual holding a patent on a machine design will be paid a royalty by a large corporation for each of the items they produce. This is true even for an exclusive lease.

This does not seem to make any sense? It would seem that the individual would prefer to sell the patent outright. This would capitalize the expected value of the design and move the risk of demand fluctuation from the individual to the corporation. Since the corporation can more easily bear this risk, because its stock and bond holders can fully diversify in the securities markets, such a lump sum payment seems efficient. Moreover, a lump sum payment would make the corporation producing and marketing the good full residual claimant to the efforts that they can control.

The explanation for the royalty payment must lie in the fact that the patent holder has the best idea about how useful or profitable the patent will be. Because the inventor has this information and not the corporation, the inventor must bear the risk. The corporation is not willing to pay the inventor the asking price in one lump sum because there is no way to know if the inventor is telling the truth or just telling stories.[2]

There is only a subtle difference between the information-measurement problem and the problem of shirking/opportunistic behavior. The book publisher or patent user might reasonably be portrayed as worrying about shirking/opportunism or, alternatively, as being unwilling to undertake costly measurement. Even if there are few distinguishing differences between the arguments, the idea of measurement gives additional flavor to the overall theory. Two other examples show the value of this added breadth.

The DeBeers corporation sells diamonds. Their virtual monopoly in the sale of diamonds is no longer driven by a monopoly in mining the stones. Rather, the fact that diamond mining companies choose to sell their stones through the DeBeers' network seems to reflect the particular effectiveness of the selling organization. The facts of the selling organization are as follows:

DeBeers invites diamond buyers to purchase stones from them. The buyers submit bids for quantities in various ranges of quality. DeBeers prepares packages of stones which are then presented to the buyers on a take-it-or-leave-it basis. There is no negotiation over price. The buyers can inspect the stones. Only if a stone in a sight is grossly mislabeled (not of the general quality requested), can the buyer request that the stone be replaced. The buyer can refuse the bundle. However, that buyer will never be again invited to purchase from DeBeers.

The other example is the booking of movies.[3] Before outlawed by the courts, movies were sold as a blind block by producers to theaters. Producer-distributors negotiated with theaters for a package of movies with a particular schedule over the coming year. Since the movies were not yet made, the booking of the block was obviously blind. The contract involved a sharing of revenues from ticket sales. The standard contract called for the share received by the producer-distributor to increase to its maximum value only after some trigger level was reached.

Measurement is at issue in both of these cases. In the DeBeers case, the diamond buyers have an incentive to reject the sight if its average quality is not greater than the price per carat, or to reject the sub average stones in the sight. To stop them from doing this, DeBeers makes it profitable to be an invited diamond buyer. This means that most of the time, the average quality exceeds the average price. Sometimes it does not, but the buyer just sucks that up. On the other hand the buyer has to worry about DeBeers shorting him and then not making it up in the future. However, the brand name of DeBeers insures that this won't happen. The no-negotiation buying scheme reduces the amount of diamond inspection and is efficient as a result.

In the movie case, the producer-distributor has to protect against the exhibitor rejecting a picture or cutting short a run once the movie's true drawing power is revealed. The producer makes a series of movies for the season. Some are good, some are not so good. Total revenue is

[2] Once the patent is proven, we expect that it will be acquired by a corporation and leased by this entity to multiple users on a royalty basis. Efficient pricing of patents and the like should be done on a per-unit of output basis. Even so, this does not always happen. It is common for individuals to continue to hold patents, which also seems only explicable on the basis of measurement. Possibly, only the inventor knows the likelihood that the invention can be superceded.

[3] Kenney, Roy W., and Klein, Benjamin. "The Economics of Block Booking," *The Journal of Law & Economics*, October 1983, pp. 497-540.

maximized by showing not only the best but also the so-so. Even so, the exhibitor has an interest in substituting out of the mediocre. To stop this, the producer makes the exhibitor sign a block contract. On the other hand, to ensure that the producer lives up to its promise to devote a certain level of resources to movies throughout the season, the contract front loads the revenues to the theater. This way, the theater gets the larger share of profits from the dog movies and the producer has to make a few big hits to make its money.

In general, these stories tell us that the suppression of information maybe valuable but it creates the potential for opportunism on the part of the seller. To solve this problem the seller can use sharing contracts, brand names and warranties. Brand names bond performance by creating a price premium that will depreciate if the seller distributes a product that has lower quality than that expected by the customer. Brand names require that the manufacturer measures the product prior to sale. If it is cheaper for the customer to measure the product after the sale, then the brand name product will have a higher cost than a product that is warranted. Because it has higher cost, it can only compete in markets where that higher cost is a smaller percent of total price, that is, in the high quality end of the spectrum.

C. Some Other Examples

The story goes that the automobile market is plagued by the problem of lemons. Hidden flaws exist in used cars and because of this the market may have no equilibrium.[4] By this I mean that anyone who has a used car that is any good will keep it because if it is put on the market, everyone assumes that it must be bad. Because the seller knows more about the car than the buyer, price is determined by the average quality of the cars on the market. However, half of the sellers will be receiving less for their autos than the cars are worth. Thus, they refuse to put their cars in the pool. In the limit this problem will cause there to be no used car market, just like Barzel's sorting problem. However, there is a used car market. Some equilibrium does obtain. Even so, we wonder how much the equilibrium is affected by informational asymmetries.

One way to pose this question is: "How much of the reduction in resale value in the first year is attributable to asymmetric information?"

Let's turn to cows:

In any exchange, Barzel (1982) notes that the determination of value of the exchanged commodity is costly. The cost of measuring the attributes and the cost of verification of measurement will be different for buyers and sellers. A potential remedy to the measurement cost problem is to use a proxy or signal. The less alterable the signal the more effective and more frequently it will be used compared to signals that can be manipulated.

Allen (1993) employs the signaling solution to explain veal calves sold at auctions.[5] In general, all breeds of cattle are sold at auction. Most calves sold at auction are raised to be slaughtered for beef. These are called feeder calves. Most calves sold at auction are four to seven months old and weigh around 500 pounds.[6] Veal calves differ from apparently identical feeder

[4] Akerlof, George. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism" in Quarterly Journal of Economics. Vol 84. 1970. P488-500.

[5] Allen, Douglas W. "Pot-Bellies, Cattle Breeds and Revealing Signals" in Economic Inquiry. Vol 31. 1993. P481-487.

[6] Beef cattle have a slaughter weight of around 1200 pounds.

calves in the method by which they are raised. Veal calves are raised in small pen in order to restrict muscle development and are fed only high quality grains and/or milk in order to produce tender pale meat. Calves raised on cheaper hay will develop to approximately the same size but will have a dark red meat.

At auction, sellers have advantage over measuring the attributes of calves, since they know what the calves are fed and how they are raised. Buyers, on the other hand, are unable to identify the sellers nor do they know how the animal were raised. Despite asymmetric information, there are sales of veal calves at auctions.

The reason for this is that Holstein calves give a signal concerning the quality of that they will yield veal meat. That is, the measurement cost problem is resolved by an accurate and non-alterable proxy or signal to reveal relevant quality. Holstein calves develop a very distinctive "pot belly" when fed hay, as opposed to only milk and grain. The pot belly is a signal of dark red meat.

Allen extends the analysis to distinguish veal calves sold at auction from veal animals sold in private transactions. Only animals intended for pink veal or baby beef are sold at auctions, not white veal. In producing either pink or white veal, animals are kept away from grass. The main difference is that white veal calves are raised only on milk or milk replacer.[7] Since neither animal develops the "pot belly" signal, the incentive is to substitute cheaper grain for milk because in cows sold at auction there is no way to distinguish the difference. Buyers anticipate that calves sold at auction will have been fed mostly grain and bid accordingly. Therefore, only animals yielding pink veal are sold at auctions, while white veal is sold directly from farmers to the slaughter house.

We know two things from this story. Holstein calves are sold at auction for veal, and only holstein calves are sold for veal at auction. By this I mean that (1) if anyone buys a Holstein calf (without a pot belly) at auction for any reason other than to slaughter it for veal, then that buyer has made a mistake because the buyer has paid a premium price associated with the value of veal; and (2) if anyone buys a calf at auction hoping to slaughter it for veal, unless it is a Holstein without a pot belly, the buyer will be disappointed. The auction market for veal is not perfect. However, an equilibrium obtains where everyone knows what they are getting (within a narrow probability range) and pays accordingly for it.

Now let's return to cars:

How is the car market similar to the cow market? Most importantly, there is an auction for used cars just like there is an auction for cows. Car auctions are held in many places and are of various sizes, but the price and quality information about wholesale auction of used autos is distributed widely. From this, both buyers and sellers of used cars know what the average car is worth given all the informational asymmetries. Buyers and sellers outside of auctions are unlikely to transact at prices that are far away from the auction prices.

It is not nearly so obvious that there are informational asymmetries in the auto market as it is in the veal market. In auto's, the seller may know things about the maintenance history of the vehicle, but the buyer may know more about mechanical characteristics. For instance, most buyers of used cars are professionals who know the mechanical problems that have been

[7] Animals raised to produce white veal are kept in the dark.

experienced by the make and model.[8] Both parties are expected to suppress information that hurts their interests and promote information to their advantage.

Are used cars a good deal? This question does not have a direct answer. Used cars like veal calves are priced by the market based on the observable information available. New cars are priced by the market as well, but this may be based on a consumption preference for newness, something like a "separating equilibrium" in which there are people who only buy new cars and people who only buy used cars. New cars sell at a premium because of this.

The question, "Are used cars a good deal?" has to be refined. If the question means, "Are used cars, *ceteris paribus*, more dependable?", then the answer can only be determined by empirical investigation of repair records. The cet. par. conditions would include year, make, mileage, etc. of the car. That is, if you have the option of going on a trip to Florida in a 5 year old, 4 wheel drive, Chevy Suburban with 100,000 miles on the odometer, or in a car that is exactly the same except that it was purchased used 2 years ago, which one would be more likely to make the trip without interruption?

In many countries including the Dominican Republic and most all of Europe, a car's title includes a complete list of the people who have owned the vehicle. This not true in the United States. However, there are private companies that will provide you with this information for a fee. Casual evidence reported by foreign students suggests that used cars with fewer owners sell for higher prices. This suggests that some of the new-car premium is due to the lemon problem.

One way to investigate how much would be to estimate the cet. par. effect of multiple ownership. That is, one could collect data on auction prices of cars and track the number of owners that these cars have had. The auction price data is apparently available from car auction lots. (There is a big one in Anderson SC.) The trick would be to get a list of the VINs, find out the number of owners for each and then map that into the transaction price. Information on make, model, mileage, age, etc., would also be necessary.

The trick is to see how much the single-owner characteristic affects price. Presumably, the single-owner characteristic will create a premium over multiple owner vehicles that increases with age. The path of this over ages 2 up could then be used to back-forecast the effect for year 1. This would give a measure of how much the new car price is due to the new car smell, and how much is due to the lemon problem.

Horse Racing

Hall (1986) analyzes complementary markets by examining how 'claim horse' markets monitor the market for betting and assure honest of horse races.[9]

Briefly, almost all horse races in North America employ a claim rule, a condition of entering the race, that every horse is committed to be sold at a price stipulated and advertised by the track. Prior to the start of the race, the track sets the claim price and assures that, if claimed, the horse is sold at the claim price after the finish. In addition, the track sets the purse or prize money, which is provided by the track in all claiming race and is divided in fixed proportions

[8] Manufacturers send out notices to dealers about various mechanical problems to lookout for. These are called "service bulletins." Lists of these can be found on the web, and it is a good idea to check them out before your car goes out of warranty because if you are experiencing a symptom and you bring it to the attention of the dealer before the warranty expires, the dealer will fix it under warranty for free even if the car has not yet broken down.

[9] Hall, Christopher D. "Market Enforced Information Asymmetry: A Study of Claiming Races" in Economic Inquiry. Vol 24. 1986. P271-291.

among the owners of the top five horses. A key feature of the claim rule is that only the horse is claimed, not the prize money.

The claim rule is used to reward experts for performing two functions: (i) experts police the list of race contestants to discourage horse switching and related fraud; and (ii) they advertise the honesty of race to bettors by claiming horse. In general, horse owners and trainers know more about their horse than bettors. To encourage betting (a disagreement over winning probabilities, where wages are placed when the pari-mutuel odds diverge from a bettor's expectations) it is essential that no significant information bias exist. Also, the track's revenues are derived as fixed proportions of the betting volume and this volume increases with the quality of the competitors in honest races. However, many types of fraud are possible, such as drugging horses, switching horse, and collusion between jockeys, but claiming discourages fraudulent activities because more people watch and inspect horses entering claming races in hope of finding a bargain. This search for bargains substitutes for other policing expenses and compensates the track for the added prize money it offers to induce entries. Furthermore, an absence of claiming in races with large purse signals the track to investigate this group of horses and, thus, the reallocation of policing resources discourages fraud.

To summarize, when the purse and claming price combination stimulate claiming, the new owners provide a signal to all observers, including bettors, that the horses are as listed-claims advertise honesty. In the absence of claiming, other policing methods will be employed by the track that acts as a signal to deter fraud. Thus, the signals that deter fraud (claiming, search for bargain horses, and bettors) indicate that policing is effective in these complementary markets.

In the opinion of Sauer[10], as well as myself, Hall over states the claiming race effect of signaling when the fix is in. There are relatively few horses claimed in claiming races. If racing officials were going to use the absence of claims as a signal that some fix was in, they would be investigating more than half of the races. Clearly such a rule is not suitably refined.

The main purpose of claiming in races is to equalize the field. Since all horses in a claiming race can be purchased at the same price, they must all have approximately the same value and ability. Claiming is a way of handicapping the race.[11]

Graduate Education

Many people claim that education is nothing but a sorting mechanism.[12] We teach nothing. All education does is erect hurdles that cause people to self select into one group or another.

A more sophisticated version of this story is that education is a form of a bond. Workers invest time and maybe money in getting an education. In order to pay back this investment they will naturally work more hours than they otherwise would have.

Sobering thought

It seems like the law school market would be a good test of the signaling effect of education. If starting salaries of law graduates are higher for top graduates of mediocre law

[10] Raymond Sauer, "Economics of Wagering Markets," *Journal of Economic Literature*, Dec. '98.

[11] The idea is similar because there is always the chance that a ringer will be inserted in a race. (The term "ringer" is American slang that emerged around the beginning of the 20th century meaning the entry of a player or horse in a contest among rivals far inferior.)

[12] Spence, A Michael. "Job Market Signaling" in Quarterly Journal of Economics. Vol 87. 1973. P355-379.

schools compared to mediocre graduates of top law schools, doesn't this imply a signaling effect that is independent of the content of education?

D: House Painting

Is house painting the same as makeup on women or washing a car before you try to sell it?

Washing the car is like cleaning the house before you sell it. Painting obscures information. Washing and cleaning do not.

Washing and cleaning may be signals. They may signal that other, similar, but non-observable activities have also been done. They might work as a signal because they are costly. However, they are more like Barzel's imperfect proxy. There is no guarantee that a clean car is also a well maintained car.

Washing and cleaning, and also makeup, may give positive information to the prospective buyer. These actions may indicate to the buyer how much quality the good has when properly displayed.

However, makeup and painting because they obfuscate information may be intended to cheat the buyer. Why do buyers prefer small things wrapped in big, pretty boxes? Is this evidence of systematic error on the buyer's part? (Systematic ignorance / stupidity)

Suppression of information is common. Bacon, opaque packaging for potatoes and cheap hamburger, orange tinted packaging for Clementines. Show only the best.

Some people claim that "not painting reveals information that cannot be good." The same might be said of makeup, but the question is why? Will the buyer never choose the unpainted house (or the unadorned girl)? (At this point, I must break with the makeup analogy because I personally do not like makeup and will definitely stop the search at the girl without it.)

Painting is the efficient suppression of information because the buyer will never stop the search on an unpainted house. This is not exactly Barzel's model, but similar.

At least it proves that the paint will stick.

Barzel's model predicts that houses that are more idiosyncratic in other ways will more likely be painted. High variance implies higher value in suppressing information. (Hard to empirically test because most houses are painted and idiosyncratic houses are probably more expensive.)

When suppression of information is valuable, other methods of quality assurance must be found.

In both makeup and painting, it would be costly to reveal all information about the product. Partial information is misleading. Hence, suppressing information about the bad parts offsets the inability to convey the information about the good parts.

Alternative theory, makeup and painting are false advertising. Fool some of the people some of the time.