Product Quality and Information in the Used Car Market

James M. Lacko

Bureau of Economics Staff Report
to the Federal Trade Commission

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CHAPTER I

INTRODUCTION

Consumers do not have information about the quality of many products prior to purchase. Consumers cannot observe the dependability of an appliance, the taste of canned vegetables, or the skill of a mechanic. While sellers may know the quality of their products, the information may never reach consumers. Sellers of low quality products may wish to conceal the information and sellers of high quality products may be unable to credibly convey the information.

One-sided, or asymmetric, information can adversely affect the overall performance of the market. The inability of consumers to observe quality prior to purchase creates incentives for sellers to attempt to earn profits through misrepresentation and cheating on quality. This may lead to deteriorating product quality and may result in only low quality products being sold.

Sellers also face incentives pushing them in the opposite direction. Sellers may profit from building and maintaining a reputation for honesty and high quality. Earning profits through misrepresentation can destroy the seller's reputation and result in the loss of future sales and profits.

The relative strengths of these opposing incentives determines how efficiently the market performs and whether public policy can potentially improve consumer welfare. If incentives to profit through misrepresentation dominate, government actions may improve the efficiency of the market. Actions may include enforcing truth in advertising or requiring disclosures of quality. If incentives to maintain a reputation dominate, these policies may be unnecessary. Sellers would already find misrepresentation unprofitable and the market would provide the quality of products consumers desired.

This study examines the potential problems introduced by asymmetric information, the potential solutions provided

by reputation incentives and other market forces, and the effects of public policy, all within the context of the used car market. The study first attempts to determine whether information in the used car market is in fact asymmetric. Where asymmetry is found, the study examines the ability of reputation and other market incentives to overcome potential problems. The study then investigates the effects of public policy by examining a Wisconsin state law that requires that used car dealers disclose defects prior to sale. The study also explores several other issues of information and product quality, including the price of model reliability, the price of warranty coverage, and the role of warranties in providing information about quality.

The study finds that information about quality is not asymmetric for a large portion of the market, specifically, for newer used cars. Buyers, however, do not appear to have information about the quality of these cars prior to purchase. Instead, sellers appear to face as much uncertainty about quality as do buyers. The study does find evidence that information about quality is asymmetric for older used cars. The evidence suggests that asymmetry prevents many high quality older cars from being sold by private sellers through newspaper ads. In sales by dealers, however, market reputation incentives appear to be at least partially successful in overcoming the problem. Wisconsin's defect disclosure law does not appear to have any positive effect on the quality of cars sold by dealers in that state. The Wisconsin law, as well as several other types of state laws, also do not appear to have any effect on prices. Prices reflect, however, the reliability of the model and the warranty coverage obtained.

Lemons Markets and Reputation Incentives

In recent years economists have theoretically examined markets in which sellers have more information about product quality than do buyers, that is, markets in which information about quality is asymmetric. The theoretical studies have

only reached ambiguous conclusions concerning how markets will perform.

Asymmetric information about quality may result in high quality sellers being driven out of the market.[1] Low quality may drive out high quality because buyers, unable to distinquish genuine high quality from misrepresented low quality, may not be willing to pay a premium for claimed high quality. High quality sellers may be unable to earn a profit and may withdraw from the market. Only low quality would remain. This type of market failure, where bad quality has driven out good, is called a "lemons market."[2]

While the incentives to earn profits through misrepresentation and quality cutting may lead to a lemons market, other market forces may prevent the problem from arising. These market forces fall into two categories: incentives to build and maintain reputations that make cheating unprofitable, and signalling mechanisms that allow sellers to indirectly convey information about their quality.[3]

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[1] See Akerlof [1970] and Wilson [1979].

[2] The term was coined by Akerlof [1970] with obvious reference to used cars. In general usage, "lemon" refers to an unexpectedly poor quality car. As used here, the term is more specific, referring instead to the particular type of market failure where high quality is not sold. This type of market failure is an example of adverse selection.

[3] Warranties are often included as another possible solution. They can insure against low quality and make the buyer indifferent to the level of quality actually obtained. In the absence of outside enforcement, however, there would be little reason for firms to fulfill their warranty obligations - except for the reputation effects of such an action. Because in the absence of reputation effects warranties cannot work without outside enforcement, they are not listed here as an additional market solution to the lemons problem.

Incentives to maintain a reputation for honesty and high quality arise when future sales are affected by the firm's actions.[4] This becomes possible when a firm continues to sell in the same market over a period of time. Customers who are cheated can punish the firm by withholding future business. New customers can avoid the firm if information about quality spreads across consumers. Even though sellers can still earn profits through cheating, the potential loss of future sales and profits makes misrepresentations unprofitable. If the loss of future profits is large enough to offset the short-run profits from cheating, a lemons market will be avoided and the quality of products offered for sale will not decline.

Indirect "signals" provide another possible solution to the lemons problem by giving high quality sellers a method of credibly conveying information to buyers. To be effective, the costs or benefits of the signal must be correlated with the quality of the firm's product. Providing warranty coverage, for example, may be less expensive for high quality firms than for low quality firms because high quality products will experience fewer problems. High quality firms, therefore, may offer greater warranty coverage as method of signalling higher quality.[5] Advertising may also act as a signal. Because high quality firms will have more satisfied customers providing repeat business and ensuring future profits, they may be able to spend more on advertising. Advertising would be correlated with quality and could be used a signal.[6] If signals are effective, a lemons market will

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[4] See Heal [1976], Klein and Leffler [1981], Shapiro [1982], Shapiro [1983], and Telser [1980].

[5] See Grossman [1981] and Golding [1982].

[6] See Nelson [1970], Nelson [1974], Kihlstrom and Riordon [1984], and Milgrom and Roberts [1984].

be avoided and the quality of products offered for sale will not decline.[7]

While reputations and indirect signals offer possible solutions to the lemons market problem, they may not always succeed. Success will vary across markets for different products, depending on a variety of factors such as the frequency at which the product is purchased, the speed at which information spreads across consumers, and the size of the production cost difference between high and low quality. Whether market forces are sufficiently strong to overcome incentives for cheating in any particular market is an empirical question that cannot be answered through theory alone.

Empirical Studies

Because theoretical analysis offers no unambiguous conclusions concerning the relative importance of lemons market problems and reputation incentives,[8] empirical examination of the issues is important for understanding markets and for determining appropriate public policy. However, while the theoretical literature is large and growing, little empirical work has been performed to examine these issues in real markets.

Several empirical studies have examined the market for used pick-up trucks, a market potentially similar to the

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[7] These signalling examples are not entirely distinct types of solutions to the lemons problem. The use of warranties requires enforcement either by outside parties or through reputation incentives. The use of advertising requires repeat transactions.

[8] The term "reputation incentives" will be used throughout the report as shorthand for market forces that can overcome the lemons problem. This includes both reputation forces and market signalling mechanisms, unless otherwise noted.

market for used cars.[9] Bond [1982] examined the market for evidence of a lemons market problem. He argued that because high quality could not obtain a high quality price when a lemons market was present, higher quality trucks would be kept by their owners instead of being sold in the used market. If a lemons market were present, therefore, the average quality of trucks purchased used would be lower than the average quality of trucks that had never been traded. Using incidence of major engine repair as a measure of mechanical quality, and controlling for differences in age and mileage, Bond found no significant difference in the quality of the two groups. He concluded that the absence of a lemons market was due to the presence of reputation incentives and other market forces.

Pratt and Hoffer [1984] criticized Bond's technique, and claiming that they performed a better test, concluded that the data did provide evidence of a lemons market. The study differed from Bond's in several respects. First, the authors claimed to use a finer measure of mechanical quality. Instead of repair incidence, the study used the sum of repair incidence in four categories, each weighted by average expenditure figures obtained from another source. Second, instead of comparing trucks that had never been traded with trucks purchased used, the study compared trucks purchased used in the previous year with all other trucks. Third, the authors argued that controlling for differences in age and mileage was unnecessary. Comparing the two groups, the study found that trucks purchased used within the previous

[9] Other markets in which the lemons market issue has been empirically examined include the market for free-agents in major league baseball, in a study by Lehn [1984], the market for slaves in nineteenth century New Orleans, in a study by Greenwald and Glasspiegel [1983], and the market for new homes, in a study by Weicher [1985]. Lemons markets and reputation incentives have also been examined experimentally, by Lynch, Miller, Plott, and Porter [1985] and by Miller and Plott [1985].

year had significantly higher repairs than other trucks. The authors concluded that this was evidence of a lemons market.

Bond [1984] criticized Pratt and Hoffer's methodology and conclusions. He repeated Pratt and Hoffer's test and found no difference in repair expenditures between recently purchased trucks and other trucks, for trucks less than ten years old. For trucks greater than ten years old, recently traded trucks had higher repair expenditures. Bond concluded that a lemons market was present in trucks greater than ten years old, but not in newer trucks. He attributed Pratt and Hoffer's result to the inclusion of very old trucks in their sample and the failure to control for observable differences in age and mileage.

The tests by Bond provide evidence of a lemons market in older used pick-up trucks but no evidence of a lemons market in newer used pick-up trucks. The absence of a lemons market in newer trucks, however, does not in itself provide evidence of the strength of reputation incentives. The result may be due to reputation incentives successfully overcoming information problems, or to a lack of any underlying information problems. If buyers and sellers have the same amount of information, a lemons market would not occur. The tests performed by Bond and by Pratt and Hoffer cannot distinquish between the possible explanations for an absence of a lemons market, but can only determine whether one is present.

The Used Car Market

This study examines the lemons market and reputation issues within the market for used cars. The study addresses three major issues: whether information about the quality of used cars is asymmetric, whether reputation incentives overcome the lemons market problem where information is asymmetric, and whether Wisconsin's defect disclosure law has had an effect on the quality or prices of used cars sold in that state.

Several features distinquish this from earlier studies. First, the study can independently test both the existence of a lemons market and the effectiveness of reputations in overcoming the lemons market problem, allowing the reason for an absence of a lemons market to be determined. Second, instead of comparing cars purchased new to those purchased used, as in the pick-up truck studies, the study compares cars purchased from different types of sellers, where each type of seller has different information incentives. Two types of tests are used: comparison of average quality across type of seller and comparison of the relationship between price and quality across type of seller. Third, the study uses three alternative measures of quality. In addition to incidence of repair, as in earlier studies, repair expenditures and buyers' rating of mechanical quality are used. Each of these measures has advantages and disadvantages; use of all three should increase the robustness of the results.

The asymmetry of information

To examine whether information about quality is asymmetric, purchases from private parties located through newspaper ads are compared with purchases from friends and relatives. Asymmetric information is more likely to result in a lemons market in purchases through newspaper ads than in purchases from friends and relatives. The difference arises because the two types of sellers represent opposite extremes in the relationship between buyer and seller.

In purchases from private sellers located through newspaper ads, buyers and sellers do not know each other and are engaging in a one-time transaction. Little possibility exists of future transactions between the parties. There is no opportunity, therefore, to develop reputations. Signalling possibilities also appear limited. Advertising and other related expenditures cannot be effective because sellers have no future sales. Warranties are not likely to be effective

because they would be largely unenforceable without relatively large expenditures by the buyer.

This does not imply that a lemons market necessarily exists in newspaper ad sales, only that if asymmetric information is present, the market forces that could potentially correct the problem are likely to be unimportant. Even if market forces are very strong and can generally overcome the lemons problem in other market settings, they would not work here. The basic factors allowing the market forces to work - repeat transactions and reputation formation - are not present.

Purchases from friends and relatives are at the opposite extreme. Regardless of whether information about used car quality is asymmetric, a lemons market is unlikely because strong non-market reputation forces are at work. Friends and relatives engage in many types of continuing non-market interactions that provide strong incentives against cheating and misrepresentation. Buyers realize this and can trust the claims of a friend or relative more than the claims of a seller located through newspaper ads. Buyers may also have direct information that reduces asymmetry. They may have observed the past history of the vehicle and its record of problems and repairs. Both factors suggest that even if information about quality is generally asymmetric, a lemons market problem should not be present in transactions between friends and relatives.

Because reputation forces are not likely to work in purchases through newspaper ads but will work in purchases from friends and relatives, information asymmetry will affect the two groups differently. Asymmetry would lead to a lemons market in purchases through newspaper ads but not in purchases from friends and relatives.

Comparing the average quality of cars purchased through newspaper ads and from friends and relatives thus provides a test of whether asymmetric information is present in the used car market. If information is asymmetric, aver-

age quality would be lower in purchases through newspaper ads than in purchases from friends and relatives. Quality would be lower because the lemons market would prevent high quality cars from being identified and obtaining a high quality price. Sellers of high quality cars would be less likely to sell in the newspaper ad market, causing average quality to fall. Because friend and relative sales would not be subject to the lemons problem, average quality would not be affected there. If information about quality is not asymmetric, there is little reason to expect sellers to specialize in different qualities in this same pattern.[10],[11]

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[10] One possibile exception is if lower quality cars are purchased largely by mechanics and others who can perform repairs at relatively low cost. Because the probability of finding an interested purchaser of this type is greater in the public at large than in one's smaller circle of friends and relatives, lower quality cars would tend to be sold through newspaper ads. This and other possible explanations for quality specialization, however, assumes that buyers know quality prior to purchase. This assumption is tested by the examination of the relationship between price and quality. Thus, if quality differences across sellers are found, arguments that this only represents a form of specialization can be tested.

[11] It is possible that asymmetry is present in purchases from dealers even though the above test shows no asymmetry in purchases through newspaper ads and from friends and relatives. This is possible if dealers have greater expertise and are able to obtain more information, or are able to obtain information at a lower cost, than private buyers and sellers. This possibility, however, appears unlikely. If dealers were able to obtain more information and found it profitable to do so, private buyers and sellers would also find it profitable and could obtain the necessary expertise by taking the car to an independent mechanic for inspection. The dealer's information advantage, therefore, could not persist. In addition to appearing theoretically unlikely, the

Examination of the relationship between price and quality, and any difference in the relationship across type of seller, provides another test for asymmetric information and a lemons market.[12] Examining whether prices reflect quality will show whether buyers have information about quality prior to purchase. If buyers have the information, differences in quality should be reflected in the prices of used cars.[13] If buyers do not have the information, differences in quality would not be reflected in price. To test whether quality information is asymmetric, the relationship between price and quality in purchases from different types of sellers is compared. If information is not asymmetric, there is no reason to expect differences in this relationship across sellers. If information is asymmetric, however, prices would reflect quality in purchases from friends and relatives but not in purchases through newspaper ads.[14]

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results from other tests, discussed below in Chapter 3, are inconsistent with a dealer information advantage.

[12] Because of data limitations, the test is not performed on the entire data set but only on cars less than eight years old. This is discussed in the data section below.

[13] A positive relationship would exist if buyers are willing to pay higher prices for higher quality, and if the opportunity cost of selling a car increases as quality increases. Both of these assumptions are reasonable for the used car market.

[14] A correlation between price and quality in purchases from relatives may be obscurred because non-market considerations are likely to affect pricing. Because this is likely to be a less serious problem in purchases from friends, the two types of sellers are analyzed separately here.

The ability of market forces to prevent the lemons problem

The information incentives of dealers lie somewhere between the two extremes of private parties located through newspaper ads and friends and relatives. While private parties selling through newspaper ads generally sell only one car, dealers sell many cars and have the opportunity to develop reputations that can prevent the lemons problem. Unlike transactions between friends and relatives, however, dealer reputation incentives cannot be presumed to necessarily outweigh the gains available through misrepresentation.

If asymmetric information and a lemons market are found in purchases through newspaper ads, the ability of market reputation incentives to overcome the problem in dealer sales can be tested by comparing the quality of cars purchased from dealers to the quality of cars purchased through newspaper ads and from friends and relatives. If reputation incentives do not mitigate the lemons market problem, the average quality of cars purchased from dealers would not be significantly different from the average quality of cars purchased through newspaper ads. If reputation incentives are successful in mitigating the lemons market problem, the average quality of cars purchased from dealers would be significantly higher than the average quality of cars purchased through newspaper ads. If reputation incentives are completely successful, average quality in purchases from dealers would equal the average quality in purchases from friends and relatives.

The relationship between price and quality in purchases from dealers provides another test of the strength of market reputation forces. If market forces successfully overcome the lemons problem, dealers will be able to credibly convey information about quality and a positive relationship would exist between quality and price.

The effect of Wisconsin's defect disclosure law

Wisconsin's defect disclosure law attempts to correct potential problems arising from asymmetric information. The law requires that dealers disclose all known defects to prospective purchasers prior to sale.[15] The FTC recently debated, but did not promulgate, a similar requirement for dealers nationwide.[16] This study examines the effect of the Wisconsin law on the price and quality of cars, and on the relationship between price and quality.

The average quality of cars purchased from dealers in Wisconsin is compared to the average quality of cars purchased from dealers in the rest of the country. If a lemons market is present in dealer sales and the Wisconsin disclosure law effectively corrects the problem, quality would be higher in cars purchased from Wisconsin dealers than in cars purchased from dealers elsewhere.[17] No difference in quality

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[15] As discussed below, this study uses data on used cars purchased between October 1978 and January 1980. At that time, the Wisconsin law required that the defects disclosure form be given to buyers at the time of sale. It appears that most dealers complied with this requirement by giving the buyer the disclosure form when the sales contract was being signed. Wisconsin has recently modified the law to require that defects be disclosed on an information sticker attached to the car.

[16] See FTC [1978] and FTC [1985]. The disclosure the FTC had considered would have required disclosure on an information sticker attached to the car.

[17] Finding that Wisconsin dealers had higher quality would not necessarily indicate a lemons market in dealer sales elsewhere. Wisconsin dealers could have higher quality, for example, if dealers stopped selling low quality as a method of reducing the risk of being incorrectly held in violation of the law. While by itself the test cannot provide unambiguous evidence of a lemons market, the results can be

would imply either that dealers are not subject to a lemons market or that the Wisconsin law is not effective in correcting the problem. The two possibilities can be distinquished with evidence from the other tests.

The relationship between price and quality in dealer sales is also examined. If a lemons market exists in dealer sales elsewhere, but is prevented by the Wisconsin disclosure law, price and quality should be positively related in Wisconsin dealer sales but not in dealer sales elsewhere. A lack of a relationship would imply either that dealers are not subject to a lemons problem or that the Wisconsin law is not effective in preventing the problem.

Disclosure requirements may impose costs on dealers that lead to increased prices. To examine the effect of the Wisconsin disclosure law on the overall level of prices, the prices of cars purchased from dealers in Wisconsin are compared to the prices of cars purchased from dealers in the rest of the country.

Other consumer protection issues

Several other issues relevent to consumer protection policy are also examined. First, in addition to Wisconsin's defect disclosure law, the study examines the effect on used car prices of laws prohibiting as-is sales, laws requiring specific disclosures for as-is sales, and laws requiring safety inspections. Second, the study examines the relationship between price and a model's reputation for reliability. Models with a reputation for above average reliability should sell for higher prices than models with a reputation for below average reliability. Third, the study examines the relationship between price and the presence of a warranty.

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examined for consistency with the results from the other tests.

Because warranties provide insurance against mechanical problems, cars sold with a warranty should sell for higher prices. Finally, the study compares the quality of warranted and unwarranted cars to test whether warranties act as a signal of quality.

CHAPTER II

DATA

Basic Data Source

A survey undertaken for the Federal Trade Commission in connection with the used car rulemaking proceedings provided the basic data source for the study.[18] The survey obtained data for a pre-rule study of the used car market, which could later be compared with a post-rule study to assess the effects of the rule. Recent buyers and sellers provided information on various aspects of the car and of their purchase and post-purchase experience.

The survey was conducted by telephone from late October 1979 to late January 1980. The sample was obtained through a random telephone dialing procedure, with residents of the state of Wisconsin being oversampled by a factor of ten.[19] The sampling methodology appears to have no major bias problems and appears to yield a nationally projectionable sample. Respondents who had bought, sold, or traded-in a used car for more than twenty-five dollars during the previous twelve months were eligible for the survey.[20]

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[18] See Federal Trade Commission, Bureau of Social Science Research and Michael Sesnowitz [1982] for a complete description of the survey's methodology, questionaire, and results.

[19] Wisconsin was oversampled to provide a control group for pre- and post-rule comparisons. Since Wisconsin was already subject to similar defect disclosure requirements, the FTC Rule should have had little effect. Any changes in the Wisconsin data would presumably be due to other factors, and could be used to control for the effect of other factors in the rest of the country.

[20] Respondents selling five or more cars were classified as dealers and excluded from the survey.

The survey interviewed 1,743 persons. This represented an estimated response rate of eighty-four percent. Respondents consisted of 312 residents of Wisconsin and 1,431 residents of other states. Because respondents were questioned about both purchases and sales, the 1,743 interviews yielded information on 2,035 used cars. Purchases accounted for 1,008 of the observations. Of these, 189 were purchased in Wisconsin and 819 were purchased in the rest of the nation.

Missing data problems in the survey responses and other data made some of the observations unusable. The average quality tests used a sample of 832 observations and the price-quality relationship tests used a sample of 501 observations.

Measures of Quality

The aspect of quality examined in this study is mechanical condition. Complaints about used cars typically refer to mechanical condition as the source of problems. Wisconsin's defect disclosure law focuses on mechanical condition, as did the disclosure requirements originally debated by the FTC.

The survey data contains three possible measures of mechanical condition. The response to a question which asked respondents to rate the mechanical condition of the car at the time of purchase on a scale of one to ten, with one being a "lemon" and ten being a "gem," provides one measure. Since the question was asked some time after purchase, respondents presumably had learned the actual quality of the car, even if that quality had been unobservable prior to purchase. Whether the car had undergone repairs since purchase provides a second measure. Cars of better mechanical condition would have been less likely to have undergone repairs. Repair expenditures provide a third measure, with better quality cars having fewer expenditures. Because each of these measures suffer from potential criti-

cisms, and because none is clearly superior to the others, each was alternatively used a measure of quality.

The mechanical condition rating variable may be criticized as unobjective, as reflecting only the subjective evaluations of respondents. If the manner in which the evaluations were made varies across respondents, the variable may be inconsistent. One respondent may rate a particular car as a "nine," for example, while other respondents rate the same car as a "seven" or a "ten." While this adds noise to the variable, it does not introduce any bias.

While the mechanical rating variable may be criticized as subjective, the variable is not affected by several problems affecting the more objective measures of quality. One problem with both repair incidence and repair expenditures data is that they only measure repairs actually performed on the car, not repairs needed or defects present. Because repairs are partly an investment decision, low expenditures do not necessarily imply few mechanical problems or high quality. Low repair expenditures may indicate few mechanical problems, or may indicate a car with so many problems that it is not worth investing additional money to improve its condition. Repair incidence and expenditures data would incorrectly measure the quality of these cars. The subjective mechanical condition rating, however, would not be affected by the problem.

The repair incidence data can also be criticized because all cars that have been repaired are considered the same quality, even though repairs may have been more extensive on some cars than on others. The repair expenditures variable avoids the problem by measuring the cost of repairs.

Warranties introduce additional problems in the repair incidence and expenditures data. When repairs are covered by a warranty, repairs may occur for minor problems that would have otherwise gone unrepaired in unwarranted cars. Warranties may also increase repair incidence if some buyers are less careful in maintaining the car because of the cover-

age. Both problems would cause the repair incidence measure to incorrectly indicate low quality.

Warranties affect repair expenditures in the opposite direction. Cars repaired under warranty will have lower repair expenditures than unwarranted cars undergoing the same repair simply because the seller would have paid part of the cost. Warranted cars may show zero expenditures even though they have had major repairs. Use of repair expenditures as a measure of mechanical condition would incorrectly identify the warranted cars as higher quality.

Because each of the three measures has advantages and disadvantages, all three were alternatively used as measures of mechanical quality. The mechanical condition rating variable takes the value of one through ten. The repair incidence variable takes the value of one for cars that had been repaired since purchase, and the value of zero otherwise.

The repair expenditures variable was constructed from several responses in the data. The survey obtained expenditures on fourteen different systems of the car.[21] For each system, the survey obtained dollar and time expenditures for repairs performed by the respondent or family member and dollar expenditures for repairs performed by others. The repair expenditures variable was constructed by aggregating these responses.[22]

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[21] The individual systems included: frame and body, engine, drive train, fuel system, cooling system, electrical system, brake system, front-end, wheels, exhaust system, lights, windows and doors, accessories, and other. Respondents were instructed to exclude repairs undertaken only to improve the appearance of the car or to repair damage due to accidents.

[22] In aggregating expenditures, time expended in self-repairs was valued at the average wage rate for non-agricul-

Missing data presented more problems for the repair expenditures variable than for the other quality measures. Incomplete repair expenditure data occurred where respondents replied "don't know" for any of the repair expenditure questions. Since the repair expenditure questions consisted of three questions for each of the fourteen different automotive systems, the opportunity for missing data was large. Forty-six of the observations were missing data for at least one of the questions. This represented approximately fourteen percent of the observations that had had repairs.

For empirical tests involving the repair expenditures variable, the sample was restricted by excluding observations with incomplete expenditures data. While dropping these observations biases the estimate of average repair expenditures downward because the excluded observations consist only of cars that had had repairs, the size of the effect appears relatively small.[23] An unrestricted sample that includes all observations is used for empirical tests involving the mechanical condition rating and repair incidence variables.

Table 1 presents the mean and standard deviation for each measure of quality in both the unrestricted and restric-

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tural workers in 1979, which equaled $6.16. Wage data was obtained from the Economic Report of the President, 1984.

[23] Average repair expenditures for the sample that excludes incomplete observations is $96. If average expenditures for the fourty-six incomplete observations are assumed to equal the average for repaired cars in the rest of the sample, overall average repair expenditures would increase to $105.

TABLE 1

MEANS AND STANDARD DEVIATIONS FOR EACH QUALITY MEASURE

Unrestricted Sample

Quality Measure	Mean	Std Dev	N
Mechanical Condition Rating	6.65	2.23	832
Repair Incidence	0.39	0.45	832
Repair Expenditures (all cars)	$103.63	333.18	832
Repair Expend. (repaired cars only)	$264.48	491.08	326

Restricted Sample

Quality Measure	Mean	Std Dev	N
Mechanical Condition Rating	6.72	2.19	786
Repair Incidence	0.36	0.48	786
Repair Expenditures (all cars)	$95.85	331.02	786
Repair Expend. (repaired cars only)	$269.07	511.39	280

Note: The restricted sample excludes observations with missing repair expenditure data. The unrestricted sample includes observations with missing expenditures data and assumes that expenditures in missing categories are zero.

Mechanical condition rating is the response to a question in which buyers were asked to rate the mechanical condition of the car at the time of purchase on a scale of one to ten.

ted samples.[24] The average mechanical condition rating in both samples was approximately six-and-a-half on a scale of ten. Approximately fourty percent of the cars had been repaired since purchase, at an average expenditure of approximately two hundred and sixty dollars. This implies an average repair expenditure of approximately one hundred dollars for all cars.

Tables 2A through 2C present comparisons of the three measures of quality. Table 2A shows that as the mechanical rating decreases, indicating lower quality, repair incidence and repair expenditures rise. The relationship appears to weaken, however, for lower ratings on the scale. This may reflect the difference between repairs needed and repairs performed. Table 2B shows a lower average mechanical rating for cars repaired since purchase than for cars not repaired. Table 2C shows that as repair expenditures increase the average mechanical rating decreases.

Other Variables

While examining the average quality of cars sold by different types of sellers, other factors affecting quality will be controlled for through the use of regression analysis. The regressions control for differences in the age and mileage of the vehicles, the expected quality of the model, the presence of a warranty, the condition of the body and interior, the length of ownership, and state laws.

The survey provided age and mileage data. Age was measured by model-year. The variable was set at zero for 1979 model-year cars, the latest model-year in the survey, and increased by one for each increase in model-year vin-

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[24] The unrestricted sample in Table 1 includes observations with incomplete repair expenditures, but assumes that expenditures in the "don't know" categories are zero.

TABLE 2A

AVERAGE REPAIR INCIDENCE AND EXPENDITURES BY MECHANICAL CONDITION RATING

Mechanical Condition Rating	N	Repair Incidence	Mean Repair Expenditures (All Cars)	Mean Repair Expenditures (Repaired Cars)
10	194	16%	$28	$168
9	124	25	35	141
8	188	35	45	130
7	111	44	106	239
6	53	60	170	281
5	55	51	278	546
4	12	58	544	932
3	16	81	291	358
2	9	67	394	591
1	24	71	264	373
Overall	786	36	96	269

Note: Mechanical condition rating is the response to a question in which buyers were asked to rate the mechanical condition of the car at the time of purchase on a scale of one to ten.

TABLE 2B

AVERAGE MECHANICAL CONDITION RATING FOR REPAIRED AND NON-REPAIRED CARS

Repairs	Mechanical Rating Mean	Std Dev	N
Yes	5.70	2.45	506
No	7.26	1.84	326

TABLE 2C

AVERAGE MECHANICAL CONDITION RATING BY REPAIR EXPENDITURE CATEGORIES

Repair Expenditures	Mechanical Rating Mean	Std Dev	N
$0	7.23	1.88	518
1- 99	6.30	2.20	128
100-199	6.31	1.84	48
200-299	5.41	2.61	27
300-399	4.93	2.49	15
400-499	4.86	2.28	14
500+	3.86		36

Note: Mechanical condition rating is the response to a question in which buyers were asked to rate the mechanical condition of the car at the time of purchase on a scale of one to ten.

tage. Odometer mileage, measured in thousands of miles, was used for the mileage variable.[25]

To control for differences in the expected quality of different models, a measure of average model quality was included. Consumer Reports repair ratings were used as the measure of model quality.[26] The Consumer Reports trouble index rates a model's frequency of repair as average, better than average, much better than average, worse than average, or much worse than average. To reduce the total number of variables, these were aggregated to three categries: better than average, average, and worse than average. Two dummy variables were created, the first taking the value of one if the model was rated better than average, and the second taking the value of one if the model was rated worse than average. The average rating was used as the excluded category.

To control for any differences between warranted and unwarranted cars, a dummy variable taking the value of one for cars purchased with a warranty was included. The variable can also be used to test whether warranties act as a signal of quality. If warranties act as a signal of quality, then controlling for other factors, warranted cars should have higher average quality than unwarranted cars.

A variable measuring the condition of the body and interior of the car at the time of purchase was included as a proxy for the maintenence and care undertaken by the previous owner. Differences in care may affect subsequent mechanical condition. Since body and interior condition is clearly observable prior to purchase, prospective buyers may use it as a proxy for prior care. To measure body and interior condition, a variable analogous to the mechanical

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[25] Observations of 1978 or older model-year cars with odometer mileage of less than 1,000 miles per year were excluded from the sample as likely response errors.

[26] See Consumer Reports [various issues].

condition rating was used in which respondents rated the condition of the body and interior at the time of purchase on a scale of one to ten.

Length of ownership was included to control for differences in the time since purchase. Length of ownership varied from less than one month to up to a year. While these differences are not likely to have as great an effect on the subjective mechanical rating as on the repair incidence and expenditures variables, they are likely to have some effect on all three. As a proxy for length of ownership, the time between the date of purchase and the end of the interview period was used. The proxy was necessary because the date of the interview was not known, making exact calculation of length of ownership impossible.

The possible effects of four types of state laws were controlled for by a variable for each law. Laws included were Wisconsin's defect disclosure law, laws prohibiting as-is sales, laws requiring specific disclosures for cars sold as-is, and laws requiring safety inspections.[27] For laws requiring

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[27] Information on state laws was obtained from the FTC Staff Report on the Used Car Rule [1978]. Wisconsin was the only state classified as having a defects disclosure law. States prohibiting "as-is" sales included: Kansas, Maryland, Massachusetts, Mississippi, and West Virginia. States requiring specific disclosures for "as-is" sales included: Arizona, Illinois, Minnesota, Oregon, Washington, and Wisconsin. States requiring safety inspections either annually, semi-annually, or at point-of-sale, (states requiring inspections only randomly or post-accident were excluded) include: Arizona, Arkansas, Colorado, Delaware, District of Columbia, Florida, Georgia, Hawaii, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Mississippi, Missouri, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Utah,

safety inspections, the variable was included as a dummy variable, taking the value of one for all cars purchased in a state with an inspection law. For the other three types of laws, because they apply only to dealer sales, the variables were included as interaction terms with cars purchased from dealers. In addition to controlling for potential differences, inclusion of the state law variables allows for tests of the effect of the laws on average quality.

Type of seller was included as a set of dummy variables. The data contained eight classifications for type of seller: friend, relative, newspaper ad, dealer selling only used cars, dealer selling both new and used cars, "someone else the buyer heard about," rental agency, and "other."[28] Friends and relatives were combined into one variable. The two types of dealers were included as separate variables in order to test for any potential differences in the strength of reputation incentives across the two. Rental agency and "other" transactions were combined into a variable called "other." Transactions with "someone else the buyer heard about" were included as a separate variable. The nature of the seller in these transactions is unclear, though one possibility is that they represent purchases from "friends of friends." Newspaper ad transactions were used as the excluded category. Coefficients on the other type seller variables, therefore, represent differences between that type of seller and newspaper ads transactions.

Vermont, Virginia, Washington, West Virginia, and Wyoming. As noted above, these variables reflect state laws in effect in 1978-79.

[28] The category interpreted as newspaper ads was worded: "someone who ran an ad." Since respondents were given "dealer" as an alternative response, it appears reasonable to interpret responses of "someone who ran an ad" as referring to a private seller.

The Price-Quality Relationship

To examine the relationship between mechanical condition and price, a hedonic price function for used cars is estimated. Hedonic analysis assumes that products such as automobiles consist of a bundle of characteristics, and that the individual characteristics provide utility to consumers.[29] Automobiles consist of a bundle of characteristics such as acceleration power, carrying capacity, comfort, styling, and economy. Consumers do not have demand for the car itself, but for these individual characteristics of the car.

Hedonic analysis assumes that the overall price of a product is determined by the amounts of the various characteristics embodied in the product. Products with more of the desirable characteristics will be priced higher. By using regression analysis to estimate the prices of used cars as a function of the amounts of the various characteristics, the implicit price of each characteristic can be found. The estimated implicit prices show the effect of a change in the amount of a characteristic on the overall price of the car. To examine the relationship between price and quality, mechanical condition will be included as one of the characteristics.

In estimating a hedonic price function, all characteristics valued by consumers should be included. The characteristics included here are measures of performance, carrying capacity, styling, comfort and luxury, economy of operation, body and interior condition, and mechanical condition.[30] In

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[29] See Rosen [1974] for a formal model of the hedonic framework.

[30] Other hedonic studies of automobile prices include Asher [1985], Goodman [1982], Agarwal and Ratchford [1980], Ohta and Griliches [1976], Hogarty [1975], Griliches [1971], Triplett [1969], and Fisher, Griliches, and Kaysen [1962].

addition to automobile characteristics additional variables are included to control for potential differences across markets and to test the information hypotheses.

Horsepower and number of cylinders were included as measures of engine power. Horsepower data was obtained from Automotive News,[31] and the number of cylinders were obtained from the survey responses. For number of cylinders, dummy variables were created for four cylinder, six cylinder, five cylinder, and rotary engine cars. Eight cylinder cars were the excluded category.

Length was included as a crude measure of the size or carrying capacity of the car. The data was obtained from Automotive News. Fuel economy was included as a measure of economy of operation. Data was obtained from EPA publications.[32]

A list of options, obtained from the survey responses, was included to proxy for differences in comfort and luxury.

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[31] See Automotive News, [various issues]. Cars from the survey were matched with those in Automotive News on the basis of make, model, model-year, and number of cylinders. Where optional engines were available for a model, the horsepower of the standard engine was used. The same procedure was followed in cases where optional carborators were available.

[32] See EPA [various issues]. Data on city mileage was used. This was the only measure presented for all of the years. Data was not available for pre-1973 models, limiting the sample to 1973 through 1979 model-year cars. Data for 1973 and 1974 was in a different format and the result of slightly different test procedures than in later years. In later years, the data presents average results from several test runs. In early years, the data consists of the raw test results.

Options included air conditioning, power brakes, power steering, power windows, power seats, vinyl top, cruise control, adjustable steering, AM radio, FM radio or tape deck, and automatic transmission. Each of these options was included as a dummy variable - taking the value of one if present in the car and zero otherwise. A dummy variable taking the value of one if the model was considered a sports car was included as a measure of styling differences.[33]

Several variables described in the previous section were also included. Age and odometer mileage were included to control for differences in price due to prior usage of the vehicle. The presence of a warranty was included as a dummy variable, as were variables measuring model reliability. Body and interior condition was included as a variable ranging from one to ten. The subjective mechanical condition rating and repair expenditures were alternatively included as measures of mechanical quality.[34]

Dummy variables were included to distinquish the type of seller the car was purchased from, and the types of state laws present in the state of the transaction. For the type seller variables, newspaper ads were used as the excluded category. Interaction variables between the type of seller and mechanical condition were also included to test whether the relationship between price and quality varied by type of seller. An interaction variable between mechanical condition and Wisconsin dealers was included to test whether the relationship between price and quality differed between dealers in Wisconsin and dealers in the rest of the country.

The price used was the total purchase price of the car, defined as the sum of cash paid plus any allowance given for

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[33] Models were considered sports cars if they had only two seats.

[34] As will be discussed in the next section, repair expenditures were included in two alternative forms: total repair expenditures and repair expenditures per month.

a trade-in. Prices were adjusted by a monthly consumer price index and by a state cost-of-living index.[35] To test for any systematic difference between the prices of cars purchased with and without a trade-in, a dummy variable taking the value of one for transactions involving a trade-in was included as an independent variable.

The sample used for the hedonic estimates was restricted to 1973 through 1979 model-year cars because of the unavailability of fuel economy data for earlier model years.

[35] The consumer price index, obtained from the Council of Economic Advisors Report to the President, was used for the overall monthly price index. The state cost-of-living indices were created from Bureau of Labor Statistics data.

CHAPTER III

RESULTS

Average Quality Differences Between Types of Sellers

This section compares the average quality of cars purchased from different types of sellers. The next section refines the comparisons by using regression analysis to control for other factors affecting quality. In both sections the sample is divided into two groups according to model-year in order to examine whether the presence of asymmetric information or a lemons market varies with the age of the vehicles. The sample is divided into cars one through seven years old and cars eight through fifteen years old.[36]

Table 3 presents the average of each quality measure for cars purchased from each type of seller for cars one to seven years old.[37] Sellers are divided into private parties selling through newspaper ads, friends and relatives, dealers selling both new and used cars, dealers selling only used

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[36] The decision of where to split the sample was somewhat arbitrary. Split as above, the model-years for the newer model sample correspond to the model-years used in the hedonic price equation, which were limited by data availability. This makes comparison of the two sets of results easier. This split also makes the number of model-years in the two groups approximately equal: seven in the first and eight in the second. While it would have been interesting to examine a sample of cars ten years of age and older, as in Bond [1984], the size of this sample would have been too small to make comparisons across types of sellers. In any case, there is no intention to imply that a structural change occurs exactly at the point between seven and eight year old cars, but only that this is a useful split for examining older versus newer cars.

[37] A comparison of the distribution of repair expenditures across type of seller is shown in Tables A1 and A2 of the Appendix.

TABLE 3

AVERAGE QUALITY BY TYPE OF SELLER ONE TO SEVEN YEAR OLD CARS

Quality Measure	Ad	Friend Relative	New Dealer	Used Dealer	Hear	Other
Mechanical Rating						
Mean	6.86	6.84	6.89	7.01	7.06	7.10
Std Dev	1.72	2.00	2.37	2.23	1.89	2.29
N	59	94	255	85	35	20
t1	---	-0.06	0.09	0.43	0.52	0.49
t2	0.06	---	0.18	0.53	0.56	0.51
Repair Incidence						
Mean	0.44	0.46	0.35	0.25	0.43	0.15
Std Dev	0.50	0.50	0.49	0.43	0.50	0.37
N	59	94	255	85	35	20
t1	---	0.18	-1.03	-1.96*	-0.07	-1.85
t2	-0.18	---	-1.48	-2.34*	-0.23	-1.98*
Repair Expenditures						
Mean	108.30	111.89	58.74	56.56	133.91	21.47
Std Dev	442.42	412.22	166.64	218.68	422.91	73.07
N	54	91	242	81	33	19
t1	---	0.05	-1.36	-0.89	0.26	-0.84
t2	-0.05	---	-1.67	-1.07	0.26	-0.94

Note: t1 is the t-statistic calculated in a comparison of means between each type of seller and newspaper ad transactions. t2 is the t-statistic calculated in a comparison of means between each type of seller and friend and relative transactions.

* indicates significance at the five percent level.

TABLE 4

AVERAGE QUALITY BY TYPE OF SELLER EIGHT TO FIFTEEN YEAR OLD CARS

Quality Measure	Ad	Friend Relative	New Dealer	Used Dealer	Hear	Other
Mechanical Rating						
Mean	5.53	6.64	6.87	6.29	5.90	3.75
Std Dev	2.13	2.12	2.30	2.51	2.11	1.89
N	58	115	30	38	39	4
t1	---	3.23*	2.69*	1.57	0.83	-1.6
t2	-3.23*	---	0.52	-0.84	-1.87	-2.67*
Repair Incidence						
Mean	0.62	0.37	0.37	0.47	0.44	0.75
Std Dev	0.49	0.49	0.49	0.51	0.50	0.50
N	58	115	30	38	39	4
t1	---	-2.30*	-1.52	-0.96	-1.17	0.32
t2	2.30*	---	0.00	0.85	0.61	1.21
Repair Expenditures						
Mean	265.13	79.99	65.20	152.71	85.24	581.50
Std Dev	650.22	327.78	177.87	320.35	187.46	484.57
N	55	110	29	34	34	4
t1	---	-2.42*	-1.60	-0.93	-1.56	0.94
t2	2.42*	---	-0.23	1.13	0.09	2.92*

Note: t1 is the t-statistic calculated in a comparison of means between each type of seller and newspaper ad transactions. t2 is the t-statistic calculated in a comparison of means between each type of seller and friend and relative transactions.

* indicates significance at the five percent level.

cars, "someone the buyer heard about," and "other." Table 4 presents the same information for cars eight to fifteen years old. Each table also presents t-statistics calculated in tests for differences in means. The rows labeled "t1" present the t-statistics for comparison of the average quality of cars purchased from each type of seller to the average quality of cars purchased through newspaper ads. The rows labeled "t2" present the t-statistics for comparison of the average quality of cars purchased from each type of seller to the average quality of cars purchased from friends and relatives.[38]

Table 3 shows no statistically significant difference between the average quality of cars purchased through newspaper ads and from friends and relatives for any of the measures of quality.[39] There are also generally no significant differences between the average quality of cars purchased from dealers and cars purchased either through newspaper ads or from friends and relatives. The one exception is that the repair incidence of cars purchased from dealers selling only used cars is significantly lower than in both purchases through newspaper ads and purchases from friends and relatives.[40] In general, however, comparison of average quality across type of seller for newer model-year cars shows no pattern of significant differences.

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[38] Because the repair incidence results are presented as proportions, a difference in proportions test, rather than a difference in means test was used. The reported test statistics, therefore, are z-statistics rather than t-statistics.

[39] The five percent level of significance is always implied when the discussion in this chapter refers to the significance or non-significance of results.

[40] Several of the t-statistics for dealers selling both new and used cars are significant at lower levels of significance. The significance of these differences, however, is reduced even further once other factors such as age and mileage are controlled.

The results are markedly different for older model-year cars. Table 4 shows that average quality is significantly higher in purchases from friends and relatives than in purchases through newspaper ads for all of the measures of quality. Purchases from friends and relatives show an average mechanical condition rating 1.1 units higher on the one to ten scale, repair incidence twenty-five percentage points lower, and average repair expenditures $185 lower than in purchases through newspaper ads. All of the differences are statistically significant.

Cars purchased from dealers selling both new and used cars show average quality equal to or higher than in cars purchased from friends and relatives for all measures of quality, but only the mechanical condition rating is significantly higher than in newspaper ads. Cars purchased from dealers selling only used cars show average quality at a level between newspaper ad and friend and relative transactions for all measures, though none are significantly higher than in newspaper ad transactions. While cars purchased from both types of dealers do not generally show average quality significantly higher than in cars purchased through newspaper ads, none of the quality measures show average quality significantly lower than in cars purchased from friends and relatives. The insignificant results may be due to the relatively small sample sizes for these transactions, or may indicate that quality in purchases from dealers lies between the two extremes of newspaper ads and friends and relatives.

The comparison of average quality across different types of sellers shown in Tables 3 and 4 shows distinct differences between newer and older used cars. For newer used cars there are generally no significant differences in the average quality of cars purchased from different types of sellers. In older used cars, however, cars purchased from friends and relatives show significantly higher average quality than cars purchased through newspaper ads for all of the alternative measures of quality. This implies that asymmetric information and a lemons market are not present in transactions of newer model-year cars, but are present in transactions of

older model-year cars. Evidence concerning the ability of market reputation incentives to overcome the lemons problem in dealer sales is ambiguous in this test.

Regression Analysis of Quality

To provide a stronger test for differences, average quality was examined using regression analysis. Regression analysis allows for control of other factors that may affect quality and allows the effect of type of seller to be isolated.

Tables 5 and 6 present the regression results for each of the alternative measures of quality.[41] Type of seller is included as a set of dummy variables with newspaper ad transactions being used as the excluded category, making coefficients on the other type seller variables relative to it. Age, mileage, average model quality, body and interior condition, presence of a warranty, length of ownership, and the presence of four types of state laws are included to control for other factors influencing quality.[42]

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[41] Because the repair incidence variable takes the values of only zero and one, ordinary least squares estimation could not be used. This equation was estimated within a logit model using maximum likelihood techniques. The mechanical condition equation was estimated within an ordered probit model and the repair expenditures equation was estimated with a tobit model, both using maximum likelihood techniques. For a discussion of these techniques, see Maddala [1983].

[42] The means for some of the variables are shown by type of seller in Tables A3 and A4 of the Appendix. A list of all variable names, both for regressions here and the price-quality relationship section, are given in Table A5 of the Appendix.

The regression results for newer model-year cars in Table 5 show the same pattern noted in the raw averages presented in Table 3. The insignificant coefficients on the friend and relative variable indicates that the quality of cars purchased from friends and relatives is not significantly different than the quality of cars purchased through newspaper ads. Cars purchased from both new and used dealers also generally show no significant difference in quality as compared to cars purchased through newspaper ads. The one exception, as in Table 3, is that used car dealers show significantly higher quality in the repair incidence measure.

The regression results for eight to fifteen year old cars, shown in Table 6, also reflect the same pattern noted earlier in the averages. The coefficient on the friend and relative variable is significant for each of the alternative measures of quality, indicating higher average quality than in purchases through newspaper ads.[43] New car dealers show significantly higher quality than newspaper ad transactions in two of the three quality measures. Used car dealers show no significant difference in quality as compared to newspaper ads in any of the three measures. However, only one of the three used car dealer coefficients is significantly different from the friend and relative coefficients.[44]

The results are generally consistent with the patterns observed in the raw averages. For newer model-year cars, the results generally show no significant differences in the

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[43] The friend and relative coefficients, evaluated at the sample means of the other variables, imply that repair incidence is twenty-three and a half percentage points lower, and average repair expenditures are one hundred and sixty-six dollars less, than in cars purchased through newspaper ads.

[44] Asymptotic t-statistics for a test of the difference between the coefficient on used car dealers and the coefficient on friends and relatives are -0.69 in the mechanical rating equation, 1.82 in the repair incidence equation, and 1.22 in the repair expenditures equation.

TABLE 5

REGRESSION ANALYSIS OF QUALITY ONE TO SEVEN YEAR OLD CARS

Variable	Mechanical Rating Coef	Mechanical Rating Asymp T	Repair Incidence Coef	Repair Incidence Asymp T	Repair Expenditures Coef	Repair Expenditures Asymp T
AGE	-0.022	-0.60	0.093	1.23	46.41	1.75
MILES	-0.005	-1.74	0.008	1.43	0.52	0.26
BETTERAVE	0.210	1.73	-0.784	-3.06*	-279.08	-2.97*
WORSEAVE	-0.045	-0.32	-0.161	-0.54	-45.06	-0.43
BODY	0.365	13.72*	-0.257	-4.25*	-86.53	-4.24*
WARRANTY	0.021	0.18	0.236	0.94	-49.11	-0.55
TIMEOWN	-0.034	-2.26*	0.156	4.84*	44.51	4.05*
FRIEND/REL.	0.311	1.48	-0.064	-0.18	-11.35	-0.09
NEWDEAL	-0.017	-0.09	-0.560	-0.16	-3.94	-0.03
USEDDEAL	0.259	1.28	-0.893	-2.21*	-277.64	-1.59
HEAR	0.448	1.92	-0.178	-0.38	23.33	0.15
OTHER	0.279	0.91	-1.170	-1.65	-196.40	-0.85

TABLE 5, continued

Variable	Mechanical Rating Coef	Mechanical Rating Asymp T	Repair Incidence Coef	Repair Incidence Asymp T	Repair Expenditures Coef	Repair Expenditures Asymp T
WISC*D	-0.053	-0.22	-0.095	-0.17	-217.10	-1.14
LAWNOASIS*D	-0.134	-0.40	0.284	0.52	226.15	1.27
LAWDISCAS*D	-0.013	-0.06	-0.550	-1.19	-126.65	-0.80
LAWINSP	-0.230	-0.22	0.143	0.65	-62.67	-0.83
CONSTANT	-0.612	-1.92	0.319	0.46	86.37	0.38
ln L	-919.43		-314.04		-1375.7	
chi-square	188.17		88.90			
n	548		548		520	

Note: Coef is the regression coefficient; asymp t is the asymptotic t-statistic; ln L is the log likelihood; chi-square is the chi-square statistic. * indicates significance at the five percent level.

See Appendix Table A5 for definition of variable names.

TABLE 6

REGRESSION ANALYSIS OF QUALITY
EIGHT TO FIFTEEN YEAR OLD CARS

Variable	Mechanical Rating Coef	Mechanical Rating Asymp T	Repair Incidence Coef	Repair Incidence Asymp T	Repair Expenditures Coef	Repair Expenditures Asymp T
AGE	0.009	0.30	0.196	2.92*	40.95	1.67
MILES	-0.003	-1.09	-0.001	-0.29	-4.09	-2.05*
BETTERAVE	-0.054	-0.35	-0.029	-0.10	-260.71	-2.33*
WORSEAVE	-0.150	-0.81	-0.424	-1.17	-294.84	-2.19*
BODY	0.184	6.76	-0.170	-2.71*	74.12	-3.27*
WARRANTY	0.582	1.54	-0.425	-0.63	-304.07	-1.16
TIMEOWN	-0.001	0.02	0.148	3.47*	59.63	3.84*
FRIEND/REL.	0.457	2.47*	-0.962	-2.71*	-417.55	-3.31*
NEWDEAL	0.905	3.29*	-0.968	-1.59	-532.92	-2.37*
USEDDEAL	0.300	1.22	-1.20	-0.24	-167.52	-0.90
HEAR	0.155	0.69	-0.794	-1.74	-448.61	-2.59*
OTHER	-0.588	-0.52	0.432	0.31	621.51	1.83

TABLE 6, continued

Variable	Mechanical Rating Coef	Mechanical Rating Asymp T	Repair Incidence Coef	Repair Incidence Asymp T	Repair Expenditures Coef	Repair Expenditures Asymp T
WISC*D	-0.840	-1.39	-0.038	0.03	790.07	1.49
LAWNOASIS*D	-0.408	-0.91	0.838	0.88	72.61	-0.21
LAWDISCAS*D	-0.166	0.28	0.302	0.29	-320.13	-0.64
LAWINSP	-0.010	-0.07	0.207	0.74	177.25	1.70
CONSTANT	0.830	1.94	-0.973	-1.03	247.65	0.70
ln L	-553.29		-171.65		-931.69	
chi-square	2094.9		47.64			
n	284		284		266	

Note: Coef is the regression coefficient; asymp t is the asymptotic t-statistic; ln L is the log likelihood; chi-square is the chi-square statistic. * indicates significance at the five percent level.

See Appendix Table A5 for definition of variable names.

average quality of cars sold by different types of sellers. This implies that neither asymmetric information nor a lemons market is present.[45,46] For older model-year cars, strong evidence of asymmetric information and a lemons market is provided by the consistently significant difference between the average quality of cars purchased through newspaper ads and cars purchased from friends and relatives.

Evidence on the effectiveness of reputation incentives in overcoming the lemons problem in older cars is mixed. For dealers selling only used cars the evidence is ambiguous. The average quality of cars purchased from these dealers lies between newspaper ad and friend and relative transactions, but in general is not significantly different from either. The evidence is stronger for dealers selling both new and used cars. Average quality for these dealers is higher than in

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[45] These results are consistent with findings by Bond [1984] in the market for used trucks, though Bond attributed the absence of a lemons market in newer model-year trucks to the strength of market forces in overcoming the problem, rather than a lack of asymmetry.

[46] Kim [1985] has shown that when maintenance determines quality and consumers differ in their valuation of quality, asymmetric information does not necessarily imply that used cars offered for sale will be of lower quality than cars kept by their owners. Kim's result, however, does not appear to explain the lack of significant differences in quality across types of sellers found here. The tests performed here will not be affected by Kim's result because they compare the average quality of cars sold by different types of sellers, not the average quality of cars sold and not sold. In addition, the pattern of results appears to be the opposite of what one would expect from Kim's model. Maintenance is likely to be have more of an influence on the quality of older cars than on newer cars, implying that Kim's model would be more applicable for older cars. But the empirical results show average quality differences for older cars and no quality differences for newer cars.

newspaper ad transactions for two of the three measures of quality. Overall, the results provide some evidence that reputation incentives may be effective in this market, and that the incentives may be stronger for dealers selling both new and used cars than for dealers selling only used cars.

The coefficient on the Wisconsin-dealer interaction term provides additional evidence suggesting an absence of a lemons market in dealer sales. The coefficient is not significant in any of the equations in either of the samples. This implies that the average quality of cars sold by dealers in Wisconsin is not different from the average quality of cars sold by dealers elsewhere. The result is consistent with either an absence of a lemons market in dealer sales or a law that ineffectively addresses the problem.[47]

The coefficients on the dummy variables for state laws prohibiting as-is sales, state laws requiring disclosure of as-is sales, and state laws requiring safety inspections were insignificant in all of the equations, indicating that no effect on quality was found.[48]

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[47] There were only thirteen observations of purchases from dealers in Wisconsin in the older car sample. It is possible that the law does have an effect on the quality of older cars, but the small sample size makes finding a significant effect difficult. This possibility, however, does not appear likely here. Two of the three coefficients have the opposite of the expected sign, showing quality to be lower in Wisconsin dealers than elsewhere. While the coefficient in the repair incidence equation has the expected sign, the size of the coefficient is very small.

[48] The absence of a significant effect for the two as-is laws in the older car sample may be due to the small sample sizes. There were only nineteen observations of purchases from dealers in states requiring disclosure of as-is sales, and only five observations of purchases from dealers in states prohibiting as-is sales.

The coefficient on the warranty variable was insignificant in all of the equations, indicating that average quality did not differ between warranted and unwarranted cars. This implies that warranties are not acting as a signal of quality in the used car market.[49]

The Relationship Between Price and Quality

To examine the lemons market and reputation issues in another way, the relationship between price and quality was examined for newer model-year cars. The mechanical condition rating and repair expenditures variables were alternatively used as measures of mechanical quality. Regression analysis was used to control for other factors affecting price.

Three equations were estimated using the mechanical condition rating as the measure of mechanical quality. The first equation includes mechanical condition and body and interior condition as continuous variables ranging from one to ten. The second equation includes mechanical condition and body and interior condition as two sets of dummy variables. The third equation uses the continuous measures of mechanical condition and body and interior condition, and includes interaction terms between mechanical condition and type of seller and between mechanical condition and Wisconsin dealers. The results of the three regressions are presented in Table 7 and are discussed below.[50]

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[49] The absence of a significant effect for the warranty variable in the older car sample may be due to the small sample size. There were only fourteen observations of purchases of older cars with warranties.

[50] A semi-log specification was used for the functional form. This was the most commonly used form in previous hedonic studies. This allows the coefficients to be interpreted as the percentage change in price arising from a unit change in the independent variable. The equation was estim-

Three equations were also estimated using repair expenditures as the measure of mechanical quality. The first equation uses total repair expenditures as the measure of quality. The second equation uses repair expenditures per month of ownership as the measure of quality.[51] The third equation uses repair expenditures per month as the measure of quality and includes the interaction terms. The results of the three regressions are presented in Table 8.

The coefficient on the mechanical condition variable was insignificant in all of the equations. The first and third equations in Table 7 used a continuous measure of the mechanical condition rating. The variable was insignificant in both equations. The second equation in Table 7 used nine dummy variables, one for each mechanical condition rating except ten, which was used as the excluded category. All of the coefficients on the dummy variables were insignificant. The first equation in Table 8 used total repair expenditures as the quality measure, while the second and third equations used repair expenditures per month. All of the variables were insignificant.[52] The insignificant coefficients imply that

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ated using ordinary least squares regression procedures.

[51] Repair expenditures were transformed to expenditures per month to control for potential problems arising because the cars had been owned for different lengths of time.

[52] The results for all three equations in Table 8 are the results obtained after two outlying observations were dropped from the sample. The two observations had both two of the highest repair expenditures and two of the highest prices (one was a Mercedes and the other a Cadillac) of cars in the sample. When these observations were included, the results showed significant coefficients for the repair expenditures variables, but the signs of the coefficents were positive, implying that cars with higher repair expenditures had significantly higher prices. As Table 8 shows, when these two observations were dropped from the total sample of 475, the repair expenditures variables were no longer significant.

TABLE 7

REGRESSION ANALYSIS OF PRICE
ONE TO SEVEN YEAR OLD CARS
MECHANICAL RATING MEASURE OF QUALITY

Variable	Equation 1 Coef	Equation 1 T	Equation 2 Coef	Equation 2 T	Equation 3 Coef	Equation 3 T
CONSTANT	7.926	13.74*	8.539	13.29*	8.017	12.58*
AGE	-0.155	-8.98*	-0.154	-8.89*	-0.152	-8.71*
MILEAGE	-0.005	-4.72*	-0.005	-4.75*	-0.005	-4.77*
MPG	0.024	2.30*	0.021	2.03*	0.024	2.35*
HP	0.003	2.20*	0.002	1.85	0.002	2.03*
WARRANTY	0.097	2.09*	0.102	2.19*	0.096	2.06*
BETTERAVE	0.030	0.63	0.038	0.79	0.026	0.55
WORSEAVE	-0.121	-2.34*	-0.115	-2.21*	-0.131	-2.51*
BODY	0.078	5.95*	---	---	0.071	5.20*
SIXCYL	-0.061	-0.80	-0.088	-1.15	-0.070	-0.92
FIVECYL	1.004	3.16*	1.009	3.19*	0.972	3.02*
FOURCYL	-0.187	-1.63	-0.185	-1.61	-0.204	-1.77
ROTARY	-0.657	-2.12*	-0.663	-2.13*	-0.577	-1.63
LENGTH	-0.005	-2.06*	-0.004	-1.93	-0.005	-2.04*
SPORTSCAR	0.683	5.78*	0.725	6.01*	0.678	5.66*
TRADE	0.064	1.31	0.061	1.24	0.065	1.33

TABLE 7, continued

Variable	Equation 1 Coef	Equation 1 T	Equation 2 Coef	Equation 2 T	Equation 3 Coef	Equation 3 T
PSTEER	0.096	1.29	0.094	1.26	0.087	1.16
PBRAKE	0.096	1.54	0.081	1.28	0.108	1.70
PSEATS	0.054	0.69	0.065	0.82	0.035	0.44
PWINDOW	0.033	0.42	0.030	0.38	0.062	0.77
ADJSTEER	0.098	1.86	0.102	1.91	0.096	1.82
VINYLROOF	0.027	0.60	0.012	0.27	0.037	0.81
CRUISE	0.077	1.30	0.065	1.09	0.082	1.38
AIR	-0.007	-0.15	-0.019	-0.36	-0.010	-0.20
AUTOTRAN	-0.010	-0.17	-0.001	-0.01	-0.022	-0.36
AM	0.119	0.89	0.143	0.30	0.153	1.13
AMFMTAPE	0.186	1.38	0.222	1.61	0.238	1.74
NEWDEAL	-0.062	-0.90	-0.050	-0.73	-0.035	-0.13
RELATIVE	-0.185	-1.98*	-0.157	-1.67	-0.396	-0.99
FRIEND	-0.177	-2.23*	-0.169	-2.11*	-0.376	-1.09
USEDDEAL	-0.186	-2.47*	-0.154	-2.02*	-0.123	-0.38
HEAR	-0.261	-2.84*	-0.253	-2.72*	-0.497	-1.14
RENT	0.040	0.17	0.030	0.12	0.559	0.24
OTHER	-0.264	-2.16*	-0.212	-1.73	-1.269	-2.85*
LAWNOASIS	0.061	0.71	0.065	0.75	0.053	0.62

TABLE 7, continued

Variable	Equation 1 Coef	Equation 1 T	Equation 2 Coef	Equation 2 T	Equation 3 Coef	Equation 3 T
LAWDISCAS	0.005	0.08	0.001	0.02	-0.011	-0.18
LAWINSP	-0.023	-0.51	-0.031	-0.68	-0.032	-0.71
LAWDEFECT	0.001	0.01	0.007	0.09	-0.046	-0.49
MECH	-0.006	-0.59	---	---	-0.012	-0.35
MECH*FRIEND	---	---	---	---	0.026	0.60
MECH*RELATIVE	---	---	---	---	0.027	0.54
MECH*USEDDEAL	---	---	---	---	-0.009	-0.21
MECH*NEWDEAL	---	---	---	---	-0.004	-0.12
MECH*HEAR	---	---	---	---	0.029	0.54
MECH*RENT	---	---	---	---	-0.055	-0.22
MECH*OTHER	---	---	---	---	0.131	2.35*
MECH*WISC*D	---	---	---	---	1.016	0.31
MECH1	---	---	0.019	0.07	---	---
MECH2	---	---	-0.001	-0.15	---	---
MECH3	---	---	-0.161	-0.61	---	---
MECH4	---	---	-0.179	-0.71	---	---
MECH5	---	---	0.085	0.42	---	---

TABLE 7, continued

Variable	Equation 1 Coef	Equation 1 T	Equation 2 Coef	Equation 2 T	Equation 3 Coef	Equation 3 T
MECH6	---	---	-0.120	-0.67	---	---
MECH7	---	---	-0.114	-0.81	---	---
MECH8	---	---	-0.044	-0.43	---	---
MECH9	---	---	-0.069	-0.95	---	---
BODY1	---	---	-0.450	-1.78	---	---
BODY2	---	---	---	---	---	---
BODY3	---	---	-0.946	-4.90*	---	---
BODY4	---	---	-0.613	-4.04*	---	---
BODY5	---	---	-0.256	-2.34*	---	---
BODY6	---	---	-0.310	-2.77*	---	---
BODY7	---	---	-0.147	-2.00*	---	---
BODY8	---	---	-0.021	-0.36	---	---
BODY9	---	---	0.006	0.11	---	---
R^2	0.70		0.72		0.71	
F	28.86		21.49		24.21	
N	501		501		501	

Notes: Dependent variable is log(price). Coef is the regression coefficient; T is the t-statistic. * indicates significance at the five percent level. See Appendix Table A5 for definition of variable names.

TABLE 8

REGRESSION ANALYSIS OF PRICE
ONE TO SEVEN YEAR OLD CARS
REPAIR EXPENDITURES MEASURE OF QUALITY

Variable	Equation 1 Coef	Equation 1 T	Equation 2 Coef	Equation 2 T	Equation 3 Coef	Equation 3 T
CONSTANT	8.351	15.00*	8.365	15.00*	8.370	14.95*
AGE	-0.157	-9.45*	-0.158	-9.46*	-0.161	-9.56*
MILEAGE	-0.005	-4.86*	-0.005	-4.73*	-0.005	-4.61*
MPG	0.014	1.36	0.013	1.32	0.012	1.23
HP	0.002	1.75	0.002	1.71	0.002	1.51
WARRANTY	0.094	2.14*	0.094	2.12*	0.093	2.08*
BETTERAVE	0.060	1.30	0.059	1.27	0.059	1.27
WORSEAVE	-0.098	-1.97*	-0.102	-2.03*	-0.107	-2.12
BODY	0.074	6.41*	0.075	6.45*	0.076	6.39*
SIXCYL	-0.015	-0.20	-0.017	-0.23	-0.027	-0.36
FIVECYL	1.089	3.64*	1.088	3.63*	1.071	3.57*
FOURCYL	-0.124	-1.11	-0.126	-1.13	-0.134	-1.19
ROTARY	-0.665	-2.32*	-0.675	-2.35*	-0.688	-2.39*
LENGTH	-0.005	-2.15*	-0.005	-2.15*	-0.005	-2.10*
SPORTSCAR	0.603	5.00*	0.593	4.89*	0.613	4.86*
TRADE	0.054	1.13	0.053	1.13	0.055	1.15
PSTEER	0.108	1.52	0.109	1.53	0.095	1.33

TABLE 8, continued

Variable	Equation 1 Coef	Equation 1 T	Equation 2 Coef	Equation 2 T	Equation 3 Coef	Equation 3 T
PBRAKE	0.101	1.70	0.101	1.69	0.104	1.72
PSEATS	0.074	0.97	0.077	1.00	0.059	0.76
PWINDOW	0.004	0.05	0.003	0.04	0.011	0.14
ADJSTEER	0.096	1.84	0.095	1.83	0.096	1.84
VINYLROOF	0.020	0.47	0.019	0.44	0.024	0.56
CRUISE	0.060	1.06	0.059	1.05	0.064	1.13
AIR	0.004	0.09	0.004	0.07	0.001	0.03
AUTOTRAN	0.174	0.30	0.012	0.21	0.010	0.16
AM	-0.211	-1.57	-0.213	-1.59	-0.195	-1.39
AMFMTAPE	-0.124	-0.92	-0.126	-0.94	-0.101	-0.71
NEWDEAL	-0.047	-0.70	-0.045	-0.68	-0.038	-0.54
RELATIVE	-0.175	-1.92	-0.178	-1.95	-0.151	-1.60
FRIEND	-0.188	-2.46*	-0.188	-2.44*	-0.225	-2.69*
USEDDEAL	-0.171	-2.33*	-0.170	-2.32*	-0.164	-2.12*
HEAR	-0.176	-1.99*	-0.174	-1.96*	-0.133	-1.41
RENT	0.029	0.13	0.031	0.14	0.049	0.71
OTHER	-0.259	-2.18*	-0.260	-2.18*	-0.198	-1.59
LAWNOASIS	0.009	0.12	0.008	0.10	0.008	0.10
LAWDISCAS	0.024	0.41	0.024	0.41	0.015	0.26
LAWINSP	0.022	0.50	0.023	0.53	0.012	0.27

TABLE 8, continued

Variable	Equation 1 Coef	T	Equation 2 Coef	T	Equation 3 Coef	T
LAWDEFECT	0.019	0.27	0.019	0.27	0.020	0.28
TOTREPAIR	0.000	0.74	---	---	---	-
REPAIR/MON	---	---	0.001	0.99	0.002	0.90
RM*FRIEND	---	---	---	---	0.004	1.06
RM*RELATIVE	---	---	---	---	-0.002	-0.82
RM*USEDDEAL	---	---	---	---	0.000	0.03
RM*NEWDEAL	---	---	---	---	-0.001	-0.34
RM*HEAR	---	---	---	---	-0.003	-1.06
RM*RENT	---	---	---	---	---	---
RM*OTHER	---	---	---	---	-0.008	-1.42
RM*WISC*D	---	---	---	---	0.002	0.30
R^2	0.72		0.72		0.72	
F	29.35		29.24		24.87	
N	474		473		473	

Notes: Dependent variable is log(price). Coef is the regression coefficient; T is the t-statistic. * indicates significance at the five percent level.

See Appendix Table A5 for definition of variable names.

differences in mechanical condition are not reflected in the prices of used cars. This suggests that buyers do not observe or learn of mechanical condition prior to purchase.

In contrast to the mechanical condition variables, the body and interior condition variable is highly significant and has the expected sign in all of the equations. The coefficient on the body and interior condition variable in the first equation in Table 7, for example, implies that a one unit increase in the subjective body and interior rating is associated with a 7.8% increase in the overall price of the car. The price increase between the lowest and highest possible ratings would be 78.0%. In the second equation in Table 7, when dummy variables were used for each rating, five of the eight coefficients were significant at the five percent level, and one was significant at the ten percent level, indicating that cars with lower ratings were priced lower than cars with the highest rating. Overall, the results imply that body and interior condition is reflected in the prices of used cars but that mechanical condition is not.

In order to test whether the relationship between price and mechanical condition differed by type of seller or between Wisconsin dealers and dealers in the rest of the country, interaction terms between mechanical condition and type of seller, and mechanical condition and Wisconsin dealers, were added in the third equation in both Table 7 and 8. All of the coefficients on variables of interest - the interactions with friends, relatives, dealers, and Wisconsin - were insignificant. This indicates that prices were not related to mechanical condition in purchases from any type of seller and in Wisconsin as well as the rest of the country.[53]

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[53] The coefficient on the interaction with "other" types of sellers in Table 7 is positive and significant. However, there appears to be no explanation or theoretical reason for this coefficient to be positive while the others are insignificant, especially given the ambiguous nature of sellers in this category.

The results are consistent with the results obtained examining average quality across different types of sellers. The absence of differences in the relationship between price and quality across different types of sellers implies that a lemons market is not present in the sale of newer model-year cars, and that information about quality is not significantly asymmetric. The absence of any overall relationship between price and quality suggests that buyers do not have information about quality prior to purchase. Together, these two results suggest that sellers face as much uncertainty as buyers regarding the subsequent mechanical condition of newer model-year used cars.

The estimated coefficients on the other variables appear reasonable. Coefficients are generally of the expected sign and of reasonable magnitude. With a few exceptions, the variables are also consistent across equations.

Coefficients on the age and mileage variables are negative and highly significant in all of the equations. The coefficient on the age variable in the first equation of Table 7 implies a decrease in price of 15.5% for each additional year of age. The coefficient on the mileage variable implies a decrease in price of 0.5% for each additional thousand miles of prior use. If the average vehicle is driven 15,000 miles in a year, then the age and mileage coefficients imply a total decrease in price of 23.0% arising from an additional year of age. This appears to be a reasonable estimate for the average depreciation rate.

To test whether the lack of a relationship was due to the fact that cars had been owned different lengths of time, the equations were re-estimated after dropping observations of cars having the three shortest and two longest number of months since date of purchase. Mechanical condition was less variant across time for the remaining observations. The results continued to show no relationship between price and mechanical condition.

The coefficient on the warranty variable is positive and significant in all equations. The warranty coefficient in the first equation of Table 7 implies that the presence of a warranty increases the price of a car by 10.2%.[54] The positive sign is expected because warranties provide insurance that is both valued by consumers and is costly to provide.

The coefficient on the dummy variable for models having a worse than average reliability rating from Consumer Reports is negative and significant in all equations. The coefficient in the first equation of Table 7 implies that models rated worse than average sell for 11.4% less than models rated average. The coefficient on the dummy variable for models rated better than average is positive but is not significant in any equation. The results imply that models with reputations for worse than average reliability sell for a substantial discount but that models with reputations for better than average reliability do not obtain a price premium.

None of the coefficients on the various state law variables, including the variable for Wisconsin's defect disclosure law, are significant.[55] This implies that the prices of cars

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[54] Because this variable is a dummy variable, the percentage change in price does not equal the coefficient. An approximation of the percentage change is obtained from [exp(c - .5v) - 1], where c is the estimated coefficient and v is the estimated variance of c. For this and most of the other coefficients below, the parameters are such that the approximation is very close to the unbiased estimate. See Derrick [1984] and Kennedy [1981].

[55] Variables for Wisconsin's defect disclosure law, laws prohibiting as-is sales, and laws requiring disclosure of as-is sales were alternatively included as both dummy variables for all transactions in the state and as interaction terms with dealer sales. None of the coefficients were significant in either specification. The results using dummy variables are shown in Tables 7 and 8.

bought in states having those laws are not different than the prices of cars bought in other states.

The coefficient on the fuel economy variable is positive and significant in Table 7 but is not significant in Table 8. The coefficient in the first equation of Table 7 implies a 2.4% increase in price for each additional mile-per-gallon of fuel efficiency. Evaluated at the average price and miles-per-gallon of cars in the sample, the estimated coefficient implies an implicit price approximately equal to the savings in fuel expenditures for one and a half years.[56] Because the coefficient is both smaller and insignificant in Table 8, however, the result is not reliable.

The coefficient on the horsepower variable is positive and significant in Table 7, but is not significant in Table 8. In all but one equation, the coefficient on length is significant but negative, opposite of the expected sign. Coefficients on the variables for four and six cylinder engines are negative but not significant in any equation. The coefficient for five cylinders is positive and significant in all equations, and the coefficient for rotary engines is negative and significant in all but one equation. Only a few observations with either of these engine types appear in the sample. The coefficient for sports car models is positive and significant in all equations, indicating a substantial price premium. The coefficient for cars purchased with a trade-in is positive but is not significant in any equation, indicating no difference

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[56] The average fuel efficiency of cars in the sample is 16 miles-per-gallon. Assuming 15,000 miles of annual driving implies total annual gasoline usage of 937.5 gallons. Increasing fuel efficiency to 17 miles-per-gallon would reduce annual usage to 882.4 gallons, an annual savings of 55.1 gallons. Assuming a price of gasoline of one dollar per gallon implies annual savings of $55.10. The 2.4% increase in price given by the MPG coefficient, evaluated at the average price of cars in the sample of $3032, implies a total increase in price of $72.77.

from cars purchased without a trade-in. Coefficients on the various options are generally of the expected sign but are not significant in any equation. This may be due to multicollinearity between the options.[57]

Coefficients on the type of seller variables for friends, relatives, used car dealers, "someone the buyer heard about," and "other sellers" are all negative and significant in the first equation of Table 7. Similar results are obtained in Table 8. The results imply that the prices of cars purchased from these types of sellers are significantly lower than the prices of cars purchased through newspaper ads. The coefficient on new car dealers is not significant, indicating that prices were not significantly different than the prices of cars purchased through newspaper ads. These results imply that prices are higher for cars purchased from new car dealers and through newspaper ads than for cars purchased from other types of sellers. Prices for new car dealers may be higher because of additional services provided. The reason for higher prices in cars purchased through newspaper ads, however, is not clear, but may possibly be due to higher search costs in this sector of the market.

[57] To investigate this, a variable was created that measured the number of options present in the car, and was included in the equation in place of the list of individual option dummy variables. The new variable was positive and significant.

CHAPTER IV

CONCLUSIONS

This study examined several issues concerning product quality and information in the used car market. First, the study attempted to determine whether information about mechanical condition is significantly asymmetric, that is, whether sellers have significantly more information than buyers. Second, where information was found to be asymmetric, the study examined the ability of market reputation forces to prevent the lemons market problem of bad quality driving out good quality. Third, the study investigated the effects of public policy designed to correct asymmetric information problems by examining Wisconsin's defect disclosure law.

The study found no evidence of asymmetric information or lemons market problems in newer model-year used cars. However, while information does not appear asymmetric, buyers do not appear to have information about quality prior to purchase. Instead, sellers appear to face as much uncertainty as buyers concerning post-purchase mechanical performance.

The study did find evidence of asymmetric information and lemons market problems in older model-year used cars purchased from private sellers located through newspaper ads. For older cars, average quality was significantly lower for cars purchased through newspaper ads than for cars purchased from friends and relatives.

Evidence on the ability of reputation and other market forces to overcome asymmetric information problems in dealer sales of older cars was somewhat ambiguous, but suggests that market forces are at least partially successful. Dealers selling both new and used cars showed quality significantly higher than cars purchased through newspaper ads for two of the three measures of quality. For dealers selling only used cars, quality was generally higher than the quality of cars purchased through newspaper ads, and lower than the quality

of cars purchased from friends and relatives, but not significantly different from either.

The results suggest that defect disclosure requirements designed to overcome information problems in the used car market may yield few benefits. Defect disclosure requirements would have little effect on newer model-year used cars because sellers do not appear to have significantly more information about post-purchase mechanical condition than do buyers.

Defect disclosure requirements may also yield few benefits in transactions of older model-year used cars. While a lemons market problem was found in older cars purchased from private sellers located through newspaper ads, a defect disclosure requirement is not likely to affect this sector of the market. Transactions with private sellers are not usually subject to such requirements because of enforcement difficulties.

The evidence concerning benefits from disclosure requirements in older cars purchased from dealers is ambiguous. While there is no clear evidence that reputation incentives have entirely eliminated all problems, there is no clear evidence of a lemons market either. For dealers selling both new and used cars, the evidence appears to suggest that market reputation incentives have been effective. At the most, therefore, possible benefits of a disclosure requirement are limited to older used cars sold by some dealers, and are not even clearly supported there. Overall, the evidence raises doubts about the potential benefits of a disclosure requirement in the market for used cars.

Examination of Wisconsin's defect disclosure law also suggests that disclosure requirements would result in limited overall benefits. The study found that the Wisconsin law had no effect on the average quality of cars sold by dealers in that state. This implies either an absence of a lemons market in dealer sales or a law that ineffectively addresses the problem. Either explanation, however, raises doubts

about the benefits of imposing these disclosure requirements.[58]

While the results do not support the need for a defect disclosure requirement and show little effect of such a law, the results also fail to find any evidence that the requirement significantly increases the prices of used cars. After controlling for other factors, prices of used cars in Wisconsin were found to be no different than prices of cars in the rest of the country. The study also did not find any evidence of significant price effects for three other types of state laws: laws requiring specific disclosures for as-is sales, laws prohibiting as-is sales, and laws requiring safety inspections.

The conclusions that the used car market is not subject to a significant lemons problem in dealer sales, and that a disclosure requirement is not likely to yield much benefit, do not imply that no problems exist in the industry or that dealers never have knowledge of defects that they fail to disclose. The results also do not imply that buyers are never deceived and injured, or that there is no role for law enforcement activity. Instances of sellers having knowledge of defects and failing to disclose, or even intentionally conceal-

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[58] As noted above, however, at the time the cars in this study were purchased, the Wisconsin law required that the defects disclosure be made at the time of sale. Most dealers complied by providing the disclosure with the sales contract. The current Wisconsin law requires that defects be disclosed on an information sticker attached to the car. The effect of the different disclosure methods is unclear. Since the information is available before consumers have decided to purchase a particular car, it may have a greater impact on purchase decisions. However, it is not clear why the difference would be large. Important information about defects should affect purchase decisions even if the information is obtained late in the transaction. In addition, consumers could presumably ask to examine the disclosure document prior to making a decision.

ing the information, assuredly occur. The results imply, however, that these types of problems do not appear to be widespread enough to have significant adverse effects on the overall performance of the market, and that industry-wide disclosure requirements are likely to have little overall benefit.

In the other issues examined, models with a reputation for below average reliability were found to be priced twelve percent lower than models with a reputation for average reliability, indicating that consumers discount the value of cars with reputations for low reliability and that consumers use the information concerning expected reliability available in the market. While a substantial discount was found for models of below average reliability, models of above average reliability did not command a significant price premium.

The presence of a warranty was found to increase price by approximately ten percent. This indicates that some buyers are willing to pay for insurance against the risk of unforeseen post-purchase mechanical problems. The study also found that the average quality of cars purchased with and without warranties did not differ, implying that warranties were not acting as a signal of quality in this market.

The results of this study provide insight into the state of information about quality in the market for used cars. The results also provide a case study of the ability of reputation and other market forces to overcome problems arising from asymmetry of information and of the effects of mandatory disclosure requirements. The results provide evidence that information problems can have a significant effect on markets, but also provide evidence that reputation forces can be effective in mitigating the problems. In order to gain a better understanding of when information problems will lead to significant market inefficiencies and when market forces will be effective in overcoming the problems, future research should continue to empirically investigate these issues in other market settings.

APPENDIX

TABLE A1

DISTRIBUTION OF REPAIR EXPENDITURES ONE TO SEVEN YEAR OLD CARS

Repair Expenditures	Ad N	Ad %	Friend Relative N	Friend Relative %	New Dealer N	New Dealer %	Used Dealer N	Used Dealer %	Hear N	Hear %
0	34	63	51	56	174	72	65	80	20	61
1-99	13	24	20	22	37	15	8	10	7	21
100-199	2	4	8	9	7	3	2	2	1	3
200-299	3	6	6	7	8	3	3	4	2	6
300-399	-	-	2	2	1	0	2	2	1	3
400-499	-	-	-	-	7	3	-	-	-	-
500-599	-	-	1	1	2	1	-	-	-	-
600-699	-	-	1	1	2	1	-	-	-	-
700-799	-	-	-	-	-	-	-	-	-	-
800-899	-	-	1	1	2	1	-	-	-	-
900-999	-	-	-	-	1	0	-	-	1	3
1000-1999	1	2	-	-	1	0	1	1	-	-
2000-2999	-	-	-	-	-	-	-	-	1	3
3000-3999	1	2	1	1	-	-	-	-	-	-
Total N	54		91		242		81		33	
Mean	108.30		111.89		58.74		56.56		133.91	

Note: Type of seller categories: ad is private sellers located through newspaper ads; friend/relative is friends and relatives; new dealer is dealers selling both new and used cars; used dealer is dealers selling only used cars; hear is "someone else the buyer heard about."

TABLE A2

DISTRIBUTION OF REPAIR EXPENDITURES EIGHT TO FIFTEEN YEAR OLD CARS

Repair Expenditures	Ad N	Ad %	Friend Relative N	Friend Relative %	New Dealer N	New Dealer %	Used Dealer N	Used Dealer %	Hear N	Hear %
$0	22	40	72	65	19	66	20	59	23	68
1-99	9	16	21	19	4	14	5	15	4	12
100-199	11	20	8	7	5	17	1	3	2	6
200-299	2	4	4	4	-	-	2	6	-	-
300-399	5	9	1	1	-	-	-	-	1	3
400-499	1	2	1	1	-	-	1	3	2	6
500-599	-	-	-	-	-	-	3	9	1	3
600-699	-	-	-	-	-	-	1	3	-	-
700-799	-	-	-	-	-	-	-	-	1	3
800-899	-	-	-	-	-	-	-	-	-	-
900-999	-	-	2	2	1	3	-	-	-	-
1000-1999	3	5	-	-	-	-	1	3	-	-
2000-2999	1	2	-	-	-	-	-	-	-	-
3000-3999	1	2	1	1	-	-	-	-	-	-
Total N	55		110		29		34		34	
Mean	265.13		79.99		65.20		152.71		85.24	

Note: Type of seller categories: ad is private sellers located through newspaper ads; friend/relative is friends and relatives; new dealer is dealers selling both new and used cars; used dealer is dealers selling only used cars; hear is "someone else the buyer heard about."

TABLE A3

MEANS OF SELECTED VARIABLES FOR EACH TYPE OF SELLER ONE TO SEVEN YEAR OLD CARS

Variable	Ad	Friend Relative	New Dealer	Used Dealer	Hear	Other
Age	4.08	3.85	2.75	3.51	4.26	2.70
Miles	47.66	44.48	34.18	43.88	44.58	42.41
Body Rating	8.54	7.82	8.84	8.49	7.77	8.20
Warranty (%)	7	5	50	24	6	15
N	59	94	255	85	35	20
% of Total N	11	17	47	16	6	4

Note: Type of seller categories: ad is private sellers located through newspaper ads; friend/relative is friends and relatives; new dealer is dealers selling both new and used cars; used dealer is dealers selling only used cars; hear is "someone else the buyer heard about;" and other is other sellers.

Age is vehicle age; miles is odometer mileage in thousands; body rating is a subjective rating by buyers of body and interior condition on a scale of one to ten; warranty is percentage of cars sold with a warranty.

TABLE A4

MEANS OF SELECTED VARIABLES FOR EACH TYPE OF SELLER EIGHT TO FIFTEEN YEAR OLD CARS

Variable	Ad	Friend Relative	New Dealer	Used Dealer	Hear	Other
Age	10.05	9.83	8.57	8.58	10.03	11.00
Miles	86.96	83.41	68.33	71.61	79.49	80.00
Body Rating	6.78	6.63	7.73	8.11	6.77	5.50
Warranty (%)	0	2	17	16	3	0
N	58	115	30	38	39	4
% of Total N	20%	40%	11%	13%	14%	1%

Note: Type of seller categories: ad is private sellers located through newspaper ads; friend/relative is friends and relatives; new dealer is dealers selling both new and used cars; used dealer is dealers selling only used cars; hear is "someone else the buyer heard about;" and other is other sellers.

Age is vehicle age; miles is odometer mileage in thousands; body rating is a subjective rating by buyers of body and interior condition on a scale of one to ten; warranty is percentage of cars sold with a warranty.

TABLE A5

VARIABLE LIST

Variable	Name
Horsepower	HP
Fuel Economy	MPG
Length	LENGTH
Model Reliability	BETTERAVE WORSEAVE
Mechanical Condition	MECH
Body-Interior Cond.	BODY
Age	AGE
Odometer Mileage	MILEAGE
Number of Cylinders	FOURCYL, FIVECYL, SIXCYL, ROTARY
Warranty	WARRANTY
Sports Car	SPORTSCAR
Options:	
Air Conditioning	AIR
Power Steering	PSTEER
Power Brakes	PBRAKE
Power Windows	PWINDOW
Power Seats	PSEATS
Vinyl Top	VINYLTOP
Cruise Control	CRUISE
Adjustable Steering	ADJSTEER
Radio/Tape Deck	FMTAPE
Automatic trans.	AUTOTRAN
Trade-in	TRADE
Type of seller:	
Friend	FRIEND
Relative	RELATIVE
Used Only Dealer	USEDDEAL
New and Used Dealer	NEWDEAL
Newspaper Ad	AD
Someone Heard About	HEAR
Rental Agency	RENT
Other	OTHER

TABLE A5, continued

Variable	Name
State Laws:	
Defect Disclosure	LAWDEFECT
Prohibit As Is Sales	LAWNOASIS
As Is Disclosure	LAWDISCAS
Safety Inspection	LAWINSP
Months Since Purchase	TIMEOWN
Interaction Terms, Mechanical condition and:	
Friend	MECH*FRIEND
Relative	MECH*RELATIVE
Used Dealer	MECH*USED
New and Used Dealer	MECH*NEW
Newspaper Ad	MECH*AD
Someone Heard About	MECH*HEAR
Rental Agency	MECH*RENT
Other	MECH*OTHER
Wisconsin	MECH*WISC
Wisconsin Dealers	MECH*WISC*D
Interaction Term between Dealers and:	
Defect Disclosure Law	WISC*D
Laws Prohibiting As Is Sales	LAWNOASIS*D
As Is Disclosure Law	LAWDISCAS*D
Interaction Terms, Repairs per month and:	
Friend	RM*FRIEND
Relative	RM*RELATIVE
Used Dealer	RM*USED
New and Used Dealer	RM*NEW
Newspaper Ad	RM*AD
Someone Heard About	RM*HEAR
Rental Agency	RM*RENT
Other	RM*OTHER
Wisconsin	RM*WISC
Wisconsin Dealers	RM*WISC*D
Total Repair Expenditures	TOTREPAIR
Repair Expenditures per Month	REPAIR/MON

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