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# THE EFFICACY OF MINIMUM QUALITY CERTIFICATION IN THE USED VEHICLE MARKET

Michael D. Pratt and George E. Hoffer

Virginia Commonwealth University
School of Business
1015 Floyd Avenue
Richmond, Virginia 23284

## I. INTRODUCTION

Few topics have become so engrained in recent American folklore as our experience with certain used cars -- the proverbial "lemon". The crux of the lemons problem is buyer-seller information asymmetry. The person selling a used vehicle has much more information about the prior use of the vehicle and the expected probability of future repairs than does the perspective buyer of that vehicle. This buyer-seller information asymmetry imposes a risk premium (possible utility loss) on the buyer due to the uncertain quality of the vehicle he wishes to purchase. Thus, since prospective buyers cannot distinguish between vehicles of good and poor quality, the average price of used vehicles is relatively lower than if full information is available and it follows that there would be fewer vehicles of "good quality" offered for sale (Akerlof, 1970; Metzger, 1983). Due to this imperfection, there are incentives to provide more vehicle information to prospective buyers in an attempt to increase purchasing inefficiency. With this increase in efficiency, a better mix of used vehicles would be traded in the used market. The incentives to provide more information can lead to both market and non-market responses (Akerlof, 1970).

It is the purpose of this study to investigate whether certain state used vehicle disclosure laws provide consumers with enough additional used vehicle information so as to impact the quality mix of traded vehicles. While state disclosure requirements may provide secondary benefits or costs to the consumer and society other than through reduced maintenance expenditures, these benefits or costs, if any, are not examined in this analysis. In the next section we present a conceptual model of disclosure requirements. Then in Section III, we discuss the disclosure requirements currently imposed by several states, detail the elements of the data base used in this analysis and

then test the hypothesis indicated by the model. The paper concludes with some observations on disclosure requirements.

## II. MODEL

In any exchange of used goods, there is an asymmetry of information between buyer and seller. Given the information gleaned from the prior use of the good, a prospective seller can assign a probability to the event that the characteristics of future performance of one's used product make it of "good" quality rather than of "poor" quality (a lemon). A prospective buyer of the used product must also attempt to assign a probability, p, to the event that the used product is of "good" quality and (1-p) that it is a lemon (Akerlof, 1970). Some prospective buyers may attempt to decrease the risk of purchasing a lemon by incurring certain transactions costs to inspect the used good in order to more accurately determine the expected quality of the good. However, the asymmetry of information between buyer and seller would remain until after the new owner had used the good. Only at that time can one assign a new, more accurate, probability to the expected quality of the good.

Since a prospective buyer cannot distinguish between used products of good quality and those that are lemons, good quality products and lemons will sell at the same price. Therefore, owners of good quality products will tend not to offer them for sale at a market price which is relatively lower than their expected value. Thus the number of transactions in the market would not be optimal and the average quality of the traded goods would decline. As Akerlof (1970) has noted, this imperfection gives rise to both market and non-market institutions that would act to certify quality. These institutions may increase welfare when they increase the number of used-product transactions and the quality mix of traded goods, at a cost less than the benefits that accrue to society.

The used automobile market has received much attention in discussions of buyer-seller information asymmetry.[1] It is a highly visible market where the differences in buyer-seller information are readily apparent. Moreover, it is a market where deceptive seller practices that take advantage of this difference in buyer-seller information are thought to be prevalent.

The market responses which act to certify quality include dealer guarantees and warranties on used vehicles. Also each domestic automobile manufacturer has attempted to certify the quality of the better used vehicles sold by their dealers by associating them with new car quality. Chevrolet dealers have differentiated their better used vehicles by designating them as "O.K.". Ford and AMC dealers similarly have attached the "A-1" and "Select" idioms to their better used vehicles. In this manner, automobile producers attempt to assure the consumer that a particular used vehicle purchased from their franchised dealers would be of better quality than the average used vehicle purchased from some other source and therefore less likely to be a lemon.

The non-market responses to quality uncertainty have evolved through state codes. All states have adopted some version of the Uniform Commercial Code to define the legal provisions of both expressed and implied warranties. Certain other states have adopted used vehicle disclosure laws, and in 1981 the Federal Trade Commission (FTC) proposed a used vehicle rule that would be applicable for all states. In the analysis that follows, we examine the efficacy of these types of non-market responses to quality uncertainty.

Legally imposed disclosure requirements are designed to decrease the buyer-seller information asymmetry encountered in the exchange of used vehicles by requiring that dealers certify that a used vehicle either does or

does not meet a certain set of minimum mechanical conditions. It is not the purpose of these laws to provide a warranty of these mechanical conditions. The two basic elements included in a disclosure law are the definition of the standards of minimum quality against which vehicles will be judged and the enumeration of those who will be subject to the law. The standards of quality are chosen from the spectrum of used vehicle qualities that can be discerned to be traded in the market. The higher the level of quality that is to be certified, the greater the inspection cost incurred by the seller. Also, the higher the level of quality that is certified, the greater is the reduction in the risk (loss of utility) associated with the purchase of a vehicle of uncertain quality. The law will either require all sellers of used vehicles or only dealers to comply with the disclosure requirement.

Metzger (1983) has investigated the case where only dealers are required to certify quality. He shows, for a given level of quality certification, that if the cost of inspection is less than the risk premium associated with buying a used vehicle of uncertain quality, then the price paid by dealers to owners of used vehicles will increase. As the price paid by dealers increases, a greater number of better quality used vehicles will be traded in the market. Given the better mix of used vehicles, the average repair expenditure incurred by new owners will decrease and the law can be considered effective. However, if the cost of inspection exceeds the risk premium, the prices paid by dealers will decrease, their total sales volume will decrease and a smaller number of better quality vehicles will be traded. Thus, on average, new owners would incur relatively greater repair expenditures.

To better indicate how the choice of a quality standard impacts the success of a disclosure requirement, consider Figure 1.[2] Let Q represent an index of certified vehicle quality and suppose that vehicle quality can range

between $Q_L$ and $Q_C$. The cost of inspection is represented by the curve I(Q) and the reduction in risk associated with buying a vehicle of uncertain quality is indicated by the curve R(Q).

Any level of certified quality chosen between between $Q_1$ and $Q_2$ would insure a better mix of traded vehicles. Any other standard would not be successful, and, in fact, could act to lower the average quality of traded vehicles.

Consider two possible situations. Suppose that in Figure 1, a quality certification of $Q_i$, $Q_1 < Q_i < Q_2$, is chosen by a regulatory agency. At this level of quality certification the cost of inspection by the dealer is less than the risk premium associated with the purchase of a vehicle of uncertain quality. Thus dealers are willing and able to increase the price they pay to owners of used vehicles since prospective buyers are willing and able to offer a higher retail price that will more than cover the cost of inspection. This higher offer-price by dealers will coax owners of higher quality vehicles to make them available for sale. Since the vehicles drawn into the market are of higher quality than the average quality of vehicles that would have been available for sale at the lower dealer offer-price prior to quality certification, average vehicle quality will increase and there will be proportionately fewer lemons traded in the market. Therefore, a successful quality certification program will increase the average transactions price which will cause an increase in the number of transactions and in the quality mix of vehicles transacted in the market.

However, a quality certification program can be unsuccessful. Suppose that in Figure 1, a quality certification of $Q_j$, $Q_L < Q_j < Q_1$, is chosen by the regulatory agency. In this situation, the cost of inspection would exceed the risk premium associated with the purchase of a vehicle of uncertain

quality. Although prospective buyers would benefit from the quality certification, the higher price that they would be willing to offer for certified vehicles is not sufficient to cover a dealer's cost of inspection. This situation can be interpreted in the same manner as we would a specific tax on a commodity. The quality certification would lead to a higher retail transactions price but, since a dealer must bear a portion of the cost of certification, a dealer will decrease the price he would offer the owners of used vehicles. At the dealer's lower offer-price, higher quality vehicles would be the first to be not offered for sale by owners. The quality mix of transacted vehicles will decrease and therefore there will be proportionately more lemons traded in the market.

This analysis indicates the importance of both the cost of quality certification and the benefits received from quality certification in how the market will respond to the regulation. As shown above, the regulatory agency must choose a level of quality certification such that the benefits received by consumers exceed the additional costs imposed on dealers. Otherwise, the regulation may in fact impose net costs on society.

The inference that this model offers is that an effective disclosure requirement will cause the mix of traded vehicles to be of better quality and, therefore, the repair expenditures incurred by the average new owner of a used vehicle would decline. Thus we can predict that if state-mandated disclosure requirements are effective, then the average maintenance expenditures on vehicles purchased used in states with higher quality standards to be less than the average maintenance expenditures on vehicles purchased in states with lower quality standards.

## III. EMPIRICAL ANALYSIS

All states have adopted some version of the Uniform Commercial Code.

This defines the legal provisions for both expressed and implied warranties. Certain other states have also adopted various types of used vehicle disclosure laws.[3] Of the states having disclosure statutes Wisconsin is unique in having a comprehensive used motor vehicle law. The disclosure requirements dictated in the Wisconsin statutes parallel those included in the proposed Federal Trade Commission Used Vehicle Rule (Trade Regulation Rule: Sale of Used Vehicles, August, 1981). The Wisconsin statutes specifically require that dealers and their representatives inform, in writing, retail used motor vehicle purchasers about any and all significant existing mechanical defects, structural defects, and damages which can be ascertained as a result of "reasonable diligence." Reasonable diligence is defined in the statute as an inspection that "shall consist of but not be limited to a walk around and interior inspection, under-hood inspection, under-vehicle inspection and a test drive." The statutes apply to all motor vehicles weighing less than 16,000 pounds. Used vehicle dealers are required to display a placard (or notification thereof) that discloses the dealer's knowledge of the mechanical condition of a certain set of vehicle parts. The purchaser is required to sign this placard prior to the execution of the sales contract (Wisconsin Code MVD 24.03(s)(a)). In the discussion that follows, we call this "quality certification."

Iowa is one of several states that has adopted a practice that can be interpreted as "safety certification." Iowa requires that any new or used vehicle undergo a safety inspection prior to a change in vehicle registration. The safety inspection must have been performed by a state-licensed garage within 60 days of the registration change. All inspections are performed by service stations or motor vehicle dealers which have been licensed by the Iowa Department of Transportation's Office of Vehicle

Registration. Safety components examined include the braking, exhaust, steering and suspension systems, as well as lights, tires, wipers/washers and the horn. Vehicles are also inspected for working defrosters, broken glass, structural rust and seat belts. The current inspection and road test fee is $8.00 for cars and light trucks. This inspection of safety related equipment is required only when vehicle registration is changed and it is not required to be performed on a periodic basis after that change.

To complete the possible set of policy options, we include Minnesota in our analysis. Minnesota, like many states, has no state vehicle inspection program or any other disclosure requirements on the sale of used vehicles. All used goods, including motor vehicles, are sold on an as-is basis. Thus we have no quality certification.

In order to test for a difference in average repair expenditures between these three states, we use the maintenance data for pickup trucks provided in the 1977 Bureau of Census Truck Inventory and Use Survey (TIU Survey). (Because of a perceived "lack of interest" by researchers in this information, the census eliminated all questions about vehicle maintenance requirements from the 1982 TIU Survey). Bond (1982) has argued effectively that the market for pickup trucks has similar characteristics to the market for automobiles.

The TIU Survey is included as a component of the Census of Transportation, which is conducted every five years, to provide information on several aspects of travel and transportation. The Census is divided into three component surveys: (1) the National Travel Survey, (2) the Commodity Transportation Survey, and (3) the Truck Inventory and Use Survey. The latter survey collects data on the characteristics and operational use of the nation's private sector truck resources.

The 1977 TUI Survey is based on a stratified probability sample of

approximately 177,000 trucks drawn from a population of approximately 28 million trucks with current 1977 registrations on file in each state's Division of Motor Vehicles (inclusive of the District of Columbia). Based on the total number of trucks registered annually in each state, the states are divided into three groups: (1) large states - over 1.5 million trucks, (2) medium states - 700,000 to 1.5 million trucks, and (3) small trucks - less than 700,000 trucks. Only California and Texas are in the large state grouping. Florida, Georgia, Illinois, Indiana, Michigan, Missouri, New York, Ohio, Oklahoma and Pennsylvania comprise the second category. The remaining 34 states were in the latter category.

A separate sample was selected from the truck population in each state. For each state sample, a stratification is made between trucks weighing less than 14,000 pounds (termed "small"), and all other trucks (termed "large"). Previous census experience has determined that a sample of 600 trucks from the small truck stratum is sufficient in every state except California, Texas and the District of Columbia.

The Census Report Form (TC-200) was mailed to owners of the sampled trucks. This form included pre-printed data on the sampled vehicle from the Division of Motor Vehicles' records (license, make, model, model year) and requested the owner to respond to questions about vehicle use. The owner's responses were manually edited and coded. Report forms which contained questionable responses were corrected when necessary. The information was finally processed through extensive computer audit. Table 1 lists the information and characteristics included in the completed TUI Survey data base.

From this data base we chose all pickup trucks in Iowa, Minnesota and Wisconsin that had been purchased used within one year of each state's census

survey date. Thus all vehicles included in this set have reported statistics for a twleve month period. Excluded were vehicles that were reported to be leased, to not be in use, or to have sold during the survey period.[4] Pratt and Hoffer (1984) have determined that these vehicles, when compared to all vehicles not transacted during the same period, are more likely to include a greater number of lemons.

The TIU Survey asked respondents to detail the maintenance problems in four major categories: motor, transmission, rear end-differential and brakes. The respondents answered "yes-no" as to whether maintenance was performed on the vehicles in any of the four enumerated categories, plus a catch-all "other" category. To capture the relative cost of those reported maintenance categories, we used the cost data presented in Table 2. These "average" cost estimates for each category in 1977 dollars were obtained from the Wisconsin Independent Garage Owners Association. For example, as shown in that table, in 1977, the average expenditure on rear end-differential maintenance per year was twice that of the average expenditure on brake maintenance.

Under the null hypothesis that a disclosure requirement is not effective, there would be no change in the quality mix of traded vehicles and therefore, we would be unable to determine a significant difference between the average maintenance expenditures of vehicles purchased used in these three states. To determine the acceptance of the null hypothesis, we performed a pairwise test of the equality of the mean maintenance expenditures of these groups. A difference in average maintenance expenditures of used vehicles purchased in Wisconsin as compared to those vehicles purchased in Iowa would indicate the relative effectiveness of two levels of quality certification. A comparison of average maintenance expenditures of used vehicles purchased in Minnesota as

compared to those vehicles purchased in Iowa or Wisconsin would indicate the relative effectiveness of two different levels of quality certification.

In the tests that follow, no control was made for vehicle age or total vehicle mileage. At any given time, the market consists of a spectrum of trucks having various age and mileage characteristics. These characteristics provide information to a prospective buyer of a used vehicle, but they do not affect the buyer-seller informational asymmetry. However, one might expect that if a mix of vehicles, when compared to some other mix, had a relatively older population and/or a relatively higher lifetime mileage that it would also have a relatively greater average expenditure on repairs. Each sample was tested to determine if this would introduce an error in our tests. The tests show that there is not a significant difference between the average age or average lifetime mileage between the used vehicles purchased in any pair of states in this study.[4] Also since the states are in the same region, the climatic conditions would not be expected to cause a difference in the maintenance expenditures.

The statistics reported in Table 3 are insignificant at the five percent level.[5] Thus, for our sample, we accept the null hypothesis: the quality certification required in Wisconsin and the safety certification required in Iowa do not seem to be effective. The mix of vehicles represented by each state's sample cannot be discerned to be of better quality than that mix reported for Minnesota.[6]

From Table 3 we see that for our sample there is no significant difference between the $347 average maintenance expenditure incurred by the Wisconsin respondents and the $317 average maintenance expenditure incurred by Iowa respondents. Thus we see no differential impact of the different quality certification represented by these state statutes. When these repair records

are compared to those reported by the Minnesota respondents, we see that the $246 in average repair expenditure incurred by the Minnesota respondents is not significantly different from either the Wisconsin or Iowa respondents. Thus, for our data set, the quality certification imposed by Wisconsin and Iowa do not seem to be effective.[7]

To more finely test the impact of a safety certification, we conducted the same tests described above, but limited the analysis to the brake maintenance category. This is the only reported category that clearly would be examined in a safety inspection. For our sample a comparison of the mean brake maintenance expenditures incurred on vehicles purchased in Iowa, with these purchased in Minnesota or Wisconsin, indicates no significant difference at the five percent level (Table 4).[8]

## IV. CONCLUSION

In our tests, we have been unable to find evidence that the currently mandated disclosure requirements in Wisconsin and Iowa are effective in increasing the number of good quality vehicles traded in the used market. Therefore, on average, these disclosure requirements do not seem to decrease a prospective buyer's risk of purchasing a lemon. This result is supported by Nevin (1983). He found that purchasers of used vehicles in Wisconsin do not perceive themselves to have a higher level of consumer satisfaction than similar purchasers in either Iowa or Minnesota. He also determined that the complaint behavior of Wisconsin used vehicle purchasers was not significantly different from similar purchasers in either Iowa or Minnesota.

We conclude with a caveat. The used pick up truck market may have less of a lemons problem than the used automobile market in general, for individuals who buy such vehicles may be more "automotive-knowledgeable" than the general population. Thus the information disparity in this submarket may

be less asymmetric.

## FOOTNOTES

1. See Akerlof (1970), Bond (1982), Metzger (1983), Pratt and Hoffer (1984) for further discussions. Minimum quality levels have also been addressed be Leland (1979) and Spence (1975).

2. Metzger (1983) uses a similar graphical analysis. We note that even the lowest level of quality certification would impose a positive cook.

3. These disclosure requirements include information about prior police or taxi use (California, Indiana, Utah) to odometer mileage certification (Colorado, Connecticut, Massachusetts). Recently, a number of states have enacted statutes generically dubbed "lemons laws." These laws generally apply to new vehicles and require that the selling dealer must buy back the consumer's vehicle if the dealer is unable to satisfactory repair a problem within legislated parameters or if the car is unavailable to the consumer for a specified period. Most laws require that the consumer pay ten cents for each mile driven. While dubbed "lemons laws", these statutes have little, if any, relationship to used vehicle disclosure laws.

4. We eliminated vehicles which were sold during the period, since we did not have a full year's observation for such vehicles.

5. A sensitivity analysis shows that the results are invariant with respect to the actual dollar amounts reported in Table 2. The analysis is dependent on the relative ranking of the reported expenditure categories.

6. These results are reinforced by the regression analysis presented in the Appendix.

7. Although our tests do not indicate that the mean repair expenditures reported by the respondents in each state are significantly different, the pattern of these means deserves comment. The model predicts that unsuccessful disclosure requirements would cause a decrease in the relative quality of the mix of traded vehicles. This could be an explanation of the means described above.

8. We also compared the mean maintenance expenditures for the other subcategories to see if there were significant differences between the three states. Again, with the exception of the "rear end-differential" category, the difference between the means was insignificant. For the one category that was significant, the mean maintenance expenditures in Minnesota, the "as is" state, were actually lower than in the other two states. This result is consistent with our comments in Footnote 7.

**TABLE 1**

TIU Survey Data Base, 1977

State Registration

Size of truck

Year, make and model of truck

Registered weight

Present vehicle ownership

When sold

How vehicle was acquired

When purchased

Lease information

Operator classification (private, different for-hire types)

Major use of vehicle

Products carried

State base of operation

Percent of miles traveled within base state

Characteristics of vehicles at base state

Annual miles

Total lifetime miles

Vehicle fuel efficiency

Maintenance record

Type of firm performing maintenance

Vehicle weight

Vehicle equipment

Vehicle body type

Number of powered ales

Vehicle cab type

Expansion factor to universe level

**TABLE 2**

Estimated Maintenance Costs,, 1977[1]

| | |
|---|---|
| Brakes | $100 |
| Rear end-differential | 200 |
| Transmission | 400 |
| Engine | 800 |

[1]Wisconsin Independent Garage Owners Association

**TABLE 3**

Tests of the Equality of Mean Maintenance Expenditures
Between States (in $100)

| State | N | Mean | Std. dev. | Std. Error |
|---|---|---|---|---|
| Wisconsin (quality certification) | 59 | 3.47 | 5.53 | .72 |
| Iowa (safety certification) | 52 | 3.17 | 5.47 | .76 |
| Minnesota ("as-is") | 93 | 2.46 | 4.82 | .50 |

t-values for Table 3

| (t-values) | Wisconsin | Iowa | Minnesota |
|---|---|---|---|
| Wisconsin | — | | |
| Iowa | 0.29 | -- | |
| Minnesota | 1.15 | -0.78 | -- |

**TABLE 4**

Tests for the Equality of Mean Brake Maintenance Expenditures Between States (in $100)

| State | N | Mean | Std. dev. | Std. Error |
|---|---|---|---|---|
| Wisconsin (quality certification) | 59 | .19 | .39 | .05 |
| Iowa (safety certification) | 52 | .13 | .34 | .05 |
| Minnesota ("as-is") | 93 | .20 | .41 | .04 |

t-values for Table 4

| (t-values) | Wisconsin | Iowa | Minnesota |
|---|---|---|---|
| Wisconsin | — | | |
| Iowa | 0.74 | — | |
| Minnesota | -0.27 | 1.09 | — |

## APPENDIX

We have used regression analysis to verify the results reported above. In this approach, we used the estimated repair expenditure made on vehicles purchased used during the survey period as the dependent variable and the reported vehicle-use characteristics as independent variables. To isolate the impact of the two types of quality certification we have examined, dummy variables were introduced to indicate in which state the vehicle was purchased. The relation estimated was the following:

$$R = a_0 + a_1 A + a_2 M + a_3 L + a_4 W + a_5 I, \qquad (A.1)$$

where R = estimated annual expenditures on reported maintenance categories,

A = age of vehicle

M = annual vehicle mileage(1000),

L = lifetime vehicle mileage(1000),

$$W = \begin{cases} 1 & \text{if the vehicle purchased in Wisconsin,} \\ 0 & \text{otherwise,} \end{cases}$$

$$I = \begin{cases} 1 & \text{if the vehicle purchased in Iowa,} \\ 0 & \text{otherwise.} \end{cases}$$

Thus, in this relation, $a_0$ is the Minnesota intercept, $a_0 + a_4$ is the Wisconsin intercept, and $a_0 + a_5$ is the Iowa intercept. To judge the effect of the quality certifications imposed by Wisconsin and Iowa, we would examine the sign and significance level of the coefficients $a_4$ and $a_5$ respectively. For example, if the Wisconsin requirement is effective in increasing the quality mix of traded vehicles $a_4$ would be negative, an adverse effect would be indicated by $a_4$ positive, and the significance level of the coefficient would indicate whether we can discern any effect of the requirement. A similar interpretation is given to $a_5$.

Using the data set described in Section III, the results of estimating (A.1) are as follows:

$$R = \underset{(0.41)}{35.30} - \underset{(-1.65)}{19.02A} + \underset{(0.44)}{17.80M} + \underset{(3.27)}{37.97L} + \underset{(0.03)}{65.78W} + \underset{(0.24)}{15.95I}. \qquad (A.2)$$

$$R^2 = 0.092$$

$$F \text{ value} = 2.78$$

The equation is significant at the .05 level. Reported below the coefficients are the t values. Only the coefficient of lifetime mileage is significant at the .05 level, no other coefficient is significant at better than the .10 level. Therefore, it seems that, for our sample, neither the quality certification required in Wisconsin nor that required in Iowa are at levels that create the market responses necessary to bring significantly higher quality vehicles into the used market.

Using equation (A.1), a second regression was run using the full TIU data set. For this analysis there were 6,551 ovservations on vehicles purchased used during the survey period. This analysis allows one to judge the performance of the quality certification requirements of Wisconsin and Iowa relative to the rest of the nation. These results are as follows:

$$R = \underset{(0.91)}{9.22} + \underset{(5.04)}{8.77A} + \underset{(5.84)}{3.42M} + \underset{(9.77)}{1.58L} - \underset{(-0.53)}{14.26W} - \underset{(-0.75)}{21.91I} \qquad (A.3)$$

$$R_2 = 0.065$$

$$F \text{ value} = 90.86$$

Again the equation is significant at the .05 level. The coefficients of the age variable, annual mileage variable and lifetime mileage value are all significant at better than the .05 level. No other variables have coefficients that are significant at better than the .10 level. Therefore, it

does not seem that the maintenance experience reported in Wisconsin or in Iowa is significantly different for other states.

We must note that the $R^2$ statistics for both equations are low. Most likely this is due to the omission of certain variables which would reflect owner characteristics. However this data is not available from the TIU Survey.

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ATTACHMENT

(30) - Public Reference

(25) - Ed Bush & (62) - Mailing labels attached

(50) - Industry Analysis (Gelman Bldg.) Rm. 754

(1) - For Distribution