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Why Has the Pricing of New Cars Changed?

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WHY HAS THE PRICING OF NEW CARS
CHANGED?

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Working Paper No. 82

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While writing this paper, we asked economists at different universities and graduate students at the University of Chicago to estimate the percentage difference between the price of a new auto at the end and the beginning of the model year. Our unscientific survey found little agreement but the mean of the estimates exceeded 10 percent. This is an accurate estimate for the early fifties but grossly overestimates the decline of only two to three percentage points in recent years. For an automobile that sells for \$16,000 at the beginning of the model year, the savings for the patient buyer appear to be around \$320. Most participants expressed surprise at the small difference and some thought we were pulling their leg. However, the seasonal variation in retail automobile prices has declined appreciably over time. Another interesting and, we believe, related change is the decrease in the depreciation rate of used automobiles.

In this paper we try to explain why these two changes have occurred. Our results indicate the vanishing seasonal in retail automobile prices is not due to a disappearing seasonal in inventories. Rather, our results indicate the declining importance of the annual model change is the primary reason for the disappearing seasonal in retail car prices and the decline in the depreciation rate. We take the analysis a step further and suggest that the declining frequency and the magnitude of the annual model change are cost driven since the cost of introducing a model change has increased over time. Our evidence suggests that the American automobile has become less of a fashion product over time. Our results suggest that the seasonal pattern of prices is affected by economic factors. In the apparel and auto industry changes in the cost of producing product variety has changed the type of product produced and altered the seasonal pattern of prices.

Sections I and II present some graphics of the disappearing seasonal, the decline in the depreciation rate and two measures of the declining importance of the model change. Section III summarizes possible explanations for these changes. Section IV presents the time series analyses of the causes for the decline in the seasonal variation. In Section V pooled cross section-time series tests show how a major model change for a given nameplate increases the depreciation rate of a one year old auto with the same nameplate. We find differences in the depreciation rates of autos, vans and pick-up trucks and the discontinuance of a model increases the depreciation rate of a used automobile with the same nameplate.

I. THE DISAPPEARING SEASONAL IN NEW CAR PRICES

Introductory textbooks teach students that the timing of the harvest determines the seasonal variation in prices of a product. A model of steadily rising prices after the harvest describes the

price pattern for many agricultural goods. For some manufactured goods, a distant analogy to a harvest is the introduction of new goods and styles at the beginning of a season. In the clothing and automobile industries new goods are introduced at the beginning of well recognized seasons. In the apparel market the two main seasons are the fall-winter and the spring-summer seasons. In the automobile market new models appear in October or November. In these markets prices are highest at the beginning of the season and then decline throughout the season in part because the styling features of clothing and automobiles change from season to season so current styles or models become obsolete and because of the uncertainty about what consumers are willing to pay for the new styles.

The seasonal in prices has changed in both of these industries but in different directions. The seasonal variation in retail apparel prices has increased dramatically since the late sixties when fashion clothing appears to have grown in importance [Pashigian and Bowen,1991]. The seasonal in clothing prices appears to be related to the type of clothing that is sold. Fashion clothing has a more pronounced seasonal decline in prices than does basic clothing.

The seasonal in new auto prices has also changed, but unlike the apparel seasonal, it has virtually disappeared. The easiest way to picture the declining seasonal is to show how the monthly seasonal factor in the Consumer Price Index has changed since 1954. The CPI reports the monthly unadjusted and the seasonally adjusted price. The monthly price relative, or what we call the seasonal factor, is the ratio of the unadjusted to the seasonally adjusted price. Typically, it exceeds one at the beginning of the model year when the new models are introduced and it is less than one by the end of the model year. The Bureau of Labor Statistics uses the X11 program to make seasonal adjustments to the price data and the X11 program smoothes the seasonal adjustment factor for each month of each year. Because our immediate interest is in displaying the long term decline in the seasonal variation of retail auto prices, the seasonal derived from the X11 program is a convenient measure since it smoothes out the yearly variation in the seasonal factor.¹ Figure 1 shows the price relatives for November of the previous calendar year (the beginning of the model year), March, June and September (the end of the model year) from November 1953 to September 1989. Figure 1 shows the spread between November and the following September price relatives has decreased appreciably over time. In the early years the spread between the November and the following September price relatives was around 9 to 10 percentage points. By the late eighties the spread drops to 2 or 3 percentage points.² Much of the decline comes early with the spread declining more rapidly during the fifties and through the early sixties. Since then, the spread declines slowly and remains virtually constant throughout the eighties between 2 and 3 percentage points. One observation appears relevant here. Because most of the decline in the seasonal occurs in the fifties and early sixties, it is unlikely that government regulation plays a major role in explaining the

decline although the automobile became an increasingly regulated product throughout the seventies and eighties.

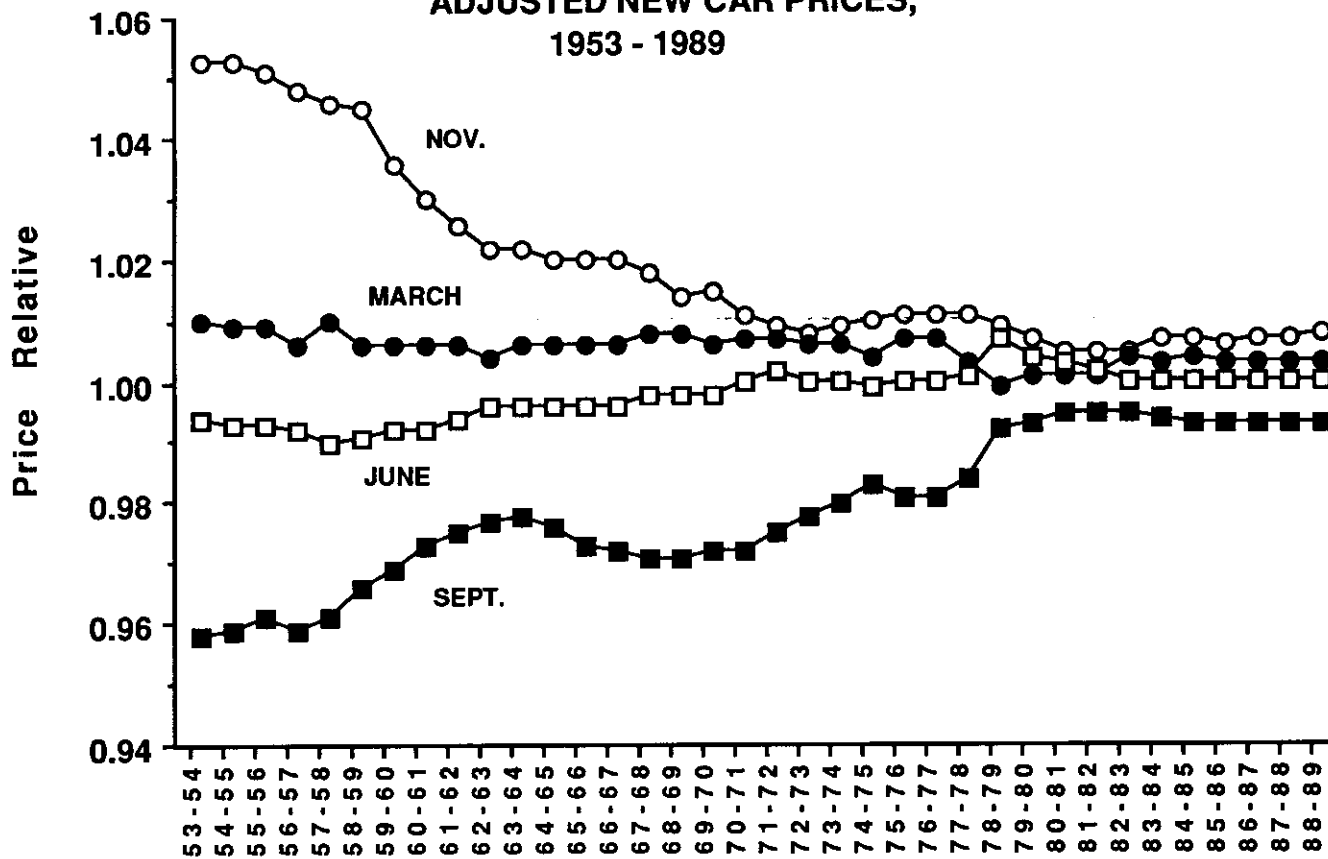
While Figure 1 shows the changes in the price relative for only four months in the model year, it is not a un-representative picture. Figure 2 presents two measures of the standard deviation of the monthly price relatives for each model-year where the model year lasts from November of one calendar year to the following October. The smooth series is derived from the X11 seasonally adjusted data. The more erratic series is derived by adjusting the unadjusted new car price index for inflation. Although the levels of the two series differ, both show the standard deviation of price relatives declines rapidly during the fifties, drops when the first wave of American small cars appears in the early sixties, then increases somewhat in the second half of the sixties as car size increases again and has stabilized at lower level during the eighties.

A different perspective of the effect of a model change on prices can be gained by comparing the price relative at the beginning of the new model year with the price relative at the end of the old model year. The percentage increase in the price relatives depends on how different the new models are relative to the old models. When major styling changes are expected, the new model imposes an obsolescence loss on the price of a new car of the old model and the willingness to pay increases for the new models so the relative price increase is large. On the other hand, cosmetic styling changes mean the obsolescence loss is smaller so the new and the old models are less differentiable and the relative price increase of a new auto is not as large when a new model is introduced.

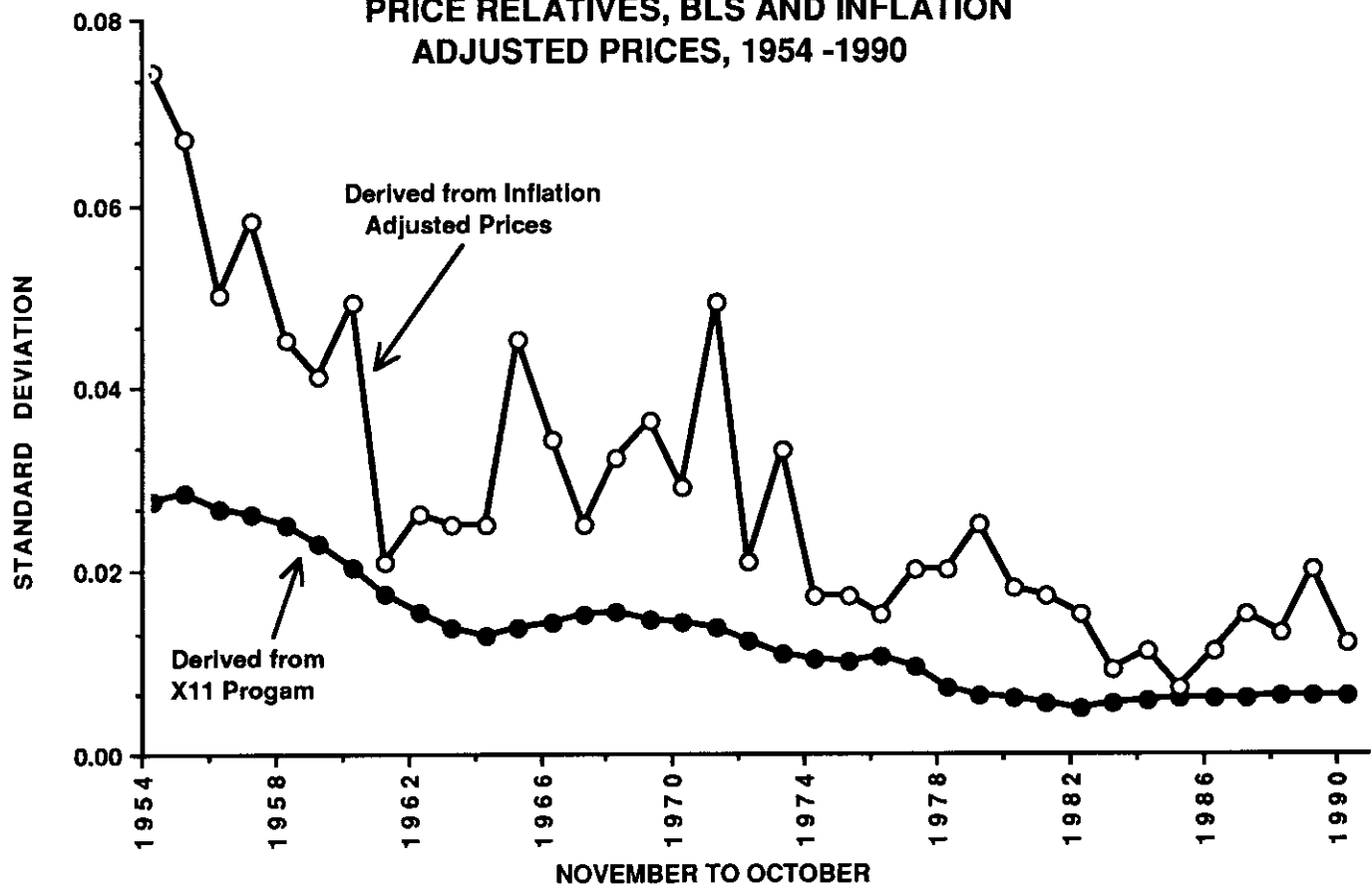
In a typical model year September marks the end of the previous model year and October is a transition month when dealers are selling the new and the old model. By November the new model accounts for most of new car sales. We can determine the relative size of the price increase for the new model by comparing the ratio of the November price relative to the September price relative for the smooth series and for the inflation adjusted price series. In Figure 3 both series show the percentage difference between the November and the September price relatives declines from 1954 to the mid-sixties and then declines more modestly until the eighties when it stabilizes. In recent years the unadjusted price of the new model is only slightly greater than the unadjusted price of the old model.

Figures 1-3 leave one impression - the retail pricing of automobiles has definitely changed over time. The price behavior in the fifties and the sixties, the golden age for Detroit, appears to be fundamentally different from that of the eighties. We have checked the seasonal variation of prices of other durables and failed to find any evidence of similar declines. The decline in the seasonal variation of retail prices for durable goods is unique to automobiles.³

**FIGURE 1: UNADJUSTED TO SEASONALLY
ADJUSTED NEW CAR PRICES,
1953 - 1989**



**FIGURE 2: STANDARD DEVIATION OF NEW CAR
PRICE RELATIVES, BLS AND INFLATION
ADJUSTED PRICES, 1954 - 1990**



These changes in pricing behavior suggest that the styling changes during the fifties and sixties were more dramatic than in more recent years. These price data suggest that American car manufacturers are introducing less frequent and less drastic model changes. Sheet metal changes that were so distinctive and differentiating and, by some accounts so ostentatiously, during the fifties and the sixties are more continuous now while technical changes are assuming greater importance, e.g., suspension systems and engine performance.

We have gathered some evidence that the frequency of major model changes has decreased over time. We developed two measures of a major model change. The first measure relies on objective data and defines a major model change as either 1) a wheelbase change of 2 or more inches or 2) a length change of 4 or more inches. The second measure relies on accounts of new automobile models that appear in *Motor Trend*, an automobile magazine.⁴ Each author independently read issues of *Motor Trend* which describe the new models in each model year since 1954 and assigned a 1 if the story indicated the automobile underwent a major restyling. To maintain a reasonably stable sample of autos throughout our period, we selected 10 of the most popular full size automobiles in 1954 and tracked these cars to 1988 or as long as they remain a full size car.⁵ For each model year we determine the fraction of the ten cars that had a major model change.

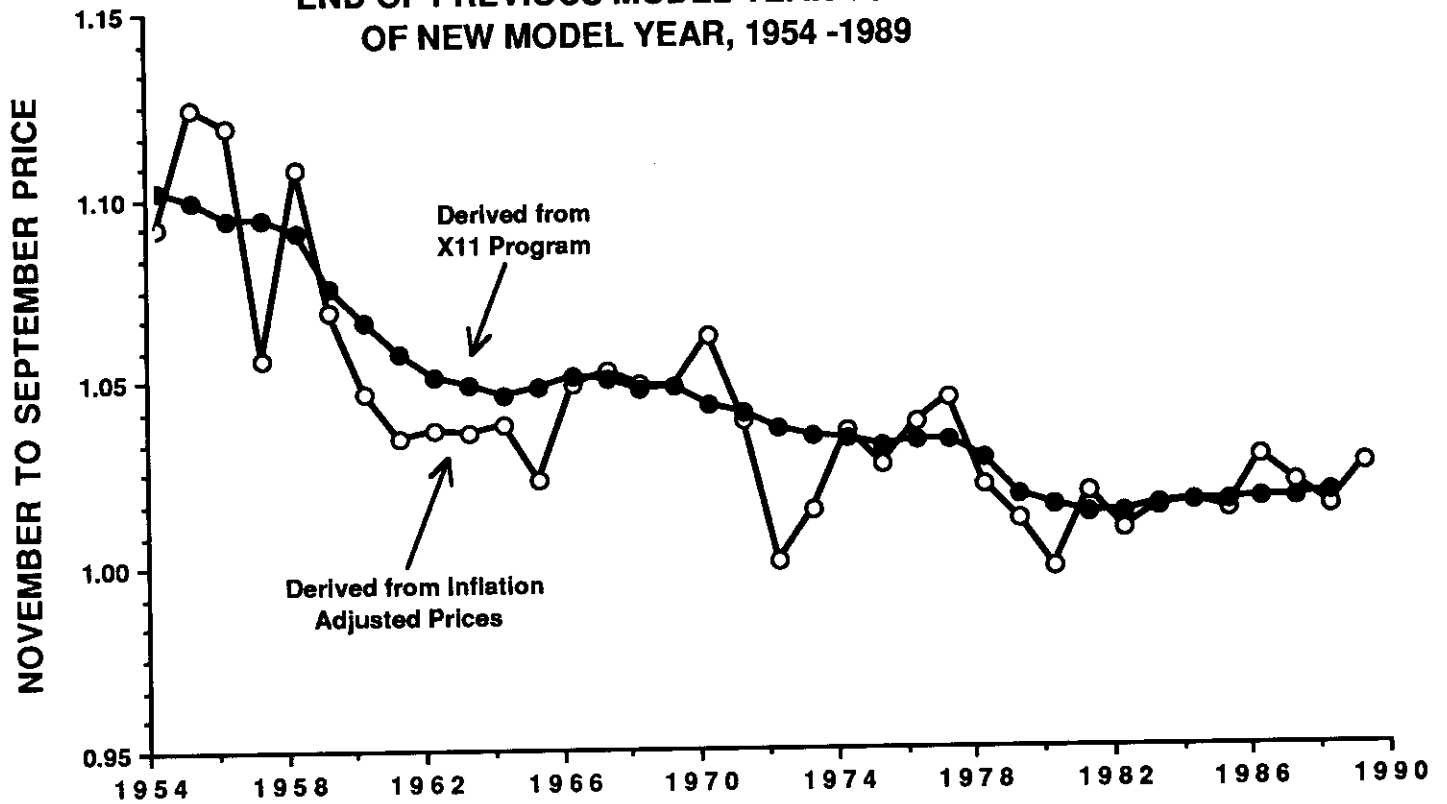
In Figure 4 we show the fraction of autos with a major model change using a three-year centered average to eliminate the variability in our measure.⁶ Figure 4 shows the series derived from objective data declines from the fifties until the major downsizing that occurred between 1977 and 1979 in response to higher gasoline prices and CAFE standards. From then on, the fraction remains relatively low compared to the fifties. The series that relies on more subjective assessments of *Motor Trend* displays more randomness. The major difference between the two series is that the series derived from *Motor Trend* has a larger fraction of major model changes occurring during the sixties when, according to *Motor Trend*, significant sheet metal changes were made without large changes in the length or wheelbase of automobiles.

II. THE DECLINE IN THE DEPRECIATION RATE OF USED CARS

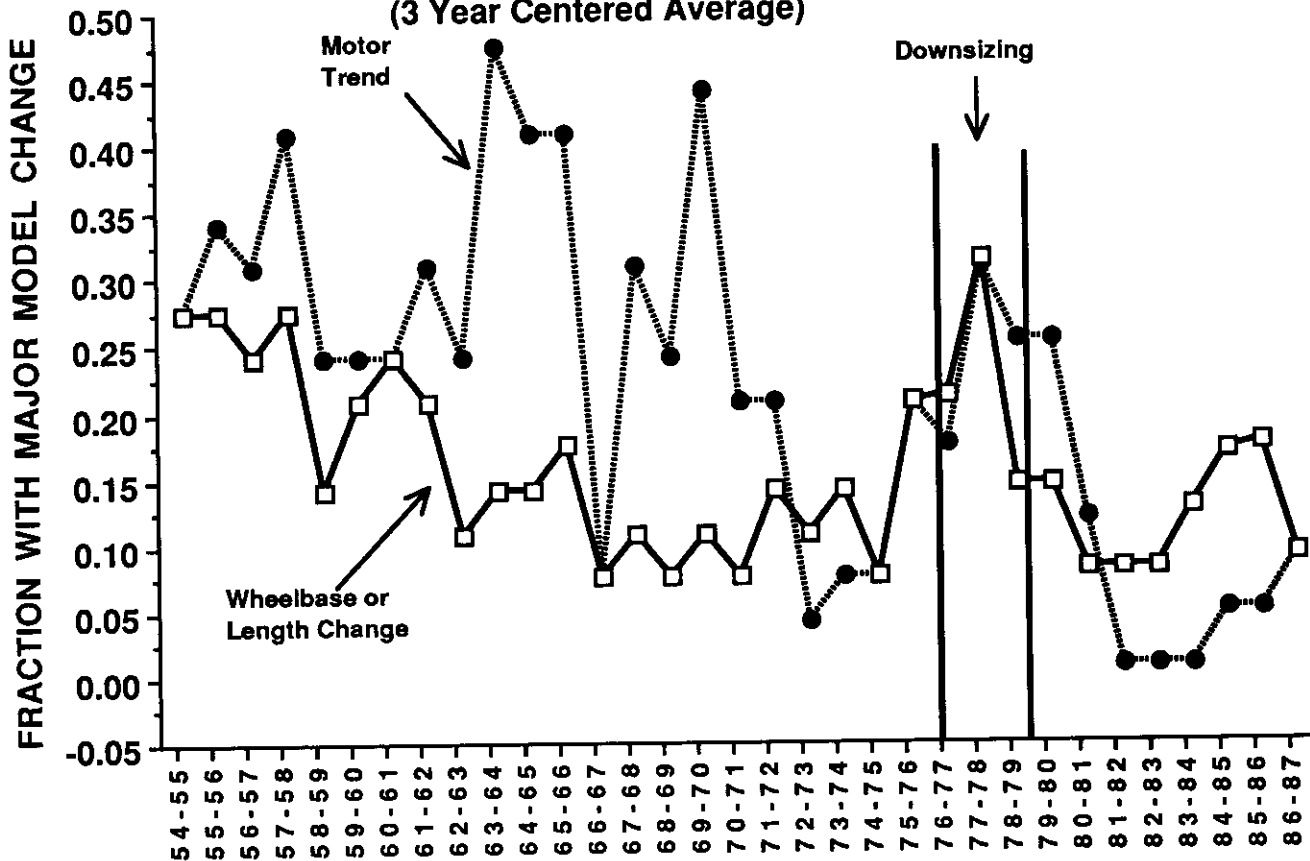
As we mentioned in the introduction, the depreciation rate of automobiles has declined over time as well. Used autos are closer substitutes for new automobiles as the automobile becomes less of a fashion good and the model change diminishes in importance.

We rely on used car price data from *Kelly's Red Book* to measure the depreciation rate of a one year old car as it ages and becomes a two-year old car.⁷ *Kelly's Red Book* estimates dealer used car prices for clean vehicles. Figure 5 shows the average percentage depreciation

**FIGURE 3: RELATIVE PRICE INCREASE FROM
END OF PREVIOUS MODEL YEAR TO BEGINNING
OF NEW MODEL YEAR, 1954 -1989**



**FIGURE4 : FRACTION OF FULL SIZE AUTOS WITH
MAJOR MODEL CHANGE
(3 Year Centered Average)**



rate of a one year old automobile for our population of ten full size cars declines over time. Automobiles are depreciating less rapidly over time. The decline in the depreciation rate in the fifties and the early sixties is not due to the increasing durability of the autos produced in those years. We calculated the number of years the median car of each model year is on the road and found the age of the median vehicle is roughly constant until 1962 when it increases modestly and then more rapidly after 1971 when gasoline prices increase. There is no evidence of an increase in the physical durability of autos built during the fifties and early sixties. A more plausible reason for the declining depreciation rate is the declining frequency and extent of major model changes.

To recapitulate, we have documented two long term trends: the decline in price dispersion in new car prices throughout the model year and the decrease in the depreciation rate of automobiles.

III. EXPLANATIONS OF THE CHANGES IN PRICING PRACTICES

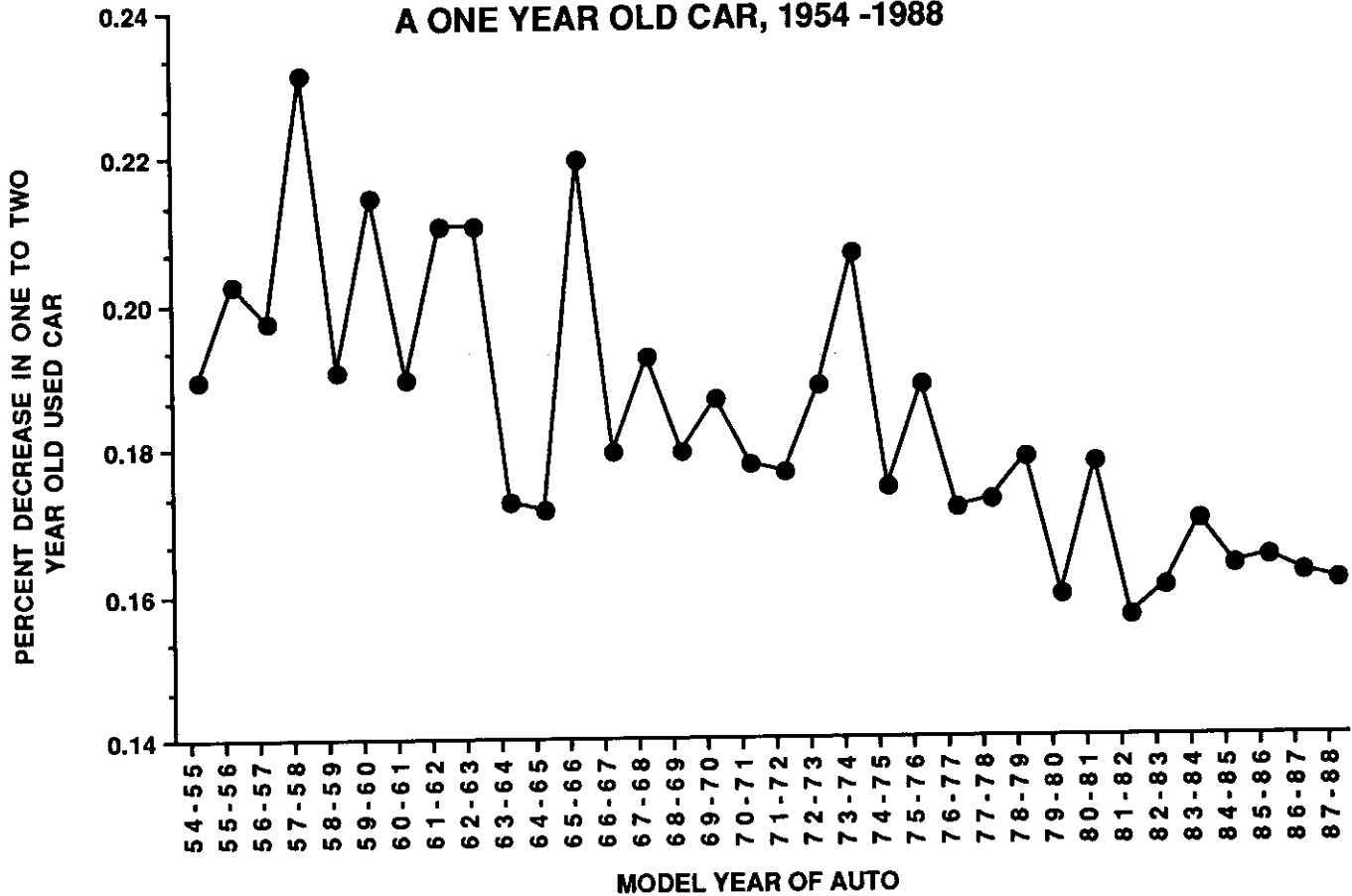
We hope to shed some light on three possible explanations of either the decline in the standard deviation of price relatives or the depreciation rate of automobiles or both.⁸

1) Changes in the Seasonal of Inventories: One place to look for an explanation of the changing seasonal in prices is in a changing seasonal in automobile inventories.⁹ Suppose the automobile manufacturers are better able to forecast sales over time and to schedule production to smooth out fluctuations in the inventory-sales ratio. Days supply in the automobile industry is the ratio of retail inventories to retail sales. In a typical year days supply is relatively low at the beginning of the model year, increases before the spring rise in sales and has historically been high at the end of the model year. To determine whether the seasonal pattern in days supply has changed, we calculated a monthly "days supply" relative, the ratio of the unadjusted days supply to the seasonally adjusted days supply using the X11 program. The standard deviation of the days supply relatives is compared to the standard deviation of the price relatives in Figure 6.

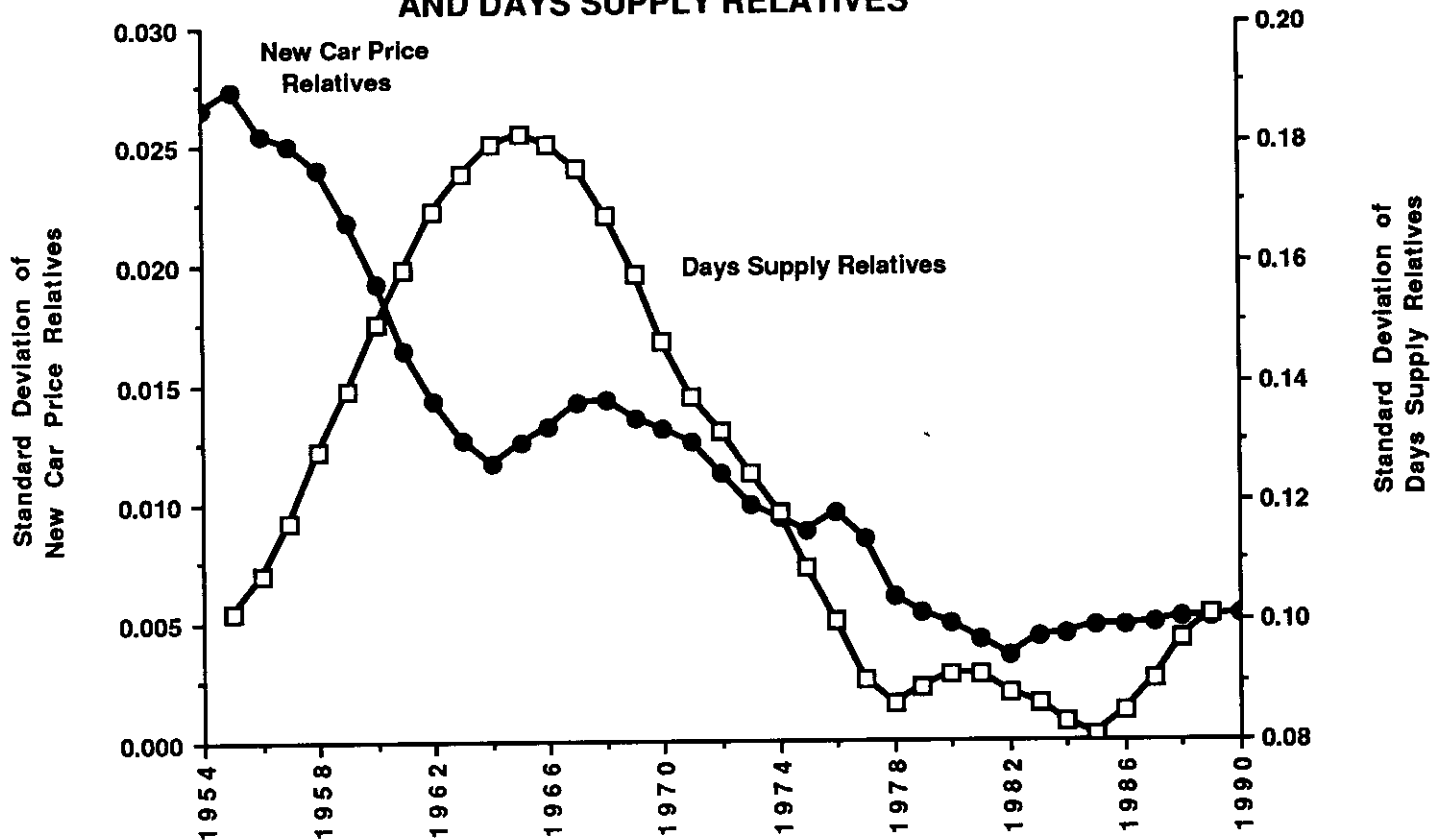
Figure 6 shows the standard deviation of days supply relatives increases from 1955 to 1966 while the standard deviation of price relatives decreases. This perverse pattern suggests that the decline in the seasonal variation in days supply is not the cause of the decline in the seasonal in prices. A second reason to reject the idea that inventories are under better control is that the standard deviation of day supply relatives is approximately the same at the beginning as at the end of the period. Yet, the standard deviation of the price relatives declines appreciably from 1954 to 1989. Overall, Figure 6 suggests that the disappearing seasonal in retail auto prices is probably not due to better control over auto inventories.

**FIGURE 5: ANNUAL DEPRECIATION RATE OF
A ONE YEAR OLD CAR, 1954 -1988**

9



**FIGURE 6: STANDARD DEVIATIONS OF PRICE
AND DAYS SUPPLY RELATIVES**



2) **The Cost of Model Change**: The frequency and magnitude of a model change depend on the cost of the model change. When the cost of a model change increases over time, we expect fewer and less dramatic changes. As we have noted above, the pricing changes could be due to the decreasing frequency and importance of model changes which in turn is due to the rising cost of introducing a model change.

Clark et al [no date] note that lead times for bringing new models out were shorter in the Japanese auto market during the eighties than in the European or American markets. They also note that competition among Japanese manufacturers took the form of design and styling competition. However, the model changes for imported cars introduced into the American market have been more continuous and less dramatic than those introduced by the American producers in the fifties. The Japanese automobile manufacturers initially entered the American market with low price subcompact and compact autos and they did not introduce major model changes for these cars. On the other hand it appears that the Japanese manufacturers introduce more frequent changes under the hood, changes in engine performance, suspension systems, etc.

3) **Durability and Monopoly**: With the growth of imports the monopoly power of the Big Three has declined. A monopolist may have an incentive to select a less durable product to overcome the opportunistic behavior [Coase, 1972]. If the Big Three had monopoly power, they could have collectively produced less durability by investing in a more fashion oriented product during the fifties and sixties. The incentive to do so diminishes as the monopoly power of the Big Three decreases. More generally, we might expect product durability of automobiles across the world to increase as competition becomes more global over time. The durable good's model hypothesis would suggest that frequent model changes would decline as a method of reducing durability.

IV. TIME SERIES RESULTS

In this section we present regression results to explain the time series variation in the standard deviation of price relatives and the ratio of the November to September price relative.

A. The Standard Deviation of Price Relatives and the Ratio of the November to September Price Relative

We study the effects of four independent variables on the two dependent variables.

1) **Cost of a Model Change**: We use the ratio of the producer price index for metal working machinery and equipment to the producer price index for new motor vehicles. The price index is for metal working machinery and equipment including a variety of cutting and forming tools,

welding machines, dies, jigs, etc. These are the kinds of tools and dies that are used to develop automobile parts. This measure is designed to indicate whether the cost of a model change has increased relative to the wholesale price of an automobile.

2) **Opportunism**: We use the combined market share of General Motors, Ford and Chrysler as a measure of monopoly.

3) **Days Supply Inventory Relatives**: The standard deviation of the days supply relatives and the ratio of the days supply relative in November to September are used as independent variables in the regression equations.

4) **The Percentage of Ten Full Size Autos with a Major Model Change**: We use the objective and subjective measures to estimate the fraction of 10 full size automobiles that underwent a major model change in each year.

Table 1 presents regression results for the standard deviation of price relatives and for the ratio of the November to September price relatives. In these regressions we use the price relatives adjusted for inflation rather than the price relatives derived from the X11 program because the X11 program smoothes out the yearly shocks in the price relatives. Since we are trying to capture the effect of a major model introduction in each year on either the standard deviation or the November to September price relatives, we use of the inflation adjusted series since they capture the effects of a model change on the standard deviation or the ratio of the November and September price relatives of the same year.

A higher cost of a model change reduces the standard deviation of price relatives and the November/September price relative. The fraction of the full size cars that experienced a major model change is a significant determinant in the regressions for the standard deviation of price relatives and marginally significant in one of the regressions for the November/September ratio. We appear to be more successful in explaining the standard deviation of price relatives than the ration of the November to September price relatives. The market share of the Big 3 is never a significant variable.

Table 1: Determinants of the Standard Deviation of Price Relatives and the November/September Price Relative				
Variable	Standard Deviation of Price Relatives		November/ September Price Relative	
	Coeff- icient	Coeff- icient	Coeff- icient	Coeff- icient
1. Intercept	.103 1.8	.1.05 2.1	1.08 8.1	1.08 8.5
2. Cost of Model Change (Producer Price Index for Metal Shaping to Index for autos)	-.095 -3.8	-.095 -4.4	-.121 -2.2	-.115 -2.2
3. Big Three Market Share	.0003 .5	.0003 .7	.0035 .3	.0003 .2
4. Fraction with Major Model Change (Using Wheelbase or Length)	.0171 1.8		.0153 .6	
5. Fraction With Major Model Change (Using Motor Trend)		.0140 2.5		.0263 1.6
6. Standard Deviation of Days Supply	-.204 -2.9	-.247 -4.7		
7. November/September Inventory Relative			.0427 1.0	.044 1.3
R ²	.74	.80	.55	.59
Durbin Watson Statistic	1.56	1.73	1.97	2.02

Note: t statistic below coefficient estimate

The standard deviation of price relatives is inversely related to the standard deviation of the days supply. This result makes little sense since a decrease in inventory variability should decrease price variability. The November/September inventory relative is not a significant determinant of the November/September price relative. It does not appear the inventory changes are the driving force for the price increases from the end to the beginning of the next model year.

In summary, these time series results indicate the seasonal in car prices has declined as the cost of introducing a major model change has increased. When a smaller fraction of cars has a major model change, the standard deviation of price relatives declines. When dramatic model changes occur, we find a larger seasonal in prices than when cosmetic changes are made.

V. CROSS SECTIONAL RESULTS

A. The Effect Of a Model Change on the Depreciation Rate of a One Year Old Automobile

We have suggested that a major model change imposes obsolescence losses on existing automobiles. In this section of the paper we determine how a major model change affects the depreciation rate of a one year old auto with the same name plate. We focus on the youngest used car of the same nameplate because we expect the largest effect of a major model change will be on the closest cousin with the same nameplate. The used car price data are from *Kelly's Red Book*. The dependent variable is the depreciation rate of a one year old auto. For example, a 1978 Chevrolet Caprice appears in the fall of 1977. We want to determine the effect of the major model change on the price of an existing one year old Caprice. A 1976 Caprice is one year old in the fall of 1977. However, the first used car price quotation for the 1976 Caprice becomes available in the second volume of *Kelly's Red Book* for transactions from 2/15 to 3/31 of 1977. Then, the 1976 Caprice is slightly more than one year old. We measure the percentage price depreciation on a 1976 Caprice from the February-March of 1977 to February-March of 1978.¹⁰ The percentage price decline of a one year old automobile for each name plate was determined for the ten cars over the entire period from 1954 to 1988.

The independent variables are:

1) Major Model Change (MMC). Prior to 1975, we use both measures for a major model change described above.

2) Major Model Downsize (MMD). A dummy variable equal to one if wheelbase decreases by more than 2 inches or if Motor Trend reports a major model change. A distinction is made between increases and decreases in wheelbase since the downsizing of automobiles occurred in the late seventies after gasoline prices increased.

3) Cost of Model Change (CMC): The wholesale price index for metal shaping machinery and equipment divided by the wholesale price of a new vehicle.

4) Share of Market by Big Three (S): The market share of US automobile market of General Motors, Ford and Chrysler.

5) Brand Dummies. Dummy variables for the ten models in the sample are in the regressions. These dummy variables control for firm specific effects on depreciation rates. We also allow for different model effects after 1974.

Regression results are in Table 2. The coefficient estimates in Table 2 are second stage results. Separate regressions were run for each name plate to adjust for any serial correlation in residuals. The dependent and independent variables for each nameplate were transformed to take account of each brand's first order serial correlation. The transformed observations were pooled and the second stage estimates are presented in Table 2. The results indicate that a major model change in a nameplate increases the depreciation rate of a one year old car of the same nameplate.¹¹ Both measures for a major model change are statistically significant. In addition, a rise in the cost of a model change (CMC) reduces the depreciation rate. The coefficients of the interaction (MMC x CMC) variables are negative. The higher is the cost of a model change, the smaller is the increase in the depreciation rate when a major model change occurs. We interpret this result to mean that less drastic changes in styling occur as the cost of a model change increases. Downsizing since 1977 has not had a significant effect on the depreciation rate. Styling changes were suppressed while downsizing was occurring.¹²

Since the relative cost of shaping steel has increased over time, the depreciation rates are lower at the end than the beginning of the period. These pooled cross sectional and time series results provide some confirming evidence that the rise in the cost of shaping steel has probably decreased the frequency and the extent of model changes. They suggest that the declining seasonal in prices and the decline in the ratio of the November and September price relatives are due to the declining importance of the model change.

Generally, depreciation rates of the upper price cars have increased after the rise of gasoline prices. Chrysler, Buick, Oldsmobile and Mercury have higher depreciation rates since 1974. We are unable to find significant changes between the depreciation rates of the different car companies over the whole period.

**Table 2: Determinants of Depreciation Rate of A One Year Old Automobile,
1954 - 1988**

Variable	Coefficient	t	Coefficient	t
Major Model Change (MMC)				
a. Wheelbase or Length Change	.1249	5.2		
b. Motor Trend			.068	2.3
Cost of Model Change (CMC)	-.060	-3.8	-.093	-3.8
Major Model Downsize(MMD)	.057	.6	.069	-.3
Interaction Variables				
MMC x CMC	-.081	-2.2	-.088	-2.0
MMD x CMC	-.071	-.7	.069	.3
Share of Market (S)	-.0002	-.9	-.0001	-.3
Chevrolet	.232	7.9	.244	5.4
Chevrolet - post 74	.221	7.3	.244	5.2
Ford	.248	8.4	.267	5.8
Ford - post 74	.238	7.8	.263	5.6
Plymouth	.238	8.1	.269	5.9
Plymouth - post 74	.250	8.1	.288	5.9
Dodge	.255	8.7	.286	6.3
Dodge - post 74	.254	8.3	.277	5.8
Pontiac	.246	8.3	.259	5.7
Pontiac - post 74	.232	7.5	.256	5.4
Mercury	.250	8.6	.277	6.1
Mercury - post 74	.256	8.4	.279	5.9
Oldsmobile	.228	7.8	.240	5.3
Oldsmobile - post 74	.252	8.3	.274	5.8
Buick	.243	8.3	.253	5.6
Buick - post 74	.245	8.1	.268	5.6
Chrysler	.250	8.6	.273	6.0
Chrysler - post 74	.262	8.7	.285	6.0
Cadillac	.209	7.2	.223	5.0
Cadillac - post 74	.203	6.7	.225	4.8
R ²	.994		.987	
Standard Error	.016		.026	
Mean Depreciation Rate	.209		.226	

B. Differences in the Depreciation Rate of New Autos, Vans and Trucks

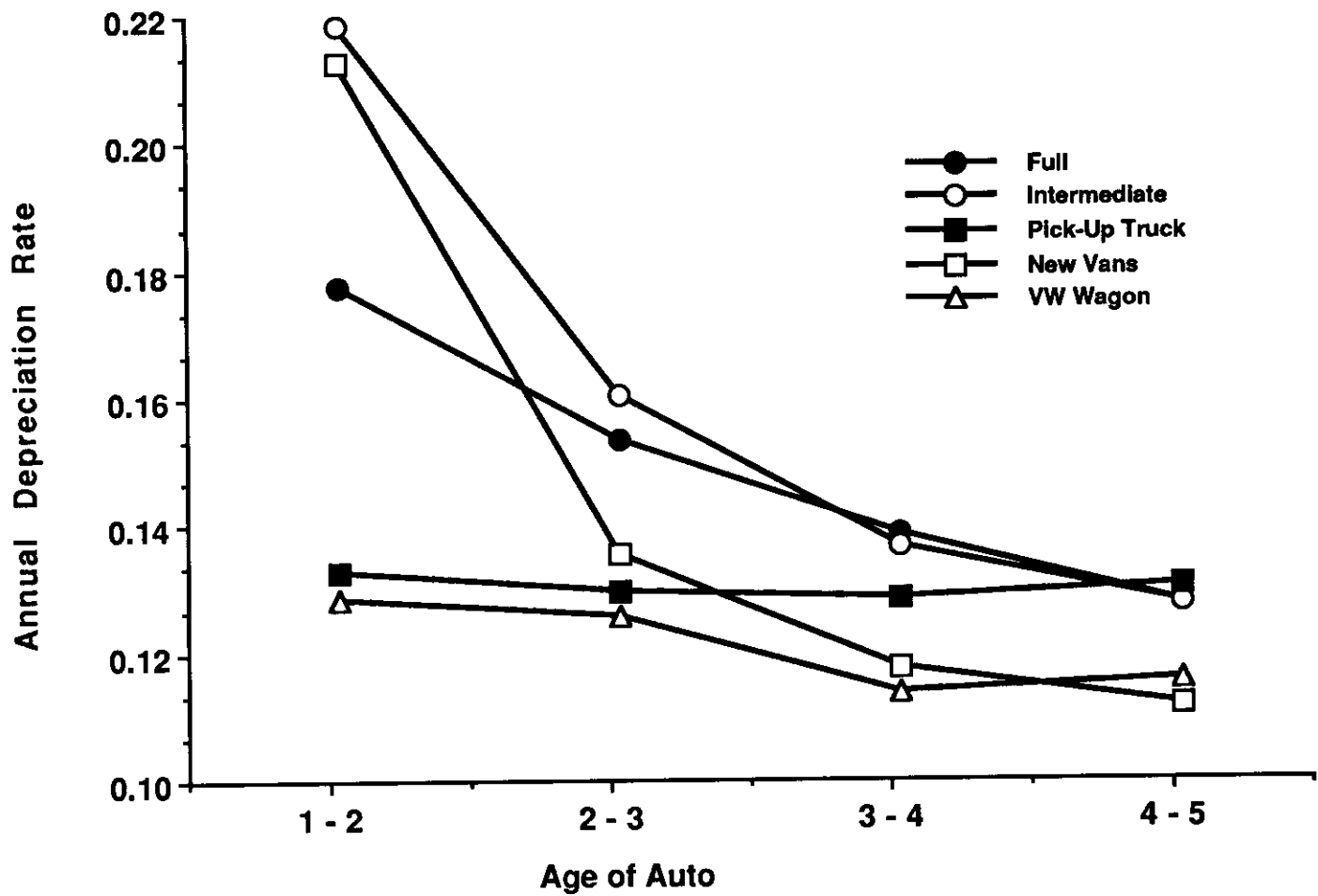
Another way to detect the effect of styling on the depreciation rate is to compare different types of motor vehicles. Even a casual observer of the automobile market knows that the annual model change is less dramatic for a pick-up truck than for a new automobile. The styling changes are less frequent and are more modest. Therefore, we expect the depreciation rate of pick-up trucks to be more a function of yearly use and less affected by obsolescence losses. Depreciation rates of trucks should show less age dependence especially in the early years than those of automobiles. We have also included the classic VW wagon, the favorite of Grateful Dead fans, and the new vans introduced by the American manufacturers in recent years. The distinctive feature of the VW bus is its time-immemorial styling. Styling receives greater emphasis on the newer vans than it did on the old VW van.

We would prefer to compare the depreciation rates of new cars, vans and pick-up trucks during their first year. Unfortunately, transaction prices of new cars are not readily available so we rely on the depreciation rates of used autos, vans and pick-up trucks. Figure 7 shows annual average depreciation rates for different types of vehicles as they age from 1 to 5 years old. Although these average depreciation rates are calculated over different periods of time, they indicate significant differences between autos and trucks.¹³ Figure 7 shows automobiles and the new vans have higher depreciation rates from year 1 to 2 in contrast to the VW wagon and pick-up trucks. The latter two types of vehicles have fewer styling changes and have annual percentage depreciation rates that are largely independent of the age of vehicle. These results suggest that the pattern of depreciation rates depend on the importance of styling of the motor vehicle and are consistent with the central theme of the paper.

C. The Effect of a Discontinuance on the Depreciation Rate of a One Year Old Automobile

Another way to test for the importance of a model change is to look at the results of an extreme model change--the discontinuance of a nameplate. After a car is introduced, subsequent technical and styling changes appear in the marketplace that reduce the demand for the car. The manufacturer can either continue the model with no changes, or modify the model, or discontinue the nameplate entirely. If the newer models are dramatically different from the older car, then maintaining the existing style may well be unprofitable because demand for the older style and technology declines. Restyling the model may bring it into line with the marketplace, but is costly.

**FIGURE 7: ANNUAL DEPRECIATION RATES
BY TYPE OF VEHICLE**



This cost is greater if the brand has an established brand name that is associated with some brand image. If this image is unfavorable or is at odds with what is currently favored in the market, then modification of this model may not be profitable. If the gains from modernizing the model fall short of the additional costs, the producer will terminate the nameplate. Therefore, the market uses the announcement of a discontinuance as a signal of the unpopularity of the features of the last model and imposes an obsolescence loss on the existing used cars of this nameplate.

Many nameplates last for just a few years before they are terminated while others last for years. For example, in 1964 Mercury discontinued the Meteor, a small car introduced in 1960. In contrast, Chevrolet discontinued the Impala nameplate in 1986 after 27 years. The short span of the Meteor suggests that it was a failure while the Impala was a success. However, it was no longer considered a profitable name plate by Chevrolet in 1986, either because it was associated with dated styling and technology or because of the decline size of the large car market. Buyers associate the name plate with a certain type of automobile and Chevrolet believed that it could not modify what the name plate represented in the eyes of buyers. The announcement of a discontinuance means that the styling and technical features of the nameplate are now considered obsolete in the used auto market.

We identify 55 nameplates that were discontinued between 1962 and 1987. Then, we determined the depreciation rate of the nameplate in the year of discontinuance and in the three prior years. To better control for the many factors that affect the depreciation rate of a nameplate and especially for company effects, we paired each discontinued nameplate with its close cousin produced by the same company. For example we pair a used Impala with a used Caprice. We found that 34 of the 55 nameplates have cousins that are sufficiently close (within 15% in price and 4 inches in wheelbase). We trace the depreciation rates of both cars for four years including the year of discontinuation of the nameplate. Our analysis assumes the announcement of a termination occurs in the year of the discontinuance. The used car price data are from *Kelly's Red Book* of used car prices.

Our dependent variable is the difference between the depreciation rate of the discontinued automobile and the depreciation rate of its nearest cousin. If there is information in the announcement of a discontinuance, we expect that the difference between the depreciation rates to widen in the year of discontinuance. The other independent variables are for the car that was discontinued. The suppressed dummy variable is for the difference in depreciation rates in the year of discontinuance.

Table 3 presents the results.

Table 3: Difference Between the Depreciation Rate of One Year Old Automobile and Closest Cousin For Three Years Prior to Year of Discontinuance, Number of Paired Nameplates Equals 34 N = 136		
Variable	Estimate	t
1. Constant	72.98	2.6
2. Year Dummy - 3 years Prior to Year of Discontinuance	-6.82	-1.9
3. Year Dummy - 2 Years Prior to Year of Discontinuance	-9.91	-2.7
4. Year Dummy - One Year Prior to Year of Discontinuance	-8.59	-2.4
5. Sales in Last Year	.02	.4
6. Wheel Base	-.47	-2.0
7. Years in Market	-.04	-.2
8. Post 1976	-6.34	-1.7
9. Post 1976	-6.34	-1.7
10. Ford Auto Dummy	.37	.1
11. Chrysler Auto Dummy	-2.03	-.4
12. American Motors Auto Dummy	-.48	-.1
R2	.10	

The coefficients of the year dummies are the ones of particular interest and are negative and significant. The difference in depreciation rates is significantly smaller in the three previous years before the year of the discontinuance. These results indicate an announcement of a discontinuance is new information and the market adjusts by reducing the price of a car as it becomes two years old, thereby increasing the depreciation rate of the one year old car of the discontinued nameplate relative to its cousin. In section IV we showed that a major model change causes the depreciation rate of a one year old car to increase. The failure to introduce a new model also imposes obsolescence loss on a one year old model. Because we are trying to explain the difference between the depreciation rate of the discontinued auto with its closest cousin rather than the level of the depreciation rate, most of the coefficients of most of the other independent variables are not surprisingly statistically insignificant.¹⁴

CONCLUSIONS

The pricing of automobiles has changed over time with the seasonal variation in retail new car prices disappearing and the depreciation rates of new automobiles decreasing. These changes appear to be caused by declining importance of the model change. We believe the cost of a model change has increased over time and this has produced less frequent and less dramatic changes.

The changes in the pricing practices in the automobile industry are just the opposite of changes in the pricing of women's and men's apparel. The seasonal variation in retail apparel prices has increased since the late sixties. The increase reflects the growing importance of fashion and variety in apparel merchandising. In autos the cost of a model change has increased. In contrast to the automobile industry, the cost of introducing fashion in apparel appears to have declined over time with the introduction of electronic equipment that permits the programming of a variety of styles and colors on a micro-computer with little downtime for knitting and weaving machines.

In both industries changes in the cost of introducing new products changed the type of product produced. In one case more fashion products were supplied while fewer fashion products were supplied in the other industry. In both industries the change in the type of product has altered the seasonal pattern of prices.

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Footnotes

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¹The X11 program smoothes the seasonal factor by using forward and past data.

²The quality of the data is poorer in the earlier years. The CPI for new autos was based on single quotation per city for each auto sampled. In 1955 the sample size was expanded to per auto per city. See Jung (1961).

³We failed to find a significant decrease in the seasonal variation in retail prices for television and sound equipment, refrigerators and freezers and other consumer durables.

⁴We selected *Motor Trend* because it had a fairly complete record of reporting new model introductions over the whole period. In some years the reporting on new models was skimpier than in other years. What we cannot know is whether there is any agreement among the reporters over time as to what constitutes a major change. We looked for descriptions such as "new from the bottom up" or "drastically restyled" to indicate a major model change.

⁵ The autos included are: Chevrolet, Ford, Plymouth, Chrysler, Buick Cadillac, Dodge, Mercury Oldsmobile and Pontiac. We selected the model of each line of automobile where a continuous series for a name plate and continuity of the size of the model existed. For example, when Ford introduced the larger Ford Galaxy, the Fairlane was replaced by the Ford Galaxy. Downsizing from 1977 to 1979 presented a special problem when 3 cars disappeared from the field of full size cars. A complete list is available upon request.

⁶A major model change may occur every third year with cosmetic changes offered in the other two years.

⁷Because the BLS does not adjust transaction prices for use cars for quality changes but does adjust new car prices for quality change, we cannot rely on the CPI to determine whether use car prices have increased relative to new car prices.

⁸The decline in the frequency of model changes could be demand driven. Throughout the fifties, a popular contention was that Detroit invested in contrived obsolescence, e.g., tail-fins [Fisher et.al. 1962]. Perhaps, the demand for variety by American consumers has decreased over time. We are unable to devise any tests of the change in taste hypothesis. If the taste for variety did change, it was changing during the fifties and the sixties when real per capita income was increasing. Furthermore, the demand for variety increased in the apparel industry where fashion has become more important over time. [Pashigian, 1988 and Pashigian and Bowen, 1991].

⁹While a change in the inventory seasonal could explain a change in the price seasonal, it would not explain the long term decline in new-used car prices.

¹⁰We use an automobile of given specifications in average condition.

¹¹We did not find a significant effect of a major model change on the depreciation rate of older cars of the same nameplate or on other name plates in the same price class.

¹²We also experimented with the fraction of yearly output that is produced during the third quarter as a proxy for the significance of a model change. The thinking here is that down time will be longer if a major model change is introduced. Downtime was inversely correlated with both of our measures of model change (-.13 with the objective measure and -.31 with the *Motor Trend* measure) but was not a significant determinant of the depreciation rate.

¹³Depreciation rates are for 1953-87 for full size cars, from 1965-87 for intermediates, from 1957-87 for pick-up trucks, from 1979-87 for new vans and from 1966-76 for the VW wagon.

¹⁴An alternative explanation for the results is that a discontinuance means an owner of a discontinued auto will incur higher cost. For example, the availability of spare parts may become a problem for the new owner. We do not believe this is the reason for our results. In some cases production of other versions of the model continues after a nameplate is discontinued. Since the body of an Impala is the same as a Caprice, most parts remain available when the Impala is discontinued. Second, the automobile companies are required to have spare parts available for discontinued models. If this is a serious problem, it would be a more severe problem for low volume nameplates. However, sales in last year are not a significant determinant of the difference in depreciation rates.