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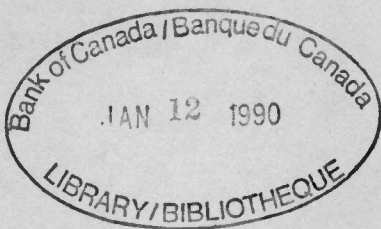
**The Stock of Automobiles in Canada:
Estimates relative to historical trends**

by Hung-Hay Lau and Louise Hyland

Bank of Canada



Banque du Canada



**THE STOCK OF AUTOMOBILES IN CANADA:
ESTIMATES RELATIVE TO HISTORICAL TRENDS**

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**The views expressed here are those of the authors and should
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Abstract

The paper compares the consumer stock of passenger cars and light trucks in Canada with its "desired" stock, measured as the estimated historical trend. The actual and estimated desired stocks are measured in both physical units and new-vehicle equivalents, allowing for age distribution of the stock. The new-vehicle equivalents are derived from our estimates of the survival rates and resale values of automobiles of various vintages. Our analysis suggests that the stock of passenger cars and light trucks in Canada is still below historical trend values despite substantial increases in new vehicle sales over the past 6 years.

Résumé

Dans la présente étude, les auteurs comparent le parc de voitures particulières et de camionnettes dont disposent les consommateurs au parc désiré, représenté par une estimation de la tendance passée. Les parcs effectif et désiré sont mesurés en unités réelles et en nombre équivalent de véhicules neufs, afin de tenir compte de la répartition par âge du parc de véhicules. Le nombre équivalent de véhicules neufs est dérivé d'estimations des taux de survie et des valeurs de revente de véhicules automobiles d'âges différents. Selon l'analyse effectuée, le parc de voitures particulières et de camionnettes au Canada demeure inférieur au parc désiré même si les ventes de véhicules neufs ont fortement progressé depuis six ans.

I. INTRODUCTION AND SUMMARY

This paper compares the stock of passenger cars *and* light trucks held in Canada by the *personal sector* with the "desired" stock, measured as the estimated historical trend. The results suggest that such stock is still below historical trend values, despite substantial increases in new-vehicle sales over the past six years.

The measurement of actual stock and the estimation of desired stock proceed through a number of steps. First, the total number of operating automobiles of all ages is estimated, based on new-motor vehicle sales and survival rates for various vintages. The stock data are broken down into several age groups. The average age of the stock of automobiles is also generated to provide information about the prospective replacement demand. Next, the stock in operating units is converted into units of new-vehicle equivalents to take account of the age structure of the stock. This is achieved by combining the survival rates with the corresponding resale values of vehicles of the same vintage. Finally, the stock of motor vehicles in standard units and in new-vehicle equivalents is expressed in units per person of driving-age (dividing by population 15 years and older) and in units per worker (dividing by the labour force) to account for changes in demographics and in employment. The resulting series are used to estimate trend values, which serve as proxies for desired stocks, notionally reflecting the influence of rising wealth and the declining relative price of motor vehicles over time.

II. STOCK OF MOTOR VEHICLES IN OPERATION

A. Passenger Cars

In this section, we briefly discuss Canadian auto statistics and our computations of the stock of automobiles in operation in terms of physical units.

1) *Stock Data*

To date, precise estimates of the stock of motor vehicles in operation are not available. A rough proxy is published by Statistics Canada in the form of registration data based on an add-up of provincial data (Catalogue No. 53-219). Currently, Statistics Canada publishes data on new registrations and total registrations for cars regardless of vintages. However, such data do not provide a reliable indication of the car stock. There are problems of double counting, of differences in registration year and of different definitions of passenger cars. The Statistics Canada data tend to overestimate the car stock, because some vehicles are registered in more than one province or territory during the same licence year, as people move from one province to another. This problem of double counting is particularly acute for Quebec, where registration data are based on transaction statistics. In consequence, a car that is sold three times in any given year is counted as three units. The accuracy of the all-Canada total registration data is also affected by interprovincial differences in the ending dates of the registration year, which vary from January 1 to March 31. Finally, there is also considerable variation in the definition of "passenger automobile." These variations are:

- ambulances and hearses are included only in P.E.I.;
- camper trucks, in New Brunswick;
- ambulances, hearses and school buses, in

Manitoba;

- motorhomes, in British Columbia where taxicabs are excluded;
- vans and four-wheel drive vehicles licensed with passenger plates, in Northwest Territories;

To overcome the problems with Statistics Canada's registration statistics, we have devised an alternative proxy. This new proxy also provides information about the number of cars of different vintages on the road -- data which are not currently available from registration statistics. Our proxy is given by:

$$K = (1 - s) * K_{-1} + QCARS / 4 \quad (1)$$

where K is the *stock* of cars in the current quarter, s is the *weighted* average scrappage rate for the universe of cars, K_{-1} is the one-period lagged value of the stock of cars, and $QCARS$ is the *flow* of new car sales in the current quarter, seasonally adjusted at annual rates. From equation (1), it is clear that new car sales data play a key role in this estimate. Such data are preferable to registrations since they do not involve problems arising from double counting, differences in registration years, and misclassification of motor vehicle types. Relying on new car sales data provides the added bonus of a quarterly (or even monthly) time series, since monthly sales data are readily available. In contrast, registration data are available only on an annual basis and with considerable time lag.¹

¹When this paper was being written, registration data were available only prior to the year 1986. In contrast, new car sales data were available to the third quarter of 1988.

Strictly speaking, equation (1) requires a bench-mark measure of the stock at some point in time. While such information is not available, it can be approximated by cumulating car sales data over an extended period of time, using detailed data on survival rates for different vintages of cars.² To obtain a realistic bench-mark stock for the first quarter of 1966, we apply equation (1) to new-car sales data beginning in the first quarter of 1946, using a rough estimate for the beginning stock. Equation (1) should provide a good stock proxy with twenty years of cumulated flows, even if the initial stock value is set to zero, because almost all cars will be scrapped within twenty years of initial sale.

The remaining data requirement of equation (1) is the aggregate survival rate (1 - s). It is replaced by detailed survival rates applied to cars of the corresponding vintages. As shown in the equation listed below, a quarterly car-stock series can be derived from car sales over the preceding 18 years (i.e. 72 calendar quarters), weighted by their corresponding survival rates.³ In Equation (2), C is QCARS divided by 4, since QCARS is measured at annual rates.

$$\begin{aligned}
 K = & + .99925 * [(C) + (C)_{.1} + (C)_{.2} + (C)_{.3}] \\
 & + .9873 * [(C)_{.4} + (C)_{.5} + (C)_{.6} + (C)_{.7}] \\
 & + .9580 * [(C)_{.8} + (C)_{.9} + (C)_{.10} + (C)_{.11}] \\
 & + .9475 * [(C)_{.12} + (C)_{.13} + (C)_{.14} + (C)_{.15}] \\
 & + .9235 * [(C)_{.16} + (C)_{.17} + (C)_{.18} + (C)_{.19}] \\
 & + .8845 * [(C)_{.20} + (C)_{.21} + (C)_{.22} + (C)_{.23}]
 \end{aligned}$$

²Alternatively, data on total car registrations could be used as a benchmark.

³Survival rates are also shown in Table 4. For simplicity, these rates are held constant for all quarters in the year.

$$\begin{aligned}
& + .8448 * [(C)_{.24} + (C)_{.25} + (C)_{.26} + (C)_{.27}] \\
& + .7870 * [(C)_{.28} + (C)_{.29} + (C)_{.30} + (C)_{.31}] \\
& + .7398 * [(C)_{.32} + (C)_{.33} + (C)_{.34} + (C)_{.35}] \\
& + .6460 * [(C)_{.36} + (C)_{.37} + (C)_{.38} + (C)_{.39}] \\
& + .4350 * [(C)_{.40} + (C)_{.41} + (C)_{.42} + (C)_{.43}] \\
& + .3875 * [(C)_{.44} + (C)_{.45} + (C)_{.46} + (C)_{.47}] \\
& + .3013 * [(C)_{.48} + (C)_{.49} + (C)_{.50} + (C)_{.51}] \\
& + .2250 * [(C)_{.52} + (C)_{.53} + (C)_{.54} + (C)_{.55}] \\
& + .1750 * [(C)_{.56} + (C)_{.57} + (C)_{.58} + (C)_{.59}] \\
& + .1250 * [(C)_{.60} + (C)_{.61} + (C)_{.62} + (C)_{.63}] \\
& + .0500 * [(C)_{.64} + (C)_{.65} + (C)_{.66} + (C)_{.67}] \\
& + .0200 * [(C)_{.68} + (C)_{.69} + (C)_{.70} + (C)_{.71}] \tag{2}
\end{aligned}$$

For passenger cars of any given vintage, the survival rate is computed by dividing the number of cars of that vintage in operation by the original number of units sold when the cars were new. While we reported in the earlier section that Statistics Canada does not break down total registration according to vintage, such data had in fact been published by R.L. Polks and Co. (Canada) Ltd for several years in the mid-1960s, for cars between one and ten years of age. The survival rates used in Equation (2) for cars 1 to 10 years old are the 1964-1968 average rates derived from these data. Because corresponding U.S. data were available for cars up to 15 years old, we used U.S. data for cars 11 to 15 years old in equation (2), after making an adjustment based on the Canada-U.S. difference in scrappage rates for cars of 1 to 10 years old. For cars 16 to 18 years old, the survival rates used in equation (2) are our best guess.

2) Stock by Age Groups

Equation (2) generates the total number of cars on the road regardless of age and age distribution. It is also quite simple to use new car sales data to generate an age breakdown of the car stock. By using the various parts of equation (2) we can break down the total car stock into several age groups. For example, the number of cars of four to six years of age, C46, can be generated by equation (3) below.

$$\begin{aligned} C46 = & .9475*[(C)_{.12} + (C)_{.13} + (C)_{.14} + (C)_{.15}] \\ & + .9235*[(C)_{.16} + (C)_{.17} + (C)_{.18} + (C)_{.19}] \\ & + .8845*[(C)_{.20} + (C)_{.21} + (C)_{.22} + (C)_{.23}] . \end{aligned}$$

(3)

In Table 1, we present our estimates of the total stocks along with four age groupings. These data are discussed in a subsequent section.

3) Reliability of the Estimates

To evaluate the reliability of our estimates, we compare the stock of automobiles generated by fitting equation (2) using data on total car sales (personal and non-personal sector) with data compiled by R.L. Polks & Co. and registration data published by Statistics Canada. For 1966, our second-quarter estimate of 5,032,872 units is 0.45 per cent higher than the 5,010,211 published by R.L. Polks & Co. for July 1, 1966, but it is 8.5 per cent *lower* than the Statistics Canada registration statistic of 5,499,527 units. Since the data published by R.L. Polks provide a better measure of the actual number of cars on the road, we believe that our estimates are reasonably accurate.

Table 1

Passenger Car and Trucks Stock by Age Group

	Total Stock	1-3 Years	4-6 Years	7-10 Years	11-18 Years
661	5100433	1949127	1319488	1251310	580510.8
662	5166608	1965848	1349321	1256834	594806.3
663	5253688	2025704	1363148	1254371	610464.7
664	5338221	2045807	1402348	1268691	621378.0
671	5413016	2059443	1453188	1271478	628911.8
672	5501853	2086254	1501997	1280801	632802.0
673	5589482	2090557	1547168	1288921	642838.3
674	5640415	2113752	1568911	1312643	645110.3
681	5722281	2129017	1606688	1335530	651046.9
682	5803108	2131131	1654285	1367560	650131.5
683	5892528	2147352	1716610	1377825	650740.3
684	5986952	2155774	1772196	1401003	657980.0
691	6083542	2172875	1825899	1419438	665330.8
692	6185278	2202977	1841107	1448491	672703.0
693	6251380	2215284	1896740	1460351	679027.8
694	6333958	2229145	1915550	1505143	684122.8
701	6387677	2222330	1928012	1544683	692872.8
702	6443624	2207136	1963139	1581900	701451.2
703	6501209	2211840	1956771	1628155	706444.4
704	6539356	2199392	1977755	1644859	717351.8
711	6597600	2192981	1991898	1691604	721119.0
712	6684361	2217277	1994076	1749124	723885.9
713	6768958	2231165	2009490	1799060	729244.8
714	6866183	2253274	2017942	1857092	737878.1
721	6947303	2256739	2034413	1906056	750095.1
722	7044322	2292946	2082400	1926778	762198.5
723	7131285	2310622	2074136	1962860	763446.0
724	7251790	2372898	2087148	2015482	776262.5
731	7393724	2481647	2080189	2043996	787912.8
732	7518468	2572495	2085713	2075581	804679.8
733	7624557	2640531	2089611	2103212	811305.1
734	7740304	2740200	2067034	2109800	833270.9
741	7857053	2824444	2050899	2126949	854762.8
742	7976581	2883426	2073991	2143958	875186.8
743	8103236	2949971	2087377	2187365	896524.8
744	8178287	2949802	2108978	2208040	909448.1
751	8269215	2988670	2113060	2237486	930001.3
752	8368694	3017267	2147440	2248173	955814.5
753	8479100	3069068	2164522	2263600	961911.8
754	8636431	3136420	2223418	2265833	1010963
761	8706795	3096275	2325910	2247923	1036688
762	8822715	3112515	2410913	2250818	1048472
763	8901188	3112460	2474529	2241577	1072621
764	9024477	3144789	2587077	2222214	1090400
771	9143870	3171083	2645349	2223223	1104217
772	9246480	3181142	2700339	2242344	1122667
773	9342310	3174286	2762907	2271712	1133407
774	9444000	3227066	2761904	2313506	1141537
781	9531152	3245921	2797278	2333377	1154678
782	9644560	3283974	2823496	2369667	1187426
783	9753343	3308775	2871526	2386986	1186068
784	9818357	3244536	2935722	2433909	1204193
791	9909128	3288477	2898155	2498824	1223675
792	10009504	3301276	2913569	2558224	1236538
793	10104009	3340772	2912851	2597779	1252610
794	10187346	3327656	2943137	2652824	1263732
801	10271473	3316443	2968578	2724927	1261529
802	10315299	3280995	2978072	2795474	1260760
803	10382194	3277234	2972033	2871746	1261184
804	10451853	3267319	3020096	2910980	1253460
811	10519039	3269143	3037832	2969488	1252796
812	10569113	3235844	3073225	2994210	1265836
813	10608929	3185192	3067012	3038964	1277786
814	10620407	3189674	3036961	3118157	1296618
821	10687236	3081884	3077621	3130370	1307263
822	10687602	3002811	3089658	3187160	1326076
823	10687812	2916902	3126149	3183820	1340943
824	10644298	2945046	3114306	3212647	1372242
831	10620570	2775405	3103996	3227847	1413325
832	10631067	2777239	3069978	3238884	1444969
833	10639766	2750600	3065909	3255049	1468210
834	10671187	2747360	3068797	3270473	1496541
841	10617969	2758789	3068263	3275715	1525214
842	10655896	2775198	3027424	3300239	1553037
843	10684163	2802170	2979820	3317311	1584866
844	10733413	2849983	2964690	3329182	1589582
851	10803909	2963126	2881643	3364932	1604211
852	10893906	3086303	2807596	3378856	1621154
853	10984996	3219485	2726931	3394304	1644279
854	11073166	3358790	2659363	3366093	1688921
861	11163252	3482629	2594458	3391899	1694269
862	11233058	3560678	2586369	3369337	1716477
863	11331500	3665811	2572218	3369562	1723911
864	11386192	3709856	2570265	3363917	1751157
871	11441400	3739852	2582762	3341350	1777437
872	11520098	3799379	2599144	3328395	1793183
873	11580603	3848176	2625253	3302970	1806206
874	11643712	3881368	2670899	3273306	1818342
881	11708706	3892743	2778762	3208496	1830708
882	11773527	3890252	2892348	3141276	1849654
883	11836600	3881664	3017337	3066818	1870783
884	11900224	3864104	3147718	3022336	1866069

Because registration data tend to over-estimate the actual stock, it is hardly surprising that our stock estimates are lower than Statistics Canada's registration figures. However, the discrepancy between our measure and that of Statistics Canada has widened in recent years to as much as 12.1 per cent.⁴ It is conceivable that the over-estimation problems associated with registration data may have worsened during the recent business cycle because of significant imbalances in economic activity among the various regions in Canada. These imbalances have led to a substantial increase in interprovincial migration and, in all likelihood, a corresponding increase in the number of cars registered in more than one province. It is also conceivable that part of the widening gap between our proxy and total registrations may be due to our assumption of a constant scrappage rate. If actual scrappage rates in the 1980s were lower than those used in equation (2), then there would be a downward bias in our car-stock estimate over time. An obvious factor in the decline in scrappage rates in the 1980s is the reduction in highway speed limits from 112 kilometres per hour to 100 kilometres per hour. Other factors, such as the rapid growth in multicar households and improvements in car quality with respect to manoeuvrability and downsizing, may have also played a role. In any case, the downward bias is unlikely to be large, and it should not affect our conclusions.

4) *Average Age*

Historically, purchases of automobiles have been procyclical, as they are highly sensitive to variations in income, consumer

⁴Since data by R.L. Polk & Co. are no longer available, we have only Statistics Canada statistics for comparison.

confidence and interest rates. Since auto outlays are postponed when economic conditions are adverse, the average age of the car stock tends to rise at such times. It is useful to look at this because the higher the average age, other things being equal, the greater the pent-up demand for autos. The age data can also provide useful information about expenditures on repairs.

The weighted-average age of the entire stock of automobiles can be computed in a fashion similar to that of equation (2). Having obtained the stock of cars in units from equation (2), we convert this stock into its equivalent *age total*. This computation is shown by Equation (4), which cumulates the total age of the stock of automobiles in car-quarter units.

$$\begin{aligned}
 \text{QUARTERS} = & .99925 * [(C) + 2*(C)_{.1} + 3*(C)_{.2} + 4*(C)_{.3}] \\
 & + .9873 * [5*(C)_{.4} + 6*(C)_{.5} + 7*(C)_{.6} + 8*(C)_{.7}] \\
 & + .9580 * [9*(C)_{.8} + 10*(C)_{.9} + 11*(C)_{.10} + 12*(C)_{.11}] \\
 & + .9475 * [13*(C)_{.12} + 14*(C)_{.13} + 15*(C)_{.14} + 16*(C)_{.15}] \\
 & + .9235 * [17*(C)_{.16} + 18*(C)_{.17} + 19*(C)_{.18} + 20*(C)_{.19}] \\
 & + .8845 * [21*(C)_{.20} + 22*(C)_{.21} + 23*(C)_{.22} + 24*(C)_{.23}] \\
 & + .8448 * [25*(C)_{.24} + 26*(C)_{.25} + 27*(C)_{.26} + 28*(C)_{.27}] \\
 & + .7870 * [29*(C)_{.28} + 30*(C)_{.29} + 31*(C)_{.30} + 32*(C)_{.31}] \\
 & + .7398 * [33*(C)_{.32} + 34*(C)_{.33} + 35*(C)_{.34} + 36*(C)_{.35}] \\
 & + .6460 * [37*(C)_{.36} + 38*(C)_{.37} + 39*(C)_{.38} + 40*(C)_{.39}] \\
 & + .4350 * [41*(C)_{.40} + 42*(C)_{.41} + 43*(C)_{.42} + 44*(C)_{.43}] \\
 & + .3875 * [45*(C)_{.44} + 46*(C)_{.45} + 47*(C)_{.46} + 48*(C)_{.47}] \\
 & + .3013 * [49*(C)_{.48} + 50*(C)_{.49} + 51*(C)_{.50} + 52*(C)_{.51}] \\
 & + .2250 * [53*(C)_{.52} + 54*(C)_{.53} + 55*(C)_{.54} + 56*(C)_{.55}] \\
 & + .1750 * [57*(C)_{.56} + 58*(C)_{.57} + 59*(C)_{.58} + 60*(C)_{.59}] \\
 & + .1250 * [61*(C)_{.60} + 62*(C)_{.61} + 63*(C)_{.62} + 64*(C)_{.63}] \\
 & + .0500 * [65*(C)_{.64} + 66*(C)_{.65} + 67*(C)_{.66} + 68*(C)_{.67}] \\
 & + .0200 * [69*(C)_{.68} + 70*(C)_{.69} + 71*(C)_{.70} + 72*(C)_{.71}] \quad (4)
 \end{aligned}$$

By dividing total age [the result of Equation (4)] by the total number of units [the result of equation (2)], we obtain the weighted-average age of the stock in calendar quarters. In Equation (5), weighted-average age is expressed in number of years.

$$AGE = (QUARTERS / K) / 4.0 \quad (5)$$

The results are shown in Table 2.

5) *Average Age and Age Dispersion*

The average age and the age distribution of cars are shown in Table 2, where it can be seen that average age has been trending up from 5.1 years in the mid-1960s to about 6 years in the mid-1980s.⁵ Since cycles in new car purchases tend to be self-perpetuating due to the timing of physical obsolescence, these cycles are also reflected in the general profile of the weighted-average age computed above. From Table 2, it is clear that following periods of weak economic growth, the average age of the car stock increased as a result of the weakness in new car sales. As new car sales increased during the subsequent economic recovery, average age began to decline to more normal levels.

In drawing conclusions from average age data, it is instructive to examine the age dispersion of the stock data (see Table 3). Even if there is no change in the weighted average

⁵Our estimate (about 6 years, currently), compares well with fragmentary evidence that is available. According to Mr. DesRosiers of DesRosiers Automotive Research Inc., the average age of passenger cars and light trucks on the road in Canada was 6.6 years in mid-1987. (See the April 18, 1988 issue of the *Globe and Mail*.) The discrepancy between our estimates and that of DesRosiers can be accounted for by his inclusion of light trucks, which last longer than passenger cars.

Table 2
New Car and Truck Sales
Car and Truck Stock and Average Age

	Age	Sales	Stock	Age Sum	Stock/Capita
661	5.141044	764821.7	5100433	.1049+009	.393846
662	5.144342	654169.7	5166608	.1063+009	.396253
663	5.125543	748786.0	5253686	.1077+009	.400108
664	5.120622	724267.4	5338221	.1093+009	.403972
671	5.119515	701720.9	5413016	.1108+009	.406983
672	5.113585	753124.4	5501653	.1125+009	.410696
673	5.125161	679198.3	5569482	.1142+009	.412658
674	5.144484	681271.6	5640415	.1161+009	.415215
681	5.148237	740062.1	5722281	.1176+009	.418612
682	5.152627	741939.5	5803106	.1196+009	.421829
683	5.150140	782670.6	5892526	.1214+009	.425402
684	5.145851	610401.6	5986952	.1232+009	.429459
691	5.137931	631130.7	6083542	.1250+009	.433692
692	5.144801	778616.6	6165278	.1269+009	.436841
693	5.149342	796338.1	6251380	.1288+009	.439970
694	5.163465	779603.5	6333958	.1308+009	.442944
701	5.198090	677112.6	6387677	.1328+009	.443825
702	5.229855	692279.9	6443624	.1348+009	.444950
703	5.259571	702466.9	6501209	.1368+009	.446042
704	5.304016	636407.4	6539356	.1387+009	.446017
711	5.333770	716304.6	6597600	.1408+009	.447335
712	5.338241	839678.9	6684361	.1427+009	.450661
713	5.343786	837898.6	6768956	.1447+009	.453754
714	5.341680	695917.6	6866183	.1467+009	.458031
721	5.352886	639114.5	6947303	.1488+009	.461074
722	5.347400	921752.1	7044322	.1507+009	.465064
723	5.357013	865638.6	7131265	.1528+009	.468330
724	5.338803	1025267	7251790	.1549+009	.473860
731	5.309812	1115521	7393724	.1570+009	.480486
732	5.292924	1063011	7518488	.1592+009	.485615
733	5.294491	980739.0	7624557	.1615+009	.489695
734	5.285870	1047642	7740304	.1637+009	.493925
741	5.277122	1081909	7857053	.1659+009	.498217
742	5.268562	1080661	7976581	.1681+009	.502629
743	5.259373	1106798	8103236	.1705+009	.507161
744	5.285266	900849.6	8176267	.1729+009	.508485
751	5.293264	1005472	8269215	.1751+009	.511340
752	5.296698	1042274	8368694	.1773+009	.514311
753	5.298592	1079257	8479100	.1797+009	.517808
754	5.287426	1294065	8636431	.1820+009	.524267
761	5.289893	951932.8	8706796	.1842+009	.525519
762	5.290184	1128293	8822715	.1867+009	.529744
763	5.313584	986394.5	8901186	.1892+009	.531435
764	5.308924	1175697	9024477	.1916+009	.536106
771	5.308390	1184195	9143670	.1942+009	.540386
772	5.314770	1120562	9246480	.1966+009	.543612
773	5.331684	1077095	9342310	.1992+009	.546451
774	5.341813	1126903	9444000	.2016+009	.549848
781	5.356731	1081316	9531152	.2042+009	.552317
782	5.357799	1198059	9644560	.2067+009	.556192
783	5.364771	1175756	9753343	.2093+009	.559336
784	5.389244	1031446	9818357	.2117+009	.561263
791	5.400827	1135601	9909126	.2141+009	.563809
792	5.408484	1180134	10009504	.2165+009	.566768
793	5.423539	1148463	10104009	.2192+009	.569475
794	5.441445	1120039	10167346	.2217+009	.571328
801	5.461359	1116535	10271473	.2244+009	.573196
802	5.498457	981650.5	10315299	.2269+009	.572699
803	5.525974	1065784	10382194	.2295+009	.573623
804	5.561810	1084333	10451853	.2321+009	.574878
811	5.574682	1090634	10519039	.2348+009	.576007
812	5.598993	1081648	10569113	.2367+009	.576329
813	5.635846	970879.8	10598929	.2389+009	.575862
814	5.689674	972557.6	10620407	.2409+009	.575164
821	5.728482	783083.1	10597236	.2426+009	.572051
822	5.776283	656366.7	10587602	.2446+009	.566798
823	5.831494	800020.1	10587812	.2465+009	.567014
824	5.879379	629587.3	10544238	.2480+009	.564266
831	5.924367	830116.0	10520570	.2493+009	.561536
832	5.946185	989840.0	10531067	.2505+009	.560690
833	5.974915	953188.0	10539765	.2519+009	.558772
834	5.986561	1065036	10571167	.2531+009	.560111
841	5.989415	1124206	10617959	.2544+009	.561163
842	5.991331	1120536	10656896	.2554+009	.561694
843	6.000079	1073624	10684183	.2564+009	.561704
844	5.997531	1180968	10733413	.2575+009	.562963
851	5.984872	1241540	10803909	.2586+009	.565235
852	5.955901	1356516	10893906	.2595+009	.568506
853	5.932932	1340912	10984996	.2607+009	.571899
854	5.898412	1398092	11073166	.2613+009	.574732
861	5.879803	1342968	11163252	.2625+009	.577978
862	5.862059	1310488	11233058	.2634+009	.579990
863	5.841106	1361404	11331500	.2648+009	.583386
864	5.834965	1248140	11385192	.2657+009	.584436
871	5.829676	1250340	11441400	.2668+009	.585437
872	5.808081	1368012	11520098	.2678+009	.587500
873	5.802076	1272480	11580603	.2688+009	.588565
874	5.789425	1309732	11643712	.2696+009	.589923
881	5.783543	1290152	11708708	.2709+009	.591448
882	5.786243	1345332	11773527	.2718+009	.592856
883	5.758563	1306904	11836600	.2726+009	.594097
884	5.746779	1322347	11900224	.2736+009	.595637

Table 3

Car and Truck Stock and Percent Distribution

	Total Units	1-3 Years	4-6 Years	7-10 Years	11-18 Years
661	5100433	38.21492	25.87011	24.53341	11.36159
662	5186608	38.04910	26.11619	24.32610	11.50864
663	5253686	36.55777	25.94850	23.67801	11.81974
664	5338221	38.32378	26.26996	23.76617	11.64013
671	5413016	38.04613	26.84814	23.48924	11.61851
672	5501853	37.91912	27.29984	23.27945	11.50182
673	5569482	37.53693	27.77938	23.14256	11.54218
674	5640415	37.47512	27.81553	23.27210	11.43726
681	5722281	37.20574	26.07778	23.33912	11.37740
682	5803106	36.72397	26.50689	23.56800	11.20318
683	5892528	36.44195	29.13199	23.38259	11.04349
684	5986952	36.00788	29.60098	23.40093	10.99023
691	6083642	35.71727	30.01375	23.33243	10.93657
692	6185276	35.73200	29.86252	23.49434	10.91118
693	6251380	35.43639	30.34114	23.36045	10.86204
694	6333958	35.19355	30.24253	23.76306	10.80087
701	6387877	34.79090	30.18331	24.16193	10.84389
702	6443824	34.25302	30.31118	24.54984	10.88597
703	6501209	34.02197	30.09858	25.01312	10.86635
704	6539356	33.83316	30.24387	25.15323	10.96978
711	6597800	33.23906	30.19125	25.63969	10.93002
712	6684361	33.17111	29.83198	26.18740	10.82954
713	6768958	32.98172	29.68684	26.57809	10.77336
714	6866183	32.81698	29.38958	27.04894	10.74663
721	6947303	32.48368	29.28360	27.43692	10.79893
722	7044322	32.55028	29.27748	27.35222	10.82004
723	7131285	32.40409	29.08513	27.80517	10.70582
724	7251790	32.72155	26.78115	27.79289	10.70443
731	7393724	33.56424	26.13425	27.64502	10.85651
732	7518468	34.21568	27.47518	27.60644	10.70271
733	7824557	34.83193	27.14270	27.58471	10.64088
734	7740304	35.40171	26.57583	27.25733	10.76535
741	7857053	35.94788	28.10265	27.07057	10.87882
742	7976561	36.14874	26.00107	28.87822	10.97198
743	8103236	36.40485	25.75980	26.74891	11.08847
744	8176267	36.07781	25.79390	27.00548	11.12302
751	8269215	36.14212	25.55333	27.05802	11.24655
752	8368694	36.05422	25.68040	26.86408	11.42131
753	8479100	36.19668	25.52773	26.69623	11.58037
754	8636431	36.31818	25.74462	26.23345	11.70579
761	8706795	35.58160	26.71374	25.81803	11.90666
762	8822715	35.27842	27.32620	25.51162	11.88378
763	8901188	34.96680	27.80000	25.18291	12.05032
764	9024477	34.84732	26.44672	24.62429	12.08269
771	9143870	34.67988	26.93030	24.31381	12.07803
772	9246480	34.40381	29.20397	24.25079	12.14145
773	9342310	33.97753	29.57413	24.31639	12.13198
774	9444000	34.17043	29.24506	24.49709	12.08743
781	9531152	34.05691	29.34879	24.48159	12.11373
782	9644560	34.05002	29.27552	24.56999	12.10450
783	9753343	33.92452	29.44148	24.47362	12.16053
784	9818357	33.04561	29.90034	24.78937	12.26471
791	9909128	33.18634	29.24732	25.21739	12.34867
792	10009504	32.98141	29.10602	25.55695	12.35364
793	10104009	33.06383	28.82867	25.71038	12.39716
794	10187346	32.86460	26.89012	26.04038	12.40492
801	10271473	32.28790	26.90117	26.52908	12.26188
802	10315299	31.80706	26.87044	27.10027	12.22224
803	10382194	31.56690	26.62625	27.68030	12.14756
804	10451853	31.26067	28.89532	27.65033	11.99271
811	10519039	31.07835	28.67747	28.13439	11.90982
812	10569113	30.81804	29.07742	26.32982	11.97875
813	10598929	30.05201	29.22004	26.87237	12.05690
814	10620407	29.84512	26.59552	29.36005	12.19933
821	10697236	29.08198	29.04174	29.54044	12.33689
822	10687602	28.36158	29.18091	29.91385	12.54369
823	10687812	27.80176	29.58180	30.12753	12.68894
824	10544238	26.98199	29.53562	30.46827	13.01414
831	10620670	26.38075	29.50407	30.88129	13.43392
832	10531067	26.37187	29.15183	30.75552	13.72101
833	10539765	26.09736	29.08897	30.88350	13.93019
834	10571167	25.98916	28.91638	30.93767	14.15682
841	10617959	25.98210	28.80274	30.85070	14.36448
842	10655896	26.04378	28.41079	30.97101	14.57444
843	10684183	26.22732	27.89006	31.04886	14.63378
844	10733413	26.55244	27.62112	31.01681	14.80986
851	10803909	27.42643	26.87222	31.05294	14.84843
852	10893906	28.33054	25.77217	31.01602	14.88129
853	10884996	29.30802	24.82414	30.89946	14.96841
854	11073186	30.33270	24.01628	30.39865	15.25236
861	11163252	31.19905	23.24106	30.38271	15.17720
862	11233058	31.69999	23.11364	29.90581	15.26056
863	11331500	32.35063	22.69971	29.73624	15.21344
864	11386182	32.58482	22.57551	29.45858	15.38100
871	11441400	32.88702	22.57363	29.20403	15.53614
872	11520098	32.98044	22.56182	28.89207	15.56569
873	11580603	33.21224	22.88940	28.52157	15.59681
874	11643712	33.33446	22.93683	28.11222	15.61652
881	11708706	33.24857	23.71536	27.40265	15.83544
882	11773527	33.04236	24.56654	28.88084	15.71028
883	11836600	32.79374	25.49159	25.90962	15.80507
884	11900224	32.47085	26.45092	25.39730	15.88086

between two points in time, the economic implications can be very different if there are variations in the age dispersion. For instance, there is no significant difference in average age for 1982Q3 and for 1987Q1. However, the age distribution of cars is very different in the two periods, with the proportion of 1-3 year old cars rising from 27.6 per cent to 32.7 per cent by 1987Q1. This difference in age composition suggests that the need for expenditures on repairs was substantially less in 1987 than in 1982, as was reflected in actual consumer expenditures.

In making inferences from car-age and age-dispersion data, it should be noted that increases in multicar households over time should lead to an upward trend in the average age of cars associated with the decline in average annual mileage travelled per car.

B. Light Trucks

In recent years, vans, pick-up trucks and sport utility vehicles have gained considerable popularity among consumers.⁶ Because a significant portion of the sales of light trucks is at the expense of the sales of passenger cars, it is necessary to take into consideration the personal sector's stock of light trucks as well.

⁶In recent years, overall sales in motor vehicles were boosted by business sector purchases associated with the investment boom. As a result, overall sales figures tend to grossly exaggerate the strength of demand by the personal sector. Ideally, we should exclude business purchases of cars and trucks from the computation of the personal sector holding of the motor vehicle stock. With the help of Statistics Canada, we are able to improve the accuracy of our estimates substantially by excluding business purchases of trucks from the analysis. In the case of new passenger cars, personal sector purchases are roughly equal to 85 per cent of total passenger car sales excluding fleet sales to businesses. Because data on fleet sales of passenger cars cannot be released for confidentiality reasons, we cannot adjust the car sales data to take account of business purchases. This shortcoming tends to overstate the stock of passenger cars held by the personal sector in recent years. In any case, this shortcoming is mitigated by the fact that an important part of fleet sales to rental companies will typically be sold as used cars to consumers within the first year.

As in the case of passenger cars, the stock of light trucks is computed by cumulating data on new truck sales adjusted for scrappage. It should be noted that data on new truck sales published by Statistics Canada include sales of heavy trucks, commercial vehicles, coaches and buses in addition to light trucks sold to both the personal and business sectors. Because business purchases represent an important part of total truck sales, it is crucial that such purchases be excluded from our estimation of personal sector motor vehicle stock. In this case, we are able to obtain data on personal sector purchases of light trucks (in terms of units) from Statistics Canada for the more recent period. Back data were estimated using constant dollar expenditures on light trucks based on the regression results using unit sales and constant dollar expenditures over the recent period when both sets of data are available.

III. CONVERSION TO NEW-UNIT EQUIVALENTS

In this section, we convert the motor-vehicle stock into units that are equivalent to new vehicles. We suggest that the desired level of vehicle stock held by individuals should be expressed in new-unit equivalents to compensate for the dispersion in vintages.⁷

The rationale is that the desired stock of autos is somehow measured in constant dollars. For a given constant dollar amount, one has a choice of owning a second older car or trading in the existing car for a newer one. In addressing questions about whether or not pent-up demand for motor vehicles has been fully satisfied, the new-unit-equivalent measure is more appropriate

⁷A similar argument could be made with regard to the dispersion in prices (and by implication, the underlying values) of new cars to take account of the variations in the market share of luxury cars.

than simply counting units regardless of age. Because of the surge in motor vehicle sales in recent years, the average age of the motor vehicle stock has declined and the new-unit equivalent, per unit of the stock, has increased accordingly. By taking this decline into consideration, we show that more of the pent-up demand for motor vehicles has been met in recent years than indicated by the unadjusted data.

A. Passenger Cars.

The methodology used in converting the motor vehicle stock to its new-unit equivalent is identical for cars and for trucks. For illustration, consider the case of passenger cars. For the stock of any given vintage, its new-car-equivalent stock can be estimated by adjusting the car-sales data for the loss of resale value and for scrappage. Our adjustment for loss of resale value is based on information about the *resale* (or trade-in) values of cars of different vintages. This procedure assumes that resale prices accurately reflect the undepreciated value of used cars relative to the current vintage of new cars.

In the following equations used to compute the new-car equivalents (NK) for four subcategories of the car stock, the survival rate is multiplied by the resale value (expressed in fractions of the original new car price).⁸ These resale values

New Car Equivalents

One-three years old

$$NK_{13} = .99925 * 0.725 * [C + (C)_{.1} + (C)_{.2} + (C)_{.3}] \\ + .9873 * 0.576 * [(C)_{.4} + (C)_{.5} + (C)_{.6} + (C)_{.7}]$$

⁸In our calculation, the resale values are held constant through all quarters in the same year as in the case of scrappage rates.

$$+ .9580*0.445*[(C)_{.8} + (C)_{.9} + (C)_{.10} + (C)_{.11}] \quad (6)$$

4-6 years old

$$\begin{aligned} NK46 = & .9475*0.329*[(C)_{.12} + (C)_{.13} + (C)_{.14} + (C)_{.15}] \\ & + .9235*0.232*[(C)_{.16} + (C)_{.17} + (C)_{.18} + (C)_{.19}] \\ & + .8845*0.164*[(C)_{.20} + (C)_{.21} + (C)_{.22} + (C)_{.23}] \end{aligned} \quad (7)$$

7-10 years old

$$\begin{aligned} NK710 = & .8448*0.108*[(C)_{.24} + (C)_{.25} + (C)_{.26} + (C)_{.27}] \\ & + .7870*0.09*[J28L(C)_{.28} + (C)_{.29} + (C)_{.30} + (C)_{.31}] \\ & + .7398*0.07*[(C)_{.32} + (C)_{.33} + (C)_{.34} + (C)_{.35}] \\ & + .6460*0.05*[(C)_{.36} + J37L(C)_{.37} + (C)_{.38} + (C)_{.39}]; \end{aligned} \quad (8)$$

11-18 years old

$$\begin{aligned} NK1118 = & .4350*0.02*[(C)_{.40} + (C)_{.41} + (C)_{.42} + (C)_{.43}] \\ & + .3875*0.02*[(C)_{.44} + (C)_{.45} + (C)_{.46} + (C)_{.47}] \\ & + .3013*0.02*[(C)_{.48} + (C)_{.49} + (C)_{.50} + (C)_{.51}] \\ & + .2250*0.01*[(C)_{.52} + (C)_{.53} + (C)_{.54} + (C)_{.55}] \\ & + .1750*0.01*[(C)_{.56} + (C)_{.57} + (C)_{.58} + (C)_{.59}] \\ & + .1250*0.01*[(C)_{.60} + (C)_{.61} + (C)_{.62} + (C)_{.63}] \\ & + .0500*0.01*[(C)_{.64} + (C)_{.65} + (C)_{.66} + (C)_{.67}] \\ & + .0200*0.01*[(C)_{.68} + (C)_{.69} + (C)_{.70} + (C)_{.71}]; \end{aligned} \quad (9)$$

and with

Total new car equivalents

$$NK = NK13 + NK46 + NK710 + NK1118. \quad (10)$$

are taken from various issues of the *Canadian Red Book - Official Used Car Valuations*.⁹ In our opinion, the resale values used in this paper (shown in Table 4) are a reasonably good approximation of the resale market, as they are based on the arithmetic means of resale values of six popular models over a seven-year period. The total stock of cars (NK), measured in new-car equivalents, is given by the sum of the four subcategories, NK13, NK46, NK710 and NK1118. Data for these series and their per-cent shares are shown in Table 5.

Table 4
Survival Rates and Resale Values of Cars

(Per Cent)

<u>Car Age</u>	<u>Survival Rate</u>	<u>Resale Value</u>
1	99.925	72.5
2	98.73	57.6
3	95.80	44.5
4	94.75	32.9
5	92.35	23.2
6	88.45	16.4
7	84.48	10.8
8	78.70	9.0
9	73.98	7.0
10	64.60	5.0
11	43.50	3.0
12	38.75	2.0
13	30.13	1.0
14	22.50	1.0
15	17.50	1.0
16	12.50	1.0
17	5.00	1.0
18	2.00	1.0

⁹Because no attempt is made to adjust these used-car prices for inflation before they are matched with the original new car prices, our estimate of the new-car-equivalent stock is biased upward.

Table 5
New-Vehicle Equivalent Units and Percent Distribution

	<u>Total Units</u>	<u>1-3 Years</u>	<u>4-6 Years</u>	<u>7-10 Years</u>	<u>11-18 Years</u>
661	1599679	72.50013	20.38240	6.396667	.720815
662	1614338	72.13535	20.72931	6.404245	.731094
663	1649598	72.45517	20.53390	6.276324	.734805
664	1674381	72.06998	20.91126	6.284161	.734899
671	1692311	71.57369	21.48418	6.221975	.740172
672	1720264	71.35340	21.76471	6.153516	.728371
673	1733836	70.68293	22.42802	6.159626	.731423
674	1743804	70.59800	22.45494	6.223226	.725834
681	1782642	70.26323	22.73828	6.274005	.724496
682	1780949	69.72951	23.19854	6.360163	.711786
683	1808465	69.34427	23.87320	6.287921	.694612
684	1838059	66.84748	24.15637	6.303133	.693016
691	1867981	66.55945	24.45295	6.294522	.693078
692	1887327	66.68319	24.24281	6.378553	.695450
693	1909673	66.39066	24.54889	6.366484	.693972
694	1925953	66.23824	24.55140	6.519817	.690543
701	1920064	67.66189	24.67729	6.740289	.700526
702	1918735	67.32356	25.04404	6.921433	.710969
703	1917624	67.15203	24.97342	7.159729	.714825
704	1903455	66.78235	25.20628	7.275790	.735580
711	1904904	66.46429	25.33552	7.463949	.736240
712	1929430	66.56946	25.09984	7.811527	.729173
713	1952343	66.43448	25.07644	7.760496	.728584
714	1966839	66.45680	24.93088	7.888696	.723626
721	2009608	66.27107	24.98990	6.008687	.730343
722	2043389	66.47819	24.86296	7.924551	.734274
723	2065958	66.44287	24.78678	6.042850	.725703
724	2116570	66.98319	24.33575	7.958252	.722813
731	2164219	66.19115	23.31949	7.778938	.710426
732	2234866	69.01559	22.55970	7.714202	.710507
733	2272432	69.60077	22.06203	7.630291	.708903
734	2315014	70.48464	21.30519	7.494382	.715784
741	2367505	71.02446	20.84092	7.408459	.726158
742	2399413	71.12024	20.81836	7.328891	.732707
743	2450200	71.36640	20.83233	7.258755	.742513
744	2455206	70.82907	21.05610	7.369115	.745723
751	2475960	70.70448	21.12535	7.414625	.755545
752	2499544	70.46161	21.37252	7.395141	.770737
753	2532833	70.53049	21.32897	7.358965	.783572
754	2605674	70.58249	21.45382	7.173624	.790099
761	2610434	69.55608	22.54632	7.087239	.810363
762	2642589	69.18365	23.05719	6.975614	.803342
763	2649838	66.69215	23.57405	6.914372	.819427
764	2684457	66.50740	23.94364	6.732559	.816404
771	2724120	66.42094	24.14861	6.621880	.806573
772	2745379	66.13578	24.39630	6.851388	.816637
773	2785172	67.65996	24.83629	6.891963	.811790
774	2779974	67.88394	24.50437	6.801211	.810486
781	2794646	67.86611	24.47427	6.845541	.814086
782	2823621	67.96253	24.33190	6.904934	.810642
783	2855696	67.92363	24.36691	6.895007	.814451
784	2848189	66.80724	25.25877	7.104110	.829680
791	2867826	67.07011	24.78604	7.325414	.837530
792	2886216	66.88347	24.79222	7.482691	.841622
793	2905204	67.09640	24.48497	7.575323	.844314
794	2914133	66.79627	24.63347	7.723832	.846426
801	2926531	66.35720	24.92644	7.881715	.834643
802	2903892	66.83326	25.21049	6.120898	.836362
803	2902930	65.56779	25.25743	6.342893	.831661
804	2903498	65.41563	25.39428	6.369432	.820653
811	2907183	65.27714	25.46423	6.439094	.819546
812	2902610	64.84114	25.80562	6.516794	.834444
813	2883606	64.16388	26.29462	6.690005	.851493
814	2861667	64.10092	25.99492	9.025834	.878325
821	2807362	63.15319	28.76451	9.176109	.906198
822	2785991	62.40001	27.25426	9.409163	.936542
823	2719407	61.51082	27.95953	9.567894	.961780
824	2877119	60.77947	28.40199	9.814019	1.004515
831	2641984	60.17058	28.71976	10.04786	1.061799
832	2633687	60.49360	28.29317	10.11716	1.096080
833	2624397	60.46377	28.22844	10.19455	1.123248
834	2634651	60.61338	28.06167	10.16130	1.143649
841	2661890	61.00970	27.73428	10.10414	1.151872
842	2680560	61.35955	27.35263	10.12453	1.163089
843	2696296	61.94293	26.71803	10.15585	1.183189
844	2722918	62.64428	26.18457	10.00516	1.166997
851	2767107	64.10025	24.82510	9.920771	1.153674
852	2825509	65.44904	23.64266	9.770852	1.137428
853	2887902	66.66946	22.39096	9.813854	1.126018
854	2951080	66.20578	21.28730	9.365146	1.141772
861	3004854	69.18910	20.45773	9.237015	1.116154
862	3042586	69.61302	20.27852	8.993552	1.114901
863	3099686	70.20730	19.88378	8.816543	1.092378
864	3122515	70.23145	19.95098	8.724045	1.083530
871	3146814	70.01811	20.24892	8.628793	1.106180
872	3184427	70.09616	20.32004	8.485625	1.098177
873	3207370	70.04734	20.52993	8.325612	1.097118
874	3234775	69.92129	20.81646	8.168342	1.083906
881	3259004	69.55031	21.47842	7.884163	1.089109
882	3282836	69.01998	22.24140	7.644782	1.083854
883	3304311	66.42203	23.09057	7.387210	1.100182
884	3326151	67.82424	23.90580	7.186764	1.081197

B. Light Trucks

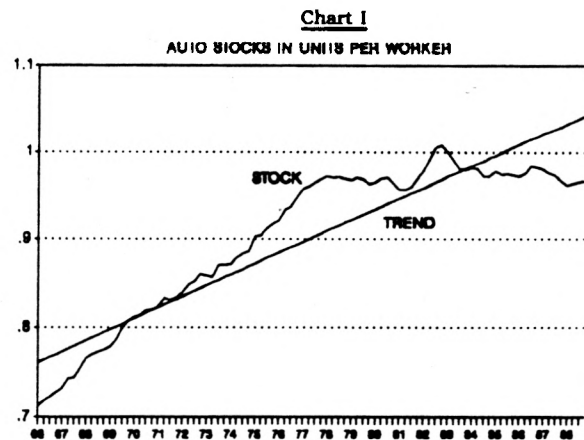
In a similar fashion, the stock of trucks in operation is translated into equivalent units of new trucks by taking account of the changes in age structure over time. Because most trucks on the road are of more recent vintage than the stock of passenger cars, the per-unit new-vehicle equivalent is correspondingly higher for trucks. As a result, the inclusion of light trucks further boosts the consumer stock of motor vehicles in new-vehicle equivalents. By combining the stock of light trucks with that of passenger cars, we make the extreme assumption that cars and light trucks are perfect substitutes. This assumption implies that a consumer purchasing a light truck would not buy a car over the service life of the vehicle. Because trucks and cars are unlikely to be perfect substitutes, our assumption imparts an upward bias to the actual stock relative to its desired level.

IV. STOCK ESTIMATES RELATIVE TO TREND VALUES

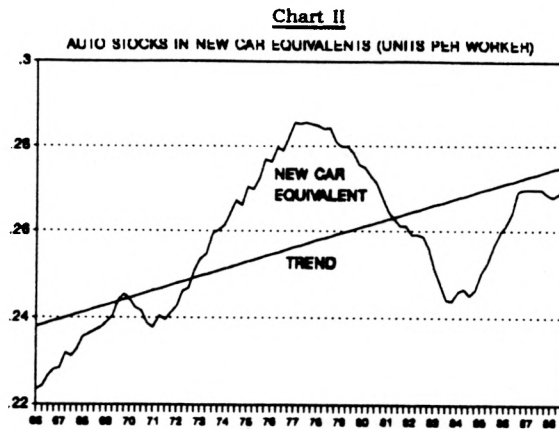
1) *Per-Capita Stock and Trend*

The auto stock (in units of new-motor-vehicle equivalents for total cars and trucks) by itself is not a good indicator of demand in the auto market, as it is likely to be affected by changes in factors such as the driving-age population and a general

upward trend reflecting rising national wealth. We feel that the stock series (K and NK) scaled by data on employment would



represent a better measure for purposes of assessing actual relative to desired stocks.¹⁰ We feel that the per-worker (as opposed to the per capita) measure is a better indicator of prospective demand in the very near term. For instance, the recent strength in employment has led to a surge in auto demand over and above the demographic requirements.



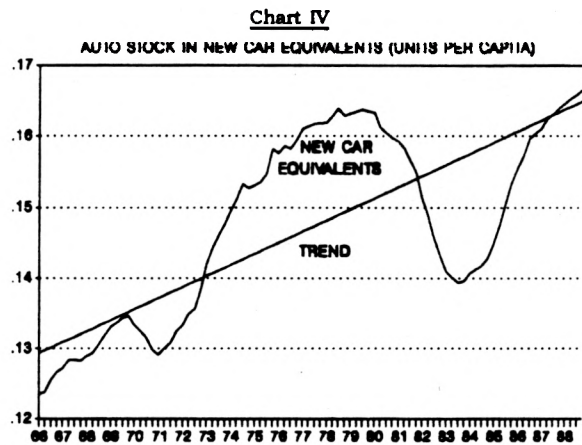
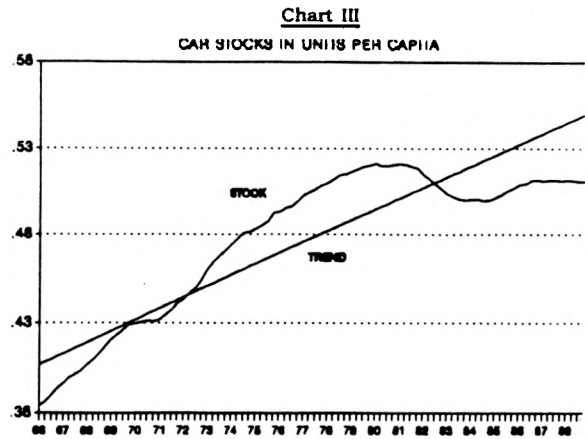
In Charts I and II, estimates of the stock of motor vehicles per worker are plotted against linear trends.¹¹ Chart I shows that the number of motor vehicle units per worker reached a peak of 1.01 in the fourth quarter of 1982 and has since declined noticeably. In terms of new-car equivalents shown in Chart II, however, the situation is rather different. The stock of new car equivalents per worker reached a peak of 0.29 units in all the four quarters in 1977 and then fell to 0.24 by the second half of 1983. Following the strength in sales in 1985 and 1986, this ratio recovered to 0.27 by 1986Q3. From these two charts, it could be concluded that the current per-worker stock is substantially below its trend value.

In Charts III and IV, these measures are scaled by data on

¹⁰Alternatively, these stock data can be scaled by data on the number of households. However, a time series on per household stock of autos is likely to be misleading as household size fluctuates over the business cycle and diminishes over time due to social and demographic factors which affect birth, death and divorce rates.

¹¹By including data for the 1980s, there is a risk that the trend values impart a significant downward bias to the desired stock. For instance, the trend line plotted using pre-1980 data has a much more pronounced upward trend.

the driving-age population. This procedure abstracts from the cyclical effects captured by employment, although we believe the business cycle has a substantial impact on auto demand. These results indicate that there is a significant upward trend in per-capita desired stock of automobile both in units and new car equivalents. It is clear from Chart III that the current per-capita number of units is substantially below trend, even after including trucks sold to the personal sector although the gap between actual and desired levels has widened less in recent years than is depicted in Chart I. In Chart IV, when we consider the fact that the passenger cars and light trucks sold in recent years are of very recent vintage, it can be seen that the current level of new-vehicle-equivalent units per capita is roughly in line with the trend value plotted over the 1966-1988 period. However, if we consider the reality that light-truck sales are not entirely at the expense of passenger cars, then the current level of this measure would still be below trend. As noted above, there is a risk that the trend value understates the desired level of the motor vehicle stock.



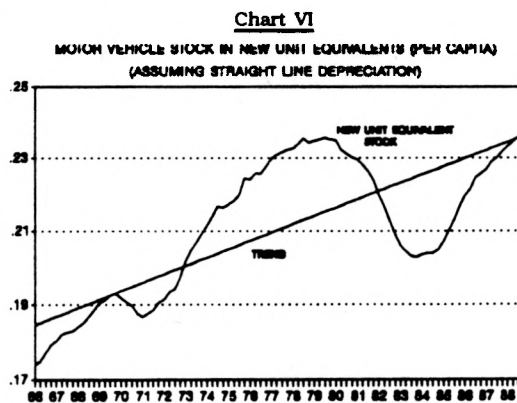
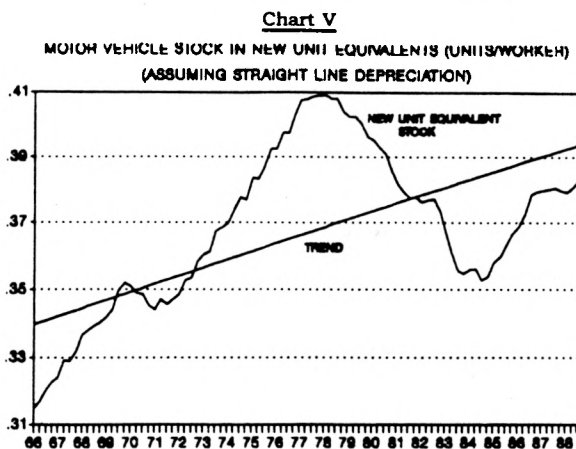
2) Sensitivity to Depreciation Assumptions

It seems likely that the estimates presented may be sensitive to assumptions about the depreciation in car values.

An alternative way of computing new-car equivalents is to set a depreciation schedule judgmentally and subtract the accumulated depreciation from the stock to get a "net stock" concept

instead of using resale values. Our first thought was to use a constant exponential depreciation rate. It turns out that this is similar to the resale values we use in our computation above. By way of alternative, we have chosen an extreme case of the standard straight-line depreciation schedule for the first 8 years' life span. Assuming a cumulative depreciation of 91 per cent in the course of the first 8 years, we reduce the value of the car by a constant fraction of 0.1138 per year.¹² For vintages of between 9 and 18 years, the remaining values are identical to those shown in Table 4.

The alternative per-capita stock series are presented in Charts V and VI. The movements of the alternative series are remarkably similar to those based on resale values, in spite of a large



¹²For recent vintages, this is much smaller than is reflected in resale values. For example, resale values show a depreciation of 27.5 per cent in the course of the first year.

difference in units per capita.

IV. CONCLUSION

We conclude that the new-motor-vehicle-equivalent stock estimates on a per-worker or per-driving-age-population basis are the best for purposes of analysing differences between actual and desired stocks. This analysis also reveals that our scrappage and depreciation rates are realistic and that alternative assumptions about depreciation rates are unlikely to alter the results significantly. Once these scrappage and depreciation rates are obtained, it is sufficient to use only new vehicle sales data to generate car stock data in terms of new-vehicle equivalents.

Viewed both from the per-capita and per-worker basis, our analysis leads us to conclude that the current stock of motor vehicles is below its desired level as proxied by its historical trend value. Moreover, the current stock is still far below the level recorded during the 10-year period between 1973 and 1982, even after adjusting for differences in age distribution over time.

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