Trucks, Chicken Taxes, and Changing Fuel Prices

1 Introduction

North Americans make an average of 75% of their trips by automobile [1], but rarely do we consider the definition of this transportation mode. The Meriam-Webster dictionary defines an automobile as: “a vehicle used for carrying passengers on streets and roads” [2]. The same dictionary defines a truck as: “a vehicle designed to carry freight and heavy articles” [3]. Yet, according to the United States Bureau of Census Statistics, trips by truck account for 20% of trips to work and 24% of work-related trips, 10% of trips to take or pick up a passenger, 12% of shopping trips and 14% of trips for other personal business [4]. In the passenger transportation realm these terms seem to have become synonymous and we allow the use of the truck, a tool designed for the movement of goods, as a tool for moving people. We will examine the principle concerns with this trend, current policy drivers, and economic factors with respect to elasticity to the price of gasoline at the pump.

2 Literature Review

Substantial work was completed by Kockelman in two papers published in 1999 and 2000 [5], [6]. Kockelman and Zhao [6] perform a detailed analysis of 1995 NPTS data to assess distinctions in ownership and use patterns for various types of vehicles. They define light duty trucks (LDT) as comprising pickup trucks, SUVs, and vans. They find that the overall class of vehicles tend to be owned by wealthier households living in less dense neighbourhoods and that they are used for loner trips with more people onboard than passenger vehicles (about 25% further per trip) [5]. However, pickup trucks tend to be owned by smaller households and carry fewer passengers (15% less person-trips) [5]. They find that LDT ownership in the United States increased from 9.8% in 1972 to 51% in 1999 [5]. There is no indication in the data that the predominant use of vans and SUVs is for work purposes and Kockelman and Zhao state that pickup trucks saw increasing popularity in this period, despite an increasingly urbanized population [5]. They do not find any strong indication that pickup trucks are being used for work purposes; although they may see occasional use for towing boats and hauling home furniture. Similar trends are present in Canada, with data being available for 2000-2003. Figures 1 and 2 contrast the passenger-kilometres reported by use for passenger cars compared to trucks with vehicle weights under 4.5 tonnes GVW. What quickly becomes clear upon examination of these data is that, although work-related trips are made almost exclusively by LDT, the passenger-kilometres travelled using this mode for other purposes are far from insignificant. We can see that these vehicles are still being utilized as largely personal vehicles for the purposes of transporting people.

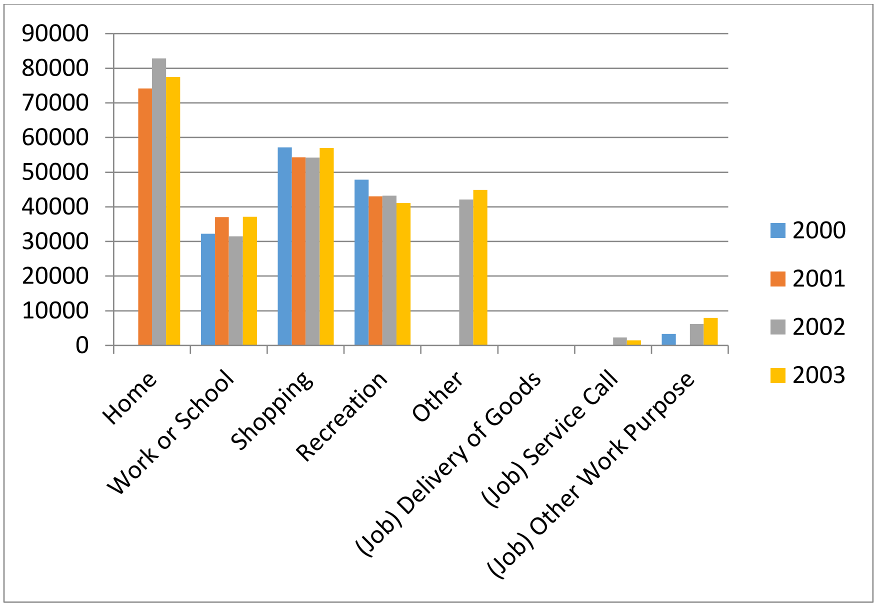

Figure 1: Passenger-Kilometres by Purpose (Passenger Car)

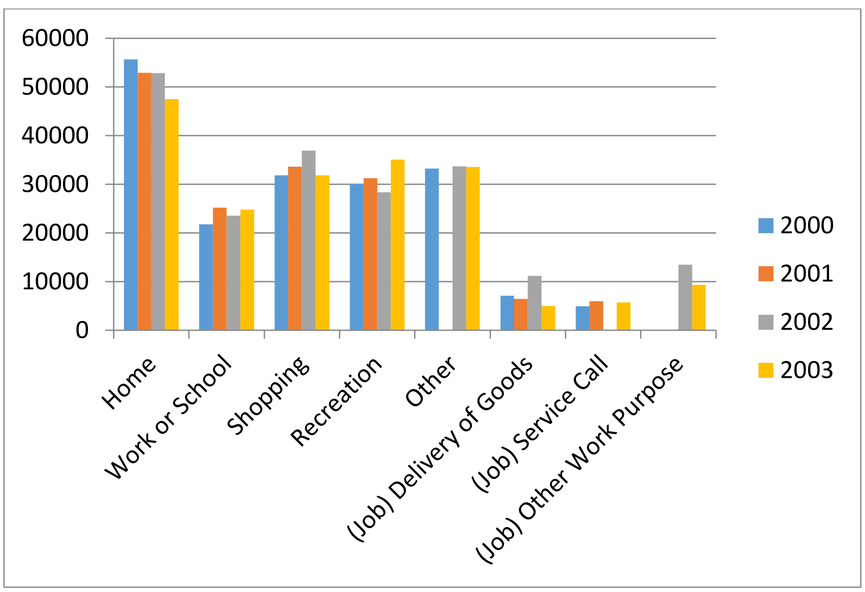

Figure 2: Passenger-Kilometres by Purpose (Other Vehicles Under 4.5 Tonnes GVW)

Kockelman also considers the regulations governing LDT manufacturing and fuel standards. Tariffs introduced in the 1960s incentivized the manufacturing of trucks in America. This was a retaliatory measure against tariffs in France and West Germany on American chickens. Known colloquially as "The Chicken Tax", President Johnson introduced tariffs on the import of potato starch, brandy, and a 25% tariff on the import of light duty trucks. Some argue [7] this has decreased competition and restricted the availability of, often smaller and more efficient, European and Asian manufactured trucks. Toyoto has sold over 16 million of its compact HiLuxes [7], but most North Americans have not even heard of this vehicle model and domestic manufactures – GM, Ford, and Chrystler – see no incentive to develop competing models. This may change with the passing of the Trans-Pacific Partnership, which contains measures to roll back the tariff over a period of several years [8].

A second policy discussed by Kockelman [6] is the formulation of the 1970s Corporate Average Fuel Economy (CAFE) legislation, it was assumed that these vehicles were used almost exclusively for work trips. There were concerns that fuel standards would raise the cost of vehicles and adversely affect manufacturing jobs. Legislators faced pressure to class LDT as commercial vehicles and thus exclude vehicles from the stricter standards on passenger cars. At the time, LDT under 10,000 lbs (4.5 tonnes) GVW were used for 50% personal trips [6]. This had increased to 75% by 1999 [6]. It is apparent that commercial use has never been the primary purpose of these vehicles under CAFE legislation.

Safety is often cited as a principle reason for buying a larger vehicle for personal use. Physical laws would suggest the greater mass will reduce the impact in a crash with a smaller vehicle. For a uniform force, a larger mass will experience a lower acceleration in a crash and it seems logical that harm to passengers should be lower. Conversely, this means greater potential damage to the smaller vehicle and its occupants; thus the cycle of users purchasing increasingly massive vehicles to maintain a competitive advantage. However, research is bringing this notion into question as studies are beginning to show that vehicle quality is far more important to safety than weight for the drivers of vehicles involved in the collision.

Ross and Wenzel [9] identify a discussion in the literature about the interpretation of traffic fatality data. They argue that an analysis based on categorization by average vehicle weight misses differences in the design of each vehicle type: citing the example of imported luxury vehicles compared with sports cars of an equal weight. Each class of vehicle has a different structural design and appeals to motorists with potentially different driving characteristics. They use the “driver death rates” concept developed by the Insurance Institute for Highway Safety (IIHS) and annual data from the Fatality Analysis Reporting Systems (FARS) published by the National Traffic Safety Administration (NHTSA) [9] to examine the risk of collisions involving various types of vehicles. Their approach differs from that of the IIHS in that, in addition to the risk to vehicle occupants, they consider the risk to occupants of vehicles involved in collisions with each type of vehicle. This provides a more complete representation of the societal welfare effects associated with the purchase of a specific type of vehicle. They use data on vehicles manufactured between 1995 and 1999, which may have different safety characteristics than more recent vehicle models. However, this provides a good approximation of the relative risks of each vehicle class. They find that pickup trucks, as driven, have the highest risk of being involved in fatal crashes. This higher risk is partially due to these vehicles being driven on rural roads, with characteristically higher speeds and trip distances. They find that pickup truck and SUV drivers are at a higher risk of death in one-vehicle crashes. More importantly to this research, they find that car drivers are at a significantly higher risk of death in car-truck collisions than car-car collisions, largely due to the design of trucks [9].

The above is provided as a summary of the historical trends and concerns with respect to LDT owernship. The present study is focused on the higher emissions of CO_2 associated with this vehicle class when compared with passenger cars. Kockelman gives this topic passing mention and states “Global warming, while not a scientific certainty, seems a rather likely result of our high energy use.” [6]. Much has changed in our view towards climate change since the publication of this paper and this concern now has a strong policy weight.

3 Analysis of LDT Purchase-Pump Price Relationship

Data were compared for the pump price faced by consumers and the proportion of truck sales of total vehicle sales (including commercial sales) based on Statistics Canada data [10]–[12]. Monthly pump price data were available for Canada from January 1979 to July 2015. Annual plots for Canada were extrapolated to 1949 based on data available for the United States from the Energy Information

Administration [13] and the corresponding exchange rate to Canadian dollars in each year. Accurate exchange rates could not be determined for earlier years and gasoline prices were taken from a variety of sources and inflated using available data [14]–[17]. The variation of pump prices does not show a complete correlation with the price of crude oil. A study by MJ Ervin & Associates finds that crude oil accounts for a wide ranging percentage (33-63% between January 2008 and March 2012) of the pump price of gasoline [18]. This variable percentage is balanced against refining margins and fuel taxes. Nominal prices for crude oil therefore have a strong bearing on consumer preferences for vehicles, but refining markets and government policy have important roles.

Figure 3 shows the pump price for gasoline and proportion trucks compose of total vehicle sales over time. The plot of trucks is based on total truck sales, including heavy trucks and other commercial-grade vehicles. The time-series plot shows a diminishing proportion following the high levels to meet the war effort of WWII until the mid-1950s. Since this time, the proportion of sales has steadily increased, despite a relatively constant – or diminishing – share of economic activity occurring in the industrial sector. As of 2015, the share of truck sales sits at 62% of total vehicle sales and it can be safely assumed that a large proportion of this increase is focused among personal users of LDT given that the national economy has not undergone a significant shift towards heavy industry – in fact, quite the opposite.

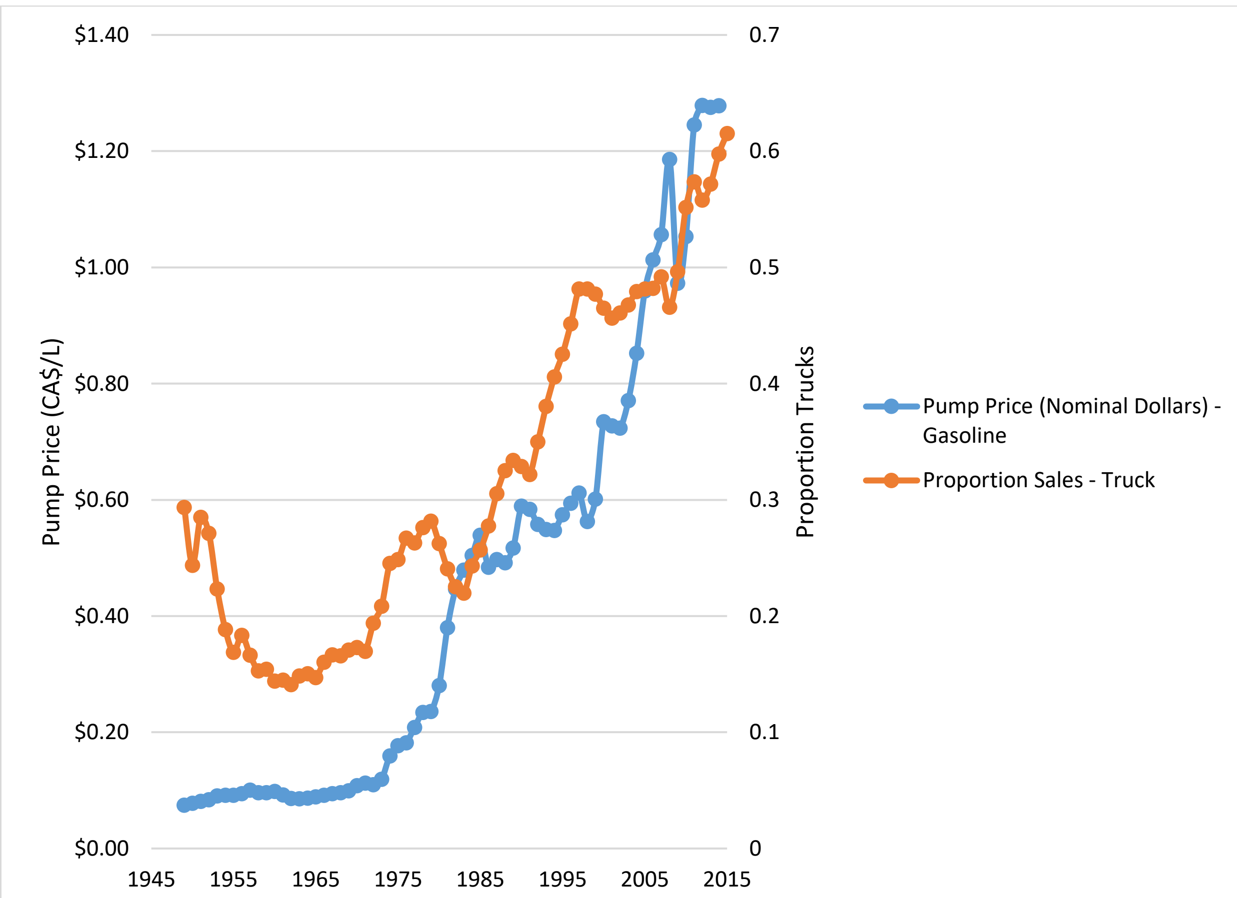

Figure 3: Time Series of Nominal Dollar Pump Price and New Trucks as Proportion of Total Vehicle Sales

Plotting the nominal price, Figure 3, does not account for the variable purchasing power of consumers resulting from other factors such as increased income from other economic sectors and changing rates of inflation. Normalizing the pump price of gasoline faced by consumers (Figure 4), we can see that the real price has remained consistent at $1.32/L (in July 2015 dollars) since the early 1980s. The only major variations in the real price of gasoline occurred as a result of the 1973-1974 OPEC Oil Embargo and in 1979 during the Iranian Crisis.

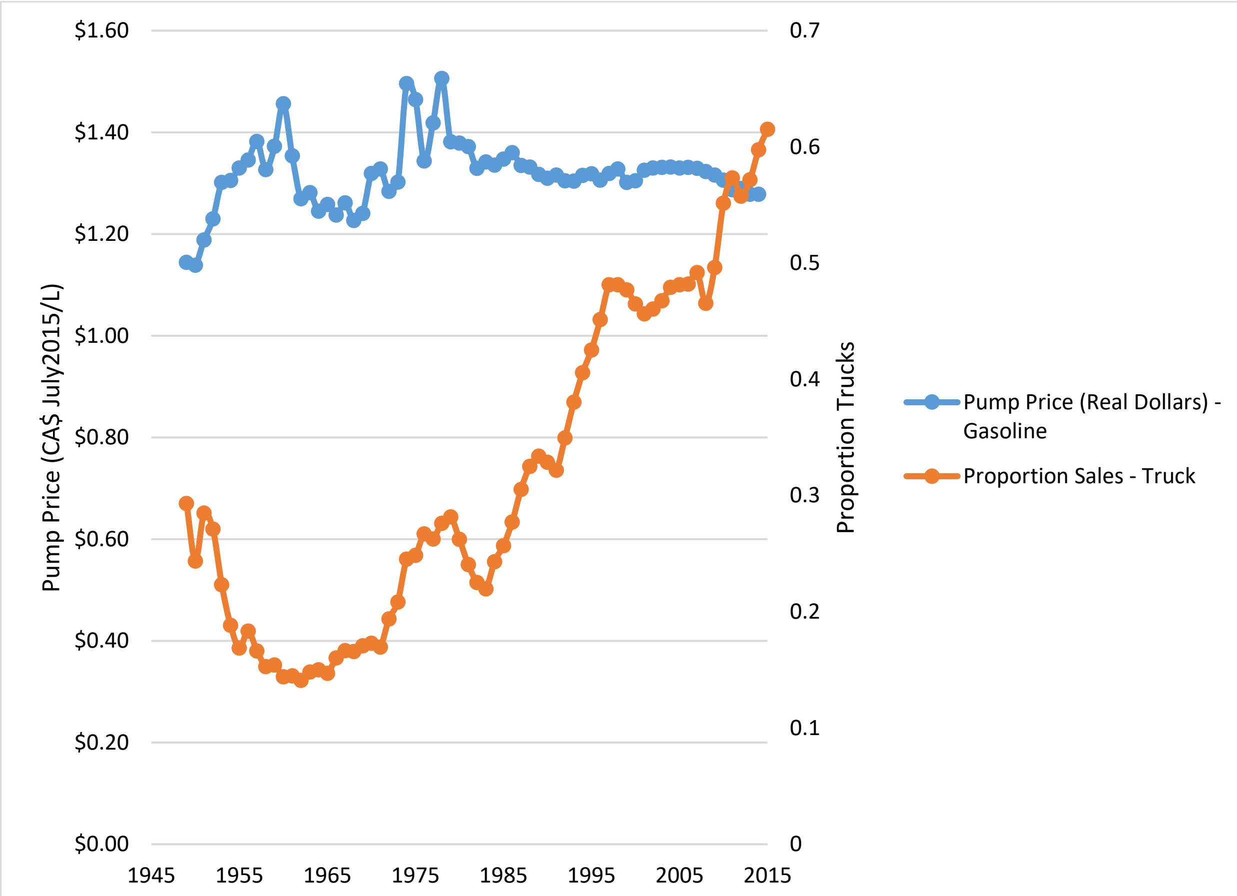

Figure 4: Time Series of Real Dollar Pump Price and New Trucks as Proportion of Total Vehicle Sales

By plotting the proportion of total vehicle sales comprised by trucks against the real price of gasoline, we can develop a relationship between the price consumers face at the pump and their willingness to purchase trucks for personal use. A stronger representation can be developed by plotting monthly data and separating gasoline and diesel prices as diesel fuel is more often used by larger, commercial vehicles. Monthly data was seasonally adjusted using the X-13ARIMA-SEATS program developed by the United States Census Bureau. Un-adjusted sales of trucks increase as a proportion of sales in the winter because consumers often purchase these vehicles for their utility in snow. Data were plotted for the last 10 years (2005-2015) so as to minimize the effects of exogenous variables (i.e. higher fuel efficiencies of trucks since their early development, changes in tariff structures, or other factors producing variation in the relative price to passenger vehicles). This is shown in Figure x. The data produce a reasonable value of elasticity of consumers to changes in pump prices. Diesel-powered trucks purchases show no observable elasticity to the price of fuel, confirming the assumption that majority of these vehicles are likely used for commercial purposes, for which a passenger vehicle would be unsuitable. Gasoline-powered truck purchases show a higher elasticity to fuel price and stronger fit with a linear model. The model suggests that a 1 cent increase in the real price of gasoline will produce a 1.8% decrease in truck sales as a proportion of overall sales. The potential for a lag between the change in pump prices and purchasing patterns was explored. It was found that a slight increase in the fit was possible by lagging purchasing data by up to 3 months (R2 = 0.6236), at which point the fit decreased dramatically. This suggests that truck sales will react within 3 months of an increasing price for gasoline, beyond which sales will begin to react to more recent trends in the price.

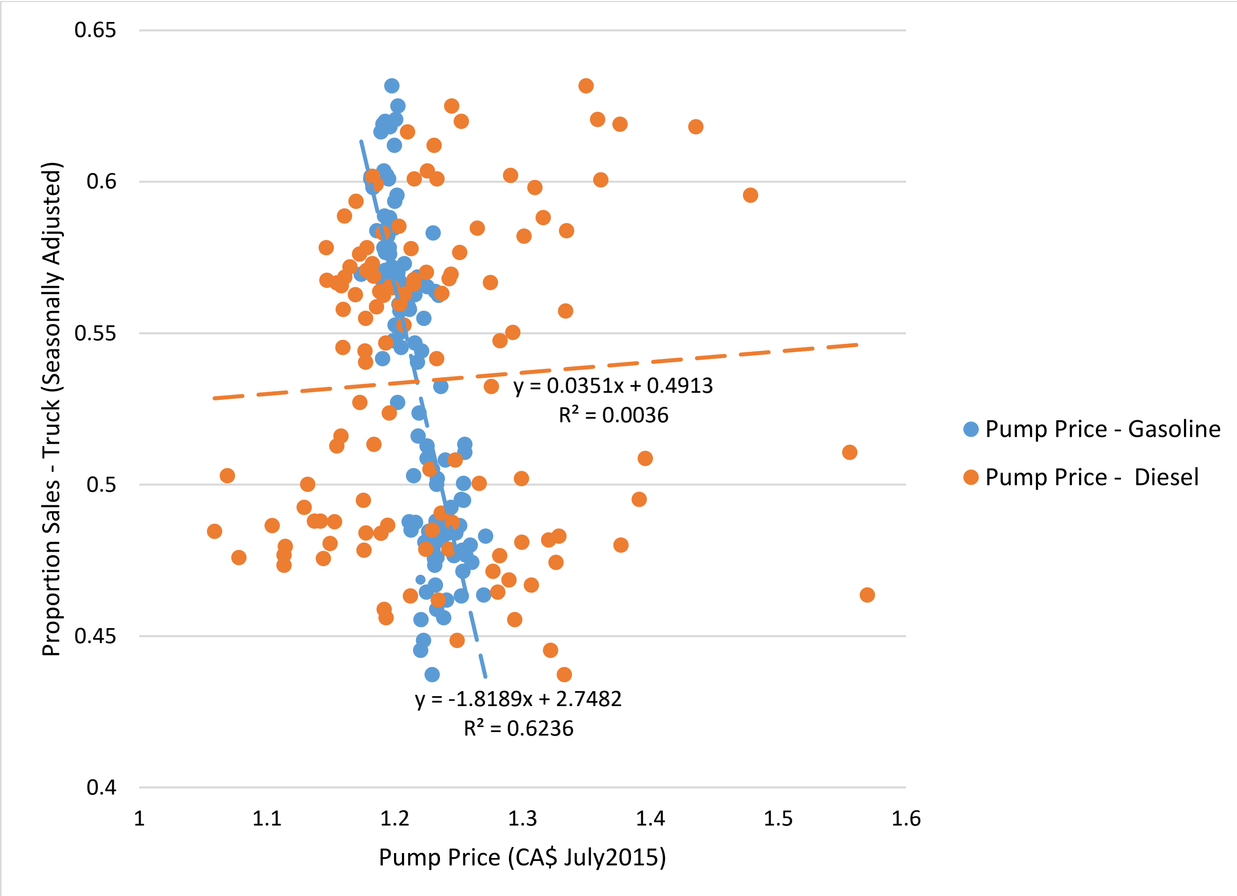

Figure 5: Seasonally Adjusted Truck Sales and Real Pump Price (Monthly August 2005 to July 2015)

This sensitivity can be partially attributed to a deviation in the CPI for gasoline from the CPI for all products since 2001. This relationship is illustrated in Figure 6. Historically the inflation for gasoline has tracked with the overall economy, but has recently seen a rapid increase. The CPI for gasoline was used in the normalization process to represent the differential change in real prices of gasoline faced at the pump and the change in purchasing power of consumers over the same period.

4 Vehicle Fuel Efficiency and Price

We can compare the direct costs of various types of vehicles based on the purchasing cost and average fuel cost.

Table 1: Fuel Efficiency of Top Selling Personal Vehicles: 2014

Vehicle Model	Vehicle Class	Fuel Efficiency (L/100km) in City	Sales (June 2014 YTD)	Seating Capacity
Ford F-Series	Large	13.8	59,350	5
Ram P/U	Large	11.8	43,926	5
Honda Civic	Small	7.6	30,696	5
Hyundai Elantra	Small	8.4	26,936	5
Dodge Grand Caravan	Midsize	13.8	26,555	7
Toyota Corolla	Small	8.1	25,545	5
Ford Escape	Midsize	10.7	25,318	5
GMC Sierra	Large	13.1	22,032	5
Mazda 3	Small	7.8	20,831	5
Chevrolet Silverado	Large	13.1	19,039	5
Chevrolet Cruze	Small	8.7	17,335	5
Honda CR-V	Midsize	8.7	16,774	5
Volkswagen Jetta	Small	7.6	16,439	5
Toyota RAV4	Midsize	10.2	16,124	5
Hyundai Santa Fe Sport	Midsize	12.4	14,066	5
Nissan Rogue	Midsize	9.0	13,887	5
Dodge Journey	Midsize	14.7	12,532	5
Ford Focus	Small	8.1	11,789	5
Jeep Wrangler	Midsize	13.8	11,476	5
Hyundai Accent	Small	8.7	11,445	5

Table 2: Fuel Efficiency of Most Efficient Vehicle Models: 2014

Class Rank	Vehicle Model	Vehicle Class	Fuel Efficiency (L/100km) in City	Seating Capacity
1	Mitsubishi Mirage	Small	6.4	5
2	Scion iQ	Small	6.5	5
3	Honda Fit	Small	7.1	5
4	BMW 328d	Small	7.4	5
5	Volkswagen Jetta	Small	7.6	5
6	Ford Fiesta	Small	7.6	5
7	Volkswagen Passat	Small	7.6	5
8	Audi A3	Small	7.6	5
9	Volkswagen Golf	Small	7.6	5
10	Honda Civic	Small	7.6	5
1	BMW X5	Midsize	8.7	5

2	Honda CR-V	Midsize	8.7	5
3	Nissan Juke	Midsize	8.7	5
4	Mazda CX-5	Midsize	9.0	5
5	Chevrolet Trax	Midsize	9.0	5
6	Subaru XV Crosstek	Midsize	9.0	5
7	Nissan Rogue	Midsize	9.0	5
8	Buick Encore	Midsize	9.4	5
9	Subaru Forester	Midsize	9.8	5
10	Mercedes-Benz GLA250	Midsize	9.8	5
1	Ford Ranger	Large	10.7	5
2	Toyota Tacoma	Large	11.2	5
3	Ram 1500	Large	11.8	5
4	Nissan Frontier	Large	12.4	5
5	Suzuki Equator	Large	12.4	5
6	GMC Sierra	Large	13.1	5
7	Chevrolet Colorado	Large	13.1	5
8	GMC Canyon	Large	13.1	5
9	Chevrolet Silverado	Large	13.1	5
10	Ford F150	Large	13.8	5

- The safest small cars, the Volkswagen Jetta and Honda Civic, were shown to be twice as safe as the comparably sized Chevrolet Cavalier, Ford Escort, and Dodge Neon.
- **http://www.iihs.org/iihs/news/desktopnews/new-crash-tests-demonstrate-the-influence-of-vehicle-size-and-weight-on-safety-in-crashes-results-are-relevant-to-fuel-economy-policies**

Vehicle Name	Capital Cost	Fuel Efficiency (L/100km)	Annual Drive	Fuel Cost (as of August 25, 2015) ($/L)	Total Annual Fuel Cost ($)	
Civic Sedan	$ 15,750.00	7.6	20000	1.141	$ 1,734.32	
Hyundai Elantra	$ 15,749.00	8.4	20000	1.141	$ 1,916.88	
Ford F-150	$ 26,805.00	13.8	20000	1.141	$ 3,149.16	
Mitsubishi Mirage	$ 12,498.00	6.4	20000	1.141	$ 1,460.48	
BMW 328	$ 38,450.00	7.4	20000	1.141	$ 1,688.68	
Toyota Tacoma	$ 25,385.00	11.2	20000	1.141	$ 2,555.84	
Toyota Hylux	$ 25,987.61	11.7	20000	1.141	$ 2,669.94	
					Annual Fuel Cost F150/Civic	1.8

6 Conclusions

References

[1] S. E. Polzin, A. E. Pisarki, B. Spear, and L. Long, “Commuting in America 2013,” 2013.

[2] “automobile,” *Merriam-Webster Dictionary*. .

[3] “truck,” *Merriam-Webster Dictionary*. .

[4] Bureau of Transportation Statistics, “Highlights of the 2001 National Household Travel Survey,” 2001.

[5] K. M. Kockelman, “Behavioral Distinctions: The Use of Light-Duty Trucks and Passenger Cars,” *Journal of Transportation and Statistics*, vol. 3, no. 3, pp. 47–60.

[6] K. M. Kockelman, “To LDT or Not to LDT: An Assessment of the Principal Impacts of Light-Duty Trucks,” *Transportation Research Record*, no. 1738, pp. 3–10, 2000.

[7] E. Peters, “The Chicken Tax,” *Washington Examiner*, 10-Jul-2015.

[8] K. Campbell, “Death to the ‘chicken tax’: Five trucks to look out for after the Trans-Pacific Partnership takes effect,” *New York Daily News*, 05-Oct-2015.

[9] M. Ross and T. Wenzel, “An Analysis of Traffic Deaths by Vehicle Type and Model,” 2002.

[10] Statistics Canada, “Table 326-0009 - Average retail prices for gasoline and fuel oil, by urban centre, monthly (cents per litre),” *CANSIM (database)*. [Online]. Available: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=3260009&&pattern=&stByVal=1&p1=1&p2=37&tabMode=dataTable&csid=.

[11] Statistics Canada, “Table 326-0020 - Consumer Price Index, monthly (2002=100 unless otherwise noted),” *CANSIM (database)*. [Online]. Available: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=3260020&&pattern=&stByVal=1&p1=1&p2=38&tabMode=dataTable&csid=.

[12] Statistics Canada, “Table 079-0003 - New motor vehicle sales, Canada, provinces and territories, monthly,” *CANSIM (database)*. [Online]. Available: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=790003.

[13] U.S. Energy Adminstration Information, “Gasoline and Diesel Fuel Update,” 2015. [Online]. Available: http://www.eia.gov/petroleum/gasdiesel/.

[14] M. Frigon, “Gasoline Prices and the Impact on Demand,” 2007.

[15] Canadian Forex, “Historical Exchange Rates,” 2015. [Online]. Available: http://www.canadianforex.ca/forex-tools/historical-rate-tools/historical-exchange-rates.

[16] Bank of Canada, “Inflation Calculator,” 2015. [Online]. Available: http://www.bankofcanada.ca/rates/related/inflation-calculator/.

[17] B. Dunn, “Gasoline Prices 421 Per Cent Higher Than in 1965,” *Montreal Gazette*, 1985.

[18] MJ Ervin & Associates, “Rising Retail Fuel Prices: An Analysis,” 2012.

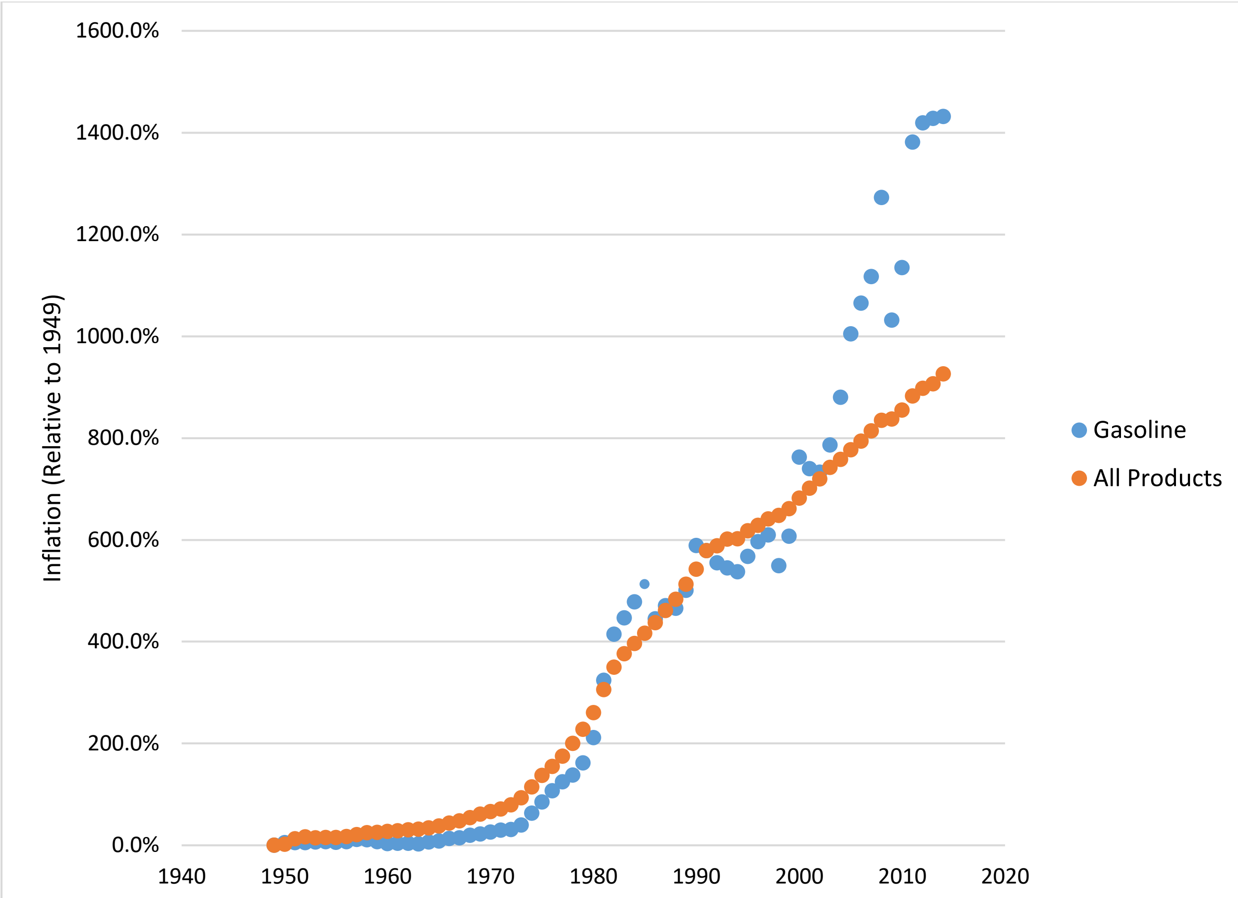

Figure 6: Time Series of Inflation for All Products and Gasoline Relative to 1949

Figure 7: Residuals Plot for Pump Price

Presidential Proclamation 3564 – "Proclamation Increasing Rates of Duty on Specified Articles – colloquially referred to as the "chicken tax", was a retaliatory measure against France and West Germany in response to a tariff on American chickens. In addition to tariffs on potato starch and brandy, it places a 25% tariff on the import of light duty trucks. This decreases competition and restricts the availability of, often smaller and more efficient, European and Asian manufactured trucks. Toyoto has sold over 16 million of its compact HiLuxes, but most North Americans have not even heard of this vehicle model and domestic manufactures – GM, Ford, and Chrystler – see no incentive to develop competing models. This may change with the passing of the Trans-Pacific Partnership, which contains measures to roll back the tariff over a period of several years. http://www.washingtonexaminer.com/the-chicken-tax/article/2567876

According to classical economic theory we should be averse to the purchase of these vehicles, which generally have higher purchasing and operating costs. Examining the data, we can see that the top two vehicles purchased in Canada are pickup trucks (Table 1) and pickups account for four of the top twenty vehicle models sold. Somehow, we have become enthralled by the image conveyed by ownership of a pickup truck. This image is exemplified in the “urban cowboy”. This is a person who idealizes the country, down-to-earth, feel of driving a truck; however, they are typically a school teacher or office worker who uses the truck mainly for daily commuting and personal trips. They purchase a truck for the movement of couches and other household items, but rarely – if ever – use it for this purpose.

Starr (ref) discusses the importance of examining multiple markets to assess the underlying drivers of changing vehicle markets in his introduction to general equilibrium theory. In early 2005, sales of SUVs were a strong revenue source for U.S. auto manufacturers. This rapidly changed as the year progressed and through the following years. From mid-2005 to mid-2008, ownership shares in GM fell by 75% and those for Ford fell by 80% as sales of high-profit SUV lines dropped precipitously. These dramatic drops in revenue showed little correlation with the management or manufacturing of vehicles. The driving reason for this loss in revenue resulted from higher nominal prices for oil. SUV sales dropped, as consumers shifted to purchasing more fuel-efficient cars – predominantly from foreign manufacturers.
https://books.google.ca/books?id=t9pSAlEMyDYC&pg=PA4&lpg=PA4&dq=general+equilibrium+oil+2005+2008&source=bl&ots=eqShL3f101&sig=zGdsuU7kE_WTabgmKFRDLzU-2Gk&hl=en&sa=X&ved=0CCEQ6AEwAGoVChMIo6iA1riVyAIVCDuICh1aSA8_#v=onepage&q=general%20equilibrium%20oil%202005%202008&f=true