CALIFORNIA POLICY BRIEFING MEMO

YEARLY AND SEASONAL PRICE VOLATILITY OF GASOLINE AND DIESEL IN CALIFORNIA AND THE EFFECT OF STATEWIDE FUEL POLICIES (C&T AND LCFS)

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I. Introduction

Like elsewhere in the U.S., California drivers are subjected to yearly and annual fluctuations in prices at the pump. However, since California uses more fuel than any other state, emits more transportation pollution than any other state, and already experiences some of the highest fuel prices in the nation, the Golden State has a lot at stake when it comes to smoothing out gasoline price volatility and avoiding further drastic price increases.

California is taking action on fuel prices and fuel volatility through the combined implementation of the AB32 cap-and-trade program (C&T) and Low Carbon Fuel Standard (LCFS), alongside a series of complementary policies. As these programs mature, strong investment and innovation signals will result in fuel diversification (i.e., decreasing reliance on a single fuel source), yielding reduced fuel price volatility. Removing the investment and innovation signals accruing from these regulations will only serve to protect the status quo – a volatile fuel system that lacks diversity.

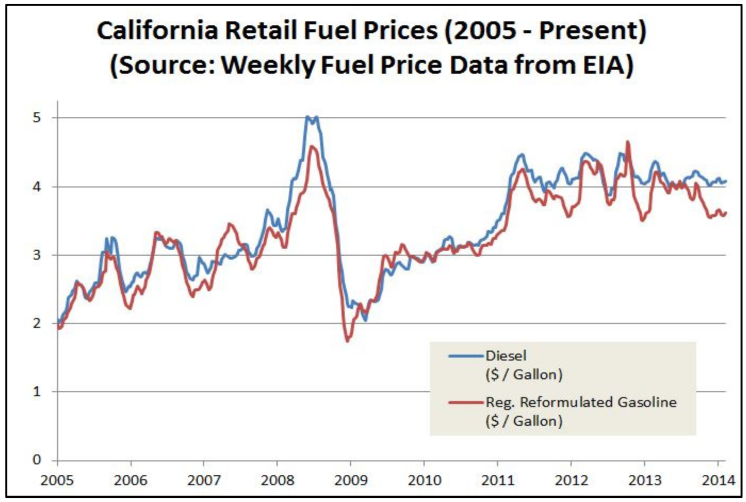
Gasoline			
Maximum Retail Price[i] (2005 – present) $ 4.69 / gallon (Oct 8, 2012)	Average Yearly Maximum Retail Price (2005 – present) $ 3.77 / gallon	Overall Average Retail Price (2005 – present) $ 3.26 / gallon	Average Yearly Variability in Retail Prices (2005 – present) $ 1.16 / gallon
Diesel			
Maximum Retail Price[ii] (2005 – present) $ 5.03 / gallon (May 26, 2012)	Average Yearly Maximum Retail Price (2005 – present) $ 3.88 / gallon	Overall Average Retail Price (2005 – present) $ 3.43 / gallon	Average Yearly Variability in Retail Prices (2005 – present) $ 1.01 / gallon

While much of California's fuel price variability is caused by fluctuations in crude oil prices and impacted by situations well beyond the state's control, a significant contributor to fuel price variability is the continued overreliance on a single fuel type: gasoline and diesel refined from crude oil. This overreliance has been documented to cost the U.S. as much as $500 billion in some years, and more than $2 trillion from 2007-2011.[iii] By diversifying the state's fuel mix with a portfolio of fuels, California's overall fuel price volatility and price levels (i.e. from all fuels in the portfolio) are likely to be reduced in the long run. By extension, policy changes that undermine or take away incentives to diversify the fuel mix are bad for California consumers, the economy, and the environment.

II. California Fuel Price Volatility

Similar to the rest of the U.S., the price of the dominant vehicle fuels in California (gasoline and diesel) fluctuates on both a yearly and annual seasonal basis (Figure 1). While the timing of California's seasonal volatility is somewhat regular, the magnitude and duration of the price fluctuation are not. When coupled with yearly volatility, the magnitude of seasonal fuel price variability in California is considered unpredictable, and is responsible for some economic uncertainty and retarded growth.[v]

Figure 1: Weekly California Gasoline and Diesel Prices[iv]



Without a significant change in the supply and demand patterns of transportation fuel over the next several decades, California can expect similar yearly and annual seasonable fluctuations in prices at the pump. From EIA data, since 2005 – the year when retail gasoline prices broke through the $2 / gallon level, the average seasonable fuel price fluctuation has been $1.16, with a maximum fluctuation of $2.85 in 2008 (Table 1).

Table 1: Seasonal Price Fluctuations (2005 – Present)[vi]

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
Minimum gasoline price ($/gallon)	1.93	2.21	2.49	1.74	1.87	2.92	3.31	3.51	3.55	2.61
Maximum gasoline price ($/gallon)	3.06	3.33	3.46	4.59	3.15	3.29	4.26	4.66	4.21	3.77
Price fluctuation ($/gallon)	1.12	1.12	0.97	2.85	1.28	0.37	0.95	1.15	0.67	1.16

III. Effects of Large Scale Fuel Price Volatility in the Current Fuel System

Since the turn of the 21st century, the volatility in gasoline prices causing price "spikes" has become increasingly common – with steep price spikes generally followed by more gentle declines.[vii] The unpredictable nature and aggregate price increase associated with this volatility is documented to harm the entire macroeconomy and is thought to have been a factor in both the 2001 and 2008 economic recessions (as well as the major recessions in the 1970s and 1980s). Economic researchers[viii] have found that oil price volatility is robustly negatively correlated with economic growth and also that corporate stock prices respond inversely to increased price volatility of petroleum products.[ix x]

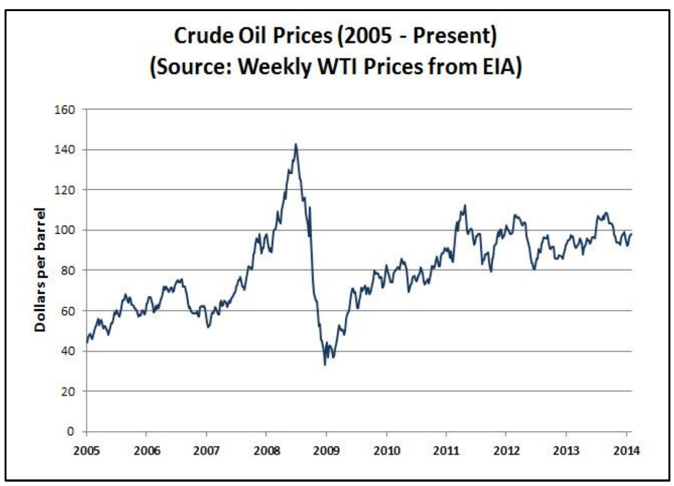
Similar to research related to the economy-wide impact of gasoline prices, significant attention has been devoted to the subject of how consumers respond to changes in gasoline and diesel prices[xi] – and thus the environmental impact of higher fuel prices.[xii] According to research from UC Davis, consumers are less likely to respond to increases in fuel prices when the overall price is highly volatile.[xiii] Accordingly, consumer responses like purchasing fuel efficient vehicles, carpooling, taking mass transit, and even living closer to work (all of which are documented behavioral changes in response to high gas prices) may be affected by fuel price volatility. These changes, since they result in reduced consumption of gasoline and diesel, yield a reduction in the associated costs of driving, including environmental costs (both local air quality and greenhouse gas), road congestion and accidents, and fuel insecurity.

IV. Reducing Fuel Price Volatility by Creating a Diverse Mix of Fuels (The Portfolio Effect)

According to evidence from fuel and energy markets world-wide, markets characterized by a diverse portfolio of products will mitigate the impact of price shocks better than highly concentrated markets.[xiv] The development of a diverse array of consumer options in the aggregate reduces reliance on any one product, allowing substitution among products, and blunting any price shocks that occur due to fluctuations in that product.[xv] This in effect yields an overall supply that is more responsive to any possible demand shock, reducing the effect on prices.

One clear example of the benefit of diversifying the California fuel mix is that fluctuating crude oil prices will have a smaller impact on prices at the pump. As illustrated in Figure 2, prices of crude oil (which are very highly correlated with retail fuel prices) can vary widely.

Figure 2. Weekly Crude Oil Prices



Through incentives established by state policies like the LCFS and C&T, and the federal renewable fuel standard, the use of alternative fuels in California, such as liquid biofuels, natural gas, electricity, and hydrogen, have recently grown. California has more than doubled the proportion of alternative fuels, from approximately 3% of the state's fuel mix in 2007 to nearly 8% in 2014.[xvi] This increasing penetration of alternative fuels is expected to continue, reaching between 11.3% and 18.8% of the state's fuel mix by 2020.[xvii] By creating a more diverse portfolio of fuels for consumers to choose in the aggregate, long-run price variability is expected to decline.

V. Conclusion

By diversifying the state's fuel mix with a portfolio of alternative and conventional fuels, California's overall fuel price volatility and price levels (for all fuels in the portfolio) are likely to be reduced in the long run. This reduction in fuel price volatility can help to mitigate the environmental externalities associated with fuel consumption by improving the responsiveness of consumers to price increases in the long run.

REFERENCES

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[i] All data on gasoline prices are collected from the US Energy Information Agency, *available at*: http://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_sca_w.htm

[ii] All data on diesel prices are collected from the US Energy Information Agency, *available at*: http://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_sca_w.htm

[iii] Greene, "Low Carbon Transportation, A Crucial Link to Economic and Energy Security", (September 2012) *available at:* http://www.arb.ca.gov/research/lectures/speakers/greene/greene.pdf

[iv] Although using weekly data will smooth out some variations associated with daily prices, weekly prices are the lowest level of granularity publically accessible from the US Energy Information Agency website, and differences associated with long-term volatility are negligible when compared to daily prices.

[v] Vedenov, Duffield and Weitzstein, Entry of Alternative Fuels in a Volatile U.S. Gasoline Market, Journal of Agricultural and Resource Economics 3 l(1): 1-13 (2006)

[vi] Fuel price data presented in nominal prices, not adjusted for inflation. If real prices were displayed the overall variability would remain the same since both the minimum and maximum prices would be adjusted by the same amount.

[vii] Radchenko, Oil price volatility and the asymmetric response of gasoline prices to oil price increases and decreases, Energy Economics 27: 708–730 (2004), *also see* Borenstein, Cameron and Gilbert, Do Gasoline Prices Respond Symmetrically to Crude Oil Price Changes?, The Quarterly Journal of Economics 112: 305-339 (1997)

[viii] Kneller and Young, Business Cycle Volatility, Uncertainty, and Long-Run Growth, Manchester School, Special Issue, 69:534-552.(2001), *also see* Vedenov et al, supra note vii.

[ix] Sadorsky, Oil Price Shocks and Stock Market Activity, Energy Economics 21:449-469 (1999)

[x] Some economics literature points out that the Federal Reserve responds to fuel price increases to help prevent inflationary pressure from growing. Accordingly, some of the macroeconomic impact from fuel price increases is driven by Federal Reserve response rather than the fuel price effect itself.

[xi] Li, Linn and Muehlegger, "Gasoline Taxes and Consumer and Behavior" Harvard Kennedy School of Government Faculty Research Working Paper Series, RWP12-006 (February 2012), *available at*: www.hks.harvard.edu

[xii] Lin and Prince, "Gasoline price volatility and the elasticity of demand for gasoline" (2009), *available at:* http://www.des.ucdavis.edu/faculty/Lin/gas_price_volatility_paper.pdf

[xiii] Id.

[xiv] Zhang, Lohr, Escalante and Weitzstein, Mitigating Volatile U.S. Gasoline Prices and Internalizing External Costs: A Win-Win Fuel Portfolio, Amer. J. Agr. Econ. 90, No. 5: 1218–1225 (2008)
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[xvi] California Energy Commission, Integrated Energy Policy Report (2013), *available at:* http://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-CMF.pdf

[xvii] Spiller, Mason and Fine, "California Policy Briefing Memo – Motor Vehicle Fuel Diversification
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