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Gasoline taxes and revenue volatility: An application to California ☆

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HIGHLIGHTS

- We examine how gasoline taxes affect government revenue volatility.
- We simulate the impact of California's Gasoline Tax Swap policy.
- Sales taxes are shown to magnify price volatility and government revenue volatility.
- A pure excise tax policy results in less volatile fuel prices and state revenues.
- We argue that reductions in both forms of volatility are welfare enhancing.

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ABSTRACT

This paper examines how applying different combinations of excise and sales taxes on motor fuels impact the volatility of retail fuel prices and tax revenues. Two features of gasoline and diesel markets make the choice of tax mechanism a unique problem. First, prices are very volatile. Second, demand for motor fuels is extremely inelastic. As a result, fuel expenditures vary substantially over time. Tying state revenues to these expenditures, as is the case with a sales tax, results in a volatile stream of revenue which imposes real costs on agents in an economy. On July 1, 2010, California enacted Assembly Bill x8-6, the "Gas Tax Swap", increasing the excise tax and decreasing the sales tax on gasoline purchases. While the initial motivation behind the revenue neutral swap was to provide the state with greater flexibility within its budget, we highlight that this change has two potentially overlooked benefits; it reduces retail fuel price volatility and tax revenue volatility. Simulating the monthly fuel prices and tax revenues under alternative tax policies, we quantify the potential reductions in revenue volatility. The results reveal that greater benefits can be achieved by going beyond the tax swap and eliminating the gasoline sales tax entirely.

1. Introduction

While an extensive literature examines the optimal level of automobile fuel taxation (Haughton and Sarkar, 1996; Fullerton and West, 2002; Parry and Small, 2005; Parry et al., 2007, and Lin and Prince, 2009), very little attention has been paid to the type of tax mechanism that should be used to achieve a given target level. In practice, the structure of gasoline and diesel taxes has grown increasingly diverse over the past several decades. Many U.S. states and E.U. member countries now levy a combination of per unit (excise) taxes as well as ad valorem (sales or value added) taxes on the purchases of gasoline and diesel fuel.[1] Despite the wide array of tax structures from which to choose, there is little guidance available to policymakers on the costs and benefits of these different kinds of fuel taxes.

In this paper, we examine how different combinations of excise and sales taxes, when levied on gasoline and diesel, affect two key outcomes: (1) the volatility of monthly retail fuel prices and (2) the resulting volatility of government revenues. Fluctuations in either retail prices or in government revenues can impose real costs on agents in an economy. For example, risk averse households faced with volatile fuel prices are effectively exposed to welfare reducing uncertainty in their disposable income. Additionally, governments constrained by balanced budget requirements or high borrowing costs may be forced to make costly expenditure adjustments during temporary revenue shocks.

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[1] Ang-Olsen et al. (1999) provide a comprehensive overview of early state experience with variable rate gasoline taxes.

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Our analysis focuses specifically on the state of California, which recently implemented substantial changes to its fuel tax structure. We simulate the counterfactual retail fuel prices and state revenues that would have resulted under a pure excise tax policy, as well as under the different combinations of excise and sales taxes used in California in recent years. The results demonstrate that, relative to policies levying sales taxes on fuel expenditures, pure excise tax policies provide a slight reduction in the volatility of retail fuel prices and a substantial reduction in the volatility of fuel tax revenues.

There are two key reasons why gasoline and diesel are different from other consumer goods subject to sales taxes. First, gasoline and diesel prices are extremely volatile. Second, demand for gasoline and diesel is very inelastic in the short-run. As a result, consumers' expenditures on gasoline and diesel vary substantially over time as fuel prices fluctuate. A sales tax, which effectively multiplies fuel prices by a factor greater than one, exacerbates the retail price swings to which consumers are exposed. In addition, a sales tax ties government revenues to these volatile fuel expenditures, resulting in a volatile stream of revenue which can result in inefficient provision of public goods. In contrast, excise taxes are an added flat fee per gallon which does not amplify retail price volatility. Additionally, because consumption varies so little in response to short-run fuel price movements, an excise tax provides a smoother stream of government revenue.

California is an interesting case study for this analysis given that it has recently changed the structure of its fuel taxes. On July 1, 2010, the state enacted Assembly Bill x8-6, the “Gas Tax Swap”. This tax change increased the state excise tax on gasoline purchases from 18 to 35.3 cents per gallon and decreased the state sales tax on gasoline expenditures from 8.25% to 2.25%. The initial motivation behind the policy change was to provide the state with greater flexibility within its budget; reducing the amount of revenues earmarked for transportation spending while remaining revenue neutral in the long-run.[2] However, we point out that this policy change has had two largely overlooked benefits; it reduces both retail fuel price volatility as well as fuel tax revenue volatility.

Our simulation results reveal that, had the Gas Tax Swap been implemented 3 years prior to its actual starting date, the spread between the minimum and maximum retail gasoline prices experienced would have fallen by 4% over this time period. Additionally, the standard deviation of the monthly fuel tax revenue would have been reduced by 30%. However, we demonstrate that even greater reductions in volatility can be achieved by going beyond the Gas Tax Swap and eliminating the sales tax on fuel expenditures entirely. Over the same 3 year period, a pure excise tax policy, generating the same total revenue, would have reduced the range of retail gasoline prices by 8% and decreased the standard deviation of monthly fuel tax revenues by 59%.

While our analysis focuses specifically on the impact of fuel taxes in California, the general results are much more widely applicable. Outside of California, currently 11 other states levy a sales tax on gasoline expenditures. In addition, with the exception of the U.S., every other OECD member currently imposes an ad valorem tax on gasoline.[3] Our results demonstrate that there is considerable scope for changes in these tax structures to reduce the volatility in the resulting retail prices and the fuel tax revenue streams.

The remainder of this paper proceeds as follows. Section 2 discusses the sources of retail fuel price volatility and the resulting impact on total fuel expenditures. Section 3 describes the structure of California's fuel tax policy. Specific attention is paid to the revenue generated by fuel taxes and the resulting impact on revenue volatility. Section 4 explains the methodology we use to simulate the alternative fuel tax policies and Section 5 presents the results and discusses further considerations. Section 6 concludes.

2. Fuel prices and consumer gasoline expenditures

2.1. Fuel price volatility

Gasoline and diesel price volatility stems from multiple sources. Shifts in supply and demand at the state and local levels account for a portion of the variation in these prices. For example, Chouinard and Perloff (2007) show seasonal shifts in driving patterns and stricter environmental regulations tend to increase prices during the summer months. Further research by Noel (2007) uncovers price cycles driven my monopolistic competition at the local level. However, the majority of retail gasoline and diesel price volatility stems from fluctuations in the price of their primary input, crude oil. A simple regression of the monthly average retail fuel prices in California on the monthly average oil price over the period from January, 2001 through December, 2010 reveals that 92% of the variation in gasoline prices, and 96% of the variation in diesel prices, is explained by the variation in crude oil prices.[4]

Fluctuations in the world demand for oil, coupled with frequent supply disruptions, generate large and persistent swings in oil prices. For example, during 2008, the average monthly spot price for a barrel of oil peaked at $145 in July. By December, 2008, the average price fell to $30/barrel. Examining historical oil prices, Hamilton (2009) concludes that price changes have been both permanent and difficult predict. Driven by these unpredictable swings in oil prices, gasoline and diesel prices have earned a reputation for being notoriously volatile and difficult to forecast.

While oil prices, and therefore gasoline and diesel prices, are prone to large fluctuations, consumption of gasoline and diesel is very stable. A household's demand for gasoline and diesel is largely driven by long-run decisions such as choice of vehicle, location of residence, and location of employment. As a result, consumers are often unable to respond significantly to swings in monthly fuel prices. Hughes et al. (2008) estimate the short-run price elasticity of gasoline demand using monthly, aggregate U.S. data and find values ranging between −0.034 and −0.077.[5] Following the authors' estimation strategy, in Appendix we present estimates of the monthly price elasticity of demand for both gasoline and diesel in California. The point estimates from our sample period, the beginning of 2001 through the end of 2010, are elasticities of −0.056 for gasoline and −0.034 for diesel.

2.2. Expenditure volatility

Combining consumer's very inelastic demand for fuel with volatile fuel prices results in large swings in the share of

[2] Proposition 42, passed March 5, 2002 by a 69–31% margin, requires sales taxes collected on motor fuel to be spent exclusively on transportation projects. Although one goal of the swap was budget flexibility, voters approved two ballot initiatives during the November 2010 election which re-established the link between fuel revenues and transportation spending.

[3] The OECD average value added tax (VAT) on gasoline is 18.13%. See OECD (2012) for details.

[4] The Energy Information Administration provides data on the average retail prices of gasoline and diesel at the state level as well as the daily spot price for oil delivered to Cushings, TX. The general finding that oil prices drive gasoline prices has been shown to hold more broadly by many authors (for example, see Chouinard and Perloff, 2007).

[5] Espey (1998) provides a review of the early literature on the price elasticity of demand for gasoline.