



Tax incidence with endogenous quality and costly bargaining: Theory and evidence from hybrid vehicle subsidies[☆]



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ABSTRACT

Endogenous quality and bargaining are important features of many markets but are typically omitted from studies of incidence. We develop a model with product upgrades and costly bargaining and find that tax rate pass-through only partially characterizes the welfare impact of taxation; consumers may respond to a tax or subsidy by changing product quality or by changing their bargaining effort. We apply the insights of our theory to the study of subsidies for green goods, specifically hybrid electric vehicles in Canada. We utilize highly detailed transaction data and leverage panel variation in subsidies across provinces for identification. Our baseline estimate finds that prices rises by \$570 for every \$1000 increase in the subsidy. But, this pass-through estimate substantially underestimates consumer gains because a majority of this price increase (\$459–≈ 80%) is due to increased product quality in the form of additional options and features.

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1. Introduction

Incidence is one of the foundational topics of public economics. When a tax, subsidy or implicit price wedge is added to a market, who bears the burden? We revisit this question so as to better understand the welfare implications of tax subsidies for energy-efficient automobiles. To accurately characterize the welfare impacts of subsidies in the automobile market, we argue that it is necessary to incorporate two considerations normally omitted from theoretical and empirical incidence studies—endogenous product quality and costly price negotiation. We show theoretically that the presence of either factor modifies the welfare interpretation of incidence;

pass-through rates are not sufficient statistics for measuring changes in consumer surplus from marginal tax changes. We show empirically that these factors are quantitatively important for the study of automobile subsidies; incorporating these concerns raises our estimate of consumer welfare gains by at least 50%.

Our study focuses on subsidies for green goods, though our results have wider implications. Concerns ranging from energy security to climate change have led governments to promote energy efficient appliances and vehicles using financial incentives. These incentives take a variety of forms, including cash rebates, income tax credits, sales tax rebates, and subsidized loans.¹ In general, incidence is important for the design and evaluation of policies to the extent that policymakers weigh benefits to consumers differently than increased

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¹ Gillingham et al. (2006), Allcott and Greenstone (2012) and Rivers and Jaccard (2011) provide overviews of financial incentives adopted by American and Canadian governments and utilities as part of Demand Side Management programs which began in the 1970s, as well as more recent incentive programs; for specific incentive programs see also Allcott and Greenstone (2012), Chandra et al. (2010), Sallee (2011), Datta and Gulati (2014), and Benneer et al. (2011).

profits accruing to the owners of firms. For green subsidies in particular, incidence is central because the subsidies are often sold to voters as improving the environment while benefitting consumers.

In standard tax incidence models, the pass-through rate (the derivative of final price with respect to the tax wedge) is a sufficient statistic for assigning burden for marginal changes. These models, however, leave out two features essential to automobile purchases. First, a subsidy may induce upgrading: consumers may add features and options to their vehicle. Standard models that ignore upgrading, or that over-control for it by comparing only identical products, understate consumer gains by ignoring valuable quality improvements. Second, automobile prices are determined in a bilateral bargaining process involving real resource costs only to determine a transfer. If a subsidy lowers the amount of bargaining that takes place, there are additional welfare benefits not embodied in the price.

Our empirical study concerns hybrid electric vehicles (HEVs), but many other markets have one or both of these features. Many durable goods—including automobiles, appliances, housing, or consumer electronics—and many services—like health or child care—have quality dimensions. Automobiles and recreational vehicles, housing and home renovations, furniture and even cosmetic surgery are subject to bilateral negotiations between buyers and sellers. Our analysis suggests a need for caution in interpreting pass-through rates to determine incidence in these markets.

Our analysis begins by deriving a theoretical model in which a consumer buying a durable good chooses a level of quality for that good and negotiates the final price with the seller. We then introduce a subsidy, which can take the form of a reduction in an existing ad valorem tax, or as a lump-sum rebate. The model predicts that a tax reduction will affect transactions through both income and substitution effects. The substitution effect is straightforward: the reduction in the sales tax lowers the price of the good as well as any options installed at the time of purchase, inducing consumers to buy more options. Either a rebate or a sales tax reduction will also create income effects: the consumer uses her rebate to buy more normal goods, including upgrades to the product. Less haggling, in turn, translates to higher profits (margins) per unit. Collectively, our model suggests that subsidies raise transaction prices, the value of options purchased, and seller margins. Importantly, because of upgrading, price increases will exceed profit increases. We note also that, in the absence of liquidity constraints or mental accounting, we would expect the substitution and especially the income effects to be small, which makes the empirically large responses we find especially interesting.

We test the model's predictions using data regarding 9661 individual HEV transactions in Canada from 2004–2009. The data include exhaustive information on the vehicle sold as well as financial characteristics of each transaction. During the sample period, there is significant variation in subsidies for HEVs at the provincial level. Of Canada's ten provinces, five have subsidies, and these change over time. The subsidies take the form of reductions in sales taxes, but the total savings is capped, so that some tax rebates act as lump-sum subsidies. Of the vehicles receiving a subsidy in our sample, the mean subsidy is \$1838, while the maximum exceeds \$3500.

Variables include vehicle trim, number of doors, engine type, transmission, the final price paid by consumers, the vehicle's invoice cost to the dealer (including the cost for options chosen), discounts, financing & leasing information, and allowances for the vehicle traded in (if any). There is also some nominal information on the dealer and customer, including the province of sale and a retailer identifying code.² We use this policy variation in a panel fixed effects

research design, which controls for unobservable attributes of each HEV model and national shocks to the HEV market, to estimate how an increase in the subsidy affects transaction prices, upgrading and dealer profits.

We find that a \$1000 HEV rebate raises the final transaction price, inclusive of all features and options, for a particular year-model by \$570. Taken at face value, this subsidy has a larger effect on transaction price than those studied by Busse et al. (2006), Sallee (2011), Busse et al. (2012), and Kaul et al. (2016). Busse et al. (2006) finds that customer cash incentives from manufacturers raise transactions prices by 10–30% of the rebate. Sallee (2011) finds cash rebates had no effect on U.S. Prius prices during the mid-2000s. This would seem to suggest that consumers benefited less from Canadian HEV subsidies than the incentives studied in prior research. Busse et al. (2012) estimate that the pass through rate from the US' 2009 Cash for Clunker program was 100%, while Kaul et al. (2016) find that an equivalent program in Germany has pass-through rates above 100% for higher-end segments of the market.

The picture changes substantially upon considering upgrading. Our data do not include details on specific options installed by the original equipment manufacturer (OEM) in each model. It does, however, include a measure of the dealer's cost of each vehicle, which will encompass the full suite of factory-installed options. Thus, we examine how subsidies affect the dealer's vehicle cost to detect upgrading. Note that, because OEMs generally set invoice schedules uniformly across dealerships and over the model year, our measure of dealer cost picks up changes in the features installed rather than changes in the prices set for dealers. Canadian HEV subsidies had a large effect on vehicle cost. Our results indicate that a \$1000 increase in the HEV rebate induces consumers to increase the cost of their vehicle by approximately \$459 through additional options.

Our results indicate that the pass-through rate for a product with variable quality is a poor indicator of the incidence of consumer subsidies. If we ignored the change in options purchased, our data would suggest consumers keep less than half of HEV subsidies in Canada. Upon accounting for upgrading, our data tell a different story: four-fifths of the increase in transaction price comes from upgrading.³ To the extent that these upgraded options impart use-value to the consumer, it seems clear that consumers enjoy a larger share of subsidy benefits than would be suggested by analyzing transaction price alone. Unfortunately, our data does not provide sufficient detail to allow us to estimate negotiating costs, and so we cannot confirm empirically that they fall in response to HEV subsidies. Nevertheless, our theory does allow us to sign the potential bias from ignoring costly negotiation. To the extent that reductions in costly negotiations will also increase consumer benefits, even our upgrade-adjusted estimates may understate consumer gains.⁴

There is a rich tradition of tax incidence analysis in economics (see Kotlikoff and Summers (1987) Fullerton and Metcalf (2002) for reviews). A key finding is that, for marginal changes in a tax, a price change (tax rate pass-through) is a sufficient statistic for changes in consumer surplus. Weyl and Fabinger (2013) demonstrate that this

³ Examining the effects of US import quotas, (Feenstra, 1988) found that half the rise in nominal price of Japanese autos was attributable to the OEM improving the attributes that come standard with the base model. Because we include model-year fixed effects in our regressions, the quality changes we identify are at the level of individual vehicles.

⁴ Note that an alternative explanation for price increases is selection, as rebates induce an expansion of the market. This is confirmed by (Chandra et al., 2010). We cannot rule this out empirically, but intuition suggests that those induced by the subsidy are especially price sensitive, and that we would expect that price sensitivity to be correlated with demand for fewer options, which would work in the opposite direction of what we find. Importantly, even if our empirical results were due entirely to selection, that our results would suggest the same overall caution to past estimates from the automobile market, and in particular for green goods where subsidies are applied fairly narrowly.

² All values are reported in Canadian dollars. During our study period, the Canadian dollar was worth between 0.73 and 1.07 US dollars and had an average value of 0.87 US dollars.

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