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Do sales tax credits stimulate the automobile market?

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ABSTRACT

In this paper, we quantitatively investigate the effectiveness of a sales tax reduction in stimulating sales and profits of durable goods manufacturers. Our question is motivated by policy makers' recent interest in helping ailing automobile manufacturers and in replacing a fleet of highly polluting vehicles. President Obama's economic stimulus plan, for instance, has directly targeted the primary market by including a sales tax credit on purchases of new cars and trucks. In this paper, we show that the benefit of reducing the sales tax, measured by its effect on firms' profits and sales, greatly decreases with the product's durability. The magnitude of our findings indicates that one must carefully account for durability and firms' behavior when evaluating such policies. Our findings are robust when we vary key parameters of the market.

1. Introduction

In this paper, we quantitatively investigate the effectiveness of a sales tax reduction in stimulating sales and profits of durable goods manufacturers. Our question is motivated by policy makers' recent interest in helping ailing automobile manufacturers and in replacing a fleet of highly polluting vehicles. President Obama's economic stimulus plan, for instance, has directly targeted the primary market by including a sales tax credit on purchases of new cars and trucks.[1] The point of our paper is to show that the benefits of reducing the sales tax on new cars, measured by its effect on firms' profits and sales, must be qualified by the durability of the product since these benefits diminish significantly the more durable the product is.

Our result hinges on the product being durable and the firm facing a time consistency problem. Durability implies that consumers are purchasing an asset, with their willingness to pay depending on the anticipated future value. The firm can increase this future value by pre-announcing cutbacks in future output (or high future prices). These pre-announcements, however, are not credible. Consumers anticipate that the firm will lower its price once it has earned its current profit, deviating from its initial announcement. In other words, the firm is competing with its own future self, who does not conform with the current self's plans. In this environment, any mechanism that permits the firm to credibly commit to lowering future output (increasing future prices) has the indirect benefit of implementing a solution that is closer to the commitment (time inconsistent) one and thus, has a (partial) positive effect on the firm's profits.

In this paper, we analyze the effects of one such mechanism, a sales tax. With a dynamic equilibrium model of durable goods with secondary markets, which we simulate using parameter values calibrated to the U. S. automobile industry, we quantify the effect of permanently modifying sales taxes when the good is durable. We show that the benefit of reducing the sales tax, measured by the effect on firms' profits and sales, greatly decreases with the product's durability. Our finding that the effect of such policies greatly depends on the durability of the product is a direct implication of the time consistency problem of the firm. The good being less durable attenuates the competition of the firm with its own future self, because finite durability implies that high-willingness-to-pay consumers return to the primary market, which reduces the

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[1] This program is referred to as the American Recovery and Reinvestment Act Vehicle Tax Deduction, which is different from the popular Cash for Clunkers. Purchasers of new cars and trucks are allowed to deduct sales or excise taxes from their income taxes, without needing to itemize them. The new car purchased must be less than $49,500 and taxpayers must have an adjusted gross income of less than $125,000 if single or $250,000 if married.

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future self's incentives to lower prices. As a result, the commitment problem is less prevalent and the indirect benefit of taxation decreases. Our results confirm this intuition, showing that the benefits from cutting back sales taxes decrease with durability. These findings are robust when we vary key parameters.

An alternative policy we could have analyzed is a temporary cut in the primary market sales tax. This alternative policy would have the same qualitative effects: taxation confers commitment benefits to the firm and thus the positive effect of a sales tax reduction (both if offered temporarily and permanently) have to be measured against the loss of commitment benefits. In the long run, however, having had a temporary tax yields no effects.

The identification of commitment mechanisms that, despite the induced distortion, may be preferable for a durable goods manufacturer is not new in the literature. Kahn (1986) analyzes the durable goods monopolist's problem with a convex cost function. The shape of the cost function can aid the firm by making cutbacks in future output credible, yielding indirect commitment benefits as well. An implication of the model is that the firm may have an incentive to choose an inefficient technology. Goering and Boyce (1996) analyze the effects of excise taxation with a stylized two-period lived durable goods monopolist model. They find that not only the commitment benefit is present, but that excise taxation can also have an overall positive effect on profits, which is a result we do not obtain in our more empirical framework. Their framework, and also ours, may be nested within Kahn's (Kahn, 1986) setup, because excise taxes are increases in the marginal cost of production. Liang (1999) studies a different mechanism, which is the tradeability in the secondary market, showing that it can give indirect commitment benefits and facilitate the return of high-willingness-to-pay consumers to the primary market, making high future prices credible.

There are other papers analyzing government intervention in the automobile market, but focusing on other effects or policies. Smith (2009) relates to our paper in that it analyzes the effects of taxation, although it focuses instead on how changes to the primary market filter down to the secondary market. Adda and Cooper (2000); Esteban (2007); Schiraldi (2009); Licandro and Sampayo (2004) and Alberini et al. (1995) focus on scrappage programs, which have recently been implemented in the U.S. but have been popular for years in the European Union. Fullerton and West (2000) Hahn (1995) West (2004) analyze various alternative policies that aim to stimulate the retirement of highly polluting vehicles.

Our findings highlight the importance of accounting for durability and time consistency in the problem of the firm when evaluating alternative public policies. Accounting for such an environment implies solving dynamic equilibrium models of demand and supply, which is a complex computational task and which requires simplifying other relevant and interesting aspects of the automobile market. In particular, our model restricts the type of consumer and product heterogeneity, making them both unidimensional, but allows consumers to be forward-looking, anticipating future prices, and firms to be an oligopoly simultaneously solving dynamic problems.

The current paper is part of our research agenda analyzing the dynamic implications of durability and secondary markets, both theoretical and empirical, when the primary market is imperfectly competitive. The model we use here is a simplification of the environment in Chen et al. (2008), where we quantify the bias in estimating the structural parameters for the model if we do not account for the durability of the product. The models differ in that here we eliminate stochastic costs yet we add primary market taxation. Also related are Esteban and Shum (2007), which derives a dynamic time-consistent oligopoly model but focuses on a linear-quadratic specification, and thus requires a more restrictive environment than the one considered here, and Chen et al. (2007), where we build a dynamic equilibrium model of durable goods oligopoly in which consumers face lumpy costs of transacting in the secondary markets to quantify the competition that secondary markets represent for durable goods manufacturers.

Also incorporating the supply-side problem with market power are Nair (2004), which estimates an equilibrium dynamic durable goods monopoly model for the console-video game market, and Goettler and Gordon (2008), which estimates a model of dynamic oligopoly with durable goods and endogenous innovation for the PC microprocessors industry. In these two models, as in our present model, both consumers and firms are forward-looking, and solve dynamic programming problems, but there is no secondary market for used goods. Other papers have added a supply side problem but made different assumptions on market power and time consistency. For example, Gavazza and Lizzeri (2008) assume the primary market is perfectly competitive, while Porter and Sattler (1999) solve for the time inconsistent solution to the monopolist's problem.

The next section presents the model. Section 3 describes the parameterization of the model. Section 4 presents the effects of primary market sales taxation. Section 5 concludes.

2. Model

We specify a durable goods oligopolistic model with primary market taxation and a competitive secondary market. The model simplifies the environment in Chen et al. (2008) by eliminating cost uncertainty and reducing the heterogeneity of the product but retaining the key dynamic properties of the model.

Both firms and consumers are forward-looking. The model is cast in discrete time and has an infinite horizon. The only characteristics of a car are its quality and age. All new cars—cars in their first period of life—are homogenous in quality and after one period of use, all depreciate into used cars also of homogenous quality (albeit possibly different from the one of new cars). Once used, cars face stochastic death and thus their expected lifetime can be more than two periods. These last two assumptions are useful as they allow us to match the average age of cars in the U.S. and the relative size of the primary and secondary markets while retaining the computational tractability of having a limited state space.

The timing of events is as follows. At the beginning of each period, consumers inherit either a used car or the outside good from their decisions in the previous period. Then firms and consumers simultaneously make production and purchase/sale decisions, whereby firms obtain per-period profits and consumers enjoy per-period utility from consumption. At the end of each period, goods depreciate and a new period arrives. We restrict our attention to Markov strategies, where firms' production choices are only a function of the stock of used cars, which is also the supply in the secondary market.

We index cars by $j = 0, 1, 2$, which are, in that order, outside good, new car, and used car. We denote by $\delta \in [0, 1]$ the probability characterizing the process of stochastic death.

In what follows, we describe the model and derive the equilibrium. We consider consumers' and firms' problem in partial equilibrium and then require full equilibrium by clearing all markets and formulating correct expectations on both sides of the market. For consumers' problem, this implies that, for now, consumers take the sequence of prices as given.