



# Dynamic interaction between markets for leasing and selling automobiles



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## ABSTRACT

We develop a model of dynamic interactions between price variations in leasing and selling markets for automobiles. Our framework assumes a differential game between multiple Bertrand-type competing firms which offer differentiated products to forward-looking agents. Empirical analysis of our model using monthly US data from 2002 to 2011 shows that variations in selling (cash) market prices lead rapidly dissipating changes of leasing market prices in the opposite direction. We discuss the practical implications of these results by augmenting a standard leasing valuation formula. The additional terms represent the leased asset value changes that can be expected on the basis of past variations in automobile selling market prices.

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## 1. Introduction

For households in developed countries the automobile is typically the second largest asset purchased after a house and is the most commonly held non-financial asset (Aizcorbe et al., 2003). In the US, one third of all cars sold is financed via leasing (e.g., see Hendel and Lizzeri, 2002; Johnson and Waldman, 2003) while a comparable proportion of sales involves cash transactions (Mannering et al., 2002; Dasgupta et al., 2007). Despite its importance, the exact association between leasing markets and cash markets (also known as selling markets) is not yet fully understood. Although some theoretical models exist (see Bulow, 1982, 1986; Bucovetsky and Chilton, 1986; Purohit and Staelin, 1994; Purohit, 1997; Desai and Purohit, 1998, 1999; Saggi and Vettas, 2000; Huang et al., 2001), they are mostly static in nature and make the unrealistic assumption of perfect substitutability. Moreover, no study examines the empirical link between leasing and selling markets for automobiles. The objective of the present paper

is to shed further light on this relationship. At a theoretical level, we make more generic assumptions which permit for dynamic interactions and imperfect substitutability. At an empirical level, we use US monthly data to model for the first time the dynamic relationship between leasing and selling market price variations. Our results motivate us to develop a new dynamic leasing asset pricing approach for automobiles whereby shocks in selling market prices are allowed to have a dissipative effect on leasing market prices and residual values.

In the next section we review the relevant literature. Section 3 lays out our model for describing the interaction between price variations for automobiles in leasing and selling markets. Section 4, estimates empirically the model using monthly US CPI data and discusses the implications of the results for leasing valuation. The final section concludes the paper.

## 2. Literature review

### 2.1. The relationship between leasing and selling markets

The earliest attempts in understanding the association between leasing and selling markets originate in the investigation of

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decisions made by agents in the markets for durable goods under the so-called durable goods monopoly problem (see Coase, 1972; Stokey, 1981; Bulow, 1982, 1986; Gul et al., 1986; Bucovetsky and Chilton, 1986; Purohit and Staelin, 1994; Purohit, 1997; Desai and Purohit, 1998, 1999; Saggi and Vettas, 2000). Most of these papers assume that leasing and selling are perfect substitutes with market participants that are indifferent between the two alternatives. Moreover, the focus of these studies is to investigate the conditions under which leasing is the optimal strategy in the context of different market structures. A related strand of literature examines the relationship between the markets for new and used automobiles. From a static perspective, Bresnahan (1981), Berry et al. (1995), Goldberg (1995) and Petrin (2002) gauge the market power of introducing new products in the automobile industry. However, as argued by Blanchard and Melino (1986) it is important to employ a dynamic approach for at least two reasons which are discussed below. First, dynamics may arise in durable goods models of two interacting markets where used cars constitute stock variables which are imperfect substitutes to new cars. For example, Berkovec (1985) uses the econometric estimates of a short-run model to forecast sales and other automobile industry variables. Rust (1985, 1986) concentrates on dynamic consumer demand in durable goods with new, used and scrappage markets for automobiles. Transaction costs in a dynamic setting are considered by Konishi and Sandfort (2002), Stolyarov (2002) and Schiraldi (2011). Esteban and Shum (2007) model the production decision of a firm in a discrete dynamic oligopoly setting in which automobile prices are endogenously determined. Adda and Cooper (2000a) build a dynamic stochastic discrete choice model of car ownership at the individual level in order to study the output and public finance effects of subsidies on automobile demand. Eberly (1994) and Attanasio (2000) study  $(S, s)$  models of household automobile demand with transaction costs and liquidity constraints. Second, forward-looking dynamics may arise also in the demand side of the durable goods market on the basis of consumer expectations of future prices for new cars. In this case consumers are not myopic towards the future since they consider their expected utility while making their primary decisions on if and when to buy. Chen et al. (2008, 2010) construct a calibrated equilibrium time consistent dynamic oligopoly model of a durable goods market, which incorporates both the sources of dynamics mentioned previously. In particular, Chen et al. (2008) ignore the dynamics by evaluating the bias in estimating the structural parameters of a static model. Chen et al. (2010) incorporate transaction costs in the used market which makes purchases important on the demand side.

A prominent issue in the durable goods markets is the possibility of oscillatory behavior. Sobel (1991) and Conlisk et al. (1984) consider a new group of consumers, with a heterogeneity of tastes, which enters the market sequentially and leads the monopolist to fluctuate the equilibrium price periodically (Sobel, 1984, studies the same problem in an oligopoly setting). Board (2008) considers the pricing behavior of a durable goods monopolist for a new good where agents can strategically time their purchases and where the demand fluctuates exogenously over time. Janssen and Karamychev (2002) allow for information asymmetry in a dynamic competitive model of identical generations entering the market over time. Caplin and Leahy (2006) develop an  $(S, s)$  model of oscillations in demand which reflects fluctuations in the number of consumers who purchase the durable goods as well as of variations in the demand of a single consumer. They use this model to analyze the equilibrium dynamics of prices, the number of purchases and the size of purchases of the durable goods. Empirical evidence by Bils and Klenow (1998) confirms that durable goods prices have a tendency to move procyclically relative to prices of nondurable goods. Blanchard and Melino (1986) construct a competitive equilibrium model with representative consumers and firms. Their

intention is to understand the common cyclical behavior of prices and quantities in a certain market for automobiles. Finally, Adda and Cooper (2000b) concentrate on the demand side and estimate a VAR(1) model of aggregate income, relative prices of cars and consumer preference shocks. They report that the impulse response function exhibits dampened oscillations in response to an income shock. This is explained on the basis of two reasons. First, due to non-convex adjustment costs with heterogeneous consumers, the endogenous growth of the stock of cars can generate replacement cycles and subsequent oscillations in sales. Second, the oscillations can arise from the serial correlation in income and prices.

## 2.2. Automobile leasing and selling market structure

The literature identifies and studies different ways in which the market for durable goods can be organized. One strand argues that the optimal strategy for a durable goods firm is to try and operate in a balanced manner in both the selling and leasing market (see Bulow, 1986; Desai and Purohit, 1998, 1999; Saggi and Vettas, 2000; Huang et al., 2001; Hendel and Lizzeri, 2002; Bhaskaran and Gilbert, 2005, 2009). In this setting leasing firms function as subsidiaries of manufacturers as, for example, General Motors Lease and Ford Credit Lease. In another setup, which is relevant to the standard consumer lease agreement framework, the lessor is a financial institution which buys on behalf of the lessee a new vehicle from a licensed automobile dealer and then leases it to a lessee (Myers et al., 1976; Giaccotto et al., 2007). Since the core business of the lessor, which is usually a retail bank or a personal finance company, does not involve selling used cars, the leased car is sold through the wholesale used car market. In this way, the lessor is neither a manufacturer nor a dealer of automobiles.

Eisfeldt and Rampini (2009) argue that firms do not operate businesses in both leasing and selling spheres. This is because in line with what practitioners argue, the possibility of the lessors to take back an asset allows them to implicitly expand more credit than lenders whose claims are protected by the same asset. Dasgupta et al. (2007) describe the elements of typical dealer financing contracts and leasing contracts and how these differ. The dealer financing contract can be described by the base price of the vehicle, the annual percentage rate, the payment period (or term) and cash rebates. The alternative is leasing, which entails financing the user cost of the vehicle rather than its entire purchase price. Consequently, leasing has lower down- and monthly-payments. Lease payments could be as low as one third of those required to buy the car. This makes leasing an attractive choice for credit constrained consumers and also allows them to acquire more luxurious cars. In terms of popularity, Dasgupta et al. (2007) report that 24.2% of the transactions were leased, 35% of the sales were dealer-financed, while the remaining 40.8% were categorized as “cash” transactions (most likely these were financed elsewhere rather than being actually paid for by cash).

Another interesting case is the separate channel described by Purohit (1997). This characterizes the state of the industry in which rental agencies and dealers are licensed solely to rent and to sell cars, respectively, and compete between them. Finally, there are also the third-party independent lessors, which are neither banks nor dealers (Myers et al., 1976; Giaccotto et al., 2007; Bhaskaran and Gilbert, 2009).

## 3. Model formulation

In this section we build a framework for modeling in a dynamic manner the interaction between leasing and selling market prices for automobiles. Such a dynamic setting has been studied

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