Promoting Trade in Durable Goods Markets: Evidence from the Used Car Market

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Abstract

This paper examines how car dealers and leasing companies influence secondary market trade and efficiency. A stylized model demonstrates that transaction cost heterogeneity, often assumed uniform, is key to understanding individual choices and the coexistence of intermediaries. Using 2006–2019 data from the Israeli car market, I analyze the impact of a 2010 tax increase on leasing costs. The results show a 26% rise in private ownership, a 35% increase in dealer-reliant sales, and reduced used car resales. Model estimates suggest the tax change reduced welfare and underscore transaction cost heterogeneity's critical role in shaping market outcomes.

Keywords: Intermediary, Secondary Market, Car Dealer, Leasing, Used Car
JEL Classification Codes: D82, D83, L15, L62

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1 Introduction

Secondary markets for durable goods have long captured the attention of economists, and understandably so. To begin with, durable goods, from vehicles to appliances, constitute a significant component of private consumption. Furthermore, trade in secondary markets is an important tool for allocation purposes because it enables transactions among high-valuation and low-valuation individuals. Lastly, at least since Akerlof (1970)'s seminal paper, economists have been concerned about the inefficiencies inherent in these markets, characterized by foregone trading opportunities and non-optimal resource allocation. In this context, it is not surprising that considerable research has discussed the mechanisms that can enhance trade, which arguably improve resource allocation, within those markets.

Existing research indicates that intermediaries such as car dealers and leasing companies can improve market efficiency. Studies have shown that dealers may reduce search costs (Rubinstein and Wolinsky, 1987), improve the matching technology (Johri and Leach, 2002), or reduce the problem of information asymmetry because they can better identify "lemons" (Biglaiser, 1993; Hendel and Lizzeri, 1999). Additionally, studies have shown that leasing contracts, which typically last 3 years, may also mitigate adverse selection because they create a "commitment to trade", regardless of the quality of the car (Hendel and Lizzeri, 2002; Johnson and Waldman, 2003). Perhaps surprisingly, the literature thus far has only examined how one particular intermediary (e.g., dealers or leasing companies) affects trade in secondary markets, and has not examined why different intermediaries coexist in markets and what roles they serve.

This paper bridges this gap by exploring why different types of intermediaries, such as car dealers and leasing companies, coexist and the specific roles they serve. While car dealers and leasing companies operate in distinct markets and offer different services, they indirectly compete with one another. Leasing companies primarily cater to *potential buyers* in the *primary market*, providing a comprehensive bundle of services. This includes the new car, financing options, operating services, and crucially, a guarantee of zero transaction costs upon contract termination, as the responsibility of reselling the car rests entirely with the leasing company. In contrast, used car dealers do not typically operate within the primary market. Their primary clientele are *potential sellers* in the *secondary market*, whom they assist by mitigating part of the transaction costs tied to selling a used car.[1] For the purpose of this paper, I concentrate on the first resale

[1] Although car dealers also serve used car buyers, this paper focuses on the decision-making

transaction of a car, which reflects the decision of individuals with a high taste for quality to dispose of their used vehicles and, as a general rule, procure new ones. Individuals who purchase new cars are cognizant of the eventual need to dispose of these cars and appreciate the complementary service offered by dealers. Therefore, leasing companies find themselves in indirect competition not just with one, but two alternatives accessible to individuals: a direct purchase of the new car from the manufacturer and subsequent self-disposal, and a bundle option involving a direct purchase and later disposal through the services provided by car dealers.

The focus of this study is the Israeli used car market, a classic example of active secondary markets. This study comprises both theoretical and empirical components. The empirical analysis capitalizes on a comprehensive dataset that includes all car transactions in both the primary and secondary markets from 2006 to 2019 and it also leverage a tax change completed in 2010 which significantly increased the cost of leasing. The theoretical and empirical analysis in this paper suggest that: (1) The coexistence of car dealers and leasing companies is primarily driven by the heterogeneity among individuals' disutility from trade in the secondary market (i.e., "trading frictions" or "transaction costs"); (2) While these intermediaries do not compete head-to-head in identical markets, there is considerable substitution between their services; (3) Both intermediaries – leasing companies and car dealers – play a key role in enhancing the turnover and efficiency of the used car market, suggesting that welfare can indeed be improved with the presence of more than one intermediary.

In this paper, I highlight a notable difference between using dealers and leasing services. Individuals who use leasing services generally face lower trading frictions than those owning a car and using car dealers' services. For example, when selling through a dealer, the individual doesn't entirely bypass trading frictions—they must negotiate the car's sale price. A primary objective of this paper is to examine whether both types of intermediaries offer unique value – that is, under what circumstances both intermediaries provide distinct value and whether their coexistence in a market is redundant. To achieve this, I examine the substitution between these intermediaries and characterize the individuals opting to sell their vehicles independently, through dealers, or by the services of leasing companies.

To guide the empirical analysis, I develop a theoretical model that considers the role of dealers and leasing companies in the durable goods markets. The model

process of used car sellers, particularly the comparison of transaction costs when selling through dealers versus selling a car that was leased.

builds on and extends existing models (e.g., Hendel and Lizzeri 1999; Peterson and Schneider 2017), assuming that individuals have heterogeneous transaction costs when selling their cars in the used car market. According to the literature, in the absence of trading frictions, individuals with a high taste for quality will resell their used cars in the secondary market once the quality depreciates and will then upgrade to new cars. Existing models assume that individuals differ from each other only in their taste for quality, i.e., their utility from the quality of the vehicle, and that the disutility from selling a car is the same for all individuals. However, in reality, just as the utility derived from the quality of the car varies among individuals, the disutility derived from selling a car is likely to be different among individuals. The model incorporates two intermediaries: leasing companies that completely mitigate individuals' transaction costs and car dealers who offer individuals partial mitigation of the transaction costs, though at a lower cost. The model shows that, in equilibrium, leasing companies and car dealers increase the level of trade in the secondary market. Notably, this this escalation in transaction volume is conventionally interpreted as an indication of a market with fewer frictions, leading to a more efficient allocation of goods (Hendel and Lizzeri 1999; Gavazza et al. 2014).

I utilize the model for the empirical analysis in multiple ways. First, I use it to derive testable predictions related to a 2010 tax change, which substantially increase leasing costs. Then I test these predictions empirically, taking into consideration that this tax change predominantly impacted cars with an initial value below 200k ("affected vehicles"). Subsequently, I estimate the models' parameters using the Method of Simulated Moments (MSM) and assess the welfare implications of the tax change.

While the impact of the 2010 tax change on the primary car market for affected vehicles is straightforward — due to the spike in leasing costs — its repercussions on the secondary market are more intricate. Indeed, after 2010, there was a significant uptick in the annual growth rate of new car sales to private owners, with the share of new cars purchased by private owners increasing from 43%-45% in 2006-2009 to 56% in 2014. However, as former leasing users transitioned into owning new cars, their involvement in the secondary market could significantly alter market dynamics, particularly if their characteristics deviate from those of individuals who were private new car buyers even before the tax change.

Given this, the model turns its attention to the secondary market, analyzing how the exogenous increase in leasing costs may influence equilibrium outcomes. The model generates three testable predictions: (1) "A substitution effect": in-

dividuals exiting the leasing cycle, and who now purchase their car themselves in the primary market, are likely to use car dealers' services when reselling their vehicles; (2) "A quality-preference effect": those who shift away from the leasing cycle are likely to sell their cars earlier in their lifespan, as compared to the typical private owner before the tax change; and (3) "The aggregate turnover effect": the total turnover in the secondary market is expected to decline post the tax change.

The empirical analysis supports the three predictions of the model, which provide a valuable cross-validation of the model. I test the model using two empirical approaches. The first approach makes a before-after comparison of the outcome variables, as outlined by the model's predictions. Using this approach, I find that the share of first used car transactions conducted through dealers among private sellers increased by nearly 9.4% and that the resale rate, which measure the share of new cars resold within five years, declined by 2.6% in the post-tax-change period. These results suggest that the tax change harmed the efficiency of the secondary market. At the same, the increase in the market share of car dealers mitigated these inefficiencies and prevented even larger inefficiencies. As Figure 1 shows, the impact of the tax change on the resale rate lasted for the entire period (until 2014),[2] indicating that the efficiency of the secondary market had not recovered. I further find that the average age of cars at the time of their first resale declined in the post-tax-change period. This change is more significant among the group of private car owners who used dealers' services. According to the model, this decline is driven by individuals who exited the leasing cycle, who likely sell their cars faster than other private owners, before upgrading to a new car.

[2]Given that my dataset extends up to 2019, the last 5-year resale rate calculation can be calculated for cars sold as new in 2014.

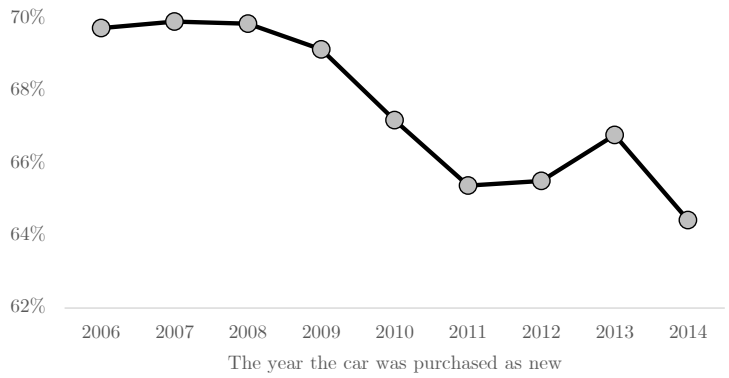

Figure 1: Resale rate, 5 years after the car was purchased as new

This figure shows the resale rate of cars within 5 years after they were purchased as new. Note that I count only the first resale transaction of each car. For example, the statistic for the year 2006 is calculated only by the number of first-hand resale transactions made in the years 2007-2011 divided by the total number of new cars purchased in 2006.

The limitation of the before-after approach is that it does not account for other factors that may have influenced the outcome variables in the post-tax-change period, simply because time has changed. For instance, between the two periods, the market might have experienced a shift in purchasing preferences due to the introduction of new vehicle types like SUVs. Urban transportation habits could have evolved due to improvements in public transportation, increased traffic congestion, or changes in car ownership costs. Additionally, economic factors, such as interest rates on car loans, might have influenced individuals' ability to purchase vehicles. All these potential shifts are not accounted for by the before-after approach. Therefore, I also test the model hypotheses using a difference-in-differences research design. The main challenge in this type of analysis is finding the right comparison group. I use, as a control group, expensive-luxury vehicles. Due to their high list price, the tax change had only a negligible impact on the leasing cost of these cars. The results using the difference-in-differences approach confirm the results of the before-after approach. In the post-tax-change period, the share of first used car transactions made through dealers among private sellers increased by nearly 10%, and the number of transactions involving private owners using dealers increased by approximately 51% compared to their comparison group. Furthermore, the average age of cars involved in those transactions decreased by roughly 2.4 months. A back-of-the-envelope calculation suggests that the marginal age-on-resale (i.e., of the "new members" of the group of private owners who use dealers) is lower by 5 months. Lastly, the difference-in-differences analysis suggests that the resale rate of cars affected by the tax change declined by up to 5.2% compared to their comparison group.

Lastly, I employ the Method of Simulated Moments (MSM) approach to estimate the model. The primary parameters of the model are individuals' preference for quality and transaction costs, which are assumed to be independent and normally distributed. Other homogenous parameters are the cost of leasing, dealer costs, and the proportion of transaction costs that dealers mitigate. The estimated model fits well with the data moments. On average, transaction costs are approximately \$5,000, representing about 15% and 25% of the average prices for new and used cars in the dataset, respectively. I then use the estimated model to assess the potential welfare impact of the tax change. The findings suggest that the utility loss is greater than the increased tax collection, but it is also concentrated among a group of individuals. This result is also consistent with the reduced-form analysis I performed.

1.1 Contribution and Related Literature

The economic literature has shown a growing interest in understanding the role of intermediaries in durable goods markets. Empirical examples include Gilligan (2004), Gavazza (2011), and Biglaiser et al. (2020). These studies focus on only one type of intermediary – either dealers or leasing companies. To the best of my knowledge, this paper is the first to study a setting with both of those participants, thereby enabling me to examine the interaction between those two participants and to test whether the two intermediates are important for promoting trade. This work is closely related to studies on trading frictions in secondary markets for durable goods and to studies examining the role of intermediaries in those markets.

The theoretical foundations of this paper lie in the literature that examined the consequences of transaction costs in secondary markets for durable goods.[3] In this literature, activity in secondary markets arises because sellers gain by upgrading their used product to a new product once the quality of their product depreciates (Hendel and Lizzeri, 1999; Peterson and Schneider, 2017; Gavazza et al., 2014). Typically, individuals with a high willingness-to-pay assess the quality of the product they use each period, and if the gain in utility from upgrading their product, net of the gap in prices, exceeds the transaction costs, they replace their

[3]Some studies assume that the transaction costs reflect a specific friction such as search cost (e.g., Rubinstein and Wolinsky 1987) or adverse selection (e.g., Hendel and Lizzeri 1999; Hendel et al. 2005). In this study, I follow the strand of the literature that considers transaction costs a generic reduced form cost reflecting all trading frictions that impede exchange, such as search cost, taxes, asymmetric information, switching costs, and so forth (e.g., Gavazza et al. 2014).

product with a new one. In equilibrium, transaction costs are the only obstacle to full trade (i.e., 100 percent) and the extent of actual trade depends greatly on the heterogeneity in preferences. Because frictions are not observable, the empirical analysis is challenging. Empirical papers in this literature may be divided into two groups. The first group includes papers that look for correlations in datasets that fit the theoretical literature. Most of these studies suggest that trading frictions are essential to explain observed trends in the data (Bond, 1982; Genesove, 1993; Emons and Sheldon, 2009; Gilligan, 2004; Peterson and Schneider, 2014, 2017; Ater and Yoseph, 2022). The second group of papers estimates structural models that incorporate transaction costs in the individual's decision. Those papers highlight the importance of transaction costs to explain consumer decisions (Stolyarov, 2002; Schiraldi, 2011; Esteban and Shum, 2007; Gavazza, 2011, 2016; Gavazza et al., 2014). Although the literature recognized that transaction costs may be heterogeneous across decision-makers (Gavazza et al., 2014), to the best of my knowledge, no paper accounted for such a possibility. The contribution of this paper to this literature is that it develops a model in which both quality preference and transaction costs are heterogeneous and incorporates two types of intermediates. Then I use the model to derive testable predictions and empirically test them.

Intermediates. The theoretical literature discusses the potential contribution of intermediaries to trade on secondary markets, with most of the papers focusing on intermediaries such as car dealers,[4] and fewer referring to leasing.[5] The empirical literature finds evidence supporting the theoretical literature. Prominent examples related to this study include: Gilligan (2004) and Gavazza (2011), who provide empirical evidence for the role of lessors in reducing frictions in secondary markets for aircraft; and Gavazza (2016) (aircraft market), and Biglaiser et al. (2020) (car market), who provide evidence of a similar nature regarding the role of dealers in the used durable goods market. I contribute to the literature by considering a setting in which individuals can use two types of intermediates – leasing companies and car dealers. Also, I empirically examine the substitution of

[4]Biglaiser (1993), Biglaiser and Friedman (1994) and Biglaiser and Li (2018) argue that intermediaries such as car dealers are experts who can identify "lemons" and reduce the negative effect of asymmetric information. Rubinstein and Wolinsky (1987), Gehrig (1993), Spulber (1996), Rust and Hall (2003), Wright and Wong (2014), Nosal, Wong, and Wright (2015, 2017), and Rhodes, Watanabe, and Zhou (2018) discuss how intermediaries save on search costs. Lastly, Hendel and Lizzeri (1999), Johri and Leach (2002), and Shevchenko (2004) discuss the role of intermediaries in facilitating efficient allocation.

[5]Hendel and Lizzeri (2002) and Johnson and Waldman (2003, 2010) theoretically showed that leasing contracts may mitigate the negative effect of asymmetric information, as they ameliorate the decrease in trading volume and resale prices that adverse selection causes.

the two types of intermediates and test their importance for increasing turnover in the used car market.

The rest of the paper is organized as follows. In Section 2 I develop the theoretical model and derive testable predictions regarding the effect of the tax change on the used car market. In Section 3 I describe the data and relevant background, and in Section 4 I review the estimation results. Section 5 concludes.

2 Model

2.1 General

In this section, I develop a model of trade in the used car market. I use the model to motivate the empirical analysis, derive testable predictions, and help in interpreting the empirical findings. The modelling approach follows a "basic" version of existing models of trade in durable goods in secondary markets (e.g., Hendel and Lizzeri 1999; Peterson and Schneider 2017), and the predictions I derive are a direct result of these models. In these models, sellers are car owners who contemplate only one decision – whether or not to sell their cars directly to a buyer (i.e., they cannot use a dealer to sell their cars). In these models, the cost of trade is typically similar for all sellers and is the only factor preventing a "full trade"[6] in the secondary market. Keeping in mind the empirical setting, the model extends the "basic" models by adding two market participants – car dealers and leasing companies and by relaxing the assumption that the cost of trade is similar and constant to all sellers.[7]

I first characterize the steady-state equilibrium of the extended model and then consider how the equilibrium changes following an increase in the cost of leasing.[8] The literature acknowledges that lessees have low trading frictions and

[6]The theoretical literature defines "full trade" as the case in which all new car buyers, who are considered individuals with a high taste for quality because they purchased a new car to begin with, sell their cars once the quality depreciates to a level deemed acceptable by individuals with a low taste for quality; the initial buyers then purchase new cars. This is considered efficient because it means better matching has been established between products and individuals.

[7]In the model, the leasing companies and car dealers are not decision makers, therefore, this model cannot be considered as a full equilibrium model, but a partial equilibrium model, which mainly focuses on consumers' demand for vehicles and for services of leasing companies and car dealers. However, I do consider the services that intermediaries offer to individuals and characterize factors that affect the demand for their services.

[8]Because individuals who wishes to consume new cars know that in the future they will have to dispose their car, in this model their choice is not only whether or not to purchase a new car, they also choose how to dispose it in the future. In particular, individuals can consume and dispose new cars in 3 ways: (1) purchase a new car and in the future sell by themselves in

tend to replace their cars faster than private car owners do (e.g., Hendel and Lizzeri 2002; Gavazza 2011). Thus, an increase in the cost of leasing is expected to decrease the demand for leasing in the primary market. This should lead to a decline in the share of lessees in the following years, and therefore to an increase the overall trading frictions in the secondary market which will be followed by a decline in turnover in the secondary market. Indeed, Figure 1 shows that since 2010, the probability of reselling a car 5 years after its "registration year", i.e. 5 years after it was purchased as new, declined.

The purpose of the model is twofold. First I use the model to examine under what conditions the existence of two types of intermediaries, such as leasing companies and car dealers, benefits individuals. This also allows me to characterize consumers who choose to sell their vehicle themselves, those who use car dealers and those who use leasing companies. More importantly, the model shows the type of individuals who are likely to switch from using leasing to using the services of dealers given an increase in the relative cost of leasing. Second, I use the model to make predictions about the influence of the tax change on trade in the secondary market. In particular, the model shows that dealers mitigate the effect of a higher cost of leasing on trade in the secondary market. Intuitively, this happens because selling through a dealer is an imperfect alternative means of selling one's car, without bearing the full cost of trade friction.

2.2 The basic model – trade only among individuals

2.2.1 Setup

In this subsection, I describe a model of trade in durable goods. The model builds on Peterson and Schneider (2017), in which trade occurs only between individuals. In the model, vehicles' quality depreciates over time and individuals characterized by a high taste for quality buy a car when it is new, then sell it in the used car market as it gets older before buying (again) a new car. Accordingly, trade in the used car market occurs between sellers with a high taste for quality and buyers with a low taste for quality.

The utility that car owners derive from using their vehicles is defined by $u_i = \theta_i Q_i$, where θ_i is the individual's taste for quality and Q is the quality of the vehicle. Sellers' taste for quality is distributed on the interval $[1; \theta^H]$. Buyers'

the used car market; (2) purchase a new car and in the future sell it in the secondary market using car dealers'; (3) lease a car, and in the future the leasing company will sell the car. In this mode, in equilibrium individuals are consistent with their choices over time, but an exogenous shock may change their choices

taste for quality is assumed to be similar among all buyers and is normalized to 1. I further assume that there are more buyers than sellers, each seller owns one vehicle, and buyers do not own any vehicle. I also assume that the quality of a new vehicle, Q^n, is greater than the quality of a used vehicle (i.e., $Q^n > Q^u$), that the price of a new vehicle is given by $Q^n < P^n < \theta^H Q^n$, and that the primary market is competitive (P^n and Q^n are determined outside the model). These assumptions, which are standard in the models, guarantee positive trade and that no lower-valuation individual would purchase a new car.

2.2.2 Equilibrium (without transaction costs)

Sellers consider upgrading their used vehicle to a new one. Seller i will sell her current car if the utility gain from owning a new car relative to the existing car, $\theta_i(Q^n - Q^u)$, is greater than the upgrading costs, the price difference between a new car and a used car, $P^n - P(Q^u)$. Because there are more buyers than sellers, the market price of the used car is given by the buyers' reservation price, which is defined by $P(Q^u) = Q^u$. Therefore, a seller with a taste for quality θ_i will upgrade her vehicle if $\theta_i(Q^n - Q^u) \geq P^n - P(Q^u)$. By substituting $P(Q^u)$ with the buyers' reservation price, I can derive a cutoff rule that defines the type of sellers who will choose to upgrade their vehicles. Equation 1 defines the taste for quality that makes sellers indifferent between upgrading and keeping their vehicle. Sellers with a higher taste for quality will choose to upgrade their vehicle:

$$\theta^{*,FT} = \frac{P^n - Q^u}{Q^n - Q^u} \tag{1}$$

According to Equation (1), in a market with no friction, any car owner $\theta_i > \theta^{*,FT}$ prefers to upgrade her current car by selling her old car in the secondary market and purchasing a new one. $\theta^{*,FT}$ is usually defined as the "full trade" cutoff, meaning it is considered economically efficient if all car owners with $\theta_i > \theta^{*,FT}$ sell their cars.

2.2.3 Equilibrium (with transaction costs)

I now assume that sellers of used cars bear the cost of trading frictions, which I define by $c(c > 0)$. Seller i will sell her current car if the utility gain from owning a new car relative to the existing car, $\theta_i(Q^n - Q^u)$, is greater than the upgrading costs. These upgrading costs are the price difference between a new car and a used car, $P^n - P(Q^u)$, plus the transaction costs c. Therefore, a seller with a

taste for quality θ_i will upgrade her vehicle if $\theta_i(Q^n - Q^u) \geq P^n + c - P(Q^u)$. By substituting $P(Q^u)$ with the buyers' reservation price, I can derive a cutoff rule defining the type of sellers who will choose to upgrade their vehicles. Equation (2) defines the taste for quality that makes sellers indifferent between upgrading and keeping their vehicle. Sellers with a higher taste for quality will choose to upgrade their vehicle:

$$\theta^{*,FC} = \frac{P^n + c - Q^n}{Q^n - Q^u} \tag{2}$$

Adding fixed transaction costs increases the cutoff value to $\theta^{*,FC}$. Figure 2 illustrates the distribution of sellers' taste, θ, and the two cutoff values, $\theta^{*,FT}$ and $\theta^{*,FC}$. Individuals with a taste for quality θ_i larger than the cutoff value upgrade their cars; the gap between $\theta^{*,FC}$ and $\theta^{*,FT}$ is the inefficiency in the market that is caused by the fixed transaction costs, c.

2.3 A model with dealers and leasing companies

2.3.1 New Equilibrium

I add to the basic model two market participants – leasing companies and car dealers. These participants affect how car owners may interact with the secondary market and, therefore, change the market equilibrium described in section 2.2.

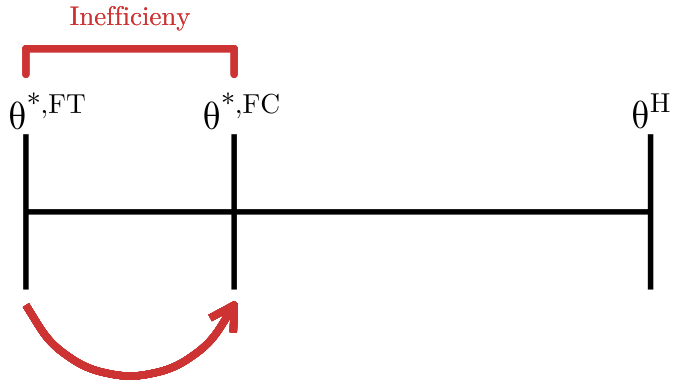

Figure 2: The effect of fixed transaction costs on equilibrium, trade only among individuals

This figure shows the cutoff rule for the simple model without transaction costs and with fixed transaction costs. Without transaction costs, all individuals with taste larger than $\theta^{*,FT}$ upgrade their cars, meaning individuals with $\theta \sim [\theta^{*,FT}, \theta^H]$. With transaction costs (fixed), the cutoff increases to $\theta^{*,FC}$. The loss of efficiency is the share of consumers in the interval $\theta^{*,FC} - \theta^{*,FC}$.

Heterogeneous Transaction Costs

I first relax the assumption that sellers' transaction costs, c, are homogeneous for

all sellers, assuming that transaction costs are heterogeneous among individuals and distributed on the interval $[0; \bar{c}], \bar{c} < P^u$. Now a seller with a taste for quality θ_i and transaction cost c_i will upgrade the vehicle if $\theta_i(Q^n - Q^u)P^n + c_i - P^u$. Notice that both the gain in utility and the upgrading costs are at the individual level. Thus, the cutoff rule can be presented by the following linear function:

$$c_i^{*,\text{ Self}} \leq \underbrace{\theta_i\left((Q^n - Q^u)\right)}_{\substack{\text{Utility gain of} \\ \text{new vehicle}}} - \underbrace{(P^n - P^u)}_{\substack{\text{Monetary} \\ \text{cost of upgrade}}} \tag{3}$$

Figure 3 provides a visual explanation of this cutoff rule. The X-axis captures the distribution of sellers' taste, θ, and the Y-axis illustrates the distribution of sellers' transaction costs. The black 45-degree line is the linear line defined in Equation (3) and defines the cutoff rule, which is different for each seller depending on their (θ, c) combination. Notice that sellers with relatively low transaction costs may not upgrade their cars if their taste for quality is not high, and vice versa. Sellers on the black 45-degree line are indifferent between upgrading their cars or not, sellers in the light blue area benefit from upgrading, and sellers in the white area prefer to keep their old cars. It is important to note that this figure is not proportional. The purpose of this figure and the series of figures in this section (Figures 3 – 7) is to characterize trends between groups of car users; therefore, the proportionality in those charts is not accurate. In particular, the indifference line does not pass at the origin, and its slope is not necessarily 45 degrees.[9]

2.3.2 Leasing Companies

I assume that leasing allows sellers to eliminate entirely their trading frictions, c_i, in return for a fixed cost, L, implying that the total cost of leasing is $P^n + L$. I assume that the additional cost of leasing, L, is constant[10,11] In this case, it would

[9] In addition, I do not assume anything about the distribution of θ_i and c_i except the range of values and that their joint distribution covers the entire plane between the points (1,0) and $(\theta^H, \bar{c})$ as shown in this figure. Therefore, the model does not necessarily predict that the number of sellers who upgrade to a new car, and the number of sellers who do not upgrade their cars, should be divided symmetrically.

[10] I do not model the pricing decision of the leasing firms in the primary market, but I assume that they cannot price discriminate and, therefore, that the additional cost of leasing, L, is constant.

[11] In practice, individuals who lease do not officially own their cars and, therefore, pay only the rental cost for the period of their contract; however, the consumers have the option of purchasing their cars by the end of the contract at a price that is usually the market value of the car, i.e., P^u. For simplicity of analysis, I assume that the leasing contract gives the consumers ownership

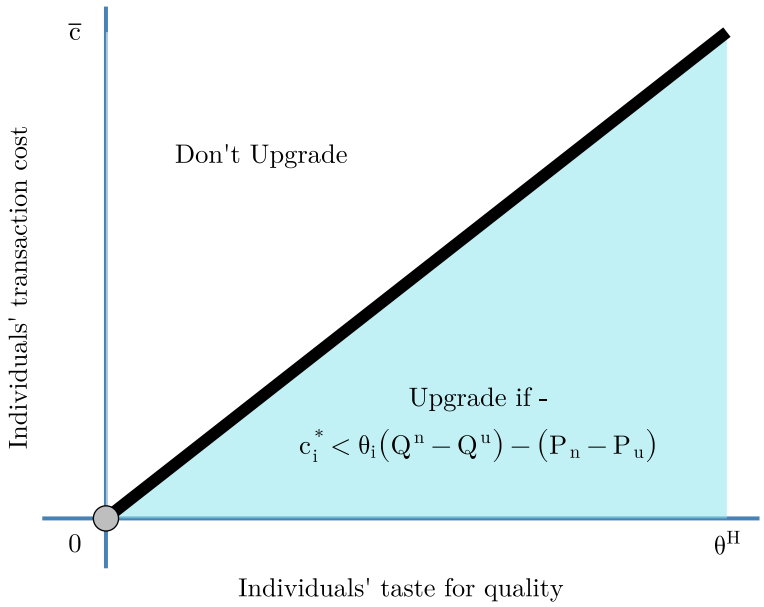

Figure 3: The effect of heterogeneous transaction costs on equilibrium, trade only among individuals

This figure shows the cutoff rule for a model with heterogeneous transaction costs. The X-axis includes the range of possible values of θ of the high taste for quality $[1; \theta^H]$. The Y-axis includes the range of possible values of the heterogeneous transaction costs $[0; \bar{c}]$ (notice that the origin of this system is (1,0)). High θ_i raises the utility from upgrade and c_i raises the cost of upgrade (causing disutility). Notice that without transaction costs, $c_i = 0$ for all individuals, and this figure is just the horizontal line, similar to Figure 2. The black 45-degree line in this case is the indifference line for each individual i, depending on θ_i and c_i. The light blue area to the right of the indifference line consists of individuals whose combination of θ_i and c_i is such that the vehicle upgrade is profitable for them, and the white area to the left of the indifference line consists of individuals for whom the vehicle upgrade is not profitable.

be profitable for a car owner to upgrade her car using a leasing firm service if: $\theta_i(Q^n - Q^u) \geq P^n + L - P^u$. Thus, I get a cutoff rule that resembles Equation (2):

$$\theta^{*,Lease} > \frac{P^n + L - Q^u}{Q^n - Q^u} \tag{4}$$

However, the decision of whether to upgrade through leasing also depends on the option of self-upgrading. Whether or not it is profitable to upgrade using the leasing companies' services is not the only comparison a seller must consider; one should also compare relative to the option of self-upgrading. That is, an individual will upgrade using a leasing company if the following condition holds:

$$\begin{array}{cccccc} \underbrace{\theta_i\left(Q^n - Q^u\right)}_{\text{increase in utility}} & - & \underbrace{\left(P^n + L - P^u\right)}_{\text{upgrading cost using leasing firm}} & > & \underbrace{\theta_i\left(Q^n - Q^u\right)}_{\text{increase in utility}} & - \quad \underbrace{\left(P^n + c_i - P^u\right)}_{\text{upgrading cost individually}^{12}} \end{array} \tag{5}$$

$$\Rightarrow c_i^{*,\text{ Lease}} > L$$

Based on Equations (4) and (5), sellers will use leasing firms' services if their individual taste for quality, θ_i, is larger than $\frac{P^n + L - Q^u}{Q^n - Q^u}$ and if their individual transaction costs, c_i, is larger than the cost of leasing, L. Figure 4 builds on Figure 3 to illustrate the effect of adding leasing companies. The dark blue square represents car owners who choose to upgrade their cars using a leasing company's services. The left edge of the square is defined by the cutoff rule in Equation (3) and the bottom edge of the square is defined by the cutoff rule in Equation (4). The light blue area represents car owners who choose to upgrade their cars by themselves and bear their own trading frictions, while the white area represents car owners who prefer to keep their old cars and not upgrade.

This extension of the model yields the following results. First, leasing attracts individuals with a combination of high taste for quality and a high cost of trading. Second, leasing increases the number of individuals who upgrade their cars (the

of their cars and a future option to sell back their car to the leasing firms for the price of P^u without any friction cost. This assumption does not change their payoffs, but it makes it easier to compare the leasing decision structure to the non-leasing decision structure.

[12]The term "*upgrading cost individually*" in Equation (5) could be lower for a given period if sellers own cars under leasing contracts, as they can sell them to the leasing company for P^u without paying their c_i for one period. However, in the next period, and the periods to follow, they will have to pay c_i each time they switch cars. I ignore this case for several reasons. First, in this model in equilibrium, individuals are consistent with their choices. In addition, it will not change the model's qualitative results, and the purpose of the model is purely qualitative. Lastly, I want the decision rule to take into account long-term considerations that are important for equilibrium and not one-time considerations.

dark blue + light blue areas in Figure 3) compared to the basic model (the light blue area in Figure 4), suggesting that leasing companies increase the efficiency of the secondary market.

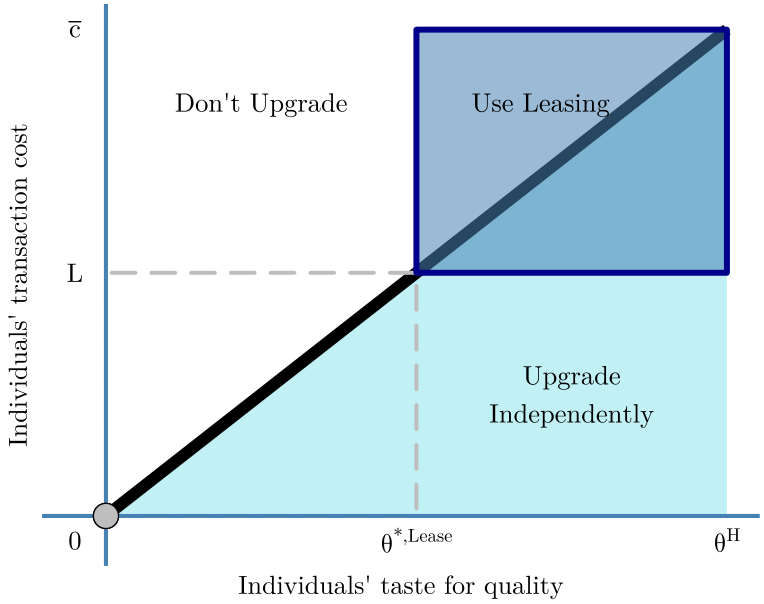

Figure 4: The effect of heterogeneous transaction costs on equilibrium in a model of trade with private individuals and leasing firms

This figure shows the cutoff rule for a model with heterogeneous transaction costs and leasing companies. This figure adds, to Figure 3, the influence of leasing companies on the decisions of individuals to sell their vehicles in the secondary market at equilibrium. To understand the structure of the chart, please read the notes in Figure 4. In this figure, the dark blue square represents individuals who, in equilibrium, prefer to use leasing companies' services each time they purchase and sell their cars. The dark blue square is a result of a combination of two constraints set in Equations (4) and (5) that determine the boundaries of the square from the bottom and the left. This figure shows that thanks to leasing companies the resale rate on the secondary market is expected to increase (compared to Figure 3) because some individuals move from the "Don't Upgrade" group to the "Use Leasing" group.

2.3.3 Car Dealers

I now assume that a second type of intermediary (dealership) offers individuals the ability to save a partial share, γ $(0 < \gamma < 1)$ of their trading frictions, c_i, in return for a fixed cost, D $(D < L)$. Selling a car through a dealer is less of a hassle than selling the car directly to individuals, but it is not friction-free as leasing contracts because the seller must find the right dealership. In this case, it is profitable for a car owner to upgrade her car through a dealer if: $\theta_i(Q^n - Q^u) \geq P^n + D + (1-\gamma)c_i - P^u$. In this case, I get a cutoff rule resembling

Equation (3):

$$c_i^{*,Dealer\,1} \leq \theta_i \frac{(Q^n - Q^u)}{1-\gamma} - \frac{P^n + D - P^u}{1-\gamma} \tag{6}$$

As before, the decision whether to upgrade using a dealer is not the only comparison a car owner must consider; one should also compare using the dealer to self-upgrading:

$$\begin{aligned} &\underbrace{\theta_i (Q^n - Q^u)}_{\substack{\text{increase in} \\ \text{utility}}} - \underbrace{(P^n + D + (1-\gamma)c_i - P^u)}_{\substack{\text{upgrading cost} \\ \text{using dealers}}} \\ &> \underbrace{\theta_i (Q^n - Q^u)}_{\substack{\text{increase in} \\ \text{utility}}} - \underbrace{(P^n + c_i - P^u)}_{\substack{\text{upgrading cost} \\ \text{individually}}} \\ &\Rightarrow \quad c_i^{*,\text{ Dealer 2}} > \frac{D}{\gamma} \end{aligned} \tag{7}$$

Figure 5 illustrates the extension of adding car dealers to the basic model, i.e., without leasing companies. The combination of cutoff rules in Equations (6) and (7) is the brown trapeze. As the figure shows, the effect of car dealers resembles the effect of leasing companies – it increases the total trade in the secondary market because it increases the number of car owners who upgrade; however, the magnitude is different, suggesting that dealers and leasing are not perfect substitutes.

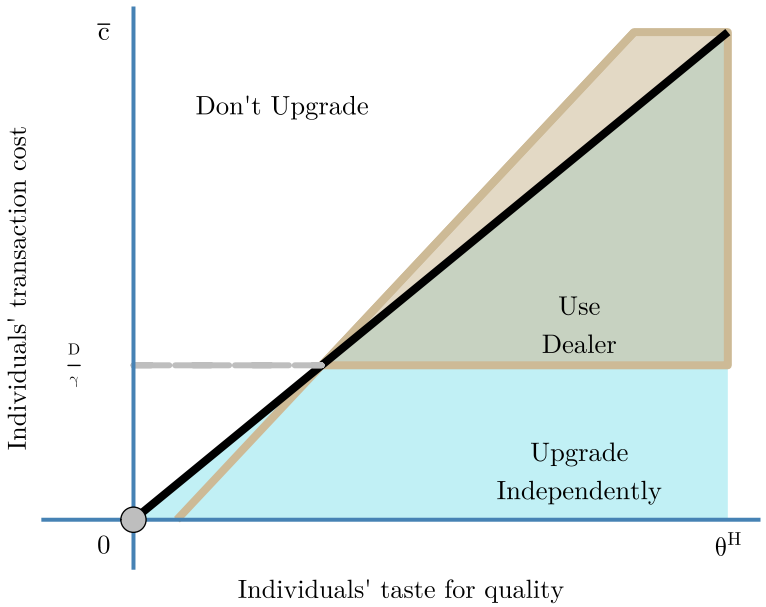

Figure 5: The effect of heterogeneous transaction costs on equilibrium in a model of trade with private individuals and car dealers

This figure shows the cutoff rule for a model with heterogeneous transaction costs and car dealers. This figure adds to Figure 3 the influence of dealers on the decisions of individuals to sell their vehicles in the secondary market at equilibrium. To understand the structure of the chart, please read the notes in Figure 3. In this figure, the brown trapeze represents individuals who, on equilibrium, prefer to use dealers' services each time they sell their cars (they purchase the car independently). The brown trapeze is a result of a combination of two constraints set in Equations (6) and (7) that determine the boundaries of the trapeze from the bottom and left. This figure shows that thanks to dealers the resale rate on the secondary market expected to increase (compared to Figure 3) because some individuals move from the "Don't Upgrade" group to the "Use Dealer" group.

Figure 6 illustrates a combination of both extensions (leasing and dealers). To do so, I must also consider when it is profitable for an individual to use lease services rather than dealer services:

$$\begin{aligned} &\underbrace{\theta_i \left(Q^n - Q^u\right)}_{\substack{\text{increase in} \\ \text{utility}}} - \underbrace{\left(\left(P^n + L - P^u\right)\right)}_{\substack{\text{upgrading cost} \\ \text{using leasing}}} \\ > \; &\underbrace{\theta_i \left(Q^n - Q^u\right)}_{\substack{\text{increase in} \\ \text{utility}}} - \underbrace{\left(P^n + D + (1-\gamma)c_i - P^u\right)}_{\substack{\text{upgrading cost} \\ \text{using dealers}}} \end{aligned} \tag{8}$$

$$c^{*L>D} > \frac{L - D}{1 - \gamma}$$

The key takeaways from Figure 6 are the following: (1) Adding both dealers and leasing companies does not mean they will cannibalize each other completely; (2) Having both dealer and leasing companies increases the resale rate on the secondary market, and presumably its efficiency (compared to having only one of them); and (3) The services of dealer and leasing companies appeal to individuals with a combination of high taste for quality and a high individual transaction cost, and among them, those with higher transaction costs lean towards leasing.

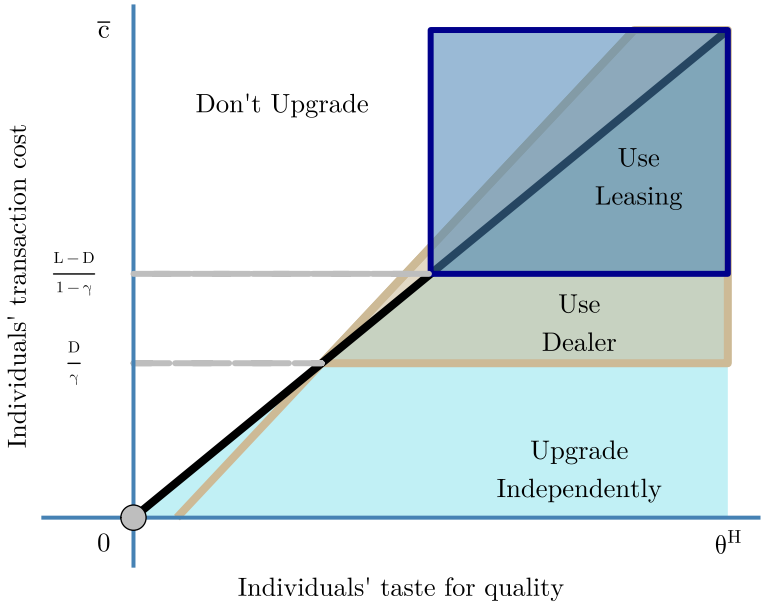

Figure 6: The effect of heterogeneous transaction costs on equilibrium in a model of trade with private individuals, leasing firms, and car dealers

This figure shows the cutoff rule for a model with heterogeneous transaction costs, leasing companies, and car dealers. This figure merges Figures 3-5. To understand the structure of this chart, please read the notes in those figures. This figure adds an additional constraint set in Equation (7) that defines when it is profitable for an individual to use lease services rather than dealer services. This figure shows that dealers and leasing overlap each other partially – meaning they are substitutes, but not perfect substitutes. This figure also shows that the turnover in the secondary market is expected to be larger when both dealers and leasing companies exist (compared to Figures 3-5).

2.4 Testable Predictions

The stylized model gives rise to several testable predictions. To make the discussion of the predictions easier, I use the following terminology when I refer to the group of car owners: "Use Leasing" are individuals who use leasing to lease a new car. In equilibrium, each time they upgrade to a new car (after returning the old car to the leasing company), they use the services of the leasing company.

"Upgrade Independently" are individuals who purchase a new car in the primary market, then sell this car themselves in the secondary market ("private-to-private transactions", or "P2P transactions"). "Use Dealer" are individuals who purchase a new car in the primary market, then use a dealership when they sell this car as it gets older ("private-to-dealer transactions", or "P2D transactions"). The latter two groups together make up the group of "Private Car Owners".

Hypothesis 1 ("Substitution Effect"): *The increase in the cost of leasing, L, is expected to increase the "Use Dealer" group over the "Use Leasing" group.*

It is important to note that Hypothesis 1 predicts a substitution from the "Use Leasing" group to the "Use Dealer" group, i.e., it does not predict a substitution to the "Upgrade Independently" group. I use this result as part of my estimation strategy in the empirical analysis.

Hypothesis 2 ("Quality Preference Effect"): *Because the "Use Dealer" group is expected to increase with individuals who were leasing users, who have relatively high taste for quality, the average taste for quality of the "Use Dealer" group and potentially the average taste for quality of the Private Car Owners group, is expected to increase.*

Hypothesis 2 is related to the key-unobservable parameter of the model – individual's taste for quality, θ. The model suggests that individuals who use leasing services have a high θ; therefore, when some of them start purchasing cars by themselves, the θ of this group should increase. In other words, individuals in Area 1 in Figure 7 have larger θ than individuals in the "Use Dealer" and the "Upgrade Independently" areas in Figure 6. Before the tax change, the individuals in Area 1 in Figure 7 were part of the "Use Leasing" group. After the tax change, they are part of the "Use Dealer" group. This is expected to increase the average θ of the "Use Dealer" group and the average θ of the Private Car Owners group.

Because θ is not observable, I cannot test this hypothesis directly. However, in general, and especially in the car segment, age is the most significant determinant of durable good deterioration. Thus, I expect that car owners with larger θ (and similar c_i) will sell their cars sooner.

Hypothesis 3 ("The Aggregate Turnover Effect"): *Because dealers do not provide full substitution for leasing services, the increase in the cost of leasing is expected to cause some individuals with a high taste for quality and high transaction costs to keep their used cars.*

According to Hypothesis 1, an increase in the price of leasing is expected to increase the demand for car dealers. This is because the dealer provides alternative services to the services of leasing companies. Area 1 in Figure 7 captures this shift from the "Use Leasing" group to the "Use Dealer" group. However, because car dealers do not provide a full substitution for leasing, some car owners are expected to keep their used cars and not upgrade; therefore, I expect to see lower turnover in the used car market. Area 2 in Figure 7 captures individuals who leave the "Use Leasing" group for the "Don't Upgrade" group.

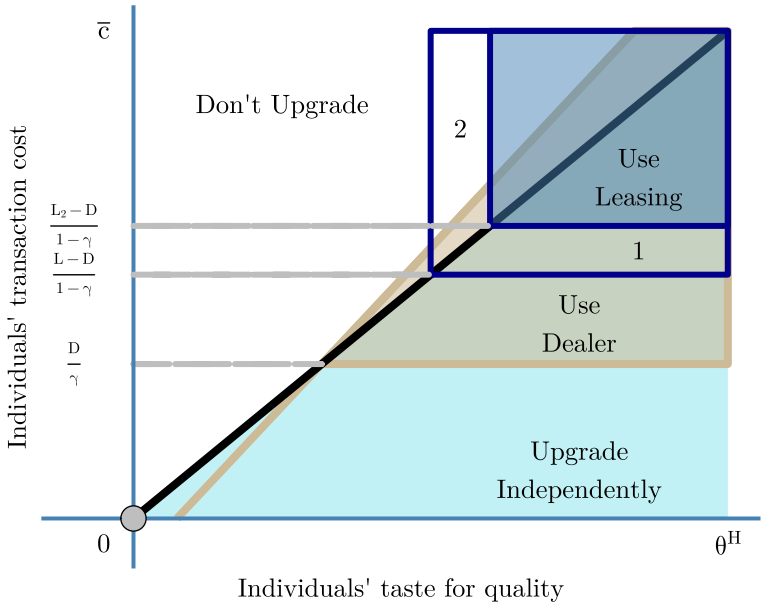

Figure 7: The effect of an increase in the cost of leasing on equilibrium in a model of trade with private individuals, leasing firms, and car dealers

This figure shows the effect of an increase in the cost of leasing on market outcome in the secondary market. This figure relies on Figure 6. To understand the structure of this chart, please read the notes in Figure 6. The increase in the cost of leasing "squeezes" the area of the dark blue square in Figure 6 from both directions (left and bottom) because it increases both cutoffs in Equations (4) and (5). This causes two effects. First, the individuals in Area 1, the brown "L"-shaped area, switches from using leasing services to dealers' services. Second, the individuals in Area 2, the white trapeze, do not upgrade their cars.

3 Data and Descriptive Statistics

3.1 Construction of the data and descriptive statistics

The "main dataset" is an administrative transaction-level dataset containing information about the universe of vehicle transactions in the primary and secondary markets in Israel between the years 2006 and 2019. Because the tax change did

not affect expensive vehicles, in the main analysis I do not consider vehicles whose price as new was more than 200,000 NIS. These data, obtained from Israel's Ministry of Transport and Road Safety ("MOT"), include information about the vehicle characteristics (e.g., car manufacturer and car model, registration year, color) and current and previous owners. Each observation is identified by the transaction date and the vehicle ID (scrambled license plate), which allows me to track vehicles over time. I also have information on the type of buyer and the type of seller involved in each transaction (i.e., private buyer/seller, leasing company, or car dealer).

I use the MOT data to calculate the following variables: **"resale rate"** measures the likelihood that a new vehicle is sold in the secondary market by its first owner within a 5-year window since it was purchased.[13] Because the last year in the MOT data is 2019 (for both new and used car transactions), I calculate this variable only for new cars sold between 2006 and 2014. Overall, 1.35 million new cars were sold in these years; 658,562 (49%) were purchased by private owners and the remainder by leasing companies, which then lease them to individual users.[14] The variable **"age-on-resale"** is the age of a car when it is transacted in the secondary market. I calculate this variable for cars purchased by private owners in the primary market and then sold during the 5-year window using car dealers. The variable **"share-of-dealers"** is the number of used car transactions by private car owners through dealers (P2D transactions) divided by the total number of transactions by private car owners. Note that in all three variables, I restrict attention to the first resale of a used car during the 5-year window. In all variables, I aggregate the data by the quarter in which the vehicle was sold as new, by the manufacturer of the vehicle (brand) and by the car category of the vehicle.

Table 1 present summary statistics of the variables share-of-dealers, number-of-transactions, age-on-resale, and resale rate. The table reports the mean values for the periods 2006-2009 (cars sold in the primary market before the tax change

[13]Constructing a resale rate variable (or turnover rate) is common in the literature as a measure of market efficiency ((Hendel and Lizzeri, 1999), Stolyarov (2002), and Schneider (2014)). I choose 5 years because the standard lease contract is 3 years. Changing the time window to 4 years does not qualitatively change the results.

[14]In the analysis, I include only vehicles sold as new to private individuals or leasing companies, which usually lease their cars to private individuals, because that is the focus of this study. Those sales account for roughly 94% of new car sales; the remaining 6% is mostly other corporates, the government, and rental companies. In addition, I omit vehicles resold in the secondary market before they reached the age of one year, observations with missing data, small manufacturers (less than 1.5% market share), and vehicles whose price as new was greater than 200,000 NIS.

was implemented) and 2010-2014 (cars sold in the primary market after the tax change was implemented) and the raw difference between those periods. As seen in Panel A of the table, the share of transactions of new privately-owned vehicles sold in the secondary market through dealers had statistically significantly increased by 9 percentage points between the pre-tax-change period (2006-2009) and the post-tax-change period (2010-2014). This is consistent with Hypothesis 1, which predicts that, following the tax change, individuals who used to lease will sell their privately owned cars through dealers. Similarly, Panel D shows that the probability of selling a new car within 5 years had statistically significantly decreased in the post-tax-change period. This result is in line with Hypothesis 3. Panel C shows that age-on-resale barely declined in the post-tax-change period only in the "Use Dealer" group. However, the regression analysis to follow finds a larger magnitude effect, which is consistent with Hypothesis 2, predicting that age-on-resale should be affected only in the "Use Dealer" group and not in the "Upgrade Independently" group.

3.2 Control groups and basic empirical patterns

In the empirical analysis to follow, I test the model's predictions regarding the effect of the tax change using two empirical approaches. First, I examine the predictions provided by the model. That is, I make a "before-after" comparison in the dependent variable. Then, I test the model's predictions employing a difference-in-differences research design. As I further explain in section 4 this ensures that I account for other factors which might have swayed the outcome variables in the post-tax-change period. In this analysis, the treatment group includes the vehicles used in the before-after analysis. For the control group, I use data on high-end cars, specifically those with a 'price as new' exceeding 200,000 NIS. This threshold was chosen due to the minimal impact the tax change had on these vehicles' leasing costs. Employees who receive a car from the workplace pay tax on it according to its "usage value". The usage value is determined by the tax authorities and it is intended to represent the monetary value of the economic benefit employees receive from company-provided vehicles. Before 2010, the usage value favored cheaper cars and wasn't directly related to the car's price. For example, in 2009, the ratio of the usage value to the car price was lower for the affordable cars comprising the control group (between 1.6% to 2.0%) and higher for the pricier ones in the treatment group (ranging from 2.3% to 2.9%).[15] Starting

[15]Prior to 2010, the tax authority divided vehicle prices into 7 groups in ascending order. Each group had a distinct usage value, which increased with the group but was fixed for all cars

in 2010, it became directly proportional to the car's original cost: 2% in 2010 and 2.5% from 2011. As a result, cars with a higher initial ratio were less affected by the tax change. Accordingly, in Figure 8, Figure 9, and Figure 10, I split the number of cars resold by private owners, the variable age-on-resale, and the resale rate (respectively) into those two distinct groups. In separate robustness analyses presented in Section 4.1.4 and Appendix A., I repeat the regression analysis using an alternative control group. I obtain results similar to those of the main analysis.

Figure 8 offers preliminary evidence of the tax change's effect on the likelihood of private car owners selling their vehicles via dealers. In both panels of this figure, the x-axis represents the "registration year", the year when the car was first sold. Panel A depicts the number of first-hand transactions made by private owners using dealers (P2D transactions) within 5 years of their registration year. To simplify the visualization, the number of transactions in 2006 is normalized to 100. Importantly, this panel highlights that the trajectory of transactions for the treatment group ("cheap cars") and the control group ("expensive cars") closely aligns and almost parallel until 2010. However, from 2011 onwards this trend changed, with the treatment group witnessing a substantial rise in transactions relative to the control group. Panel B displays the ratio of the number of P2D transactions from Panel A to their respective inventory—the number of new cars sold to private owners in each registration year. Prior to the tax change, this ratio for both groups remained notably stable. Yet, post-tax change, there was a significant increase in the ratio for the treatment group while the ratio for the control group remained stable. Such a trend implies a potential change in group members' characteristics, possibly influenced by individuals transitioning out of the leasing cycle and opting to purchase new cars independently. Furthermore, it also reaffirms that the results from Panel A aren't merely a reflection of any anomalous inventory spike within the treatment group.

Figure 9 shows that a significant trend of decline in the age-on-resale of cars belonging to the treatment group started in 2011, while the age-on-resale in the control group increased. Note that according to the model, this effect was probably driven by the marginal consumers who joined this group after they had stopped using the leasing companies' services.

Lastly, Figure 10 plots the resale rate of cars in the treatment group compared to cars in the control group. This figure shows that while in the control group there is no significant trend in the resale rate over time, in the treatment group

within each group. But, the ratio between the usage value and the price of the vehicles was not consistent across groups, favoring the cheaper cars.

the decrease in the resale rate starting with vehicles purchased as new in 2010 and onwards is clearly observed.

Figure 8: Average number of P2D transactions and share of those transactions of inventory by group

(a) Panel A

(b) Panel B

Notes: The x-axis of this figure is the year the car was purchased as new. In Panel A, the blue and the orange lines represent the number of first-hand transactions made by private car owners through dealers within a 5-year window from the year it was purchased as new, for each respective group. To adjust for the scale disparities between the series, all 2006 values were normalized to 100. This panel demonstrates that both groups followed similar trends in the period preceding the tax-change. However, after the tax change, the volume of transactions in the treatment group increase substantially relative to the control group. Recognizing that this could be driven by a change in vehicle inventory, Panel B show ratio of these first-hand transactions to their initial inventories. Similarly, to Panel A, Panel B reveals a surge in the percentage of inventory sold using dealers in the treatment group post-2011, while the control group remains relatively stable.

Figure 9: Average of age-on-resale by group

Notes: The x-axis of this figure is the year the car was purchased as new. This figure shows the average age-on-resale, which is the average age of the transacted cars in Figure 9. Similar to Figure 9, this figure shows that both groups follow similar trends in the pre-tax-change period and that in the post-tax-change period the average age-on-resale among the treatment groups declined while the average age-on-resale in the control group increased.

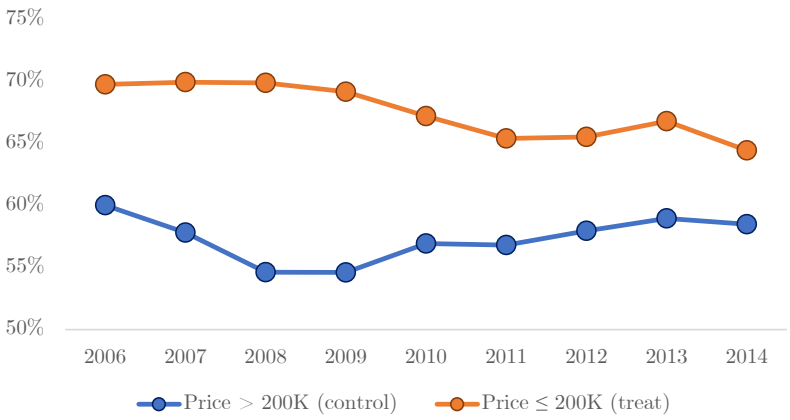

Figure 10: Average of resale-rate by group

Notes: The x-axis of this figure is the year the car was purchased as new. This figure shows the average resale rate by group. In line with the model's prediction, because Hypothesis 3 is regarding the entire car market the resale rate takes into account all first-resale transactions, and not just P2D transactions.

4 Empirical Analysis

In section 4.1, I test the hypotheses outlined in section 2.3.1 using a reduced form regression analysis. The hypotheses of the model present a before-after predictions about the impact of the tax change, but without taking into account the potential concerns with the before-after empirical analysis. I begin the analysis using a regression framework that essentially carries out a before-after comparison, also

referred to as the ("B-A approach") in section 4.1.1. However, the B-A approach has an inherent limitation: it fails to account for other factors that might have affected the outcome variable in the post-tax-change period simply because time has passed. For example, changes in consumer preferences can impact the demand for various car models over time. Additionally, factors such as the quality of public transportation, rising traffic congestion, fluctuation in car ownership costs, and broader macroeconomic trends like economic downturns or booms can influence the general demand for cars, as well as for specific models. These factors remain outside the before-after analysis. A commonly used solution for this issue is the difference-in-differences regression framework ("DID approach") which I employ in section 4.1.2. This approach compares changes in the outcome variable pre- and post-"shock" (in this case, the tax change) between a treatment group and a control group. However, the major challenge in using this approach is finding a control group. In section 3.2, I propose the use of expensive cars unaffected by the tax change as the control group. The control group is then compared with the treatment group. The underlying assumption in the DID approach is that, absent the tax change, the trends for the treatment and control groups would have been similar after January 2010. This assumption is supported by Figures 8, 9, and Figure 10, which demonstrate that pre-trends were largely parallel for the most part. This supports the validity of using this control group for the difference-in-differences analysis.

Lastly, after testing the model's predictions, I employ the Method of Simulated Moments (MSM) approach to estimate the model's parameters in section 4.2. This technique involves simulating some parameters and estimating them based on their capacity to align with the moments of the empirical data. Utilizing this estimated model, I proceed to assess the welfare effect of the tax change on individuals. Importantly, the results from this analysis also serve to validate the theoretical model presented.

4.1 Reduced form analysis

4.1.1 Testing hypotheses 1-3 using the before-after analysis

The following estimation tests Hypotheses 1-3 using the B-A approach:

Model 1: $y_{i,t} = \beta_o + \beta_1 \times POST_t + brand_i + quarter_t + \epsilon_{i,t}$

The dependent variable, $y_{i,t'}$, is either $ln(transactions)$ the natural logarithm of the number of P2D transactions involving a used vehicle produced by brand i that was purchased as new in quarter t; Share-of-dealers, the percentage of

secondary market transactions made through dealers of a vehicle produced by brand i that was purchased as new in year or quarter t; Age-on-resale, the mean age of cars first resold in the secondary market of a vehicle produced by brand i that was purchased as new in year or quarter t;[16] or resale-rate, the probability of reselling a car in the secondary market within 5 years after it was purchased as new of a vehicle produced by brand i that was purchased as new in year or quarter t.

$POST_t$ is a dummy variable that equals one if the car was first purchased during the follow-up period, i.e., between 2010 and 2014, and zero otherwise. The coefficient on $POST_t$, β_1, is the main coefficient of interest and arguably captures the effect of the tax change on the dependent variable. Finally, $brand_i$ and $quarter_t$ are brand-level and quarter-level fixed effects that control for prevailing market conditions and time-invariant brand preferences.

4.1.2 Testing hypotheses 1-3 using the difference-in-differences approach

The following estimation tests Hypotheses 1-3 using the difference-in-differences approach:

Model 2: $y_{i,t,k} = \beta_o + \beta_1 \times \text{Group}_k \times Post_t + \beta_2(\text{Group}_k) + brand_i + quarter_t + \epsilon_{i,t,k}$

The dependent variable, $y_{i,t,k}$, is similar in nature to the dependent variable used in the B-A approach, to estimate Model 1, except that now the variable is calculated separately for each group k (treatment or control).

$Group_k$ is a dummy variable that equals one if an observation belongs to the treatment group. $Group_k \times POST_t$ is the interaction variable and its coefficient, β_1, is the main coefficient of interest capturing the effect of the tax change on the dependent variable. The other variables are defined as in Model 1. In some specifications I also use the variable $Category_c$, a fixed effect variable that control for car-category preferences (small cars, family cars, crossovers, commercial, MPV and luxury).

4.1.3 Results of the reduced form analysis

Tables 2-4 show the regression results for testing Hypotheses 1-3 (respectively) by estimating Models 1-2. Using the B-A approach, the results in Table 2 suggest that the tax change had a statistically significant positive effect of approximately

[16] Recall that for testing Hypotheses 1 and 2 (ln(share-of-dealers and age-on-resale), this analysis is on the sub-sample including only cars owned by private individuals.

84% on the number of transactions in the Use Dealer group. Additionally, there was a 9.4 percentage point increase in the share-of-dealer variable. This suggests that the likelihood of private owners selling their car through dealers grew by 9.4%, up from a baseline average of 37%. Using the difference-in-differences approach, I find that after the implementation of the tax change, the number of transactions in the treatment group increased by 30-50% compared to the number of transactions in the comparison group and that the share-of-dealers increased by roughly 8-10 percentage points compared to its comparison group.

Table 3 reports the effect of the tax change on age-on-resale. In Model 1 (column 1), the coefficient is negative, as predicted by Hypothesis 2, but its magnitude is small and statistically insignificant. Using the difference-in-differences approach, I find a statistically significant decline of 0.18-0.20 years in age-on-resale after the implementation of the tax change. Lastly, the results in Table 4 suggest that the tax change had a statistically significant negative effect of roughly 2.1%-5.2% on the resale rate of new cars sold after 2010. These results lend support to the predictions of the theoretical model regarding the effect of the increase in the cost of leasing on the efficiency of the secondary market in Hypothesis 3.

4.1.4 Robustness

In Appendix A., I carried out an additional analysis demonstrating the robustness of the analysis presented in the Sections 4.1.1-4.1.2. A common concern in a difference-in-differences analysis is that the "intervention" also affects the control group, which may bias the results. In the main empirical analysis, I use "expensive" vehicles, those whose price as new was more than 200,000 NIS, to control for common unobserved market-level changes. However, if, due to the tax change, individuals who used to lease "cheap" vehicles are now privately purchasing "expensive" vehicles, this may affect the outcome in the control group. To show why this concern is unlikely to affect my results, I conduct an additional analysis using different kinds of groups.

First, I repeat the analysis using different treatment groups. I exclude from the original treatment group cars whose price as new was more than 150,000 NIS ("Rob1"). In this analysis, the treatment group includes only vehicles whose price as new is between 55,000 NIS and 150,000 NIS, while the control group includes only cars whose price as new is greater than 200,000 NIS. Thus, I significantly reduce the substitutability between vehicles in the treatment group to vehicles in the control group. I expect that this analysis will be less subject to the substitution concern.

In addition, I test Hypothesis 1 and Hypothesis 2 using another control group to the treatment group in the main analysis and using a placebo test. Both of these analyses are inspired by one of the predictions of the model. Hypothesis 1 predicts that the substitution from leasing due to the tax change will affect the outcome only in the Use Dealer group. Therefore, in the main analysis, I consider only P2D transactions and use expensive vehicles as a control group. In this robustness analysis ("Rob2"), I use the same treatment group as in the main analysis, i.e. (P2D transactions of cheap vehicles), and use P2P transactions of cheap vehicles as a control group. In the placebo test ("Placebo"), I consider all P2P transactions and divide them into treatment and control groups based on their prices as new.[17]

Table A1 shows the result of the robustness analysis regarding the effect of the tax change on the demand for car dealers' services. For ease of comparison, column 1 and column 3 include the estimation of the main specification ("Baseline") for the dependent variables *share-of-dealers* and *ln(transactions)*, respectively. Then, column 2 and column 3 report the first robustness analysis (Rob1) for those variables. Due to the nature of how I calculate *share-of-dealers*, I cannot perform Rob2 and Placebo analyses for it. Thus, column 5 and column 6 show the results of the Rob2 and the Placebo analyses with respect to *ln(transactions)*. Table 2 and Table 3 are constructed similarly to TableA1. Note that in Table 3 I include only the first robustness analysis because Rob2 and the Placebo test are not applicable for examining *resale-rate*. In all cases, the estimated difference-in-differences coefficients in Rob1 and Rob2 are relatively similar to the Baseline result in both magnitude and significance. In addition, the Placebo results find no effect, as expected.

4.2 Structural Estimation

4.2.1 Estimation framework

I estimate the parameters of the model described in the previous section using a method of simulated moments (MSM) estimator. I adopt a two-step strategy, similar to the one used by Gourinchas and Parker (2002), Cagetti (2003), French and Jones (2007), De Nardi, French, and Jones (2010), and Benhabib, Bisin, and Luo (2019). In the first step, I estimate or calibrate those parameters that can be

[17] I cannot test the dependent variables share-of-dealers (Hypothesis 1) and resale rate (Hypothesis 3) with this alternative control group and using the placebo test. Both tests relay on P2P transactions, which I use in-order to calculate share-of-dealers and the overall resale rate.

cleanly identified without explicitly using the model. For example, I estimate the quality of the new cars and the quality of the used cars using data on their prices. Let χ denote the collection of these first-step parameters $\chi = (Q_n, Q_u, P_n, P_u)$. In the second step, I estimate the remaining parameters by matching the targeted moments generated by the model and those in the data.

More formally, let Δ denote the vector of the parameters to be estimated.[18] Let s_t, for $t = 1, \ldots, T$, denote a generic empirical moment in time t; and let $F_t(\Delta)$ denote the corresponding moment generated by the model for a given parameter vector Δ. I minimize the deviation between each targeted moment and the corresponding simulated moment. For each moment t, define $M_t(\Delta) = F_t(\Delta) - s_t$. The MSM estimator is:

$$\hat{\Delta} = \arg\min_{\Delta} M(\Delta)' W M(\Delta)$$

where $M(\Delta)$ is a column vector in which all moment conditions are stacked, i.e., $M(\Delta) = [M_1(\Delta), \ldots, M_T(\Delta)]^T$. The weighting matrix W in the baseline is a diagonal matrix with identical weights for all moments. I also made an efficient two-step estimation with the optimal weighting matrix which produces no relevant changes in the estimated parameters.

The mechanics of the MSM approach is fairly standard. It takes as a given the elements of χ that were estimated in the first step and searches for the optimal vector $\hat{\Delta}$ which aligns best with observed moments through a generalized method of moments (GMM) criterion function. In practice, given the values in χ and the values for each guess of the homogenous parameters $\hat{\Delta}_2$, I formulate a generalized decision rule for each choice alternative. I compute choices for a large number of artificial individuals. Each of these individuals is endowed with a taste for quality and disutility from transactions (θ_i and c_i, respectively) drawn from a normal distribution whose properties (mean and standard deviation) are simulated in $\hat{\Delta}_1$. After obtaining these choices, the model calculates the market shares for each alternative by aggregating the individual choices.[19] The model then compares these simulated market shares with the actual market shares observed in the

[18] Δ incorporates two groups of parameters. The first group consists of heterogeneous parameters, denoted by $\Delta_1 = (\mu_\theta, \mu_c, \sigma_\theta, \sigma_c)$. These parameters represent the means (μ_θ and μ_c) and standard deviations (σ_θ and σ_c) of θ_i and c_i, respectively, which are assumed to follow a normal distribution. The second group consists of homogeneous parameters, denoted by $\Delta_2 = (L, D, \gamma)$. Here, L refers to the cost of leasing, D denotes the cost of dealers (both as a percentage of the new/used car value), and γ represents the share of trading frictions that dealers can mitigate.

[19] This process is the function in the model which takes the estimated parameters and provides the shares which I denote as F_t.

data. If the differences (the moment conditions) are not sufficiently small, the model adjusts the parameter values in $\hat{\Delta}_1$ and $\hat{\Delta}_2$ and repeats the process.

4.2.2 First-step calibration

In this subsection, I describe the calibration of the parameters in the first step of the estimation ($\hat{\chi}$). χ includes the quality of the new car Q^n, the quality of the used car Q^u, the price of the new car P^u, and the price of the used cars, P^n. Both P^n and P^u are observable. Based on the model $Q^u = P^u$, therefore, I estimate Q^u to be P^u. Based on the model $Q^n < P^n$, but it is not clear by how much. On average, the price of a used vehicle after one year of average usage is 85% of P^u. Therefore, I find it reasonable to assume that $Q^n = 0.95P^n$. The baseline model is estimated on the pre-tax change period. In the counterfactual analysis, I use data from the follow-up period. Therefore, each estimation ($\hat{\chi}$) is different, but constructed similarly.[20]

Because my underlying motivation is to explain the reasons for the existence of two types of intermediaries and identify the kinds of individuals who select each type, my primary focus is on aggregated resale decisions. This means that the analysis does not examine closely how each individual selects a specific models; rather, it explores the broad trends of how individuals opt to replace an average vehicle. To facilitate this, I utilize the mean values of Q^n, Q^u, P^n and P^u in each period to compute $\hat{\chi}$.

4.2.3 Estimation results

Panel A of Table 5 presents the estimated values and standard errors of the structural parameters: $\Delta_1 = (\mu_\theta, \mu_c, \sigma_\theta, \sigma_c)$ and $\Delta_2 = (L, D, \gamma)$. With the exception of the estimation for L, all the parameter estimates are statistically significant.

I first turn the attention to the homogeneous parameters in Δ_2. The results from Panel A suggest that both the leasing cost (L) and the dealer cost (D) approximate 10%. However, it's crucial to distinguish that the leasing cost constitutes 10% of the new car price, whereas the dealer cost is 10% of the used car price, which equates to about 53% of new car prices. Furthermore, the estimation results for γ imply that dealers offset approximately 50% of their clients' transaction costs.

Consider now the heterogeneous parameters in Δ_1. The estimated mean taste for quality, μ_θ, approximates 1.5, and its standard deviation, σ_θ, is around 0.4.

[20] In the baseline period the average..

Based on the theoretical model, μ_θ should exceed 1, a prediction the estimation results clearly support. It's important to note that this outcome was not artificially imposed during the estimation process as it was not part of any constraints applied to the algorithm. The estimated mean transaction costs, μ_c, is 15,506 NIS, and its standard deviation, σ_c, is 2,922 NIS. This implies that the transaction costs for 95% of individuals with high taste for quality lie between 10,000 and 21,700 NIS, equating to approximately 15% to 34% of the used car price. When calculating the coefficient of variation for both parameters, it appears that there is more heterogeneity in individuals' taste for quality than in their transaction costs ($CV_{taste} = 28$ versus $CV_{transaction} = 19$). However, the variation in transaction costs is still notably substantial .

Lastly, Panel B of Table 5 compares simulated moments with their empirical counterparts. This comparison is useful for provides a measure of the model's effectiveness in replicating observed behavior. The compatibility between the simulated and empirical moments suggests that the model adequately mirrors real-world scenarios, lending credence to the theoretical premises and computational strategies. This similarity between the two sets of moments adds to the model's reliability.

4.2.4 Welfare implications

The tax change sought to address a tax distortion that rendered workplace car leasing cheaper than leasing a car privately for certain vehicles. As expected, this change enhanced the tax revenue per leased vehicle, but it resulted in a decrease in the number of lessees due to heightened costs. Nevertheless, despite this reduction in lessees, the total tax collection saw an increase. For leasing contracts started in 2014, I estimate an increase in tax collection at approximately 300 million NIS.

Nevertheless, this tax change posed adverse implications for market efficiency. Specifically, the utility of individuals with a high taste for quality, who stopped using leasing services and decided not to upgrade their cars due to high transaction costs, declined. Based on the model, this decrease in utility is equal to the difference in utility derived from using a new, superior car, minus the utility from their old car ($\theta_i(Q^N - Q^U)$), and further reduced by the leasing cost prior to the tax change (L). Using the model, I am able to estimate both θ_i and the pre-change leasing costs (L) for these individuals. My estimates reveal that, for those individuals anticipated to have leased a car in 2014 if the tax change hadn't been implemented, the monetary equivalent of their overall utility decline amounted to approximately 400 million NIS.

This analysis indicates that the increase in tax revenue is overshadowed by the utility loss attributable to the tax change, suggesting an overall negative impact on consumer welfare. On the flip side, there is a silver lining in terms of redistribution of wealth. The enhanced tax collection benefits the entire population, whereas the utility loss predominantly burdens a relatively small group of individuals. Consequently, the tax change has indirectly led to a more equitable wealth distribution, despite its adverse effect on consumer welfare.

5 Conclusion

This paper addresses a gap in the economic literature by exploring the economic rationale behind the existence of multiple types of intermediaries within durable goods markets. Specifically, it focuses on the roles of two crucial intermediaries in automobile markets: leasing companies and dealers. I begin the discussion with the introduction of a theoretical model, which incorporates two significant extensions to existing frameworks: it accounts for heterogeneous transaction costs and permits individuals to trade through two types of intermediaries. This innovative model highlights the importance of heterogeneous transaction costs in understanding individual choices and their preference for intermediaries' services.

The empirical analysis of the model's predictions aligns convincingly with the observed trading patterns within the Israeli used car market, especially in response to a tax change that significantly escalated leasing costs. Furthermore, the model's estimation provides valuable insights into structural parameters like individuals' taste for quality, individuals' transaction costs, among others. The compatibility between simulated moments and empirical data lends credibility to the model, demonstrating its ability to replicate real-world scenarios effectively. Lastly, I use the model to evaluate the welfare effect of the tax-change. I find evidence that the overall welfare decreased, but a positive distributional effect.

The novelty of this paper lies in its multi-pronged exploration of the importance of multiple types of intermediaries in a market. It brings the overlooked aspect of heterogeneous transaction costs to the forefront, emphasizing its role in the existence of multiple types of intermediaries. Through its empirical support for theoretical assumptions about leasing companies and car dealers, it also contributes to the broader durable goods literature. Finally, this research emphasizes the critical need for policymakers to consider potential side effects when orchestrating tax changes, suggesting that such insights should play a pivotal role in future policy formulations.

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Tables

Table 1: Summary Statistics

	Count	mean	2006-2009 mean	2010-2014 mean	Raw Gap
Panel A: Share of dealers					
Main dataset / treatment group	612	42%	37%	46%	9%***
Control group	1,071	46%	46%	46%	0%
Panel B: No. of transactions					
Main dataset / treatment group	612	471	352	567	214***
Control group	1,071	49	44	52	8*
Panel C: Age on resale					
Main dataset / treatment group	612	3.16	3.15	3.17	0.02
Control group	1,071	3.07	3.01	3.11	0.10***
Panel D: Resale rate					
Main dataset / treatment group	612	64%	66%	63%	−3%**
Control group	1,091	58%	56%	59%	3%***

$^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Table 2: The effect of the tax change on the demand for car dealers' services

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	ln(transactions)	ln(transactions)	ln(transactions)	% of dealers	% of dealers	% of dealers
Estimation Approach	Before-After	DID	DID	Before-After	DID	DID
DID = After * Treat		0.508***	0.294***		0.101***	0.083***
		(0.068)	(0.067)		(0.012)	(0.011)
After	0.837***			0.094***		
	(0.045)			(0.006)		
Treat		2.357***	1.485***		-0.062***	-0.051***
		(0.061)	(0.066)		(0.012)	(0.012)
Year — Quarter FE	No	Yes	Yes	No	Yes	Yes
Manufacturer FE	Yes	Yes	Yes	Yes	Yes	Yes
Category FE	No	No	Yes	No	No	Yes
Observations	612	1,666	4,025	612	1,666	4,025
Adjusted R-squared	0.688	0.844	0.544	0.720	0.506	0.354

Robust standard errors in parentheses.

$***p < 0.01, **p < 0.05, *p < 0.1$

Hypothesis 1 predicts that following the tax-change more private car owner will use the services of car dealers. Accordingly, In columns (1)-(3) I examine Hypothesis 1 using the dependent variable *ln(transactions)* which is the natural logarithm of the number of cars sold by privates using car dealers (the numerator of *share-of-dealers*). In columns (4)-(6) I examine Hypothesis 1 using a different dependent variable: share-of-dealers which reflects the share of private car owners who sold their car using the services of car dealers ($share - of - dealers = \frac{\#\text{ of cars sold by privates using car dealers}}{\#\text{of cars sold by privates using car dealers} + \#\text{ of cars sold by privates independently}}$). Within this division of the columns there is a difference between the estimation approach and the specification of the model. In columns (1) and (4), I test Hypothesis 1 using "Approach 1", i.e. a before-after analysis. In the rest of the columns I use a difference-in-differences estimation approach.

Table 3: The effect of the tax change on Age on (first) Resale

	(1)	(2)	(3)
Dependent variable	Age on Resale	Age on Resale	Age on Resale
Estimation Approach	Before-After	DID	DID
DID = After * Treat		-0.202***	-0.183***
		(0.034)	(0.033)
After	-0.025		
	(0.015)		
Treat		0.136***	0.121***
		(0.035)	(0.035)
Year — Quarter FE	No	Yes	Yes
Manufacturer FE	Yes	Yes	Yes
Category FE	No	No	Yes
Observations	612	1,666	4,025
Adjusted R-squared	0.494	0.237	0.150

Robust standard errors in parentheses.
$***p < 0.01, **p < 0.05, *p < 0.1$
Hypothesis 2 predicts that following the tax-change the *age-on-resale* among transaction of private car owner that use dealers' services will decline, therefore I use *age-on-resale* as a dependent variable. In column (1) I test Hypothesis 2 using "Approach 1", i.e. a before-after analysis, and in columns (2) and (3) I use difference-in-differences research design.

Table 4: The effect of the tax change on Resale Rate

	(1)	(2)	(3)
Dependent variable	Resale Rate	Resale Rate	Resale Rate
Estimation Approach	Before-After	DID	DID
DID = After * Treat		-0.052***	-0.021*
		(0.012)	(0.011)
After	-0.026***		
	(0.005)		
Treat		0.120***	0.093***
		(0.011)	(0.011)
Year — Quarter FE	No	Yes	Yes
Manufacturer FE	Yes	Yes	Yes
Category FE	No	No	Yes
Observations	612	1,823	4,740
Adjusted R-squared	0.659	0.230	0.157

Robust standard errors in parentheses.

$***p < 0.01, **p < 0.05, *p < 0.1$

In contrast to hypotheses 1-2, which focus on the group of private car owners who use the services of car dealers, Hypothesis 3, refers to the entire secondary market and predicts that the *overall* resale rate should decline. In column (1) I test Hypothesis 3 using "Approach 1", i.e. a before-after analysis, and in columns (2) and (3) I use difference-in-differences research design.

Table 5: Structural Estimates

	Distribution of taste for quality		Distribution of transaction costs		Leasing cost	Dealer cost	Mitigation share
	μ_θ	σ_θ	μ_c	σ_c	L	D	γ
Panel A. Point estimates							
Estimate	1.5	0.4	15506	2922	0.1	0.1	0.5
Standard error	(0.29)	(0.08)	(3430.76)	833.299	(0.11)	(0.01)	(0.05)

Panel B. Simulated versus data moments

	Data	Simulated	Gap	Gap (%)
LS_2007	0.515	0.516	0.001	0.2%
LS_2008	0.519	0.515	-0.004	-0.8%
LS_2009	0.505	0.506	0.001	0.2%
P2D_2007	0.065	0.064	-0.001	-1.5%
P2D_2008	0.065	0.064	-0.001	-1.5%
P2D_2009	0.072	0.069	-0.003	-4.2%
P2P_2007	0.117	0.116	-0.001	-0.9%
P2P_2008	0.112	0.117	0.005	4.5%
P2P_2009	0.113	0.116	0.003	2.7%
UnSold_2007	0.303	0.304	0.001	0.3%
UnSold_2008	0.303	0.304	0.001	0.3%
UnSold_2009	0.310	0.31	0.000	0.0%

Notes: Panel A contains estimates for parameters in Δ based on calibrated values of χ. For P^n and P^u I use the mean of new car price and used car price, derived from the data. Based on the model I made the next two assumptions: $Q^n = 0.95P^n$ and $Q^u = P^u$. Panel B compares the moments generated by the simulations with empirical data. The simulation is based on 10,000 individuals. The model, based on its seven parameters, shows strong alignment with the data, reflecting its simplicity yet effective design

Appendix

Appendix A. Robustness analysis

Table A1: Robust analysis to the effect of the tax change on the demand for car dealers' services

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	% of dealers	% of dealers	ln(transactions)	ln(transactions)	ln(transactions)	ln(transactions)
Analysis type	Baseline	Rob1	Baseline	Rob1	Rob2	Placebo
DID = After * Treat	0.100***	0.089***	0.508***	0.451***	0.436***	0.064
	(0.013)	(0.014)	(0.068)	(0.078)	(0.067)	(0.075)
After						
Treat	-0.011	-0.009	2.357***	2.009***	-0.594***	2.668
	(0.014)	(0.014)	(0.061)	(0.066)	(0.053)	(0.070)
Year — Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Manufacturer FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,753	1,753	1,666	1,664	1,224	1,713
Adjusted R-squared	0.401	0.390	0.844	0.844	0.639	0.839

Robust standard errors in parentheses.
$***p < 0.01, **p < 0.05, *p < 0.1$

Table 2: Robust analysis to the effect of the tax change on Age on (first) Resale

	(1)	(2)	(3)	(4)
Analysis type	Baseline	Rob1	Rob2	Placebo
DID = After * Treat	-0.202***	-0.251***	-0.050***	0.014
	(0.034)	(0.035)	(0.020)	(0.032)
After				
Treat	0.136***	0.144***	0.120***	0.004
	(0.035)	(0.035)	(0.016)	(0.032)
Year — Quarter FE	Yes	Yes	Yes	Yes
Manufacturer FE	Yes	Yes	Yes	Yes
Observations	1,666	1,664	1,224	1,713
Adjusted R-squared	0.237	0.230	0.466	0.161

Robust standard errors in parentheses.
$***p < 0.01, **p < 0.05, *p < 0.1$

Table 3: Robust analysis to the effect of the tax change on Resale Rate

	(1)	(2)
Analysis type	Baseline	Rob1
DID = After * Treat	-0.052***	-0.052***
	(0.012)	(0.012)
After		
Treat	0.120***	0.122***
	(0.011)	(0.012)
Year — Quarter FE	Yes	Yes
Manufacturer FE	Yes	Yes
Observations	1,823	1,823
Adjusted R-squared	0.230	0.229

Robust standard errors in parentheses.
$***p < 0.01, **p < 0.05, *p < 0.1$