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Essays on Market Response to Changes in Costs and Price Transparency

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1. Introduction

Price is one of the important marketing mix instruments (McCarthy 1960) in order to manage sales. As a strong profit driver, firms may use price to determine the level of demand. For consumers, price is one of the most important influence factors for their decision-making. Thus, the price determines consumers' reaction. The challenge for managers is to forecast the response of consumers to price increases or decreases. Observing consumers' behavior can help firms to better forecast and adjust their prices accordingly. However, when strong variations in prices occur, the questions arise how consumers react to these price fluctuations and what are firms' strategies behind these variations.

This dissertation takes a closer look at price fluctuations using German gasoline prices as an example for a homogenous good with the most varying prices. It analyzes consumers' reaction to price fluctuations and respectively the pricing behavior of firms. Although gasoline is a homogenous product, consumers experience strong price differences among gas stations as gasoline prices change multiple times a day among gas stations. Since the search for price information from different gas stations for consumers is time consuming, gas stations may exploit the high search costs by setting price variations. Thus, the topic of gasoline prices has been frequently discussed in the empirical literature, especially in economics. Researchers have attempted to explain these strong fluctuations by focusing mostly on economic drivers. For instance, crude oil and wholesale prices have been analyzed as primary drivers of gasoline prices. Researchers have examined how shocks to crude oil prices are passed through to gasoline prices and whether gasoline prices respond asymmetrically to cost shocks such that stations increase gasoline prices more quickly in response to an oil price increase than they decrease gasoline prices when oil



prices decrease (e.g., Borenstein et al. 1997, Balmaceda and Soruco 2008). Other studies have paid much attention to determinants of prices and price dispersion. Researchers have attempted to explain price dispersion by analyzing factors such as gas station characteristics, station location and density as well as stations brand affiliation (e.g., Barron et al. 2004, Lewis 2008). However, the findings of price dispersion were mixed.

Although in recent years, researchers and politicians/governments have addressed the gasoline price topic in different countries, strong price dispersion still exists in Germany and there is still a research gap. Therefore, this dissertation contributes to the literature by addressing this void. Recently, regulators have implemented certain mechanisms in order to increase price transparency in the German market. Since December 2013, all German gasoline stations have to report all price changes instantaneously to a central database, from which third-party providers (e.g., mobile apps and websites) can inform their customers about gasoline price changes. Thus, consumers can view gasoline prices via smartphones or internet to find the cheapest station in their vicinity. The goal of the policy intervention is a reduction of price dispersion and prices respectively, i.e., to increase price transparency in the German market. However, it is unclear to what extent the possibility for consumers to be easily informed about gasoline prices in fact leads to a change in consumers' behavior and a reduction in prices and price dispersion. Thus, there is a need for a deeper analysis of the effect of a large-scale policy intervention – increased price transparency – on the pricing behavior of firms. The first part of this doctoral thesis therefore scrutinizes this effect.

Furthermore, as economic research states that crude oil prices are the main driver of gasoline prices, the strong gasoline price fluctuations can also be explained by crude oil price changes. Crude oil prices react to a variety of



political and economic situations and therefore fluctuate over time. Gas stations might react to crude oil prices and, therefore adjust their retail prices differently as they seek to differentiate themselves through their brand strength and services. Thus, the question arises whether German gas stations adjust their retail prices asymmetrically in response to crude oil price changes, i.e., whether gas stations react quicker to crude oil price increases than to crude oil price decreases. If so, to which extent do brand stations differentiate themselves regarding price adjustments? To answer these questions, the second part of my dissertation investigates the asymmetric price responses of firms.

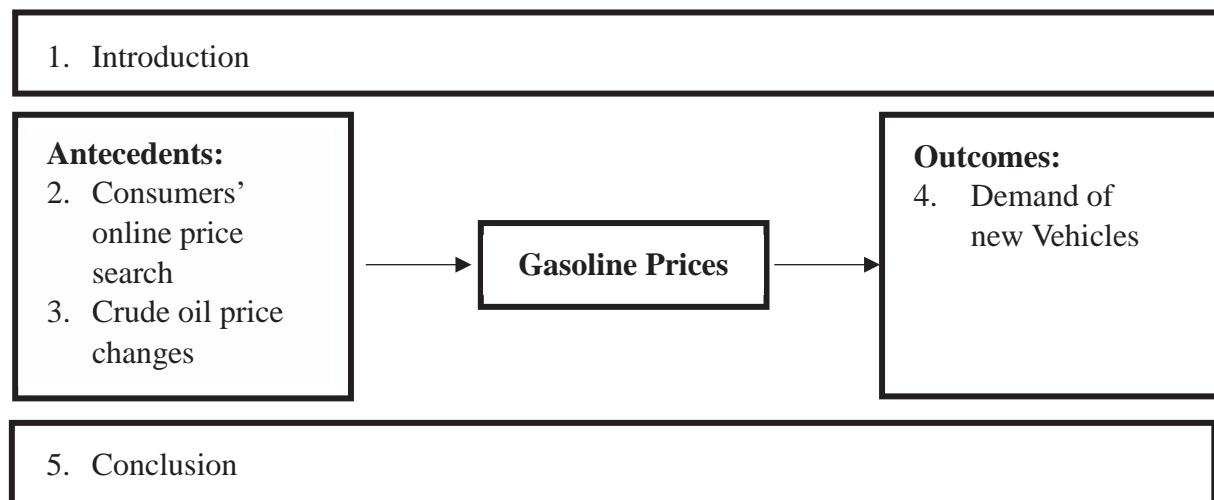
Price variations in the market can lead to consequences in consumers' purchase behavior as they potentially affect household budgets. For instance, changes in gasoline prices have a direct effect on the spending behavior of households for grocery goods as they plan their shopping trips based on gasoline prices (Ma et al. 2011). Furthermore, increases in gasoline prices can shift consumers' preferences to purchase more fuel efficient cars (Busse et al. 2016). Hence, the outcomes of the price policy intervention are not only relevant for consumers but also for firms in other industries. Therefore, the third part of my dissertation analyzes the relationship between gasoline price changes and demand for new vehicles in the German market.

In sum, the previous literature rarely focused on marketing aspects such as behavioral traits of consumers and firms in the gasoline market. Therefore, it is crucial to analyze not only the economic factors of gasoline prices but also behavioral aspects. Thus, this doctoral thesis addresses this void and contributes to the literature by analyzing the large-scale policy intervention that was designed to increase price transparency in the German market. First, it is unclear whether this interference increases consumers' gasoline price knowledge, and thus leads to a reduction in price level and price dispersion. Second, gas stations

may reconsider their pricing strategies in response to the policy intervention. Therefore, it is relevant to know to which extent gas stations react to crude oil price changes and how brands differ in their reactions. Third, the outcomes of this policy intervention are relevant for firms in other industries as gasoline price changes could affect consumer spending. Therefore, it is important to investigate whether gasoline price changes affect consumers' new vehicle choices.

This dissertation is structured as follows. This Chapter 1 contains the introduction. Chapter 2 and 3 analyze the antecedents of gasoline prices and Chapter 4 investigates the outcomes of gasoline prices. Chapter 5 includes a conclusion. Figure 1 presents the framework of the doctoral thesis.

Figure 1.1: Dissertation Framework



In Chapter 2, joint work with Wiebke Keller and Dominik Papies, we explore consumers' online price search effects on the pricing behavior of firms (gasoline price level and price dispersion). As regulators have recently implemented a mechanism for reporting all price changes to a central data base, the core assumption of this price reporting scheme is that the increase in price transparency will lead to a decline in the price level and a reduction in price



dispersion. Previous empirical literature analyzed the issue of market efficiency mainly in the online market. However, the results have been mixed. Some researchers indeed find that an increase in price transparency leads to lower prices and price dispersion in the market (e.g., Brown and Goolsbee 2002, Brunger and Perelli 2009), while other studies however find the opposite effect (e.g., Brynjolfsson and Smith 2000). Because most of the studies compare the offline market to the online market, where search costs and switching costs are reduced, it is not clear whether the results of these studies can be transferred to the gasoline market. Furthermore, online and offline markets might differ in terms of consumer price elasticity. We therefore contribute to the literature by studying whether that exogenous shock – introduction of market transparency for fuel – can make an offline market more efficient. To this end, we compile a panel data set that contains all price changes for all German gas stations (close to 14,000 stations) from December 2013 to January 2015 and information on consumer searches for gasoline prices. We use various cross-sectional measures of price dispersion as dependent variables. The results are mixed, as an increase in price information reduces price dispersion across gas stations on some measures. In contrast, however, we also find that prices tend to increase as consumers become more informed. Furthermore, brand strength and the number of competitors moderate several of these effects.

Chapter 3 focuses on the effect of crude oil price changes. The reasons for the continuous variation in gasoline prices might be based on crude oil price changes. Crude oil is the key raw material for the production of gasoline and thereby the main cost element for gas station owners. Past studies have analyzed whether gas stations adjust their prices asymmetrically when crude oil prices change, i.e., whether stations increase gasoline prices more quickly in response to an oil price increase than they decrease gasoline prices when oil prices decrease (e.g., Borenstein et al. 1997, Balmaceda and Soruco 2008). Although



past studies have already studied the asymmetric price response, this part of the dissertation contributes to the literature by analyzing the short-run effect of crude oil price changes on a daily basis. Previous research has used weekly, biweekly or monthly price data. The advantage of daily data is the consideration of daily price volatility, which is hidden when using weekly or monthly data. The daily price volatility reveals immediately visible reactions by gas stations to the crude oil price changes while a more aggregated data set does not show this effect and thus leads to aggregation bias. Furthermore, I investigate whether brands differ in their reactions to crude oil price changes as strong brand stations might differ in their price adjustments. Using the same data base as in chapter 2, my data consists of an unbalanced panel data set comprising the daily gasoline prices of 13,277 stations from December 2013 to January 2015. Methodologically, I apply an error correction model, which captures the short- and long-run effects of crude oil prices on gasoline prices. The results show that it takes some time for crude oil price increases to pass through to retail prices, but overall, increases seem to be passed along faster than decreases. Furthermore, this part of the dissertation shows different asymmetric price responses among strong brands, as well as comparing strong with weak brands.

Since price changes in the gasoline market might potentially affect household budgets in other sectors, e.g., food industry (e.g., Ma et al. 2011), Chapter 4 aims to analyze how consumers react to gasoline price changes, i.e., whether they react more strongly to gasoline price increases or to price decreases when considering buying a new vehicle. This part of the dissertation concentrates on different car classes in the German market and uses a panel dataset of 7,487 new car registrations of different vehicle models from 2006 to 2014. Previous literature has long noted that consumers respond asymmetrically to the purchase price (e.g., Kalwani et al. 1990), but they focused on the direct effects of price changes. This part of my dissertation is not only interested in



identifying the main effect of gasoline price changes, but also in potential moderators, such as CO₂ emissions. The results suggest – contrary to my expectation – that consumers respond more sensitively to gasoline price decreases than to gasoline price increases and the largest asymmetric effect is found for higher vehicle classes. Furthermore, this study shows that gasoline price increases and price decreases are not statistically moderated by CO₂ emissions of vehicles for most car classes.

Chapter 5 provides a conclusion, where I summarize the results of all chapters before I outline the implications based on the findings. For each chapter I present general remarks on the data and methods.

2. The effect of consumer online price search on pricing behavior of firms

Chapter 2 is a slightly modified version of the working paper “The effect of consumer online price search on pricing behavior of firms” by Anna Smolnik, Wiebke Keller and Dominik Papies. The contributions of the respective coauthors were as follows: The data management, all analyses and the first draft of the working paper was conducted by Anna Smolnik. Wiebke Keller contributed to the data management programming, the analyses and gave constructive feedback. Dominik Papies provided continued support and feedback with regard to questions that arised during the whole process and eventually revised the draft of the working paper.

Abstract

The advent of different online price comparison mechanisms has stirred an ongoing debate on whether an increase in price transparency indeed makes markets more efficient, as economic theory would predict. This discussion was supported by empirical studies focusing on different online price comparison mechanisms, however, the results have been mixed. Recently, regulators have implemented mechanisms to increase price transparency, with the goal of reducing price dispersion and ultimately prices. For instance, German gasoline stations have to report all price changes instantaneously to a central data base since December 2013. Third-party providers (e.g., mobile Apps, price comparison sites) can then tap this data base to inform their customers about real-time gasoline prices. In the wake of this regulatory change, many price comparison Apps and websites entered the market, and consumer usage of these price comparison tools surged.

We exploit this surge in consumer search for price information to study its effect on the pricing behavior (price level and price dispersion) of the firms. To this end, we compile a panel data set that contains all price changes for all German gas stations (close to 14,000 stations) for more than 400 days and