What determines price changes and the distribution of prices? Evidence from the Swiss CPI.☆

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Abstract

This paper examines how firms set and adjust their prices depending on macroeconomic, sectoral and individual conditions. A large panel of quarterly firm and product price data, which underlie the sectoral CPIs, from 1993 to 2012 is used for this purpose. The data allow a detailed traceability of the pricing decisions over time. Among several macroeconomic factors, an appreciation of the Swiss franc leads to an increase in the probability of positive price change as well as in the size of this price change. Singling out one policy measure, we found that an increase of the VAT is proportionally shifted to prices although the costs of the concerned producers do not increase to the same extent due to the deductibility of input cost. Finally, the dataset allows to analyze the development of price dispersion at product level. We can show that an increase in the VAT leads to a decrease of the variance of prices whereas macroeconomic factors have no impact.

Keywords: Price setting behavior of firms, Frequency of price changes, Price dispersion
JEL-Classification: E31, E37, E52

1. Introduction

The price setting behavior of firms is central for the understanding of macroeconomic policies. The fact the prices are temporarily sticky is well documented by the empirical literature (e.g., Bils and Klenow (2004), Álvarez et al. (2006)). However, these papers focus on the frequency of price adjustments only without studying the size of price changes: There is little knowledge how strong a firm adjusts its price (if it adjusts)

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and what determines the size of a price change. The same holds for the price setting vis-à-vis the competitors, i.e., for the distribution of prices over time. This paper fills these two gaps by using a panel data set of specific product prices which underlie several sectoral CPI data. The available sectors are typical non-tradable services, i.e. cinemas, hairdressers and restaurants (food & drinks). The advantage of this data set is that it does not rely on a qualitative survey and allows an apportionment of each data point to a specific firm, sector or product group.

We investigate which observable factors influence the price setting behavior for both, the simple frequency as well as the size of price changes. Following the literature, we distinguish between time-dependent and state-dependent variables whereas our special focus lies on the impact of the macroeconomic environment. In line with previous results, we find that time-dependent variables are of less importance with the exemption of seasonality components, i.e. we can observe not only more but also stronger price adjustments in the first quarter of a year.

Among several policy parameters we study the impact of changes in the VAT, addressing the question how this external cost shock is shifted to prices. During the observed time period, Switzerland experienced four increases of the VAT. Our results indicate that an increase of the VAT is proportionally (or even over-proportionally) shifted to the prices although the costs of the firms do not increase to the same extent.

Finally, the dataset allows us to analyze price dispersion at product level over a relatively long time period. This is a unique feature compare to other datasets. The phenomenon of price dispersion is of growing interest in macroeconomics as producer heterogeneity becomes more important. Our results indicate that an increase in the VAT lead to a decrease of the variance of prices whereas there is no impact of other macroeconomic factors. Other moments are not even influenced by the VAT.

The remainder of the paper is organized as follows: Section 2 provides review on the relevant literature. Section 3 describes the data and shows some descriptive statistics. Section 4 presents the results of the econometric estimation regarding the price setting behavior whereas section 5 shows the analyze of the development of price dispersion. Finally, section 6 concludes.

2. Review of existing literature

There are several theoretical models explaining the (not perfectly flexible) price setting behavior of firms from a macroeconomic perspective. Two branches can be identified: On the one hand, time dependent models consider the timing of price changes as exogenously given, only the size of the price change is chosen by the respective firm. The most cited and used approach has been developed by Calvo (1983) implying that a specific firm can adjust its price in each period at a given, constant probability.[4] Other models

[4]A similar and even earlier study developed by Taylor (1980) considers the length of contracts as fixed and postulate that prices can only be changed at the beginning of a contract.

like the sticky information approach by Mankiw and Reis (2002) keep the main idea of a time dependent price setting behavior of firms. State dependent pricing, normally referenced as menu cost models, assume that firms react to idiosyncratic shocks, i.e. that firms' pricing decision is independent of timing (Dotsey et al., 1999; Gertler and Leahy, 2008; Golosov and Lucas, 2007). A very popular approach following this view is proposed by Rotemberg (1982) who models price changes as a costly action whereas the costs increase disproportionally with the size of the price change. A newer approach taking up the same main idea is the rational inattention model developed by Maćkowiak and Wiederholt (2009). They assume that firms decide what to pay attention to, which is a constrained action.

Most empirical research focus on the frequency of price adjustments and its determinants only and less on the size of price changes. On the one hand, this is a direct consequence of the fact that most theoretical models do also rather concentrate on the frequency (as a measure of price stickiness). On the other hand, this might also be a result of limited data availability. Cecchetti (1986) used data on the newsstand prices of American magazines in order to find a relationship of inflation and the frequency of price adjustments, a finding which is supported by other authors as well. However, the concentration on one single product shrinks the relevance of Cecchetti's work somewhat. A broader set of data, i.e. twelve selected retail goods, is therefore used by Kashyap (1995). He states that prices are normally fixed for more then one year, however, he also clearly stress that the time between price changes is irregular, i.e. there is probably no stable frequency at all. It is therefore not surprising that other papers found different frequencies. Bils and Klenow (2004), for example, who consider over 350 categories of consumer goods, examine a frequency around five months. Nakamura and Steinsson (2008) propose that 9-12% of prices are changed in every month whereas price adjustments are very seasonal, i.e. most prices are changed at the beginning of a year.

Using a survey across industrial firms in Switzerland, Lein (2010) stresses the importance of state-dependent variables. Her data set also allows to consider the impact of individual cost structures and expectations but not the size of price changes. Kaufmann (2009) uses a very similar dataset as we do, even for a broader set of subindices, however, his contribution remains at a descriptive stage. Honoré et al. (2012) use also data from subindices of the Swiss CPI investigating the contribution of general inflation on the share of positive price change in Switzerland.[5]

As mentioned, little is known empirically about the impact factors on the size of price adjustments. To some extent an exemption is the work of Klenow and Kryvtsov (2008). They use item-based pricing for three sub-areas of the US-CPI, suggesting that frequency and size of price adjustments are unrelated to the timing. However, they do not discuss

[5]Some studies investigate the reaction of sectoral price indices (instead of prices in a narrow sense) to macroeconomic disturbances, e.g. Boivin et al. (2009), Maćkowiak et al. (2009), Kaufmann and Lein (2013), Altissimo et al. (2009)

the size of the impact of macroeconomic fluctuations and developments. Our work fills this gap.

Regarding price dispersion, existing empirical literature only focuses on very small industries, a short time period or on price dispersion across countries. Borenstein and Rose (1994), for example, look at the Airline industry in the year 1986 and found higher dispersion on routes with more competition.[6] Clay et al. (2001) investigate the effect of advertising and branding on the differentiation of prices and found a positive impact. A comparison of the general price level among EMU-countries is performed by Hoeberichts and Stokman (2011), finding that the dispersion of price levels is negatively related to the business cycles. Contrary to the existing work, our dataset allow to observe price dispersion for many products over a relatively long time period.

3. Data description and descriptive statistics

3.1. The data

Our analysis is based on a set of panel data underlying subindices of the Swiss CPI. Data are provided by the Swiss federal office of statistics [SFOS]. The dataset allows to track the development of a single price for a given product charged by a given firm over time. Data are available for four subindices of the Swiss CPI: Hairdressers, Cinemas, Food in restaurants, and Drinks in restaurants, representing a total weight of 4.13% in the CPI in 2013. These four available sectors all represent classical non-tradable services.[7]

Data are on a quarterly basis form 1993Q2 to 2012Q4. Firms and products enter and exit the dataset on a irregular basis but this is documented.[8] Thus, a few prices can be tracked over the whole sample. This is a main advantage of the dataset compared to other ones (e.g. Klenow and Kryvtsov (2008), where products always drop out the dataset after at least five years). Furthermore, only 0.21% of all recorded price changes in the data set are due to temporary sales which largely eliminates a critical source of disturbances in the estimation. A disadvantage of the data is that we cannot observe any additional information about the tracked firms, i.e. we do not know anything about the location or the firm size.

In the second quarter of the year 2000, we observe a disproportional high number of firms and products that have been replace since the calculation method of the CPI has changed at this point in time (see Kaufmann (2009) for a broader discussion). A few high price jumps indicate potential measurement errors at this date, however, we keep them in data since they are not extraordinary.

[6] Sengupta and Wiggins (2014) expand this work by taking into account internet purchase of airline fares. They do not find a reduction of dispersion from a greater internet shooping.

[7] Note that detailed price data underlying the CPI are normally confident and not available. This is why more sectors are not available.

[8] Also the total number of recorded prices varies over time.

The dataset records, based on the statistical criteria of the SFOS, if a certain product has been replaced by a new one, e.g. because of a substantial quality improvement. If we observe such a replacement, we let the given price series end and start a new one. With this procedure, we end up with a total of 15'932 price series containing 73 different products. Overall, the data comprises 345'963 observations representing an unbalanced panel structure.

Two variables are constructed from the data: First, at each point in time and for each price series, the number of periods since the last non-zero price change. Let's $p(i_n, j, t)$ be the price of product i_n (where n is the number of the product, if the same product type i is sold more then once by the same firm), charged by firm j, in period t, then, $\hat{p}(i_n, j, t) \equiv \frac{p(i_n,j,t)-p(i_n,j,t-1)}{p_(i_n,j,t-1)}$ subsequently defines the respective relative change of this price. Furthermore, we denote $k_1(i_n, j), k_2(i_n, j), \ldots, k_m(i_n, j), \ldots, k_M(i_n, j)$ as those periods when we observe a change of the price $p(i_n, j, t)$. In formal terms:

$$t = \begin{cases} k_m(i_n, j), & \text{if } \hat{p}(i_n, j, t) \neq 0 \\ k_m(i_n, j) + z(i_n, j, t), & \text{otherwise} \end{cases}, \tag{1}$$

where $z(i_n, j, t,) \equiv \min\limits_{k_m(i_n,j)<t} (t - k_m(i_n, j)) \; \forall \, t, m$ therefore represents the aspired number of periods since the last price change. By constructing the variable $z(i_n, j, t,)$, we had to skip the data before the first price change in every price series, $k_1(i_n, j)$. This procedure follows Klenow and Kryvtsov (2008), who also pointed out that estimations would be biased otherwise.

Second, we are interested in the accumulated sectoral inflation after a price-change as a measure for the general price development. Each product i belongs to one of the four used CPI-subindices which we denote by Ω.[9] $\mathrm{CPI}_{\Omega(i)}(t)$ therefore represents the subindex to which product i belongs (in period t). Given this notations, accumulated inflation since the last price change, denoted as $\pi(i_n, j, t)$, is defined as follows:

$$\pi(i_n, j, t) = \min_{k_m(i_n,j)<t} \frac{\mathrm{CPI}_{\Omega(i)}(t-1) - \mathrm{CPI}_{\Omega(i)}(k_m(i_n, j))}{\mathrm{CPI}_{\Omega(i)}(k_m(i_n, j))}. \tag{2}$$

Note that equation (2) implies that accumulated inflation is measured as the inflation between the last price change and period $t-1$. This is assumed for the following reason: A firm, that is deciding in period t whether it wants to change the price of one of its products or not, knows the inflation rate until period $t-1$ only as the inflation rate until period t is not known before all firms have made their pricing decisions in period t. Moreover, the construction of the variable also prevents from a potential endogeneity problem.

Table 1 finally provides an overview on the data structure. Note that the total number of observations refers to the number of observed prices but not to the number of price changes.

[9] Data on the CPI-subindices are provided by the SFOS.

Table 1: Overview data

Specification	**Number**
Producers (or firms), j	457
Product groups, Ω	4
Products, i	73
Price series, $p(i_n, j)$	15'932
Quarters, t	79
Observations, $p(i_n, j, t)$	345'963
Time span	1993Q2-2012Q4

Table 2: Share of price changes

Product sector, Ω	Cinema	Hairdresser	Rest., drinks	Rest., food	**Total**
Price change (abs.)	0.060	0.089	0.094	0.091	**0.091**
Pos. price change	0.051	0.084	0.082	0.074	**0.078**
Neg. price change	0.009	0.005	0.012	0.017	**0.013**
Numb. of obs.	12'870	42'104	132'140	142'893	**330'007**

3.2. Descriptive statistics

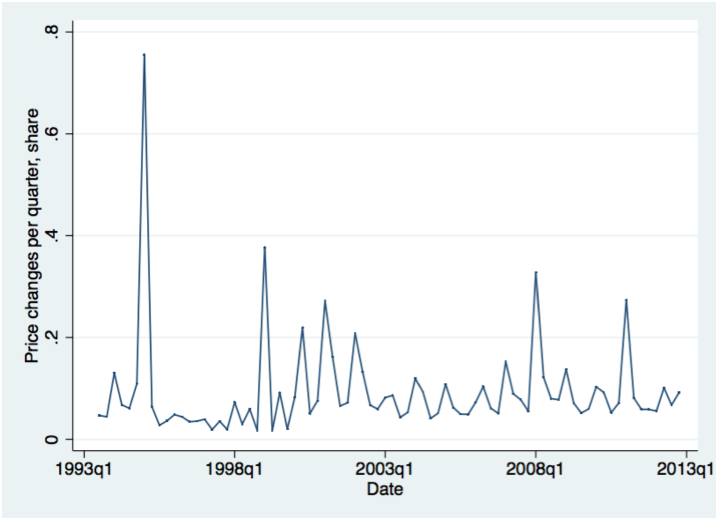
Table 2 presents the frequency of price changes (positive and negative) broken down into each individual product sector Ω. Over the whole sample, prices are changed in 9% of all observations. Compared to the literature, firms in our dataset change prices relatively seldom. Lein (2010), for example, reports values that are three times higher for Swiss manufacturers. The reason for this difference might lie in the different set of products (non-tradable services) that our dataset contains.

The data also suggest a strong downward rigidity of the prices. This is in line with the findings by Kaufmann (2009) and can be to some degree explained by a nominal downward rigidity of wages as it is described by Fehr and Goette (2005) for the case of Switzerland.

Figure 1 graphically illustrates the (unweighted) frequency of prices changes over time measured as a share of all observations in each quarter. The graph provides two main insights: First, the peaks in the first quarter of the year 1995 and 1999 and to a less extent in the first quarter of the years 2001 and 2012 indicate increases of the VAT that took place at this dates. In the first quarter of 1995, when the VAT was introduced, 75.5% of all prices in the sample have been changed.[10] Second, the graph indicates that the frequency of price changes is seasonal with a peak in the first quarter of a year and a decline afterwards.

[10]Note that the service sector in Switzerland did not have to pay any sales or value added taxes before this point in time.

Figure 1: Frequency of price changes, quarter by quarter



The seasonality of the frequency of price changes is also supported when looking at the distribution of time periods between price changes as illustrated in figure 2. As it is in line with most models, the distribution is right skewed, i.e. the more time has passed since the last price change, the higher is the probability that a firm will adjust its prices. However, we can also observe a local peak in every forth period, indicating the mentioned concentration of price changes at the first quarter of a year.

Contrary to other datasets, we are able to calculate not only the frequency but also the size of price changes. Table 3 and figure 3 describe how the size of non-zero price changes are distributed. For this purpose, we have normalized the data in the sense that we have subtracted the accumulated sectoral inflation at every non-zero price change (data points without a price change, which are the majority are excluded), i.e. the statistics refer to data of the following form:

$$\hat{p}_{norm}(i_n, j, t) = \begin{cases} \hat{p}(i_n, j, t) - \pi(i_n, j, t), & \text{if } \hat{p}(i_n, j, t) \neq 0 \\ \emptyset, & \text{otherwise} \end{cases}. \quad (3)$$

The normalization allows us an interpretation of the size of price change abstracting form the potential "distortion" of the general price development. Not surprisingly, the the average normalized price change is therefore statistically not different from zero. However, we can observe a relatively wide distribution of the price changes, implying that other factors might also be important in the price setting process.

Figure 2: Distribution of times between price changes

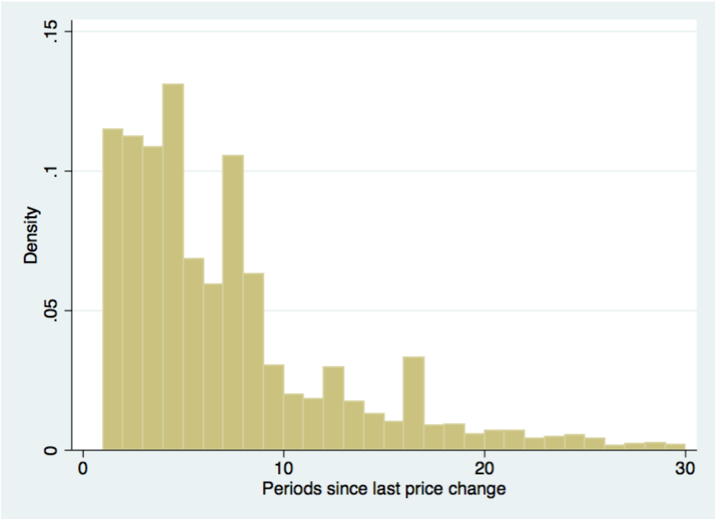
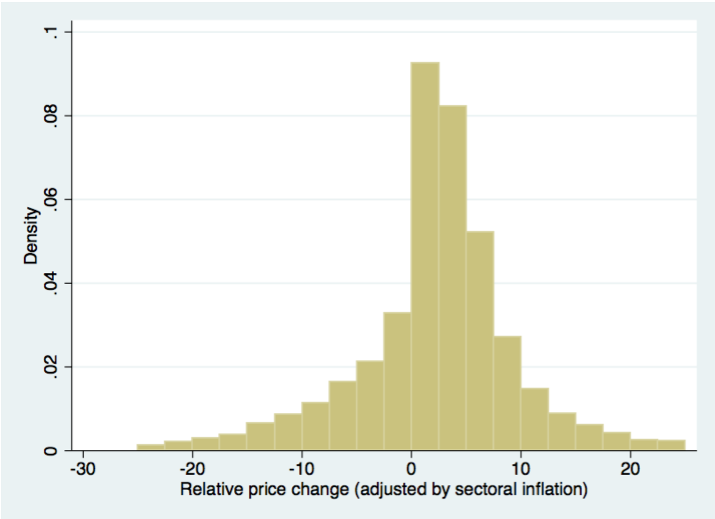


Table 3: Statistics rel. price changes corrected by sectoral inflation

	Mean	St.Dev.	Min.	Max.
Normalized price change, $\hat{p}_{norm}(i_n, j, t)$	0.141%	2.265%	-79.86%	193.2%

Figure 3: Histogram (non-zero) relative price changes , $\hat{p}_{norm}(i_n, j, t)$



4. Econometric results

4.1. Methodology

Two kinds of estimations are conducted within this section. First, we focus on the extensive margin, i.e. we estimate how the different factors influence the probability of a (positive or negative) price change. For this purpose, a conditional logit model is employed. We have to rely on the conditional form since we are not able to observe any individual attributes of firms or prices series within the dataset. In the second part, we focus on the intensive margin, i.e. we estimate how the different factors influence the size of price adjustments by relying on a standard OLS-framework.

In each of the two models, we run three regression specifications whereas the the specifications differ in the number of variables included. The first specification is estimated by using time-dependent variables and the variables concerning the VAT, as a specific and important policy measure, only.[11] Time-dependent variables consist of the number of periods between two price changes, $z(i_n, j, t)$ as well as dummies for the first, second and third quarter in each year.

The variables concerning the VAT are of three kinds: One reports the relative change of the VAT at the quarter this change happens.[12] The second group of VAT variables simply consists of the first two lags of the first variable. The third kind of variables contain the relative change of the VAT at the points in time this change was officially known to happen some quarters in the future and is zero otherwise.[13]

The second specification adds the accumulated sectoral inflation, $\pi(i_n, j, t)$, as a proxy for a price series specific state variable. The third specification finally adds variables for the macroeconomic environment. These are the real year on year GDP growth[14], the quarter on quarter growth rate of the real exchange rate index[15], and the first difference of the three month Libor interest rate[16]. All macroeconomic variables are added up to a lag of four quarters.

A dummy for the second quarter of the year 2000 is included as well in each estimation[17], the same holds for starting and ending points of temporary sales. All estimations also include product series specific fixed effects. Standard errors are clustered by firm as it is proposed by Lein (2010).

[11] See also Kaufmann (2009) who find a significant impact of of the VAT at the aggregated level.

[12] The relative change of the VAT, denoted as τ_t (for period t), is determined as follows: $\frac{(1+\tau_t)}{(1+\tau_{t-1})} - 1$.

[13] For the case of Switzerland, this means that the change of the VAT has been approved in a popular vote or that the deadline for referendum against an increase of the VAT has passed. The VAT increases in 1995 and 2001 has therefore been known four quarters before they were enacted. The VAT increase in 1999 was three quarters and the one in 2012 five quarters known in advance.

[14] Data are provided by the SFOS

[15] Data are provided by the Swiss National Bank. Note that the use of the exchange rate relative to the Euro does change the results only slightly

[16] Data are provided by the Swiss National Bank.

[17] This is done because of the relatively high proportion of product replacements in this period due to a change in the calculation method of the CPI.

4.2. The conditional logit probability model

This section presents the results of the conditional logit probability model. The estimations for the three specifications are performed twice, once for positive price changes, and once for negative price changes. All tables report marginal effects evaluated at the variables' mean given that the fixed effect is zero. For dummy variables, the marginal effect are calculated at the change of the dummy from 0 to 1.

Table 4 presents the results for the estimations. These are generally in line with the literature regarding the rather small role of the number of periods since the last price change and the confirmation of the thesis from the descriptive statistics that most price changes happen in the first quarter of a year, i.e. seasonality is the most important time dependent factor. The respective coefficient is highly significant in all estimations and specifications.

Table 4: Cond. logit probability model

Panel A: Positive price changes	Specification 1	Specification 2	Specification 3
Rel. change VAT	0.709***	0.708***	0.583***
	(0.047)	(0.051)	(0.052)
Rel. chan. VAT, 1 Lag(s)	0.037	0.012	−0.052
	(0.055)	(0.050)	(0.054)
Rel. chan. VAT, 2 Lag(s)	0.017	−0.002	−0.082
	(0.058)	(0.059)	(0.064)
Fut.VAT-incr. known, 1 Lag(s)	0.249***	0.246***	0.235***
	(0.053)	(0.051)	(0.057)
Fut.VAT-incr. known, 2 Lag(s)	0.180***	0.185***	0.234***
	(0.061)	(0.058)	(0.057)
Fut.VAT-incr. known, 3 Lag(s)	−0.068	−0.036	0.095
	(0.106)	(0.092)	(0.070)
Fut.VAT-incr. known, 4 Lag(s)	0.004	0.004	0.065
	(0.070)	(0.071)	(0.063)
Fut.VAT-incr. known, 5 Lag(s)	0.158	−0.007	0.249
	(0.603)	(0.604)	(1.056)
Periods since last price change, $z(i_n, j, t,)$	0.125***	0.081***	0.082***
	(0.011)	(0.013)	(0.013)
$z(i_n, j, t,)^2$	−0.001***	−0.002***	−0.002***
	(0.000)	(0.000)	(0.000)
Dummy 1st quarter	1.285***	1.298***	1.258***
	(0.093)	(0.093)	(0.110)
Dummy 2nd quarter	0.596***	0.556***	0.563***
	(0.100)	(0.099)	(0.118)
Dummy 3rd quarter	0.111	0.097	0.230**
	(0.086)	(0.086)	(0.094)
Sales	−14.623***	−13.734***	−14.262***
	(0.493)	(0.479)	(0.415)
Sales end	3.225***	3.269***	3.391***
	(0.536)	(0.537)	(0.523)
Dummy 2000Q2	0.871***	0.958***	1.123***
	(0.148)	(0.150)	(0.196)
Acc.sec.infl., $\pi(i_n, j, t)$		0.182***	0.192***
		(0.034)	(0.034)
GDP growth, yoy			0.025
			(0.042)
Lag 1 quarters			−0.029
			(0.066)
Lag 2 quarters			0.008

			(0.068)
Lag 3 quarters			−0.155**
			(0.065)
Lag 4 quarters			0.242***
			(0.038)
RER index, gr. qoq			0.096***
			(0.015)
Lag 1 quarters			0.098***
			(0.019)
Lag 2 quarters			0.015
			(0.019)
Lag 3 quarters			−0.033**
			(0.017)
Lag 4 quarters			−0.017
			(0.018)
3m Libor, 1st diff.			−0.074
			(0.105)
Lag 1 quarters			−0.126
			(0.110)
Lag 2 quarters			0.379***
			(0.095)
Lag 3 quarters			0.080
			(0.125)
Lag 4 quarters			0.124
			(0.095)
Pseudo R^2	0.162	0.166	0.188
Observations	180'032	180'032	180'032

Panel B: Negative price changes	Specification 1	Specification 2	Specification 3
Rel. change VAT	−0.032	−0.030	−0.045
	(0.047)	(0.049)	(0.064)
Rel.chan. VAT, 1 Lag(s)	−0.223***	−0.211***	−0.206***
	(0.068)	(0.068)	(0.073)
Rel.chan. VAT, 2 Lag(s)	−0.093	−0.084	−0.089
	(0.058)	(0.058)	(0.066)
Fut.VAT-incr. known, 1 Lag(s)	−0.002	−0.004	−0.007
	(0.045)	(0.047)	(0.055)
Fut.VAT-incr. known, 2 Lag(s)	−0.058	−0.068	−0.074
	(0.060)	(0.062)	(0.066)
Fut.VAT-incr. known, 3 Lag(s)	0.004	−0.006	−0.025
	(0.054)	(0.057)	(0.062)
Fut.VAT-incr. known, 4 Lag(s)	−0.132	−0.136	−0.134
	(0.108)	(0.106)	(0.109)
Fut.VAT-incr. known, 5 Lag(s)	−0.185	−0.107	−1.178
	(0.744)	(0.747)	(1.122)
Periods since last price change, $z(i_n, j, t,)$	−0.014	0.018	0.016
	(0.019)	(0.025)	(0.024)
$z(i_n, j, t,)^2$	0.001*	0.002**	0.002**
	(0.001)	(0.001)	(0.001)
Dummy 1st quarter	0.285**	0.285**	0.282**
	(0.111)	(0.111)	(0.111)
Dummy 2nd quarter	0.156	0.177*	0.166
	(0.099)	(0.099)	(0.103)
Dummy 3rd quarter	0.086	0.093	0.031
	(0.110)	(0.110)	(0.121)
Sales	18.924***	18.887***	22.986***
	(0.344)	(0.340)	(0.345)
Sales end	1.196	1.185	1.162
	(0.900)	(0.894)	(0.894)
Dummy 2000Q2	2.042***	1.995***	1.659***
	(0.236)	(0.235)	(0.284)

Acc.sec.infl., $\pi(i_n, j, t)$		-0.123^{***}	-0.120^{***}
		(0.046)	(0.046)
GDP growth, yoy			0.016
			(0.068)
Lag 1 quarters			−0.059
			(0.086)
Lag 2 quarters			0.068
			(0.087)
Lag 3 quarters			−0.069
			(0.088)
Lag 4 quarters			0.014
			(0.058)
RER index, gr. qoq			−0.006
			(0.017)
Lag 1 quarters			0.014
			(0.019)
Lag 2 quarters			0.015
			(0.019)
Lag 3 quarters			0.008
			(0.019)
Lag 4 quarters			0.004
			(0.022)
3m Libor, 1st diff.			0.214
			(0.164)
Lag 1 quarters			−0.002
			(0.128)
Lag 2 quarters			0.114
			(0.147)
Lag 3 quarters			−0.113
			(0.179)
Lag 4 quarters			0.113
			(0.126)
Pseudo R^2	0.035	0.037	0.038
Observations	71'300	71'300	71'300

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

An increase of the VAT has a clear positive effect on the probability of a positive price change where this effect is only significant at the time point of the increase itself or up to 2 lags before. After the VAT increase the coefficient becomes insignificant or even negative. Not surprisingly, the probability of a negative price change decreases as the VAT increases.

Macroeconomic factors play a role in the estimation for positive price changes only. Whereas the effect of the business cycle is rather unclear, we can observe a positive impact of the real exchange rate index and the change of the interest rate. Both results are interesting since an appreciation of the home currency as well as an increase of the interest rate is intended to lead to a decrease of the price level. Remember that our dataset is based on non-tradable services which generally are not directly influenced by movements of the exchange rate. However, an appreciation of the home currency leads to a decrease of prices of imported goods which imply that households' available income increases. This effect probably leads to a higher demand for non-tradable services as they are represented in our dataset.[18] This increasing demand might be the reason for the positive impact of the real exchange rate index.

4.3. Estimations for the size of price changes

This section presents the results of the OLS-estimations treating size of price changes as the dependent variable. Note that all relative changes are expressed in percent allowing for a direct interpretation of the coefficients. Table 5 presents the respective results for the three specifications. Again, we can observe that the number of periods since the last price change has only a small impact of the current price change. The price development within a sector is of more importance, however, the respective coefficient is around 0.1, i.e. only a small part of the general price evolution seems to be considered in the pricing decision. We also observe that the size of price changes (not only the probability) is higher in the first quarter of a year then in others. This sesonality might to some degree be connected to the fact that wage contracts are typically renewed at the beginning of a calendar year in Switzerland (see Fehr and Goette (2005)).

As in the conditional logit model, we can observe a positive impact of the real exchange rate index, also when adding up the effects of all lags. Furthermore, we can locate some evidence for a pro-cyclical behavior of the size of price changes but with some lag. Finally and in contrast to the results from the conditional logit model, the impact of the interest rate is undetermined in this model as a test considering the sum of all coefficients as zero cannot be rejected.[19]

Table 5: Estimation results: Size of relative price change

	Specification 1	Specification 2	Specification 3
Rel. change VAT	0.992^{***}	0.993^{***}	0.959^{***}
	(0.048)	(0.047)	(0.050)
Rel. chan. VAT, 1 Lag(s)	0.039^{***}	0.028^{***}	-0.009
	(0.012)	(0.011)	(0.015)
Rel. chan. VAT, 2 Lag(s)	0.033^{***}	0.020^{***}	-0.001
	(0.007)	(0.007)	(0.012)
Fut.VAT-incr. known, 1 Lag(s)	0.082^{**}	0.087^{***}	0.070^{**}
	(0.032)	(0.032)	(0.033)
Fut.VAT-incr. known, 2 Lag(s)	0.041^{***}	0.051^{***}	0.065^{***}
	(0.015)	(0.015)	(0.017)
Fut.VAT-incr. known, 3 Lag(s)	0.000	0.014	0.052^{***}
	(0.017)	(0.017)	(0.019)
Fut.VAT-incr. known, 4 Lag(s)	0.011	0.015	0.020
	(0.027)	(0.028)	(0.028)
Fut.VAT-incr. known, 5 Lag(s)	-0.047	-0.153	-0.037
	(0.249)	(0.251)	(0.455)
Periods since last price change, $z(i_n, j, t,)$	0.046^{***}	0.015^{***}	0.013^{**}
	(0.004)	(0.005)	(0.006)
$z(i_n, j, t,)^2$	-0.000^{***}	-0.001^{***}	-0.001^{***}
	(0.000)	(0.000)	(0.000)

[18] In more technical terms: The income effect of an exchange rate fluctuation seems to dominate the substitution effect.

[19] The respective P-value is 0.384.

Dummy 1st quarter	0.377***	0.384***	0.393***
	(0.035)	(0.035)	(0.040)
Dummy 2nd quarter	0.149***	0.129***	0.195***
	(0.033)	(0.033)	(0.040)
Dummy 3rd quarter	0.027	0.022	0.095***
	(0.026)	(0.026)	(0.033)
Sales	−18.816***	−18.823***	−18.789***
	(2.219)	(2.225)	(2.267)
Sales end	16.258***	16.273***	16.291***
	(5.710)	(5.700)	(5.680)
Dummy 2000Q2	0.246	0.307	0.390
	(0.331)	(0.331)	(0.337)
Acc.sec.infl., $\pi(i_n, j, t)$		0.117***	0.124***
		(0.015)	(0.016)
GDP growth, yoy			0.016
			(0.018)
Lag 1 quarters			−0.026
			(0.026)
Lag 2 quarters			−0.000
			(0.031)
Lag 3 quarters			−0.017
			(0.028)
Lag 4 quarters			0.097***
			(0.016)
RER index, gr. qoq			0.039***
			(0.007)
Lag 1 quarters			0.032***
			(0.008)
Lag 2 quarters			−0.003
			(0.007)
Lag 3 quarters			−0.016***
			(0.006)
Lag 4 quarters			−0.021***
			(0.008)
3m Libor, 1st diff.			−0.068
			(0.044)
Lag 1 quarters			−0.030
			(0.045)
Lag 2 quarters			0.095**
			(0.041)
Lag 3 quarters			−0.048
			(0.051)
Lag 4 quarters			−0.047
			(0.036)
Constant	−0.138***	−0.117***	−0.252***
	(0.030)	(0.031)	(0.057)
Sum VAT-Coef.$^{\phi}$	1.150	1.055	1.119
P-Value$^{\phi\phi}$	0.586	0.842	0.802
Adjusted R^2	0.064	0.065	0.068
Observations	219'209	219'209	219'209

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
$^{\phi}$Sum-up of all VAT-related coefficients, i.e. of the first eight coefficients in each column.
$^{\phi\phi}$Null hypothesis: Sum of all VAT-related coefficients equals one.

4.4. The VAT

A special focus should be led on the impact of the VAT. The results in table 5 indicate that the total effect, i.e. the elasticity of the relative price change with respect to the relative change of the VAT, deducted by summing up all relevant coefficients, is not statistically different from one (or even above) in all specifications.[20] This implies that firms seem to increase their prices in accordance with the relative change of the the VAT, i.e. the tax increase is directly mirrored in the prices.

At a first glance, this might be not surprising, however, one should keep in mind the functioning of the VAT which taxes the value chain of a product as a whole but not each stage of it. Suppose that price of a product without VAT consists of its marginal costs c as well as a markup μ, i.e. (using our notation) $p(i_n, j, t) = (c(i_n, j, t) + \mu(i_n, j, t))\,(1 + \tau_t)$, where τ_t is the VAT-rate in period t. The elasticity of this pricing equation with respect to the (gross-) VAT is given by $\epsilon_1 = \frac{\partial p(i_n,j,t)}{\partial[(1+\tau_t)]}\frac{[(1+\tau_t)]}{p(i_n,j,t)} = 1$, i.e. an increase of the VAT-rate is proportionally shifted to the price.

However, as the VAT taxes only added value, the costs of inputs goods and services are tax deductible. Thus, the marginal costs c can be expressed as the sum of two parts: Costs of input goods or services (let's denote them as c_1) and cost of the own added value, e.g. wages, interest rates, etc. (let's denote them as c_2). Thus, the pricing equation can be written as

$$p(i_n, j, t) = \left(\frac{c_1(i_n, j, t)}{1 + \tau_t} + c_2(i_n, j, t) + \mu(i_n, j, t)\right)(1 + \tau_t). \tag{4}$$

This implies that the actual price elasticity with respect to τ_t is given by

$$\epsilon_2 = \frac{\partial p(i_n, j, t)}{\partial[(1 + \tau_t)]}\frac{[(1 + \tau_t)]}{p(i_n, j, t)} = \frac{c_2(i_n, j, t) + \mu(i_n, j, t)}{c_1(i_n, j, t) + c_2(i_n, j, t) + \mu(i_n, j, t)}, \tag{5}$$

which is below one. Moreover, the elasticity directly depends on the deductible cost share, i.e. the higher $c_1(i_n, j, t)$ the lower is the reaction of the price to a change of the VAT rate.

So, in order to evaluate the price setting behavior of the firms in our sample, we have to know which share of total costs are costs of input goods/services in the related sectors. It is clear that we cannot determine these shares for single firms as we do not have the necessary information. Nevertheless, we can determine a product group specific approximation by using the sectoral input-output-statistic provided by the SFOS for the year 2008, we can determine the added value relative to total output generated by the most important sectors.[21] For the restaurant and hotel sector (to which two of our four product groups belong to), the added value in 2008 accounted for 11.997 Billion Swiss Francs (i.e. this is the value to be taxed by the VAT) whereas the total output of the sector was 23.969 Billion Swiss Francs. This implies a elasticity for the restaurant sector of about 0.5. Hair dressers belong to the group of personal services which show an added value of 3.946 and a total output of 5.263 Billion Swiss Francs, implying an elasticity of about 0.75. Input-output data for the cinema sector are unfortunately not available.

[20] cp. last two lines in table 5

[21] Those are the main NOGA-sectors. In total, the input-output-table contains data for 42 sectors.

However, the available data on sectoral added value strongly suggests that the price elasticity with respect to the VAT-rate should be below one. This contrasts with our finding that the firms in our sample increase their price (at least) proportionally in accordance with the relative change of the VAT. Firms seem to take a VAT increase as a chance to increase the markup.

4.5. Endogeneity issues

In the estimations above, we considered macroeconomic factors having a clear causal effect. However, it might be possible that shocks influencing macroeconomic variables as GDP growth do also have an impact on the price setting considerations of firms, i.e. they are sometimes simultaneously determined.[22] This would cause an endogeneity problem as the error terms in the estimations above are not uncorrelated with the regressors. As a result, our estimated coefficients might be inconsistent.

To address this possible bias, we re-estimate our chosen specifications above using an instrumental variable approach. Remember that our price data series rely on non-tradable services. However, the Swiss economy in general is a typical example of a small open economy. Thus, it is clear that macroeconomic or policy parameters of the most important trading partner (European Union and USA) do have an impact on the macroeconomic conditions in Switzerland. A good example are short term interest rates set by the respective central bank. They have a direct impact on the exchange rate and are therefore also correlated with the Swiss business cycle. Moreover, the short-term interest rate for the Swiss Franc is also heavily influenced by the interest rates of Switzerland's most important trading partners. However, there is no reason to believe that non-trading firms do consider foreign central banking policy in their pricing decisions making the short term interest rates of the trading partners a valid instrument.

In the re-estimation, each macroeconomic variable is separately to the standard regression and then instrumented using the short term interest rates (and their lags) of the European Union and the U.S. This procedure also allows us also to check whether our results are robust to the individual inclusion of the macroeconomic variables. For the non-linear conditional logit model, our estimation rely on the instrumental variable approach proposed by Terza et al. (2008). Note, that standard errors in this estimations are bootstrapped in order to keep them consistent and comparable.[23] The estimation procedure for the linear standard TSLS estimation follows the procedure of Schaffer (2005) in order to obtain unbiased, clustered standard errors.

Tables A.7 - A.8 in the appendix show the results of the performed IV regressions. As can be observed, the IV-regressions generally tend to report a stronger effect relative

[22]Note that we do not consider the VAT as potential endogenous variable as the VAT is not used as an instrument to do macroeconomic policy in Switzerland. The setting of the VAT is the result of a political process and the time of introduction/change is random. See Strittmatter and Sunde (2013) for a similar discussion about health insurance.

[23]The bootstrapping procedure consists of 1'000 replications.

to the standard estimations with respect to the impact of the macroeconomic factors (in both, the conditional logit as well as the standard OLS model). This particularly holds for the impact of the interest rate on the relative price change which is clearly negative and significant in the IV-regression.

4.6. Additional robustness checks

In this section, we test whether our results are robust with respect to data preconditions. First, we run our regressions by restricting the included time frame to the time after the year 1995. With this restriction we exclude the introduction of the VAT which can be considered as an exceptional incident in the sense that the increase of the VAT was extraordinary high at this point in time (compared to other increases of the VAT) which might potentially lead to an overestimation of the effect of the VAT. Moreover, as we have seen in the descriptive statistics section, the number of price changes was very high in 1995. Surprisingly, the effect of the VAT even increases somewhat with the restricted time frame whereas the impact of other variables stay constant. However, the goodness of the fit nearly halves with the restricted time frame.

Second, we modify our data in the sense that we assume the first data point in each price series to be a price change, i.e. $k_1(i_n, j) \equiv t_1 \; \forall \; i, j$. This procedure expands the number of available data points making the estimation more precise, however, Klenow and Kryvtsov (2008) argue that the results become biased. However, our results mostly do not disclose a notable difference between the usage the two data types for the estimations.

Third, we perform our estimations separately for the four product groups (i.e. Cinema tickets, Hairdresser services, Drinks at restaurants, and Food at restaurants).[24] The results suggest that the impact of a change of the VAT is stronger in the restaurant and the hairdresser sector but less pronounced for cinemas. Moreover, the impact of the real exchange rate seems undetermined in the cinema sector, whereas the hairdresser sector is the most affected. However, this results are not surprising as the cinema sector tends to change prices less frequently then the other sectors.

5. Price dispersion

A special feature of our dataset is that it allows to estimate price dispersion (variance and higher moments) for each of the 73 product type at each point in time. For this purpose, we calculate each price relative to the mean price of this product category at each point in time. In formal terms:

$$\rho(i_n, j, t) = \frac{p(i_n, j, t)}{\frac{1}{A(i,t)} \sum_{n,j} p(i_n, j, t)} - 1, \tag{6}$$

[24]The respective results are available on request.

where $A(i,t)$ is the total (unweighted) number of product series of product i in period t[25]. Thus, we denote $VAR(\rho(i,t)) = \frac{1}{A(i,t)} \sum_{n,j} \rho(i_n, j, t)^2$ as the variance, $SKE(\rho(i,t)) = \frac{1}{A(i,t)} \sum_{n,j} \rho(i_n, j, t)^3$ as the skewness, and $KUR(\rho(i,t)) = \frac{1}{A(i,t)} \sum_{n,j} \rho(i_n, j, t)^4$ as the kurtosis of the relative price of product i in period t.

Based on this calculation, we perform a regression of the variance, the skewness and the kurtosis on their own first two lags as well as on the change in the VAT and the year on year GDP growth rate. Furthermore, we add again dummies for the second quarter of the year 2000 and for the number of the quarter in each year. Additionally, we add a dummy for all periods after 2000Q2 as we might have a structural break after this point in time. The estimation results are presented in table 6.

The results indicate a decreasing effect of a change in the VAT on the variance of prices. A possible explanation for this result might be that firms with relatively low prices at the time of the VAT increase tend to take this increase as a chance to close the gap relative to producers which already charge high prices. This would also explain to some extent our puzzle from section 4.4 where we found evidence that rises of the VAT are taken as a chance for relatively high price increases. No significant impact can be found regarding the business cycle since the coefficient are not jointly different from zero.[26]

[25] Note that by construction it holds $\frac{1}{A(i,t)} \sum_{n,j} = 0$.

[26] The p-value of the respective F-test is 0.134.

Table 6: Estimation results for price dispersion

	Variance 1	Variance 2	Skewness 1	Skewness 2	Kurtosis 1	Kurtosis 2
Lag 1 period	0.653***	0.653***	0.801***	0.801***	0.668***	0.668***
	(0.148)	(0.148)	(0.0808)	(0.080)	(0.125)	(0.125)
Lag 2 period(s)	0.212*	0.211*	0.097	0.096	0.179**	0.179**
	(0.120)	(0.120)	(0.066)	(0.066)	(0.085)	(0.085)
Rel. change VAT	−4.170**	−6.501***	−0.004	−0.006	−0.007	−0.022
	(1.738)	(2.067)	(0.004)	(0.005)	(0.031)	(0.039)
Dummy 1. quarter	5.824	6.876	−0.005	−0.004	−0.039	−0.029
	(9.190)	(9.139)	(0.015)	(0.015)	(0.092)	(0.094)
Dummy 2. quarter	−2.849	−2.807	0.001	0.001	0.049	0.052
	(10.485)	(10.714)	(0.011)	(0.011)	(0.065)	(0.065)
Dummy 3. quarter	−9.259	−8.873	0.018	0.018	0.170*	0.175*
	(8.093)	(8.249)	(0.014)	(0.014)	(0.097)	(0.098)
Dummy 2000Q2	274.377**	269.980**	0.428**	0.412**	2.518	2.447
	(133.988)	(134.362)	(0.167)	(0.170)	(1.580)	(1.593)
Post 2000Q2	13.412*	12.140	0.014	0.013	0.002	0.015
	(7.621)	(7.312)	(0.017)	(0.017)	(0.130)	(0.126)
GDP growth, yoy		−1.934		0.001		−0.010
		(3.560)		(0.007)		(0.040)
Lag 1 quarter		4.339		−0.004		−0.003
		(3.740)		(0.008)		(0.045)
Lag 2 quarters		1.023		0.011		0.050
		(3.439)		(0.010)		(0.058)
Lag 3 quarters		−7.629*		−0.012		−0.095
		(4.073)		(0.010)		(0.069)
Lag 4 quarters		5.839**		0.005		0.034
		(2.440)		(0.005)		(0.034)
Constant	116.386*	114.459	0.067**	0.065*	0.804**	0.830**
	(67.769)	(70.621)	(0.029)	(0.033)	(0.352)	(0.377)
Adjusted R^2	0.689	0.689	0.791	0.791	0.677	0.677

Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6. Conclusion

Using a dataset of price series underlying the Swiss CPI, we have analyzed which factors influence the price setting behavior of firms and the price dispersion within an economy. Contrary to most previous research, our dataset not only allowed to analyze which factors influence the frequency but also the size of price changes as the development of single prices can be observed over a relatively long time period. We have found that the time span between price changes is not very important for the size of price changes which supports the finding of previous papers that time-dependent variables are of small importance. Accumulated inflation between price change plays a more important role, however, we find a clear underproportional impact. In line with many previous studies, we found that frequency and size of price changes are highly frequency as firms generally tend to adjust prices at the beginning of a calendar year.

Our results indicate furthermore, that the influence of macroeconomic determinants on the price setting behavior is rather small in size as well as in explanatory power. Nevertheless, we found some positive impact of GDP growth as well of the real exchange rate index. The later results can be explained by the fact that our dataset contains prices of non-tradable services only. Given that imports become cheaper due to the stronger home currency, the demand for this kind of services can increase due to a dominating income effect. The results of the IV-regressions also show a negative impact of a change of the short-term interest rate.

We lied a special focus on the role of the VAT as an important policy parameter. Our results indicate that increases in the VAT are shifted at least proportionally to prices although cost would not have increase that much since a part of the VAT is deductible, i.e. price elasticity with respect to the VAT would be expected to be below one. This might imply that an increase of the VAT, which can be seen as an external policy shock, is taken as a chance by the firms to increase their margins.

Finally, the dataset also allowed to estimate price dispersion for each product category. By performing a regression of several moments on their lags as well as on changes of the VAT and the business cycle, we found some hints that an increase in the VAT reduces the variance of prices within an economy. On the contrary, the impact of the business cycle is undetermined.

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Appendix A. IV regressions

The following tables present the results for the IV-estimations. Model 1 includes GDP growth, model 2 the relative change of the real exchange rate index, and model 3 the short-term interest rate (i.e. the first difference). For each model, the three month LIBOR of the Euro Zone and of the U.S. are used as instruments.

Table A.7: Estimation results: IV regressions

Rel. price change	model1	model1IV	model2	model2IV	model3	model3IV
Rel. change VAT	0.980^{***}	1.002^{***}	0.970^{***}	0.952^{***}	0.993^{***}	1.017^{***}
	(0.048)	(0.050)	(0.048)	(0.054)	(0.048)	(0.048)
Rel.chan. VAT, 1 Lag(s)	0.024^{*}	-0.034^{*}	-0.007	-0.117^{***}	0.010	-0.003
	(0.012)	(0.020)	(0.012)	(0.022)	(0.012)	(0.015)
Rel.chan. VAT, 2 Lag(s)	0.027^{***}	0.017	0.003	-0.084^{***}	-0.010	-0.059^{***}
	(0.009)	(0.019)	(0.009)	(0.025)	(0.009)	(0.014)
Fut.VAT-incr. known, 1 Lag(s)	0.094^{***}	0.094^{***}	0.073^{**}	-0.033	0.091^{***}	0.097^{***}
	(0.033)	(0.035)	(0.031)	(0.034)	(0.032)	(0.032)
Fut.VAT-incr. known, 2 Lag(s)	0.050^{***}	0.001	0.041^{***}	0.021	0.062^{***}	0.087^{***}
	(0.016)	(0.021)	(0.016)	(0.031)	(0.015)	(0.015)
Fut.VAT-incr. known, 3 Lag(s)	0.036^{**}	0.050^{**}	0.006	-0.102^{***}	0.028	0.037^{**}
	(0.018)	(0.021)	(0.018)	(0.030)	(0.017)	(0.017)
Fut.VAT-incr. known, 4 Lag(s)	0.052^{*}	0.107^{***}	-0.007	-0.049	0.048^{*}	0.065^{**}
	(0.027)	(0.030)	(0.028)	(0.030)	(0.027)	(0.029)
Fut.VAT-incr. known, 5 Lag(s)	0.462^{*}	1.188^{***}	-0.038	-0.156	0.617^{*}	0.516
	(0.278)	(0.381)	(0.246)	(0.273)	(0.339)	(0.550)
Periods since last price change, $z(i_n, j, t,)$	0.013^{**}	0.022^{***}	0.015^{***}	0.039^{***}	0.014^{**}	0.029^{***}
	(0.006)	(0.007)	(0.006)	(0.009)	(0.005)	(0.006)
$z(i_n, j, t,)^2$	-0.001^{***}	-0.001^{***}	-0.001^{***}	-0.001^{***}	-0.001^{***}	-0.001^{***}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dummy 1st quarter	0.403^{***}	0.410^{***}	0.399^{***}	0.284^{***}	0.345^{***}	0.260^{***}
	(0.036)	(0.036)	(0.038)	(0.078)	(0.033)	(0.036)
Dummy 2nd quarter	0.133^{***}	0.167^{***}	0.173^{***}	0.248^{***}	0.102^{***}	0.061
	(0.034)	(0.040)	(0.034)	(0.043)	(0.035)	(0.042)
Dummy 3rd quarter	0.034	0.076^{***}	0.058^{**}	0.040	0.048	0.084^{**}
	(0.026)	(0.029)	(0.028)	(0.061)	(0.030)	(0.041)
Sales	-18.775^{***}	-18.808^{***}	-18.824^{***}	-18.843^{***}	-18.834^{***}	-18.916^{***}
	(2.243)	(2.275)	(2.242)	(2.241)	(2.248)	(2.266)
Sales end	16.327^{***}	16.426^{***}	16.245^{***}	16.283^{***}	16.301^{***}	16.332^{***}
	(5.694)	(5.716)	(5.695)	(5.638)	(5.710)	(5.723)
Dummy 2000Q2	0.352	0.492	0.296	0.550^{*}	0.357	0.665^{*}
	(0.335)	(0.336)	(0.326)	(0.331)	(0.332)	(0.346)

Acc.sec.infl., $\pi(i_n, j, t)$	0.124***	0.110***	0.116***	0.068***	0.122***	0.096***
	(0.015)	(0.016)	(0.016)	(0.021)	(0.015)	(0.016)
GDP growth, yoy	−0.003	−0.005				
	(0.015)	(0.035)				
Lag 1 quarters	−0.026	−0.226***				
	(0.025)	(0.061)				
Lag 2 quarters	0.057**	0.196***				
	(0.027)	(0.068)				
Lag 3 quarters	−0.023	0.055				
	(0.022)	(0.070)				
Lag 4 quarters	0.058***	0.007				
	(0.012)	(0.033)				
RER index, gr. qoq			0.030***	0.044		
			(0.006)	(0.029)		
Lag 1 quarters			0.032***	0.178***		
			(0.007)	(0.031)		
Lag 2 quarters			0.005	0.017		
			(0.005)	(0.026)		
Lag 3 quarters			−0.010	0.056***		
			(0.006)	(0.019)		
Lag 4 quarters			−0.009	0.006		
			(0.006)	(0.022)		
3m Libor, 1st diff.					−0.103***	−0.408***
					(0.032)	(0.062)
Lag 1 quarters					−0.085***	−0.368***
					(0.033)	(0.080)
Lag 2 quarters					0.094***	0.116**
					(0.032)	(0.059)
Lag 3 quarters					0.131***	0.128*
					(0.037)	(0.076)
Lag 4 quarters					0.107***	0.217***
					(0.025)	(0.046)

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.8: Cond. logit probability model: IV regressions

Panel A: Positive price changes	model1	model1IV	model2	model2IV	model3	model3IV

Rel. change VAT	0.680***	0.709***	0.632***	0.575***	0.706***	0.766***
	(0.048)	(0.052)	(0.048)	(0.076)	(0.048)	(0.049)
Rel.chan. VAT, 1 Lag(s)	−0.00255	−0.121**	−0.0652	−0.307***	−0.0166	−0.0409
	(0.054)	(0.059)	(0.051)	(0.065)	(0.051)	(0.057)
Rel.chan. VAT, 2 Lag(s)	0.015	0.006	−0.061	−0.236***	−0.073	−0.187***
	(0.063)	(0.109)	(0.060)	(0.067)	(0.060)	(0.068)
Fut.VAT-incr. known, 1 Lag(s)	0.276***	0.359***	0.217***	0.011	0.269***	0.280***
	(0.0536)	(0.0620)	(0.0526)	(0.0716)	(0.0534)	(0.0581)
Fut.VAT-incr. known, 2 Lag(s)	0.188***	0.101	0.159***	0.0886	0.238***	0.275***
	(0.057)	(0.067)	(0.059)	(0.093)	(0.057)	(0.059)
Fut.VAT-incr. known, 3 Lag(s)	0.043	0.187**	−0.049	−0.268**	0.034	0.044
	(0.081)	(0.082)	(0.088)	(0.112)	(0.085)	(0.099)
Fut.VAT-incr. known, 4 Lag(s)	0.123**	0.252***	−0.045	−0.135*	0.133**	0.138**
	(0.057)	(0.072)	(0.071)	(0.075)	(0.057)	(0.068)
Fut.VAT-incr. known, 5 Lag(s)	1.747**	2.022**	0.396	0.048	1.989**	1.101
	(0.701)	(0.811)	(0.617)	(0.637)	(0.852)	(1.193)
Acc.sec.infl., $\pi(i_n, j, t)$	0.205***	0.161***	0.176***	0.0652*	0.205***	0.136***
	(0.033)	(0.035)	(0.034)	(0.038)	(0.033)	(0.034)
Periods since last price change, $z(i_n, j, t,)$	0.076***	0.103***	0.082***	0.141***	0.076***	0.115***
	(0.013)	(0.015)	(0.013)	(0.018)	(0.013)	(0.015)
$z(i_n, j, t,)^2$	−0.002***	−0.002***	−0.002***	−0.002***	−0.002***	−0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dummy 1st quarter	1.333***	1.428***	1.321***	1.152***	1.194***	0.993***
	(0.097)	(0.099)	(0.104)	(0.202)	(0.090)	(0.098)
Dummy 2nd quarter	0.569***	0.641***	0.654***	0.868***	0.472***	0.371***
	(0.104)	(0.115)	(0.105)	(0.124)	(0.107)	(0.132)
Dummy 3rd quarter	0.139	0.266***	0.210**	0.242*	0.142*	0.235**
	(0.087)	(0.093)	(0.089)	(0.139)	(0.086)	(0.096)
Sales	−14.470***	−14.760***	−13.710***	−13.260***	−14.310***	−13.470***
	(0.413)	(0.765)	(0.463)	(0.837)	(0.431)	(0.764)
Sales end	3.456***	3.750***	3.223***	3.340***	3.382***	3.472***
	(0.558)	(0.623)	(0.516)	(0.916)	(0.542)	(0.661)
Dummy 2000Q2	1.096***	1.462***	1.041***	1.544***	0.983***	1.801***
	(0.179)	(0.267)	(0.159)	(0.272)	(0.166)	(0.237)
GDP growth, yoy	−0.011	0.102				
	(0.033)	(0.083)				
Lag 1 quarters	−0.066	−0.739***				
	(0.051)	(0.130)				
Lag 2 quarters	0.146***	0.676***				
	(0.0565)	(0.122)				

	model1	model1IV	model2	model2IV	model3	model3IV
Lag 3 quarters	−0.043	−0.213				
	(0.051)	(0.142)				
Lag 4 quarters	0.130***	0.276***				
	(0.032)	(0.082)				
RER index, gr. qoq			0.073***	0.137**		
			(0.014)	(0.068)		
Lag 1 quarters			0.097***	0.383***		
			(0.016)	(0.067)		
Lag 2 quarters			0.027*	0.067		
			(0.015)	(0.046)		
Lag 3 quarters			−0.043***	0.115**		
			(0.014)	(0.047)		
Lag 4 quarters			−0.010	0.032		
			(0.015)	(0.039)		
3m Libor, 1st diff.					−0.222***	−0.900***
					(0.060)	(0.113)
Lag 1 quarters					−0.234***	−0.815***
					(0.054)	(0.113)
Lag 2 quarters					0.381***	0.288**
					(0.080)	(0.135)
Lag 3 quarters					0.330***	0.208
					(0.0934)	(0.158)
Lag 4 quarters					0.330***	0.520***
					(0.065)	(0.104)
Pseudo R^2	0.176	0.189	0.176	0.186	0.176	0.186

Panel B: Negative price changes	model1	model1IV	model2	model2IV	model3	model3IV
Rel. change VAT	−0.021	0.016	−0.027	0.035	−0.033	−0.024
	(0.057)	(0.063)	(0.050)	(0.098)	(0.052)	(0.057)
Rel.chan. VAT, 1 Lag(s)	−0.219***	−0.292***	−0.210***	−0.288***	−0.186***	−0.186**
	(0.068)	(0.075)	(0.070)	(0.105)	(0.067)	(0.083)
Rel.chan. VAT, 2 Lag(s)	−0.079	−0.052	−0.093	−0.131*	−0.085	−0.122*
	(0.061)	(0.076)	(0.059)	(0.073)	(0.061)	(0.065)
Fut.VAT-incr. known, 1 Lag(s)	0.001	0.052	−0.006	−0.097	−0.015	−0.014
	(0.047)	(0.062)	(0.052)	(0.081)	(0.050)	(0.056)
Fut.VAT-incr. known, 2 Lag(s)	−0.078	−0.152**	−0.064	−0.022	−0.060	−0.041
	(0.061)	(0.073)	(0.065)	(0.105)	(0.062)	(0.068)
Fut.VAT-incr. known, 3 Lag(s)	−0.001	0.073	−0.015	−0.102	−0.017	−0.005
	(0.058)	(0.069)	(0.058)	(0.084)	(0.059)	(0.061)
Fut.VAT-incr. known, 4 Lag(s)	−0.137	−0.097	−0.135	−0.130	−0.129	−0.090
	(0.108)	(0.291)	(0.107)	(0.250)	(0.104)	(0.207)
Fut.VAT-incr. known, 5 Lag(s)	−0.049	0.163	−0.080	−0.095	−1.283	−1.433

	(0.789)	(1.050)	(0.740)	(0.769)	(1.066)	(1.231)
Acc.sec.infl., $\pi(i_n, j, t)$	-0.116^{**}	-0.118^{**}	-0.126^{***}	-0.155^{***}	-0.115^{**}	-0.126^{**}
	(0.047)	(0.051)	(0.046)	(0.056)	(0.046)	(0.050)
Periods since last price change, $z(i_n, j, t,)$	0.015	0.016	0.020	0.034	0.014	0.020
	(0.024)	(0.027)	(0.024)	(0.026)	(0.024)	(0.026)
$z(i_n, j, t,)^2$	0.002^{**}	0.002^{**}	0.002^{**}	0.001^{**}	0.002^{**}	0.002^{**}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dummy 1st quarter	0.292^{***}	0.350^{***}	0.269^{**}	0.046	0.282^{***}	0.207^{*}
	(0.108)	(0.114)	(0.113)	(0.235)	(0.105)	(0.114)
Dummy 2nd quarter	0.184^{*}	0.243^{**}	0.170^{*}	0.181	0.169^{*}	0.091
	(0.100)	(0.105)	(0.100)	(0.115)	(0.101)	(0.109)
Dummy 3rd quarter	0.102	0.184	0.090	-0.055	0.026	-0.023
	(0.108)	(0.114)	(0.116)	(0.187)	(0.116)	(0.136)
Sales	18.930^{***}	20.540^{***}	18.900^{***}	19.610^{***}	18.170^{***}	19.290^{***}
	(0.339)	(1.803)	(0.340)	(1.522)	(0.343)	(1.613)
Sales end	1.183	1.252	1.191	1.259	1.164	1.231
	(0.892)	(4.885)	(0.898)	(4.833)	(0.898)	(4.821)
Dummy 2000Q2	1.924^{***}	1.753^{***}	2.034^{***}	2.213^{***}	1.762^{***}	1.833^{***}
	(0.275)	(0.360)	(0.235)	(0.327)	(0.246)	(0.317)
GDP growth, yoy	0.040	0.229^{*}				
	(0.057)	(0.117)				
Lag 1 quarters	-0.055	-0.485^{***}				
	(0.084)	(0.175)				
Lag 2 quarters	0.051	0.426^{***}				
	(0.086)	(0.163)				
Lag 3 quarters	-0.024	-0.194				
	(0.092)	(0.168)				
Lag 4 quarters	0.005	0.091				
	(0.054)	(0.091)				
RER index, gr. qoq			-0.012	-0.062		
			(0.016)	(0.084)		
Lag 1 quarters			0.007	0.124		
			(0.016)	(0.082)		
Lag 2 quarters			0.006	-0.032		
			(0.016)	(0.061)		
Lag 3 quarters			0.002	0.089		
			(0.016)	(0.057)		
Lag 4 quarters			0.002	-0.015		
			(0.016)	(0.046)		
3m Libor, 1st diff.					0.156	0.081
					(0.110)	(0.131)

Lag 1 quarters					-0.030	-0.246^{*}
					(0.098)	(0.130)
Lag 2 quarters					0.069	0.107
					(0.010)	(0.167)
Lag 3 quarters					-0.178	-0.169
					(0.130)	(0.179)
Lag 4 quarters					0.078	0.267^{*}
					(0.086)	(0.146)
Pseudo R^2	0.037	0.039	0.037	0.037	0.038	0.038

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix B. Additional robustness checks

Appendix B.1. Reduced time frame

The following tables show the estimation results using a shorted time frame (i.e. 1996Q1-2012Q4).

Table B.9: Results with restricted time frame

Rel. price change	Specification 1	Specification 2	Specification 3
Rel. change VAT	1.696***	1.812***	1.535***
	(0.213)	(0.217)	(0.213)
Rel.chan. VAT, 1 Lag(s)	-0.145**	-0.133*	-0.203**
	(0.0687)	(0.0685)	(0.0831)
Rel.chan. VAT, 2 Lag(s)	0.302**	0.317***	0.228*
	(0.121)	(0.121)	(0.131)
Fut.VAT-incr. known, 1 Lag(s)	-0.135*	-0.0274	-0.302***
	(0.0722)	(0.0730)	(0.0808)
Fut.VAT-incr. known, 2 Lag(s)	0.0126	0.139*	0.172*
	(0.0827)	(0.0837)	(0.0945)
Fut.VAT-incr. known, 3 Lag(s)	-0.312***	-0.192***	0.0309
	(0.0693)	(0.0703)	(0.103)
Fut.VAT-incr. known, 4 Lag(s)	-0.755***	-0.767***	-0.673
	(0.255)	(0.254)	(0.416)
Fut.VAT-incr. known, 5 Lag(s)	-0.0769	-0.140	-0.250
	(0.251)	(0.252)	(0.453)
Periods since last price change, $z(i_n, j, t,)$	0.0468***	0.0240***	0.0264***
	(0.00372)	(0.00582)	(0.00611)
$z(i_n, j, t,)^2$	-0.000460***	-0.000603***	-0.000657***
	(0.0000893)	(0.0000903)	(0.0000918)
Dummy 1st quarter	0.346***	0.347***	0.348***
	(0.0365)	(0.0365)	(0.0451)
Dummy 2nd quarter	0.198***	0.176***	0.216***
	(0.0381)	(0.0376)	(0.0474)
Dummy 3rd quarter	0.00929	-0.00214	0.0526
	(0.0281)	(0.0279)	(0.0373)
Sales	-18.79***	-18.79***	-18.76***
	(2.223)	(2.229)	(2.258)
Sales end	16.30***	16.31***	16.31***
	(5.741)	(5.737)	(5.714)
Dummy 2000Q2	0.229	0.275	0.417
	(0.330)	(0.330)	(0.335)
Acc.sec.infl., $\pi(i_n, j, t)$		0.0783***	0.0746***
		(0.0147)	(0.0153)
GDP growth, yoy			0.000992
			(0.0190)
Lag 1 quarters			0.00330
			(0.0275)
Lag 2 quarters			-0.0342
			(0.0306)
Lag 3 quarters			-0.0131
			(0.0338)
Lag 4 quarters			0.0943***
			(0.0205)
RER index, gr. qoq			0.0375***
			(0.00789)
Lag 1 quarters			0.0355***
			(0.00779)
Lag 2 quarters			-0.00463
			(0.00742)

Lag 3 quarters			-0.0119*
			(0.00612)
Lag 4 quarters			-0.0183**
			(0.00826)
3m Libor, 1st diff.			-0.0902**
			(0.0427)
Lag 1 quarters			0.0294
			(0.0449)
Lag 2 quarters			0.0912**
			(0.0460)
Lag 3 quarters			-0.0414
			(0.0568)
Lag 4 quarters			-0.0721
			(0.0476)
Adjusted R^2	0.028	0.028	0.030
Observations	198989	198989	198989

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.10: Cond. logit probability model, restricted time frame

Panel A: Positive price changes	Specification 1	Specification 2	Specification 3
Rel. change VAT	1.868***	2.091***	1.469***
	(0.141)	(0.152)	(0.188)
Rel.chan. VAT, 1 Lag(s)	-0.925***	-0.914***	-1.229***
	(0.310)	(0.312)	(0.401)
Rel.chan. VAT, 2 Lag(s)	0.923***	0.954***	0.801***
	(0.245)	(0.247)	(0.302)
Fut.VAT-incr. known, 1 Lag(s)	-0.617	-0.416	-1.028**
	(0.405)	(0.405)	(0.409)
Fut.VAT-incr. known, 2 Lag(s)	0.260	0.509**	0.730***
	(0.246)	(0.253)	(0.265)
Fut.VAT-incr. known, 3 Lag(s)	-1.078***	-0.864**	-0.143
	(0.341)	(0.350)	(0.387)
Fut.VAT-incr. known, 4 Lag(s)	-1.672***	-1.695***	-1.600*
	(0.515)	(0.514)	(0.960)
Fut.VAT-incr. known, 5 Lag(s)	-0.109	-0.224	-0.582
	(0.605)	(0.604)	(1.091)
Periods since last price change, $z(i_n, j, t,)$	0.114***	0.070***	0.091***
	(0.011)	(0.014)	(0.014)
$z(i_n, j, t,)^2$	-0.001**	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
Dummy 1st quarter	1.130***	1.132***	1.037***
	(0.103)	(0.103)	(0.119)
Dummy 2nd quarter	0.665***	0.624***	0.576***
	(0.101)	(0.099)	(0.120)
Dummy 3rd quarter	-0.031	-0.054	-0.002
	(0.090)	(0.090)	(0.105)
Sales	-13.830***	-14.554***	-14.027***
	(0.481)	(0.468)	(0.425)
Sales end	3.272***	3.304***	3.354***
	(0.572)	(0.569)	(0.545)
Dummy 2000Q2	0.869***	0.951***	1.204***
	(0.149)	(0.152)	(0.207)
Acc.sec.infl., $\pi(i_n, j, t)$		0.159***	0.119***
		(0.036)	(0.034)
GDP growth, yoy			0.008
			(0.044)

Lag 1 quarters			0.039
			(0.069)
Lag 2 quarters			-0.068
			(0.066)
Lag 3 quarters			-0.193**
			(0.077)
Lag 4 quarters			0.262***
			(0.052)
RER index, gr. qoq			0.091***
			(0.017)
Lag 1 quarters			0.100***
			(0.020)
Lag 2 quarters			0.016
			(0.018)
Lag 3 quarters			-0.013
			(0.018)
Lag 4 quarters			-0.022
			(0.018)
3m Libor, 1st diff.			-0.217**
			(0.106)
Lag 1 quarters			0.026
			(0.115)
Lag 2 quarters			0.379***
			(0.105)
Lag 3 quarters			0.136
			(0.129)
Lag 4 quarters			0.058
			(0.134)
Pseudo R^2	0.127	0.130	0.144
Observations	158057	158057	158057

Panel B: Negative price changes	Specification 1	Specification 2	Specification 3
Rel. change VAT	0.636***	0.458**	0.432*
	(0.207)	(0.213)	(0.247)
Rel.chan. VAT, 1 Lag(s)	-1.389***	-1.369***	-1.430***
	(0.396)	(0.394)	(0.447)
Rel.chan. VAT, 2 Lag(s)	0.366	0.370	0.291
	(0.273)	(0.270)	(0.299)
Fut.VAT-incr. known, 1 Lag(s)	-1.198***	-1.347***	-1.383***
	(0.340)	(0.333)	(0.394)
Fut.VAT-incr. known, 2 Lag(s)	0.339	0.132	0.164
	(0.363)	(0.355)	(0.408)
Fut.VAT-incr. known, 3 Lag(s)	-0.192	-0.383	-0.629
	(0.397)	(0.395)	(0.437)
Fut.VAT-incr. known, 4 Lag(s)	-0.912	-0.912	-1.172
	(0.657)	(0.660)	(1.247)
Fut.VAT-incr. known, 5 Lag(s)	-0.393	-0.315	-1.386
	(0.749)	(0.751)	(1.175)
Periods since last price change, $z(i_n, j, t,)$	-0.015	0.029	0.029
	(0.019)	(0.025)	(0.025)
$z(i_n, j, t,)^2$	0.001**	0.002**	0.002***
	(0.001)	(0.001)	(0.001)
Dummy 1st quarter	0.187	0.192	0.205
	(0.120)	(0.120)	(0.132)
Dummy 2nd quarter	0.168	0.203*	0.242**
	(0.106)	(0.105)	(0.114)
Dummy 3rd quarter	-0.043	-0.026	-0.071
	(0.121)	(0.121)	(0.135)
Sales	18.449***	18.347***	22.793***
	(0.348)	(0.343)	(0.345)
Sales end	1.190	1.172	1.156

	(0.891)	(0.890)	(0.889)
Dummy 2000Q2	1.986***	1.924***	1.625***
	(0.237)	(0.234)	(0.291)
Acc.sec.infl., $\pi(i_n, j, t)$		-0.157***	-0.160***
		(0.048)	(0.049)
GDP growth, yoy			0.011
			(0.073)
Lag 1 quarters			-0.034
			(0.092)
Lag 2 quarters			0.059
			(0.089)
Lag 3 quarters			-0.068
			(0.099)
Lag 4 quarters			0.001
			(0.064)
RER index, gr. qoq			-0.012
			(0.019)
Lag 1 quarters			0.020
			(0.019)
Lag 2 quarters			0.020
			(0.018)
Lag 3 quarters			0.015
			(0.020)
Lag 4 quarters			0.007
			(0.022)
3m Libor, 1st diff.			0.172
			(0.165)
Lag 1 quarters			0.070
			(0.131)
Lag 2 quarters			0.099
			(0.167)
Lag 3 quarters			-0.123
			(0.189)
Lag 4 quarters			0.082
			(0.168)
Pseudo R^2	0.040	0.042	0.044
Observations	65010	65010	65010

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix B.2. Results with censored data

The following tables present the estimation results for a modified dataset, where we have assumed $k_1(i_n, j) \equiv t_1 \; \forall \; i, j$, i.e. the first datapoint of each price series is considered as a price change.

Table B.11: Regressions for relative price change, censored data

Rel. price change	Specification 1	Specification 2	Specification 3
Rel. change VAT	1.075***	1.066***	1.042***
	(0.041)	(0.041)	(0.043)
Rel.chan. VAT, 1 Lag(s)	0.072***	0.042**	0.007
	(0.019)	(0.016)	(0.020)
Rel.chan. VAT, 2 Lag(s)	0.042***	0.016*	-0.000
	(0.008)	(0.008)	(0.013)
Fut.VAT-incr. known, 1 Lag(s)	0.101***	0.100***	0.093***
	(0.019)	(0.019)	(0.021)

Fut.VAT-incr. known, 2 Lag(s)	0.068^{***}	0.069^{***}	0.086^{***}
	(0.015)	(0.015)	(0.018)
Fut.VAT-incr. known, 3 Lag(s)	0.050^{***}	0.055^{***}	0.089^{***}
	(0.015)	(0.015)	(0.016)
Fut.VAT-incr. known, 4 Lag(s)	0.088^{***}	0.092^{***}	0.083^{***}
	(0.018)	(0.018)	(0.020)
Fut.VAT-incr. known, 5 Lag(s)	-0.169	-0.278	-0.116
	(0.235)	(0.237)	(0.443)
Periods since last price change, $z(i_n, j, t,)$	0.047^{***}	0.004	0.001
	(0.004)	(0.005)	(0.005)
$z(i_n, j, t,)^2$	-0.001^{***}	-0.001^{***}	-0.001^{***}
	(0.000)	(0.000)	(0.000)
Dummy 1st quarter	0.351^{***}	0.359^{***}	0.387^{***}
	(0.036)	(0.035)	(0.039)
Dummy 2nd quarter	0.135^{***}	0.107^{***}	0.213^{***}
	(0.032)	(0.032)	(0.037)
Dummy 3rd quarter	-0.001	-0.008	0.101^{***}
	(0.026)	(0.026)	(0.031)
Sales	-19.252^{***}	-19.257^{***}	-19.239^{***}
	(2.353)	(2.367)	(2.427)
Sales end	16.681^{***}	16.701^{***}	16.726^{***}
	(5.844)	(5.837)	(5.819)
Dummy 2000Q2	0.739^{*}	0.814^{*}	0.882^{**}
	(0.430)	(0.430)	(0.443)
Acc.sec.infl., $\pi(i_n, j, t)$		0.139^{***}	0.152^{***}
		(0.012)	(0.012)
GDP growth, yoy			0.032^{*}
			(0.018)
Lag 1 quarters			-0.032
			(0.029)
Lag 2 quarters			0.002
			(0.031)
Lag 3 quarters			-0.013
			(0.027)
Lag 4 quarters			0.113^{***}
			(0.014)
RER index, gr. qoq			0.043^{***}
			(0.007)
Lag 1 quarters			0.032^{***}
			(0.008)
Lag 2 quarters			-0.002
			(0.007)
Lag 3 quarters			-0.019^{***}
			(0.006)
Lag 4 quarters			-0.028^{***}
			(0.007)
3m Libor, 1st diff.			-0.089^{**}
			(0.039)
Lag 1 quarters			-0.028
			(0.042)
Lag 2 quarters			0.101^{**}
			(0.040)
Lag 3 quarters			-0.092^{*}
			(0.049)
Lag 4 quarters			-0.098^{***}
			(0.030)
Adjusted R^2	0.092	0.095	0.097
Observations	314803	314803	314803

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.12: Cond. logit probability model, censored data

Panel A: Positive price changes	Specification 1	Specification 2	Specification 3
Rel. change VAT	0.633***	0.616***	0.523***
	(0.025)	(0.026)	(0.036)
Rel.chan. VAT, 1 Lag(s)	0.123***	0.069*	0.006
	(0.044)	(0.039)	(0.042)
Rel.chan. VAT, 2 Lag(s)	0.068	0.027	-0.040
	(0.044)	(0.045)	(0.050)
Fut.VAT-incr. known, 1 Lag(s)	0.265***	0.249***	0.254***
	(0.033)	(0.033)	(0.043)
Fut.VAT-incr. known, 2 Lag(s)	0.167***	0.157***	0.206***
	(0.040)	(0.039)	(0.043)
Fut.VAT-incr. known, 3 Lag(s)	0.095**	0.093**	0.168***
	(0.040)	(0.038)	(0.040)
Fut.VAT-incr. known, 4 Lag(s)	0.143***	0.136***	0.147***
	(0.028)	(0.028)	(0.036)
Fut.VAT-incr. known, 5 Lag(s)	-0.042	-0.215	0.242
	(0.591)	(0.591)	(1.004)
Periods since last price change, $z(i_n, j, t,)$	0.120***	0.063***	0.062***
	(0.009)	(0.011)	(0.010)
$z(i_n, j, t,)^2$	-0.001***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)
Dummy 1st quarter	1.228***	1.248***	1.198***
	(0.087)	(0.087)	(0.099)
Dummy 2nd quarter	0.551***	0.507***	0.547***
	(0.093)	(0.092)	(0.104)
Dummy 3rd quarter	0.103	0.089	0.246***
	(0.083)	(0.083)	(0.089)
Sales	-14.721***	-14.713***	-13.984***
	(0.487)	(0.461)	(0.386)
Sales end	3.381***	3.447***	3.609***
	(0.605)	(0.623)	(0.595)
Dummy 2000Q2	0.854***	0.950***	1.044***
	(0.147)	(0.149)	(0.194)
Acc.sec.infl., $\pi(i_n, j, t)$		0.207***	0.230***
		(0.025)	(0.025)
GDP growth, yoy			0.046
			(0.038)
Lag 1 quarters			-0.034
			(0.064)
Lag 2 quarters			0.042
			(0.064)
Lag 3 quarters			-0.176***
			(0.061)
Lag 4 quarters			0.280***
			(0.036)
RER index, gr. qoq			0.096***
			(0.014)
Lag 1 quarters			0.098***
			(0.017)
Lag 2 quarters			0.015
			(0.018)
Lag 3 quarters			-0.034**
			(0.016)
Lag 4 quarters			-0.032*
			(0.016)

3m Libor, 1st diff.			-0.108
			(0.090)
Lag 1 quarters			-0.183*
			(0.098)
Lag 2 quarters			0.368***
			(0.088)
Lag 3 quarters			-0.005
			(0.111)
Lag 4 quarters			0.014
			(0.091)
Pseudo R^2	0.189	0.196	0.217
Observations	270384	270384	270384

Panel B: Negative price changes	Specification 1	Specification 2	Specification 3
Rel. change VAT	-0.010	-0.006	-0.030
	(0.032)	(0.032)	(0.049)
Rel.chan. VAT, 1 Lag(s)	-0.184***	-0.171***	-0.197***
	(0.065)	(0.065)	(0.069)
Rel.chan. VAT, 2 Lag(s)	-0.080	-0.072	-0.068
	(0.050)	(0.049)	(0.055)
Fut.VAT-incr. known, 1 Lag(s)	-0.026	-0.025	-0.027
	(0.033)	(0.034)	(0.043)
Fut.VAT-incr. known, 2 Lag(s)	-0.116*	-0.116*	-0.131**
	(0.060)	(0.061)	(0.064)
Fut.VAT-incr. known, 3 Lag(s)	-0.013	-0.014	-0.026
	(0.034)	(0.034)	(0.042)
Fut.VAT-incr. known, 4 Lag(s)	-0.107**	-0.107**	-0.114**
	(0.045)	(0.045)	(0.049)
Fut.VAT-incr. known, 5 Lag(s)	-0.201	-0.172	-1.070
	(0.709)	(0.711)	(1.077)
Periods since last price change, $z(i_n, j, t,)$	-0.002	0.014	0.009
	(0.017)	(0.020)	(0.019)
$z(i_n, j, t,)^2$	0.001*	0.001**	0.001**
	(0.001)	(0.001)	(0.001)
Dummy 1st quarter	0.320***	0.319***	0.307***
	(0.099)	(0.099)	(0.102)
Dummy 2nd quarter	0.170*	0.179*	0.179*
	(0.093)	(0.093)	(0.097)
Dummy 3rd quarter	0.113	0.116	0.049
	(0.104)	(0.104)	(0.115)
Sales	20.507***	20.499***	19.875***
	(0.343)	(0.342)	(0.340)
Sales end	1.392	1.382	1.340
	(0.881)	(0.879)	(0.876)
Dummy 2000Q2	2.043***	2.021***	1.532***
	(0.215)	(0.214)	(0.255)
Acc.sec.infl., $\pi(i_n, j, t)$		-0.055	-0.047
		(0.034)	(0.034)
GDP growth, yoy			0.022
			(0.064)
Lag 1 quarters			-0.091
			(0.083)
Lag 2 quarters			0.111
			(0.082)
Lag 3 quarters			-0.124
			(0.080)
Lag 4 quarters			0.027
			(0.051)
RER index, gr. qoq			0.003
			(0.016)
Lag 1 quarters			0.020

			(0.018)
Lag 2 quarters			0.014
			(0.018)
Lag 3 quarters			0.013
			(0.018)
Lag 4 quarters			-0.006
			(0.019)
3m Libor, 1st diff.			0.234
			(0.151)
Lag 1 quarters			0.044
			(0.120)
Lag 2 quarters			0.189
			(0.136)
Lag 3 quarters			-0.046
			(0.153)
Lag 4 quarters			0.130
			(0.098)
Pseudo R^2	0.034	0.035	0.037
Observations	96446	96446	96446

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$