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PRICE SETTING BEHAVIOUR IN SPAIN. STYLISED FACTS USING CONSUMER PRICE MICRO DATA

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1. Introduction

The fact that individual firms do not adjust continuously their prices to all the relevant shocks in the economy is uncontroversial and represents a standard assumption in macroeconomic modelling that allows for nominal shocks to influence real variables. However, the precise way to incorporate microfounded price adjustment policies in macroeconomic models is less clear-cut. A large strand of literature has been devoted to analysing the implications of alternative forms of nominal rigidities on the dynamic behaviour of aggregate inflation and output. This theoretical literature has shown that the nature of these nominal rigidities determines the shape of the response of the economy to a broad range of potential disturbances and has clear implications for the conduct of monetary policy. In spite of the relevance of the issue of price setting behaviour, empirical work on this area has been scarce and partial, probably due to the lack of appropriate information at the individual level. Moreover, the scant available research has mainly focused on the US economy.

The aim of this paper is to characterise the basic features of the price setting mechanism in the Spanish economy, drawing on a large dataset containing around 1.1 millions of price records, covering the period from January 1993 to December 2001. The dataset includes prices for items corresponding to product categories that cover around 70% of the expenditure of the CPI basket and therefore is well suited for the analysis of the key features of price setting behaviour and, in particular, to identify differences in the pervasiveness of nominal rigidities across types of products. Moreover, the relatively large time dimension of the dataset allows exploring the dependence of price setting behaviour on macroeconomic conditions, in particular the level of inflation.

The scope of the paper is basically descriptive. We provide evidence on the frequency and size of price adjustments, distinguishing between price increases and price reductions, and report direct estimates of the duration of price spells. We document differences in the general features of price setting behaviour across types of products and explore how these general features are conditioned by some specific factors: seasonal patterns in pricing behaviour, the level of inflation, changes in indirect taxation and the practice of using psychological and round prices.

The remainder of this paper is organised as follows. Section 2 describes the dataset and provides a brief overview of the main inflation developments over the sample period. Section 3 discusses the statistical concepts used throughout the analysis. Section 4 presents the main findings on the frequency of price changes, while Section 5 reports the basic results on the size of price changes. Section 6 reports direct estimates of price durations and analyses the influence of the duration of price spells on the probability of adjusting the price as well as on the magnitude of the price change. Section 7 summarises our conclusions.

2. The dataset

The available dataset is a longitudinal subsample of the micro data collected by Instituto Nacional de Estadística (INE) in order to compute the base 1992 Spanish Consumer Price Index (CPI). The methodology of data collection is described in INE (1994) and the restrictions applied by INE to define the subsample reflect the legal requirement to preserve the confidentiality of the data.

The sample is made up of 1,112,076 prices, contains monthly records for 9 years (January 1993 to December 2001) and each record corresponds to a precisely defined item sold in a particular outlet in a given city which can be followed over time. Along with each individual price quote (i.e. the exact[1] price level of the product), the following additional information is provided:

- the year and month of the record
- an item code, which allows to determine the subclass[2] to which the item belongs
- a numeric outlet code, which does not permit to determine the name of the outlet
- a numeric city code, which does not permit to identify the name of the city
- a numeric code to determine whether the item is a good or a service

The base 1992 CPI subclass code along with the code for goods or services enables us to obtain two additional breakdowns. On the one hand, the components typically used by the Eurosystem to analyse inflation developments (e.g. in the Narrow Inflation Projection Exercise). On the other hand, the harmonised Classification Of Individual COnsumption by Purpose (COICOP) classification at the 2 digit level.

On the whole, the dataset covers 70.1% of the expenditure of the CPI basket and exclusions mostly correspond to those product categories whose prices are collected in a centralised way, such as housing rents, energy, telecommunications, car prices, tobacco, financial, insurance and household services, hospital and dental services, and hotels. The

[1] Strictly speaking, the information available refers to *final prices,* so that all correcting coefficients are considered, including those to correct changes in the unit of measure.

[2] Roughly speaking, this corresponds to the COICOP 5 digit code.

database excludes administered prices with the exception of those determined at the regional or local level.

Table 2.1 illustrates the breakdown of the available records by HICP subcomponents, and their coverage rate. The coverage rate is relatively homogeneous across non-energy components, the highest one corresponding to unprocessed food (88.7%) and the lowest one to processed food (65.6%), reflecting the absence of tobacco prices. Moreover, since all energy prices were regulated in most of the sample period no information is available for them. In terms of the COICOP-2 classification, disparities in the coverage are considerably greater. Almost full coverage is available for groups 3 (Clothing and footwear), 11 (Hotels, cafés and restaurants) and 12 (Miscellaneous goods and services). On the other hand, the lowest coverages correspond to groups 2 (Alcoholic beverages and tobacco), 7 (Transport) and 4 (Housing). For group 8 (Communications) no information is available, since their prices were regulated.

The restrictions in terms of coverage reflect the restrictions in terms of items (190 items out of the 471 are available) and subclasses (71 subclasses are available out of 110 in the CPI). Moreover, with respect to the geographical coverage, it has to be stressed that information refers to the 17 region's capitals[3], whereas the base 1992 CPI recorded prices in 130 cities for food items and in 70 cities for the rest of the items.

2.1. Specific data issues

The periodicity of data collection is product-dependent, although prices are generally collected on a monthly basis. On the one hand, some prices like those corresponding to fresh fruit and vegetables are collected three times every month. In these cases INE has provided us with the price corresponding to the first week of every month and has chosen products which are generally available all year round. On the other hand, for some non-food items, prices are generally collected on a quarterly basis using a rotating scheme, so that the same outlet is interviewed only once a quarter. However, if important changes are observed in a given month all outlets are investigated in the next month. In these cases, we have information for those outlets typically interviewed in the first month of every quarter and INE follows the *carry forward* procedure: the unobserved price of the item is assumed to be the same throughout the quarter[4].

Note that sales and promotion prices were not included in the base 1992 Spanish CPI, so that a lower frequency of price adjustment and smaller sizes of price changes are expected in comparison to countries which considered them. Furthermore, energy prices,

[3] There are two exceptions: The regions (*Comunidades Autónomas)* of Galicia and Extremadura are represented by the cities of A Coruña and Badajoz.

[4] There are 23 items out of 190 whose prices are collected at a quarterly frequency.

most of which change rather frequently, are excluded. Finally, some administered prices are included and they are typically characterised by low frequencies of adjustment.

2.2. Consumer price developments over 1993-2001

For reference purposes it is useful to describe inflation performance in the sample period[5]. Figure 2.1 depicts the year-on-year rate of change of headline inflation and its main subcomponents. The observed variation over time of the inflation rate is useful to unveil potential differences in price setting behaviour at different levels of inflation. Moreover, the different CPI components show different inflation developments.

The sample period can be broken into two different subperiods characterised by decreasing and rising inflation. In the 1995-1998 convergence period, the fulfilment of the inflation targets set by the Bank of Spain was facilitated by the increasing credibility of economic policy as a whole and by the change of expectations induced by the perspective of joining EMU. This change was helped, although with a certain delay, by the progressive convergence of wage growth to consumer prices growth. The year on year CPI rate was reduced from around 5% at the start of 1995 to 1.4% at the end of 1998.

The 1999-2001 period was characterised by a rise in the consumer-price inflation rate. In 1999 and 2000, the acceleration of the CPI was largely due to external factors: higher oil and other commodity prices on international markets and the depreciation of the euro against the dollar. In contrast, over the course of 2001, the deterioration of inflation responded to domestic factors. In particular, food prices were particularly affected as a result of the veterinary crises of the national livestock, as well as the notable rising trend in the price of milk products and olive oil.

3. Statistical issues

The aim of this paper is to characterise the main features of the price setting behaviour of the Spanish economy. For this purpose, we offer a descriptive analysis mainly based on the frequency and size of price adjustment, although we also provide some direct estimates of the duration of price spells. In this section, we provide a brief explanation of the statistics used throughout our analysis, making explicit the assumptions under which they are derived.

3.1. The frequency of price changes and the duration of prices

The periodicity with which prices are changed by firms represents a key element to characterise price-setting behaviour. To quantify this periodicity two different measures may

[5] A more detailed review of the recent inflation developments in the Spanish economy can be found in Malo de Molina (2003).

be used: the frequency of price changes and the duration of price spells. Obviously, these two measures are closely linked and should lead to similar conclusions in terms of the degree of price flexibility and, in particular, when establishing comparisons across products.

We define the frequency of price changes, defined here as the proportion of non-zero price change observations over the total number of observations. The main advantage of this statistic as compared to the average duration of price spells is that it uses all the relevant statistical information available, and consequently, is less potentially affected by selection biases. On the contrary, the direct computation of the average duration of price spells has to be done taking into account only uncensored spells (i.e., those spells that start and end with a price change[6]). In addition to discarding some available information, this procedure of computing average duration may be affected by a selection bias since longer price spells are more likely to be censored and, hence, to be discarded. Additional advantages of using the frequency of price changes are that long time series are not required and the measure is less sensitive to specific events. As a disadvantage, it is difficult to derive the full distribution of price durations and for this reason in the last section of the paper we also report the direct computation of price durations than can be compared to those predicted by theoretical models.

As discussed in Baudry et al. (2004), assuming stationarity and homogeneity of price changes behaviour in the cross-sectional dimension, the inverse of the frequency of price changes converges, in a large sample, to the mean duration. This asymptotic property can be used to obtain an estimate of the average duration of price spells (T^F) from the frequency of price changes (F). Thus:

$$T^F = \frac{1}{F}$$

This expression is derived under the implicit assumption of discrete time (i.e. prices are changed at most once per month, just at the monthly interval). On the contrary, if we assume that prices can be changed at any moment, with the probability of a price change being constant within a given month, the average duration can be derived from the following expression:

$$T^F = -\frac{1}{\ln(1-F)}$$

[6] Alternative definitions of censoring might be used. For instance, Aucremanne and Dhyne (2004) consider as uncensored spells those spells that start and end with a price change or with a product replacement. In other words, price spells affected by product replacement are considered as uncensored spells. Since we do not have an indicator to signal that a product replacement has taken place we cannot adopt that definition.

We present the analysis of price durations (T^F) based on the frequency approach in Section 4, while in Section 6 we report the results based on the direct computation of the duration of the price spells (T^D).

3.2. Size of price changes

In addition to the measures of frequency of price adjustments and duration of price spells, we also compute a measure of the size of price changes (*?P*), which is the logarithmic change. Here, our assumption is that prices only change once within a given month (or within a quarter for those products whose prices are collected on a quarterly basis). This assumption seems to be realistic with the exception of some unprocessed food items for which the duration of prices is often shorter than a month[7].

3.3. Aggregation (weighting)

In order to compute aggregate measures of the variables of interest (frequency of price changes, duration of prices and size of price changes), it seems desirable to employ some weighting scheme. In the cases of the frequency and the size of price changes, we use just one weighting procedure. Since the subclass level is the lowest level for which we have CPI weights, we first compute for each subclass the frequency (or the size) of price changes using all the observations of products belonging to that subclass. We then compute the aggregate frequency (or size) averaging over subclasses using CPI weights.

The computation of an aggregate indicator of price duration might be based either on the frequency approach or on the duration approach. Under the first approach, the simplest alternative would be to make use, at the most aggregate level, of the theoretical relationship between the frequency of price changes and the average price duration. In other words, the overall duration could be computed as the inverse of the weighted average frequency, which is a weighted harmonic mean of the durations at the subclass level:

$$T^F = \frac{1}{F} = \frac{1}{\sum_j w_j F_j} = \frac{1}{\sum_j w_j \left(1/T_j^F\right)}$$

where j is an index for subclasses and w_j denote CPI weights.

This indicator is not fully consistent with the assumption of homogeneity of observations that is required for the theoretical relationship between the frequency of price changes and the average price duration to hold. An alternative procedure would be first to compute the average duration at the subclass level and then average over all subclasses

[7] As mentioned above, INE collects price quotes for these items three times a month.

using CPI weights. Thus, an estimate for the overall price duration would be given by the weighted average of the inverse frequencies, as in the following expression:

$$T^F = \sum_j w_j \frac{1}{F_j} = \sum_j w_j T_j^F$$

A potential problem with this approach comes from the fact that some frequencies of price changes may be very close to zero, implying very high durations and strongly influencing aggregate duration. Bearing this in mind, the weighted median of inverse frequencies may be a reasonable alternative indicator. This measure, used among others by Bils and Klenow (2002) is less sensitive to the existence of items with very high price durations although, as pointed out by Baudry et al. (2004), it cannot be interpreted as an estimator for the average price duration[8].

The computation of an aggregate indicator of price duration stemming from the direct computation of the duration of the individual price spells admits several alternatives. The simplest one is to weight equally the durations of all the individual price spells. As an alternative, we use a weighting scheme in which the weight assigned to each price duration is the CPI weight of its subclass divided by the number of observed durations in that subclass. Thus, we are taking into account that, for a given time horizon, a larger number of spells is observed for products with short durations. However, with this approach we still overweight, within each subclass, trajectories with very short durations. For this reason, we also consider a third weighting approach in which we first average durations within the same trajectory before deriving the distribution at the subclass level.

As mentioned in the previous section, price quotes for some items are collected on a quarterly basis and, therefore, an assumption needs to be made in order to compare the frequency of price changes of these items with that corresponding to items with monthly price observations. In this respect, we follow the *carry forward* approach of INE: for items with quarterly observations, the observed price in one month is assumed to be the same in the following non-observed two months. In other words, we assume that items with quarterly observations experience at most one price change within a quarter, so that the monthly frequency of price changes is one third of the corresponding quarterly frequency. In our view, this assumption is realistic since these items are typically characterised by long price durations[9]. Nevertheless, this assumption might create a slight downward bias in the estimate of the frequency of price changes.

[8] Another possibility to ensure robustness would be to compute a trimmed mean.

[9] An alternative assumption to derive the monthly frequency of price changes from a higher frequency is considered in Bils and Klenow (2002) or Dias et al. (2004). In their approach, the assumption adopted is that the monthly frequency of price changes is constant over time and does not depend on duration.

4. Frequency of price changes

4.1. Main findings

Table 4.1 reports average frequencies of price changes for our whole basket as well as for the main CPI components. The weigthed average frequency of price changes for all items taken together is 0.15. Computing the implied duration as the inverse of the weighted average frequency of price durations under the continuous time assumption, prices change, on average, once every 6.2 months. Our estimate is somewhat lower than the estimates available for other European countries. Aucremanne and Dhyne (2004), Baudry *et al*. (2004) and Dias *et al*. (2004) report estimates of 0.17, 0.19 and 0.22 for Belgium, France and Portugal, respectively. The lower frequency of price changes in Spain is to some extent explained by the absence of energy items in our sample, the fact that sale or promotion prices are not considered in our dataset and the inclusion of some administered prices.

Moreover, there is a marked heterogeneity across products in the frequency of price changes. The flexibility of prices is considerably larger for food than for other items. In particular, focusing on the main CPI components, the highest frequency of price changes is observed for unprocessed food: almost one half of these items change prices at any given month. Two factors help explain the flexibility of these prices to market conditions. On the one hand, changes in the weather determine changes in the supply of unprocessed food. On the other hand, these items are typically highly perishable.

The frequency of price changes is much smaller for the other components, although greater for processed food than for non-energy industrial goods - which in our sample are not affected by sales or promotions. The highest degree of price stickiness is observed for services, whose average frequency is 0.06.

The marked heterogeneity in the degree of price flexibility across products is even more evident when looking at the cross sectional distribution of price changes for items at the most detailed level available (190 items in our case). Figure 4.1 displays the distribution of monthly frequencies of price changes for food and for non-food items (66 and 124 items, respectively)[10].

Columns 2 and 3 of Table 4.1 report monthly frequencies of price increases and decreases, respectively, for all items in our basket and split by main CPI components. A first observation arising from these two columns is that price decreases are rather frequent in our sample: almost 40% of the price changes are price reductions, a fact that could be interpreted against the hypothesis of downward nominal rigidity. Again, there are important differences in this pattern across the main CPI components. Thus, while price reductions in

[10] Table A3.1 reports the average frequencies of price changes at the subclass level.

services are quite rare (less than 15% of price changes are decreases), in the case of unprocessed food, price increases and decreases are evenly distributed. Moreover, comparing these figures across the main CPI components a clear pattern emerges: the higher is the average frequency of price adjustment, the higher is the proportion of price reductions on price changes. This general rule seems to hold also at a more detailed level (see Table A4.1), and a correlation coefficient of 0.6 is obtained.

4.2. Factors that affect the frequency of price changes

The previous section has documented the existence of important differences in the frequency of price changes across products. Even within each main CPI component category there is a substantial dispersion in the frequency of price adjustment (see Figure 4.1 and Table A4.1). There are several microeconomic factors that could explain such dispersion, including differences in products' characteristics, characteristics of the markets in which they are sold or shares of the different types of outlet. Regrettably, our database does not allow exploring the potential role of these factors.

So far, the evidence presented has shown a marked heterogeneity in the degree of price stickiness across products. Moreover, although to a lesser extent, the frequency of price changes also displays variation over time. Figure 4.2 illustrates this fact by plotting the time series of the frequency of price increases and decreases for the whole basket and for the main CPI components. These time series are computed in the cross-sectional dimension as a weighted average of the frequency of price changes at the subclass level[11]. As the prices of some products in the non-food categories are collected on a quarterly basis we plot the time series at that frequency. In the light of this figure, we explore in this section the incidence of some factors potentially affecting the frequency of price adjustment over time. In particular we focus on four issues. First, we check whether there is a seasonal pattern in the pricing behaviour, that could be considered as evidence in favour of time dependent pricing strategies. Second, we assess the impact of changes in indirect taxation on the frequency of adjustment. Third, to capture possible state dependent pricing strategies we analyse whether the frequency of price adjustment depends on the inflation level. Finally, we check whether the fact of setting prices in attractive terms (*i.e.* the use of both psychological and round prices) has an incidence on the frequency of price changes.

4.2.1. Seasonality

Figure 4.3 summarizes the seasonal pattern in the frequency of price increases and decreases. It reports a box plot of the frequencies observed in each quarter. The seasonal pattern is clearer in the case of price increases, as it was also the case from Figure 4.2. On average, prices are more frequently raised in the first quarter of the year, whereas there are

[11] For the analysis of the size of price changes, we follow the same approach.

less price changes over the summer months. This evidence can be interpreted in favour of some firms following time dependent price setting strategies.

The seasonal pattern in the frequency of price changes differs across the main CPI components. In general, the seasonal pattern of the frequency of price increases differs from that corresponding to price decreases. In the unprocessed food category the highest frequency of price increases is observed in January, whereas the lowest one is found in February. The opposite result is perceived for price decreases. In the case of processed food products the highest frequency of price increases is observed at the beginning of the year, whereas the highest frequency of price decreases is found over the spring months. In non-energy industrial goods, the lowest frequency of price changes (and, in particular, of price increases) is detected over the summer months, a period in which production of these goods is markedly lower than in the rest of the year. In services, the highest frequency of price changes is found in the first quarter, this being particularly clear in the case of price raises. Again, the lowest frequency is observed in the third quarter.

4.2.2. Indirect taxation: VAT and excise duties

During the sample period, some changes in indirect tax rates were implemented. First, in January 1995 a 1 percentage point increase in VAT rates was introduced. Table 4.2 compares the average frequency of price increases and decreases in January 1995 with that observed for the whole sample period. From this table as well as from Figure 4.2, it can be seen that this tax change had a sizable impact on the frequency of price increases for all categories with the exception of unprocessed food. However, the percentage of firms that changed their prices in that particular period is still relatively low, a behaviour that could reflect that the size of the tax change was small in respect to the typical size of price changes.

The sample period was also characterised by some changes in excise duties affecting tobacco and alcoholic beverages. Unfortunately, our sample does not contain information on tobacco prices, so we restrict our attention to a number of changes in tax rates of excise duties on alcoholic beverages. In particular, tax rates on beer were increased in January 1994, January 1995 and January 1996. In these same dates as well as in August 1996 tax rates on spirits were raised. In the case of beer, the frequency of price changes was substantially higher in the months were the tax changes were implemented, although the frequency of firms changing their prices did not reach 50% (see Figure 4.4). Interestingly, this result is not found in the case of spirits where the tax changes hardly affect the frequency of tax changes. If any, the maximum impact is observed one month after the change in the tax rate.

4.2.3. Macroeconomic conditions: inflation rate

Macroeconomic conditions are likely to influence the price setting behaviour. In particular, to shed some light on the importance of state-dependent pricing strategies we could analyse the relationship between the frequency of price adjustment and the level of inflation, measured as the year on year rate of change. This analysis might offer some insights on the determinants of price setting behaviour. Thus, the higher are the costs of changing prices, the higher will be the dependence of the frequency of price changes with respect to the average level of inflation.

To obtain a clearer view of the relationship between frequency of price adjustment and aggregate inflation Figure 4.5 plots the frequency of price changes, increases and decreases against the average inflation rate. These series are adjusted for seasonality and indirect tax changes[12]. This figure indicates that upward changes in prices are more frequent when inflation is higher[13]. Analogously, downward changes in prices are less frequent with high inflation rates. If we jointly consider upward and downward changes, we find that the positive relationship between frequency and inflation dominates.

As can be seen in Figure 4.6, which plots the frequency of price increases (decreases) against the average sectoral inflation rate, similar patterns are observed for the main CPI components. Nevertheless, the negative relationship between the frequency of price reductions and the average inflation rate is less clear in the cases of unprocessed food and services.

In order to obtain additional evidence on state-dependent pricing strategies, we have also considered some other demand pressure variables (measures of the output gap, real GDP and consumption growth) and measures of costs (Unit labour costs and compensation per employee), although none of them has been significant in time series regressions.

4.2.4. Attractive prices

4.2.4.1 Reasons for the use of attractive prices

A number of studies have documented the common observation that certain digits are more likely than others to appear as rightmost digit or ending of consumer prices. In particular, the digits 0, 5 and 9 are considerably more frequent in practice than what a

[12] More precisely, Figure 3.6 plots the residuals of the linear regression of the inflation rate over a constant, seasonal dummies and a dummy for the VAT change in January 1995 against the residuals of the linear regression of the frequency of price increases (decreases) over a constant, seasonal dummies and the 1995 VAT change. A similar plot will be made to relate the size of the price changes and inflation.

[13] We are considering the current year-on-year inflation rate, which is a lagging indicator of month-on-month changes. To try to pick up forward looking elements in the frequency of price change we have run regressions with leads of inflation, although they have not been significant.

uniform distribution would suggest. Table 4.3 presents some international evidence in this sense. This tendency reflects both the rational behaviour of both consumers and price setters.

Among other factors, the use of so-called round prices (typically those ending in 0 or 5) reflects a more general pattern underlying the use of numbers in human communication (Dehaene and Mehler (1992)), that is associated with the higher cognitive accessibility of these numbers, particularly in decimal numeration systems. Against this background, the use of round numbers facilitates the communication of retailers with consumers (Schindler and Kirby (1997)). Moreover, given the incentives to make transactions easier, the denominations of coins and banknotes used by central banks is an additional factor supporting the use of round prices.

Use of so-called psychological prices is also widespread, reflecting a series of factors. Historically, its use is associated with Macy's department store practice of using 9-ending prices to oblige clerks to use the cash register to make change and thus reduce the opportunity to pocket the payment. More recently, other explanations have been put forward. For instance, Schindler and Kirby (1997) propose the perceived gain effect: a tendency for consumers to interpret 9 ending prices as round-number prices with a small amount given back. Moreover, theories of bounded rationality consider that the analysis of every digit in a price is costly, so that rational consumers may decide to ignore rightmost digits. This truncation strategy would result in a benefit to sellers using 9 endings. Finally, Schindler (1991) considers that the price ending serves as a cue that gives information about a product or retail outlet. In particular, just-below price endings may connote sales or discount prices or even that the price is low relative to competition.

4.2.4.2 Relevance of attractive prices

Figure 4.7 offers some evidence on the relevance of attractive price setting strategies of Spanish retailers. Attractive prices defined as those ending in 0, 5 or 9% represent 61% of all prices in our sample. Consumer prices ending in 0 (35%) and 5 (17%) are the most frequent, whereas those ending in 9 (9%) appear to be less important. There also exist considerable differences across the main CPI components, accounting for 87% of the prices in the case of unprocessed food but only 51% in the case of non-energy industrial goods. In services, the percentage is 72%. These figures are similar, although slightly lower, than the ones obtained by Álvarez and Jareño (2002) for Spanish food prices. For instance, for unprocessed food prices they find a share of 94%, instead of 87%, whereas for processed food prices their figure is 79% instead of 58%. There are two reasons that could explain this difference in results. On the one hand, our database contains final prices, so that changes in weights or size of the items sold affect the price ending from that moment onwards. On the other hand, sales and promotions prices -which probably are set more often in attractive terms- are excluded in our sample.

Figure 4.7 suggests that defining attractive prices in terms of their rightmost digit is probably too general, since the reasons to support the use of attractive prices need not apply to all of them (e.g. 69 or 45 pesetas are probably not considered attractive). As a narrower definition, we consider attractive those prices ending in 00, 25, 50, 75, 90, 95 and 99 pesetas[14]. This definition takes into account the importance of 25 and 75 price endings which are associated to the relevance of the 25 peseta coin.

4.2.4.3 Attractive prices and frequency of adjustment

In terms of the frequency of price adjustment the existence of attractive pricing could be seen as a rigidity in the price setting process. Given a certain disturbance, retailers may decide not to reset their prices until a new attractive price point is appropriate. This would result in longer price durations than in the case of retailers not using attractive pricesand larger sizes of price changes. Employing the above mentioned definition results in the frequency of price adjustment reported in Table 4.4. For all items, the frequency of price adjustment for attractive prices is 0.13, whereas 0.16 is obtained for non attractive prices. In terms of durations, these figures would correspond to 7.4 and 5.8 months, respectively if we employ the continuous time assumption. For the main CPI components the same pattern is observed and attractive pricing leads to more sluggish adjustments. However, there are strong differences across categories. For instance, the frequency of price adjustment for unprocessed food items is only slightly lower for those prices that are attractive in comparison to the rest. At the other end of the spectrum, the frequency of change for non attractive non energy industrial goods prices is 60% higher than for the rest. It has to be stressed, though, that these differences may be somewhat underestimated to the extent that the prices in our dataset include the effect of changes in the units of measurement of products sold. Analysis of price increases and decreases shows similar features.

4.2.5. Determinants of the time-series variation of the frequency of price changes

As has been emphasised in the preceding sections, we have found differences both in the cross section and time series variation of prices changes. In this section we concentrate in the time series variation of the frequency of adjustment, given that some of the preceding explanatory factors either depend on time (seasonality), are presumed to affect only specific time periods (changes in indirect taxation) or have an aggregate nature (inflation). This set up also allows us to shed some light on the issue of price versus state dependence of pricing strategies and the impact of attractive pricing behaviour.

[14] 100 pesetas represented 60 euro cents.

To summarise the influence of these factors on the frequency of price changes, we run time-series regressions, both for the whole basket as well as for the CPI components. We estimate the following regression model:

$$F_t = a + \sum_{i=1}^{3} b_i \; Q_i + g \;\; DT95Q1 + d \;\; INF_t + f \;\; ATR_t + e_t$$

where *F* denotes the average frequency of price changes (alternatively F^+ and F^- will denote, respectively, the average frequency of price increases and decreases), *INF* is aggregate inflation (or the inflation rate of the corresponding CPI component in the case of the sect oral regressions), *Q* are seasonal dummies[15], *DT95Q1* is a dummy variable for the VAT rate change, *ATR* is the average incidence of attractive prices and *e* is a residual term[16]. Models are estimated by maximum likelihood.

Table 4.5 reports the results of these regressions. These results may be summarised as follows. First, seasonal dummies are always significant. Seasonal factors significantly affect the average frequency of price changes (both increases and decreases) for the whole CPI basket as well as for the different CPI components. Effects are stronger for price increases than for price decreases and are particularly marked for services. Second, the change in the VAT rate in January 1995 significantly affected the frequency of price increases (with the exception of the unprocessed food component) although it did not have any influence on the frequency of price decreases. Third, inflation has a positive and significant impact on the frequency of price increases (the exception being the processed food component) and a negative effect on the frequency of price reductions (although this effect is not significant in the cases of unprocessed food and services). This latter result suggests that when inflation is high, firms with a negative gap between optimal and current price have some incentives to delay their price adjustment, expecting that this gap will be closed as a consequence of trend inflation. Finally, a weak negative link between the frequency of attractive prices and the frequency of price changes is found suggesting that those items whose prices are fixed in attractive terms have a lower probability of being changed.

5. Size of price changes

In this section we present results on the size of price changes (*?P*), which are defined as logarithmic changes. Here, our assumption is that prices change only once

[15] Q_i takes value 1 in quarter *i* and -1 in the fourth quarter. Thus, the constant term can be interpreted as the average frequency and the coefficient of Q_i as the difference between the average frequency in quarter $_i$ and the overall average frequency.

[16] To account for possible autocorrelation of the residuals we consider Ljung-Box statistics and simple and partial correlograms. Although, we do not restrict *a priori* the ARIMA model generating the disturbance term we find that, when there is autocorrelation, an AR(1) process is sufficient. Its coefficient is reported as RHO.

within a given month (or within a quarter for those products whose prices are collected on a quarterly basis). Note that in the case of some unprocessed food items, in which the duration of prices is often shorter than a month, the computed change is the sum of those actually made within a given month.

5.1. Main findings

Table 5.1 reports the average absolute size of price changes for the whole basket, as well as for the main CPI components. Results for average price increases and decreases are also reported. The size of the typical change in prices is 8.6%, which is relatively large. Moreover, the average size of price increases is 8.2%, and that of price reductions is even larger: -10.3%. Our estimates are similar to the estimates available for other European countries. For positive price changes, Aucremanne and Dhyne (2004), Baudry et al. (2004) and Dias et al. (2004) report estimates of 6.8%, 12.5% and 8.1% for Belgium, France and Portugal[17], respectively, whereas average price decreases are -8.7%, -10,0% and -7.5%. Note that inclusion of sale or promotion prices in our dataset would increase average price changes whereas the consideration of unregulated energy prices would tend to reduce the size of both positive and negative changes. Inclusion of some regulated prices should probably result in larger sizes of price changes.

Again, there is a marked heterogeneity across products in the size of price changes, although it is less pronounced than in the case of the frequency of price adjustment. The highest average size of price changes corresponds to unprocessed food prices, which tend to increase by 14.9% and decrease by 15.6%. Note that changes in weather conditions determine notable changes in the supply of unprocessed food and that their relatively low demand elasticity make supply shifts cause relatively large changes in prices. Moreover, these items are typically highly perishable, so price reductions are more likely the closer to the end of the life of the product. For services, whose prices tend to be sticky, price increases (8.2%) and, particularly, price decreases (-11.2%) are also quite large. Finally, the lowest changes correspond to non energy industrial goods and processed food prices.

5.2. Factors affecting the size of price changes

The previous section has shown the existence of marked differences in the size of price changes across product categories. Moreover, although to a lesser extent, the size of price changes also displays time variation. Figure 5.1 illustrates this fact by plotting the time series of the absolute size of price increases and decreases for the whole basket. As in the case of section 4.2, where we analysed the frequency of price adjustment, we focus on some factors that could affect the size of price changes over time. In particular: the

[17] Estimates for Portugal and Belgium refer to median price changes. Median sizes tend to be smaller than mean sizes.

seasonal pattern, the impact of changes in indirect taxation, the level of inflation, and, finally, the incidence of attractive price-setting prices strategies.

5.2.1. Seasonality

Figure 5.1 shows that the size of price changes displays a mild seasonal pattern, although it is considerably less pronounced than that of the frequency of price adjustment. The seasonal pattern is more marked in the case of price increases, being not clear in the case of price reductions. On average, price increases tend to be greater in the second half of the year than in the first one. Note that sale prices are not included in our dataset, a fact that would entail a more pronounced seasonal pattern.

Analysing the main CPI components, we find again that the seasonal pattern of the size of price increases is clear, although not so in the case of price decreases. As expected, the seasonality is particularly marked in the unprocessed food category and also, but to a lesser extent, in the case of processed food products. The seasonal pattern is much less pronounced in the case of non-energy industrial goods and services, although the size of price increases for services in the fourth quarter is considerably higher than in the rest of the year.

5.2.2. Indirect taxation: VAT and excise duties

Figure 5.1 also allows examining the impact of the 1 percentage point increase in VAT rates that was introduced in January 1995. It can be seen that this tax change did not have much impact on the size of price increases or decreases. The relatively small change in the tax rate in respect to typical price changes could explain this result. Analysis of the excise duties changes in the sample period shows that in the case of beer, the size of the price changes was not affected by the tax rate changes. For spirits, changes in excise duties did not affect the size of price changes, with the exception of the change in January 1996.

5.2.3. Macroeconomic conditions: inflation rate

Macroeconomic conditions are likely to influence the price setting behaviour. In particular, to shed some light on the importance of state-dependent pricing strategies we analyse the relationship between the size of price adjustment and the level of inflation. For price increases, we would expect that periods with high inflation would be characterised by larger price increases and *viceversa.* On the contrary, price decreases should be smaller in high inflation periods and higher in low inflation periods.

To obtain a clearer view of the relationship between the size of price changes and aggregate inflation, Figure 5.2 plots the time series of the size of price changes, increases and decreases against the average inflation rate. Both series are adjusted for seasonality and indirect tax changes in the way described in section 4.2.3. This figure seems to suggest that the size of price increases is greater the higher the rate of inflation. As expected, for the size of price decreases, we find that periods of higher inflation are associated with smaller – in absolute terms- price decreases.

As can be seen in Figure 5.3, which plots the frequency of price increases (decreases) against the average sectoral inflation rate, similar patterns are observed for the main CPI components. Note that the negative relationship between sectoral inflation and size of price decreases seems to be quite weak.

5.2.4. Attractive prices and size of adjustment

In terms of the observed size of price adjustment the existence of attractive pricing could be seen as a rigidity in the price adjustment process. Given a certain disturbance, retailers may decide not to reset their prices until a new attractive price point is appropriate. This would result in smaller frequencies of change but greater -in absolute terms- price changes than in the case of retailers not using attractive pricing strategies.

As can be seen in Table 5.2, for all items, the average absolute size of a price change is higher for retailers using attractive pricing strategies than for those that do not employ them. Specifically, the typical price change for a firm setting attractive prices is 9.5% whereas it is 8.1% for the rest of retailers. For the main CPI components the same pattern is observed and attractive pricing leads to larger adjustments. The largest discrepancies correspond to services and unprocessed food prices and the smallest ones to processed food prices. Again, it has to be stressed that these differences may be somewhat underestimated to the extent that the prices in our dataset include the effect of changes in the units of measurement of products sold, a fact that tends to reduce the relevance of attractive prices.

Table 5.2 also reports the size of price increases and decreases for retailers using attractive price setting strategies and the rest. As expected, we observe that attractive pricing strategies lead to greater positive and negative changes. For the main CPI components the same pattern is observed.

5.2.5. Determinants of the time-series variation of the size of price adjustment

We explore in this section the effect of seasonality, changes in indirect taxation, inflation and attractive price setting strategies on the size of price changes. It has to be stressed that, in contrast to the other determinants, the impact of attractive pricing, should have a greater effect in the cross sectional dimension. Moreover, our price data are somewhat affected by changes in the unit of measure.

To summarise the influence of these factors on the frequency of price changes, we run time-series regressions, both for the whole basket as well as for the CPI components. We estimate the following regression model:

$$S_t = a + \sum_{i=1}^{3} b_i \, Q_i + g \; DT95Q1 + d \; INF_t + f \; ATR_t + e_t$$

where S denotes the average size of price changes in absolute terms (alternatively S+ and S- denote, respectively, the average size of price increases and decreases), and the rest of the variables have been defined in section 4.2.5. Models are estimated by maximum likelihood[18].

Table 5.3 reports the results of these regressions and results may be summarised as follows. First, for the whole CPI seasonal factors affect significantly the average size of price increases, although not price decreases. By components, there is some heterogeneity and, as expected, the greatest effects are found for unprocessed food prices. There is also a marked seasonal component for price increases in the service sector. Second, the rise in the VAT rate in January 1995 did not significantly increase the size of the price adjustments. Third, inflation has a positive and significant impact on the size of price changes and prices increases, but does not seem to affect the size of price decreases. By components, the same pattern is observed for price increases, except for unprocessed food where sectoral inflation does not have explanatory power. For prices decreases and absolute values, inflation does not have much explanatory power. Finally, the size of prices increases is greater the share of attractive prices and the same pattern is observed –in absolute terms- for price decreases. By components, the evidence is weaker.

6. Duration

As already mentioned in section 3, the main disadvantage of using the frequency approach to analyse the duration of price spells is the difficulty in deriving the distribution of price durations. For this reason, in this section we report direct estimates of price durations. After describing the main features of the distribution of price durations, we analyse the influence of the duration of price spells on the probability of adjusting the price as well as on the magnitude of the price change.

6.1. Main results

Figure 6.1 plots the unconditional distribution of price durations while Table 6.1 summarises the main descriptive statistics computed using alternative weighting procedures. Panel A of Table 6.1 reports the summary statistics of the unweighted

[18] We find that an AR(1) process or AR(2) is sufficient to pick up the autocorrelation present in some cases.

distribution. This distribution is extremely skewed and there is a high concentration of price spells with very short durations: the overall mode of the distribution is at duration 1 month and the median is 2 months. The average unweighted duration is 4.9 months and there is a very long right-side tail. To take into account that price spells with very short durations are overrepresented in this distribution (since for a given time horizon, a larger number of spells are observed for products with short durations), we consider two alternative weighting schemes. In the first approach, the weight assigned to each price duration is the CPI weight of its subclass divided by the number of observed durations in that subclass. This weighting procedure results, as reported in Panel B, in higher statistics for durations. The average duration is 11.4 months and the median is 8 months. Nevertheless, with this approach we still overweight, within each subclass, trajectories with very short durations. For this reason, we consider a second weighting approach in which before deriving the distribution at the subclass level, we first average durations within the same trajectory. As reported in Panel C, the average duration is 14.7 months while the median duration is one year.

Finally, it is worth mentioning that the results reported in Figure 6.1 and in Table 6.1 are obtained using uncensored spells only. Nevertheless, the distribution of price durations is quite similar to that constructed using all price spells. If anything, considering also censored spells moves the distribution of durations to the right, since long-lasting price spells are more likely to be censored. Thus, the weighted average duration of price spells is 14.7 months when censored durations are discarded, compared to 15.7 when all spells are considered.

Figure 6.2 plots the distributions of price durations for the main CPI components. As expected, there are substantial differences across them. In the case of food items, there is a very high concentration of price spells with very short durations. In both cases, processed and unprocessed food, the overall mode of the distribution is at duration 1 month and the percentile 25^{th} of the unweighted distribution is also 1 month. Focusing on the CPI weighted distributions of price spells averaged by trajectory (panel C), the average duration for unprocessed food is 3 months and the percentile 75^{th} is even below this figure.

In the case of non-energy industrial goods and services local modes are observed at months 3, 6, 9, 12 …reflecting the fact that for some items within these components, prices in our dataset are collected on the first month of each quarter. Nevertheless, the existence of a second mode at 12 months suggests that there are a significant fraction of firms, especially in the service sector, that review their prices once a year, in line with a Taylor-type price setting rule. The weighted average durations (panel C) for these two components are well above one year.

There is some evidence suggesting that the duration of a price spell is shorter after a price decrease than after a price increase. Higher frequencies for very short durations are observed in the case of the distribution of durations after a price decrease. The unweighted average duration of price spells after a price decrease is 3.6 months, compared to 5.9 for the distribution of durations after a price increase.

6.2. Probability of changing prices as a function of duration. Logit models

As a way to complement the evidence presented in section 4.2, on the determinants of the frequency of price changes, we present estimates of logit[19] models for the probability of changing prices. Unlike the regressions in section 4.2.5 where only the time–series variation was exploited, we now use both the time-series and cross-section dimensions of the data. Thus, we can assess to what extent the duration of a price spell has some bearing on the probability of it being changed. The dependent variable is a binary variable indicating whether a price change has taken place. The explanatory variables are dummy variables that indicate the month, the year[20], the type of good and whether the price is set in attractive terms, another dummy variable that takes a value of 1 in January 1995 (when a change in VAT rates took place), the inflation rate and a variable that specifies the number of periods elapsed since the last price change. The model is estimated on the whole sample and observations are unweighted.

The results are reported in the first three columns of Table 6.2. Most of the explanatory variables included in the specification turn out to be significant. Monthly dummies are jointly significant suggesting that seasonal factors have an influence on the probability of changing prices and indicating time dependent strategies. The probability of a price change is almost 40 pp. higher for unprocessed food items (12 pp. higher for processed food and 1.2 pp. higher for non-energy industrial goods) than for services items (services is the reference sector). We find that the higher is the duration of the price spell, the lower is the probability of observing a price change. In particular, an increase of one month in the duration of a price spell decreases the probability of a price change in 0.5 pp. These results are consistent with Baudry *et al.* (2004) where decreasing hazard functions are reported. The coefficients of the VAT change dummy and the inflation rate are both positive and significant, while that of the attractive pricing dummy is negative and significant. The last six columns of Table 6.2 report the estimates of logit models for the probabilities of a price increase and of a price decrease. The main differences with respect to the results of the logit model for the probability of a price change are the following. First, as expected, the level of inflation has a positive and significant effect on the probability of observing a price increase, but a significantly negative one on the probability of a price decrease. Second, the VAT tax change significantly raises the probability of a price increase, while its effect on the probability of a price cut is substantially smaller.

[19] Preliminary estimates with probit models showed very similar marginal effects.

[20] The results reported correspond to a specification that excludes the year dummies, since we include a macro variable (the inflation rate).

One potential drawback of the estimates reported in Table 6.2 is that observations belonging to the same trajectory (sequence of prices of a given product in a given outlet) may have special unobserved characteristics that are potentially correlated with the explanatory variables. In our model, the individual effect is likely to be correlated with the duration variable: trajectories with a higher constant term (fixed effect) are likely to display lower durations. In order to control for the existence of such individual effects, we use a fixed effect estimator developed by Chamberlain (1980) and applied in a similar setting by Cecchetti (1986). It is important to note that in the conditional logit estimation procedure proposed by Chamberlain (1980), only the slope parameters are estimated while the constant term for each trajectory is not computed.

The results of the conditional logit models are reported in Table 6.3[21]. Interestingly, the main difference with respect to the results from the standard logit estimation is found in the coefficients for duration that lose their significance in all cases. The intuition for this difference is as follows. By construction, the probability of observing a price change is higher in trajectories with shorter durations. If we do not control for individual trajectories, the coefficient of duration will reflect the cross-trajectory dimension in the relationship between duration and probability of price changes. Thus, we find that the longer is the duration the lower is the probability of finding a price change. However, when we control for individual trajectories, no link between duration and probability of price change is found[22]. In general, the remaining results do not qualitatively differ from those in Table 6.2. The relevance of time dependent strategies is supported again by the significance of the monthly dummies. The VAT reform induced a substantial increase in the probability of a price change of 13.62, mainly reflecting the rise in the probability of a price increase. The coefficient of the inflation rate is positive and significant, although the magnitude of the effect is moderate: a one percentage point increase in inflation translates in a 0.89 pp. increase in the probability of a price change. Again, when distinguishing between price increases and decreases, the effect of the inflation level is, as expected, positive on the former and negative on the latter. Finally, prices set in attractive terms display a lower probability of being changed.

The results of the logit models with fixed effects for the probability of changing prices for the different CPI components are reported in Table 6.4. In line with the evidence presented in the preceding section, the explanatory power of the different regressors differs across components. Monthly dummies are jointly significant in all cases. In general, duration does not affect the probability of changing prices. A negative effect of duration on

[21] Two important features of the estimation procedure are worth mentioning. First, trajectories where the dependent variable is either always zero (the price never changes), or always one (the price always changes) are discarded, so the number of usable observations is slightly below that in the standard logit model. Second, variables that do not display within-trajectory variation, such as the dummy variables for the type of good, cannot be included in the model.

[22] This result is related to that of Álvarez et al. (2004), where it is analytically shown that the common finding of decreasing unconditional hazard functions may be due to composition effects.

this probability is only observed for the processed food component and even in this case the marginal effect is very low. Inflation, measured by the corresponding sectoral index, has a significantly positive effect in the models for all components, the exception being processed food items[23]. An additional percentage point of inflation translates into a moderate (between 0.1 and 2.1 pp.) increase in the probability of a price change. The effect of the VAT rate change is significant for all components, with the exception of unprocessed food. The marginal effect of this tax change ranges from 13.6 pp. in the non-energy industrial goods to 16.3 pp. in the case of processed food. Finally, prices set in attractive terms display a lower probability of being.

6.3. Size conditioned on duration

In this section, we analyse the determinants of the magnitude of the price changes. In particular, we explore the relationship between the size of the price adjustments and duration of price spells. A positive sign in this relationship would be consistent with the predictions of menu cost models. In the presence of high menu costs, firms will postpone a price change until the desired adjustment is large enough to warrant paying the menu cost. Thus, the higher are the menu costs, the lower will be the frequency of price adjustments and the larger will be the magnitudes of the changes once they take place. Note that a similar argument applies to attractive price setting theories.

Table 6.5 provides a first piece of evidence on this relationship. It reports the average size of price changes for different duration classes[24]. The relationship between the duration of price spells and the size of the price changes is not clear. In the case of food items, the absence of a monotonic relationship may be explained by the fact that some of these items, being especially prone to suffer frequent supply shifts, have low demand elasticity and, as a consequence, experience large price changes. At the other extreme, in the case of services longer price spells tend to end with larger price changes, what is consistent with the predictions of menu cost models.

Finally, to assess the influence of duration on the size of price adjustment, we use Heckman's sample selection model. What we try to explain is the magnitude of the desired price change, but this is only observed when a price change takes place[25]. We consider fixed effects both in the selection mechanism and in the equation for the size of price changes. In particular, in both equations we allow for a different constant term for each specific product in each specific outlet. To be able to estimate the corresponding model we have restricted our sample to those observations corresponding to just one city. Thus, the selection mechanism is a probit model explaining the probability of a price change with the

[23] A positive effect of inflation is observed in the models for the probability of price increases.

[24] Only uncensored spells are used to compute this table.

[25] Our underlying assumption to use this approach is that when a firm changes its price, it fully adjusts to the desired price.

same explanatory variables that those in the model of the previous section. We exclude duration, because in the previous section we found it to be unsignificant and the dummies for special components and the dummy for attractive pricing[26] because they are fixed effects themshelves . To specify the model for the size of the price changes, we assume that the size of price changes (in absolute value) is just determined by the duration of the price spell, the inflation rate and a set of seasonal dummies. The results are reported in Table 6.6. First, we note that r , the correlation coefficient of the disturbance terms of the size and probability of change equations is different from zero, so standard regression techniques applied to the size equation would lead to biased results. Second, it is worth noting that the estimates for the selection mechanism are consistent with the estimates of the logit model in the previous section. Third, as expected, inflation has a significantly positive influence on the size of price adjustments. Interestingly, the estimated coefficient for the duration of the price spell is not significant, indicating that there is not a clear relationship between the time elapsed since the last prince change and the magnitude of the price adjustment. This evidence is against the hypothesis of firms facing menu costs.

7. Conclusions

This paper documents the main stylised facts of price setting behaviour of Spanish retailers over the period 1993-2001. To this end, we exploit a subsample of the micro prices underlying the base 1992 Spanish consumer price index. Our analysis mainly focuses on the frequency and size of price changes as well as on the duration of price spells. The main conclusions of our empirical research are the following:

1. Consumer prices are moderately sticky. The average monthly frequency of price changes is 0.15, so that prices change on average every 6 or 7 months. Alternatively, the direct computation of the duration of price spells indicates that the average duration is slightly over 1 year. The difference between both statistics is mainly explained by the asymmetry of the cross-item distribution of the frequency of price changes.

2. We find a great deal of heterogeneity in the frequency of price adjustment. As expected, the flexibility of prices is greatest for unprocessed food prices and the highest degree of price stickiness is observed for services. Heterogeneity is somewhat less marked for the size of price changes.

3. While nominal prices are moderately sticky, we do not find signs of a higher degree of downward rigidity. With the exception of the services component, price decreases

[26] In principle, outlets could display some variation in their use of attractive prices through time. However, we think that in our sample this observed variation corresponds mostly corresponds to the introduction by INE of correcting coefficients in prices.

are only slightly less frequent than price increases, which is consistent with a positive and moderate trend inflation.

4. Even though prices of most products do not change often, they typically change by a large amount (8.6% on average). Moreover, the size of price decreases tends to be somewhat higher than that of price increases.

5. The observed seasonality in the frequency of price change suggests that some retailers follow time dependent strategies. In turn, the size of price changes shows a mild seasonal pattern, mostly reflecting the pattern in the size of price increases.

6. Both the frequency and the size of price adjustment depend on the inflation rate. Upward changes in prices are more frequent when inflation is high and downward changes are less frequent with high inflation rates. This fact is consistent with state dependent pricing strategies. Similarly, as expected, periods of high (low) inflation are characterised by larger (smaller) price increases. On the contrary, price decreases are smaller (larger) in high (low) inflation periods.

7. The application of state dependent strategies is also supported by the fact that the frequency of price changes is significantly affected by changes in indirect taxation. However, these changes do not generally affect the size of price adjustments, a fact that could be due to their small magnitude with regard to the typical size of a price change.

8. Use of attractive prices (i.e. psychological and round) is associated with more sluggish price adjustments and with larger price changes. In absolute terms, price rises and decreases are larger for retailers using attractive pricing strategies.

9. Once we control for individual effects, we do not find a significant relationship neither between the duration of a price spell and the probability of observing a price change nor between the duration of a price spell and the size of the price change. This evidence is not consistent with firms facing menu costs.

In future work, we plan to study the price setting behaviour at the producer level and compare it with the price setting behaviour of retailers analysed in this paper. Future research should also focus on testing alternative theories of price setting. To this end, we intend to estimate models that incorporate both state dependent and time dependent variables.

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Table 2.1

Coverage of the sample in terms of expenditure

Main CPI components

	CPI weight	Sample weight	Coverage
Unprocessed food	118.8	105.4	88.7
Processed food	174.8	114.7	65.6
Non-energy industrial goods	328.8	257.8	78.4
Energy	71.2	0.0	0.0
Services	306.4	223.5	72.9
Total	1000.0	701.3	70.1

COICOP groups

	CPI weight	Sample weight	Coverage
1. Food and non-alcoholic beverages	267.8	215.0	80.3
2. Alcoholic beverages and tobacco	25.8	5.0	19.5
3. Clothing and footwear	114.8	111.1	96.8
4. Housing	102.8	41.1	39.9
5. Furniture and household equipment	64.3	52.7	81.9
6. Health	24.7	20.6	83.2
7. Transport	135.8	37.7	27.7
8. Communications	14.4	0.0	0.0
9. Recreation and culture	67.9	47.1	69.4
10. Education	12.9	8.9	69.3
11. Hotels, cafes and restaurants	109.6	104.3	95.2
12. Miscellaneous goods and services	59.1	57.7	97.6
Total	1000.0	701.2	70.1

Table 4.1

Monthly frequency of price changes				
Main component	**Frequency of price changes**	**Frequency of price increases**	**Frequency of price decreases**	**% of price increases**
Unprocessed food	0.50	0.26	0.23	53.1%
Processed food	0.18	0.11	0.07	59.0%
Non-energy industrial goods	0.07	0.05	0.02	74.9%
Services	0.06	0.05	0.01	86.5%
All items	0.15	0.09	0.06	62.2%

Table 4.2

Effect of VAT change in the frequency of price changes

Main component	Frequency of price increases		Frequency of price decreases	
	Overall sample	January 1995	Overall sample	January 1995
Unprocessed food	0.26	0.33	0.23	0.16
Processed food	0.11	0.22	0.07	0.07
Non-energy industrial goods	0.05	0.14	0.02	0.02
Services	0.05	0.31	0.01	0.01
All items	0.09	0.24	0.06	0.04

Table 4.3

Frequency of attractive prices (%)

Country	Authors	Price ending			
		0, 5 and 9	**0**	**5**	**9**
New Zealand	Holdershaw et al. (1997)	97	8	29	61
Germany	Fengler and Winter (2001)*	80	-	-	80
United States	Schindler and Kirby (1997)	76	27	19	31
Belgium	Aucremanne and Cornille (2001	72	-	-	-
Netherlands	Folkerstama (2002)**	67	24	12	31
Spain	Álvarez and Jareño (2002)	91	5	52	34
United States	Bergen et al. (2003)	81	5	11	65

* Result for price endings 8 and 9

** The 5 price ending only covers prices ending in 25 and 75

Table 4.4

Frequency of price changes

Main component	Attractive prices	Non attractive prices
Unprocessed food	0.47	0.51
Processed food	0.14	0.20
Non-energy industrial goods	0.05	0.08
Services	0.05	0.06
All items	0.13	0.16

Frequency of price increases

Main component	Attractive prices	Non attractive prices
Unprocessed food	0.25	0.27
Processed food	0.08	0.12
Non-energy industrial goods	0.04	0.06
Services	0.04	0.06
All items	0.08	0.10

Frequency of price decreases

Main component	Attractive prices	Non attractive prices
Unprocessed food	0.22	0.24
Processed food	0.06	0.08
Non-energy industrial goods	0.01	0.02
Services	0.01	0.01
All items	0.05	0.06

Table 4.5

Determinants of the time-series variation of the frequency of price changes

	All items		Unprocessed food		Processed food		Non-energy industrial goods		Services	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Intercept	0.141	0.00	0.631	0.00	0.250	0.00	0.060	0.00	0.059	0.00
Q1	0.010	0.00	-0.018	0.00	0.014	0.00	-0.001	0.30	0.035	0.00
Q2	-0.004	0.02	-0.014	0.01	-0.001	0.67	0.005	0.00	-0.012	0.00
Q3	-0.010	0.00	0.034	0.00	-0.015	0.00	-0.022	0.00	-0.016	0.00
DUM95Q1	0.047	0.00	-0.005	0.82	0.073	0.00	0.039	0.00	0.071	0.00
INF	0.003	0.01	0.002	0.03	0.000	0.95	0.003	0.00	0.006	0.00
FREQ_ATR	-0.016	0.52	-0.280	0.23	-0.279	0.01	0.001	0.89	-0.061	0.02
RHO					0.495	0.00				

	All items	Unprocessed food	Processed food	Non-energy industrial goods	Services
Number of observations	35	35	35	35	35
Wald joint significance test	144.02	57.22	76.06	722.05	668.18
p-value	0	0	0	0	0
Log likelihood	127.06	92.11	98.43	146.36	128.97
Residual standard error	0.00641	0.01741	0.01448	0.00370	0.00607
Wald sesonality test	48.26	47.23	20.53	577.52	333.86
p-value	0	0	0.0001	0	0

Determinants of the time-series variation of the frequency of price increases

	All items		Unprocessed food		Processed food		Non-energy industrial goods		Services	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Intercept	0.084	0.00	0.412	0.00	0.162	0.00	0.041	0.00	0.051	0.00
Q1	0.013	0.00	-0.008	0.25	0.017	0.00	0.002	0.12	0.034	0.00
Q2	-0.008	0.00	-0.023	0.00	-0.011	0.01	0.003	0.00	-0.012	0.00
Q3	-0.009	0.00	0.030	0.00	-0.012	0.00	-0.020	0.00	-0.013	0.00
DUM95Q1	0.044	0.00	-0.005	0.85	0.060	0.00	0.040	0.00	0.070	0.00
INF	0.006	0.00	0.003	0.03	0.004	0.18	0.005	0.00	0.006	0.00
FREQ_ATR	-0.034	0.18	-0.307	0.28	-0.263	0.06	-0.014	0.14	-0.060	0.01
RHO					0.546	0.00				

	All items	Unprocessed food	Processed food	Non-energy industrial goods	Services
Number of observations	35	35	35	35	35
Wald joint significance test	166.13	36.06	70.48	837.82	758.94
p-value	0	0	0	0	0
Log likelihood	125.92	85.11	93.30	151.82	132.50
Residual standard error	0.00663	0.02127	0.01675	0.00316	0.00549
Wald sesonality test	57.05	28.82	21.94	585.76	367.18
p-value	0	0	0.0001	0	0

Determinants of the time-series variation of the frequency of price decreases

	All items		Unprocessed food		Processed food		Non-energy industrial goods		Services	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Intercept	0.058	0.00	0.220	0.05	0.087	0.00	0.019	0.00	0.007	0.00
Q1	-0.003	0.00	-0.011	0.05	-0.003	0.19	-0.003	0.00	0.002	0.00
Q2	0.004	0.00	0.008	0.10	0.009	0.00	0.002	0.00	0.000	0.82
Q3	-0.001	0.08	0.004	0.43	-0.003	0.17	-0.002	0.00	-0.003	0.00
DUM95Q1	0.003	0.36	0.000	1.00	0.013	0.10	-0.001	0.44	0.001	0.72
INF	-0.002	0.00	0.000	0.61	-0.004	0.00	-0.002	0.00	0.000	0.62
FREQ_ATR	0.018	0.10	0.027	0.91	-0.008	0.87	0.014	0.04	-0.001	0.90
RHO					0.297	0.07	0.347	0.04		

	All items	Unprocessed food	Processed food	Non-energy industrial goods	Services
Number of observations	35	35	35	35	35
Wald joint significance test	41.89	6.20	44.11	172.51	38.15
p-value	0	0.4014	0	0	0
Log likelihood	155.63	93.18	120.47	174.77	176.97
Residual standard error	0.00284	0.01689	0.00773	0.00164	0.00154
Wald sesonality test	22.75	5.28	21.75	148.92	35.75
p-value	0	0.1525	0.0001	0	0

Table 5.1

Size of price changes

CPI component	Average price change	Average price increase	Average price decrease
Unprocessed food	15.2%	14.9%	-15.6%
Processed food	7.3%	6.9%	-8.0%
Non-energy industrial goods	6.5%	6.1%	-8.3%
Services	8.4%	8.2%	-11.2%
All items	8.6%	8.2%	-10.3%

Table 5.2

Absolute size of price changes		
Main component	**Attractive prices**	**Non attractive prices**
Unprocessed food	16.2%	14.3%
Processed food	7.7%	7.2%
Non-energy industrial goods	7.2%	6.4%
Services	9.9%	7.4%
All items	9.5%	8.1%

Size of price increases		
Main component	**Attractive prices**	**Non attractive prices**
Unprocessed food	15.8%	14.0%
Processed food	7.2%	6.8%
Non-energy industrial goods	6.8%	5.9%
Services	9.7%	7.3%
All items	9.1%	7.7%

Size of price decreases		
Main component	**Attractive prices**	**Non attractive prices**
Unprocessed food	-16.6%	-14.6%
Processed food	-8.6%	-7.9%
Non-energy industrial goods	-8.6%	-8.2%
Services	-12.7%	-9.3%
All items	-11.1%	-9.5%

Table 5.3

Size of price changes

	All items		Unprocessed food		Processed food		Non-energy industrial goods		Services	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Intercept	0.0689	0.00	0.1263	0.06	0.1263	0.00	0.0590	0.00	0.0703	0.00
Q1	-0.0011	0.32	-0.0004	0.80	-0.0004	0.45	0.0008	0.59	-0.0062	0.01
Q2	-0.0017	0.08	-0.0024	0.12	-0.0024	0.03	-0.0021	0.16	-0.0003	0.91
Q3	0.0009	0.39	0.0084	0.00	0.0084	0.58	0.0015	0.30	-0.0051	0.02
DUM95Q1	-0.0065	0.02	-0.0049	0.47	-0.0049	0.00	-0.0064	0.23	-0.0018	0.83
INF	0.0016	0.00	-0.0006	0.43	-0.0006	0.61	0.0016	0.19	0.0031	0.07
FREQ_ATR	0.0393	0.00	0.0501	0.71	0.0501	0.00	0.0155	0.28	0.0118	0.73
RHO1	0.2011	0.28	0.489321	0.04	0.4893	0.00				
RHO2	-0.4080	0.02								
Number of observations	36		36		36		36		36	
Wald joint significance test	101.46		44.85		74.57		14.81		40.32	
p-value	0.00		0.00		0.00		0.02		0.00	
Log likelihood	160.17		126.67		150.52		136.23		120.89	
Residual standard error	0.0025		0.0065		0.00		0.0049		0.0077	
Wald sesonality test	4.76		35.69		5.24		2.59		28.88	
p-value	0.19		0.00		0.16		0.46		0.00	

Size of price increases

	All items		Unprocessed food		Processed food		Non-energy industrial goods		Services	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Intercept	0.0669	0.00	0.1380	0.03	0.0477	0.00	0.0535	0.00	0.0714	0.00
Q1	-0.0019	0.07	-0.0017	0.39	-0.0010	0.46	0.0009	0.51	-0.0060	0.03
Q2	-0.0019	0.04	-0.0064	0.00	0.0009	0.46	-0.0012	0.34	-0.0001	0.97
Q3	0.0014	0.14	0.0091	0.00	0.0010	0.41	0.0004	0.76	-0.0048	0.05
DUM95Q1	-0.0051	0.15	0.0010	0.90	-0.0083	0.07	-0.0053	0.25	-0.0019	0.84
INF	0.0020	0.00	-0.0004	0.53	0.0010	0.01	0.0041	0.00	0.0048	0.01
FREQ_ATR	0.0283	0.04	0.0129	0.92	0.0707	0.00	-0.0114	0.36	-0.0115	0.76
RHO			0.4365	0.05						
Number of observations	36		36		36		36		36	
Wald joint significance test	48.49		41.39		35.17		25.94		35.14	
p-value	0.00		0.01		0.00		0.00		0.00	
Log likelihood	151.11		123.62		141.82		141.55		117.22	
Residual standard error	0.0032		0.0071		0.0042		0.0042		0.0085	
Wald sesonality test	11.69		33.98		1.76		1.07		21.11	
p-value	0.01		0.00		0.62		0.78		0.00	

Size of price decreases

	All items		Unprocessed food		Processed food		Non-energy industrial goods		Services	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Intercept	-0.0721	0.00	-0.1639	0.00	-0.0474	0.00	-0.0778	0.00	-0.0161	0.70
Q1	-0.0025	0.31	0.0051	0.06	-0.0012	0.28	-0.0031	0.46	-0.0054	0.65
Q2	0.0004	0.84	-0.0001	0.97	-0.0009	0.36	0.0080	0.04	-0.0058	0.61
Q3	-0.0018	0.42	-0.0098	0.00	0.0020	0.05	-0.0051	0.18	0.0023	0.84
DUM95Q1	0.0023	0.78	0.0045	0.66	0.0043	0.29	0.0030	0.83	0.0297	0.42
INF	0.0001	0.96	-0.0002	0.70	0.0001	0.91	0.0031	0.35	0.0062	0.33
FREQ_ATR	-0.0811	0.01	0.0332	0.77	-0.1260	0.00	-0.0567	0.14	-0.2416	0.05
RHO					0.6014	0.00			-0.2908	0.08
Number of observations	36.00		36.00		36.00		36.00		36.00	
Wald joint significance test	16.16		19.76		38.37		7.10		8.34	
p-value	0.01		0.00		0.00		0.31		0.30	
Log likelihood	121.09		117.83		139.80		101.77		68.56	
Residual standard error	0.0076		0.0084		0.0044		0.0132		0.0341	
Wald sesonality test	3.54		17.13		4.33		5.04		1.14	
p-value	0.32		0.00		0.23		0.17		0.77	

Duration of price spells

Panel A. Unweighted average of individual price spells

		Observations	Mean	Median	Standard deviation	Interquartile range	Percentile p25	Percentile p75	Minimun	Maximun
All items		167179	4.9	2.0	8.0	4.0	1.0	5.0	1	104
Special components										
Unprocessed food	1	82211	1.9	1.0	2.9	1.0	1.0	2.0	1	87
Processed food	2	46920	4.9	2.0	7.0	5.0	1.0	6.0	1	100
Non-energy industrial goods	3	29856	11.3	8.0	11.5	11.0	3.0	14.0	1	103
Services	5	8192	13.1	12.0	12.2	8.0	6.0	14.0	1	104

Panel B. CPI weighted average of individual price spells

		Observations	Mean	Median	Standard deviation	Interquartile range	Percentile p25	Percentile p75	Minimun	Maximun
All items		167179	11.4	8	12.8	11	2	13	1	104
Special components										
Unprocessed food	1	82211	2.0	1	3.4	1	1	2	1	87
Processed food	2	46920	5.1	2	7.4	5	1	6	1	100
Non-energy industrial goods	3	29856	13.7	11	12.3	11	6	17	1	103
Services	5	8192	16.1	12	14.5	14	7	21	1	104

Panel C. CPI weighted average of individual price spells (averaged by trajectory)

		Observations	Mean	Median	Standard deviation	Interquartile range	Percentile p25	Percentile p75	Minimun	Maximun
All items		167179	14.7	12.0	13.1	13.4	5.8	19.2	1	104
Special components										
Unprocessed food	1	82211	3.0	1.6	5.1	1.5	1.2	2.6	1	87
Processed food	2	46920	8.1	5.6	8.2	5.8	3.5	9.4	1	100
Non-energy industrial goods	3	29856	17.4	14.4	11.9	10.4	10.3	20.8	1	103
Services	5	8192	20.1	16.0	14.1	12.4	11.6	24.0	1.3	104

Table 6.2

Logit model. Conditional probability of price change. All items

	Price changes			Price increases			Price decreases		
	Coeff.	Marginal effect	p-value	Coeff.	Marginal effect	p-value	Coeff.	Marginal effect	p-value
Intercept	-2.0995	--	0.00	-2.2659	--	0.00	-4.4341	--	0.00
month2	-0.0269	-0.0026	0.07	-0.3599	-0.0215	0.00	0.5601	0.0189	0.00
month3	-0.1300	-0.0122	0.00	-0.3156	-0.0191	0.00	0.2929	0.0089	0.00
month4	0.0941	0.0095	0.00	-0.1249	-0.0081	0.00	0.4586	0.0148	0.00
month5	-0.1219	-0.0114	0.00	-0.3923	-0.0231	0.00	0.4214	0.0134	0.00
month6	-0.2423	-0.0219	0.00	-0.6307	-0.0343	0.00	0.4948	0.0163	0.00
month7	-0.1862	-0.0171	0.00	-0.4712	-0.0271	0.00	0.4062	0.0129	0.00
month8	-0.2575	-0.0231	0.00	-0.5168	-0.0292	0.00	0.3288	0.0101	0.00
month9	-0.1055	-0.0099	0.00	-0.2879	-0.0176	0.00	0.3020	0.0092	0.00
month10	0.1227	0.0125	0.00	-0.0944	-0.0062	0.00	0.4709	0.0153	0.00
month11	-0.0082	-0.0008	0.58	-0.1976	-0.0125	0.00	0.3617	0.0112	0.00
month12	-0.2794	-0.0249	0.00	-0.4631	-0.0267	0.00	0.2081	0.0061	0.00
spcomp1	2.3719	0.3983	0.00	1.5436	0.1663	0.00	3.3072	0.2997	0.00
spcomp2	0.9980	0.1186	0.00	0.5366	0.0409	0.00	2.1743	0.1098	0.00
spcomp3	0.1180	0.0116	0.00	-0.1073	-0.0072	0.00	1.0309	0.0304	0.00
DUR	-0.0517	-0.0050	0.00	-0.0381	-0.0026	0.00	-0.0701	-0.0019	0.00
DUM95Q1	0.4967	0.0584	0.00	0.4840	0.0401	0.00	0.0996	0.0028	0.05
INF	0.0253	0.0025	0.00	0.0650	0.0044	0.00	-0.0447	-0.0012	0.00
FREQ_ATR	-0.1416	-0.0136	0.00	-0.1524	-0.0101	0.00	-0.0694	-0.0018	0.00
Number of observations		1082576			1082576			1082576	
Wald joint significance test		180730.99			71387.51			99708.19	
p-value		0			0			0	
Log likelihood		-391061.58			-311190.98			-210993.78	

Table 6.3

Logit model. Conditional probability of price change. All items. Fixed-effects estimation

	Price changes			Price increases			Price decreases		
	Coeff.	Marginal effect	p-value	Coeff.	Marginal effect	p-value	Coeff.	Marginal effect	p-value
month2	-0.0272	-0.0068	0.09	-0.3716	-0.0904	0.00	0.5948	0.1416	0.00
month3	-0.1571	-0.0390	0.00	-0.3328	-0.0812	0.00	0.3000	0.0733	0.00
month4	0.1074	0.0268	0.00	-0.1301	-0.0321	0.00	0.4849	0.1167	0.00
month5	-0.1463	-0.0364	0.00	-0.4134	-0.1003	0.00	0.4415	0.1067	0.00
month6	-0.2925	-0.0722	0.00	-0.6654	-0.1575	0.00	0.5155	0.1237	0.00
month7	-0.2285	-0.0566	0.00	-0.5007	-0.1205	0.00	0.4170	0.1010	0.00
month8	-0.3096	-0.0764	0.00	-0.5457	-0.1308	0.00	0.3366	0.0820	0.00
month9	-0.1335	-0.0332	0.00	-0.3076	-0.0752	0.00	0.3062	0.0748	0.00
month10	0.1326	0.0331	0.00	-0.1031	-0.0255	0.00	0.4914	0.1182	0.00
month11	-0.0164	-0.0041	0.30	-0.2106	-0.0518	0.00	0.3765	0.0915	0.00
month12	-0.3330	-0.0820	0.00	-0.4884	-0.1177	0.00	0.2106	0.0518	0.00
DUR	-0.0004	-0.0001	0.37	-0.0004	-0.0001	0.39	-0.0002	-0.0001	0.79
DUM95Q1	0.5529	0.1362	0.00	0.5052	0.1254	0.00	0.1040	0.0257	0.05
INF	0.0358	0.0089	0.00	0.0754	0.0187	0.00	-0.0488	-0.0121	0.00
FREQ_ATR	-0.2727	-0.0678	0.00	-0.2223	-0.0550	0.00	-0.1466	-0.0365	0.00
Number of observations		1068623			1062976			769649	
LR joint significance test		3866.92			4635.71			1384.79	
p-value		0			0			0	
Log likelihood		-322819.64			-271297.86			-172417.83	

Table 6.4

Logit model. Conditional probability of price change. Main CPI components. Fixed-effects estimation

	Unprocessed food			Processed food			Non-energy industrial			Services		
	Coeff.	Marginal effect	p-value	Coeff.	Marginal effect	p-value	Coeff.	Marginal effect	p-value	Coeff.	Marginal effect	p-value
month2	0.0601	0.0150	0.05	0.1482	0.0370	0.00	0.0912	0.0223	0.00	-0.80376	-0.11824	0.00
month3	-0.2139	-0.0533	0.00	0.0162	0.0040	0.55	0.2739	0.0659	0.00	-1.43929	-0.18009	0.00
month4	-0.0479	-0.0120	0.12	-0.0097	-0.0024	0.73	0.7841	0.1777	0.00	-0.86311	-0.12507	0.00
month5	-0.0231	-0.0058	0.45	-0.0267	-0.0067	0.33	0.2479	0.0597	0.00	-1.73289	-0.20149	0.00
month6	0.0197	0.0049	0.52	-0.0997	-0.0248	0.00	-0.1531	-0.0378	0.00	-2.26655	-0.23201	0.00
month7	0.0077	0.0019	0.80	-0.1352	-0.0335	0.00	0.0010	0.0002	0.98	-1.4389	-0.18005	0.00
month8	0.2280	0.0569	0.00	-0.1908	-0.0472	0.00	-0.3757	-0.0933	0.00	-2.27439	-0.23239	0.00
month9	0.2757	0.0687	0.00	-0.1345	-0.0334	0.00	-0.0363	-0.0089	0.28	-1.12721	-0.15271	0.00
month10	0.1443	0.0361	0.00	-0.0486	-0.0121	0.08	0.7444	0.1696	0.00	-0.81955	-0.12009	0.00
month11	0.0010	0.0002	0.97	-0.0132	-0.0033	0.63	0.5707	0.1330	0.00	-1.54333	-0.18814	0.00
month12	-0.2218	-0.0552	0.00	-0.0330	-0.0082	0.23	-0.1303	-0.0322	0.00	-2.23833	-0.23059	0.00
DUR	0.0024	0.0006	0.09	-0.0016	-0.0004	0.04	-0.0006	-0.0001	0.36	0.001155	0.000206	0.30
DUM95Q1	0.0829	0.0207	0.21	0.6667	0.1634	0.00	0.5929	0.1362	0.00	0.772445	0.163288	0.00
INF	0.0050	0.0012	0.00	-0.0027	-0.0007	0.29	0.0858	0.0211	0.00	0.094078	0.016809	0.00
FREQ_ATR	-0.1493	-0.0373	0.00	-0.2176	-0.0540	0.00	-0.5039	-0.1246	0.00	-0.51178	-0.09078	0.00
Number of observations		165731			272949			473699			156244	
LR joint significance test		694.3			627.84			4866.89			4577.48	
p-value		0			0			0			0	
Log likelihood		-80356.953			-106809.66			-103409.48			-28793.757	

Table 6.5

Average size of price changes by duration

	All items	Unprocessed food	Processed food	Non-energy industrial goods	Services
T<=3	8.8%	15.3%	7.9%	7.4%	7.1%
3<T<=6	7.7%	13.8%	7.5%	5.8%	7.0%
6<T<=9	7.7%	13.4%	7.3%	6.3%	6.7%
9<T<=12	7.8%	13.8%	7.2%	6.2%	7.1%
12<T<=15	7.8%	14.6%	6.9%	6.4%	6.8%
15<T<=18	8.3%	13.2%	7.5%	6.8%	8.0%
18<T<=21	8.3%	12.1%	6.8%	7.3%	8.3%
21<T<=24	8.6%	14.5%	7.1%	7.1%	8.5%
T>24	9.2%	13.7%	7.7%	7.1%	10.1%

Table 6.6

Heckman selection model

Size equation

	Coefficient	p-value
month2	-0.0121	0.16
month3	-0.0512	0.00
month4	-0.0214	0.00
month5	-0.0468	0.00
month6	-0.0501	0.00
month7	-0.0426	0.00
month8	-0.0634	0.00
month9	-0.0266	0.00
month10	-0.0169	0.00
month11	-0.0217	0.01
month12	-0.0611	0.00
dur	-0.0001	0.47
inf	0.0092	0.00

Probability of change equation

	Coefficient	p-value
month2	-0.2072	0.00
month3	-0.3378	0.00
month4	-0.0317	0.38
month5	-0.3361	0.00
month6	-0.4204	0.00
month7	-0.2554	0.00
month8	-0.4720	0.00
month9	-0.2054	0.00
month10	0.0122	0.73
month11	-0.1964	0.00
month12	-0.4418	0.00
inf	0.0384	0.00
vat95	0.1784	0.01
rho	0.8748	
sigma	0.1347	
lambda	0.1178	

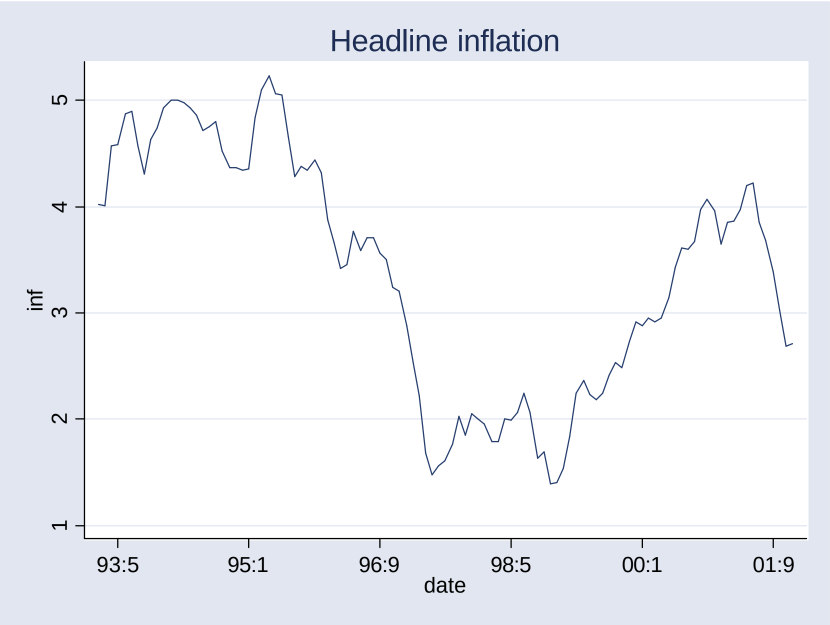
Number of observations	59603
Wald joint significance test	10602.33
p-value	0

Table A4.1

Frequency and size of price changes at the subclass level

Base 92 CPI code	Frequency of price changes: Total	Price increases	Price decreases	%Decreases/ Total	Size of price changes: Total (Absolute value)	Total (Mean)	Price increases	Price decreases
1104	17.0%	9.5%	7.6%	44.3%	7.9%	0.1%	7.2%	-8.8%
1105	13.4%	7.1%	6.2%	46.7%	8.7%	0.1%	8.2%	-9.2%
1113	40.0%	21.2%	18.8%	47.1%	9.0%	0.4%	8.9%	-9.1%
1114	53.5%	29.7%	23.8%	44.4%	10.8%	0.7%	10.4%	-11.3%
1115	41.2%	21.4%	19.8%	48.0%	10.3%	0.5%	10.3%	-10.2%
1116	12.7%	7.7%	4.9%	38.8%	7.9%	1.3%	7.5%	-8.5%
1117	13.4%	8.5%	4.9%	36.4%	8.2%	0.9%	7.1%	-10.0%
1121	56.2%	28.8%	27.4%	48.7%	17.3%	0.1%	17.0%	-17.7%
1122	12.2%	7.9%	4.3%	35.1%	7.6%	2.0%	7.4%	-8.0%
1123	30.6%	17.0%	13.6%	44.5%	13.7%	1.1%	13.3%	-14.2%
1131	22.2%	13.5%	8.7%	39.3%	4.9%	0.6%	4.6%	-5.5%
1133	16.5%	10.0%	6.4%	39.0%	8.9%	1.0%	8.1%	-10.2%
1134	20.1%	11.3%	8.7%	43.5%	8.7%	0.7%	8.3%	-9.2%
1142	37.4%	20.9%	16.5%	44.1%	6.2%	0.7%	6.2%	-6.3%
1151	52.2%	28.2%	24.0%	46.0%	16.4%	0.7%	15.8%	-17.1%
1153	60.9%	32.0%	28.9%	47.5%	24.9%	0.8%	24.5%	-25.4%
1154	15.1%	8.6%	6.5%	42.9%	9.0%	1.5%	9.2%	-8.7%
1161	36.5%	19.7%	16.7%	45.9%	18.1%	1.2%	17.8%	-18.4%
1171	15.6%	10.1%	5.4%	35.0%	2.8%	1.0%	2.9%	-2.5%
1181	17.9%	9.4%	8.4%	47.2%	7.9%	0.9%	8.4%	-7.4%
1191	12.2%	7.6%	4.7%	38.1%	7.0%	1.1%	6.6%	-7.7%
1192	14.8%	8.3%	6.6%	44.3%	8.8%	-0.1%	7.8%	-10.1%
1201	17.2%	9.9%	7.3%	42.4%	7.4%	0.6%	6.9%	-8.0%
1301	20.8%	13.7%	7.1%	34.1%	4.1%	1.3%	4.1%	-4.2%
1303	15.4%	9.6%	5.7%	37.3%	7.7%	1.3%	7.2%	-8.6%
2101	5.0%	4.1%	0.9%	17.8%	5.6%	3.1%	5.3%	-7.1%
2102	5.2%	4.8%	0.5%	8.7%	6.1%	4.9%	6.1%	-6.8%
2103	4.4%	3.8%	0.7%	14.8%	5.9%	3.7%	5.6%	-7.6%
2104	5.2%	4.6%	0.5%	10.0%	5.9%	4.4%	5.7%	-7.7%
2105	5.2%	4.4%	0.9%	16.5%	6.5%	3.3%	5.9%	-9.7%
2107	5.6%	5.3%	0.3%	4.7%	7.1%	6.4%	7.1%	-7.0%
2201	5.2%	4.4%	0.9%	16.5%	6.5%	3.9%	6.2%	-7.9%
2202	5.4%	4.9%	0.5%	9.8%	6.1%	4.5%	5.9%	-7.7%
2203	7.5%	6.5%	1.0%	13.7%	5.2%	3.8%	5.2%	-5.4%
3104	5.8%	4.9%	0.9%	15.1%	6.7%	4.5%	6.6%	-7.2%
3111	8.3%	8.0%	0.3%	3.3%	7.4%	6.5%	7.2%	-14.7%
4101	5.2%	4.3%	0.9%	16.7%	6.5%	4.3%	6.5%	-6.5%
4102	5.0%	4.5%	0.5%	10.9%	6.4%	5.1%	6.4%	-6.3%
4201	5.2%	4.4%	0.8%	15.0%	7.7%	3.8%	6.8%	-12.9%
4301	8.5%	4.7%	3.8%	44.5%	4.8%	0.1%	4.3%	-5.3%
4304	8.6%	4.6%	4.0%	46.4%	6.0%	-0.2%	5.5%	-6.7%
4401	5.4%	4.5%	0.9%	16.6%	7.7%	4.4%	7.2%	-9.9%
4402	6.6%	4.9%	1.6%	24.9%	8.5%	3.3%	7.9%	-10.6%
4501	14.4%	8.6%	5.8%	40.4%	7.5%	1.2%	7.3%	-7.8%
4502	10.8%	6.8%	4.0%	37.1%	8.9%	1.6%	8.3%	-9.9%
5102	10.4%	7.1%	3.4%	32.2%	7.5%	2.8%	7.6%	-7.2%
5201	7.8%	6.5%	1.2%	15.9%	4.3%	2.7%	4.2%	-4.8%
5301	2.2%	2.0%	0.2%	8.5%	13.7%	11.1%	13.6%	-15.1%
5501	7.8%	7.2%	0.6%	8.2%	6.6%	6.1%	6.9%	-3.2%
6201	9.4%	7.8%	1.7%	17.6%	5.4%	2.3%	4.7%	-9.0%
6221	6.8%	6.0%	0.8%	12.3%	6.5%	3.8%	5.9%	-11.2%
6301	6.7%	6.5%	0.2%	2.4%	7.1%	6.8%	7.1%	-6.2%
6311	6.8%	6.5%	0.3%	4.3%	3.9%	3.4%	3.8%	-5.0%
7101	9.2%	5.2%	4.0%	43.1%	5.7%	0.2%	5.2%	-6.3%
7102	7.9%	3.1%	4.8%	60.8%	6.4%	-2.7%	4.7%	-7.5%
7111	8.8%	3.4%	5.4%	61.0%	8.0%	-3.7%	5.6%	-9.6%
7122	5.1%	3.8%	1.3%	24.6%	7.8%	2.8%	7.1%	-10.1%
7123	5.9%	3.1%	2.8%	47.9%	9.2%	-0.4%	8.5%	-10.0%
7201	29.5%	16.1%	13.4%	45.5%	8.6%	1.6%	9.4%	-7.7%
7211	4.3%	2.9%	1.4%	32.1%	7.9%	0.3%	6.0%	-11.8%
7401	8.3%	7.9%	0.5%	5.5%	6.5%	3.7%	5.4%	-25.5%
7402	7.9%	7.8%	0.1%	1.7%	6.8%	5.6%	6.3%	-34.2%
7405	5.7%	5.6%	0.2%	3.2%	5.6%	5.2%	5.6%	-7.5%
8101	4.3%	4.1%	0.2%	3.8%	8.2%	7.5%	8.1%	-9.0%
8111	11.6%	7.7%	3.9%	33.7%	9.0%	2.5%	8.7%	-9.6%
8112	11.7%	7.3%	4.5%	38.1%	8.9%	1.2%	8.1%	-10.1%
8201	4.3%	3.7%	0.6%	13.8%	6.7%	5.0%	6.8%	-6.3%
8211	7.0%	5.6%	1.4%	19.5%	6.4%	3.2%	6.0%	-8.4%
8221	5.5%	4.3%	1.2%	22.0%	10.3%	5.3%	10.0%	-11.3%
8301	4.2%	4.0%	0.2%	5.3%	9.4%	8.1%	9.2%	-11.7%
8601	6.8%	6.2%	0.6%	8.8%	4.7%	3.7%	4.6%	-6.0%

Figure 2.1


Headline inflation
inf
1
2
3
4
5
93:5
95:1
96:9
98:5
00:1
01:9
date

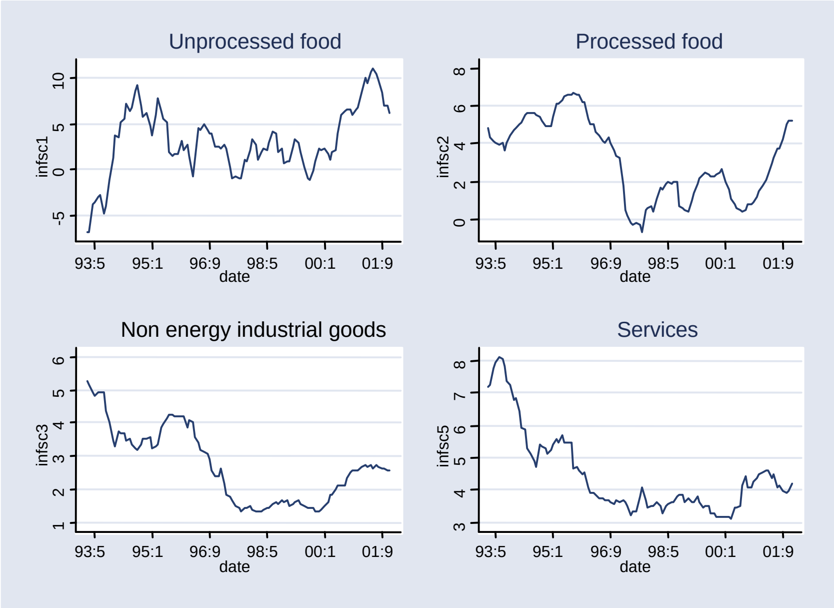

Unprocessed food
infsc1
Processed food
infsc2
Non energy industrial goods
infsc3
Services
infsc5
93:5
95:1
96:9
98:5
00:1
01:9
date

Figure 4.1

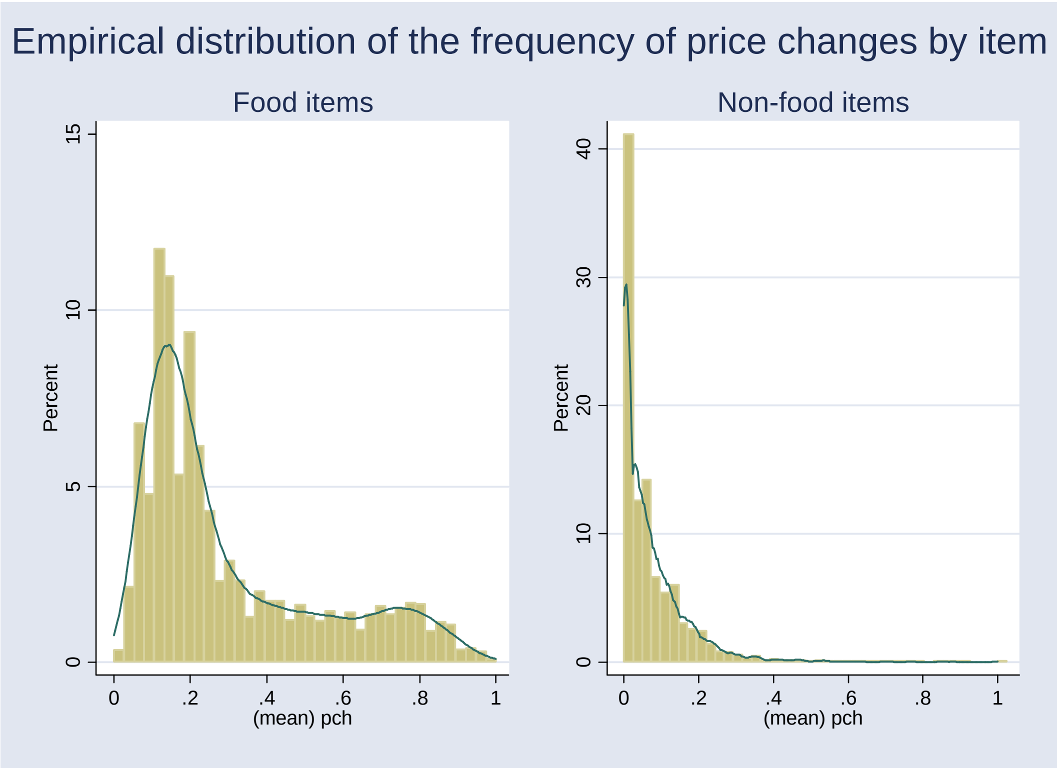
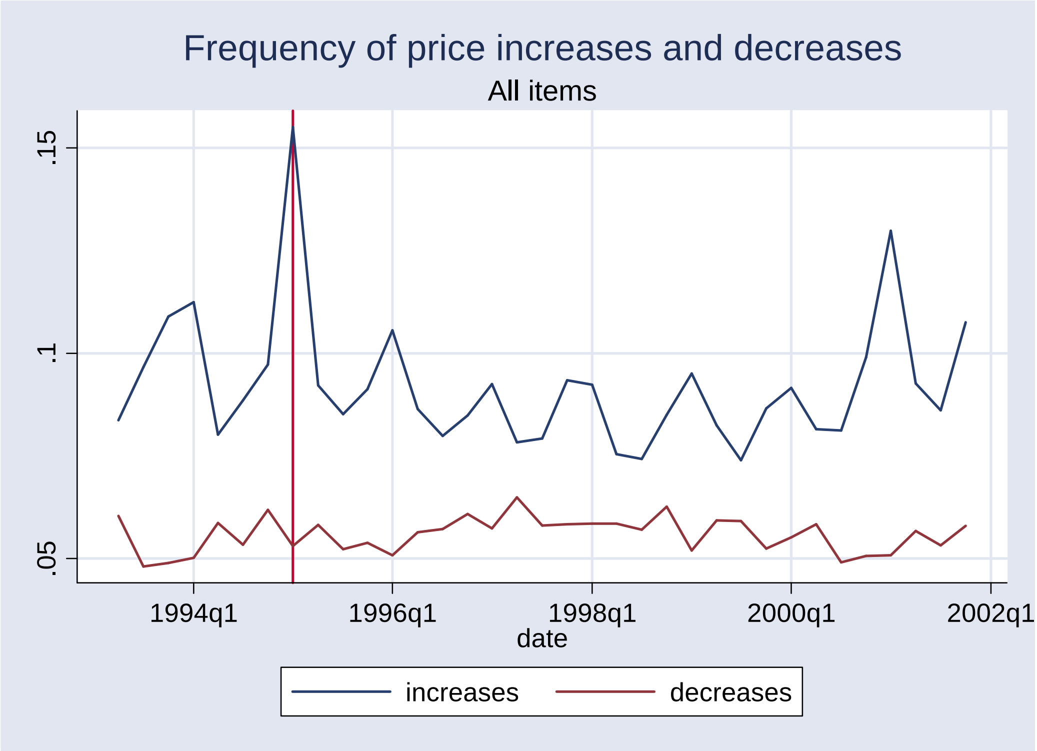

Empirical distribution of the frequency of price changes by item
Food items
Non-food items
Percent
(mean) pch
0
5
10
15
0
10
20
30
40
0
.2
.4
.6
.8
1

Figure 4.2


Frequency of price increases and decreases
All items
.05
.1
.15
1994q1
1996q1
1998q1
2000q1
2002q1
date
increases
decreases

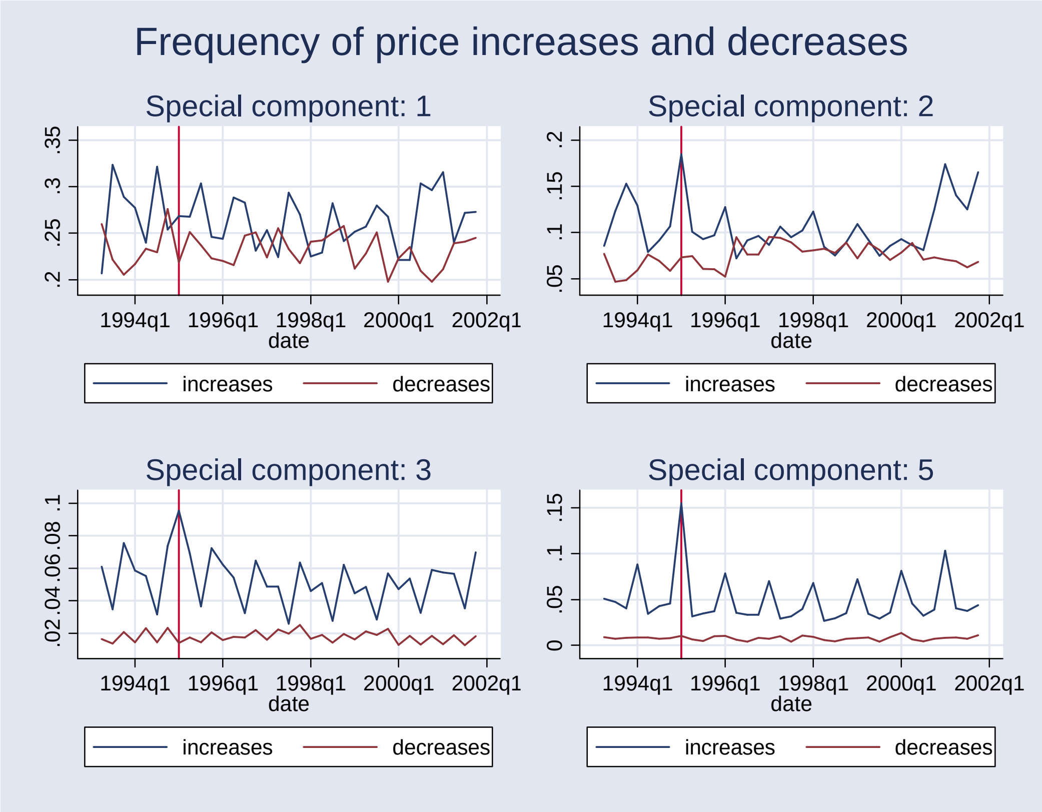
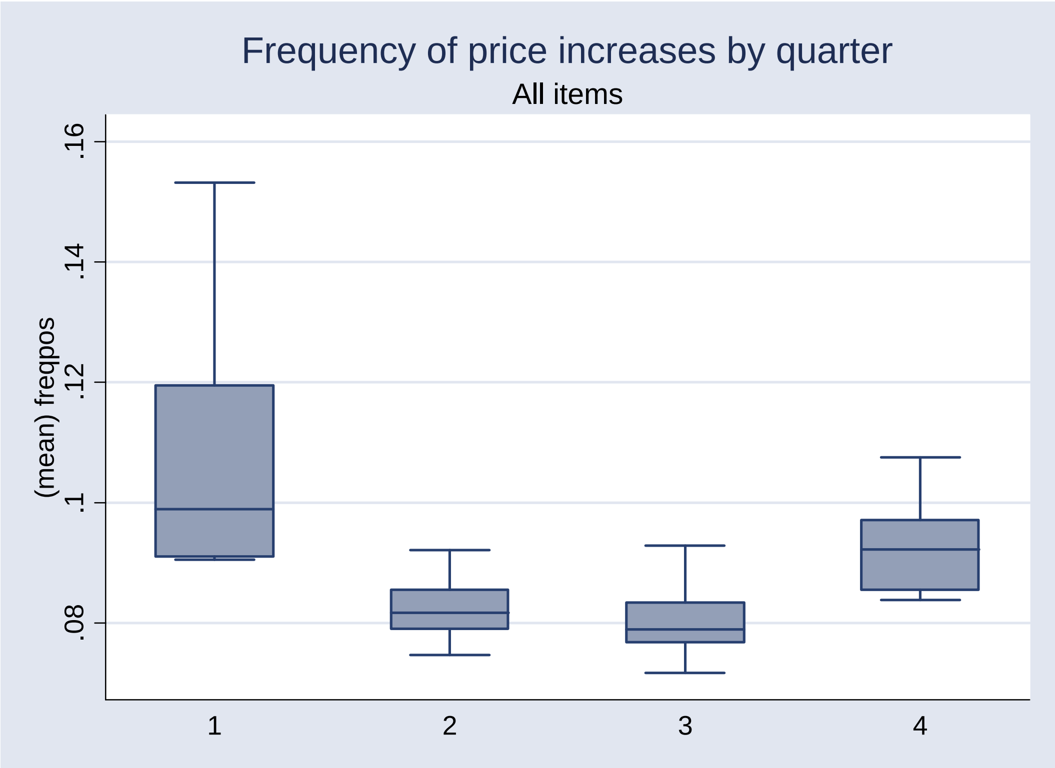

Frequency of price increases and decreases
Special component: 1
Special component: 2
Special component: 3
Special component: 5
1994q1
1996q1
1998q1
2000q1
2002q1
date
increases
decreases

Figure 4.3


Frequency of price increases by quarter
All items
(mean) freqpos
.08
.1
.12
.14
.16
1
2
3
4


Frequency of price decreases by quarter
All items
(mean) freqneg
.045
.05
.055
.06
.065
1
2
3
4

Figure 4.4

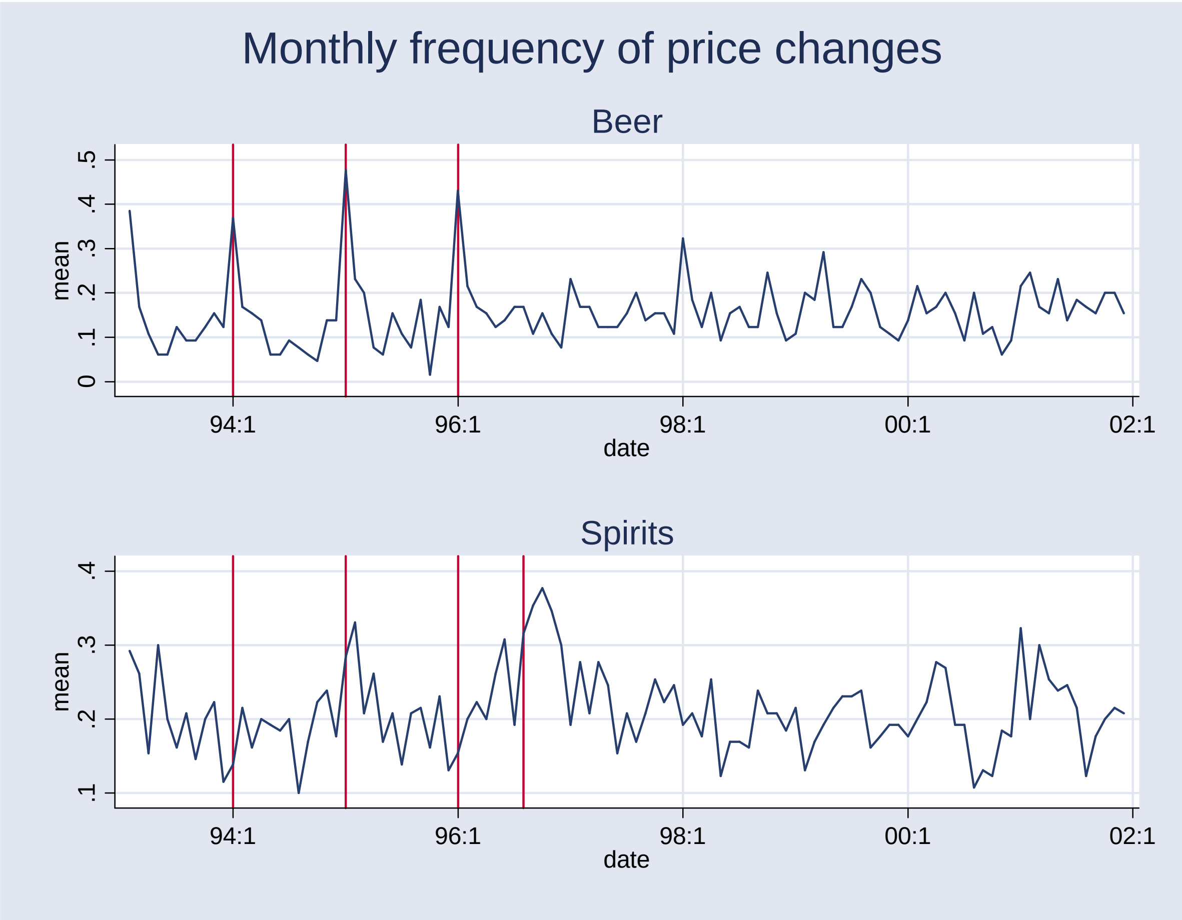
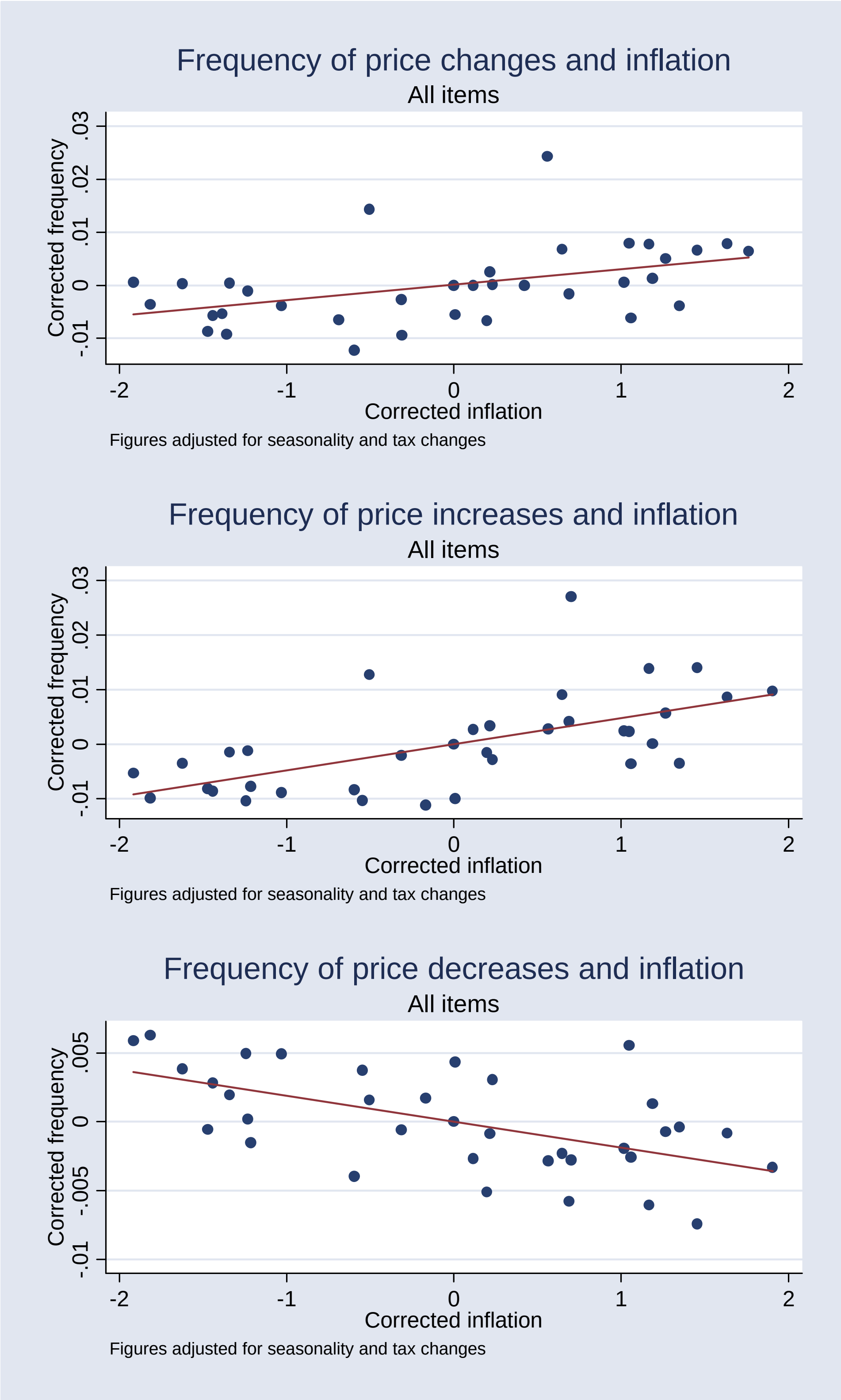
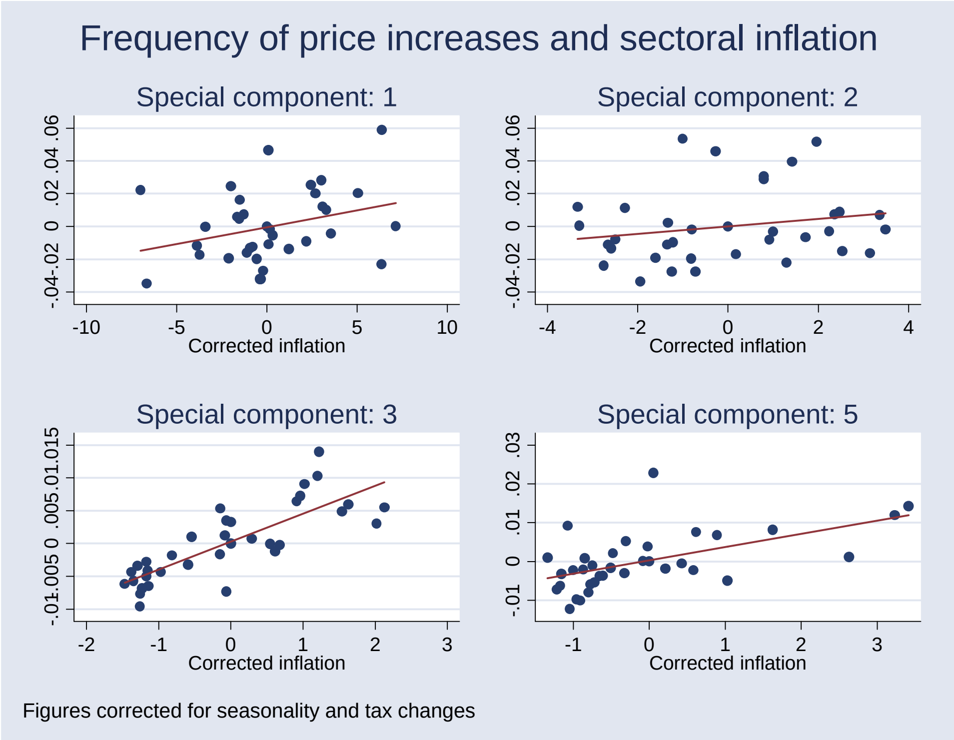

Monthly frequency of price changes
Beer
mean
0
.1
.2
.3
.4
.5
94:1
96:1
98:1
00:1
02:1
date
Spirits
mean
.1
.2
.3
.4
94:1
96:1
98:1
00:1
02:1
date

Figure 4.5

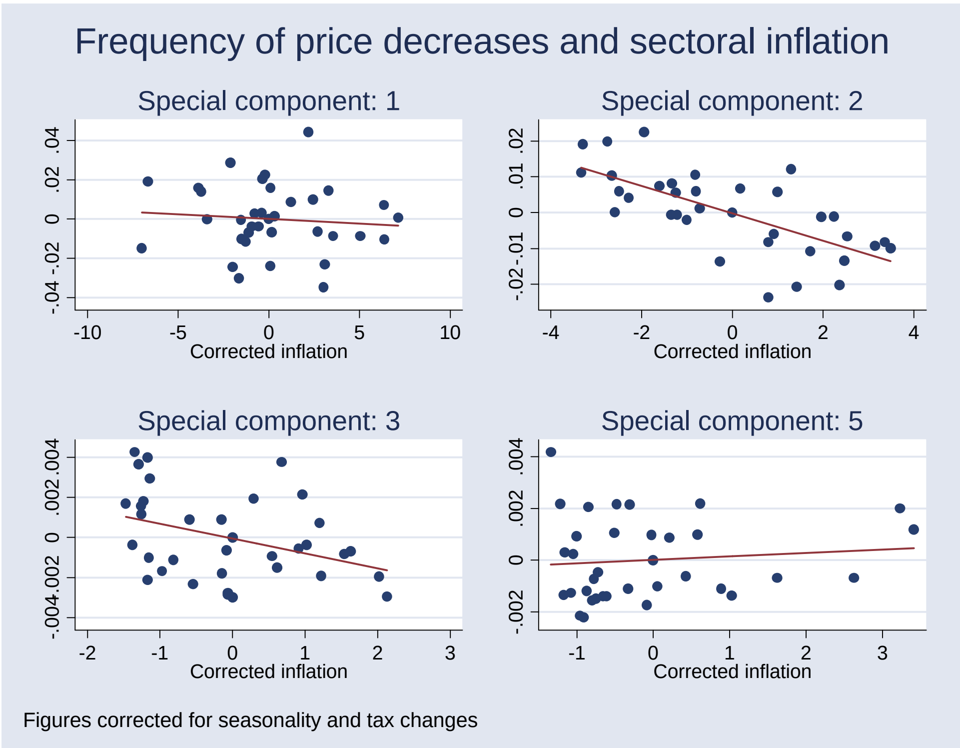


Frequency of price changes and inflation
All items
Corrected frequency
-.01
0
.01
.02
.03
-2
-1
0
1
2
Corrected inflation
Figures adjusted for seasonality and tax changes
Frequency of price increases and inflation
All items
Corrected frequency
-.01
0
.01
.02
.03
-2
-1
0
1
2
Corrected inflation
Figures adjusted for seasonality and tax changes
Frequency of price decreases and inflation
All items
Corrected frequency
-.01
-.005
0
.005
-2
-1
0
1
2
Corrected inflation
Figures adjusted for seasonality and tax changes

Figure 4.6

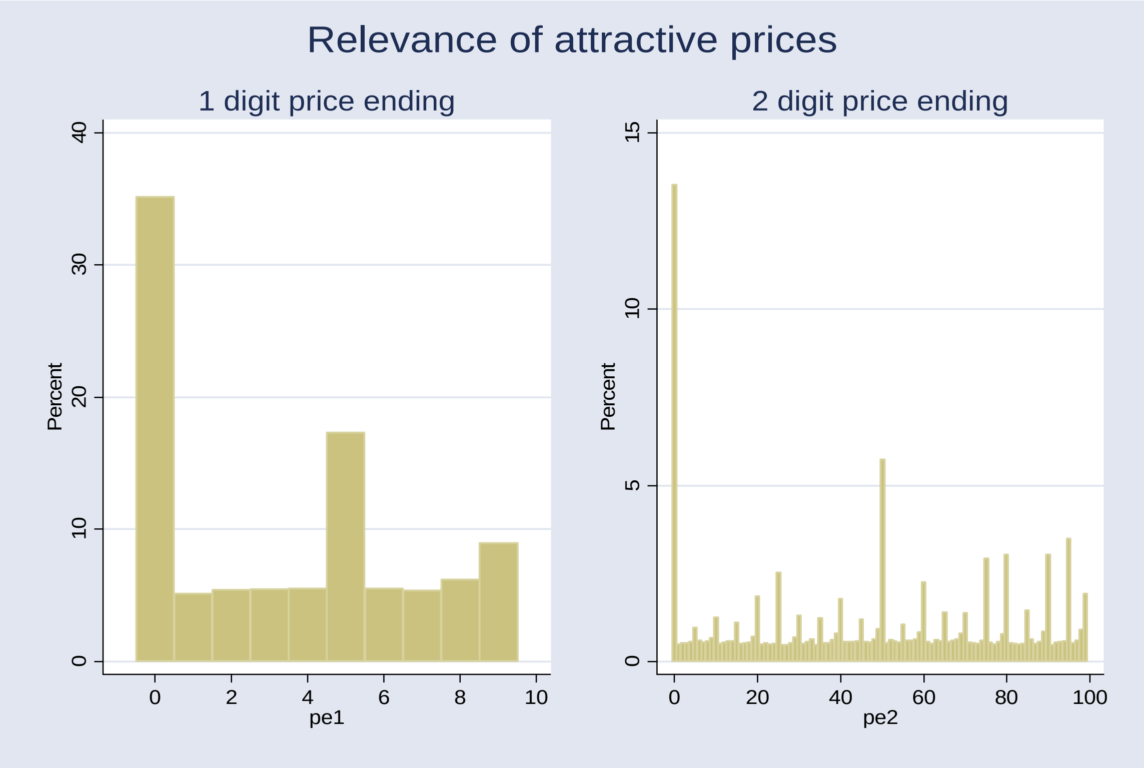


Frequency of price increases and sectoral inflation
Special component: 1
Special component: 2
Special component: 3
Special component: 5
Corrected inflation
Figures corrected for seasonality and tax changes



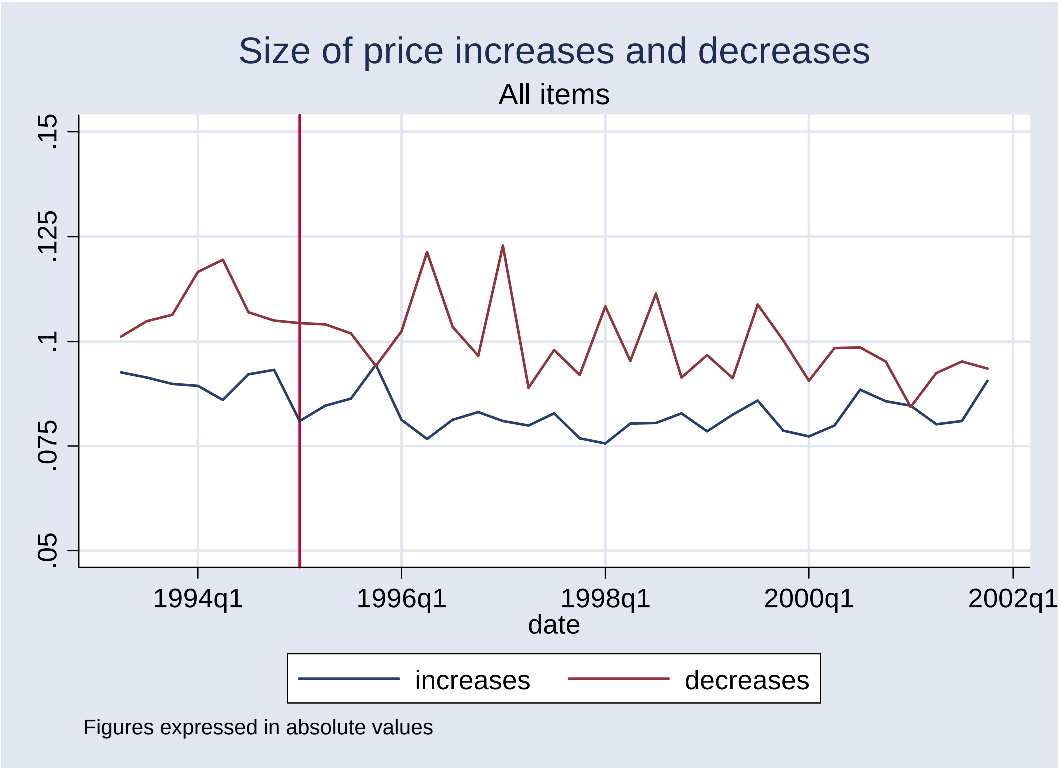
Frequency of price decreases and sectoral inflation
Special component: 1
Special component: 2
Special component: 3
Special component: 5
Corrected inflation
Figures corrected for seasonality and tax changes

Figure 4.7



Relevance of attractive prices
1 digit price ending
2 digit price ending
Percent
pe1
pe2
0
10
20
30
40
0
5
10
15
0
2
4
6
8
10
0
20
40
60
80
100

Figure 5.1



Size of price increases and decreases
All items
.05
.075
.1
.125
.15
1994q1
1996q1
1998q1
2000q1
2002q1
date
increases
decreases
Figures expressed in absolute values

Figure 5.2

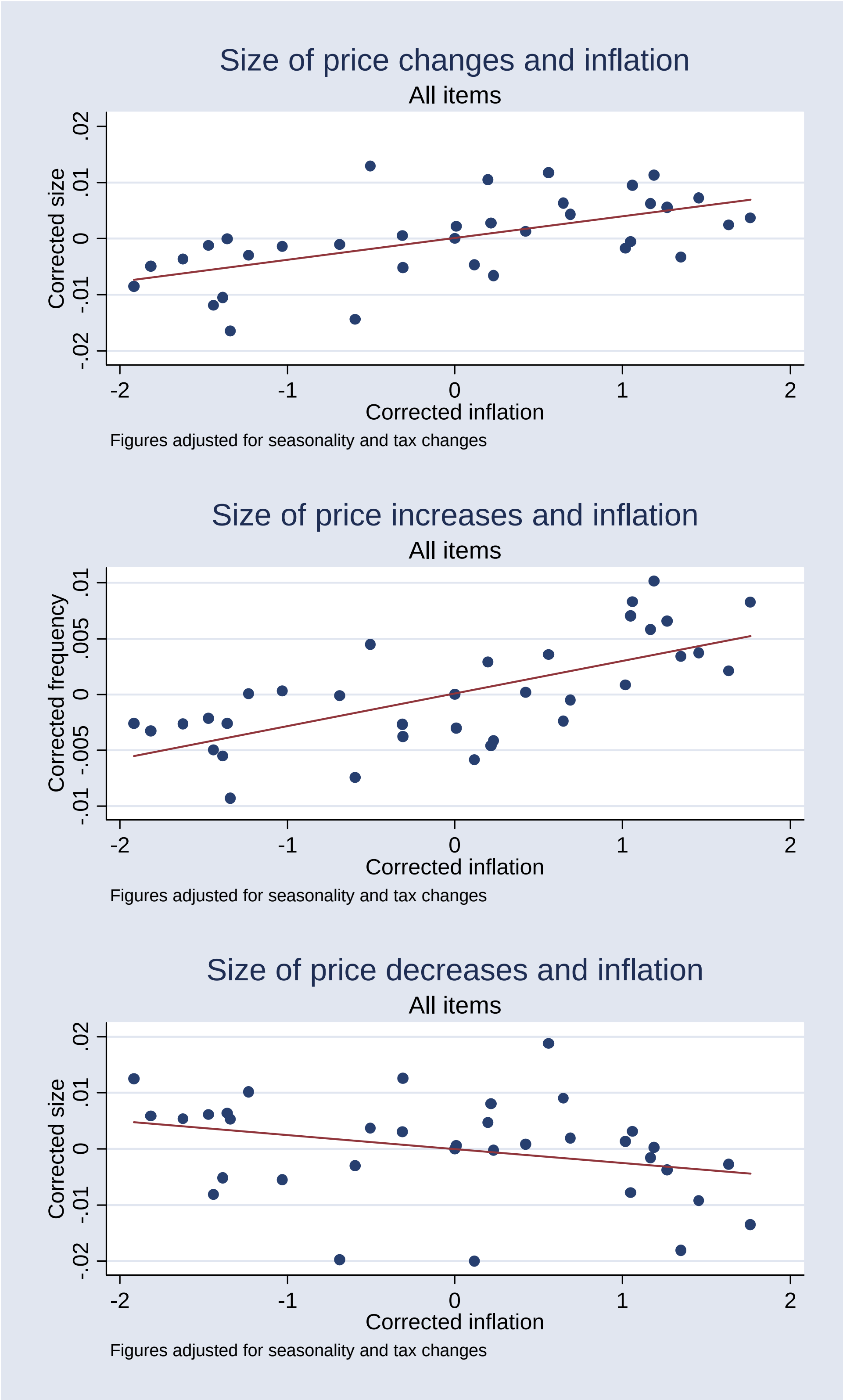
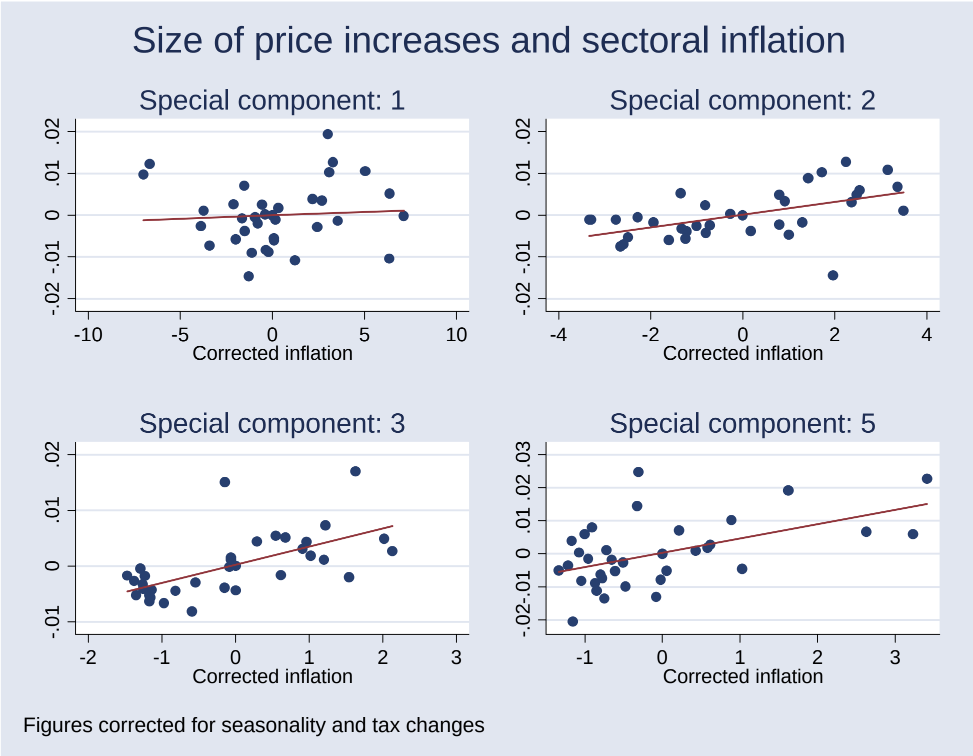

Size of price changes and inflation
All items
Corrected size
-.02
-.01
0
.01
.02
-2
-1
0
1
2
Corrected inflation
Figures adjusted for seasonality and tax changes
Size of price increases and inflation
All items
Corrected frequency
-.01
-.005
0
.005
.01
-2
-1
0
1
2
Corrected inflation
Figures adjusted for seasonality and tax changes
Size of price decreases and inflation
All items
Corrected size
-.02
-.01
0
.01
.02
-2
-1
0
1
2
Corrected inflation
Figures adjusted for seasonality and tax changes

Figure 5.3


Size of price increases and sectoral inflation
Special component: 1
Special component: 2
Special component: 3
Special component: 5
Corrected inflation
Figures corrected for seasonality and tax changes

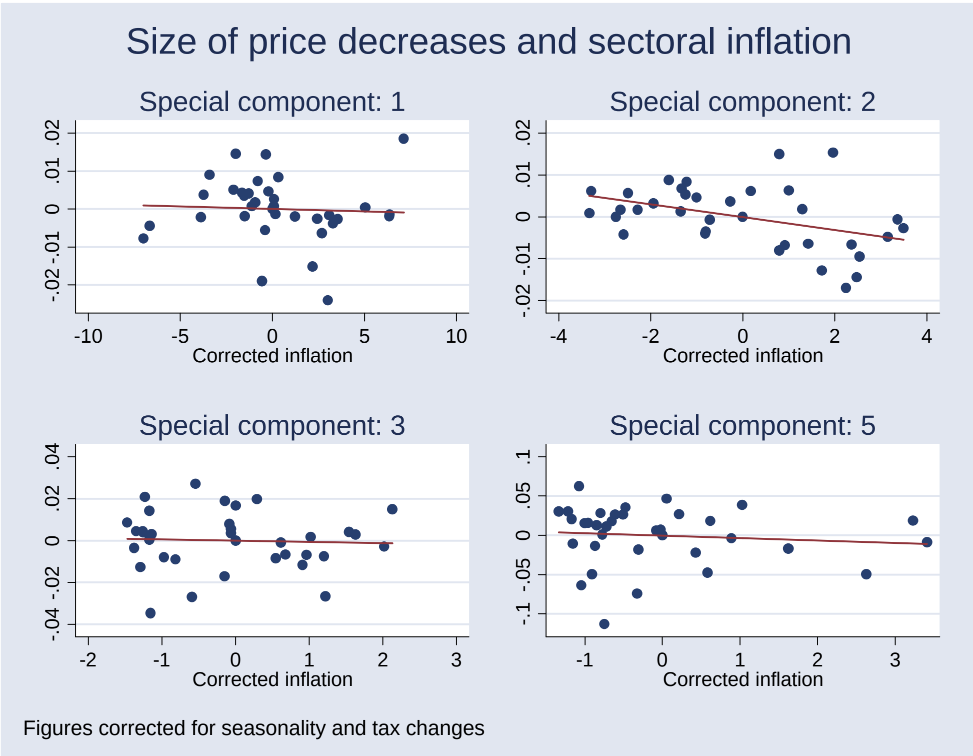
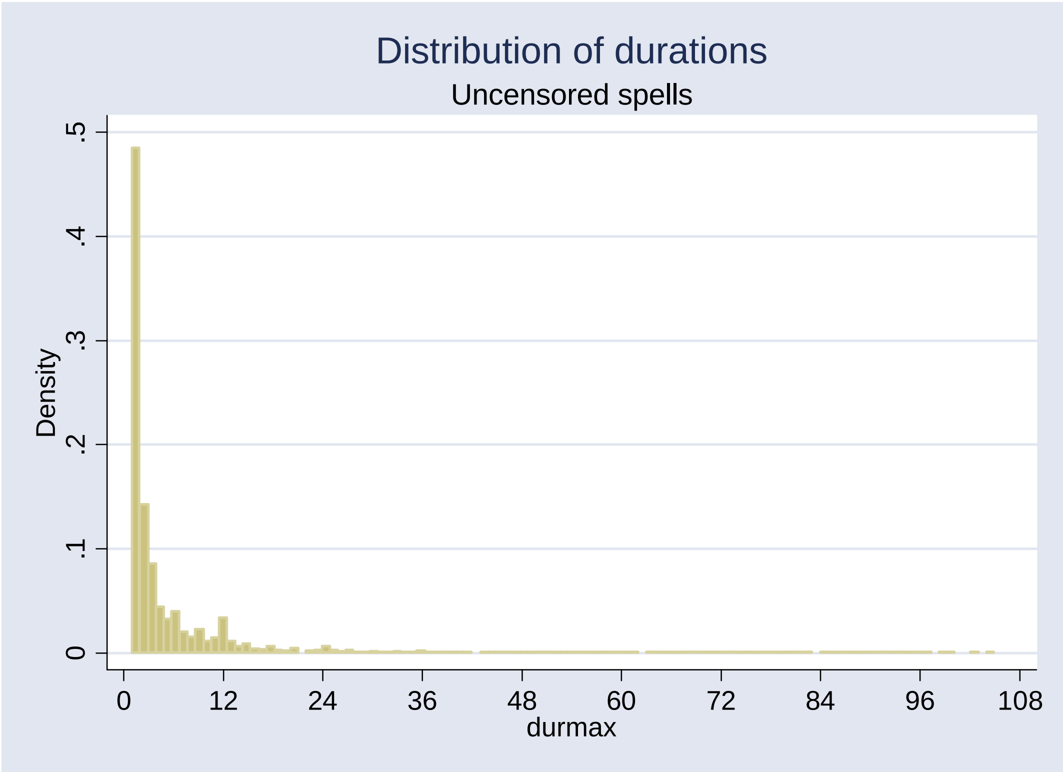
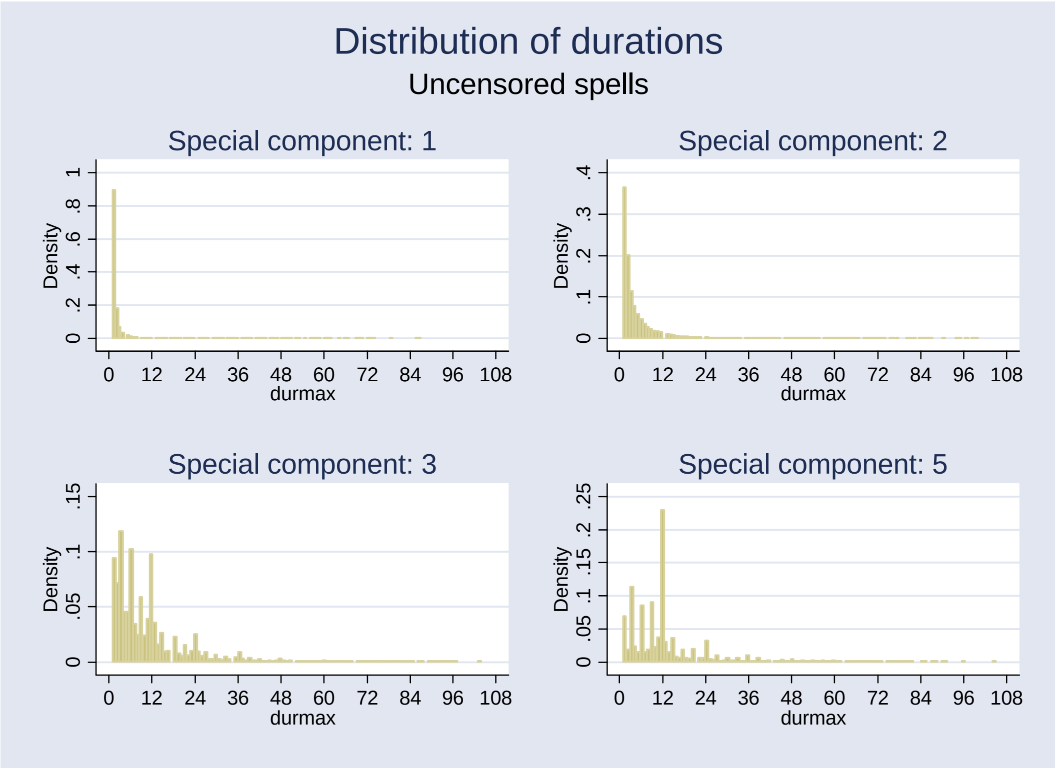

Size of price decreases and sectoral inflation
Special component: 1
Special component: 2
Special component: 3
Special component: 5
Corrected inflation
Figures corrected for seasonality and tax changes

Figure 6.1



Distribution of durations
Uncensored spells
Density
0
.1
.2
.3
.4
.5
0
12
24
36
48
60
72
84
96
108
durmax

Figure 6.2


Distribution of durations
Uncensored spells
Special component: 1
Special component: 2
Special component: 3
Special component: 5
Density
durmax
0
12
24
36
48
60
72
84
96
108