How Often do Prices Change in Finland? Micro-Level Evidence from the CPI

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Abstract

This paper uses recently obtained microlevel data on consumer prices to derive estimates of average duration of consumer price spells in Finland. The monthly data for the period from January 1997 to December 2003 with full CPI coverage has, mainly for technical reasons, been split to two, the pre- and post-2000 data. According to the results, average duration of consumer price spells is in the range from six to nine months, depending on the specific estimator used to construct the estimate. There is surprisingly little variation in the estimated mean durations across regions in Finland, whereas the estimates indicate more variation across outlet types and across categories of consumer goods. By and large large outlets change their prices more frequently and unprocessed food as well as energy related consumer goods typically have their prices changed every month or once in two months. Also, the pattern of price decreases and increases has remained relatively stable over time with weak but positive correlation between average duration of price spells and the (absolute) size of a price change. Individual prices are not downward rigid and on average price decreases are in absolute terms as large as price increases. Consequently, aggregate inflation is the outcome of price increases occuring more frequenly.

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1 Introduction

One of the starting points of many macroeconomic models for monetary policy analysis is that, because of sticky prices, monetary policy has short-term real effects on goods and services produced. However, recent research[1] on the frequency of price adjustment using microdata has cast some doubt on the validity of some of the popular (time dependent) models of infrequent price adjustment. Microdata is particularly useful in this context, since they enable us to utilize observed heterogeneity in the frequency of price adjustment across different sectors of the economy to analyze e.g. the effects of expansionary monetary policy shocks on the relative prices of goods and services with different average duration of price spells, ie. different degrees of price stickiness. One particularly important aspect of this problem is how much heterogeneity we actually observe in the average duration of price spells across different dimensions such as commodity groups, regions and outlets.

This is the issue taken up in this paper using recently obtained microdata on consumer prices in Finland. More specifically, we use the whole microdata underlying the calculation of the monthly consumer price index in Finland over the periods 1997-99 and 2000-03 to provide estimates of average duration of price spells. The main reason for working with split samples 1997-99 and 2000-03, corresponding to two different underlying base years, is a discontinuity that arises from the differences in the information structure on individual items in the two data sets. More specifically, in the case of the former, 1997-99 data, we cannot identify the type of the outlet that has been used to collect prices from. Since the ensuing discontinuity is fundamental we have decided to work with two separate samples. On the positive side, we can still do comparative analysis on the duration of price spells along other dimensions across the two samples. Furthermore, the

[1] See, in particular, Bils and Klenow (2002) and Bils, Klenow and Kryvtsov (2003).

whole data covers a period, when Finland already was in the ERM, the re-entry having taken place in the fall of 1996 and when, at the beginning of 1999, Finland joined the monetary union.

Although the formal framework for policymaking certainly changed at the onset of the EMU, we think that the actual change in the conduct of monetary policy was less pronounced. First of all, the immediate years preceeding the start of the EMU in 1999 were characterised by strong monetary policy and, in particular, interest rate convergence among the countries that were then perceived as most likely members of the monetary union. Secondly, over the same period expectations concerning future monetary policy in Finland were increasingly affected by the prospect of Finland joining the monetary union. In short, over most of the period covered by our earlier data set perceived future common monetary policy affected monetary policymaking as well as expectations about future monetary policy at the national level.

We can estimate average durations of price spell using alternative, but related estimators and, as already indicated above, they can in principle be calculated along a number of dimensions. We will mainly concentrate on estimates across different regions of the country as well as across commodity groups and, for the latter 2000-03 data, across outlet types that underlie the consumer price index. We shall also discuss the properties of the estimated distribution of the size of price changes and, in particular, try to find evidence of the correlation between the frequency and size of price changes. It is often argued in this context that the two are negatively correlated, ie. we should expect to find, on average, more frequent price changes occuring with smaller price changes. The intuition is that firms do not have to adjust prices by so much once they are able to do it more frequently. A related issue in this context is whether there are important differences between price increases and decreases. The data will allow us to take a stand on this issue

too.

The paper has the following structure. Section two gives an overview of the Finnish CPI data over the periods 1997-99 and 2000-03. Section three reports simple estimates of average durations along the above mentioned dimensions. Section four summarizes the evidence of the size distribution of price changes and relates them to the frequency of price changes. Finally, section five concludes and discusses possilities for future work..

2 The Finnish CPI Data

2.1 Overview[2]

For calculating the CPI[3], Statistics Finland (SF) currently collects prices on about 50000 goods and services per month. These prices are collected from approximately 2000 outlets across six geographic areas. The practical calculation of the CPI[4] is based on observations of the prices of commodities in an "index basket". More precisely, SF divides consumption into 490 group of commodities or categories, which constitute the index basket[5]. The group of commodities should be representative with the additional requirements that each commodity is uniformly available all over Finland and represents at least 0.01 % (0.1 per mil) of the value of private consumption. The index basket is updated as new commodities are introduced and old ones discarded and the definitions of the remaing ones are revised. The weights, obtained form consumer surveys, of different consumption categories used in the calculation of the CPI are revised in five year intervals.[6] These weights will

[2] This section relies heavily on Kinnunen-Lehtinen (1998).

[3] Nowadays actually HICP, ie. *Harmonized* CPI.

[4] The Laspeyers index formula is used in the calculation of the CPI.

[5] We could also call these Entry Level Items, ELIs, as in the case of the BLS data on US CPI analysed by Bils and Klenow (2002) and Bils, Klenow and Kryvtsov (2003).

[6] Since changes in the structure of consumer demand, either due to relative prices changes or to preference shocks, are a source of bias for the Laspeyers index, increasingly so if the weights are revised only infrequently, the SF stands ready to revise the weights more often than once in

be revised next time in 2005. By and large, the statistical methods used by the SF to construct the monthly CPI have not changed during the whole sample period from 1997 to 2003.

Sample of goods and services. The SF chooses the sample of goods and services, ie. items in the index basket, on the basis of consumption surveys as well as of other information sources, such as sales figures from retail trade and, ultimately, expert opinion. In some cases, like automobiles, package tours and newspapers and journals, the SF chooses goods probabilistically. Prices of goods and services in CPI are collected by field agents (local price collection for groceries and durables) or is carried out centrally by the SF for goods the prices of which are the same throughout the country (e.g. cigarettes) or which are based on other statistics (e.g. alcohol). For a more detailed description of the data collection methods, see Kinnunen-Lehtinen (1998).

Sample of outlets. Price quotes are collected from a group of outlets that represents the structure of retail trade as closely as possible. Currently the SF chooses outlets probabilistically only in the case of groceries, the reason being that no reliable and sufficiently detailed framework exists for sampling other outlets randomly from. Consequently, outlets from major cities are selected on the basis of the selection criteria imposed by the SF and on the basis of regional expert knowledge of the field agents.

Collection frequency. Most of the prices, e.g. those for all groceries, in the CPI are collected every month. The collection frequency does vary, however. Apart from the monthly collection frequency, prices are collected bi-monthly, quarterly or whenever required. Also some prices[7] are collected every month for a prespesified

five years.

[7] These include mostly seasonal goods. Examples are glass fibre boats and outboard motors, cut flowers, plants and plant bulbs, skis and skates, football match, ice-hockey match

period during a year, ie. for a prespecified number of consecutive months in a year. For the 2000=100 CPI data we do not, at the moment, have at our disposal the detailed information on the collection frequency at the level of individual goods and services, but we think that the relevant information in SF (1998, Appendix 1) for 1995=100 CPI data is gives us the correct flavour. To this end, then, seasonal goods like glass fibre boats and outboard motors, cut flowers, plants and plant bulbs, skis and skates, football and ice-hockey matches are examples of goods for which prices are collected for a prespecified number of consecutive months in a year.

Table 1 summarizes our 1997-99 and 2000-03 CPI data. In the earlier sample, we have three years of monthly data, so that the maximum length, $T_{\max}$, say, of an individual price series is 36 months, whereas the latter sample consists of four years of monthly data with $T_{\max} = 48$ months. Due to some special features and idiosyncracies in the way the data have actually been coded and maintained in the computer, a couple of clarifying comments to table 1 are in order. Firstly, we do not have information about the outlet type in our 1997-99 samaple. Furthermore, as noted above SF collects prices from about 2 000 outlets each months. The set of outlets where prices are collected from has changed somewhat during the period 2000-03[8]. Consequently, the number of outlets, 3 000, in table 1 gives us the total number of different outlets that the SF has used to collect prices from during the period 2000-03. Similar reasoning applies to the number of items and of (different) prices in table 1, since each month 492 items and approximately 50 000 prices are currently included in the calculation of the monthly CPI. More specifically, the number of items, 1074, as well as the number of prices, 99 000, in table 1 reflect item substitution.[9]

[8] Also during the earlier sample, although we do not have hard evidence to back this view.

[9] Item substitution is related to discontinuation of an item in an outlet. If an item is not on sale at the time prices are collected, it is not excluded from the calculation of the cpi for that particular month. A missing price quote can exist only for at most two months after which it has

The number of items and of prices has risen over time, as table 1 also indicates. Acutally, to be more precise, the number of price quotes remained less than 23500 for the whole of the year 1997, after which the SF increased it, in the beginning of 1998, to $45 - 48000$. During the last three months of 2001, the SF sampled an increasing number of prices, approximately 90000 per month, bringing the number of sampled prices down to the "baseline" 50000 in May 2002, just five months after the introduction of the euro. All this is very clearl in figure 1, which plots the time series of monthly price quotes for the whole period of 1997-2003.

Table 1 Summary information on the Finnish CPI data

		Sample
	1997-99	**2000-03**
Number of months	36	48
Number of items	456	1074
Number of prices	(appr.) 62000	(appr.) 99000
Number of observations	(appr.) 1.4×10^6	(appr.) 2.5×10^6
Number of outlets	NA	(appr.) 3000

At the more detailed level, the CPI data is organized so that it contains specific pieces of information on prices such as

- an item code
- a price code
- an outlet code
- an area code
- an outlet type code (hypermarket, department store, supermarket etc.)

to be replaced by a new one. Of course, the price of the new (substitute) item can be subjected to quality adjustment along the lines explained above in the main text.

- a price type code (normal/discount/missing etc.)
- a package size (or size of the unit, can change from month to month)
- a quality code (quality adjustment)

Apart from using the hedonic method to adjust prices for quality changes[10], the SF applies the so called *quality change codes* to account for the effects of quality changes on individual prices. As an example, code 00 means that the quality has remained the same, so that the price difference (if any) enters the index in full, code 01 means that 10 % of the price difference is due to quality change, so that 90 % of the price difference (if any) enters the index an so on. On the other extreme, code 10 refers to completely different products, so that it is not appropriate to compare the products and 100 % of the price difference is interpreted as quality change.

3 Estimating average durations

Using the whole non-grouped data. There are altogether 61988 and 98988 individual raw observations or price series in the whole 1997-97 and 2000-03 CPI data sets, respectively. As suggested by the total number of price series, the length of the individual price series varies in both samples. Figure 3 shows the distributions of the length of the price series in the two data sets. The average length of the price series, 22.9 and 22.4[11] months, respectively, is in both samples actually relatively high. As figure 3 suggests, however, long average times series appear

[10] E.g. in the case of used cars and owner-occupied housing. Hedonic methods are also increasingly used to quality adjust prices of mobile phones, and the SF is developing these methods also for some other durable goods as well as for rented housing.

[11] In an earlier version of the paper the average length of the price series in the 2000-03 sample was approximately 26 months. Underlying this average was a sample, where we combined a number of price trajectories. That is, we assumed that in these case the separate price trajectories are sections of a longer trajectory. In the present context an individual good is identified via a three-dimensional index: brand-outlet-size. Observe differences in any of these three dimensions, we have a different product.

to be the result of a large number of price trajectories with $24 - 27$ time series observations, although a major contribution also comes from the concentration of observations with maximum length (36 or 48 months, respectively). However, the evidence in figure 3 is not inconsistent with the idea that censoring occurs in our samples.

The average number of price spells per trajectory is, respectively, 4.6 in the 1997-99 and 3.7 in the 2000-03 sample. Upon combining these figures with those above on average length of the price series, we obtain our first estimates of the (unweighted) average duration of price spells, $\overline{T}^F = 5.3$ and 6.1 months respectively in the two samples. Thus, according to this measure, the average duration has slightly increased in the more recent, 2000-03 sample compared to the earlier one. The difference essentially comes from different average number of price spells in the two samples or from differences in the average frequency of price changes, $\overline{F}$, say, in the two samples.

There are various alternative ways to estimate 'average duration', as shown in e.g. Baudry *et al* (2004). The one we are using here, as already indicated above, is the *inverse of the frequency of price changes*

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

or, to enhance comparability with other related papers in the IPN, the following "continuous time approximation" to $\overline{T}^F$ in eq. (5)

$$\overline{T}^F = -\frac{1}{\ln\left(1 - \overline{F}\right)} \tag{2}$$

where $\overline{F}$ denotes the (unweighted) average frequency of price changes[12]

$$\overline{F} = \frac{1}{Q}\sum_{j=1}^{J}\sum_{t=1}^{\Gamma_j} I_{j,t} = \sum_{j=1}^{J}\omega_j \overline{F}_j \tag{5}$$

In eq. (5) $I_{j,t}$ is an indicator function with value zero if the price has changed in period t from its value in the previous period $t-1$ and one otherwise.[13], J is the number of goods and Γ_j the length of the price trajectory j. Also, $\overline{F}_j$ denotes the average frequency of price changes[14] for good j and the good specific weight is defined as $\omega_j = \Gamma_j/Q$, $j = 1, \ldots, J$. In the case of a balanced panel of individual price series $\Gamma_j = \Gamma$ and $Q = \Gamma \cdot J$ so that $\omega_j = \Gamma/Q = 1/J$, $j = 1, \ldots, J$. Now, using the "continuous time approximation", average duration is, respectively, 4.8 and 5.6 months in the 1997-99 and 2000-03 samples. The corresponding median durations are 3.3 and 3.9 months respectively. Here, median duration is estimated using the estimator

$$\overline{T}^{Md,F} = \frac{\ln(0.5)}{\ln\left(1-\overline{F}\right)} \tag{7}$$

[12] Note that

$$\overline{F} = \frac{1}{Q}\sum_{j=1}^{J}\sum_{t=1}^{\Gamma_j} I_{j,t} = \sum_{j=1}^{J}\omega_j \overline{F}_j \tag{3}$$

where $\omega_j = \frac{\Gamma_j}{Q}$, $j = 1, ..., J$ and where $\overline{F}_j$ denotes the average frequency of prices changes for good j

$$\overline{F}_j = \frac{1}{\Gamma_j}\sum_{t=1}^{\Gamma_j} I_{j,t} \tag{4}$$

[13] I.e.

$$I_{j,t} = \begin{cases} 0, & \text{if } P_{j,t-1} = P_{j,t} \\ 1, & \text{if } P_{j,t-1} \neq P_{j,t} \end{cases} \tag{6}$$

[14] Ie. $\overline{F}_j = \frac{1}{\Gamma_j}\sum_{t=1}^{\Gamma_j} I_{j,t}$.

which is a "continuous time approximation" to

$$\overline{T}^{Md,F} = -\frac{\ln(0.5)}{\overline{F}} \tag{8}$$

Note that the critical assumption here and in what follows is that of an uncensored data. Since censoring most likely occurs in our data sets, we should interprete our estimates in this respects with due caution and as providing lower (upper) bounds to mean durations (frequencies of price changes). However, there can be other features of the data, like those related to quoting prices of seasonal goods outside nonseasonal months, that may actually work to increase estimated mean durations.

To check for the robustness of our results to censoring and, in particular, to attrition we re-estimated the average duration for both periods using sub-samples incorporating only price series with a maximum number of price records, ie.price series of maximum length. For the earlier 1997-99 period we consequently have a balanced panel of monthly price series where the length of each series is 36 month, while for the latter 2000-03 period the length of each individual price series in the corresponding balanced panel is 48 months. The estimated average frequency of price changes is, respectively, 0.20 and 0.17 in these sub-samples. The implied durations are, then, 4.6 and 5.4 months, respectively, using the "continuous time approximation". These estimates are very close to the ones obtained using the complete data sets. Although our procedure does not solve the problema caused by censoring, it certainly reduces its importance, so that our procedure represents a simple and straightforward way of controlling for the effects of censoring (and attrition). Also, some information may have been lost by applying the procedure, but judging by the estimated average durations, the costs of the loss of information will potentially show up in the higher moments of the distribution of the duration of price spells. On balance, then, we think that ourk initial estimates provide

a reliable input into an analysis of price durations and, more generally, price stickiness in the Finnish consumer price data.

The observed differences between the median and average duration indicate that the distribution of durations is not symmetric around the mean in either of the two samples. More preceisely, the distributions are skewed to the right, ie. both of them has a long right tail. We can see this visually from the empirical distribution of average durations as shown in figure 4. The figure is constructed by first computing the average frequency of price changes for each individual good, ie. the $\overline{F}_j$s, and then deriving an estimate for the average duration of price spells,$\overline{T}_j^F$, say, for each good j by using $\overline{T}_j^F = -1/\ln\left(1-\overline{F}_j\right)$.

We can immediately infer from figure 4 that the empirical distribution of average duration is not symmetric around the estimated mean, but skewed to the right, ie. the distribution The extent of the skewness can be appreciated by comparing the median durations of 4.1 and 5.4 months, respectively, to the estimated means, 6.7 and 9.4 months, of the empirical duration distributions. Note how the estimated durations increase from their unweighted estimates of $\overline{T}^F = 4.8$ and $\overline{T}^F = 5.6$ to $\overline{T}^{F,W} = 6.7$ and 9.4 months by first computing average frequency of price changes per individual price trajectory.[15]

Our estimate of the average duration of consumer prices is in the range of estimates obtained elsewhere in the literature. For example, in Baudry *et al.* (2004) the corresponding unweighted estimate is 5.3 months, while Bils and Klenow (2002)

[15] Here

$$\overline{T}^{F,W} = \frac{1}{J}\sum_{j=1}^{J}\left(\frac{1}{\overline{F}_j}\right) \tag{9}$$

ie. weighted average of inverted average frequencies with uniform weighting, where

$$\overline{F}_j = \frac{1}{\Gamma_j}\sum_{tj=1}^{\Gamma_j} I_{jt}$$

a median duration of about four and a half months (temporary sales included) in the US CPI data.[16]. Moreover, it is encouraging that our estimates of average duration come out almost exactly also in the control experiment outlined above, where we use data only on price series with maximum length of 36 and 48 months respectively. As argued above, our procedure does not by itself solve the problems caused by censoring and attrition, but it certainly reduces their potential effects on estimating average durations. .

Average duration by major regions The SF collects consumer prices from six major regions, so that the CPI data incorporate information on the conditional distributions of price durations across these regions. Our estimates of the mean durations by regions - as measured by the median and average - are given in table 2. The graphs of the corresponding regional distributions of the duration of the price spells are given in figure 5.

Table 2 Mean durations by major regions

	Median Duration		**Average Duration**	
	Period		**Period**	
Region	$1997-99$	$2000-03$	$1997-99$	$2000-03$
Uusimaa	3.4	3.7	4.9	5.3
South	3.2	3.9	4.6	5.7
East	3.7	4.1	5.9	5.3
Middle	3.1	3.9	4.5	5.7
North	3.1	3.9	4.5	5.6
Aaland Islands	4.3	6.2	6.2	8.9
Country	3.9	3.2	5.4	4.6
Total	3.3	3.9	4.8	5.6

[16] It exceeds six months with *regular* prices (Bils and Klenow, 2003, p. 8).

Total refers to the unweighted average of the respective data.

As is strongly suggested by table 2[17], and, to a lesser extent, also by figure 5, there is surpirisingly little regional variation in median and mean durations. From the mean duration of 4.5 months for the northen and middle parts of Finland and 6.2 months for Aaland Islands[18] in the 1997-99 CPI data, we can infer that on average prices change 16 to 22 percent of the months across the regions. In the more recent 2000-03 CPI data, average durations have, with the exception of the data sampled from the whole country (by the SF) and eastern parts of Finland, increased by approximately a month from the earlier data. The estimates are very similar in the smaller balanced panel data sets on prices with a maximum number of time series observations, so that the bias from censoring or attrition does not seem too critical an issue in this context .

The estimated regional durations now imply that on average prices change 11 (Aaland Islands) to 22 percent (South) of the months across the regions. Estimated medians agree with the general pattern in the simple means: median duration has increased somewhat over the seven year period with the estimates implying that on average consumer prices changed, respectively, 25-30 and $16 - 30$ percent of the months in the two data sets. As for the empirical distribution of the regional durations in figure 4, we can see apart from being skewed to the right, the distributions display isolated frequency spikes at midway durations, ie. around 24 months. Also, the zero frequencies at durations longer than 24 months and less than the longest durations are accompanied by another set of frequency spikes at these very long average durations. Idiosyncracies apart, the empirical distributions of average durations look remarkably similar across the regions.

Average durations across outlet type As already indicated, the major incompleteness in the information in the 1997-99 CPI data set, compared to the information available in the 2000-03 data, is that we cannot identify the type of outlet where the individual price price quotes have been sampled from. This im-

[17] Most of the price observations are collected from Uusimaa, which is a 9300 km^2 province on the coast of the Gulf of Finland. Uusimaa's population is about 1.5 million, most of which comes from the great Helsiniki area.

[18] An autonomous province in the south-western archipelago of Finland. The ground area covers a little less than 1500 km^2 and the population is about 25 000.

plies that one of the defining properties of individual goods is missing from the 1997-99 CPI data, so that we cannot combine the two data sets. So, we will restrict our analysis to the 2000-03 CPI data. To this end, outlets are in the data classified into ten categories, as shown in Table 3, which gives information on estimated average durations by outlet type. We can immediately see from table 3 that there is more variation in the estimated mean durations across outlet type than across region. More specifically, the median duration ranges from one months (filling stations) to elevan and a half months (cafés), so that according to this measure prices changed each month in filling stations and once in five months in cafés. Due to the right skewness in the empirical distributions of durations across outlet types - see figure 6 - the estimated average durations are longer that the corresponding medians, generally in the range from two to five months. Furthermore note from the empirical distributions in figure 6 that the moments of the distribution in the case of filling stations is overwhelmingly dominated by the mode at one month, whereas for the case of cases it the isolated frequency spike at 48 months that drags the right tail of the distributions further out. In any case, these distributions largely share the general feature already alluded to above that most of the frequencies in the range from 24 to 48 months are zero.[19]

[19] Again, estimated durations across outlet types are well in line with those in table 3 in the smaller data set on only the longest price series.

Table 3 Mean durations by outlet type: 2000-03 data

Outlet type	Median Duration	Average Duration
Hypermarkets	4.1	5.9
Department stores	4.2	6.0
Supermarkets	3.7	5.3
Self-service shops	3.9	5.6
Cafés	11.6	16.8
Kiosks	8.7	12.5
Filling stations	1.2	1.7
Specialist's shop	3.9	5.6
Services	7.4	10.6
Other shops	7.9	11.4
Total	3.9	5.6

Average durations across commodity groups. Finally, we calculated average durations across commodity groups, see table 4. The classification of commodities in table 4 derives from the structure of the previous, 1995=100, CPI and thus reflects the structure of consumer demand in Finland as documented in the relevant consumer survey at that time. The estimates in table 4 will be immediately updated once we have all the relevant information on the structure of the consumer basket from the latest consumer survey. In particular, table 4 will be updated to correspond to the structure of the HICP in Finland. However, we think that the general pattern observed in table 4 will survive (reasonable) re-grouping of the individual goods and services.[20]

Table 4 clearly suggests that there is indeed more variation in the estimated mean durations across the commodity groups than across the regions. Estimated median durations range from one month (Transport) to almost 23 months (Education). Transport prices thus change very frequently, whereas in education typical price spell are long. The observed right skewness in the distribution of average durations across the CPI commodity groups implies that estimated average durations are longer than the corresponding median durations, see figure 7. On both measures, mean duration is slightly higher in the more recent, 2000-03 CPI data,

[20] The general pattern observed in table 4 comes out also in the smaller data sets on only the longest price series.

compared to the earlier one.Whether the increase is statistically significant remains to be tested. Economically, it can be considered as significant in some fo More specifically, the increase is approximately one month for most of the commodity categories. Education, where prices seem to change very infrequently, is perhaps an exception to this rule. Note, however, that for 'Education' the distribution of average durations is somewhat bizarre: it displays zero frequencies everywhere in the domain of the distribution except at six isolated durations. Furthermore, the mode is at approximately 15 months, where the frequencies peak at the value of about 0.6. Otherwise the empirical distributions roughly follow the general pattern observed in the previous cases of durations across regions and outlet types.

Table 4 Mean durations by COICOP categories

	Median Duration		**Average Duration**	
	Period		**Period**	
Category	1997 – 99	2000 – 03	1997 – 99	2000 – 03
Food and non-alc. bev.	3.0	3.4	4.3	4.9
Alcoholic bev. and tob.	2.7	5.5	3.9	7.9
Clothing and footware	3.3	3.5	4.8	5.1
Housing, el. and energy	2.7	3.4	4.0	4.9
Furniture, househ. equipm.	5.1	5.8	7.4	8.4
Health and medical care	5.5	6.9	7.9	9.9
Transport	1.0	1.9	1.4	2.7
Communication	1.8	1.8	2.6	2.6
Recreation	4.4	4.5	6.3	6.4
Education	19.5	26.2	28.1	32.6
Hotels, cafés and rest.	6.7	6.8	9.7	9.8
Miscellaneous	5.5	6.3	7.9	9.1
Total	3.3	3.9	4.8	5.6

Perhaps a sharper picture on the possible difference in the estimated mean durations across commodity groups emerges if we aggregate the consumer goods in an alternative way. Table 5 summarizes the evidence from both data sets on estimated mean durations across five broad categories of consumer goods: energy, non-energy industrial goods, processed food, unprocessed food and services.

Clearly the differences between the categories come out more sharply.

Table 5 Mean durations by NIPE categories

	Median Duration		**Average Duration**	
	Period		**Period**	
Category	1997 – 99	2000 – 03	1997 – 99	2000 – 03
Energy	0.40	0.44	0.56	0.64
Unprocessed Food	1.0	1.0	1.4	1.5
Non-energy industrial goods	3.7	4.6	5.3	6.6
Pprocessed food	4.7	6.2	6.8	9.0
Services	5.2	6.3	7.4	9.1
Total	3.3	3.9	4.8	5.6

So, energy and unprocessed food are flex price goods with prices changing (at least) every month, while service and processed food can be classified as sticky price goods. For these latter goods, prices are presently (ie. according to the more recent CPI data) changing once in nine months. Furthermore, whereas flex prices keep changing roughly every month, sticky prices currently change once in nine months compared to once in seven months in the late 1990's. Once again, we emphasize that the estimated increase in average durations needs to be tested for statistical significance.

Anyway, the evidence does suggest that average durations may be edging up. We do not think that e.g. falling inflation per se is the root cause of the increase in the overall mean duration of price spells and, in particular, in the mean duration of the sticky price goods Consumer price inflation has been stable almost all through the whole sample period from 1997 onwards, see figure 2. More precisely, with exception of the period around the turn of the century, consumer price inflation in Finland has remained below two percent, using the cumulative 12 months percentage change in consumer prices as the relevant measure of the inflation rate. More general change in the monetary policy regime, brought about the common monetary policy together with the introduction of the euro, implying, in particular, more open money and financial markets as well as more stable interest rates, is potentially more important in this context. Note, however, that while the observed effects on the overall CPI of the introduction of the euro are

small by most accounts, these effects are actually very pronounced in the case of e.g. specific categories of services. More specifically, Hobijn *et al.* (2004) bring in evidence showing that in January 2002 the annualized rate of inflation of services in restaurants was 16 % in the whole Euro area, 26 % in Finland, 19 % in France, 29 % in Germany and 50 % in the Netherlands.

4 Size and symmetry of price changes

In this section we will provide further evidence on consumer price changes in Finland by focusing on estimating the average size of price changes as well as by focusing on possible asymmetries between price decreases and increases.[21] To this end, we will concentrate on the narrower set of 50 common consumer goods, sampled from the COICOP categories, also used by a number of other participants in the IPN. We will here discuss only those estimation results that correspond to the NIPE categories of energy, unprocessed food, non-energy industrial goods, processed food and services.[22] Dhyne *et al.* (2004) gives a full description of the construction and contents of this common sample.[23]

[21] The estimates in Table six correspond to first computing average durations per price trajectories in each of the categories and then taking an unweighted average of these.

[22] The result for the corresponding COICOP categories are available from the authors upon request.

[23] Some of the individual items in the common sample do not have the exact counterpart in the Finnish CPI data. Therefore, a substitute has been used in these cases. Biases may thus be present in our estimates, but we think they are not that critical at the more aggregate level. This problem is more acute in the pre-2000 data. .

Table 6a. COICOP durations: common sample 1997-99

CATEGORY	ENERGY	UNPF	NEIG	PF	SERV	CORR
Average Duration	0.7	1.2	6.7	7.8	12.0	
Median Duration	0.5	1.1	4.6	5.4	8.3	
Frequency	0.79	0.52	0.21	0.18	0.15	
Freq. of price incr.	0.30	0.26	0.12	0.09	0.10	
Size of price incr.	5	23	18	16	17	0.29
Freq. of price decr.	0.50	0.27	0.09	0.09	0.05	
Size of price decr.	4	23	17	16	19	0.40

UNPF = Unprocessed food, NEIG = Non-energy industrial goods, PF = Processed food, SERV = Services, CORR. = Correlation between average duration and size of price changes.

Table 6b. COICOP durations: common sample 2000-03

CATEGORY	ENERGY	UNPF	NEIG	PF	SERV	CORR
Average Duration	0.5	1.8	7.5	7.5	11.7	
Median Duration	*na*	*na*	*na*	*na*	*na*	
Frequency	0.87	0.52	0.22	0.15	0.10	
Freq. of price incr.	0.47	0.28	0.13	0.08	0.07	
Size of price incr.	4	23	19	14	13	0.10
Freq. of price decr.	0.41	0.23	0.08	0.07	0.03	
Size of price decr.	5	26	18	16	17	0.20

See Table 6a.

The estimation results for the NIPE categories are presented in table 6a and b. The table reports average and median duration, average frequency of price changes, average frequency and size of price decreases and increases for consumer goods in each of the five NIPE categories.[24] As can be seen from the table, the estimated median and average durations agree with those reported for the whole CPI data in table 5. In particular, 'energy' and 'unprocessed food' (UNPF) are the flex price goods, whereas 'sevices' represent sticky price goods. Also, the increase

[24] To be precise, the estimates in table 6a and 6b for each group correspond to the unweighted average of mean durations of individual price trajectories within the group.

in average durations in the post-2000 CPI data is more or less born out also by the estimation results in table 6.

What Table 6 also suggests is that for most of goods categories price decreases typically occur less frequently than price increases. Energy, which is a strongly procyclical product, maybe an exception to this pattern: price increases occur somewhat more frequently than price decreases in the post-2000 data, whereas the opposite pattern comes out in the pre-2000 period. Finally, there seems to be no major asymmetries between the average size of price decreases and increases of these categories of consumer goods. The typical size of a price decrease and increase has also remained stable over time. More specifically, prices of energy related consumer goods change very frequently, as already noted above, and typically by a relatively small amount. Prices of unprocessed food also change relatively frequently but typically by a large margin. Services, on the other hand, have their prices reduced very infrequently, only five and three percent of the months, respectively, and the typical size of the price reduction corresponds to the overall mean of the whole common sample (– 18 % and -17 %, respectively). What we can infer from these estimation results is that aggregate consumer price inflation appears not to be driven by an average larger price increases than price decreases, both of them occuring at similar frequencies, but by an average higher frequency of price increases relative to price decreases. Also, note that according to the estimation results, individual prices are not downward rigid: price decreases do occur all through the product spectrum, albeit with differing frequencies. Finally, the correlation between average duration and (absolute) size of a price change is positive, but not that strong nor robust over time. Consequently, there seems to be weak evidence in favour of the hypothesis that prices change by a larger percentage the longer they have stayed fixed. That correlation may have, moreover, weakened further over time.

5 Conclusions and suggestions for future work

Mean duration of consumer price spells in Finland is presently about six months. Taking the estimated mean of the distribution of average durations of the price trajectories, brings the estimated mean duration up to about nine and a half months. Hence, these estimates provide us with a range from six to nine month

which is consistent with the international evidence on mean duration of consumer price spells. Of course, the distribution of (average) durations is skewed to the right also in Finland with the additional feature that durations longer than 24 months and shorter than the length of the sample (36 and 48 months, respectively, in our case) occur with zero frequencies. The right skewness also shows up in the median duration being less, by two to three months, than the corresponding average duration.

Mean duration of consumer price spells seems to have increased from the pre-2000 period by approximately a month or two. The statistical significance of this increase remains, however, to be tested. Although we did not in our analysis delve deeper into the underlying reason for the observed increase in average duration, we argued that e.g. falling inflation cannot be the reason, at least not on its own. Over the whole period, consumer price inflation in Finland has been relatively low and stable. More so, we suspect that the contribution of the common monetarty policy through, especially, more open money and financial markets and more stable interest rates, is more important in this context. Clearly, however, more work on this point needs to be done to provide more definite results and interpretations.

There is surprisingly little variation in the estimated mean durations across the regions in Finland. With the exception of Aaland Island, with its mean duration of about nine months, the estimated regional mean durations fall in a tight range around the overall mean of six months of the whole data. We think this is because of the structure of our retail sector, where a couple of big players dominate the markets having distribution networks that cover the whole country. Hence, pricing takes place at the level of the whole country, contributing to a high degree of synchorinization in price changes across the regions.

There is more variation in mean duration across outlet types and across commodity categories. Cafés and kiosks, representing smaller business, change their prices less frequently, approximately once in twelver to sixteen months. For larger outlet, like hypermarkets, department stores and supermarket, prices change on average once in six months. Services and processed food, on the other hand, are the categories of consumer goods, which have longer duration of price spell, typically about nine months, whereas energy and unprocessed food have their prices changed monthly.Prices are currently equally likely to fall and rise typically by a

large percentage in the case of unprocessed food, whereas they are twice as likely to rise by smaller amounts in the case of energy. Overall, the pattern of consumer price decreases and increases has not changed too much between the pre- and post-2000 period.

Although our initial duration estimates survived our simple control experiment, the idea of which was to control for the potential effects of censoring and attrition, more work needs to be done to refine our estimates to account for censoring as well as attrition in our data more efficiently and in a more standard way.[25] Both censoring and attrition tend to increase the frequency of price changes and thus to reduce the estimated duration of price spells. However, as noted in the text there are other features of the (construction of the) data that may well have the opposite effect on frequency of prices changes. If the prices of seasonal products are actively quoted only during the seasonal months of the year, they will tend to reduce the average frequency of price changes, if their prices are basically kept constant all through the months between the seasons. Another issue is the collection frequency. Not all prices are collected monthly and additional work needs to be done to identify these products and adjust the data and estimates accordingly. All these issues will be taken up in the future extension of the paper. A longer run research interest lies, on the one hand, on the specifying and estimating a model for the hazard function and, on the other hand, in an excercise similar to Bils and Klenow (2002) and Bils, Klenow and Kryvtsov (2003) to investigate the effects of e.g. identified monetary policy shocks on the relative prices of flex and sticky price goods.

References

[1] Bils M. and Klenow P. (2003), "Some evidence on the importance of sticky prices", NBER WP 9069.

[2] Bils M., Klevow P. and Kryvtsov O. (2003), "Sticky Prices and Monetary

[25] In this context Kiefer's (1998) ML-estimate of a constant hazard model, $\overline{T}\left(N/N^{U}\right)$, where $\overline{T}$, N and N^{U} denote, respectively, average durations over censored and uncensored observations, total number of spells and number of uncensored spells, is often referred to. His estimate is for right-censored data and since right-censoring is not the only type of censoring that is present in the data and since left- and right-censoring should not, in general, be treated in a similar way, an approach to a satisfactory treatment of censoring is in our interest.

Policy Shocks", Fed Bank of Minneapolis QR, vol. 27, no.1, 2-9.

[3] Hobijn B., Ravenna F. and Tambalotti A. (2004), "Menu Costs at Work: Restaurant Prices and the Introduction of the Euro", Federal Reserve Bank of New York, Staff Papers no. 195.

[4] Kiefer N. (1998), "Economic Duration Data and Hazard Functions", Journal of Economic Literature, vol. 26, 646-679.

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[6] Baudry L., Le Bihan H., Sevestre P. and Tarrieu S. (2004), "Price rigidity. Evidence from the French CPI micro-data", ECB WP No. 384, August 2004.

Figure 1: Number of price quotes over the whole sample period 1997-2003.

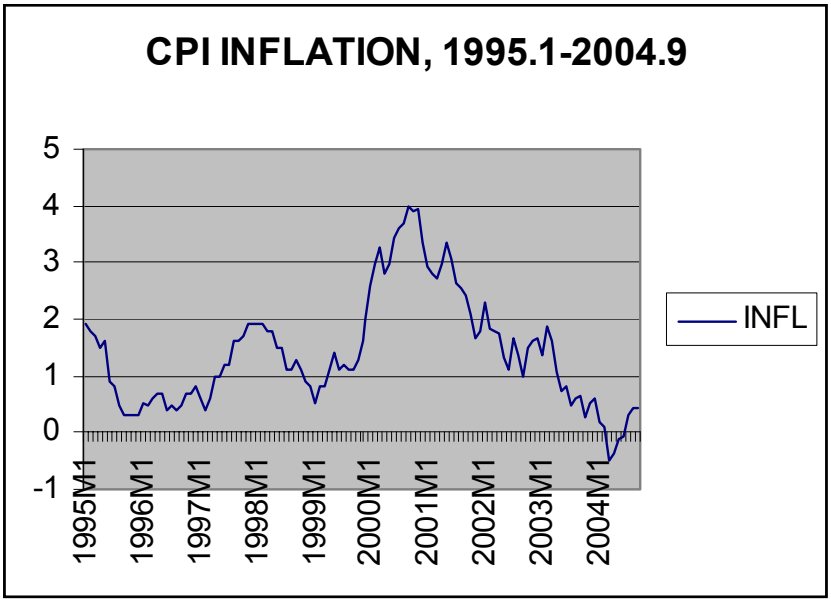
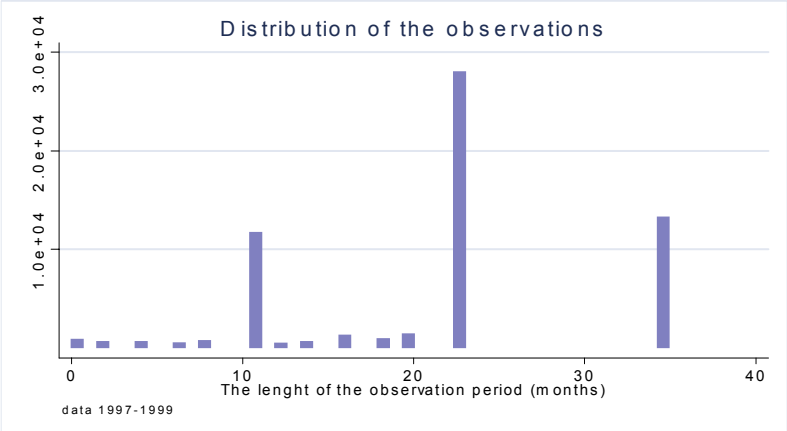


Figure 2: 12 month change in consumer price inflation in Finland, 1995.1-2004.9.



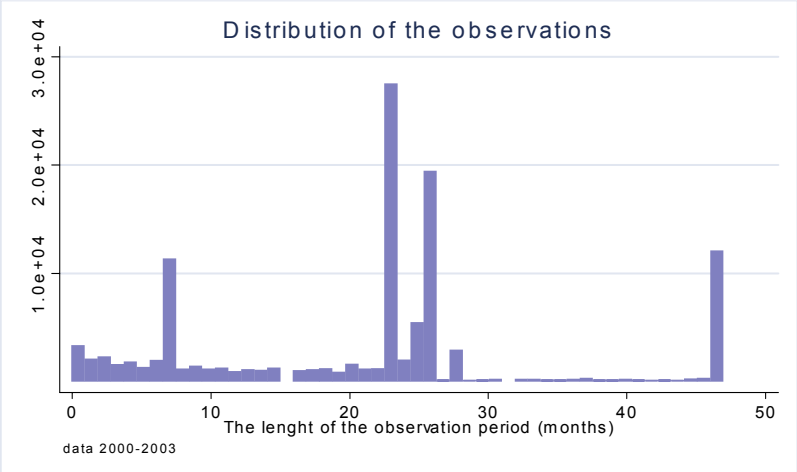
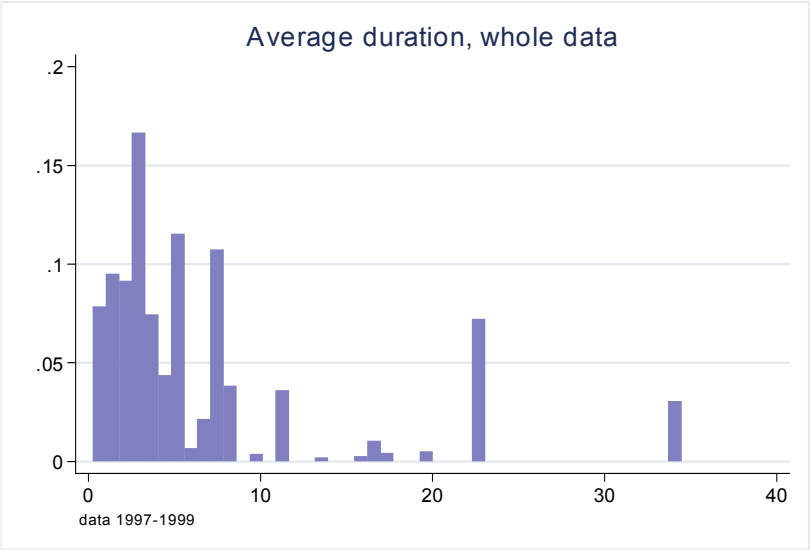


Figure 3: Distribution of the length of the observations. Upper figure 1997-99 data, lower figure 2000-03 data.



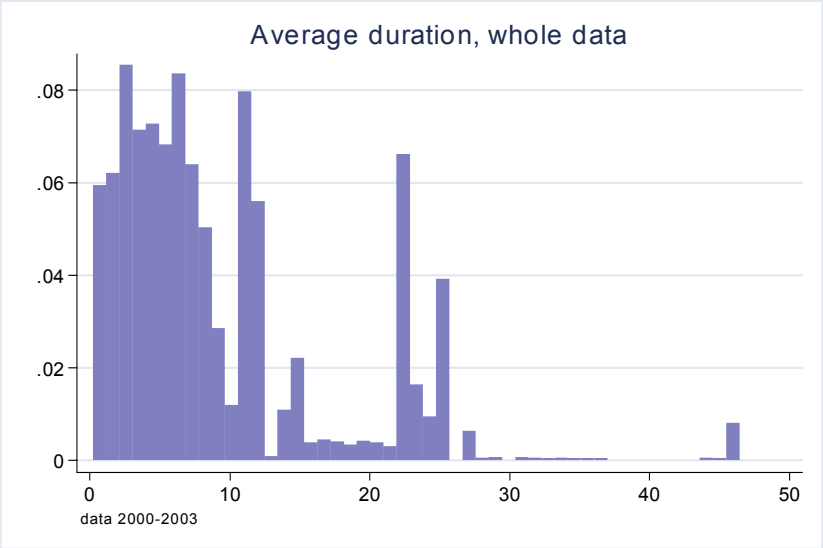
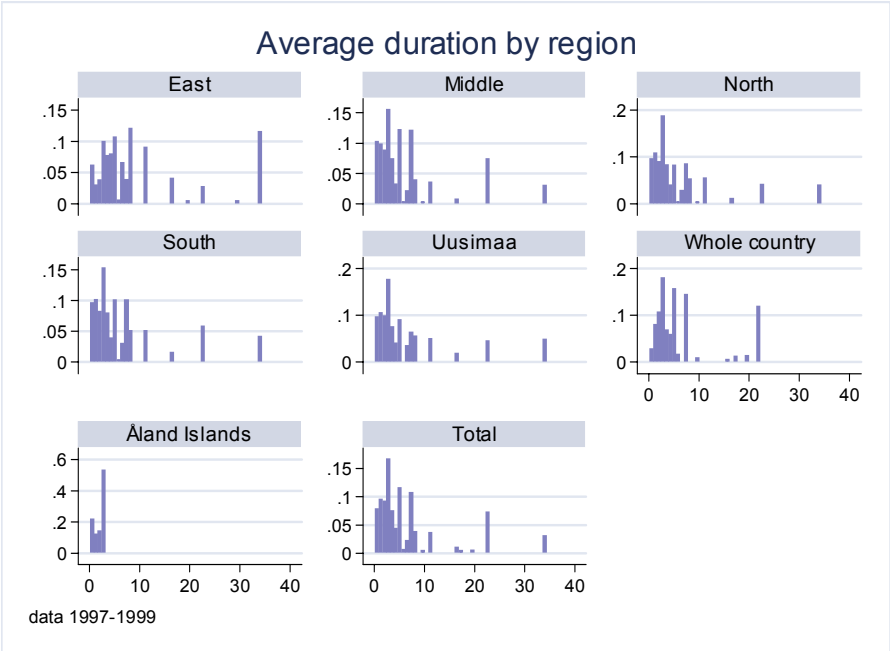


Figure 4: Distribution of average durations. Upper figure 1997-99 data, lower figure 2000-03.



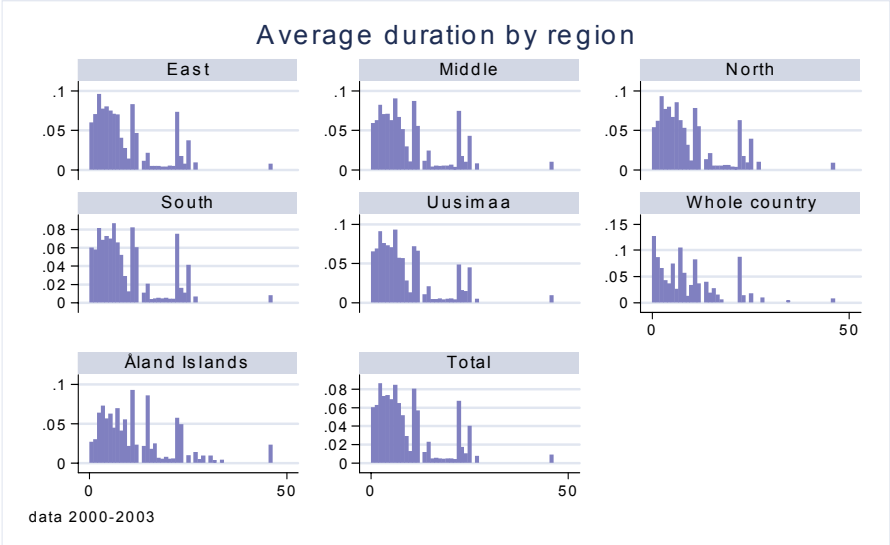


Figure 5: Distribution of average durations across regions. Upper figure 1997-99 data, lower figure 2000-03 data.

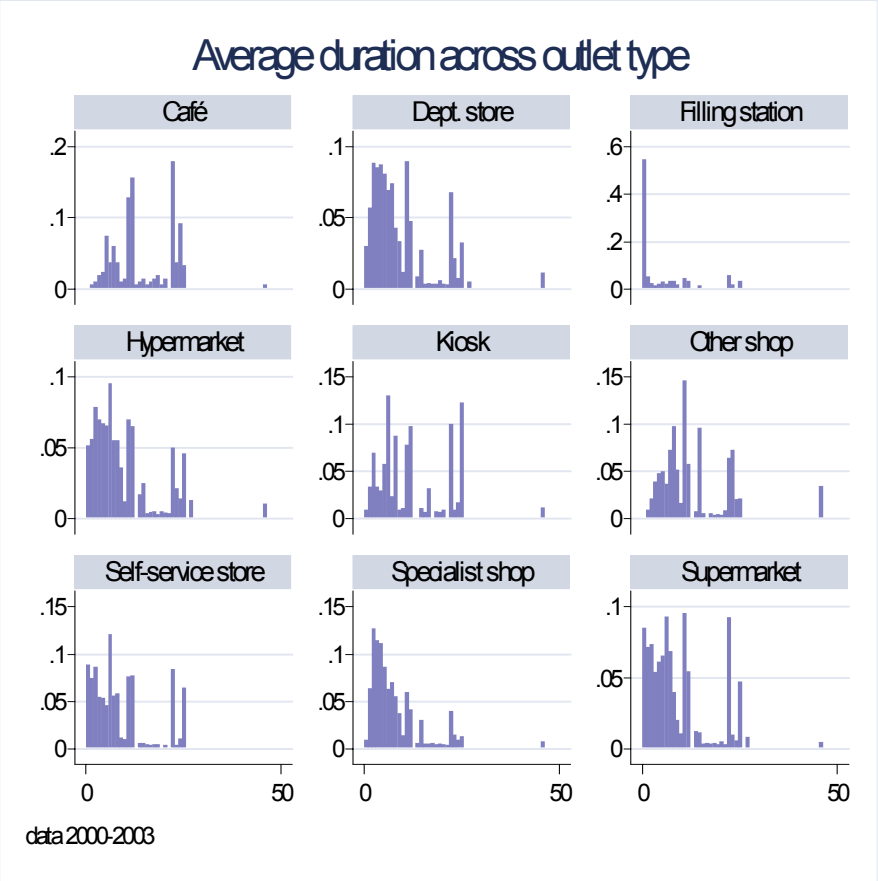
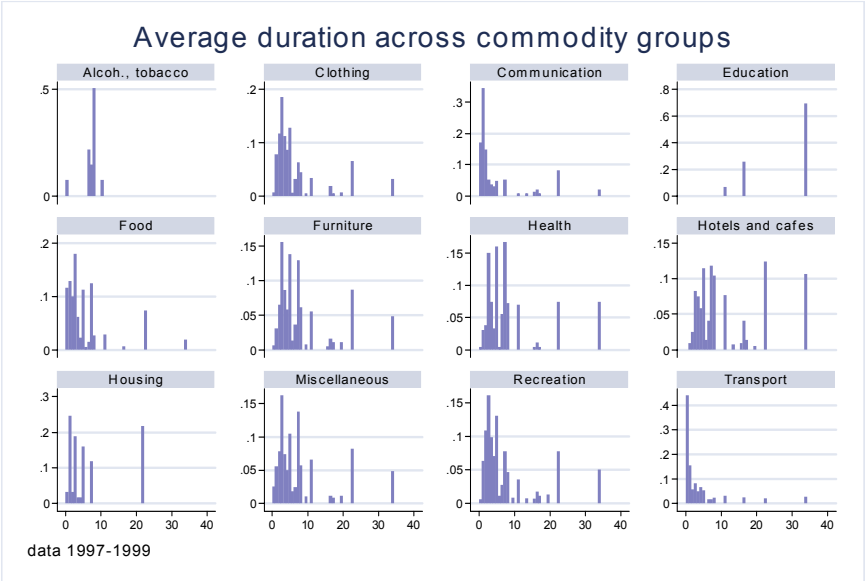


Figure 6: Distribution of average durations across outlet types. 2000-03 data.



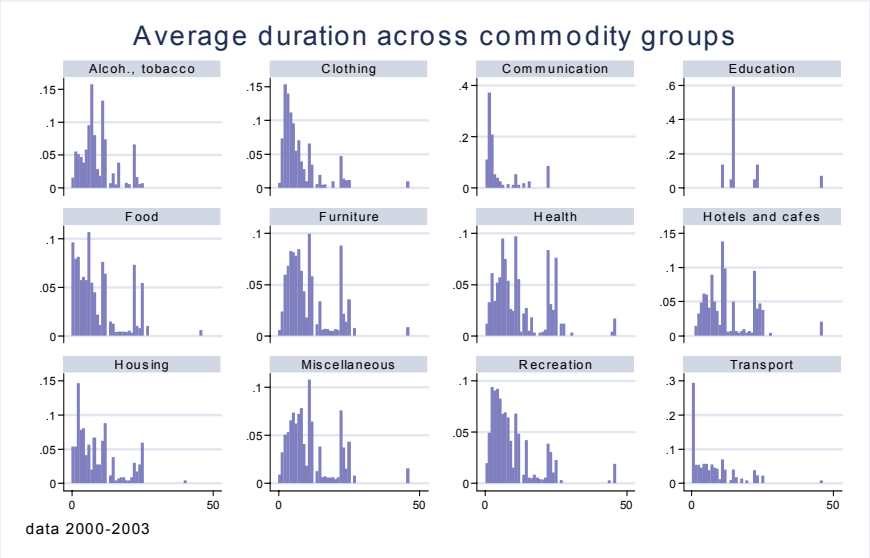
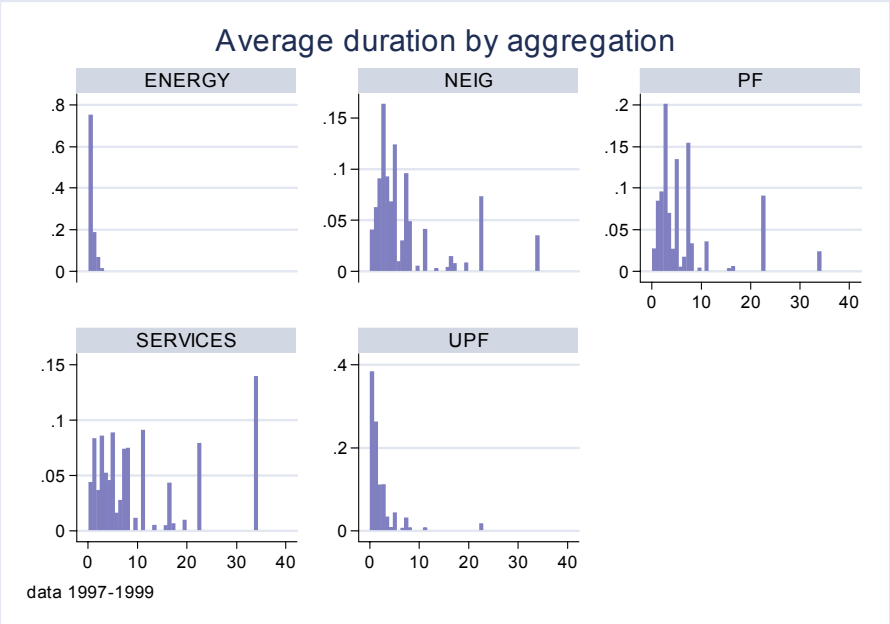


Figure 7: Distribution of average durations across COICOP groups. Upper 1997-99 data, lower 2000-03 data.



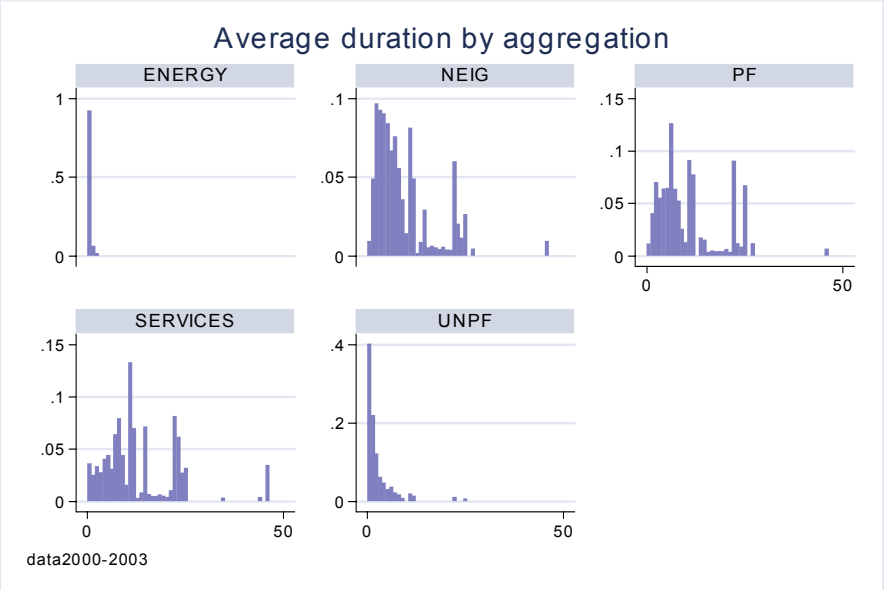


Figure 8: Distribution of average durations across NIPE groups. Upper 1997-99 data, lower 2000-03 data.