Learning, Search and Arbitrage - Evidence from a Natural Experiment

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Abstract

We study the behavior of price dispersion in Poland following the big-bang transition to a market economy in 1990 using a large, disaggregated data set. Intra- and intermarket dispersions fall rapidly in the early stages of transition. This is not fully explained by changes in inflation or in inflation variability. We attribute the initial decline to learning how to set prices in the new environment. Learning is very fast: within 6-12 months dispersion reaches long-run values. There are significant differences in price dispersion across goods throughout the period of study. They are consistent with search for the best price within regions and active arbitrage across regions**.** Overall agents respond to new opportunities by acting precisely as economic theory predicts they would.

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1. Introduction.

In this paper we look at price behavior in an economy undergoing dramatic changes. The changes create a natural experiment which allows us to address several interesting questions. How quickly do people learn? How fast does the economy converge to long-run equilibrium? What economic mechanisms lead to the convergence? What are the dynamics of convergence?

The natural experiment is Poland's big-bang transition to a market economy[1]. In August 1989 the opposition unexpectedly won the general election; the new government was formed in September. A package of radical economic reforms was prepared during the next couple of months and introduced on January 1, 1990. The planned system was abolished and the groundwork for a market economy was established creating, virtually overnight, an entirely new economic environment.

We study the behavior of price dispersion during the first seven years following the big-bang, using a large, disaggregated data set. Before 1990 price dispersion was minimal as uniform prices were set by either the central planner or by state firms[2]. The freeing of prices in January 1990 resulted in large differences in prices across stores and geographical regions.

Three types of agents are involved in the natural experiment: a shopkeeper, a customer and an entrepreneur. The shopkeeper used to receive insufficient supplies, which she would sell at predetermined prices. All of a sudden she is able to set prices; also, shortages rapidly disappear. Over a short period of time the shopkeeper goes from being a distributor of scarce commodities to being a profit maximizer. The customer used to search for availability of goods,

[1] See Sachs (1993) for a description and analysis of the reforms.

[2] Differences arose only when goods were sold in unregulated private markets; the volume of these transactions was small.

as most products were in short supply. Now he is able to buy the goods he wants but prices vary across stores. This creates incentives to search for the best price. The entrepreneur used to be a shady character, who would bribe shopkeepers to buy goods which were in short supply and sell them to street sellers. Now shortages disappear but new opportunities for profit arise: prices differ across regions. She now establishes trading networks to buy goods at the wholesale level in cheap regions and sell them in expensive ones, arbitraging the price differences.

This short description explains why the period period following the big-bang transition can be viewed as a natural experiment in which, all of a sudden, economic agents are provided with opportunities to maximize profits and to search for the best price (as opposed to search for availability).

Both intramarket price dispersion - differences in price levels for a given good between stores in a region, and intermarket price dispersion - differences in price levels for a given good across regions - are initially large but rapidly fall. The standard explanation is the well-documented relationship between dispersion and inflation and inflation variability. These variables explain only part of the changes in dispersion.

The rest of the initial decline in dispersion is attributed to learning how to set prices in the new environment. Learning is very fast: within a year dispersion reaches long-run values for a vast majority of goods in our sample. Firms engage in active learning: in markets in which search is intensive, there are more price changes per store (until the end of the first stage of transition) than in markets with little search.

We find evidence that search for the best price determines the behavior of intramarket price dispersion over time. Intermarket dispersion is determined by arbitrage: over time intra- as

well as intermarket dispersion decline more for tradable goods than for nontradables. Furthermore, the ratio of intra- to intermarket dispersion rises more for tradable than for nontradable goods.

The dynamics of convergence are interesting. The initial decline in the intra- and intermarket dispersion overshoots their long-run values. A possible explanation is as follows. As agents' information about price distribution is limited, search and arbitrage activities react to the decline in price dispersion with a delay. As incentives fall, search and arbitrage become, eventually, less active and price dispersion rises above long-run average.

The initial decline in intramarket dispersion is faster than in intermarket dispersion, and ends sooner; overall intermarket dispersion declines more. The reason is that arbitrage is a more difficult activity to organize, but economic incentives are larger.

Overall agents respond to new opportunities by acting precisely as economic theory predicts they would.

The plan of the paper is as follows. In the next section we briefly review theoretical issues and existing empirical evidence. Data are described in section 3. In Section 4 we analyze the behavior of intramarket and intermarket price dispersions over time. In section 5 we discuss various explanations of the observed behavior of dispersion. The last section concludes.

2. Theory and Empirical Evidence.

There are four basic reasons for prices to differ at the individual level. The first is due to the obvious factors affecting local cost, supply and demand conditions. If goods are locally produced, costs may vary across locations. For goods that are not locally produced, prices vary

due to differences in transportation costs. Differences in costs arise also due to differences at the wholesale and retail level (for example labor costs, rents or local taxes). Finally, there are differences in competition at the wholesale and retail level as well as differences in search patterns by customers. The first three factors affect mainly intermarket dispersion; the last affects both inter and intramarket dispersion.

The second reason is due to nominal rigidities at the individual level. The most popular explanation of these rigidities is the menu cost approach, started by Barro (1972) and developed by Sheshinski and Weiss (1977, 1983) and others. The basic menu cost model (Sheshinski and Weiss, 1977) implies that, as the expected rate of inflation increases, the size of nominal price changes rises. If price changes within a region are not perfectly synchronized, or if stores are heterogeneous, this implies higher intramarket dispersion.[3] Intermarket price dispersion would rise if local price changes are not perfectly staggered and price change patterns differ across markets.

The third reason is the Lucas' (1982) aggregate/local confusion approach, which implies that prices may differ due to different composition of local shocks as well as different history of local shocks. The driving force is the inability of agents to distinguish between local and aggregate shocks. Combined with different supply and demand elasticities and with different degrees of persistence of local shocks (Barro, 1976, Cukierman, 1984), aggregate and local shocks generate price differences between individual sellers. The local/aggregate confusion

[3] Empirically, though, while price changes do appear to be staggered (Lach and Tsiddon, 1992 and 1996, Tommasi, 1993 and Fisher and Konieczny, 1999a) empirical studies find many instances when the size of price changes falls as inflation increases (see Fisher and Konieczny, 1999b, for a review of empirical evidence).

approach can explain both intra- and intermarket dispersion.

Finally, during a period of rapid economic changes, prices may differ across stores and across regions as price setters, in the absence of a stable and well-understood environment, pursue different pricing policies.

Regardless of the model, intramarket price dispersion creates incentives to search for the lowest price. Search intensity depends on the importance of given product in consumer expenditure, the value of a single purchase and the frequency of purchases. Search intensity, in turn, affects price dispersion.

Intermarket price dispersion creates incentives for arbitrage. Arbitrage opportunities depend on transportation costs, durability of goods, the competitive nature of the wholesale market and on demand elasticity. The last reason is an important link between intra- and intermarket price dispersion: elasticity of demand is higher in markets where search is more intensive. Therefore we expect intra- and intermarket price dispersion to be correlated across goods.

The empirical literature concentrated on the relationship between inflation and relative price variability (see Mills (1927), Vining and Elwertowski (1976), Parks (1978), Fischer (1981), Danziger (1987), Domberger (1987), Van Hoomissen (1988) Lach and Tsiddon (1992), Parsley (1996) and Debelle and Lamont (1997), among others). The general conclusion is that relative price variability and price dispersion at the individual level are positively related to various measures of inflation and of inflation variability.

3. Description of the Data.

The analysis is based on two unique data sets. The first data set, which we use to construct a measure of *intramarket* price dispersion, consists of price information on individual products and services in individual stores in Poland during the period 1990-1996. The data were collected by the Polish Central Statistical Office (GUS) in order to calculate the Consumer Price Index. GUS obtains data on 1500-1800 products in 307 districts, with one seller (store, street market, restaurant or service provider) per district (Bauc et al, 1996, p. 55). Out of this set we have a sample of 58 goods in 47 stores (districts) each. The data comprise the complete set of price information for four out of the 49 administrative provinces in Poland (Voivodships). We selected the voivodships with the largest number of districts. Two are urban (Warsaw and Katowice, with about 90% of population in towns); the other two are less urbanized (Olsztyn and Lublin, with about 60% of population in towns). The number of districts in each voivodship is 14, 15, 10 and 8, respectively. There are 2-4 observations per month in 1990 and 1-3 observations a month in 1991-96, depending on the good. It is important to note that the recorded prices are the actual transaction prices as sales, coupons or volume discounts are very rarely used, and were virtually unknown in the first few years of transition. The sales tax (VAT) is included in prices. The tax is the same in all regions but varies slightly across goods.

The second data set, which we use to construct a measure of *intermarket* price dispersion, consists of the average price levels of the same 58 goods in each of the 49 Voivodships during the same period. These data are available monthly. GUS obtains the averages by calculating averages of prices recorded in individual stores in a given month. Therefore the average price levels for the four voivodships are the averages of the data for the given month from the first data

set.

In order to be included in our data, each good has to meet several criteria. We require that it did not change during the period in question. We excluded goods and services with regulated prices, and eliminated several products where there were many missing observations. Finally, we wanted to have data on a variety of goods. This was difficult as a lot of goods have changed following the collapse of the planned economy. In the end, out of the 58 goods, 38 are groceries (20 perishable and 18 storable), 3 are cigarettes, 10 are manufactured products, 4 are sold in cafeterias/cafes and 3 are services. The list of the goods and various product groupings is in Appendices A and B.

One problem with the data is that we do not know the identity of the store where a price is being sampled. The sampling procedure is as follows. Each Voivodship is divided into several districts. One store is picked in each district. The instructions for price inspectors are to choose the same store each time, but this is not enforced and changes of stores are not recorded. Changes in stores may be caused by limited availability of goods, transformation in the retail sector following the collapse of the planned system (for example ownership changes) or simply by the inspector's decision.

The data start at the beginning of transition and cover a period of seven years from 1990 until 1996. Data from before 1990 are not comparable as the methodology of collecting data was completely revamped in January 1990.

4. Intra- and Intermarket Price Dispersion.

In this section we concentrate on the description of the intra- and intermarket price dispersion over time.

4.1. Measures of Intra- and Intermarket Price Dispersion.

There are two measures of price dispersion used in the literature: the coefficient of variation of price levels and the standard deviation of the rates of change of prices.[4] As we are interested in consumer search and in arbitrage, the first measure is more appropriate. The main motivation for search and arbitrage are differences in the level of prices of a given good between stores. Variability of the rates of change of prices affects search through its effect on the depreciation of search information, but this effect is secondary. The second reason for using the standard deviation in price levels is that there are changes in stores. A change in a sampled store affects the standard deviation of the rates of price change but, as long as the new store is drawn from the same distribution, it has little effect on the within-sample dispersion of price levels.

To calculate the measure of intramarket price dispersion we have to use all the individual price data since some observations are missing. This is done as follows. Define the price of good *i* in store *j* in voivodship *v* at time *t* as P_{it}^{jv}. For the analysis of individual store data we first calculate the measure of price dispersion within voivodship *v*, CV_{it}^{v}:

[4]The second measure was suggested by Parks (1978). It is used in most recent studies of the relationship between inflation and price dispersion. Its advantage is that it eliminates store-level idiosyncratic differences and facilitates comparisons across goods.

$$CV_{it}^{v} \equiv \left[\frac{1}{N_{it}^{v} - 1} \sum_{j} \left(\frac{P_{it}^{jv} - \overline{P}_{it}^{v}}{\overline{P}_{it}^{v}} \right)^{2} \right]^{1/2} \quad (1)$$

where $\overline{P}_{it}^{v}$ is the average price of good *i* across stores at time *t* in voivodship *v* and N_{it}^{v} is the number of stores with a (non-missing) price observation for good *i* in voivodship *v* at time *t* . The measure of price dispersion, CV_{it} , is the unweighted average of the four voivodship measures. This approach assures that we have a sufficient number of data points for each good in each period and is not sensitive to differences in price level across the four voivodships.

The measure of intermarket price dispersion, $\overline{CV}_{it}^{v}$, is constructed by calculating the coefficient of variation for price averages in 49 individual voivodships:

$$\overline{CV}_{it}^{v} \equiv \left[\frac{1}{48} \sum_{v=1}^{49} \left(\frac{\overline{P}_{it}^{v} - (\overline{P})_{it}}{\overline{P}_{it}^{v}} \right)^{2} \right]^{1/2} \quad (2)$$

where $\overline{P}_{it}$ is the average, over all 49 voivodships, of the price of good *i* at time *t*.

4.2. The Behavior of Price Dispersion Over Time.

In Figure 1 we show the behavior of the average intra- and intermarket price dispersion over time. It is evident that both fall very rapidly in the early stages of transition. They reach a minimum in October 1990 and increase until the beginning of 1991. The subsequent changes are small; there is a slow downward trend until 1993 and, at least for intramarket dispersion, a slow upward trend from 1994 on.

The behavior of the average dispersion masks the varied behavior of dispersion for

individual goods.[5] The behavior of intramarket price dispersion over time for some of the goods is shown in Figure 2. The typical pattern is shown in the panel A of Figure 2, which graphs dispersion for selected meat products. It is high initially and then rapidly declines. For goods in panel A, within 6 to 9 months intramarket dispersion falls from about 0.2 to about 0.05. For most goods, after the initial period of decline the value of intramarket dispersion stabilizes (with the exception of services) and the trend differs from good to good. In many cases (a bit more than half) dispersion increases over time but for almost all goods it remains much lower than in 1990.

The remaining panels of Figure 2 show various categories of goods. In most cases they are selected to illustrate departures from the typical pattern. The dispersion of prices of specialty breads (panel B, goods 18 and 20) varies significantly over time, while for good 19, which is the standard loaf, is similar to the typical behavior illustrated in panel A. Panel C shows the behavior of dispersion of cigarette prices (goods 56-58). Cigarette prices were regulated until 1994 and differences in prices prior to 1994 were very small (prices differed as some stores were selling old stock). Hence we show the dispersion starting in November 1993. Unlike for other goods, it does not fall rapidly following the removal of controls. The dispersion of prices of goods bought in a cafeteria/café (panel D, goods 49-51) as well as of services (panel E, goods 53-55) is much higher than for meats and much more variable. While it falls initially, it quickly returns to the levels observed in 1990. Finally, panel F shows the behavior of price dispersion of manufactured goods. For big-ticket items (goods 39-41) and small-ticket items (goods 43-45) dispersion

[5] Also, it is, in some respects, misleading. As we show later, intramarket dispersion falls faster than intermarket dispersion; Figure 1 suggests the opposite is the case. The reason is that the average is dominated by outliers.

follows the usual pattern, but it is much higher for the latter.[6]

The behavior of intermarket price dispersion, shown in Figure 3, follows a similar pattern of an initial rapid decline, followed by a period of much more stable values. There are several differences. The initial decline is more gradual, occurs over a longer period of time, and dispersion falls more than in the case of intramarket price dispersion. Moreover, increases in dispersion in the later period are rare.[7]

To verify these initial observations we regress the measures of dispersion on time and time squared. All regressions are estimated using OLS with non-parametric consistent estimation of standard errors, described by Newey and West (1994) and Andrews and Monahan (1992). This is a non-parametric kernel method. We use a quadratic-spectral kernel as suggested in Andrews (1991) and Andrews and Monahan (1992). We also use a prewhitening procedure suggested in Andrews and Monahan (1992) and automatic lag selection described in Newey and West (1994).

We use this approach to estimate standard errors for two reasons. First, the Durbin-Watson statistics indicate autocorelation of the error terms. Second, as our sample is not balanced, the number of observations that we use to calculate the coefficients of variation varies over time and across goods, causing heteroscedasticity. So standard errors calculated in the usual manner are inconsistent.

We use OLS instead of some other, potentially more efficient estimation technique (for

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[6] Big-ticket items are a vacuum cleaner, a kitchen mixer and a bicycle; small-ticket items are razor blades, toothpaste and shaving cream.

[7] Intermarket variability is also less volatile. The reason is that, first, it is calculated from voivodship averages of individual store prices and, second, some data are missing at the individual level and so intramarket variability is sometimes calculated from a small number of observations.

example maximum likelihood estimation, assuming some particular form of autocorelation and heteroscedasticity) because we don't have a theory of the behavior of the stochastic components. Hence any other method would have to be based on some *ad hoc* assumptions and could result in inconsistent estimation of the parameters and their standard errors.

Regression results are in Table 1. We run the regressions for two subperiods: 1990 and 1992-96 (in the second case we added monthly dummies to the explanatory variables). The first period is chosen because, as Figure 2 indicates, for most goods the initial period of rapid dispersion decline ends within the first 12 months. The intuition for including the time squared variable on the right hand side is that learning about optimal price setting and search should be fast initially and would slow down over time, as agents figure out how to optimize their objective functions in the new environment. Hence we expect the coefficient on time squared to be positive during transition. The second subperiod is chosen to show the behavior of markets in the new equilibrium (which need not be stationary). We exclude data from 1991 to make sure that, for all goods, the first stage of transition is over by the beginning of the period included in the regression. There are 55 regressions in each run. Cigarettes are excluded as prices were regulated until 1994.

The results for intramarket price dispersion in 1990 are as expected. The coefficients on time are negative for 44 goods. For 26 - about half of all goods - they are significant at the 5% level. None of the positive coefficients is significant. The coefficients on time squared are positive for 42 goods, and significant for 23. Only for one good (35 -halvah) is the coefficient on

time squared negative and significant.[8]

In the 1992-96 period the behavior of goods is much more varied. The most predominant pattern is an increase at a decreasing rate; this pattern is exhibited by about 2/3 of the goods for which the coefficients are significant. Changes are much slower than in the first year.

Regression results for intermarket dispersion exhibit a similar pattern. One difference worth noticing is that, during the period 1992-1996, intermarket price dispersion increases slower than intramarket dispersion (in fact, for 45% of the goods for which the average slope[9] is significant, intermarket dispersion decreases).

The comparison of the regression results for the first year suggests that intramarket dispersion falls more slowly, in the sense that the absolute value of the average slope of the trend curve, as well as the coefficient on time, are smaller than intermarket dispersion.[10] This is further documented by regression results of the ratio of intramarket to intermarket dispersion over the whole sample period, shown in the last column of Table 1, and by the data shown in Figure 9. The typical pattern is that the ratio increases, at a decreasing rate. The coefficients are significant at the 5% level for about half of the goods.

4.3. The Distribution of Prices.

How big is intramarket price dispersion? In Figure 4 we plot the lines for price

[8] Halvah is the only good for which the coefficient on time is positive and significant at the 10% level.

[9] We define the average slope for a given good to be the average (over time) of the first derivative with respect to time of the estimated model.

[10] As discussed below, data for individual goods show the opposite is the case.

observations that are at least 30%, 20% or 10% away from the average.[11] Dispersion is substantial. The probability of finding a price at least 30% higher or at least 30% lower than the average is 16% in January 1990. It declines rapidly to about 3% in November 1990 and fluctuates around 3-4% for the rest of the sample period. The probability of finding a price at least 20% higher or at least 20% lower than the average is 29% in January 1990, declines to about 9% in October 1990 and fluctuates around 10% for the rest of the sample period.

The distribution of logs of prices is almost symmetric throughout the sample. Large (above 20%) and small (below 10%) positive deviations from the mean are a bit more frequent than the corresponding negative deviations. Changes in the distribution of prices are shown in Figure 5. The distribution converges very rapidly to its long-run value: by June 1990 it is very similar to the distribution in 1992-96. The distribution becomes more peaked, with thinner tails.[12] This means that very expensive and very cheap stores disappear. This is most likely due to changes in pricing policies by shopkeepers, as bankruptcies were very rare during that period.

4.4. How Long is the First Stage of Transition?

A limitation of the regressions discussed in the previous subsection is that, in most cases, the period covered by the regressions is longer than the initial period of the rapid decline in dispersion (which varies significantly across goods)[13]. A shorter regression period would reduce the number of degrees of freedom and still would not solve the problem of heterogeneity of

[11] The numbers are the differences of the natural logarithms of nominal prices from their geometric average.

[12] Kurtosis increases monotonically in the first six months of 1990.

[13] Also, the functional form and parametric approach can lead to wrong inferences.

goods. Therefore we supplement the analysis with simple statistics, shown in Table 2. They allow us further to characterize the behavior of price dispersion over time.

We define *the first stage of transition* as the initial period during which dispersion declines rapidly. The most interesting question is: how long is the first stage? To answer it we need a criterion which would reliably pick up the end of the initial period. After examining the data carefully we propose a simple one. The first stage of transition is assumed to end whenever the current level of dispersion, as measured by CV_{it} , falls below its averages in the next three, six and twelve months. This approach avoids choosing, as the end of the initial period, a month in which the dispersion is temporarily low, but allows the choice of a month which is followed by small variations in dispersion.[14]

The histogram of lengths of the first stage of the transition is in Figure 6. The first stage of transition is shorter for intra- than for intermarket dispersion. The relevant statistics on intramarket dispersion are shown in Table 2a and on intermarket price dispersion in Table 2b. On the average, the first stage of transition for intramarket dispersion lasts 7 months, while the decline of intermarket dispersion takes about 10.5 months. The decline is dramatic: intramarket dispersion falls to 40% of its value in January 1990 while intermarket dispersion falls to 35% of its January 1990 value.[15]

The first stage ends the earliest for services (including goods purchased in cafeteria/café) and for perishable foodstuffs. It should be noted that the decline in price dispersion for services is

[14] We also used a heuristic criterion, whereby the end of the first stage of transition was selected by examining data by hand. In most cases results are identical and averages are almost the same so we do not report them.

[15] Intramarket dispersion is the highest in January 1990 for 22 out of 55 goods; intermarket dispersion is the highest for 32 goods.

only temporary: dispersion returns to initial level within, at most, two years. It is actually higher in 1992-96 than in 1990, unlike for the other goods.

The evidence on the speed of intra- versus intermarket transition differs from that in Table 1. This is due to the fact that the regression period covers the initial decline as well as the subsequent rebound in dispersion.

As already noted, the overall decline in intramarket price dispersion is smaller than the decline in intermarket dispersion. While their values are initially similar, the former is larger in the 1992-96 period for 50 out of the 55 goods.[16] On the average the value of intramarket dispersion in 1992-96 is 55% of the value in January 1990 and 78 % of the average value in 1990; for intermarket dispersion the corresponding numbers are 39% and 65%.

4.5 Overshooting.

An interesting feature of the data set is what we call *overshooting.* The initial decline in dispersion in the first stage of transition overshoots the average in 1992-96. It is followed by a rapid increase above the 1992-96 average.

Overshooting is more pronounced for intra- than for intermarket dispersion. Columns 9 and 10 of Table 2 show the month and the value of the first local maximum of dispersion following the end of the first stage of transition. The following statistics characterize overshooting; the values for intermarket dispersion are in brackets. The value of intramarket (intermarket) dispersion at the end of the first stage of transition is below the average in 1992-96

[16] The five exceptions are the two cafeteria products (49 and 50), two meats (1 and 5) and radiator coolant (48).

for 49 (38) goods. It then increases rapidly, reaching the first local maximum, on the average, within 1.8 (2.5) months. The average dispersion at the first local maximum is 54% (30%) higher than at the end of the first stage of transition, and for 40 (38) products it is above the average in 1992-96.[17] We return to the issue of overshooting in the next section.

To summarize, price dispersion declines rapidly in the early stages of transition. The decline proceeds at a faster pace for intramarket dispersion but ends earlier; intermarket dispersion continues to fall and eventually declines significantly more than intermarket dispersion does. The initial decline overshoots the long run value; this effect is more pronounced for intramarket dispersion.

5. Explaining the Behavior of Price Dispersion.

We now turn to explanations of the behavior of price dispersion over time and across goods. We consider several possibilities. First, the behavior of both intra- and intermarket dispersion may be due to the well-documented relationship between price dispersion and inflation as well as inflation variability. Second, the initial rapid decline may be the result of price-setters learning how to operate in the new environment. Third, changes in intramarket dispersion may be driven by consumer search and by changes in the retail structure as market institutions become established. Fourth, changes in intermarket dispersion may be the result of agents taking

[17]It should be noted that the criterion we use only assures that dispersion increases following the end of the first stage of transition. Other aspects of the overshooting effect are not the result of the chosen criterion.

advantage of arbitrage possibilities.[18] To summarize the results, we reject the hypothesis that that the first explanation can fully account for the initial decline of price dispersion and we find evidence supporting the other three explanations.

5.1. Inflation, Inflation Variability and Price Dispersion.

Is the behavior of price dispersion solely the effect of changes in inflation and in inflation variability? This is certainly possible. The graphs of CPI inflation and a measure of inflation variability (described below) in Figure 7 show that those two series behave in a similar fashion to price dispersion. To test this hypothesis we add measures of inflation and of inflation variability to the regressions shown in Table 1. The estimated equations are:

$$CV_{it} = \alpha_0 + a_1 \Pi_{it} + a_2 x_{\mathrm{var}\,t} + a_3 t + a_4 t^2 + \boldsymbol{a}\boldsymbol{d}_{MD} + \varepsilon_\tau \qquad (3)$$

where CV_{it} is price dispersion of good i , a's are the parameters to be estimated, Π_{it} is the measure of inflation (CPI$_t$ or own inflation of good i, INF$_{it}$) x_{vart} is the measure of inflation variability, t denotes time, $\boldsymbol{d}_{MD}$ is the vector of monthly dummies (monthly dummies are not included in regressions for period 02/90-06/91) and ε_t is a stochastic component.

The results are in Table 3. In the first 4 columns we use the rate of change of CPI as a measure of inflation for all goods. This approach is problematic when there are large relative price changes (which is the case in our data); CPI may not measure the underlying inflation

[18] Another possibility is that firms sell old stock at old prices and so dispersion is the artifact of staggered deliveries of new stock (Diamond, 1991, provides an example of a market in which repricing old stock was illegal). This explanation does not apply to goods which are priced in the store: meats (1-8), eggs (9), live carp (10) and breads (18-20). The behaviour of price dispersion for these goods, however, is similar to the behaviour of price dispersion for the remaining foodstuffs.

adequately. Therefore, in the last 4 columns of Table 3, we replace CPI with own inflation, i.e. the rate of change of the national average price of the good in question. The proxy for inflation variability is the standard deviation of inflation rates across the 55 goods (excluding cigarettes). The regressions use the first 18 moths of data; there are 12 degrees of freedom as we cannot calculate own inflation, or the inflation variability measure, for January 1990.

The additional variables do not alter the general pattern of dispersion behavior over time. Coefficients on time and time squared are of the same sign as in regressions shown in Table 1. They are smaller in absolute value and are less often significant. This is to be expected since both inflation and inflation variability are correlated with time, as can be seen in Figure 7[19].

Conclusions presented above are drawn simply by looking at the estimated coefficients. Figure 8 provides further, evidence that inflation and its variability do not fully explain the behavior of price dispersion. We run regression given by (3) on the entire sample (2/90-12/96) and plot the average (across goods) of the following variable:

$$y_{it} = CV_{it} - \hat{\alpha}_0 - \hat{a}_1 INF_{it} - \hat{a}_2 x_{\mathrm{var}t} - \hat{\boldsymbol{a}}\boldsymbol{d}_{MD} \qquad (4)$$

The value of y_i shows the behavior of price dispersion of good *i* after the effects of inflation, of inflation variability, seasonal effects and differences between goods have been controlled for. The familiar pattern of an initial rapid decline followed by smaller changes later on, as well as a larger decline in intermarket dispersion, is evident.[20]

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[19] The correlation between time and CPI inflation is -0.50; between time and inflation variability is -0.56, the average correlation between time and own inflation is -0.26

[20] The changes in dispersion in Figure 8 are smaller than those in unadjusted data (see Figure 1). Note, however, that inflation and its variability are correlated with the economic forces (learning, search and arbitrage) to which we attribute changes in dispersion.

Regression results in Table 4 indicate that the variability of inflation has a strong positive effect on price dispersion, especially in the later period. The effect of the two measures of inflation is mixed. As expected, own inflation has a stronger effect than CPI, but for many goods the coefficient is of the opposite sign than predicted; indeed, in the case of own inflation, its effect on intermarket dispersion in the later period is more often significantly negative than significantly positive.

Those results appear inconsistent with existing empirical evidence. They are, however, consistent with price behavior in an economy in which price dispersion is due to staggered price adjustment by firms which face menu costs. The intuition is as follows. Consider a market in which all firms are identical and stagger price changes uniformly over time, as in Caplin and Spulber (1987). A decrease in the rate of inflation will prompt firms whose real prices are low to adjust their nominal prices upwards. This changes the ordering of firms with respect to their real price but, as long as most firms leave their prices unchanged, has little effect on our measure of dispersion.[21]

This issue does not arise in most empirical work as the typical measure of dispersion is the standard deviation of the rates of change of prices, rather than levels. Using the first data set, in a companion paper (Konieczny and Skrzypacz, 1999), we find that the effect of own inflation on the standard deviation of rates of price change is significant and positive.[22] Hence the results are an artifact of the dispersion measure used.

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[21] This argument applies to intramarket price dispersion. It would hold for intermarket price dispersion as well if price changes were synchronized within voivodships and staggered across voivodships. Evidence reported in section 5.3 suggests this is not the case.

[22] Lach and Tsiddon (1992) also note that the effect of inflation on the dispersion of rates of change is much stronger than on the dispersion of price levels.

Apart from regression results, there are three additional arguments against the hypothesis that inflation and its variability fully explain the behavior of price dispersion. First, in 1992-96 the inflation rate and inflation variability both fall while price dispersion increases for many goods. Second, inflation and inflation variability cannot explain the overshooting pattern discussed in section 4.5. Third, these variables do not explain the timing (and its variability across goods) of the end of the first stage of transition.

The fact that the behavior of price dispersion cannot be explained by the behavior of aggregate variables is not surprising. Standard models of price setting, in particular the menu cost and the Lucas' models, deal with stationary, or predictably nonstationary, environments. Economists do not have much experience with modeling behavior under conditions of radical, unpredictable change.

5.2. Learning.

The big-bang transition in Poland created an entirely new, constantly changing environment. Economic agents faced both aggregate and local uncertainty. First and foremost, it was far from certain that the reform process would succeed. In retrospect, we know that the transition to a market economy produces a variety of results and that the Polish experience is an outlier (it is the first country to reach its pre-reform level of GDP). So it is obvious that optimizing agents approached the reform process with a degree of skepticism. Monetary and fiscal policy, set by a new government in an unprecedented environment, produced further sources of aggregate uncertainty.

From the point of view of this paper local uncertainty is most important. Consider a

shopkeeper who decides what price to charge for her goods. Her optimal price depends on the usual things: inflation, costs, demand and their expected behavior over time. Optimal pricing models depend crucially on the ability of agents to form expectations about the relevant variables. Now, however, these variables are impossible to predict. The inflation rate is driven by an entirely new regime. Supply arrangements are freed from the planned-economy straightjacket and so commercial relations are fluid. Not only does she not know what wholesale prices will be but she faces uncertainty about the sources of supply as well. Past information on price elasticity of demand is useless for several reasons. In the past, markets often did not clear as prices were dictated by planners, so the elasticity was usually zero. Also, prices did not differ between stores so consumer search for the best price is a new phenomenon. Finally, strategic considerations were irrelevant. Now her prices depend on prices set at other stores, which face the same uncertainty and whose decisions are difficult, if not impossible, to predict. The whole arrangement is akin to Keynes' beauty contest problem, with one modification: the participants are from a newly discovered, and distinct, tribe.

Under those circumstances agents can be expected to start by using simple rules of thumb. One possibility is a constant markup. We do not have data on wholesale prices by location but it is unlikely that the dispersion is due to differences in wholesale prices across districts. The voivodships are small (in particular Warsaw, which consists of the city and a small surrounding area) and initial dispersion is large even for goods which have a single national producer (goods 39-46) and, presumably, few distributors.[23]

[23] For 6 out of the 8 single-producer goods the maximum dispersion in Warsaw is higher than the numbers reported in table 2.

It is, of course, possible that stores use a constant markup, but the value of the markup differs across stores. What is more likely is that different stores use different rules and it is not surprising that, given the informational problems, these rules lead, initially, to widely different prices. We attribute the behavior of price dispersion to learning by price setters, both about the new task of profit maximization and about the new environment. Over time information is acquired (either passively or by active manipulation of prices) and the environment becomes more predictable. As a consequence, their decisions become more similar.

What is remarkable is the speed with which agents learn how to set prices. For most goods the initial period of rapid dispersion decline is over by July 1990; for 3/4 of goods it is over by October 1990. As Figure 5 indicates, by the end of June the distribution of prices is very similar to its long run (1992-96) shape. We can safely conclude that, for a vast majority of goods, the initial stage of transition ends within the first year.

The behavior of cigarette prices provides another argument that learning is responsible for the evolution of price dispersion over time. By the time price controls on cigarettes are eliminated (1994) agents are familiar with the environment and know how their products should be priced. Hence there is no initial decline of dispersion; in fact, the behavior of cigarette prices at the beginning of 1994 is no different than the behavior in a later period, as can be seen in Figure 2.

The data allow us to make some inferences about the learning process. A price setter can passively observe the behavior of demand as the real price falls over time, or can actively experiment by changing the nominal price. In column 7a of Table 2a we show the average

number of price changes per store to the end of the first stage of transition.[24] The correlation between the length of time to the end of transition and the number of changes is about 0.65; if we eliminate outliers (the five goods with the longest transition - at least 17 months, and the five goods with the shortest transition - 2 months) the correlation is 0.46. This indicates that firms use both passive and active approaches to learn the pricing mechanism.

As we argue below, search for the best price is responsible for the differences across goods. In table 2a we show the averages for goods grouped by search considerations; the description of the categories is in the next subsection. The more active is search, the more elastic is demand. Hence we expect that, as the effect of a suboptimal price on profits is large, learning will be more active. Indeed, with the exception of the grouping based on the amount spent on single purchase, the more active is search the higher is the average number of price changes per store. On the other hand, as can be seen in Table 2a, search considerations do not have much impact on the length of time to the end of transition (if outliers are eliminated, the average time for the grouping based on the amount spent on single purchase is between 4.7 and 6.2 months; for the remaining groupings it is between 5.1 and 5.7 months).

5.3. Consumer Search and Price Dispersion.

We now ask whether the behavior of intramarket price dispersion is consistent with

[24] As there are missing observations, we calculate it as follows. For a given good, let l_j denote the number of price changes in store j before the month in which the first stage of transition ends, m_j denote the number of observations in which the price could change (ie. the number of cases in which there are observations in two consecutive periods) and n_j denote the maximum value of m_j (ie. when there are no missing observations). Then the average number of price changes per store is the average of $l_j \cdot n_j / m_j$.

consumer search for the lowest price. Consumer search is not a new phenomenon in Poland: consumers were very experienced searchers prior to the introduction of market reforms in 1990. It is the nature of search that changed. Under central planning search was for availability, as many goods were in short supply. One consequence of market reforms was the fast elimination of shortages (see, for example, Sachs, 1993). The combination of experienced searchers with the new phenomenon of price dispersion created conditions of intensive search for the lowest price.

One way of testing this hypothesis is to regress dispersion on expenditure shares. Unfortunately, we were unable to obtain data on expenditure shares of the goods in our data set. In the absence of this information we have to resort to providing summary statistics for various groups of goods. We expect dispersion to fall to a lower value, and perhaps fall faster, for products which either constitute a large portion of household expenditure or are expensive relative to other items. *CV* measures dispersion in units of the product; so a value of 10% is more important for the purchase of a bicycle than for the purchase of jam. We expect prices to vary more for heterogeneous goods than for homogenous goods. As far as durable and perishable foodstuffs are concerned, there are no clear predictions. There are 2 effects. Demand for durable goods may be more elastic, as consumer can buy large amounts for later use (something they used to do a lot when goods were in short supply). On the other hand, avoiding setting price which is too high is more important in case of perishable foodstuffs. Overall it is difficult to say how durability affects price dispersion.

Figure 2 provides evidence that search does matter. Panel F shows the behavior of price dispersion of manufactured goods. The relevant data are in Table 2a. For large, expensive items (39 - vacuum cleaner, 40 - kitchen mixer, 41 - bicycle) the decline in dispersion is faster, and

dispersion falls to a much lower level, than for small, inexpensive items (43 - razor blades, 44 - toothpaste, 45 - shaving cream). Among breads (panel B), dispersion falls faster, and to a lower level, for the standard loaf (19) than for specialty breads. The average dispersion in 1992-96 is the lowest for meats, dairy products, baby formula, flour, sugar and large-ticket manufactured goods. All those foodstuffs constitute a large portion of household expenditure.[25] Prices differ more (and dispersion does not tend to fall) for heterogeneous items where quality differs: goods bought in cafeteria/café (panel D) and for services (panel E). Price dispersion for durable foodstuffs is greater than the dispersion for perishable foodstuffs and falls slower. The reason is that, with some exceptions (sugar, flour as well as fish) perishable foodstuffs in our sample are more important in household expenditure.

To analyze search more systematically, we grouped the goods on the basis of characteristics which are relevant for search. There are four groupings. Three are the standard ones: the importance in household expenditure (conditional on the household buying the good), search (purchase) frequency[26] and the amount spent on a single purchase. We also add a subjective measure of search intensity, which tries to aggregate the factors relevant for search - the three discussed above and the omitted factors which do not fall neatly into one of the three categories.[27] It reflects our opinion how much effort a typical consumer puts into finding the best

[25] It should be noted that what is important is the share of a given product in the expenditure of households which buy it. For example, baby formula may be a small portion of total household expenditures, but it is important for people with small children.

[26] Frequency matters as it affects the value of information acquired in earlier search.

[27] For example, live carp is usually bought for Christmas or Easter holidays; its weight in expenditure, the frequency of purchases and the amount spent on a single purchase are low, but search for the best price is intensive.

price for the good. The classification of products by the four groupings is in Appendix B.

As we do not have data on the weight of the goods in household expenditure, the groupings are arbitrary. We grouped the goods independently and then reconciled the rankings. To minimize arbitrariness, for each grouping goods are divided into three categories. The groupings do measure different aspects of search, as can be seen in Table 4 which shows the correlation coefficients between the four classifications.

The results are in Tables 2a (intramarket dispersion) and 2b (intermarket dispersion). The results for the level of dispersion, despite the arbitrary nature of the rankings, are striking. We compare the average levels of dispersion at three exogenous moments of time (January 1990, average in 1990, average in 1992-96 - columns 3-5), two endogenous moments of time (value at the end of the first stage of transition, value at the first subsequent maximum - columns 8 and 10) as well as the values of the overall minimum and maximum - columns 1 and 2.

If search for the best price matters, we expect intramarket dispersion to be the lowest for goods which: are the most important in household expenditure, are bought most frequently, are most expensive, and are subject of the most intensive search. We expect the goods with the highest dispersion to have the opposite characteristics.

There are 84 possible pairwise orderings (4 groupings, with 3 categories in each, times 7). Of those, 71 (85%) orderings are as predicted by the search model. Of the remaining 13, 9 are due to a single outlier. There are only five products classified as having the highest amount spent on a single purchase: the four big-ticket manufactured products (39-42) and one service (floor varnishing - 54). As price dispersion of floor varnishing is much larger than that of the big-ticket products, it dominates the category. If it is excluded, all orderings in that grouping are as

predicted; overall 80 (or 95%) of orderings are as predicted. Moreover, the dispersion in the highest category in each grouping is always the smallest. The results for intermarket price dispersion are similar to those for intramarket dispersion.

If search determines the behavior of price dispersion in the first stage of transition, the decline in dispersion should be larger in cities as opportunities for search are greater. We cannot compare individual regions as we do not know how urbanized they are. We can, however, compare the behavior of dispersion among voivodships. There are two distinct groups. Two out of the four voivodships for which we have individual data, Warsaw and Katowice, are predominantly urban: in 1992 about 88% of population lived in towns (GUS, 1993). In the other two (Olsztyn and Lublin) the proportion of urban population was 60%. We compare the average (across goods) dispersion in both groups. In January 1990 the average dispersion in the urban voivodships is 3.4% higher than in the remaining two. The difference reaches its peak value of 4.3% in June 1996 and drops rapidly to a minimum of -0.3% in January 1991. To put those numbers in perspective assume that the entire difference is due to the difference in urbanization rates. Under this assumption, between January 1990 and January 1991 the dispersion in a hypothetical region which is 100% urban would have fallen by about 10% relative to the dispersion in a hypothetical region which is 100% rural.

5.4. Overshooting.

Overshooting provides further evidence that search matters. The evidence is discussed in section 4.5. It should be noted that overshooting is not due to the behavior of aggregate variables. As can be seen in Figure 7, both CPI inflation and inflation variability exhibit a

pattern similar to overshooting: the former reaches a local maximum in January 1991, the latter in December 1990. This peak (and the preceding through) do not coincide with the similar behavior for individual goods. For intramarket dispersion the first local maximum following the end of the first stage of transition is in January 1991 for only 2 out of 55 goods, and within two months of January 1991 for only 11 goods. For intermarket dispersion the first local maximum is in December 1990 for 7 goods and within two months of December 1990 for 16 goods (see column 9 of Table 2).

Our proposed explanation of the overshooting is as follows. Over time price dispersion declines. Given that search is costly, each consumer samples only a finite number of stores and notices the decline in price dispersion with some delay. Hence, even after price dispersion has declined, search is intensive. This explains why dispersion at the end of the first stage of transition overshoots long-run values. Eventually, consumers realize the distribution of prices has changed and search incentives have fallen. Search effort is reduced. Firms, in turn, notice the decline in demand elasticity with some delay. When they do, they allow prices to vary more from those charged by their competitors and, as a result, dispersion increases.[28]

This rise in dispersion following the end of the first stage of transition should be the largest for goods where search is time consuming and the smallest for goods where search is easy. The search characteristic which is the most relevant is search frequency. If a good is purchased rarely, new search has to start each time from scratch, and so it is time consuming. On the other hand, for goods which are purchased frequently, search information does not deteriorate fast and so search is inexpensive. Indeed, as can be seen from columns 8 and 10 of Table 2a, the

[28] We are grateful to John Leach for suggesting this interpretation.

increase in dispersion from the end of the first stage of transition to the first subsequent maximum is the largest for goods purchased rarely, and smallest for goods purchased frequently. This is also the case for intermarket dispersion.[29]

5.5. Arbitrage.

We now turn to the analysis of the behavior of intermarket price dispersion.

Before we analyze those issues, we need to address a potential problem with our data. In section 4 we documented the large level, and big changes, of intermarket dispersion of prices. It is possible that this is the artifact of the small number of observations in each voivodship.[30] The intuition is as follows. Price changes are large: the average price increase (decrease) is between 33% (14%) in 1990 and 9% (8%) in 1996 (1995). With a small number of observations, a voivodship in which a store has just increased price will have a high price level. Hence intermarket dispersion may be due to staggering of price changes across voivodships.

If that is the case, the ordering of voivodships with respect to their price levels should change all the time. Hence the correlation between the orderings in adjacent periods should be close to zero. To test this hypothesis we compute, for each good, the ranks of prices for each voivodship in each period. The data cover 58 goods and 84 periods. To make sense of this

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[29] Note that the time between the end of the first stage of transition and the first local maximum following it differs little across the frequency of purchase classification. As discussed above, this is also true of the time to the end of the first stage of transition.

[30] There are 307 districts (stores) in 49 voivodships, so that the average number of observations in a voivodship is about 6. Also, many data are missing: the proportion of missing data in the four voivodships for which we have store-level information is between 30% in 1990 and 10% in 1996.

information, for each period we calculate the average of the ranks across goods. Then we compute correlations of the average ranks between two adjacent periods and yearly averages of the correlations. They vary between 0.461 in 1990 and 0.715 in 1995. In few cases individual correlations are close to zero and so we conclude that the intermarket dispersion is not an artifact of the small number of observations.

Economic changes started with the big-bang transition create opportunities for arbitrage. In a planned economy, the opportunities for arbitrage are limited as the planner dictates the geographic distribution of goods as well as sources of supply. Market reforms, started with the big-bang transition, allow stores to choose their suppliers. Together with the elimination of shortages, this process leads to a reduction in price dispersion within, and across voivodships. As can be seen in Tables 2a and 2b, both intra- and intermarket dispersions decline more for tradable goods: manufactured products, durable goods than for nontradable goods: breads, goods sold in cafeteria- café and services (see columns 4 and 5).

The comparison of interregional price dispersion with intraregional price dispersion is a topic of interest in international trade literature. Engel and Rogers (1999) compare dispersion of the rates of change of a given product aggregate between cities with the dispersion of the rates of change of various aggregates across cities. They find that the Law of One Price - or more accurately, Relative Purchasing Power Parity (PPP)- does not hold. One striking result is that the departures from Relative PPP are greater for aggregates of traded goods than for aggregates of nontraded goods.

In Figure 9 we plot the ratio of intramarket to intermarket dispersion for all goods.[31] Initially, intramarket price dispersion is about the same as intermarket dispersion. The ratio slowly increases and by 1992 intramarket dispersion is about 40% higher than intermarket dispersion. So our data appear to support Engel and Rogers' (1999) findings. When we look at various categories of goods a different picture emerges. As we are concerned with the dispersion of price levels, our data allow us to analyze departures from the Absolute PPP, not the Relative PPP. If Absolute PPP holds, the ratio of intra- to intermarket price dispersion should be low for traded goods and high for non-traded goods. The most tradable group in our sample are goods 39-46. Each of those goods has a single producer, making arbitrage particularly easy. The non-traded products are 49-52 (goods purchased in a cafeteria or café), 53-55 (services) and 18-20 (breads). Also, durable foodstuffs are easier to trade than perishable foodstuffs. The ratios of intra- to intermarket dispersion for those groups are plotted in Figure 9. Their behavior is consistent with active arbitrage for traded goods and less active (or absence of) arbitrage for non-traded goods.

5.6. A Comparison of the Behavior of Intra-and Intermarket Dispersion.

Finally, we turn to explaining the differences and similarities of the behavior of intra- and intermarket price dispersion. As discussed above, for intramarket dispersion the initial decline proceeds at a faster pace and the end of the first stage of transition happens earlier (see Figure 6), but the overall decline is smaller than for intermarket dispersion (see, for example, the last

[31]All ratios in Figure 9 are calculated as the average ratio for all goods (rather than the ratio of the averages).

column of Table 1 or Figure 9). We interpret these differences as follows. Compared to the search for the best price, arbitrage is a more difficult activity to set up. Finding price differences is more difficult across than within regions; reliable sources of (cheap) supply as well as demand (in expensive regions) have to be found, commercial relations have to be established, transportation arranged, etc. All this takes time, and so the initial decline in intermarket dispersion is slower.

On the other hand, the potential monetary benefit from arbitrage is obviously larger than from the search for the best price. Hence active arbitrage proceeds even when price differences do not justify the search effort.

Apart from these quantitative differences, a striking feature in the data is the qualitative similarity in the behavior of intra- and intermarket dispersion. We attribute this to the dominant role of search for the best price. In markets in which search is intensive demand elasticity is high. This creates large incentives for active arbitrage within, as well as across, regions. As a result, both intra- and intermarket dispersions are small.

6. Conclusions.

When the big-bang reform turns the economic environment inside out, agents learn gradually how to behave in this natural experiment. Store managers (or owners) face, for the first time, the decision to set prices. They initially respond by choosing widely dispersed prices. Consumers respond by searching for the best price, which is more financially (if not psychologically) rewarding than searching for availability they had to endure under central planning. Entrepreneurs respond by arbitraging price differences between regions. These forces

move the economy rapidly towards the long-run equilibrium. The remarkable feature of the process is that economic agents respond to new opportunities by acting precisely as economic theory predicts.

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Appendix A. List of goods:

1. Back bacon “Sopocka”, 1kg; 2. Sausage “Krakowska sucha", 1 kg; 3. Sausage “Mysliwska sucha”, 1 kg; 4. Sausage “Krakowska parzona”, 1kg; 5. Sausage “Zwyczajna”, 1kg; 6. Pork wieners, 1 kg; 7. Sausage “Torunska”, 1 kg; 8. Sausage “Zywiecka”, 1 kg; 9. Eggs, each; 10. Carp, live, 1 kg; 11. Herring, salted, 1 kg; 12. Sprats, smoked, 1 kg;; 13. Cheese “Gouda”, 1 kg; 14. Cheese “Edamski”, 1 kg; 15. Butter, 82.5% fat, 250g; 16. Margarine “Palma”, 250g; 17. Veggie butter, 250g tub; 18. Rye bread, 1 kg; 19. Bread “Baltonowski”, 1 kg; 20. Bread “Wiejski”, 1 kg; 21. Powdered baby formula, 500g. 22. Flour “Tortowa”, 1 kg; 23. Flour “Krupczatka”, 1 kg; 24. Flour “Poznanska”, 1 kg; 25. Pearl barley “Mazurska”, 1 kg; 26. Sugar, 1 kg; 27. Plum butter, 460g jar; 28. Jam, blackcurrant, 460g jar; 29. Apple juice, 1 l box; 30. Pickled cucumbers, 900g jar; 31. Candy “Krowka”, 1 kg; 32. Cookies “Delicje szampanskie”, 1kg; 33. Cookies “Petit Beurre” type, 100g; 34. Pretzel sticks, 100g; 35. Halvah, 1 kg; 36. Vinegar, 10%, 0.5l bottle; 37. Citric acid, 10g bag; 38. Tea “Madras”, packed domestically, 100g; 39. Vacuum cleaner, type 338,5; 40. Kitchen mixer, type 175,5; 41. Folding bicycle “Wigry-3"; 42. Radio receiver “Ania” 43. Razor blade “Polsilver”, each; 44. Toothpaste “Pollena”, 98g; 45. Shaving cream; 46. Sanitary pads “Donna”, box of 20; 47. Paint thinner, 0.5l; 48. Radiator coolant “Borygo” or “Petrygo”, 49. Mineral water in a cafeteria, 0.33l bottle; 50. Boiled egg in a cafeteria, each; 51. Mineral water in a café, 0.33l bottle; 52. Pastry “W-Z” in a café, each; 53. Car-wash, of car: “FSO 1500"; 54. Varnishing of hardwood floor, twice, $1m^2$; 55. ECG test; 56. Cigarettes “Popularne”, 1 pack; 57. Cigarettes “Klubowe”, 1 pack; 58. Cigarettes “Mocne”, 1 pack.

Appendix B. Goods by Type and Category.

	Good number	Type of good*	Importance in expenditure**	Search frequency**	Amount spent on single purchase**	Search intensity**
Back bacon "Sopocka"	1	p	1	1	2	1
Sausage "Krakowska sucha"	2	p	1	1	2	1
Sausage "Mysliwska sucha"	3	p	1	1	2	1
Sausage "Krakowska parzona"	4	p	1	1	2	1
Sausage "Zwyczajna"	5	p	1	1	2	1
Pork wieners	6	p	1	1	2	1
Sausage "Torunska"	7	p	1	1	2	1
Sausage "Zywiecka"	8	p	1	1	2	1
Eggs	9	p	1	1	2	1
Carp, live	10	p	3	3	3	2
Herring, salted	11	p	3	2	2	2
Sprats, smoked	12	p	3	2	2	2
Cheese "Gouda"	13	p	2	1	3	1
Cheese "Edamski"	14	p	2	1	3	1
Butter, 82.5% fat	15	p	1	1	3	1
Margarine "Palma"	16	p	1	1	3	1
Veggie butter,	17	p	1	1	3	1
Rye bread	18	p	1	1	3	1
Bread "Baltonowski"	19	p	1	1	3	1
Bread "Wiejski"	20	p	1	1	3	1
Powdered baby formula	21	d	1	2	2	1
Flour "Tortowa"	22	d	2	2	3	1
Flour "Krupczatka"	23	d	2	2	3	1
Flour "Poznanska"	24	d	2	2	3	1
Pearl barley "Mazurska"	25	d	3	3	3	2
Sugar	26	d	1	2	3	1
Plum butter	27	d	2	2	3	2
Jam, blackcurrant	28	d	2	2	3	2
Apple juice	29	d	2	2	3	2
Pickled cucumbers	30	d	2	2	3	2
Candy "Krowka"	31	d	2	2	3	2
Cookies"Delicje szampanskie"	32	d	2	2	3	2
Cookies "Petit Beurre" type	33	d	2	2	3	2
Pretzel sticks	34	d	2	2	3	2
Halvah	35	d	2	2	3	3
Vinegar	36	d	2	2	3	2
Citric acid	37	d	3	3	3	3
Tea "Madras"	38	d	1	2	2	1

Appendix B continued.

	Good number	Type of good*	Importance in expenditure**	Search frequency**	Amount spent on single purchase**	Search intensity**
Vacuum cleaner, type 338,5	39	m	3	3	1	1
Kitchen mixer, type 175,5	40	m	3	3	1	1
Folding bicycle “Wigry-3"	41	m	3	3	1	1
Radio receiver "Ania"	42	m	3	3	1	1
Razor blade "Polsilver"	43	m	3	2	3	3
Toothpaste "Pollena"	44	m	2	2	3	2
Shaving cream	45	m	3	2	3	2
Sanitary pads "Donna"	46	m	2	2	2	1
Paint thinner	47	m	3	3	3	3
Radiator coolant	48	m	3	3	3	3
Mineral water in a cafeteria	49	s	2	2	3	3
Boiled egg in a cafeteria	50	s	2	2	3	3
Mineral water in a café	51	s	2	2	3	3
Pastry "W-Z" in a café	52	s	2	2	3	3
Car-wash, of car: "FSO 1500"	53	s	2	2	2	2
Varnishing of hardwood floor	54	s	3	3	1	1
ECG test	55	s	3	3	2	3
Cigarettes "Popularne"	56	c	1	1	2	1
Cigarettes "Klubowe"	57	c	1	1	2	1
Cigarettes "Mocne"	58	c	1	1	2	1

Notes:

* p - perishable foodstuffs;
d - durable foodstuffs;
m - manufactured goods;
s - services (includes goods in cafeteria/café)
c - cigarettes.

** 1 denotes goods with highest weight in expenditure, highest search frequency, largest amount spent on a single purchase and highest search intensity.

Table 1

		Intramarket dispersion		Intermarket dispersion		Ratio intra / inter
Period		1990	1992-96	1990	1992-96	1990-96
time	mean coeff	-2.449	0.115	-3.436	-0.059	0.012
	median coeff	-2.389	0.053	-3.002	-0.030	0.011
	max coeff	5.461	1.509	6.051	0.799	0.066
	min. coeff	-9.152	-0.644	-13.120	-0.836	-0.039
	+ve signif. *	0	17	3	12	26
	-ve signif.*	26	10	35	19	5
time ^{2}	mean coeff	0.120	-0.001	0.176	0.001	-0.0001
	median coeff	0.113	0.000	0.165	0.001	-0.0001
	max coeff	0.670	0.005	0.736	0.008	0.0004
	min. coeff	-0.532	-0.014	-0.479	-0.007	-0.0007
	+ve signif.*	23	9	32	20	5
	-ve signif.*	1	18	3	11	24
R^2	average	0.541	0.383	0.753	0.504	0.343
	median	0.549	0.396	0.760	0.516	0.309
	max	0.926	0.683	0.975	0.857	0.658
	min	0.014	0.100	0.287	0.091	0.093
average slope		-0.892	0.016	-1.155	0.004	0.0041172

Notes:
1. * denotes significance at the 5% level.
2. Average slope is the average first derivative with respect to time in the fitted equation.

Table 2a
Intramarket Price Dispersion

		Value of overall minimum	Value of overall maximum	Value in January 1990	Average in 1990	Average in years 1992-96	Max in 1/90? x =yes	Month transition ends	Price changes to end of transition	Value at end of transition	Month of first max. after end of trans.	Value of first max. after end of trans.
Column		1	2	3	4	5	6	7	7a	8	9	10
Average for all goods		0.072	0.302	0.242	0.169	0.132		7.33		0.098	9.16	0.151
Averages for types of goods												
Perishable foodstuffs		0.049	0.209	0.185	0.101	0.086		6.30	6.96	0.067	8.15	0.102
Durable foodstuffs		0.076	0.287	0.209	0.171	0.116		8.11	5.36	0.100	9.78	0.150
Manufactured products		0.067	0.391	0.279	0.223	0.132		9.90	2.60	0.098	12.00	0.154
Services		0.135	0.479	0.438	0.280	0.302		4.57	1.35	0.181	6.43	0.289
Meats		0.043	0.180	0.169	0.097	0.071		7.63	8.39	0.064	9.38	0.092
Dairy products		0.042	0.188	0.158	0.089	0.067		6.20	5.82	0.056	8.20	0.078
Breads		0.080	0.312	0.312	0.137	0.153		3.67	3.22	0.105	5.67	0.157
Flours		0.055	0.250	0.149	0.150	0.082		12.25	5.34	0.079	14.50	0.108
Sweets		0.080	0.277	0.172	0.155	0.125		6.40	5.68	0.099	8.00	0.142
Canned fruits and vegetables		0.079	0.257	0.200	0.161	0.118		5.50	3.42	0.118	6.75	0.157
Manufactured goods - big items		0.037	0.195	0.194	0.107	0.089		6.75	1.16	0.058	8.50	0.103
Manufactured goods - small items		0.087	0.522	0.335	0.300	0.161		12.00	3.56	0.125	14.33	0.188
Cafeteria/café		0.138	0.474	0.453	0.271	0.260		5.75	2.00	0.173	7.00	0.251
Other Services		0.132	0.487	0.419	0.292	0.357		3.00	0.48	0.191	5.67	0.340
Averages for goods grouped by search considerations												
Weight in expenditure	highest	0.051	0.211	0.190	0.102	0.088		6.33	6.79	0.069	8.11	0.101
		0.090	0.319	0.245	0.192	0.147		8.36	4.64	0.117	10.00	0.166
	lowest	0.072	0.386	0.300	0.214	0.161		7.00	2.76	0.105	9.20	0.188
Search frequency	highest	0.050	0.209	0.195	0.102	0.085		6.53	7.25	0.069	8.35	0.098
		0.086	0.327	0.235	0.197	0.147		8.44	4.48	0.112	10.11	0.165
	lowest	0.071	0.383	0.331	0.203	0.167		5.82	1.95	0.108	8.09	0.199
Amount spent on single purchase	highest-incl. product 54	0.049	0.259	0.257	0.156	0.151		6.20	0.99	0.098	8.20	0.171
	highest-excl. product 54	0.037	0.195	0.194	0.107	0.089		6.75	1.16	0.058	8.50	0.103
		0.062	0.250	0.202	0.139	0.130		6.88	6.43	0.087	8.65	0.145
	lowest	0.081	0.341	0.268	0.191	0.138		7.62	4.46	0.108	9.50	0.159
Search intensity	highest	0.050	0.222	0.191	0.117	0.097		7.55	5.64	0.074	9.38	0.113
		0.083	0.313	0.227	0.196	0.135		7.56	4.87	0.112	9.50	0.163
	lowest	0.119	0.517	0.414	0.275	0.228		6.30	2.40	0.147	8.00	0.241
Individual goods												
1	Back bacon "Sopocka"	0.038	0.185	0.185	0.086	0.056	x	7	6.23	0.045	9	0.087
2	Sausage "Krakowska sucha"	0.039	0.222	0.222	0.089	0.095	x	4	3.36	0.060	7	0.084
3	Sausage "Mysliwska sucha"	0.061	0.217	0.194	0.136	0.095	o	5	5.55	0.100	7	0.217
4	Sausage "Krakowska parzona"	0.037	0.176	0.176	0.074	0.066	x	6	6.15	0.055	7	0.057
5	Sausage "Zwyczajna"	0.038	0.182	0.167	0.136	0.058	o	17	18.30	0.073	20	0.091
6	Pork wieners	0.052	0.136	0.136	0.094	0.064	o	9	13.85	0.057	10	0.060
7	Sausage "Torunska"	0.036	0.215	0.215	0.087	0.063	x	8	8.70	0.056	9	0.061
8	Sausage "Zywiecka"	0.046	0.108	0.059	0.075	0.070	o	5	5.01	0.061	6	0.075

Table 2a continued

		Value of overall minimum	Value of overall maximum	Value in January 1990	Average in 1990	Average in years 1992-96	Max in 1/90? x =yes	Month transition ends	Price changes to end of transition	Value at end of transition	Month of first max. after end of trans.	Value of first max. after end of trans.
Column		1	2	3	4	5	6	7	7a	8	9	10
9	Eggs	0.054	0.236	0.236	0.098	0.088	x	8	17.40	0.061	9	0.069
10	Carp, live	0.031	0.202	0.107	0.074	0.093	o	4	4.13	0.059	7	0.116
11	Herring, salted	0.056	0.176	0.176	0.106	0.082	x	6	5.37	0.080	7	0.118
12	Sprats, smoked	0.038	0.248	0.091	0.110	0.096	o	5	6.31	0.038	7	0.136
13	Cheese "Gouda"	0.042	0.175	0.175	0.089	0.070	x	9	9.70	0.047	11	0.082
14	Cheese "Edamski"	0.046	0.139	0.117	0.093	0.069	o	7	5.23	0.064	9	0.079
15	Butter, 82.5% fat	0.040	0.163	0.163	0.081	0.059	x	4	4.77	0.055	6	0.071
16	Margarine "Palma"	0.041	0.201	0.201	0.082	0.062	x	6	4.25	0.053	8	0.076
17	Veggie butter,	0.042	0.263	0.132	0.099	0.076	o	5	5.16	0.063	7	0.081
18	Rye bread	0.104	0.313	0.313	0.167	0.212	x	2	1.93	0.137	3	0.233
19	Bread "Baltonowski"	0.056	0.223	0.223	0.106	0.102	x	5	4.39	0.079	7	0.101
20	Bread "Wiejski"	0.079	0.399	0.399	0.137	0.145	x	4	3.34	0.099	7	0.137
21	Powdered baby formula	0.052	0.179	0.113	0.113	0.074	o	10	7.46	0.068	12	0.117
22	Flour "Tortowa"	0.053	0.203	0.203	0.140	0.072	x	7	2.54	0.080	9	0.140
23	Flour "Krupczatka"	0.050	0.278	0.119	0.151	0.075	o	22	7.65	0.068	23	0.078
24	Flour "Poznanska"	0.050	0.206	0.102	0.120	0.075	o	12	7.22	0.069	15	0.087
25	Pearl barley "Mazurska"	0.067	0.312	0.170	0.190	0.104	o	8	3.96	0.098	11	0.127
26	Sugar	0.039	0.211	0.211	0.084	0.080	x	8	6.28	0.048	10	0.066
27	Plum butter	0.088	0.230	0.230	0.168	0.129	x	7	5.17	0.113	9	0.144
28	Jam, blackcurrant	0.096	0.248	0.184	0.177	0.134	o	8	4.61	0.139	9	0.134
29	Apple juice	0.057	0.225	0.116	0.114	0.101	o	5	3.04	0.061	6	0.137
30	Pickled cucumbers	0.074	0.324	0.270	0.185	0.106	o	2	0.88	0.160	3	0.212
31	Candy "Krowka"	0.073	0.246	0.207	0.159	0.117	o	10	12.15	0.083	12	0.158
32	Cookies"Delicje szampanskie"	0.067	0.204	0.204	0.107	0.112	x	4	2.92	0.074	5	0.087
33	Cookies "Petit Beurre" type	0.092	0.355	0.174	0.162	0.147	o	4	1.84	0.136	6	0.169
34	Pretzel sticks	0.097	0.230	0.150	0.153	0.131	o	4	4.98	0.127	6	0.176
35	Halvah	0.072	0.351	0.123	0.196	0.118	o	10	6.53	0.072	11	0.121
36	Vinegar	0.087	0.295	0.221	0.206	0.119	o	13	9.29	0.114	14	0.128
37	Citric acid	0.193	0.891	0.888	0.549	0.278	o	11	4.54	0.210	13	0.476
38	Tea "Madras"	0.061	0.176	0.080	0.095	0.124	o	1		0.080	2	0.141
39	Vacuum cleaner	0.035	0.225	0.225	0.109	0.080	x	10	2.08	0.035	13	0.122
40	Kitchen mixer	0.036	0.139	0.138	0.075	0.085	o	5	1.28	0.047	6	0.056
41	Folding bicycle	0.042	0.170	0.170	0.104	0.088	x	6	1.01	0.076	7	0.122
42	Radio receiver "Ania"	0.037	0.245	0.245	0.139	0.102	x	6	0.27	0.074	8	0.113
43	Razor blade "Polsilver"	0.122	0.516	0.122	0.286	0.234	o	9	1.10	0.153	11	0.194
44	Toothpaste "Pollena"	0.097	0.578	0.342	0.376	0.179	o	17	5.59	0.161	21	0.205
45	Shaving cream	0.082	0.624	0.474	0.480	0.165	o	21	7.17	0.108	24	0.183
46	Sanitary pads "Donna"	0.047	0.327	0.118	0.183	0.104	o	17	4.18	0.071	18	0.134
47	Paint thinner	0.133	0.445	0.312	0.246	0.182	o	6	2.57	0.145	8	0.197
48	Radiator coolant	0.044	0.643	0.643	0.229	0.104	x	2	0.74	0.113	4	0.213
49	Mineral water in a cafeteria	0.049	0.306	0.774	0.287	0.181	x	10	1.97	0.104	11	0.285
50	Boiled egg in a cafeteria	0.084	0.386	0.234	0.215	0.189	o	6	3.90	0.169	7	0.164
51	Mineral water in a cafe	0.203	0.759	0.445	0.300	0.364	o	5	1.06	0.204	6	0.233
52	Pastry "W-Z" in a cafe	0.215	0.443	0.358	0.283	0.307	o	2	1.07	0.217	4	0.322
53	Car-wash, of car: "FSO 1500"	0.233	0.514	0.514	0.364	0.346	x	3	0.60	0.238	5	0.374
54	Varnishing of hardwood floor	0.095	0.517	0.505	0.352	0.399	o	4	0.30	0.256	7	0.442
55	ECG test	0.069	0.429	0.239	0.161	0.326	o	2	0.55	0.080	5	0.203

Table 2b
Intermarket Price Dispersion

		Value of overall minimum	Value of overall maximum	Value in January 1990	Average in 1990	Average in years 1992-96	Max in 1/90? x =yes	Month transition ends	Value at end of transition	Month of first max. after end of trans.	Value of first max. after end of trans.
Column		1	2	3	4	5	6	7	8	9	10
Average for all goods		0.069	0.295	0.265	0.160	0.104		10.53	0.093	13.00	0.122
Averages for types of goods											
Perishable foodstuffs		0.051	0.186	0.182	0.099	0.072		9.40	0.065	11.60	0.079
Durable foodstuffs		0.050	0.280	0.251	0.152	0.074		12.56	0.070	15.11	0.091
Manufactured products		0.054	0.374	0.310	0.192	0.088		12.60	0.089	15.30	0.116
Services		0.192	0.535	0.474	0.312	0.295		5.57	0.237	8.29	0.335
Meats		0.050	0.148	0.148	0.088	0.069		8.13	0.064	10.88	0.080
Dairy Products		0.032	0.230	0.230	0.087	0.048		10.80	0.047	12.80	0.057
Breads		0.093	0.239	0.239	0.128	0.126		7.00	0.101	9.00	0.120
Flours		0.037	0.338	0.332	0.135	0.053		17.50	0.051	20.50	0.069
Sweets		0.056	0.233	0.181	0.128	0.084		9.00	0.069	11.00	0.083
Canned fruits and vegetables		0.046	0.280	0.264	0.154	0.069		9.75	0.082	13.25	0.115
Manufactured goods - big items		0.034	0.347	0.347	0.132	0.055		8.75	0.075	12.25	0.114
Manufactured goods - small items		0.067	0.392	0.286	0.231	0.110		15.17	0.098	17.33	0.117
Cafeteria/café		0.175	0.426	0.319	0.260	0.266		6.25	0.203	9.25	0.246
Other Services		0.215	0.680	0.680	0.381	0.335		4.67	0.281	7.00	0.455
Averages for goods grouped by search considerations											
Weight in expenditure	highest	0.051	0.182	0.176	0.092	0.072		8.78	0.063	11.00	0.078
		0.075	0.312	0.266	0.172	0.111		11.27	0.102	13.91	0.127
	lowest	0.082	0.406	0.371	0.225	0.133		11.53	0.114	14.07	0.168
Search frequency	highest	0.051	0.186	0.185	0.094	0.072		8.76	0.065	11.12	0.080
		0.072	0.308	0.251	0.175	0.107		11.70	0.097	14.15	0.121
	lowest	0.091	0.434	0.425	0.228	0.145		10.36	0.123	13.09	0.191
Amount spent on single purchase	highest-incl. product 54	0.076	0.401	0.401	0.182	0.120		7.80	0.116	11.20	0.186
	highest-excl. product 54	0.034	0.347	0.347	0.132	0.055		8.75	0.075	12.25	0.114
		0.077	0.250	0.242	0.146	0.113		9.41	0.099	11.71	0.141
	lowest	0.070	0.312	0.267	0.171	0.105		11.29	0.091	13.74	0.114
Search intensity	highest	0.052	0.236	0.232	0.111	0.076		10.41	0.069	12.97	0.093
		0.057	0.285	0.242	0.177	0.087		11.19	0.094	13.31	0.117
	lowest	0.137	0.484	0.399	0.275	0.215		9.80	0.159	12.60	0.216
Individual goods											
1	Back bacon "Sopocka"	0.049	0.143	0.143	0.103	0.063	x	14	0.071	17	0.081
2	Sausage "Krakowska sucha"	0.056	0.215	0.215	0.104	0.081	x	5	0.084	8	0.096
3	Sausage "Mysliwska sucha"	0.061	0.209	0.209	0.119	0.093	x	7	0.083	9	0.106
4	Sausage "Krakowska parzona"	0.055	0.112	0.112	0.073	0.066	x	3	0.064	4	0.094
5	Sausage "Zwyczajna"	0.043	0.148	0.148	0.093	0.059	x	13	0.056	17	0.073
6	Pork wieners	0.044	0.129	0.129	0.077	0.062	x	10	0.054	14	0.062
7	Sausage "Torunska"	0.047	0.117	0.117	0.065	0.062	x	6	0.056	9	0.062
8	Sausage "Zywiecka"	0.043	0.114	0.114	0.068	0.065	x	7	0.043	9	0.065

Table 2b continued

		Value of overall minimum	Value of overall maximum	Value in January 1990	Average in 1990	Average in years 1992-96	Max in 1/90? x =yes	Month transition ends	Value at end of transition	Month of first max. after end of trans.	Value of first max. after end of trans.
Column		1	2	3	4	5	6	7	8	9	10
9	Eggs	0.036	0.104	0.099	0.070	0.059	o	9	0.052	11	0.074
10	Carp, live	0.051	0.218	0.179	0.147	0.085	o	12	0.072	13	0.091
11	Herring, salted	0.049	0.128	0.125	0.093	0.059	o	12	0.049	14	0.061
12	Sprats, smoked	0.046	0.213	0.190	0.155	0.067	o	15	0.070	16	0.066
13	Cheese "Gouda"	0.030	0.177	0.177	0.087	0.042	x	8	0.054	12	0.065
14	Cheese "Edamski"	0.030	0.182	0.182	0.089	0.043	x	15	0.052	16	0.052
15	Butter, 82.5% fat	0.037	0.164	0.164	0.069	0.051	x	4	0.053	5	0.068
16	Margarine "Palma"	0.025	0.259	0.259	0.078	0.043	x	11	0.032	14	0.048
17	Veggie butter,	0.040	0.369	0.369	0.115	0.063	x	16	0.046	17	0.049
18	Rye bread	0.112	0.206	0.206	0.149	0.148	x	7	0.130	9	0.147
19	Bread "Baltonowski"	0.075	0.216	0.216	0.112	0.096	x	7	0.076	9	0.100
20	Bread "Wiejski"	0.092	0.293	0.293	0.124	0.134	x	7	0.096	9	0.113
21	Powdered baby formula	0.028	0.153	0.125	0.082	0.038	o	10	0.043	12	0.062
22	Flour "Tortowa"	0.033	0.335	0.335	0.118	0.042	x	27	0.033	32	0.065
23	Flour "Krupczatka"	0.034	0.334	0.334	0.122	0.048	x	15	0.051	17	0.059
24	Flour "Poznanska"	0.036	0.327	0.327	0.113	0.050	x	14	0.039	18	0.055
25	Pearl barley "Mazurska"	0.044	0.358	0.334	0.186	0.071	o	14	0.082	15	0.095
26	Sugar	0.026	0.099	0.099	0.053	0.035	x	13	0.029	14	0.030
27	Plum butter	0.050	0.186	0.184	0.121	0.078	o	7	0.083	9	0.088
28	Jam, blackcurrant	0.053	0.212	0.187	0.141	0.073	o	6	0.104	12	0.168
29	Apple juice	0.039	0.423	0.423	0.190	0.061	x	8	0.101	11	0.142
30	Pickled cucumbers	0.042	0.300	0.260	0.162	0.063	o	18	0.042	21	0.061
31	Candy "Krowka"	0.050	0.154	0.118	0.091	0.066	o	11	0.059	12	0.060
32	Cookies"Delicje szampanskie"	0.058	0.192	0.192	0.098	0.087	x	6	0.070	7	0.087
33	Cookies "Petit Beurre" type	0.037	0.221	0.221	0.098	0.077	x	10	0.058	12	0.069
34	Pretzel sticks	0.076	0.172	0.114	0.121	0.100	o	7	0.096	11	0.131
35	Halvah	0.056	0.424	0.259	0.229	0.091	o	11	0.062	13	0.070
36	Vinegar	0.050	0.271	0.245	0.172	0.067	o	8	0.091	9	0.130
37	Citric acid	0.134	0.652	0.618	0.531	0.216	o	32	0.146	36	0.194
38	Tea "Madras"	0.056	0.232	0.151	0.100	0.078	o	9	0.065	11	0.071
39	Vacuum cleaner	0.027	0.389	0.389	0.153	0.046	x	16	0.073	21	0.097
40	Kitchen mixer	0.026	0.508	0.508	0.157	0.048	x	5	0.074	9	0.123
41	Folding bicycle	0.042	0.253	0.253	0.092	0.054	x	5	0.063	7	0.075
42	Radio receiver "Ania"	0.040	0.239	0.239	0.127	0.070	x	9	0.092	12	0.161
43	Razor blade "Polsilver"	0.091	0.521	0.299	0.219	0.154	o	13	0.091	16	0.121
44	Toothpaste "Pollena"	0.069	0.552	0.318	0.310	0.100	o	21	0.083	23	0.092
45	Shaving cream	0.041	0.453	0.278	0.394	0.114	o	19	0.138	21	0.174
46	Sanitary pads "Donna"	0.049	0.198	0.198	0.138	0.069	x	26	0.049	27	0.054
47	Paint thinner	0.088	0.313	0.308	0.163	0.106	o	8	0.110	9	0.118
48	Radiator coolant	0.062	0.313	0.313	0.162	0.117	x	4	0.114	8	0.141
49	Mineral water in a cafeteria	0.158	0.500	0.379	0.294	0.260	o	7	0.222	8	0.215
50	Boiled egg in a cafeteria	0.128	0.306	0.176	0.173	0.203	o	7	0.130	12	0.197
51	Mineral water in a cafe	0.199	0.399	0.319	0.258	0.312	o	6	0.201	8	0.238
52	Pastry "W-Z" in a cafe	0.215	0.499	0.400	0.317	0.288	o	5	0.259	9	0.335
53	Car-wash, of car: "FSO 1500"	0.161	0.508	0.508	0.353	0.221	x	5	0.311	7	0.359
54	Varnishing of hardwood floor	0.243	0.616	0.616	0.382	0.383	x	4	0.277	7	0.474
55	ECG test	0.239	0.916	0.916	0.407	0.401	x	5	0.256	7	0.531

Table 3.

		Intramarket Dispersion		Intermarket Dispersion		Intramarket Dispersion		Intermarket Dispersion	
Period		2/90-6/91	92-96	2/90-6/91	92-96	2/90-6/91	92-96	2/90-6/91	92-96
CPI	mean coeff.	-0.010	-0.018	-0.003	0.024				
	+ve signif. *	3	10	11	13				
	-ve signif. *	6	13	3	11				
Own inflation	mean coeff.					0.071	0.196	0.065	0.093
	+ve signif. *					13	30	19	27
	-ve signif. *					7	5	5	8
Inflation variability	mean coeff.	0.202	0.033	0.264	0.026	0.135	-0.004	0.122	0.012
	+ve signif. *	11	16	16	21	12	10	14	13
	-ve signif. *	2	12	4	14	3	11	8	11
time	mean coeff.	-0.939	0.003	-1.189	-0.063	-0.878	0.020	-1.281	-0.059
	median coef	-0.612	0.008	-0.978	-0.039	-0.720	0.011	-0.854	-0.057
	max. coeff.	9.400	1.378	4.450	0.730	9.827	1.656	4.251	0.733
	min coeff.	-15.290	-2.610	-8.052	-0.771	-13.140	-2.597	-10.370	-0.765
	+ve signif. *	4	19	2	12	2	17	3	13
	-ve signif. *	19	12	30	18	14	13	28	21
time ^{2}	mean coeff.	0.034	0.000	0.043	0.001	0.032	0.000	0.045	0.001
	median coef	0.026	0.000	0.035	0.000	0.028	0.000	0.038	0.001
	max. coeff.	0.527	0.021	0.260	0.008	0.452	0.021	0.333	0.009
	min coeff.	-0.355	-0.013	-0.154	-0.006	-0.371	-0.015	-0.155	-0.007
	+ve signif. *	18	12	28	20	16	14	27	22
	-ve signif. *	4	18	1	11	3	17	4	12
Ave slope	mean coeff	-0.250	0.008	-0.336	0.004	-0.232	0.015	-0.375	0.006
	+ve signif. *	9	22	7	20	8	22	6	24
	-ve signif. *	17	12	23	20	15	10	23	19
R^2	average	0.639	0.429	0.782	0.531	0.661	0.496	0.799	0.576
	median	0.6762	0.4269	0.834	0.5575	0.7206	0.5087	0.8694	0.602
	maximum	0.9079	0.839	0.9903	0.8612	0.9534	0.9064	0.9921	0.8636
	minimum	-0.3547	-0.01335	-0.1536	-0.0064	-0.3708	-0.01535	-0.1551	-0.006522

Notes:

1. * denotes significance at the 5% level.
2. Average slope is the average first derivative with respect to time in the fitted equation.

Table 4

Correlations Between Search Indicators.

	Weight in expenditure	Search frequency	Amount spent on single purchase	Search intensity
Weight in expenditure	1	0.86	-0.12	0.52
Search frequency	0.86	1	-0.19	0.47
Amount spent on single purchase	-0.12	-0.19	1	0.43
Search intensity	0.52	0.47	0.43	1

Figure 1

Average Intra- and Itermarket dispersion

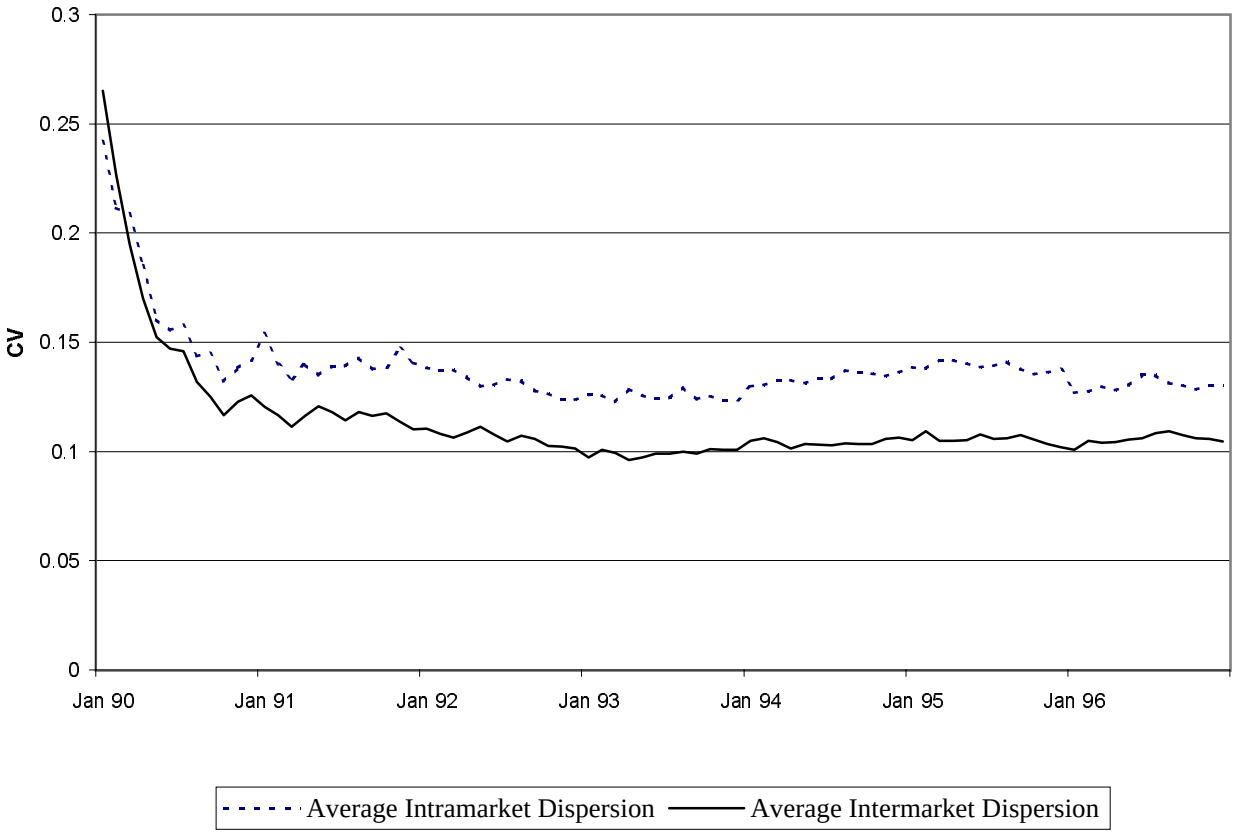
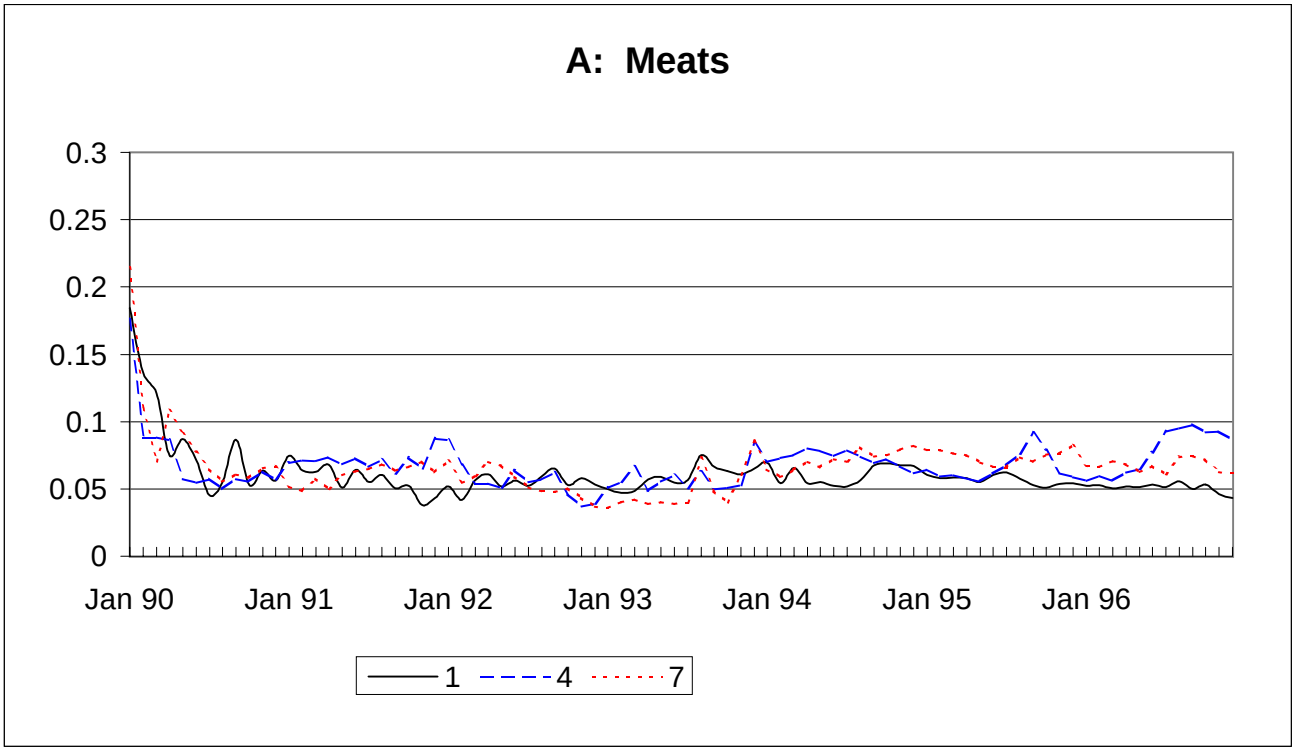
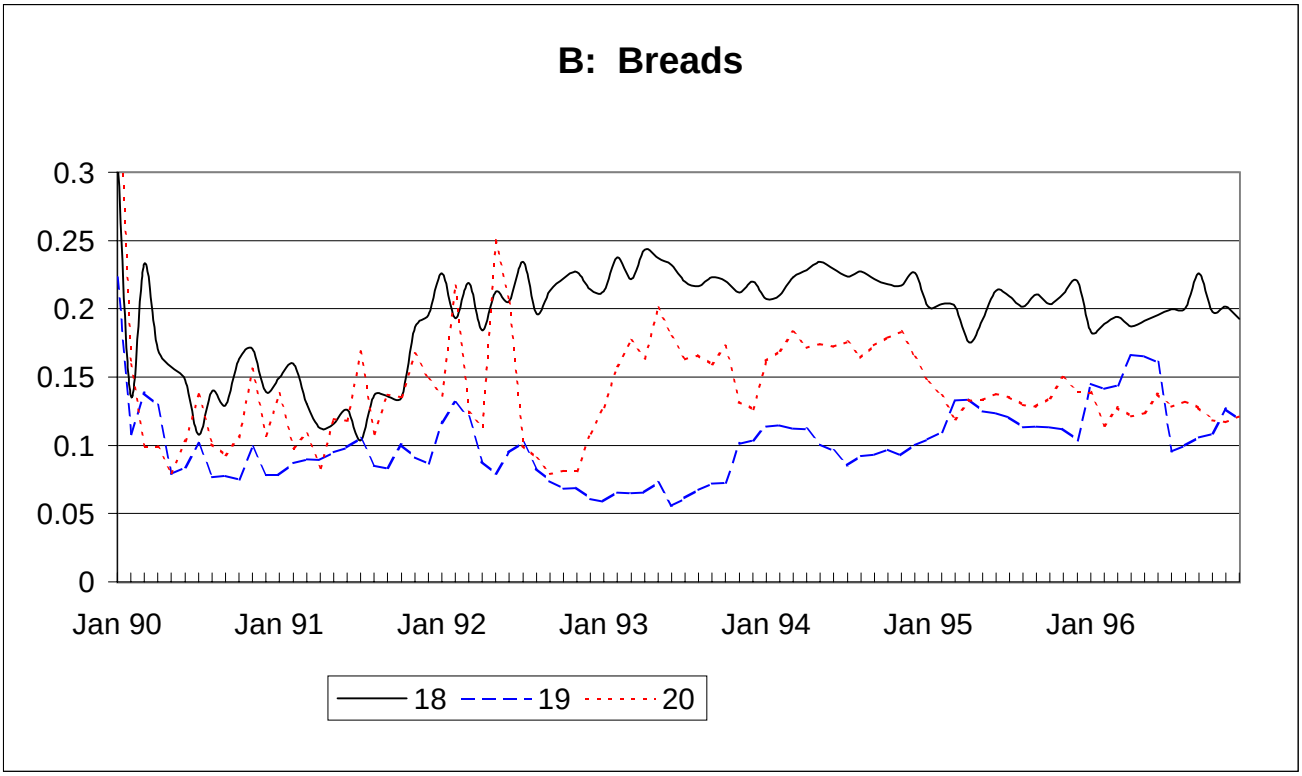
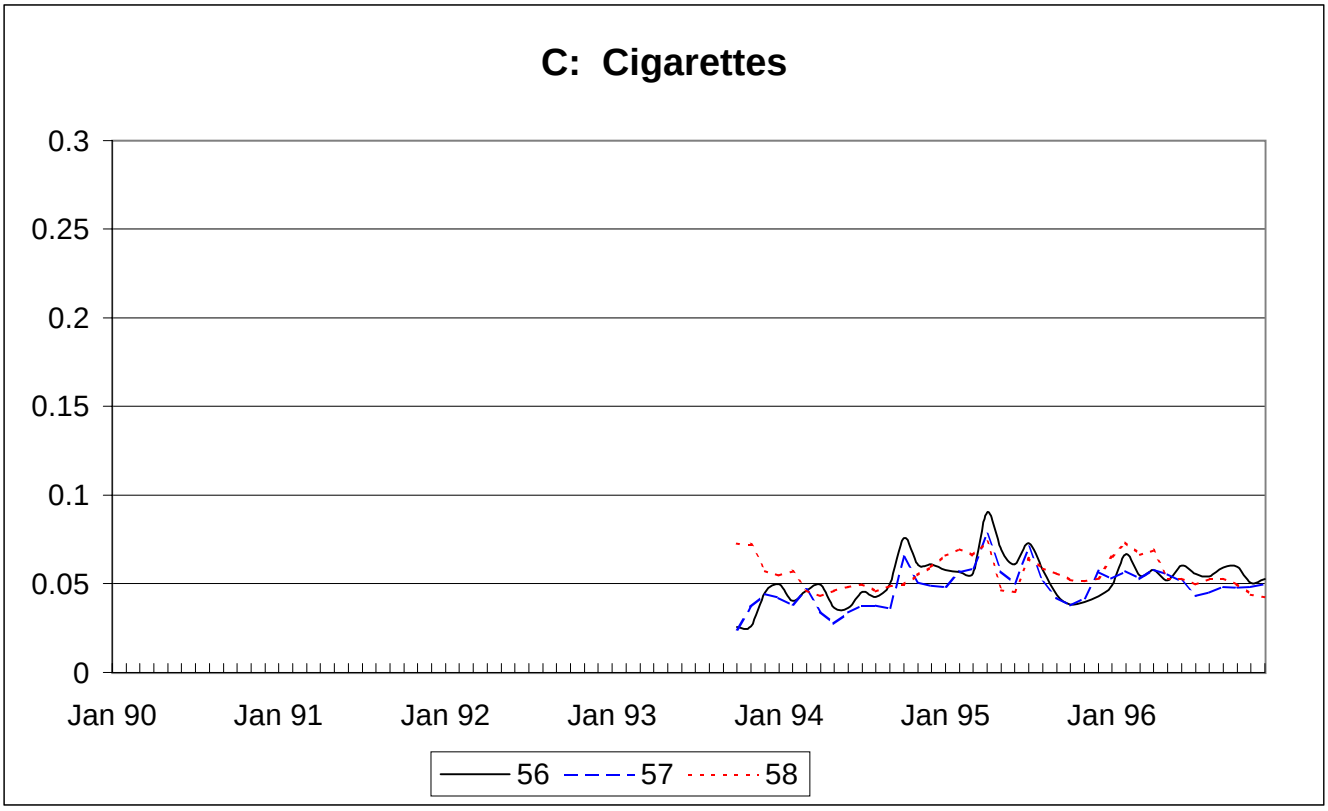
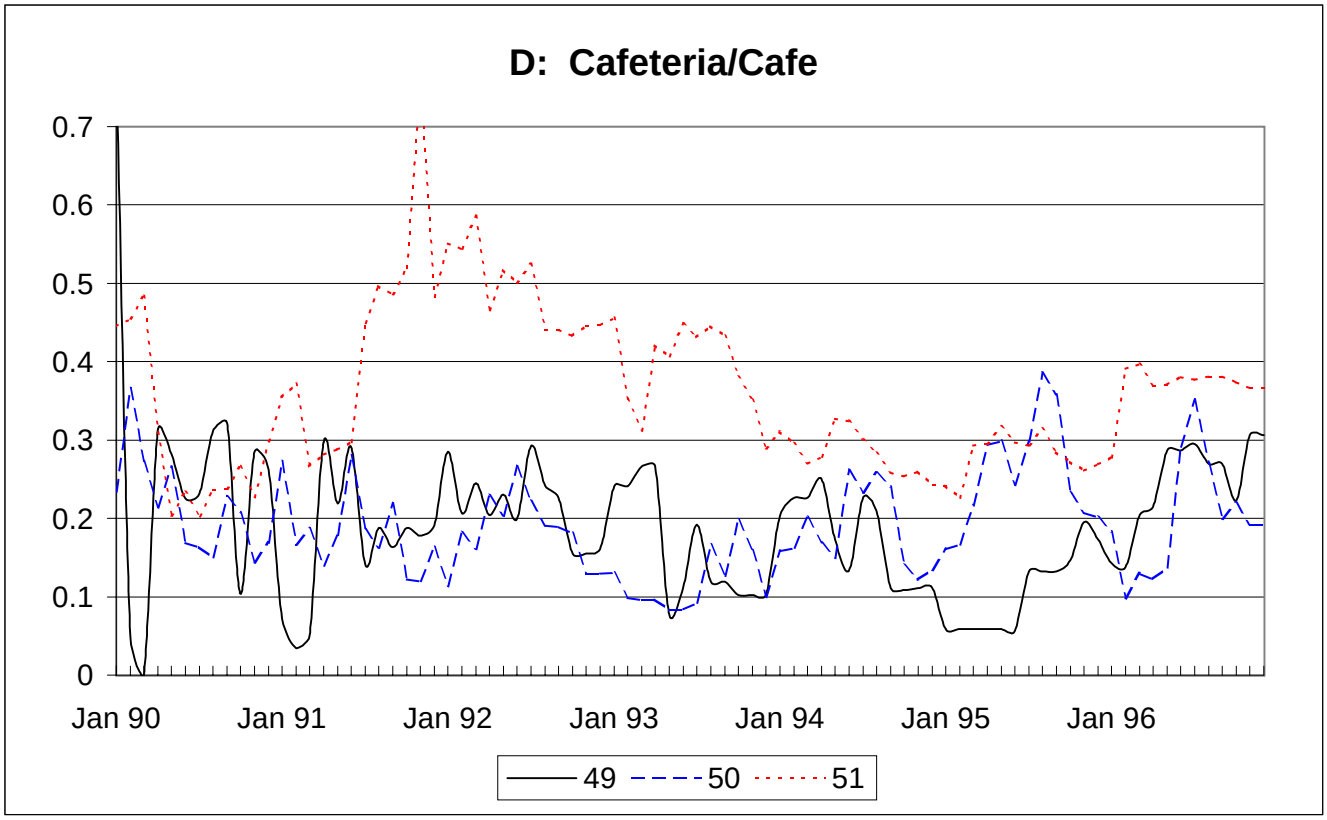


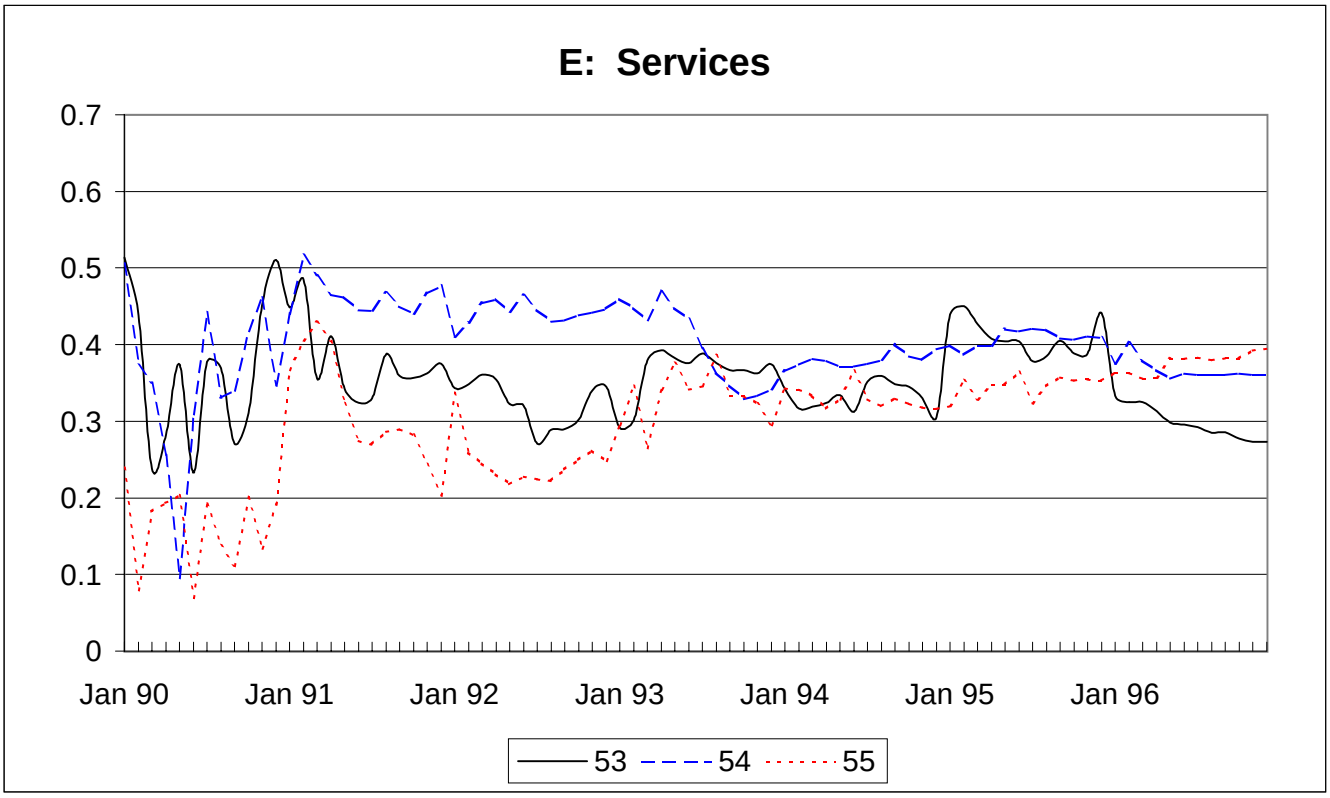
Figure 2 - Intramarket price dispersion






C: Cigarettes
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan 90
Jan 91
Jan 92
Jan 93
Jan 94
Jan 95
Jan 96
56
57
58


D: Cafeteria/Cafe
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan 90
Jan 91
Jan 92
Jan 93
Jan 94
Jan 95
Jan 96
49
50
51


E: Services
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan 90
Jan 91
Jan 92
Jan 93
Jan 94
Jan 95
Jan 96
53
54
55

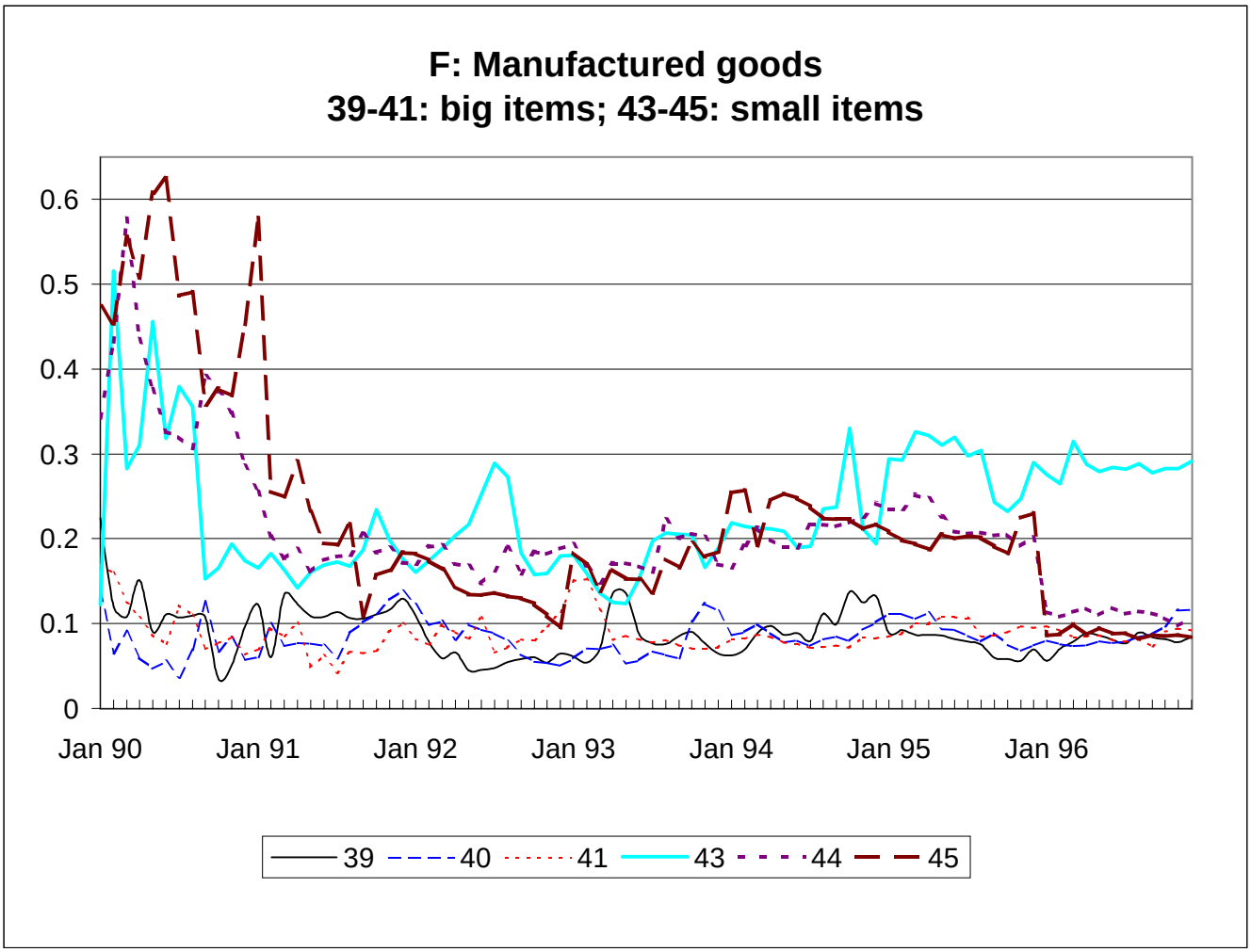
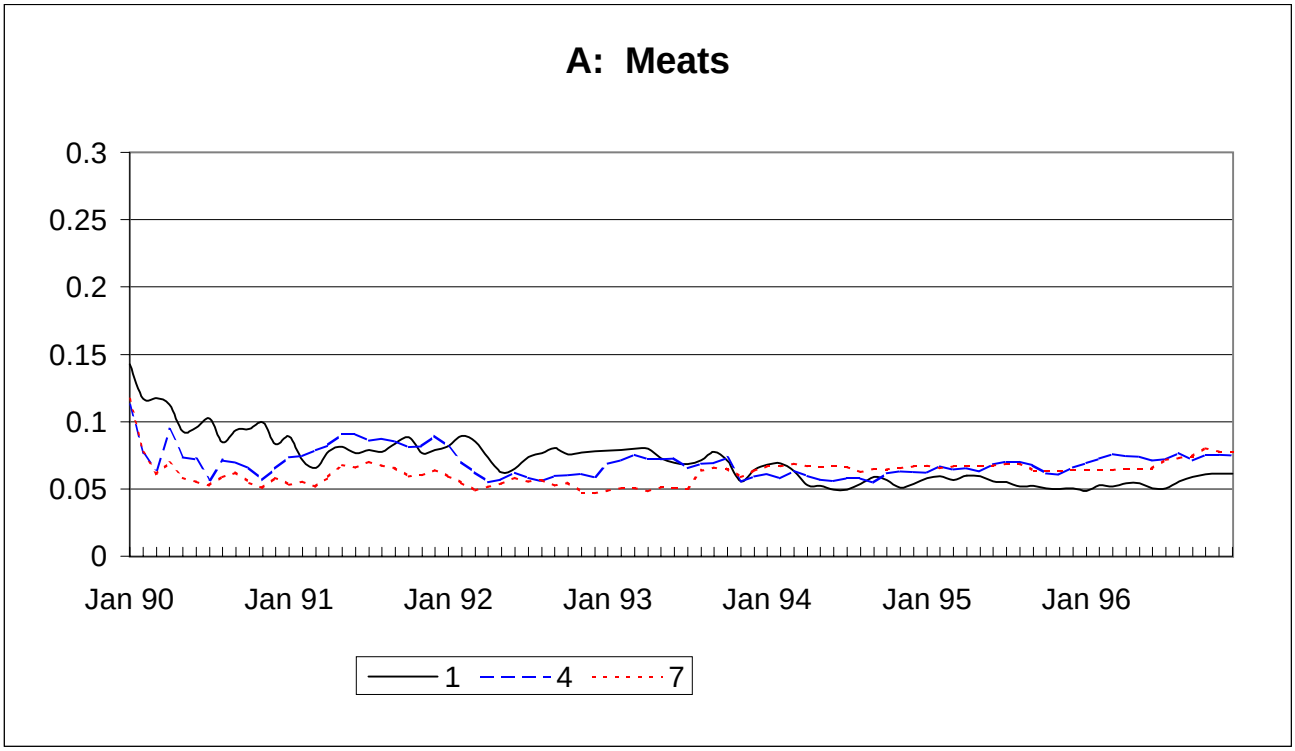
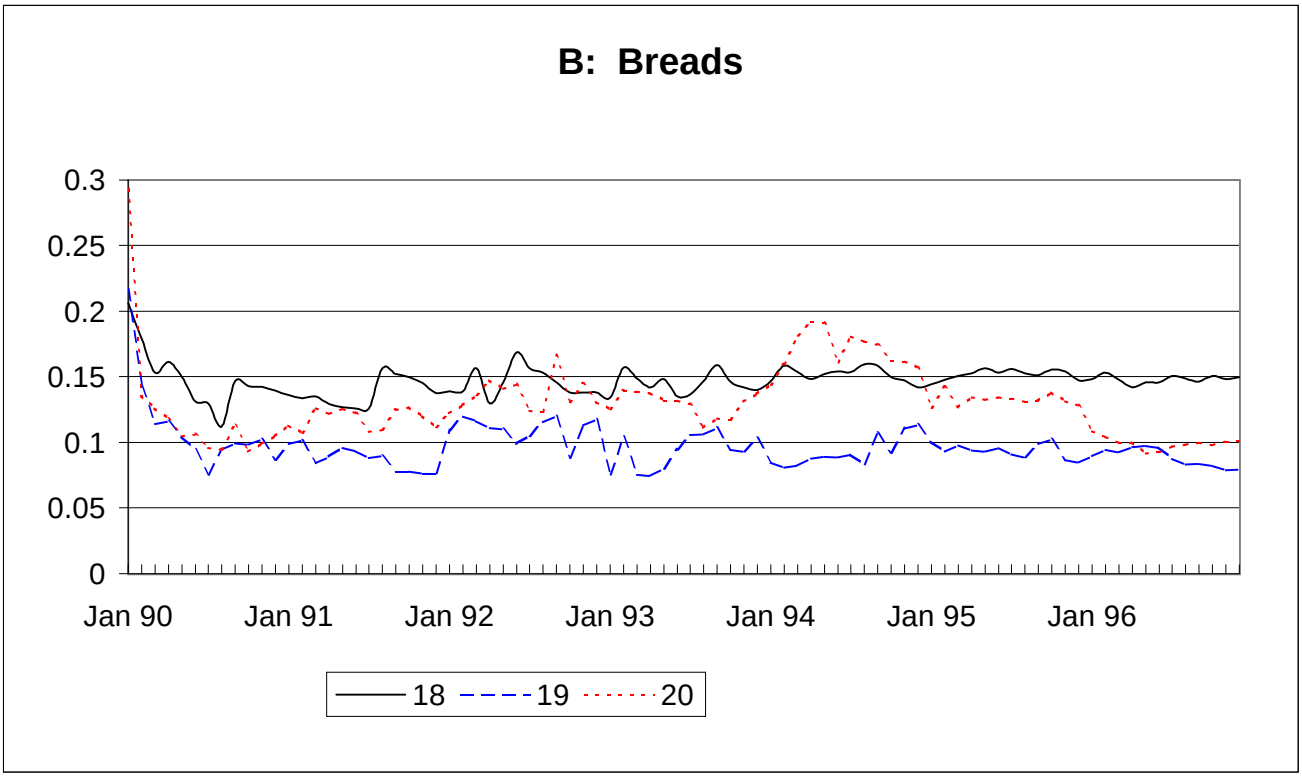
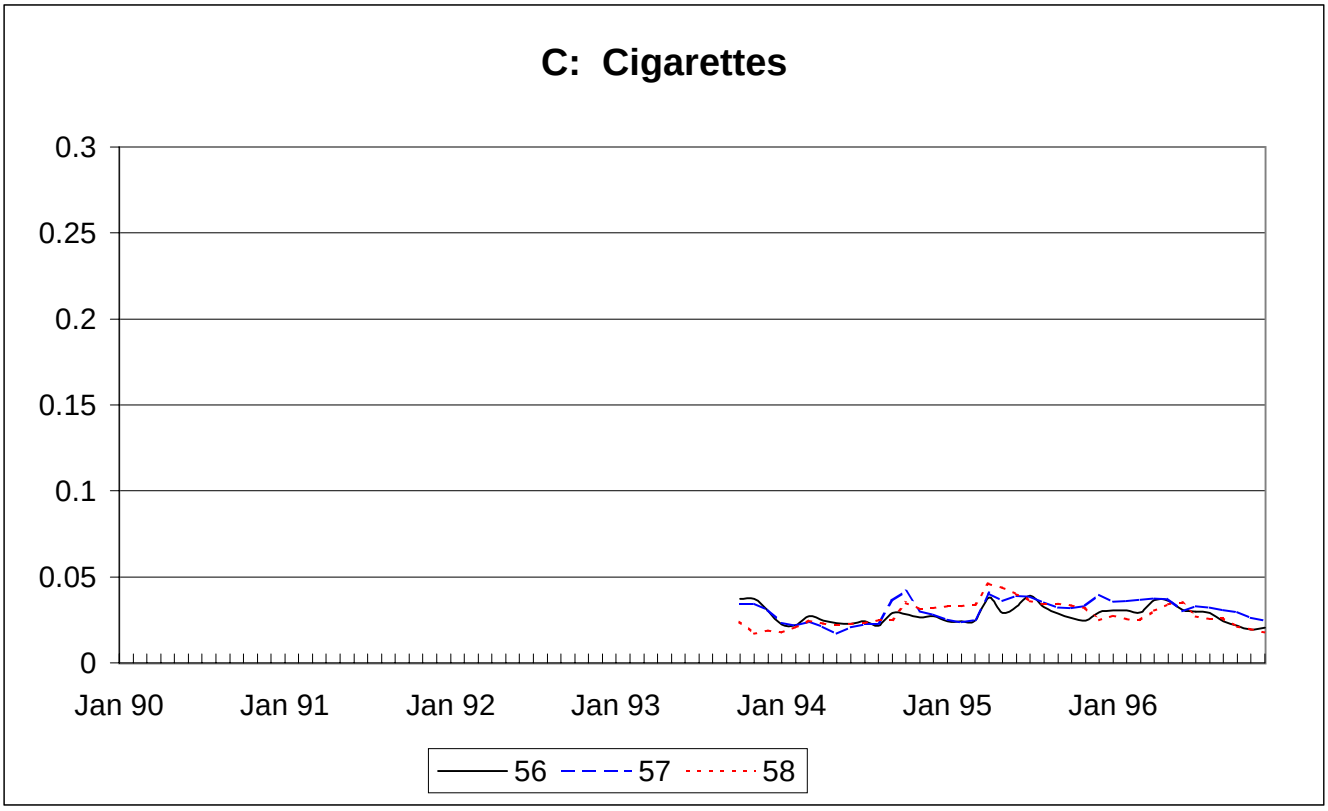
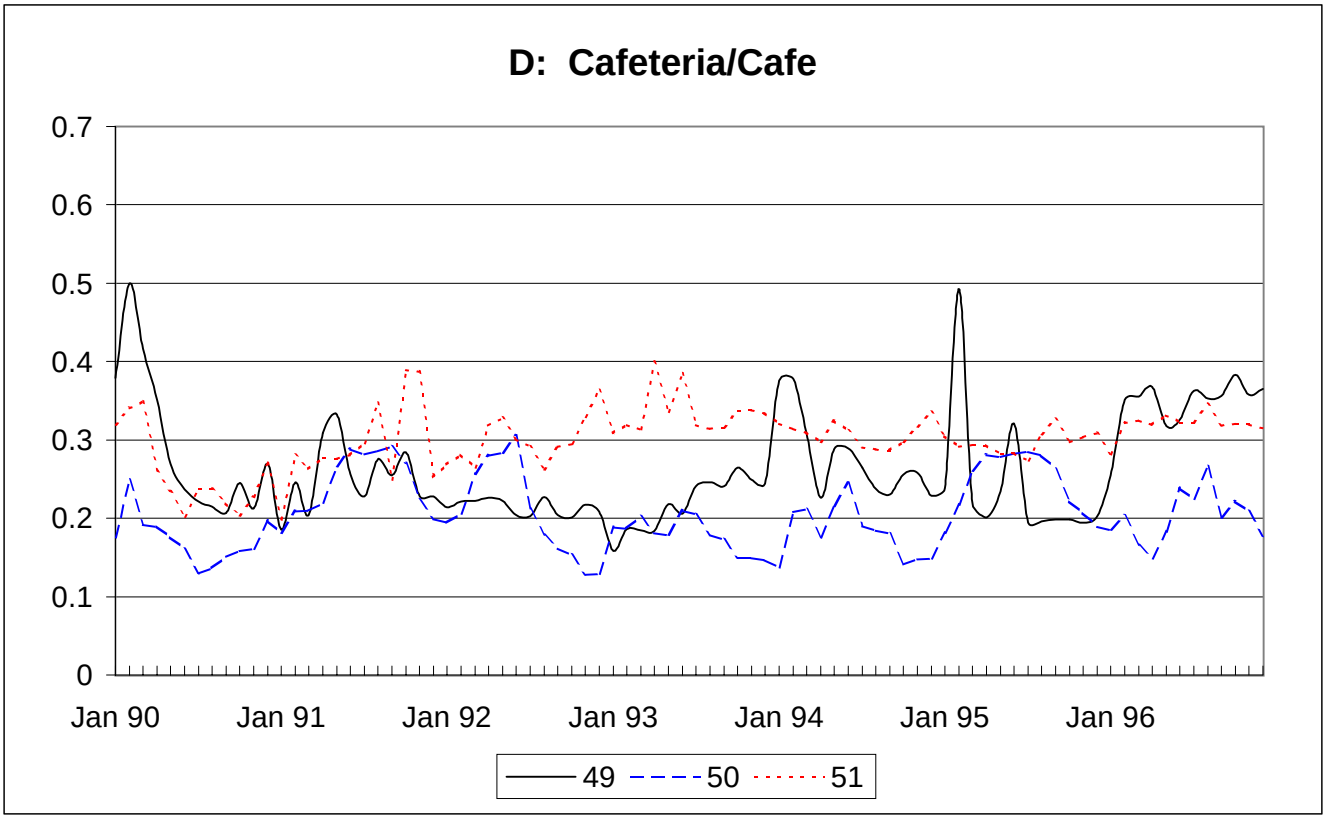

F: Manufactured goods
39-41: big items; 43-45: small items
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan 90
Jan 91
Jan 92
Jan 93
Jan 94
Jan 95
Jan 96
39
40
41
43
44
45

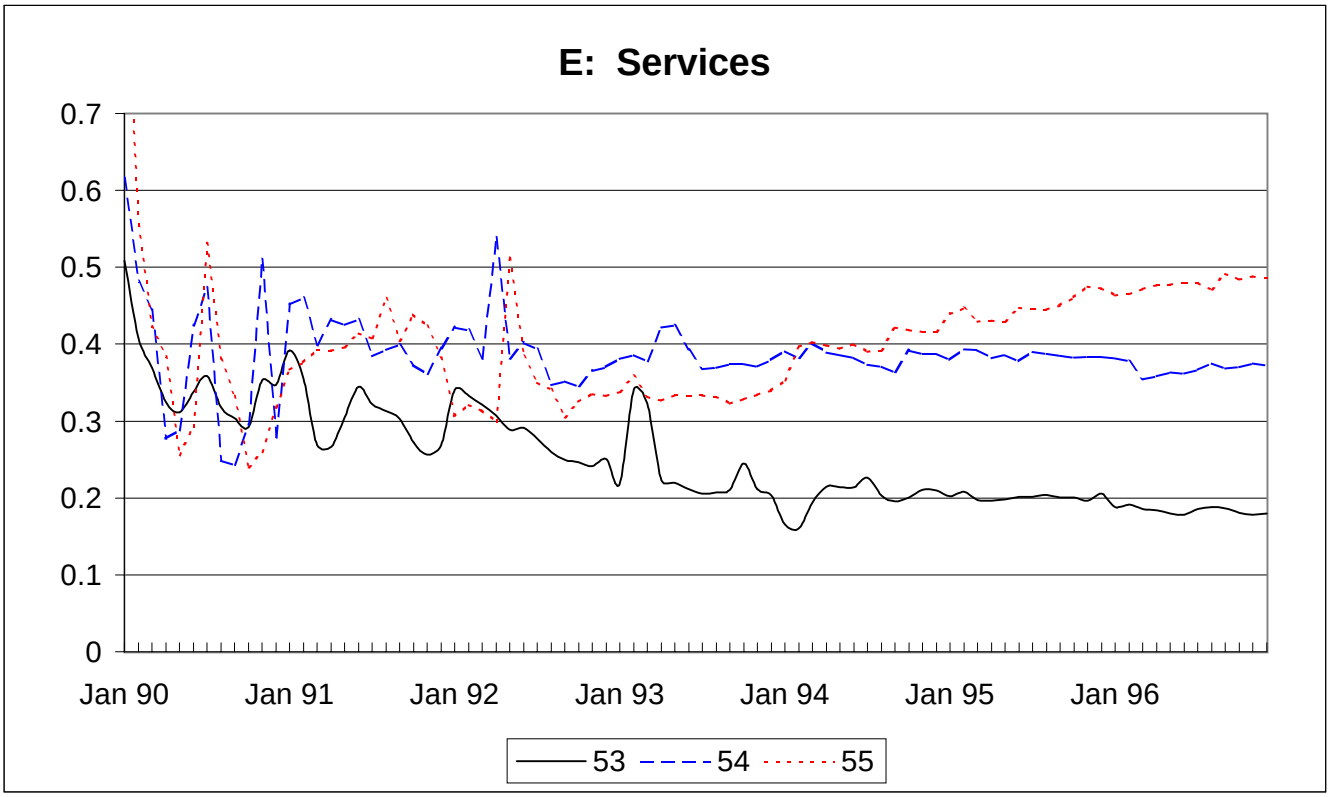
Figure 3 - Intermarket price dispersion






C: Cigarettes
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan 90
Jan 91
Jan 92
Jan 93
Jan 94
Jan 95
Jan 96
56
57
58


D: Cafeteria/Cafe
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan 90
Jan 91
Jan 92
Jan 93
Jan 94
Jan 95
Jan 96
49
50
51


E: Services
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan 90
Jan 91
Jan 92
Jan 93
Jan 94
Jan 95
Jan 96
53
54
55

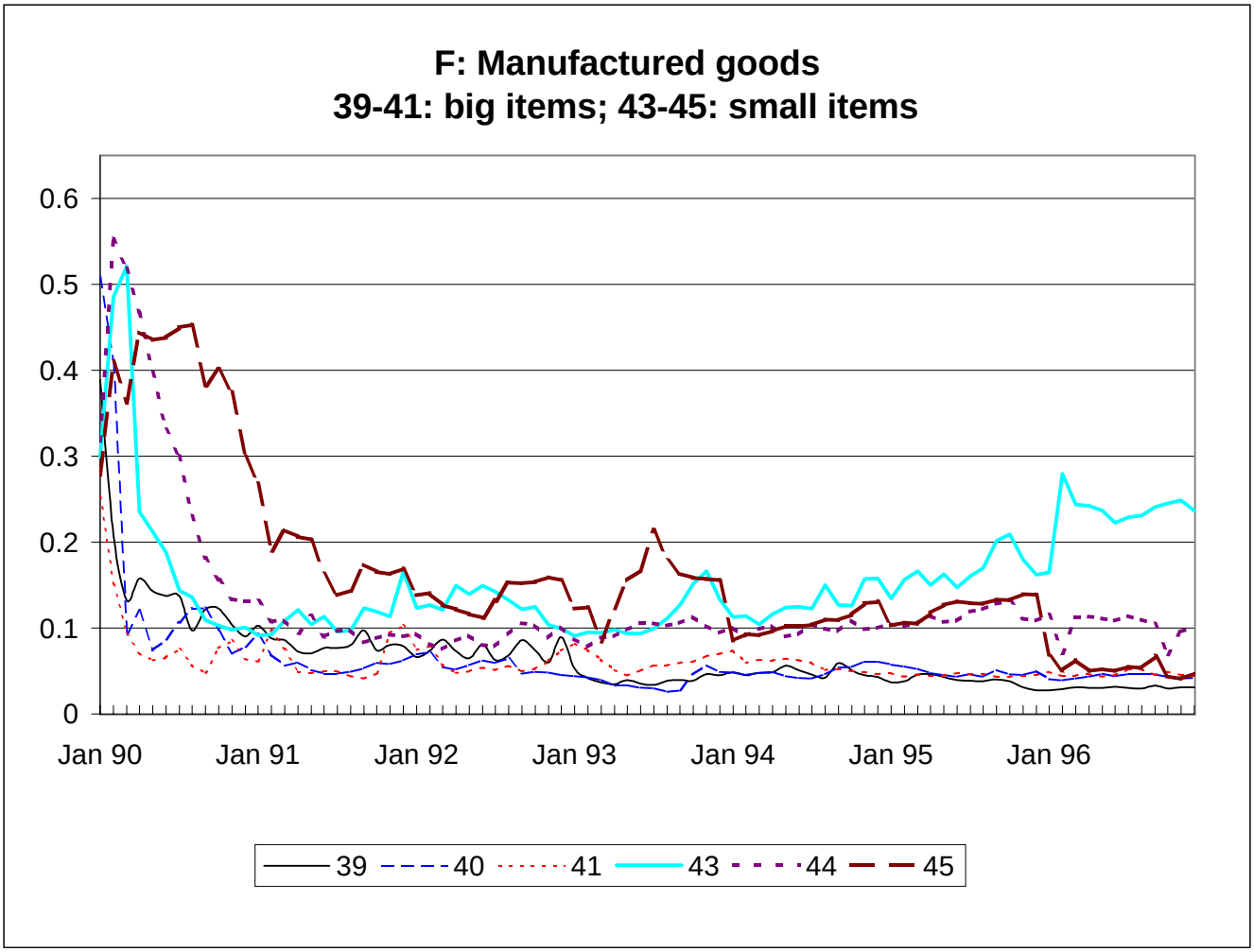

F: Manufactured goods
39-41: big items; 43-45: small items
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan 90
Jan 91
Jan 92
Jan 93
Jan 94
Jan 95
Jan 96
39
40
41
43
44
45

Figure 4

Each line shows the percentage of observations which are at least the given amount away from the average price.
Data for below-average prices are shown as negative for clarity.

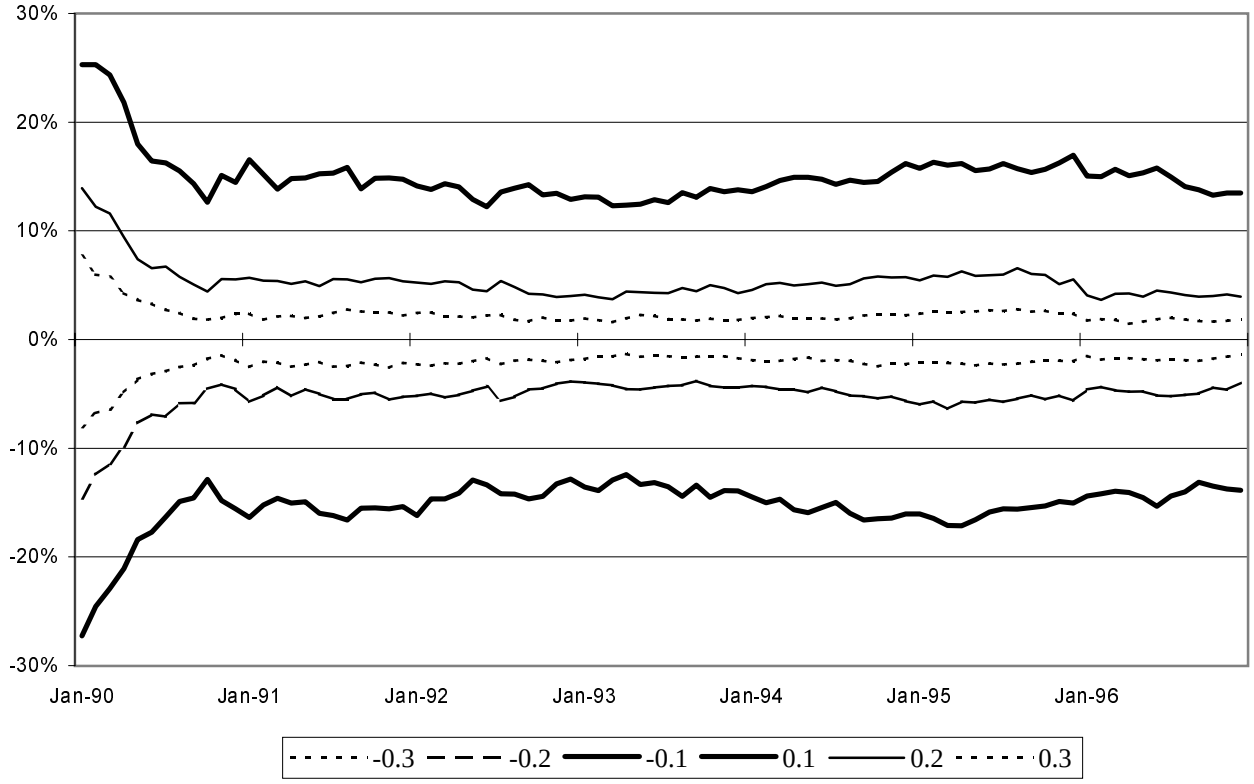


Figure 5

Price distributions

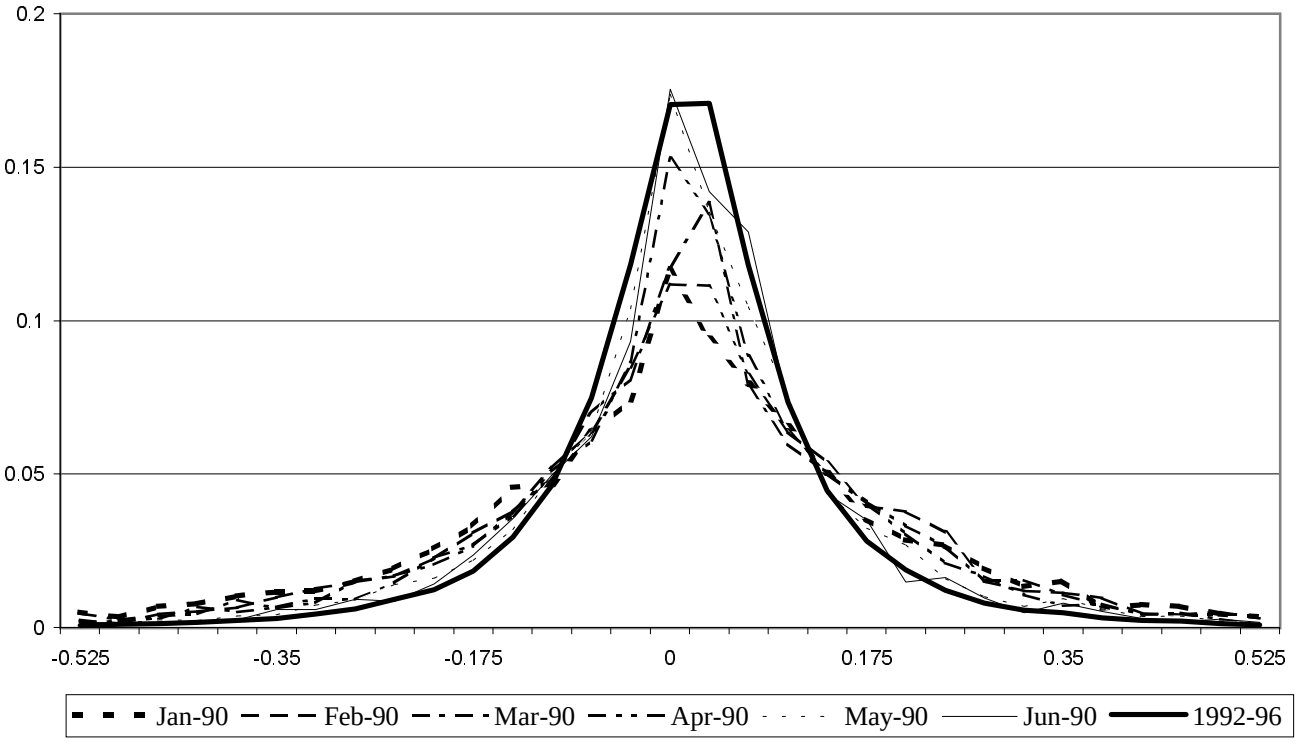


Figure 6

Months to end of transition period

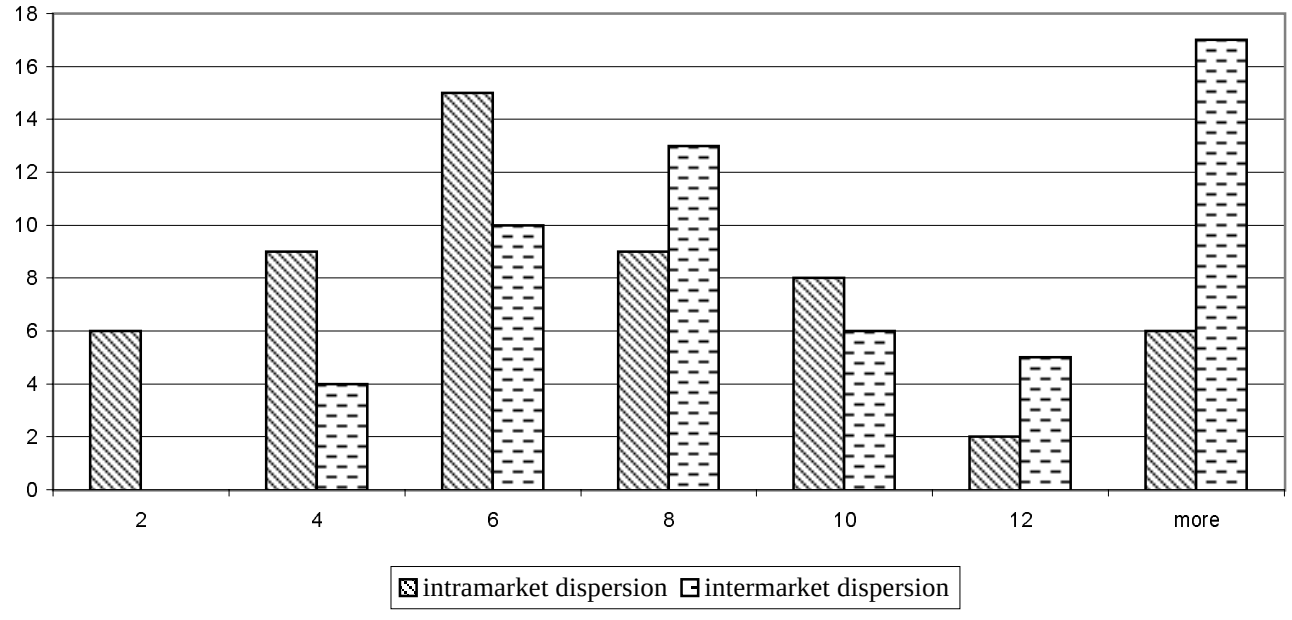


Figure 7

CPI inflation and Inflation Variability

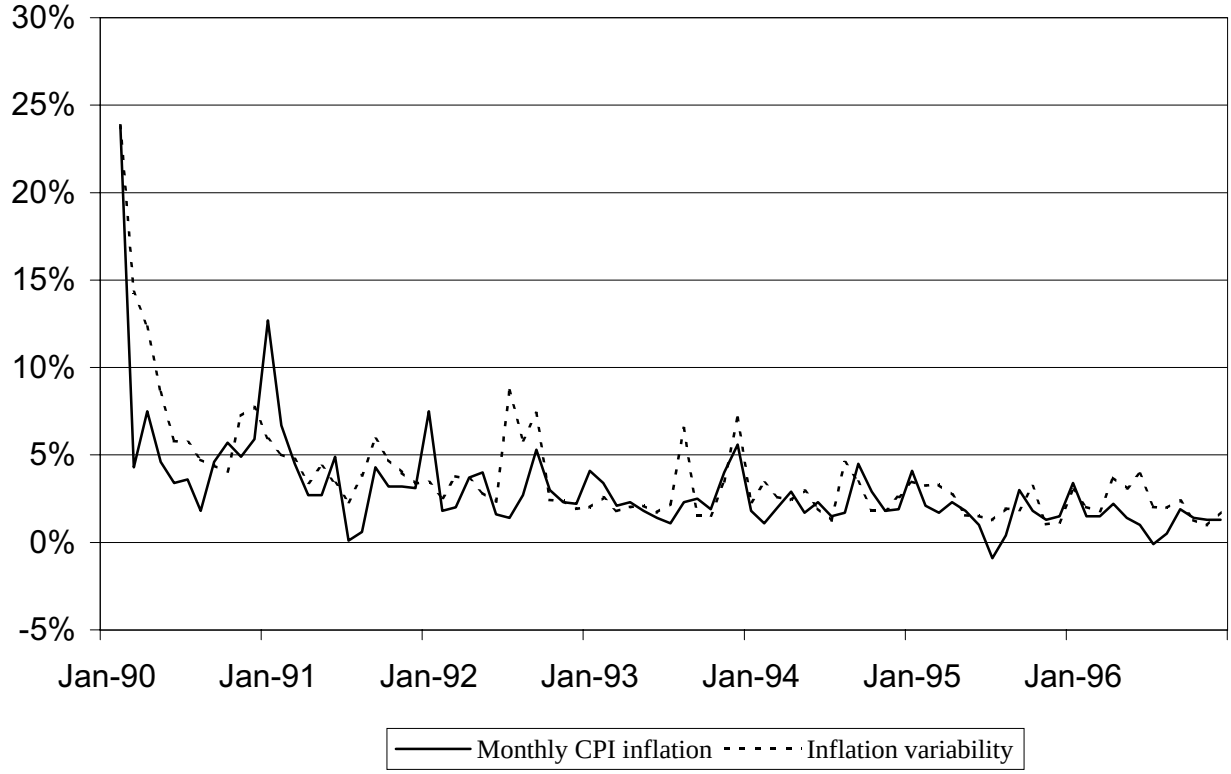


Figure 8

Average Intra- and Intermarket Price Dispersion Controlled for Inflation, Inflation Variability, Seasonal Effects and Differences in Levels Across Goods.

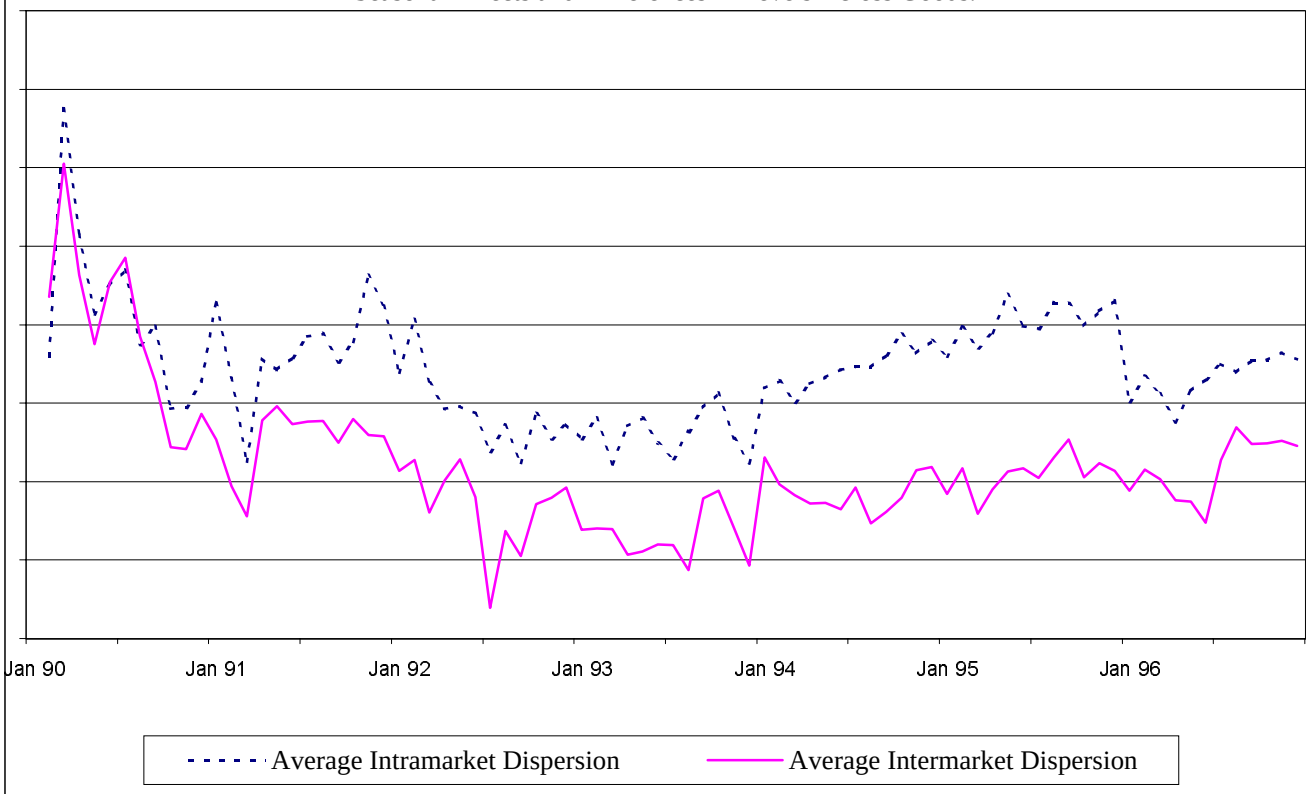


Figure 9a

Behaviour of the ratio of CV intramarket to CV intermarket

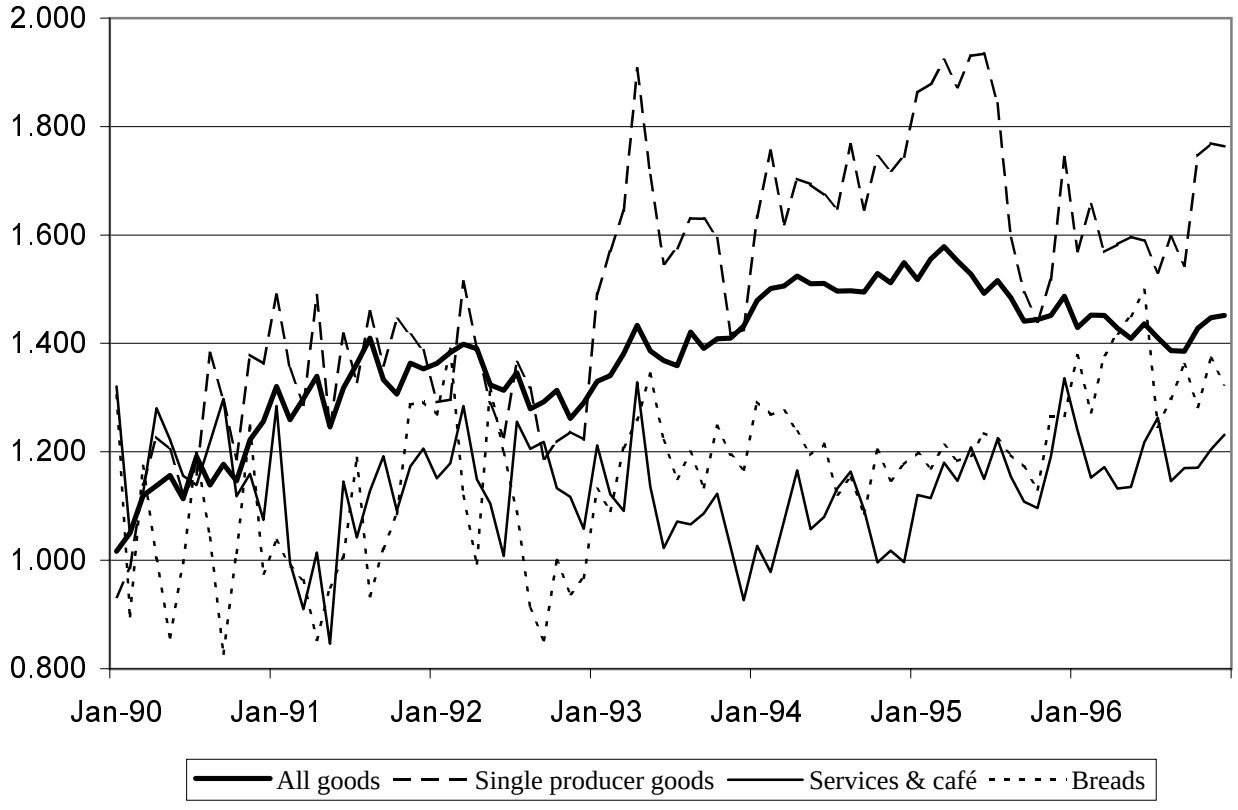


Figure 9b

Behaviour of the ratio of CV intramarket to CV intermarket