Price Rigidity in German Manufacturing

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Preliminary and incomplete!

Abstract

Price setting in German manufacturing is analysed using a monthly panel of individual price data for more than 2 500 products groups that covers the period from 1980 to 2001. The mean duration of price spells turns out to be shorter for intermediate goods (2 quarters) than for investment goods (3 quarters) and consumer goods (3-4 quarters). The pattern of price increases and price decreases varies across industries. Regarding investment goods there is a clear asymmetry between price increases and price decreases. For investment goods an atheoretical Cox-duration model is estimated. Price increases can be explained by a combination of state-dependence and time-dependence. Time-dependence comes in by seasonal effects and by a bathtube shaped duration dependence that is independent of other factors. Whereas a price increase comes unexpected to firms in less than 20 percent, price reductions are unexpected in more than 40 percent of all cases. Prices of investment goods react stronger to demand decreases than to demand increases. Demand expectations can partly be explained by backward-looking behaviour.

JEL classification: D43, E31, L11

Keywords: price rigidity, duration analysis, business survey data

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Price Rigidity in German Manufacturing *)

I. Introduction

Price rigidity lies at the heart of the microfoundations of modern macro economic inflation models. Nevertheless there are only few empirical studies on that issue based on microdata and even fewer regarding European countries. One reason is the lack of databases containing both data on prices and on explanatory variables. This paper uses a monthly panel of individual data on price changes, demand changes, capacity utilisation and other variables for West-German Manufacturing that covers the period from 1980 to 2001.

With this dataset at hand it is possible to investigate several aspects of price setting at the individual level eg. time dependent and state dependent price setting. In particular, it allows to investigate a suggestion by Ball and Romer (1991) on how to reduce price stickiness. According to them sticky prices may arise from a failure to coordinate price changes. Firms want to increase their prices but they are afraid that their competitors do not follow and that they will loose market share. Ball and Romer argue that their result "suggests a role for government regulation of price-setting, such as restrictions on the lengths of labor contracts.[...] Instead of prohibiting certain contract provisions, the government could simply convene meetings of business leaders to coordinate adjustment (as some European governments appear to do.)". Blinder's survey on sticky prices (1998) corroberates the importance of coordination failure. There manufacturing firms rank coordination failure second as explanation for sticky prices.

The fact, that in Germany there is a single collectively negotiated wage contract for all producer of investment goods allows to shed some light on the impact of this potential coordination mechanism on the synchronisation of price increases. Moreover, the length of the wage contracts and price spells can be compared. If the impact of wages were overwhelming there should be long yet no staggered price spells. But if all price changes are synchronised the maximum lag of the aggregate response to shocks would be the length of the wage contract. This raises the question of staggering or synchronisation in general, beyond wage contracts.

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An approach that is capable of dealing with all types of price staggering was proposed by Dotsey, King and Wolman (1999). It allows the aggregation of state-dependent price setting that in other models proved difficult and covers time-dependent price setting as well. A crucial role in their model plays the hazard rate that makes it possible to analyse staggering and synchronisation in a multivariate context.

The paper is organised as follows. The next section discusses the data. Section 3 presents some simple patterns of price setting for different industries and time periods: the distribution of the duration of price spells, firm-specific average durations of price spells and the monthly frequency of price changes. Where possible, comparisons to other countries are made. Further, synchronisation ratios for disaggregated industries are calculated by a univariate approach. Section 4 takes a closer look at very short and very long spells, in particular whether they should be included in the further analyses or not. Sections 3 and 4 show that there is a lot of heterogeneity in the data. Therefore, in sections 5 and 6 analysis is restricted to investment goods or more precisely to the metal-working industries that are covered by one single collective wage agreement. Section 5 describes the related wage bargaining process. In section 6 an empirical hazard function is estimated. Section 7 concludes.

II. The Data

The analysis is based on monthly qualitative individual panel data covering the period from 1981 to 2000 from the Ifo business survey for manufacturing. The number of participants dropped from about 5 500 in 1980 (monthly average) to 2 500 in 2000. Firms are asked at plant level whether their price for their main product or product group is higher, lower or equal to the price in the preceding month. Further monthly questions concern changes in demand, production, orders, inventories of finished products and the "business sentiment". In addition there are monthly questions on expectations for the next three months on production, prices and exports and for the next six months on the "business sentiment". Following other studies, eg. König and Seitz (1991) the expectations on business sentiment are taken as proxy variable for expected demand. Additionally, there are quarterly quantitative questions on capacity utilisation, orders and inventories of finished products and once a year it is asked for information on innovation activity. There is no information on costs in the survey. Aggregated data has to be used instead.

Plants report for narrow product groups (eg ”sawn pine”, PRODCOM[1] classification 2010 10 350) but Ifo provides only four digit NACE Rev.1 classification. Industries not covered by the survey are NACE 221 “Publishing” that belonged to the service sector before the introduction of the NACE in Germany and NACE 273 “Other first processing of iron and steel” due to nonresponse. In terms of PPI-weights 94 percent of manufacturing is covered by the survey but half of “Publishing, printing and reproduction of recorded media” and “Manufacture of basic metals” is missing (see Table 1.) Manufacturing itself covers 83 percent of PPI.

Some qualifications to the degree of disaggregation have to be made that limits the analysis of durations in some industries. For reasons of secrecy Ifo sometimes provides only the three digit code. In other cases, especially in the chemical industry, some firms refuse answers for detailed product groups and report only a kind of index, eg. “compared to last month prices have increased for 30 percent of total sales”. In these cases Ifo does not record the figure 30 percent but creates two artificial questionnaires with the same identifier, one with a price increase and a weight of .3 and a second with no price change and a weight of .7. These questionnaires can still be used if data has to be aggregated but they have to be disregarded in other cases.

The sample is not random but by purpose. Big plants are overrepresented. The send out of the questionnaires takes place between the 15th and 20th each month, the deadline is the 5th or 6th the following month but a significant part of the questionnaires is send back till 10th of the following month (Ifo, 1989). Tables A5 to A6 in the appendix provide some information on the length of participation.

III. Patterns of price changes

The main aim of this chapter is to present some patterns of price setting and to investigate whether there are differences between industries and between the periods of 1981 to 1990 and 1991 to 2000. Since more than half of the price spells are censored (see Table A7 in the appendix) unconditional analysis is performed by using frequencies of price changes whenever possible (see Bils and Klenow 2002). This is also the only way to deal with the „artificial“ questionnaires mentioned in the previous section. The frequency approach is not without problems either, foremost in the case of non randomly missing values. Fortunately, the business survey provides questions, as whether a price change is expected within the next three months,

[1] For classifications visit Eurostat’s classification server http://europa.eu.int/comm/eurostat/ramon/

that allow in some cases to estimate the missing values. The comparison of the actual, fitted and imputed share of price changes for different industries shows a small bias but the direction of the bias depends on the industry and the direction of the price change and it has only negligible influence on the aggregate figures.

III.1 Average price durations

The weighted mean duration of a price spell has been calculated as the weighted inverse of the share of price changes within a given period and NACE 4-digit industries (s. formula A1 in the appendix). The weights are those of the PPI for the base year 1995, they are pan-German.

Table 1: Mean duration of price and demand spells (in months) during the eighties and the nineties by industry.

Period	1981 to 1990 West-Germany		1991 to 2000 Germany		Weights 1995	
	price	demand	price	demand	smpl.	pop.
whole PPI						1000
Industry					778.5	829.8
15 Food and beverages	9.1	2.9	10.0	3.0	122.6	122.7
16 Tobacco	-	-	-	-	16.6	16.6
17 Textiles	8.8	2.5	10.0	2.4	13.3	13.8
18 Wearing apparel	9.4	2.5	8.1	2.3	10.6	11.4
19 Leather and leather products	10.5	2.5	13.7	2.4	4.0	4.0
20 Wood and wood products	5.1	2.4	4.5	2.5	19.2	19.2
21 Pulp, paper and paper products	4.4	2.6	3.4	2.5	24.2	24.2
22 Printing	7.3	2.9	6.3	2.8	*20.5*	43.1
23 Refined petroleum products	-	-	-	-	37.3	37.3
24 Chemicals	7.0	3.4	6.6	2.9	69.5	69.5
25 Rubber and plastic products	5.8	2.6	5.5	2.6	41.8	41.8
26 Other non-metallic mineral products	6.6	2.4	6.1	2.6	39.5	40.2
27 Basic metals	3.7	2.6	3.6	2.4	*19.9*	44.9
28 Fabricated metal products	7.0	2.6	6.5	2.7	58.0	58.4
29 Machinery	9.2	2.7	10.0	2.6	79.5	80.6
30 Office machinery	-	-	-	-	9.4	9.4
31 Electrical machinery	8.7	2.6	7.5	2.7	43.4	43.4
32 Radio, tv, communication eq. and appar.	9.7	2.4	6.7	2.7	17.3	17.3
33 Precision instruments	10.0	2.4	12.3	2.3	17.2	17.1
34 Motor vehicles	8.6	3.0	9.6	2.4	81.1	81.1
35 Other transport equipment	-	-	-	-	4.2	4.4
36 Furniture, toys, jewellery	9.2	2.2	10.7	2.1	29.6	29.6

A distinction between East and West-German plants is made in an additional weighting step using gross value added. The survey started in East-Germany in 1991 with a lot of drop outs until 1995. During this early period much more price reductions occurred in the East rather than in the West but the contribution of East-German production to the pan-German PPI is negligible. The weighted mean duration in manufacturing is 8 months, the weighted 25% percentile is 5 months and the weighted 75% percentile 10 months. Differences within industries are larger than between industries. Section 6 will investigate these differences for products belonging to Nace 29 to Nace 35 in more detail.

Table 2: Mean duration of price and demand spells (in months) during the eighties and the nineties by type of good

Period	1981 to 1990 West-Germany		1991 to 2000 Germany		Weights 1995	
	price	demand	price	demand	smpl.	pop.
Type of good						
intermediate goods	6.1		5.3		296	
investment goods	8.7		9.1		215	
durable consumer goods	9.6		11.6		43	
non-durable consumer goods	9.6		10.7		187	
Means and quartiles						
Weighted mean	7.7	2.8	7.9	2.8		
Weighted 25%-quantile	5.3		4.4			
Weighted median	7.7		7.1			
Weighted 75%-quantile	9.7		9.6			

Rem: 1. The weighted mean duration is calculated as the weighted inverse of the frequency of price changes (s. formula (A1) in the appendix).
2. All goods (tobacco, refined petroleum products, ...) are included in the overall figures.
3. The definition of type of good as used in the analysis deviates from the definition underlying the PPI in Germany at that time but it is comparable to other EU-countries.

The mean duration of price spells is shorter for intermediate goods (2 quarters) than for investment goods (3 quarters) and consumer goods (3-4 quarters). On average, durations during the nineties are not different from those of the eighties. This is confirmed by looking at the weighted frequencies of machinery and chemicals including petroleum refinement over a longer time horizon which is possible since the definition of these two sectors did change only slightly since the sixties. Only the seventies with the oil price shocks show a higher frequency of price changes.

Table 3. Frequency of price changes for machinery and chemicals since the sixties.

decade	Chemicals and refined petroleum products		Machinery	
	Frequency	Standard error	Frequency	Standard error
1961-1970	23.4	14.7	10.6	7.7
1971-1980	29.9	16.3	11.2	8.2
1981-1990	24.1	10.5	10.9	6.6
1991-2000	25.4	9.0	10.5	4.7

Rem: Differences between Table 1 and 2 should be attributed mainly to a more elaborate weighting scheem used by ifo that uses actual weights based on the number of employees.

Quite volatile prices (less than 4 months) are found for simple, basic products and food that cannot be preserved well:

- "Manufacture of basic precious and non-ferrous metals" (Nace 274),
- "Manufacture of dairy products" (NACE 155),
- "Manufacture of grain mill products, starches and starch products" (NACE 156),
- "Preparation and spinning of textile fibres" (NACE 171),
- "Tanning and dressing of leather" (NACE 191),
- "Manufacture of pulp, paper and paper board" (NACE 211),
- "Sawmilling and planing of wood; impregnation of wood" (NACE 201) and
- "Manufacture of veneer sheets, plywood, laminboard, particle board, fibre board and other panels and boards" (NACE 202).

All products with a high degree of nominal price rigidity (5 quarters and more) are consumer goods, non-durables (CN) and durables (CD):

- "Manufacture of knitted and crocheted articles" (NACE 177; CN),
- "Manufacture of other food products" (NACE 158; CN),
- "Manufacture of beverages" (NACE 159; CN),
- "Manufacture of footwear" (NACE 193; CN),
- "Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations" (NACE 245; CN) and
- "Manufacture of optical instruments and photographic equipment" (NACE 334; CD).

Demand changes much more frequently than prices. That is already an indication of price stickiness. Surprisingly, the frequency of demand changes does not vary across industries. But the reported demand "spells" deserve some comments. Dealing with business survey data one assumes that demand changes continuously and that demand changes are reported only when some threshold is crossed. Therefore reported demand changes should be interpreted as economically significant changes. On the other hand, in face-to-face interviews conducted by the author one manufacturer of special purpose machinery reported that he sells per year on average three of its machines within Germany and another manufacturer reported that he normally sells one machine every month within Germany but last year he sold only one.

Table A2 in the appendix provides means and medians for three-digit NACE industries. To allow comparison with Bils and Klenow the formulas (A2) and (A3) in the appendix have been used. They differ from the one used in Table 3. Durations calculated by the Bils and Klenow method are approximately half a month shorter.

III.1.1 Comparison with data for other countries

At this point a comparison of the Ifo data and the Stigler-Kindahl data presented by Carlton (1986) in his Table 1 may be worthwhile. That is the only published data on producer prices known to the author. The Stigler-Kindahl data cover the period between January 1957 to December 1966. For some observations he had only quarterly data available. If he observes a price change within a quarter, he assumes that at least one additional price change has taken place during the two missing months. Thus, there is a tendency for his data to show less nominal rigidity compared to the Ifo data.

Durations in Germany between 1981 and 1990 are roughly two months shorter than in the United States between 1957 and 1966. The average duration of about half a year for refined petroleum products seems implausible. The large increase in the level and volatility of energy costs since the oil crises in the 1970s and the switch from fixed to flexible exchange rates may be the reasons for less rigidity in the prices of refined petroleum products, rubber tyres, paper and chemicals. On the other hand this effect does not show up in the longer German series of Table 2. There seems to be a real difference in the case of household appliances. In the United States between 1957 and 1966 price changes had taken place every quarter on average whereas in Germany between 1980 and 1989 prices were kept constant for one year. Overall, one gets the impression that the differences between the United States and Germany are not large and that the differences between the Stigler-Kindahl data and the Ifo data are caused by

different time periods or, to be more specific, by different energy prices. Bretton-Woods may have had an influence, too.

Table 4. Duration of price spells in Germany and the United States (in months)

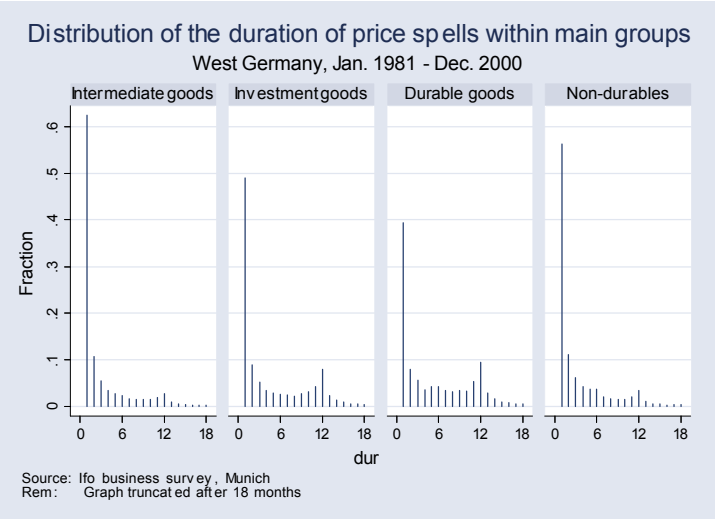
Product group	United States (Carlton)		Germany (Ifo)	
	Mean Duration of Transactions	Mean Duration of Price Spells	Median Duration of Price Spells	Mean Duration of Price Spells
Steel	17.9	13.0	-	-
Nonferrous Metals	7.5	4.3	2.0	2.7
Refined Petroleum Prod	8.3	5.9	-	-
Rubber Tires	11.5	8.1	6.0	6.7
Paper	11.8	8.7	4.1	5.7
Chemicals	19.2	12.8	7.3	10.2
Cement	17.2	13.2	7.7	10.9
Glass	13.3	10.2	6.0	8.5
Truck Motors	8.3	5.4	-	-
Plywood	7.5	4.7	2.8	3.8
Household appliances	5.9	3.6	6.0	8.4

For New Zealand, for the period from 1984 to 1995, Carlson and Buckle find an average duration of prices for manufacturing and building firms of 6.7 months.

III.2 Distribution of the duration of price spells within industries

A look at the shape of the density of the durations of completed price spells shows a huge number of very short spells and small number of long spells. This picture is a biased since short spells are overrepresented due to unavoidable length based sampling. But this should have only negligible consequences for the shape of the density, e.g. the number of modes.

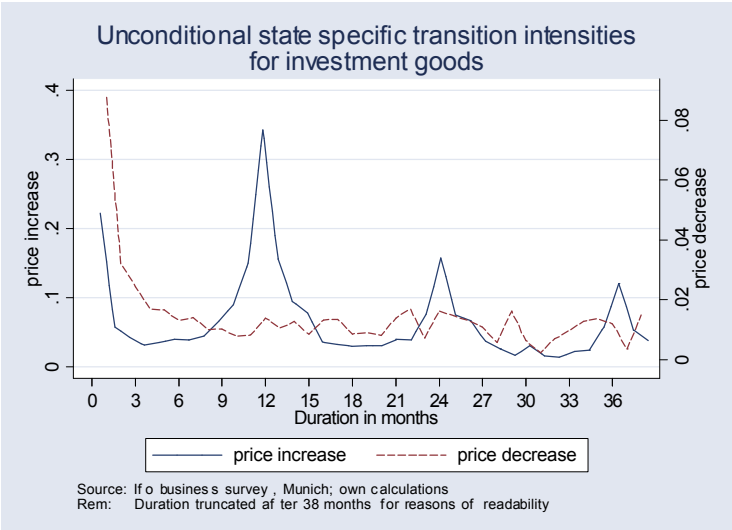
Graph 1.



The main mode is always one month. Basic and investment goods have a second mode at 12 months (and 24, 36 months) whereas consumer goods have a third mode at 6 months (and 18, 30 months). This is a first evidence against Calvo-Pricing since it implies a continuously decreasing shape with a single mode at one month.

The huge amount of short spells suggests to condition the probability that a price is changed after a certain period on the probability that is has not been changed before. This is the so called hazard function. In case of a distinction between price increases and price decreases it is called transition intensity (s. appendix, formulas A2 and A3). Graph 2 shows Kaplan-Meier estimates for these intensities for investment goods. Since the Kaplan-Meier estimator is able to handle right-censoring only left censored spells are ignored.

Graph 2.



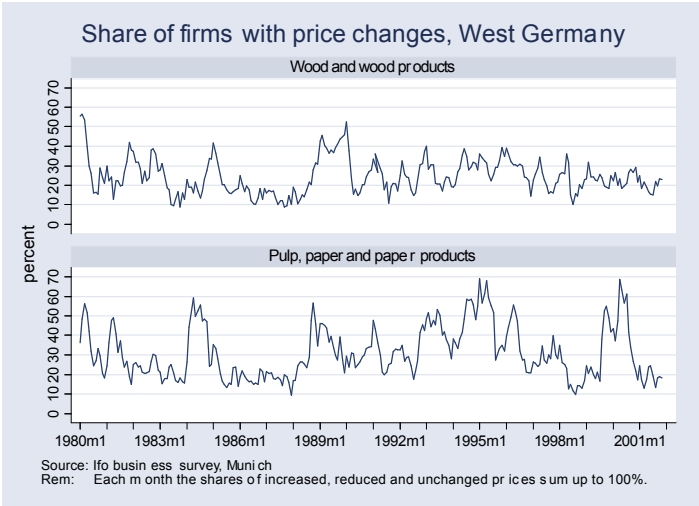
Out of all prices for investment goods that have not been changed for 12 months, 33% are increased during the 13th month and 1% are decreased. Duration dependence is more or less negligible for price decreases, they adjust immediately. It is not that severe for price increases either, but it shows a very systematic pattern. Section 6 tries to analyse both patterns of duration dependence in the framework of a multivariate duration model.

III.3 The time-series dimension of the frequency of price changes

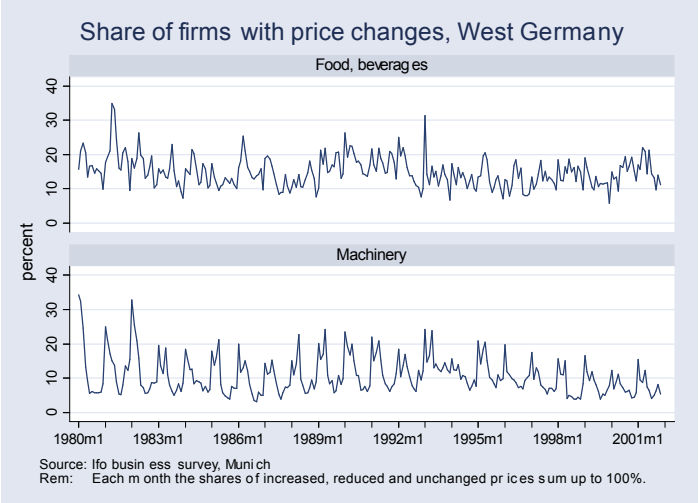
The previous findings on price setting are complemented by observing the frequencies of price changes in the time dimension. There are obvious differences between industries. Graphs 3 and

4 show examples of typical time-patterns for the time period from January 1980 to November 2001. For obvious reasons the pattern of Graph 3 shall be called ‘cyclical’, the pattern of ‘Machinery’ in Graph 4 - during the eighties - ‘seasonal’ and the pattern of ‘Food, beverages’ in Graph 4 ‘idiosyncratic’. (Further graphs, Graph A10 to Graph A15, can be found in the appendix.)

Graph 3.



Graph 4.

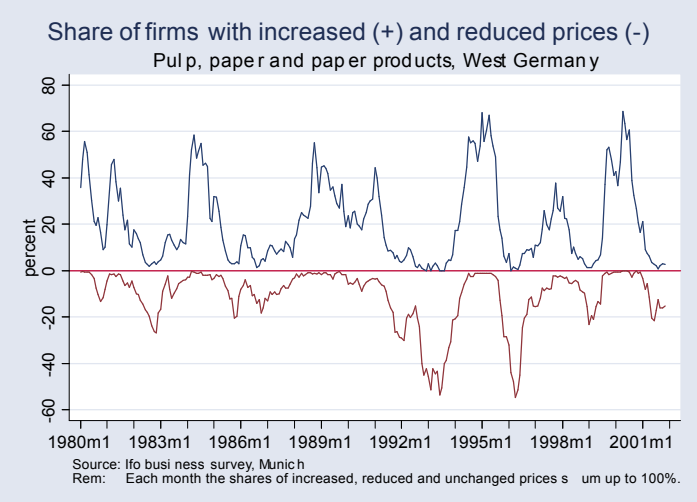


To classify three-digit-industries according to these three types of time-pattern cyclical, seasonal and firm specific effects for each industry were calculated by an analysis of variance, (ANOVA) with years and months taken as proxy variables for cyclical and seasonal effects (see Table A1 in the appendix). In most three-digit industries these effects explain less than 20% of the total variance. The seasonal effect dominates in the investment goods producing industries and in the durable consumer goods producing industries. The cyclical effect dominates in the

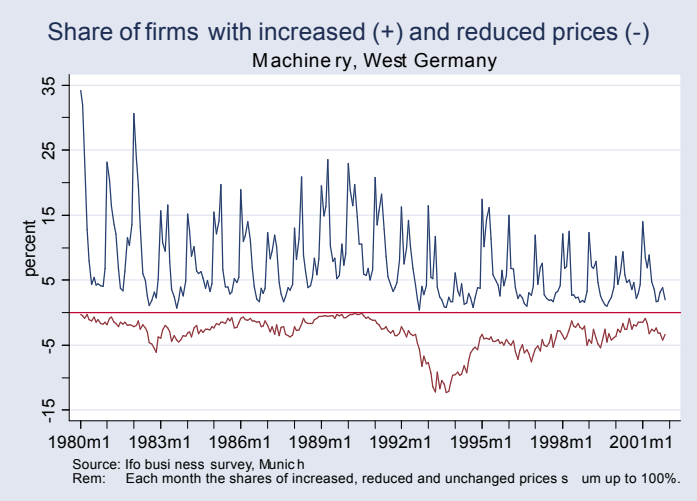
basic goods producing industries with wood as basic raw material: ”Manufacture of wood and wood products”, ”Manufacture of pulp, paper and paper products”, ”Printing and publishing” and, to a certain extent, in ”Manufacture of leather and leather products”. The individual effect dominates in ”Manufacture of food and beverages”, ”Manufacture of textiles and textile products”, ”Manufacture of chemicals and chemical products” and ”Manufacture of other non-metallic mineral products”.

Graphs 5 and 6 show strikingly different patterns of price increases and price reductions between industries. Whereas in ”Manufacture of pulp, paper and paper products” periods of price increases and price reductions alternate, with frequencies being of the same order, in the investment goods producing industries price increases and price reductions follow a different pattern. Price increases show a combination of a cyclical and a seasonal pattern whereas price reductions are only cyclical. During the 1980s there were almost no price reductions at all.

Graph 5.



Graph 6.



The huge increase in the share of price reductions during the recessions of the 1990s explains the varying pattern of price changes in 'Machinery' in Graph 6.

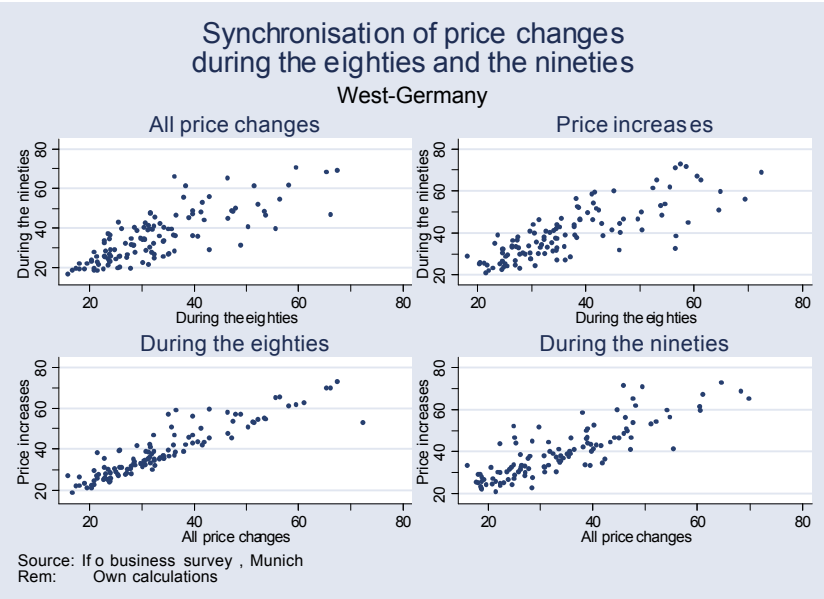
III.3.1 Synchronisation of price changes

The ANOVA already provides some information in staggering and synchronisation. If all prices changes took place during the same month the share of price changes would be 1 in that month and 0 in the remaining. On the other hand, if all price spells had the same length and were perfectly staggered, the share of price changes in every month would be the inverse of the duration of the price spell, there would be no between class variation and the standard deviation would be zero. Since the ANOVA revealed monthly, yearly and product group specific effects there can be no perfect staggering. And even if there is some kind of staggering, there are differences between product groups.

Fisher and Konieczny (2000) move the ANOVA on step further. They notice that in case of perfect synchronisation all variance should be attributed to the grand mean and none to the months. In case of perfect staggering all variance should be attributed to the months and none to the grand mean. Then they calculate the ratio of the standard deviation due to staggering to the standard deviation due to synchronisation. Accordingly, this synchronisation ratio is 0 in case of perfect staggering and 1 in case of perfect synchronisation (s. formula A4 in the appendix).

These synchronisation ratios were calculated for four-digit industries for all price changes and for price increases alone, since given Graph 7 at least in machinery price increases seem to be much more synchronised than price reductions.

Graph 7.



Synchronisation ratios vary between 15 and 70 percent with an average of 35 percent for all price changes and 40 percent for price increases. There is no clear tendency for higher or lower synchronisation during the eighties compared to the nineties, neither for all price changes nor for price increases alone.

Table 5. Synchronisation ratios for selected industries

Industry	All price changes	Price increases
high synchronisation ratio		
1751 Carpets and rugs	66	46
1910 Tanning and dyeing of leather	47	65
2111 Pulp	66	68
2511 Rubber tyres and tubes	58	61
2611 Flat glass	68	68
2622 Ceramic sanitary fixtures	60	70
low synchronisation ratio		
1721 Cotton type weaving	18	19
1822 Other outerwear	17	18
2220 Printing	22	18
2521 Plastic plates, sheets, tubes and profiles	16	16
2740 Manufacture of basic metals precious and nonferrous- metals	22	22
2922 Manufacture of lifting and handling equipment	22	21
2940 Machine tools	21	19
2954 Machinery for textile, apparel and leather production	24	24
2956 Special purpose machinery	18	22
3210 Electrical valves and tubes	19	19
3310 Medical and surgical equipment	20	22
3320 Instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	23	19
3340 Optical instruments	20	23
3612 Other office and shop furniture	20	22

High synchronisation rates are found in industries with homogeneous goods and large scale production. Low synchronisation rates are typical for industries with differentiated goods like special purpose machinery or for industries with a local market like printing. Yet, totally unexpected, among the industries with the lowest synchronisation rates are those where due to a collective wage agreement wages are increased at the same time in whole Western Germany.

Such an agreement exists eg. for all metal-working industries together and another for printing. In contrast, in the chemical industry Western-Germany is subdivided into three different not necessarily neighbouring regions, where the times of the increases are staggered over three consecutive months. Wages are raised first in the region with the most competitive firms and last in the region with the least competitive firms. Besides, in the chemical industry big firms have firm-specific contracts. In the textile or food industry agreements are even more differentiated.

IV. A closer look at the very long and very short spells

In section III.2 it was shown that the data contains a lot of spells lasting just one month and a few spells lasting several years. This section takes a closer look at both phenomenons. They are interesting in themself but the more important question is whether they reflect economic substance or whether they are a particularity of the dataset. The very long spells might be simply reporting errors and the very short spells might be seperate price changes for separate products within the product group. The analysis starts with the very long spells, which are defined as spells lasting longer than 120 months. Then consecutive price changes are investigated. An example for two consecutive price spells is a price change in February followed by a price change in March and no price change in April. That is the same definition and wording as in Lach and Tsiddon (1996).

The dataset contains 66 long spells. For 29 spells of them the data contains information on the preceding spell as well. These show the usual pattern: 7 spells lasting just one month, 10 spells lasting between 2 and 11 months, 6 spells lasting 12 months and 6 spells lasting longer, two of them roughly 4 years. Therefore, the long spells do not seem to be a characteristic of the specific firm. For 13 very long spells the data contains information on the following spell. 6 of the following spells are censored, so that it can only be said how long they are at least. But three of the censored spells show durations longer than 4 years! So there is a puzzle that cannot be solved. Very long spells may be characteristic for specific firms or they may not. The number of available observations is too small to draw a conclusion.

One should assume that the longs spells result in a price increase. But it turns out that price reductions are as likely as price increases. The very long spells, and persistently long spells, may be explained by monopolies in niche markets. So there may be firms producing spare parts for old machines that are still running but not produced any more. If such a machine has to be replaced it will be replaced by completely new technology. Therefore the market is small and

contracting. There is no incentive for other firms to enter the market as long as the incumbent does not misuse its monopoly power. Yet, its mark-up is constantly shrinking.

There is one yearly question that can shed some light on this assumption. It is asked, whether the market is assumed to be growing or contracting in the medium run. Table 6 shows for the spells longer than 120 months, how the estimation changed during the years. Almost 19 percent of firms assumed during the first two years that the market will grow significantly and only 27 percent thought that it will remain unchanged. After 5 years only 2.5 of firms believe their market will grow significantly and 42 percent think it will remain unchanged. Since still more than 50 percent of firms assume after 5 years of unchanged prices that their market will grow, the "old technology" argument does not hold. Perhaps it is new technology. Firms have introduced a new product on the market with a high markup, believing of course that the market will increase. As time passes by imitators enter the market and the mark-up is shrinking, yet the price is kept constant. Eventually, some of the firms are forced to reduce their price, even after more than 10 years.

Table 6. Changing market expectations of firms with spells lasting longer than 120 months

	We assume that the market for our product in the medium run (about 5 years), ie excluding purely cyclical fluctuations, will ...				
	grow significantly	grow	remain unchanged	contract slightly	contract significantly
1 and 2 years	18.9	44.1	26.9	6.5	3.5
3 to 5 years	7.1	48.2	31.9	10.9	1.9
6 to 10 years	2.4	47.1	41.3	8.1	1.1
more than 10 years	2.6	44.5	43.4	8.8	0.1

In the case of consecutive price spells there are several possible explanations. One reason may be a sharp change in the environment eg a sharp increase in oil prices, another reason may be competition. The first firm raises its price only a bit, since it is afraid that other firms do not follow suite, and if they follow and increase their prices, the first firm raises its price again. The analysis starts with costly price adjustment.

Most theories of price rigidity assume costly price adjustment, either in the form of lump-sum or menu costs (Barro, 1972, Sheshinski and Weiss, 1983, Caplin and Leahy, 1991) or in the form of convex or quadratic adjustment costs (Rotemberg, 1982). Menu costs are often related

to costs of administering price changes like changing price lists, informing dealers and so on. Convex adjustment costs are justified by Rotemberg by assuming that "[...] there is the implicit cost that results from the unfavourable reaction of customers to large price changes. [...] In particular, customers may well prefer small and recurrent price changes to occasional large ones". This justification leads him to argue that only price increases should be costly. He does not exclude menu costs but in his model the implicit costs dominate.

An implication of the assumption that the frequency of price changes is proportional to the intended price change for firm data is that the time for adjustment does not have to be constant nor does it prevent adjustment within one month if only the desired price change is small enough. But for convex adjustment to be a meaningful concept adjustment within one month should be the exception and not the rule. On the other hand it should be the rule and not the exception for firms with predominantly once and for all adjustment.

Investigating the type of adjustment could be dealt with in a sophisticated model (Dixit, 1993) but some simple descriptive statistics may already provide a partial answer. Since the data is only qualitative it is not possible to tell whether price changes are large or small or if there are several price changes within one month. But it is possible to tell whether there are ongoing price changes for several months. Further an estimate for the share of one and for all adjustments can be calculated for firms participating sufficiently often.

Table 7 shows the frequency of up to five consecutive price changes for the whole sample. In most cases the series consist either of price increases or price reductions. Therefore, if adjustment happens in several steps then it is convex. A change of sign occurs only in a few cases. It seems that firms „do not want to antagonize their customers" (Okun). The price reversals may be explained by very flexible prices but they are too small in number to be investigated further.

Table 7. Frequency of immediate reversions of price changes in percent

Number of consecutive price changes	price increase	changes of sign	price reduction	total
2	69.8	4.0	26.2	100
3	62.3	6.4	31.3	100
4	57.6	8.5	33.9	100
5	52.3	11.7	36.1	100

Series of price increases are more frequent than series of price reductions but they tend to be shorter. If the number of adjusting steps is proportionate to the „desired“ price change either desired reductions are larger than desired increases or the steps are smaller resulting in slower adjustment.

In order to get firm specific results the adjustment behaviour of firms with at least 10 series of price increases was analysed. For textbook firms with convex adjustment costs the share of adjustment periods of 1 month should be zero and the share of periods of say 2 months should be 100 percent. For firms with lump-sum adjustment costs the share of adjustments periods of 1 month should be 100 percent for all these firms. Looking in Table 8 at the first row and first and second column between 5 and 10 percent of firms producing intermediate goods change their price always in just one step. Not more than 50 percent of firms change their price all at once in at least 6 out of 10 cases. On the other hand a quarter of firms increases its price in roughly 3 out of 10 times in two steps[2]. The same applies for three or more steps. For investment goods and durable consumer goods all at once adjustment is more frequent. The share of firms adjusting their price all at once in at least 4 out of 5 cases, what could be called as „normally at once“, amounts to 50 percent for these products.

This differs from Blinder's result. Asking firms whether they rise or lower their prices all at ones or in small steps 74 percent answered "normally all at once" 10 percent "it varies" and 16 percent "normally in small steps". In German manufacturing the share of firms adjusting prices all at once seems to be smaller and the share of firms where it varies seems to be larger. Firms adjusting their prices all at once are more likely to be found in the investment goods and the durable consumer goods sector. One explanation for adjustment in small steps could be that due to comparatively large cost changes firms should increase their prices by a large amount, too. The larger the increase the likelier is a misperception of the competitors‘ reaction. Therefore firms adjust in smaller steps waiting for competitors to follow. The longer the production chain the less likelier are large cost changes and the less often adjustment in steps is necessary. Interestingly there are almost no differences between the types of goods in the case of adjustment in two months.

Thus, one may draw two conclusions: adjustment is mainly lump-sum but adjustment in two or more steps is so frequent that firstly adjustment costs cannot be that large and secondly firms cannot be divided into two groups, one with always convex adjustment costs and another with always lump-sum adjustment costs.

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2 Less than five percent in two steps and another five percent in three or more steps.

Table 8. Intra-firm distribution of „adjustment“ periods by type of good

Type of goods	... percent of firms raise their price all at once / in three steps in ... percent of cases or more often					
	<=5%	<=10%	<=25%	<=50%	<=75%	<=90%
	all at once					
Intermediate goods	100	92	80	62	45	31
Investment goods	100	100	92	79	62	47
Durable consumer goods	100	100	92	83	67	47
Non-durable consumer goods	100	93	87	73	57	42
	in two steps					
Intermediate goods	40	35	27	18	10	5
Investment goods	42	33	23	14	7	
Durable consumer goods	43	33	24	14	7	
Non-durable consumer goods	42	36	27	17	8	
	in three or more steps					
Intermediate goods	55	45	30	12		
Investment goods	35	25	13			
Durable consumer goods	29	18	7			
Non-durable consumer goods	40	29	17	7		

Rem: Firms with at least 10 price increases

So far the descriptive analysis has shown that there is a lot of heterogeneity in the data. Further, the data includes no variables on costs. Taken together, it seems sensible to concentrate on a more homogeneous yet still sufficiently heterogeneous subset of industries where aggregate information on costs can be added. The chosen subset consists of the industries whose employees are organised in the IG-Metall, the trade union of the metal-workers. That is approximately NACE 29 to NACE 35 and covers all of investment goods, almost all of durable consumer goods, besides the manufacture of furniture, and some intermediate products. These industries are characterised by a strong seasonal pattern, as Table A1 in the annex shows, their synchronisation ratios are low and they change their prices all at once.

V. Potential influence of collective wage bargaining in the investment goods producing industries

In Germany (former FRG) wage setting in the metal-working industries is highly synchronised. According to Kohaut and Schnabel (2001) 42 percent of firms and 66 percent of employees were covered by the collective agreement in 2000. An additional 30 percent of firms and 19 percent of employees were covered by agreements that follow closely the collective agreement[3]. Since coverage by that single agreement of larger firms is higher and larger firms are overrepresented in the business survey most firms should be subject to that single agreement. Therefore, if costs were a major determinant of price changes, one would expect a high degree of synchronisation in price setting within the investment goods producing industries. But that is in contradiction to the results reported in Table 5, where some of these industries show the lowest synchronisation rates of whole manufacturing.

Further, since there have been longer contract periods than the usual 12 months, up to 36 months, the agreed wages can serve as proxy for expected marginal costs, both for the econometrician and the firm owner. To explain the modalities of collective wage bargaining in these industries the negotiation round in the metal-working industries in 2002 is briefly described. The general procedure that was agreed upon by the trade union and the employers federation in 1979 is:

1. The trade union makes its claim public four weeks before the contract expires.

2. Negotiations start two weeks before the contract expires.

3. Strikes are not permitted within four weeks after the contract expires.

In the 2002 negotiation round the preceding agreement ended 28 February 2002. The round started informally on 10 December 2001 when the trade union's board announced its recommendation: a range of between 5% and 7% and a duration of 12 months. It was motivated by an expected inflation rate of up to 2% in 2002 and an expected economy wide productivity increase of up to 2%. "The rest is redistribution and backlog demand." Experience shows that the final result is about half, ie 3.0%. Exceptional in this round was the sudden failing of the negotiation process because of rivalries within the trade union and the first strikes for many years.

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[3] In the eastern part of Germany only 60 percent of employees producing investment goods were covered directly or indirectly by collective wage bargaining.

The main stages were:

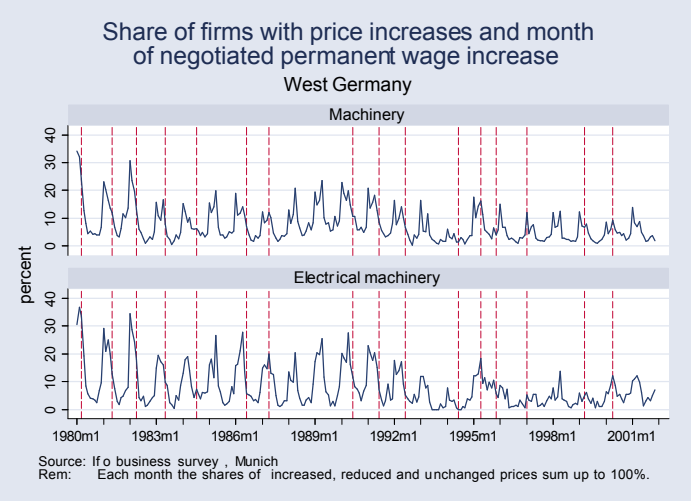
10 December 2001	wage claim recommended by the trade union's board: 5% - 7%
28 January 2002	official wage claim: 6.5%
7 February 2002	start of negotiations in Bavaria
15 March 2002	initial offer from employers in Baden-Württemberg: 2% from March 2002 and an additional 2% from March 2003
28 March 2002	first warning strikes
19 April 2002	failure of negotiations in Baden-Württemberg
25 – 30 April 2002	first trade union ballot (on strike): 90% yes vote
6 May 2002	start of strikes
15 May 2002	restart of negotiations and pilot agreement in Baden-Württemberg
21 – 25 May 2002	second trade union ballot (on agreement): 57% yes vote

The final agreement was: March and April 2002, no wage increase; in May a lump-sum payment of €120; from June 2002 4.0%; and from June 2003 an additional 3.1%. Duration 22 months (March 2002 – December 2003). A back-of-the-envelope calculation yields 3¼% wage increase per year. That is ¼% higher than first expected, based on the recommendation on 10 December 2001, but fits well within the official wage claim.

Table A3 summarizes the wage bargaining process for the years from 1980 to 2001. Graph 8 shows that price increases take place mainly between January and the month of an increase in payments. Not included in the graph are the wage increases during long-term contracts.

During the periods of long-term wage contracts it was comparatively easy for firms to build expectations on the increase in marginal costs. However, Graph 8 shows basically no different pricing pattern during the periods of long-term wage contracts.

Graph 8.



VI. Multivariate estimation of transition intensities for investment goods

The descriptive analysis so far has given some indication for potential factors influencing the price setting decision. Now the data is analysed within the framework of a multivariate duration model. The model is ad hoc but it follows the menu cost literature and ows much Sheshinski and Weiss (1977) and Cecchetti (1985). In both approaches there are adjustment costs and out-of-equilibrium costs due to sticky prices. A price is reset if the out-of-equilibrium costs are larger than the adjustment costs. This paper is not specific about the type of adjustment costs. They may be menu costs, they may be decision costs, they may be costs due to antagonizing customers.

Unlike in aggregate models where, say, the wage increase compared to the same quarter in the preceding year matters, now the increase in the wage level since the last price change matters, since it is implicitly assumed that the last price change has led to a new equilibrium. If there is a trend in the evolution of such a variable it is obvious that the likelihood of a price change increases with the duration since the last price change.

The analysis includes a price index for domestic intermediate inputs, a price index for imported intermediate inputs and the change in collectively negotiated wage level as measures for cumulated costs. In addition, a proxy variable for cumulated demand is used. Since demand change is measured ordinally, cumulated demand is approximated by the number of demand increases and decreases, under the assumption that demand varies by an almost fixed

percentage that is identical for all firms and periods. That is the usual assumption underlying the construction of indicators from business cycle surveys.

Denote these variables by $\Delta x_i(t) = x_i(t) - x_i\left(t_{(s-1)} - 1\right)$ where $x_i\left(t_{(s-1)} - 1\right)$ is eg the price index of imported intermediate inputs for good i at the calendar time of the end of the preceding price spell.

Beside these cumulative effects accruing from the past expectations are taken into account, a dummy proxy-variable for the expected change in demand within the next three months and a dummy variable that states whether given expected demand and technical capacity will be sufficient in 12 months. Denote these variables by $x_i^e(t)$.

Starting with Blinder (1998) there have been several surveys asking firms about their prices and price setting. These surveys show that firms attribute to menu costs only minor importance. Coordination failure, explicit and implicit contracts rank first. Many firms fear that price changes antagonize their customers.

Since the collective wage agreement dominates wage setting in the investment goods producing sector the point of time of the collectively agreed wage increase may increase the likelihood of a price increase in several ways. Firstly, it is a true cost increase, secondly every customer knows the agreement and may be therefore less antagonized and secondly every domestic competitor apply the same wage contract so that it simplifies coordination greatly. Therefore the month of the collectively negotiated wage increase ($w^d(t)$) is taken into account in contrast to the marginal wage increase that is due to the business cycle or the difference in wage levels formally denoted by $\Delta w_i(t) = w_i(t) - w_i\left(t_{(s-1)} - 1\right)$.

Capacity over or under utilisation should be endogenous if firms really optimize far sighted. But it may be that firms react myopic and in a very simple manner. They look at the prices of their competitors and their own disequilibrium that is proportional to the capacity over utilisation. Denote these time varying variables by $z_i(t)$. The time constant variables firm size and the two-digit industry classification is included too and the information whether the preceding price change was a price increase. Denote the time constant variables as tc_i and the lagged state as $y_{i,s-1}$.There are monthly and yearly time dummies for the calendar time of the end of the price spell. Denote these variables $c(t)$. Finally, the duration is specified nonparametrically using dummies. Denote the corresponding coefficients by I_{0t}.

Two separate equations are estimated for the period from 1980 to 2001, the one for price increases as exit states and the other for price reductions. Left censored spells are ignored

under the assumption of independent censoring. The underlying model is a grouped Cox-model. Its hazard rate is given by

$$h(t|x) = 1 - \exp\left(-\exp\left(\lambda_{0t} + \beta_1 \Delta x(t) + \beta_2 x^e(t) + \beta_3 w^d(t) + \beta_4 z(t) + \beta_5 tc + \beta_6 y_{s-1} + \beta_7 c(t)\right)\right)$$

Since firms stop reporting for a specific product group at a certain point of time, and some spells are therefore right censored, firms specific information can only be collected until the time shortly before the censoring occurs, in monthly data the last month available. Therefore a spell starts with a price change and ends shortly before the next price change. Eg if a price is increased 5th February and the second increase takes place 9th April, that spell starts February and ends March and its duration is 2 month. Decisions by the firms are taken shortly before the price change. Decisions for the spell in April in the above mentioned example are based on experiences in February and March. By the same token expectations are built shortly before the price change ie in March. Contemporaneous effects can only be taken into account if they are not firm specific, eg a collectively negotiated wage increase in April can be coded already in March. Then it is not a wage increase in March expected for April.

This treatment of right censoring is problematic as Table 9 shows. While it seldom occurs that a price increase was not anticipated before, in every second case a price reduction came by surprise and the share of planned price changes, both increases or decreases, that were not realised is equally high. Therefore for price reductions an alternative model was estimated that includes the contemporaneous demand change and a dummy for not knowing the contemporaneous demand change due to right censoring.

Table 9. Planned and actual price changes in West Germany

Type of good	Share of unexpected price changes				Share of planned price changes that did not happen			
	increase		reduction		increase		reduction	
	81-90	91-00	81-90	91-00	81-90	91-00	81-90	91-00
Intermediate goods	13	13	51	38	40	38	33	27
Investment goods	19	21	52	35	43	44	46	35
Durable consumer goods	14	12	67	50	42	43	58	51
Non durable consumer goods	21	23	53	45	47	49	35	29
Weighted average	16	17	52	40	43	42	37	30

As expected, this results in a simultaneity bias. But if neglected, it leads to an omitted variable bias as it seems. This alternative model for price increases is not reported since it has not yielded sensible results. There the simultaneity bias seems much more severe than the omitted variable bias.

VI.1 Results

In Germany, producers of investment goods increase prices predominantly between January and April, even after controlling for various other factors. One reason may be that at no other time so much up-to-date information is available: Firms have balanced their books, the forecasts of the German Council of Economic Experts are made public mostly in November and the trade union for that part of the economy normally has already declared its wage claim for the coming negotiations. This would suggest economically significant costs of information gathering. It would also suggest a re-optimisation at the beginning of the year and some rule of thumb behaviour during the rest of the year. The timing of the collective wage bargaining rounds is probably endogenous to the price setting. Since firms have started calculating their prices for the coming year or even have already changed their prices, it is the proper time to negotiate. Several points of time of the bargaining round have an impact on the likelihood of price increases. In the first month after the preceding wage contract has formally expired prices are already likelier to be raised (and less likelier to be reduced). The month of the actual increase of a permanent wage increase has the same effect as the month preceding the month of the permanent wage increase. A much larger impact has the month of a permanent wage increase if it is known several months in advance because of a long-term wage contract of two or more years. Thus collective wage bargaining reduces coordination failure, if it exists.

Of course, the fact that at a certain point of time wages are raised, is not the only impact of wage increases on the likelihood of a price change. The increase of the hourly wage level since the last price change raises c.p. the distance of the sticky price from the optimal price and has therefore an impact until the sticky price is changed again. Yet, the effect is statistically significant only at the 7 percent level. This may be due to the fact that there is no firm level information on wages. Instead, yearly wages from the National Accounts have been used. This may be improved by using more disaggregated data. But unfortunately there is a break in the official time series due to the reclassification in 1995 from German SYPRO to NACE. Using quarterly or monthly wages instead of yearly wages rises a problem of causality. It is very unlikely, that a firm rises its price because of some overtime hours. That such an effect is observed in aggregate data is much likely caused by a different relationship. Overtime hours are observed if business is going well. If business is going well not only more is produced but also customers may be willing or forced to pay higher prises. Higher prices and higher

production means higher revenues what allows firms to pay bonuses, facilitates promotions, prevents lay-offs, etc.. If wage contracts are understood as long term contracts these things should happen anyway, but not at that specific point of time. Therefore, in the long run causation should go from wage increases to price increases but in the short run causation may go in the opposite direction from price increases to wage increases. Interestingly, wage increases do not reduce the likelihood of a price reduction. It is lower only during the first month that follows the formal end of a wage contract.

Another part of costs are imported intermediate inputs. The change in the prices of imported intermediate inputs has the expected sign but it is statistically significant at the 5 or 1 percent level only above and below certain thresholds: more 10 percent increase and more than 2 percent reduction. The reason may be that the share of imported intermediate inputs and their price volatility is so low, that firms normally do not care. Only under certain circumstances, eg. oil price increase or decrease that are reported in TV or newspapers, producer of investment goods watch more closely input prices and take them into account. Domestic intermediate inputs have been ignored for the time being, since within investment goods it is not clear who provides inputs, who is customer and who is competitor.

Besides input prices, labour and intermediate inputs, technological progress in form of new or improved technological processes has an impact on costs and prices. Yet it is not the progress within the firm itself but the cost reducing progress of competitors that increases the likelihood of a price reduction.

The impact of past demand reductions and increases and the impact of expected demand changes depends much on the inclusion of the contemporaneous demand change. If it is not included then increases a demand reduction the likelihood to reduce prices but does not reduce the likelihood to increase prices besides demand is reduced several times. A demand increase rises the likelihood of a price increase but does not lower the likelihood of a price reduction. If firms expect demand to decrease within the next six months it is much more likelier that they reduce their price and it is less likelier that they increase their prices. If demand is expected to increase prices are more often raised and less often reduced. Since the reaction of price reductions to demand reductions is larger than the reaction of price increases to demand increases there seems to be upward rigidity in the case of demand changes.

If instead the contemporaneous demand change is included then past demand reductions increase the likelihood of price reductions only in case of four or more demand reductions and the impact itself is much lower compared to the exclusion of the contemporaneous demand change. The contemporaneous demand reduction itself increases the likelihood of a price

reduction dramatically. But this likelihood is increased by a contemporaneous demand increase too. The reason could be that the price reduction has led to the demand increase ie. a deal has been made because the price has been reduced or the price has been reduced because a further demand decrease was expected and the decision was "sticky" ie. the firm could not react immediately and change its decision. Only the latter explanation is compatible to the loss of the statistical significance of the one to three cumulated past demand reductions. They have served as basis for a forecast. If one assumes that firms attribute a higher probability to a further demand decrease in the coming month if the cumulative number of demand decreases is larger then the actual decrease should be correlated to this number. Then the distance between the optimal and the sticky price should not become larger. But if the actual demand reduction was not expected and the cumulated past demand reduction itself had not been expected in the past then both demand reductions should increase the distance of the optimal from the sticky price and both should be significant. Now, in the past, three or less demand reductions were expected but not four or more. Thus four and more cumulated demand decreases are significant. In some cases the actual demand decrease was expected, based on the demand decreases in the past. Part of the actual demand decrease comes as surprise. Therefore it contains more information as the prediction and makes the predictors insignificant. Yet, whether the positive impact of a demand increase on the likelihood of a price decrease is due to simultaneity or stickiness cannot be decided. Maybe the inclusion of the price expectation in the preceding month could solve this problem. The reduced impact of the expected demand decrease during the next six months may be explained be a decreasing impact the more distant the demand decrease may appear. Thus after the inclusion of the contemporaneous demand decrease the expected demand measures the impact of an expected demand decrease in five or six months while in case of exclusion of the contemporaneous demand decrease the expected demand puts more weight on a demand decrease in the next or next two months. The same argument holds in the case of a price increase but empirically some further variables that have been significant at the 10 percent level then become insignificant. This has not been investigated in detail until now. But the above mentioned argument shows, that firms are to a certain degree backward looking.

The influence of both past and expected demand changes has to be conditioned on the actual level ie. on actual capacity over or under utilisation. In the business survey questionnaire the firm specific full utilisation is defined as 100 percent but the possibility to report more than 100 percent is explicitly given. Therefore in this paper over utilisation is defined as deviation from the firm specific mean utilisation. Over utilisation leads to price increases and under utilisation to price reductions. That is compatible with fixed costs and a procyclical mark-up. The size of the reaction is the same in absolute terms.

If the capacity given actual and expected orders within the next 12 months is not sufficient, firms rise prices and if it is more than sufficient they reduce prices. That implies that capacity cannot be adjusted costlessly in the short run. The pressure for firms to reduce prices is less if other firms will be capacity constraint because in that case they tend to increase their prices and customers switch to the firms with spare capacity. This seems to be the case since the likelihood of price reductions is lower if the share of capacity constrained competitors (in the future) is higher. By the same token firms that are capacity constrained should not increase prices if competitors will have spare capacity. But for this combination the share of domestic competitors with more than sufficient capacity given actual and expected orders is insignificant. Contrary to the upward rigidity of prices in the face of demand changes that have already happened or are expected for the near future (the next six months) firms behave downward rigid in the case of capacity constraints within the next 12 months. In other words they have the impression that for that horizon sufficient time to react is left.

If firms have the impression that the stocks of finished products are too large, they are more likely to reduce their prices. If instead they have the impression that stocks are too small they more likely increase prices and less likely reduce them. Firms that usually have no stocks of finished products are less likely to increase prices but this effect is hardly significant. This implies that stocks of finished products are not used for smoothing price changes.

This is partly achieved by exports since firms that do not regularly export are much more likelier to reduce prices. But there is no impact on price increases. That is another case of downward rigidity.

There are no size effects measured as persons employed in the production of the product group besides that production with less than 50 employees lowers the likelihood of price reductions. If there were economically significant physical menu costs one would expect a negative correlation between firm size and menu costs since fixed costs of adjustment are divided by larger sales. And the costs should occur for both price increases and reductions. Therefore the observed size effects are evidence against the importance of physical menu costs.

The price setting of competitors has a clear impact of the likelihood of a price change. If a larger share of competitors rises its prices the likelihood of a price change rises and the likelihood of a price reduction decreases. If the case of price reductions by competitors the likelihood of price increases shrinks, but the effect on a price reduction is not significant anymore, although the sign is correct. That is due to the share of competitors with process

innovations that can be seen as proxy for permanent cost reductions by competitors. Thus only temporary price reductions are left that provoke no significant reaction.

Table 10. Regression results for a discrete Cox-model

Exit state	price increase		price reduction I		price reduction II	
	coefficient	std. err.	coefficient	std. err.	coefficient	std. err.
specific months of collective wage bargaining						
formal start of contract	.2002***	.0327	-.1121**	.0563	-.1206**	.0558
month before month of permanent wage increase (not in the mid of long-term contract)	.2353***	.0377	-.0154	.0563	-.0167	.0434
month of permanent wage increase (not in the mid of long-term contract)	.2500***	.0389	-.0290	.0569	-.0167	.0434
long term contracts only						
mid-term permanent wage increase	.5860***	.0510	-.0368	.0860	-.0404	.0864
cumulated change in wages (in %)						
no change	-	-	-	-	-	-
(0,3]	-.0800*	.0428	-.0321	.0609	-	-
(3,4]	.0800*	.0450	.0449	.0702	-	-
(4,5]	.1096**	.0494	-.1092	.1181	-	-
(5,6]	.0904*	.0483	-.1864*	.0946	-	-
>6	.1255*	.0726	.2939**	.1386	-	-
cumulated change in the price index of imported intermediate inputs (in %)						
< -2	-.1031***	.0367	.2475***	.0567	.2899***	.0568
(-2,4]	-	-	-	-	-	-
(4,10]	.0637*	.0359	-.1109	.0853	-.1437*	.0853
>10	.2413**	.1136	-1.2186***	.4526	-1.3597***	.4519
cumulated demand change						
more than 4 reductions	-.1127**	.0488	.4409***	.0793	.2092***	.0795
4 reductions	-.0477	.0651	.4579***	.0933	.2647***	.0933
3 "	-.0105	.0536	.2234***	.0799	.0743	.0506
2 "	.0506	.0439	.2440***	.0562	.0743	.0506
1 "	-.0460	.0292	.1336***	.0312	-.0032	.0319
no change	-	-	-	-	-	-
1 increase	.0861***	.0260	-.0119	.0416	-.0690	.0420
2 "	.0211	.0430	-.0773	.0781	-.1198*	.0671
3 "	.2112***	.0510	.0192	.1078	-.1198*	.0671
4 "	.1462**	.0633	-.1165	.1616	-.2074	.1616
more than 4 increases	.1130**	.0531	-.3766***	.1379	-.4329***	.1381
contemporaneous demand change						
demand reduction	-	-	-	-	.6997***	.0279
no change	-	-	-	-	-	-
demand increase	-	-	-	-	.0935**	.0386
share of domestic competitors with demand decrease	-.2032**	.0961	.5127***	.1112	.3013***	.1138

Table 10. Regression results for a discrete Cox-model (cont.)

Exit state	price increase		price reduction I		price reduction II	
	coefficient	std. err.	coefficient	std. err.	coefficient	std. err.
expected demand change during the next six months						
demand decrease expected	-.0534**	.0267	.3571***	.0291	.2555***	.0296
no change expected	-	-	-	-	-	-
demand increase expected	.2094***	.0961	-.0471	.0402	-.0350	.0404
expected market evolution in the medium run (5 years)						
significant growth	-	-	.2115***	.0502	.2296***	.0503
unchanged or slight growth or contraction	-	-	-	-	-	-
significant contraction	-	-	.1723***	.0504	.1377***	.0508
log capacity over utilisation	.3014***	.0701	-.2685***	.0712	-.3055***	.0719
technical capacity given actual and expected orders within the next 12 months						
own firm:						
not sufficient	.1841***	.0335	.0957	.0641	.1274**	.0643
sufficient	-	-	-	-	-	-
more than sufficient	.0084	.0244	.0664**	.0284	.0594**	.0286
(share of) domestic competitors:						
not sufficient	-	-	-.6092**	.2940	-.5665*	.2942
more than sufficient	-	-	.0786	.1220	.1013	.1224
innovations within the product group during the year						
own firm:						
new or improved products but no process innovations	.0065	.0289	-.0901**	.0340	-.0614*	.0369
no new or improved products but process innovations	.0481	.0382	-.0490	.0550	-.0486	.0301
new or improved products and process innovations	-.0211	.0255	-.0646*	.0342	-.0450	.0533
neither new or improved products nor processes	-	-	-	-	-	-
(share of) domestic competitors:						
with new or improved products	-	-	-.1080	.1041	-.1596	.1040
with processes innovations	-	-	.2581**	.1026	.2699***	.1027
product life cycle						
sales share of products within the product group in the final phase of the life cycle	-.0160	.0097	.0307***	.0112	.0302***	.0109

no sales with products within the product group in the final phase of the life cycle	-.0413*	.0238	-.0353	.0362	-.0223	.0349

Table 10. Regression results for a discrete Cox-model (cont.)

Exit state	price increase		price reduction I		price reduction II	
	coefficient	std. err.	coefficient	std. err.	coefficient	std. err.
stocks of finished products						
too large	.0338	.0296	.0864**	.0345	.0651*	.0346
sufficient	-	-	-	-	-	-
too small	.2535***	.0361	-.2752***	.0864	-.2554***	.0866
no stocks	-.0379*	.0279	-.0345	.0327	-.0275	.0329
exports						
no exports	-.0216	.0584	.2559***	.0544	.2298***	.0546
number of employees in product group						
<50	-.0413	.0279	-.1596***	.0392	-.1721***	.0394
cumulated change in the CPI (in %)						
< 0	.0967**	.0455	.0657	.0450	.0518	.0452
[0,½]	-	-	-	-	-	-
(0,2]	-.0396	.0295	-.0866**	.0384	-.0564	.0384
(2,4]	.0243	.0439	-.0671	.0758	.0493	.0742
(4,6]	.0265	.0575	.0463	.1246	.0493	.0742
>6	.0045	.0747	.4514***	.1468	1.0571***	.1412
price setting of domestic competitors						
share of price increases	1.0546***	.1055	-1.6904***	.2357	-1.6528***	.2365
share of price reductions	-1.6655***	.2665	.3580	.1845	.2699***	.1027
preceding price change was an increase	1.2302***	.0365	-2.500***	.0373	-2.510***	.0373
month						
January	.7598***	.0439	-.0050	.0592	.0269	.0594
February	-	-	-	-	-	-
March	.1326***	.0470	-.0475	.0692	-.0458	.0695
April	.0720***	.0414	-.0239	.0595	-.0576	.0597
May	-.2977***	.0444	-.1340**	.0572	-.1436**	.0574
June	-.3165***	.0611	.0516	.0704	.0391	.0708
July	-.2702***	.0515	-.2716***	.0589	-.2713***	.0590
August	-.5080***	.0572	-.1759***	.0588	-.1990***	.0590
September	-.3632***	.0743	-.1651**	.0741	-.1622**	.0744
October	-.0804	.0524	-.1389**	.0607	-.1432**	.0609
November	-.3412***	.0535	-.1872***	.0594	-.1860***	.0596
December	-.1495**	.0659	-.2941***	.0771	-.2985***	.0775

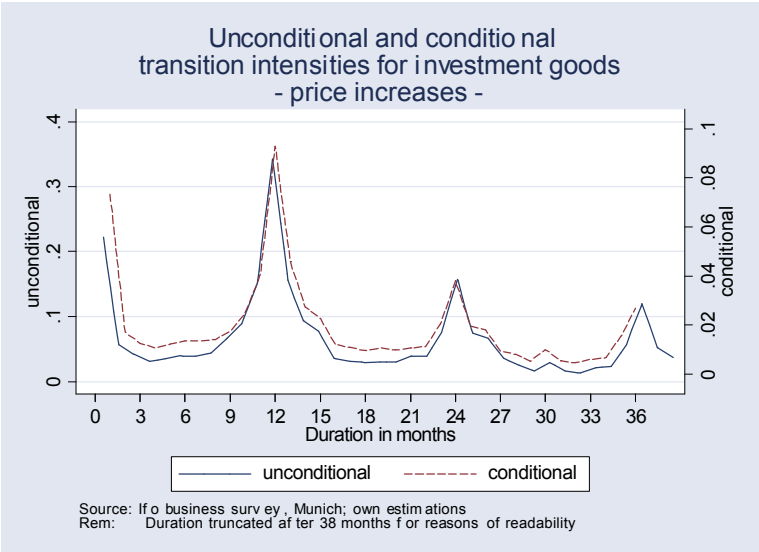
Table 10. Regression results for a discrete Cox-model (cont.)

Exit state	price increase		price reduction I		price reduction II	
	coefficient	std. err.	coefficient	std. err.	coefficient	std. err.
year						
1980	-.0433	.0698	-.7178***	.1273	-.6888***	.1278
1981	.2110***	.0552	-.4756***	.0919	-.4559***	.0923
1982	-.1010*	.0547	-.2864***	.0750	-.2587***	.0754
1983	-.1860***	.0627	-.1842**	.0743	-.1452*	.0746
1984	-.0670	.0627	-.2659***	.0814	-.2129***	.0818
1985	-.0813	.0638	-.4262***	.0979	-.4030***	.0981
1986	-.1343**	.0673	-.2566***	.0925	-.2370***	.0926
1987	-.2209***	.0669	-.0938	.0735	-.0617	.0739
1988	.0571	.0643	-.3712***	.0917	-.3114***	.0919
1989	.1066*	.0619	-.5324***	.1206	-.4848***	.1206
1990	.0985	.0615	-.6077***	.1266	-.6028***	.1267
1991	.0305	.0619	-.0703	.0824	-.0896	-.0826
1992	-	-	-	-	-	-
1993	-.4913***	.0800	.1390**	.0616	.1786***	.0619
1994	-.4080***	.0836	.0461	.0676	.1193*	.0679
1995	.2009***	.0649	.0807	.0740	.1012	.0743
1996	-.4221***	.0830	.0438	.0664	.0791	.0668
1997	-.2728***	.0844	-.0139	.0738	.0349	.0742
1998	-.3127***	.0856	-.1178	.0790	-.1046	.0793
1999	-.3452***	.0887	-.0488	.0740	-.0121	.0743
2000	.0333	.0760	-.0624	.0945	-.0001	.0946
2001	-.0966	.0836	-.2945***	.0946	-.3349***	.0947
constant	-2.7630***	.0863	-.8132***	.1246	-1.1126***	.1133

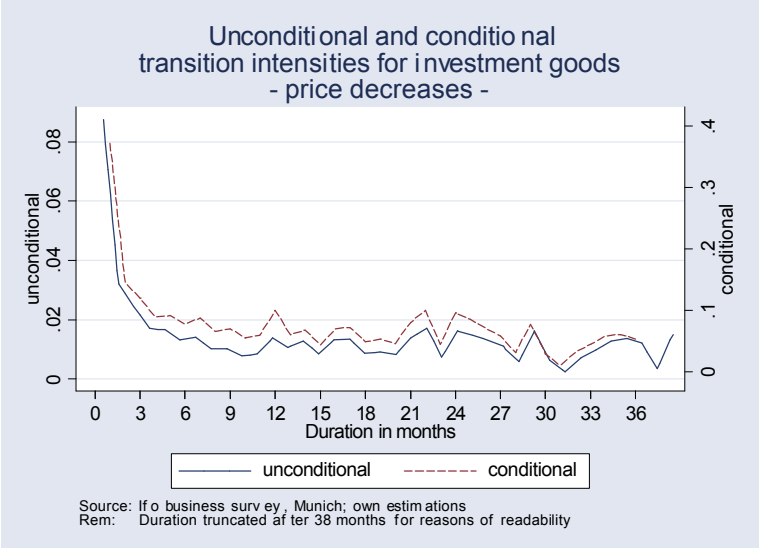
If this share of competitors with process innovations is left out from the regression, price reductions of competitors increase the likelihood of price reductions in a statistical significant way. Nonetheless the coefficient is only slightly higher and not comparable to the other reactions. There is again some downward rigidity.

Graphs 9 and 10 show that the above mentioned variables do not have much impact on the shape of the unconditional transition rates.

Graph 9:



Graph 10.



That means that eg the month of a collectively negotiated wage increase rises the likelihood of a price increase but that wage increases do not happen more often after price spells of say 12 months than after price spells of say 6 months.

VII. Conclusion

Using panel data from a monthly business survey for German manufacturing that covers the period from 1980 to 2001 it is shown that the mean duration of price spells is shorter for intermediate goods (2 quarters) than for investment goods (3 quarters) and consumer goods (3-4 quarters). Differences within industries are larger than between industries. The distributions of price changes for different industries show modes at multiples of 12 months.

The pattern of price increases and price decreases varies across industries. Especially for investment goods there is a clear asymmetry between price increases and price decreases. Further investment goods and durable consumer goods are characterised by lump-sum price adjustment whereas for intermediate goods and to a lesser extend for non-durable consumer goods convex price adjustment costs are observed.

For investment goods an atheoretical Cox-duration model is estimated. Price increases are state-dependent as well as time-dependent. The time-dependence comes in by monthly effects and by a “u” shaped duration dependence. This “u”-shape is independent of other factors. The collective wage bargaining process increases the time-dependence since as a consequence wage increases occur very regularly every 12 month and even more regular during long-term wage contracts. Firms seem to be backward-looking to a certain degree in their expectations on future demand changes.

That firm size does not matter may be seen as evidence against physical menu costs, yet the higher likelihood for price increases at the beginning of the year and in connection with collective wage bargaining does not contradict economic significant costs of information gathering etc.

Firms try to avoid price reductions through exports and product improvements or new products. They reduce prices if they are forced to, eg by reduced demand, capacity underutilization and permanent cost reductions of competitors through process innovations. Then prices react more flexible downward than upward. Strategic long term considerations lead firms to reduce prices if they expect the market to contract strongly within the next 5 years and they reduce prices if they expect the market to grow strongly. Thus, they try to increase or keep their market share in the long run.

Capacity over- or underutilization has an important impact. That is a sign of high fixed costs and procyclical mark-ups. Capital is firm-specific and cannot be instantaneously reallocated after a shock.

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Annex I - Formulas

Let $p_{lt}^{+}, p_{lt}^{-}, p_{lt}^{0}$ be binary variables that denote whether the price of item l is higher, lower or the same at time t compared to time $t-1$. Then the frequency f_{Lt}^{+}, f_{Lt}^{-} of a price increase or decrease at time t in category L is calculated as

$$f_{Lt}^{+} = \frac{\sum_{l \in U_L} p_{lt}^{+}}{\sum_{l \in U_L} p_{lt}^{+} + \sum_{l \in U_L} p_{lt}^{-} + \sum_{l \in U_L} p_{lt}^{0}}$$

$$f_{Lt}^{-} = \frac{\sum_{l \in U_L} p_{lt}^{-}}{\sum_{l \in U_L} p_{lt}^{+} + \sum_{l \in U_L} p_{lt}^{-} + \sum_{l \in U_L} p_{lt}^{0}}$$

where U_L is the sample of all units (elements) belonging to category (set) L.

The frequency of a price change f_{Lt} at time t in category L is calculated as $f_{Lt} = f_{Lt}^{+} + f_{Lt}^{-}$.

The weighted frequency of a price increase f_{Lt}^{w+} is calculated according to

$$f_{Lt}^{w+} = \frac{\sum_{l \in U_L} w_{lt} p_{lt}^{+}}{\sum_{l \in U_L} w_{lt} p_{lt}^{+} + \sum_{l \in U_L} w_{lt} p_{lt}^{-} + \sum_{l \in U_L} w_{lt} p_{lt}^{0}}$$

where w_{lt} is the weight of unit l at time t.

The frequency f_{LT}^{+} of a price increase over a time period T in category L is calculated as

$$f_{LT}^{+} = \frac{\sum_{l \in U_L, t \in T} p_{lt}^{+}}{\sum_{l \in U_L, t \in T} p_{lt}^{+} + \sum_{l \in U_L, t \in T} p_{lt}^{-} + \sum_{l \in U_L, t \in T} p_{lt}^{0}}.$$

The weighted duration d_T^w is calculated as the inverse of the weighted frequency

(A1) $$d_T^w = \left(f_{LT}^w\right)^{-1}$$

For Table A2 in the appendix different formulas have been applied to allow comparison with Bils and Klenow (2002). There the median and the average price duration are calculated according to

(A2) Median price duration: $$T_{50,LT} = \frac{\ln(0.5)}{\ln(1 - f_{LT})}$$

(A3) Average price duration: $$\overline{T}_{LT} = \frac{1}{\ln(1 - f_{LT})}$$

Synchronisation:

In case of perfect synchronisation all variance should be attributed to the grand mean and none to the months. The respective standard deviation is given by

$$s_L^{\max} = \sqrt{f_L(1 - f_L)}\,.$$

In case of perfect staggering all variance should be attributed to the months and none to the grand mean. The respective standard deviation is given by

$$s_L = \sqrt{\frac{1}{T}\sum_{t=1}^{T}(f_{Lt} - f_L)}$$

The synchronisation ratio is the ratio of the standard deviation due to staggering to the standard deviation due to synchronisation.

(A4) Synchronisation ratio $$sync_L = \frac{s_L}{s_L^{\max}}$$

Accordingly, this synchronisation ratio is 0 in case of perfect staggering and 1 in case of perfect synchronisation.

Hazard rate:

Let T denote a continuous random variable that represents the duration of a price spell.

The survival function $S(t)$ gives the probability that a price is still unchanged at time t

$S(t) = P(T \geq t)$.

The hazard function $h(t)$ is defined as the probability that a price that has not be changed before time t is changed in the short intervall dt after t

(A5) $$h(t) = \lim_{dt \to 0} \frac{P(t \leq T < t + dt | T \geq t)}{dt}.$$

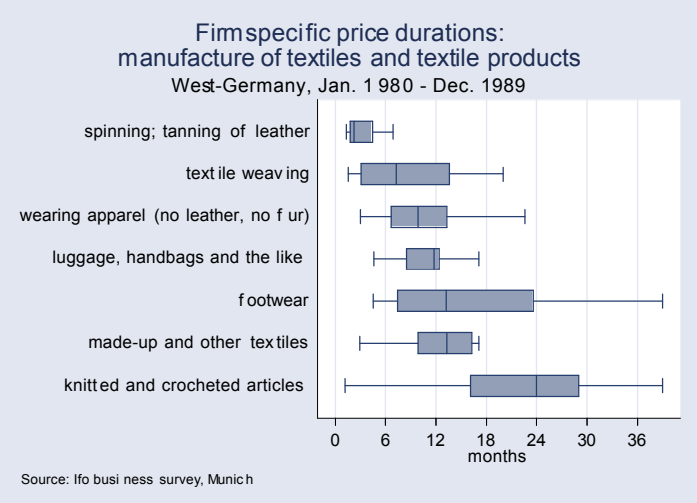
The state specific hazard rate or transition intensities $h_j(t)$ is defined as the probability that a price that has not be changed before time t is changed in the short intervall dt after t and is changed to state j

(A6) $$h_j(t) = \lim_{dt \to 0} \frac{P(t \leq T < t + dt, D_j = 1 | T \geq t)}{dt},$$

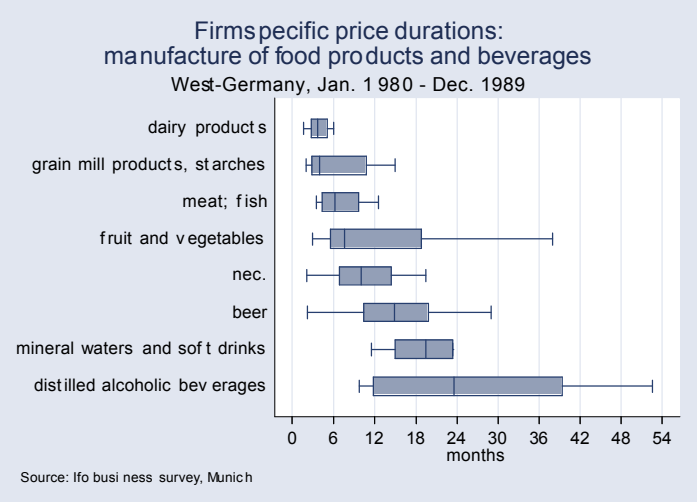
where D_j is a dummy variable that takes the value 1 if is state j is entered and 0 otherwise. States are here price increase or price decrease.

Annex II - Graphs and Tables

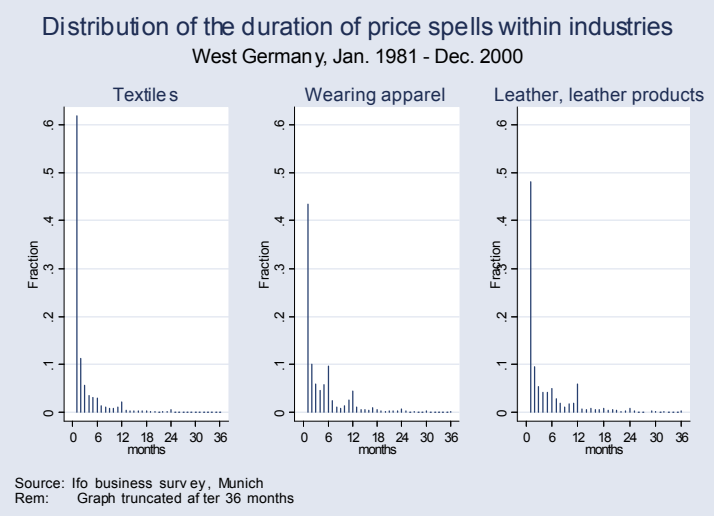
Graph A1.



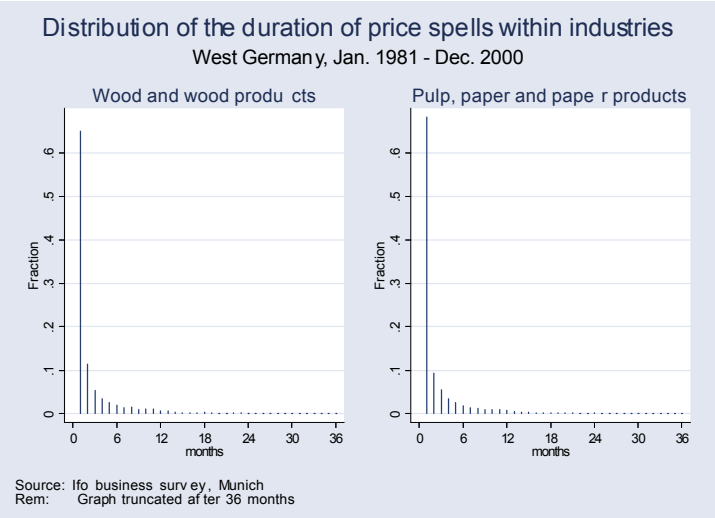
Graph A2.



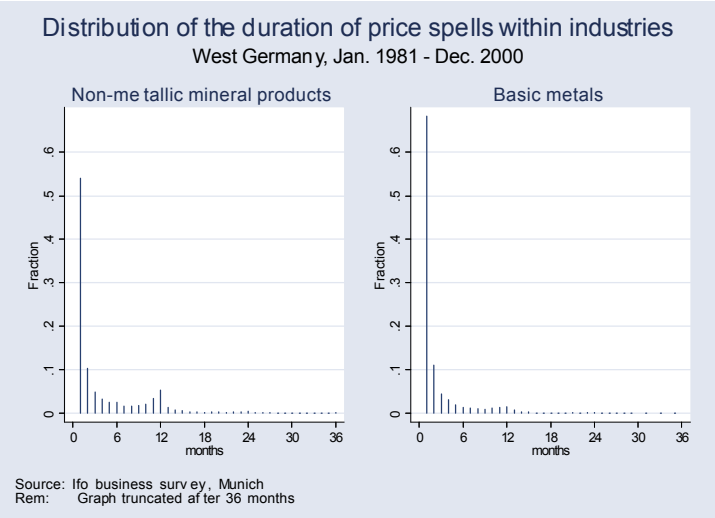
Graph A3.



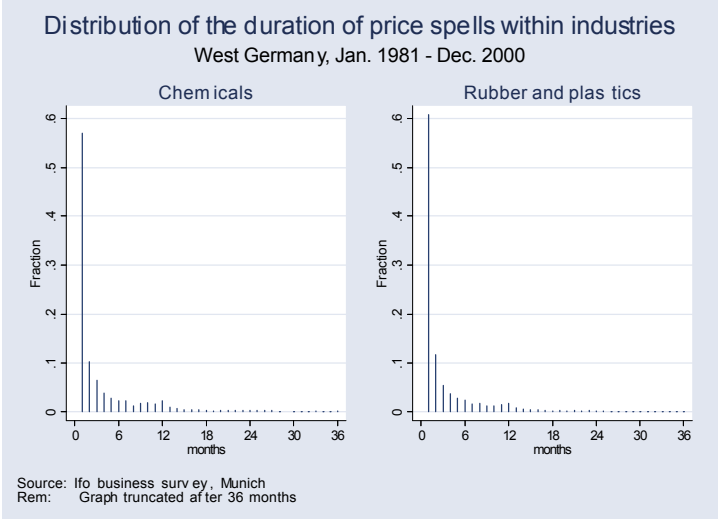
Graph A4.



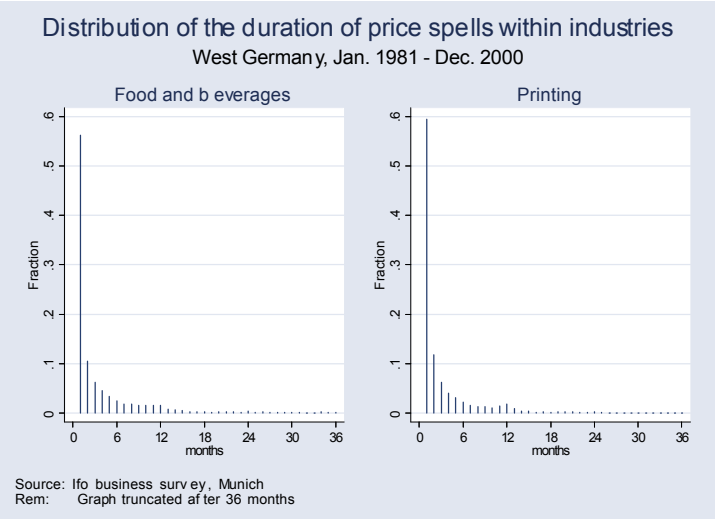
Graph A5.



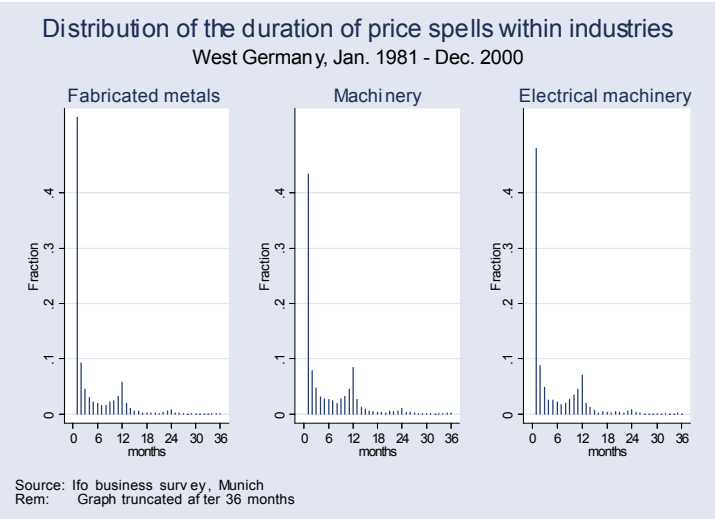
Graph A6.



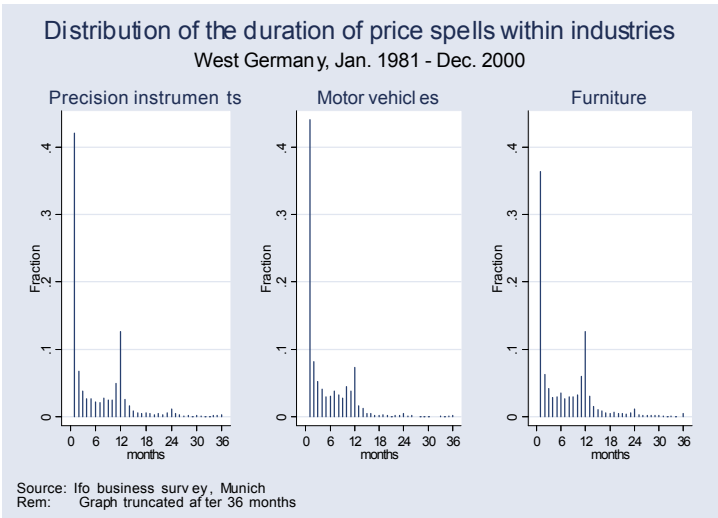
Graph A7.



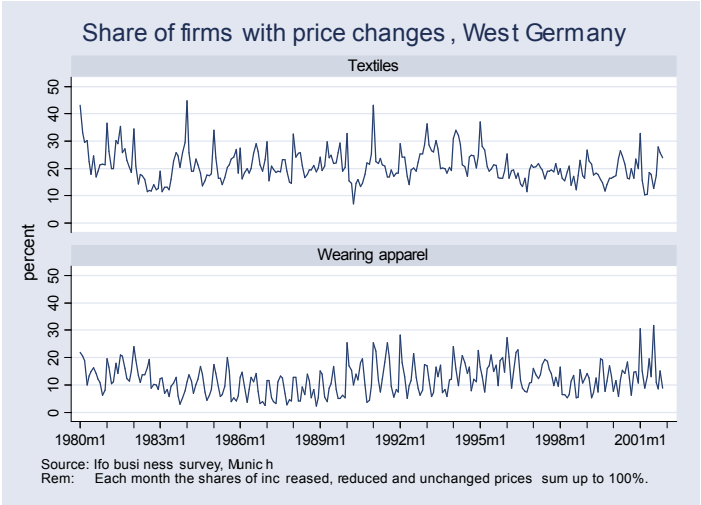
Graph A8.



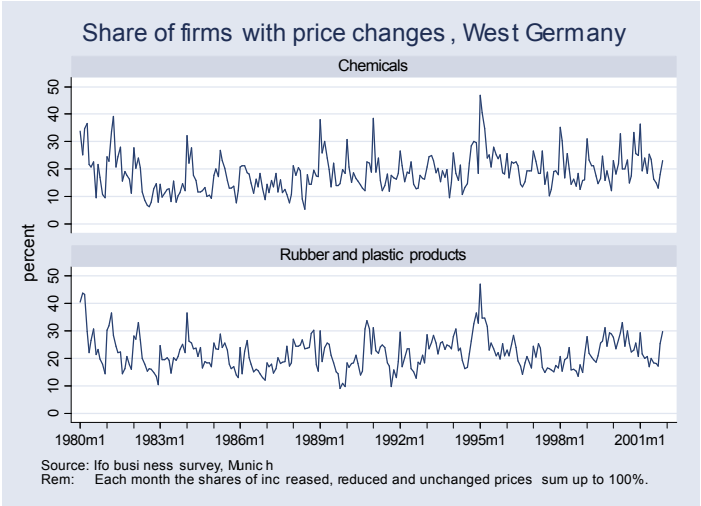
Graph A9.



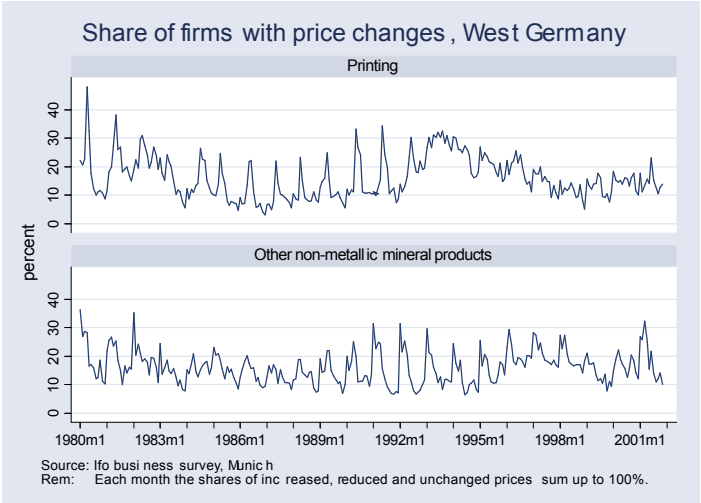
Graph A10.



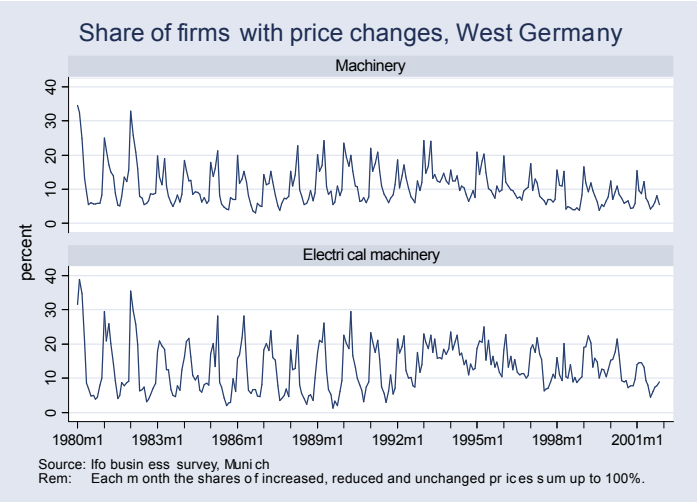
Graph A11.



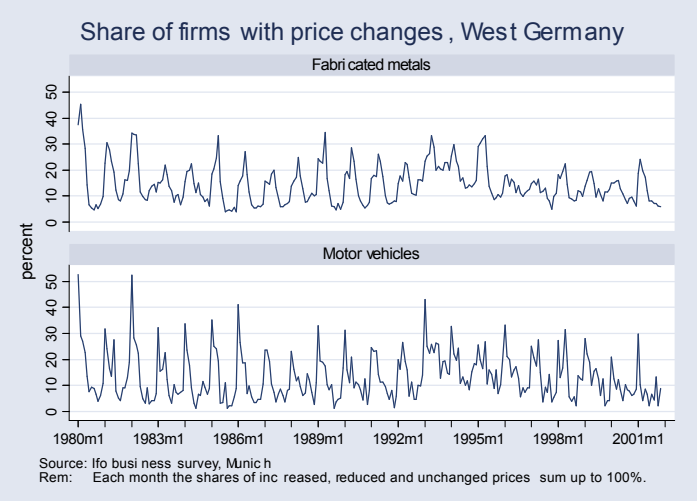
Graph A12.



Graph A13.



Graph A14.



Graph A15.

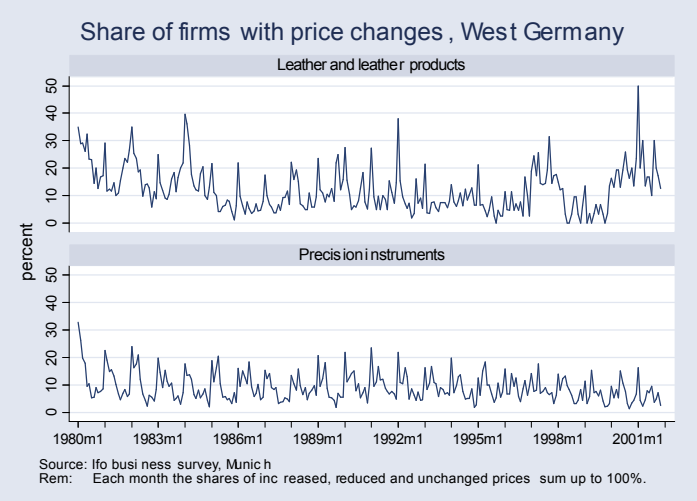


Table A1. Analysing the variance of frequency of price changes, mean square errors

Nace	Type of good	individual effect	yearly effect	monthly effect	adj. R-square
151	CN	0.48	0.93	0.34	0.08
152	CN	1.02	0.40	0.14	0.08
153	CN	1.25	0.68	0.15	0.10
155	CN	1.82	0.69	0.71	0.09
156	A	3.02	0.40	0.54	0.16
158	CN	2.21	0.17	0.27	0.15
159	CN, A	0.54	0.36	0.41	0.09
171	A	4.04	1.73	0.23	0.14
172	A	3.44	0.83	0.58	0.19
173	A	1.06	0.70	0.11	0.14
174	CN	1.05	0.27	0.40	0.15
175	A (CN)	0.32	0.08	4.83	0.40
177	CN	3.77	0.17	0.24	0.44
182	CN	0.46	0.88	1.69	0.07
191	A (CN)	0.20	1.26	0.17	0.08
192	CN	0.27	0.36	1.88	0.17
193	CN	0.50	0.97	0.58	0.13
201	A	3.75	6.82	1.00	0.26
202	A	6.02	0.62	0.54	0.24
203	A	0.45	0.61	0.22	0.06
204	A	0.83	3.83	0.13	0.18
211	A	1.79	3.86	2.06	0.12
212	A	3.29	13.50	1.43	0.19
222	A (CN)	1.66	7.36	3.86	0.14
243	A (CN)	1.81	0.84	0.98	0.20
245	CN	0.58	0.07	0.04	0.06
249	CN	2.78	0.49	0.47	0.16
251	A	0.28	0.47	0.70	0.06
252	A	4.22	2.10	3.27	0.22
261	A	0.50	0.79	0.50	0.06
262	A	1.20	0.21	1.35	0.15
263	A	.	.	.	.
264	A	3.38	0.57	0.50	0.21
265	A	0.29	0.73	1.13	0.12
266	A	1.52	1.32	0.23	0.15
267	A	1.02	0.32	0.29	0.08
268	A	4.08	0.41	1.38	0.21
274	A	7.77	0.54	0.55	0.30
275	A	1.43	0.07	2.52	0.20

Rem. The dominating effect is shaded
Basic goods (A), Investment goods (B), Durable consumer goods (CD), Non-durable consumer goods (CN)
(cont. next page)

Table A1. Analysing the variance of frequency of price changes, mean square errors (cont.)

Nace	Type of good	individual effect	yearly effect	monthly effect	adj. R-square
281	A	1.19	1.14	0.42	0.10
284	A	2.73	0.94	5.00	0.25
286	A	0.23	0.27	7.11	0.10
287	A	1.02	0.58	2.46	0.10
291	B	0.73	0.89	7.37	0.11
292	B	1.52	0.29	1.46	0.13
293	B	0.39	0.12	0.49	0.04
294	B	0.24	0.08	1.81	0.06
295	B	0.72	0.77	2.64	0.09
297	CD	0.75	1.11	1.21	0.11
311	B	0.43	0.32	4.27	0.09
312	A	0.27	0.24	3.44	0.14
313	A	1.02	0.39	1.37	0.11
315	A	0.84	0.27	1.99	0.13
322	B	0.05	0.06	0.37	0.06
331	B	0.17	0.06	0.36	0.03
332	B	0.12	0.17	1.86	0.07
334	CD	0.22	0.12	0.56	0.05
335	CD	0.31	0.18	0.14	0.04
341	B	0.03	0.10	0.60	0.03
343	A (B)	0.53	0.22	4.94	0.19
351	B	0.61	0.19	0.01	0.09
361	CD	0.29	0.03	2.70	0.05
365	CN	0.03	0.03	2.91	0.30
366	CN	0.10	0.06	0.24	0.02

Rem. The dominating effect is shaded

Basic goods (A), Investment goods (B), Durable consumer goods (CD), Non-durable consumer goods (CN)

Table A2. Mean durations by Nace -3 digit code

Nace	Mean		Percentiles 25%		Median		75%		Number of price observations per year	
	81-90	91-00	81-90	91-00	81-90	91-00	81-90	91-00	81-90	91-00
151	4.5	3.9	1.6	1.5	3.2	2.9	6.0	5.2	122	127
152	6.9	6.9	2.3	2.3	4.9	4.9	9.4	9.4	70	48
153	6.2	6.3	2.1	2.2	4.4	4.5	8.4	8.5	129	112
154	.	-	.	-	.	-	.	-	.	13
155	3.4	3.8	1.3	1.5	2.5	2.8	4.5	5.1	163	91
156	3.2	2.9	1.3	1.2	2.4	2.2	4.3	3.8	84	60
157	.	-	.	-	.	-	.	-	.	17
158	14.8	16.9	4.6	5.2	10.4	11.8	20.4	23.2	179	196
159	12.5	14.6	4.0	4.6	8.8	10.3	17.2	20.1	458	323
160	10.1	11.2	3.3	3.6	7.1	7.9	13.8	15.3	63	44
171	3.0	2.8	1.2	1.2	2.3	2.1	4.0	3.6	437	262
172	5.8	6.1	2.0	2.1	4.1	4.4	7.8	8.3	520	275
173	8.3	6.5	11.3	8.9	5.9	4.7	2.7	2.2	34	37
174	8.0	9.9	2.7	3.2	5.7	7	10.9	13.5	85	65
175	10.8	13.5	3.5	4.2	7.6	9.5	14.7	18.5	107	81
176	6.6	4.7	1.9	1.4	4.6	3.3	9.2	6.5	28	30
177	15.8	17.4	4.9	5.4	11.1	12.2	21.7	24.0	136	82
182	9.4	8.1	3.0	2.7	6.6	5.7	12.8	11.0	715	384
191	3.4	4.0	4.5	5.4	2.5	3	1.3	1.5	79	36
192	9.7	11.2	3.1	3.6	6.9	7.9	13.2	15.3	131	84
193	13.6	21.1	4.3	6.4	9.6	14.8	18.7	29.0	167	103
201	3.6	3.6	1.4	1.4	2.6	2.6	4.8	4.8	363	255
202	3.8	2.9	1.4	1.2	2.8	2.2	5.0	3.9	202	156
203	6.5	5.5	2.2	1.9	4.6	3.9	8.8	7.4	127	178
204	5.6	5.7	2.0	2	4.0	4.1	7.6	7.8	109	117
211	4.1	2.8	1.5	1.2	3.0	2.1	5.4	3.6	391	344
212	4.6	3.7	1.7	1.4	3.3	2.7	6.1	4.9	590	486
222	7.3	6.3	2.5	2.2	5.2	4.5	9.9	8.5	2333	1564
230	-	-	-	-	-	-	-	-	39	43
243	5.6	7.3	2.0	2.5	4.1	5.2	7.6	10.0	130	108
245	13.2	21.1	4.2	6.4	9.3	14.8	18.2	29.0	42	57
247	4.8	3.8	6.5	5	3.5	2.8	1.7	1.4	26	24
249	6.0	3.8	2.1	1.5	4.3	2.8	8.1	5.1	263	481
251	6.7	7.1	2.3	2.4	4.8	5	9.1	9.6	103	107
252	5.6	5.2	2.0	1.8	4.0	3.7	7.5	7.0	1297	957
261	9.5	8.5	3.1	2.8	6.7	6	13.0	11.6	287	251
262	8.9	10.6	2.9	3.4	6.3	7.5	12.1	14.5	122	128
263	6.0	7.8	8.1	10.6	4.3	5.6	2.1	2.6	34	29
264	5.2	4.6	1.8	1.7	3.7	3.3	7.0	6.1	167	132
265	10.9	10.1	3.5	3.3	7.7	7.2	14.9	13.8	129	109
266	4.8	4.3	1.7	1.6	3.5	3.2	6.4	5.8	159	190
267	8.1	6.2	2.7	2.2	5.7	4.5	11.0	8.5	115	110
268	3.8	3.6	1.4	1.4	2.8	2.7	5.0	4.8	190	145

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Table A2. Mean durations by Nace -3 digit code (cont.)

Nace	Mean		Percentiles 25%		Median		75%		Number of price observations per year	
	81-90	91-00	81-90	91-00	81-90	91-00	81-90	91-00	81-90	91-00
271	.	-	.	-	.	-	.	-	.	27
272	.	-	.	-	.	-	.	-	.	11
274	2.7	2.5	1.1	1.1	2.0	1.9	3.5	3.3	177	152
275	5.7	5.4	2.0	1.9	4.1	3.9	7.6	7.3	900	815
281	5.6	5.4	2.0	1.9	4.1	3.9	7.6	7.3	271	378
282	5.9	5.1	2.1	1.8	4.2	3.7	8.0	6.9	47	47
283	-	-	-	-	-	-	-	-	21	21
284	5.0	4.9	1.8	1.8	3.6	3.6	6.7	6.6	255	240
285	.	-	.	-	.	-	.	-	.	23
286	9.8	8.1	3.2	2.7	7.0	5.7	13.4	11.0	661	525
287	7.7	7.9	2.6	2.6	5.5	5.6	10.5	10.8	432	303
291	8.0	8.0	2.7	2.7	5.7	5.7	10.9	10.9	717	629
292	8.0	9.4	2.7	3.1	5.7	6.7	10.9	12.9	417	374
293	8.1	10.7	2.7	3.4	5.7	7.6	11.0	14.6	185	120
294	11.2	10.1	3.6	3.3	7.9	7.2	15.4	13.9	470	376
295	10.2	10.1	3.3	3.3	7.2	7.2	14.0	13.9	931	796
297	11.1	15.3	3.5	4.8	7.8	10.8	15.2	21.0	325	298
300	8.2	-	2.7	-	5.8	-	11.1	-	47	25
311	8.4	7.2	2.8	2.4	6.0	5.1	11.4	9.7	523	422
312	9.8	7.9	3.2	2.6	7.0	5.6	13.4	10.7	273	251
313	6.7	4.3	2.3	1.6	4.8	3.1	9.1	5.7	124	110
314	.	-	.	-	.	-	.	-	.	8
315	7.6	8.1	2.5	2.7	5.4	5.8	10.3	11.0	152	191
316	.	-	.	-	.	-	.	-	.	16
321	5.4	5.7	1.9	2	3.9	4.1	7.2	7.7	246	211
322	11.1	6.2	3.6	2.1	7.9	4.4	15.2	8.3	55	47
323	10.6	8.8	3.4	2.9	7.5	6.2	14.5	12.0	113	67
331	9.6	15.8	3.1	4.9	6.8	11.1	13.2	21.7	166	117
332	9.8	9.5	3.2	3.1	6.9	6.7	13.3	13.0	386	261
333	.	-	.	-	.	-	.	-	.	15
334	12.4	14.3	3.9	4.5	8.7	10.1	16.9	19.7	218	159
335	-	-	-	-	-	-	-	-	40	23
341	8.9	11.5	2.9	3.7	6.3	8.1	12.2	15.8	92	78
342	-	9.0	-	3	-	6.4	-	12.3	37	50
343	7.7	5.6	2.6	2	5.5	4.0	10.4	7.6	264	218
351	-	20.9	-	6.4	-	14.6	-	28.7	40	48
352	.	22.4	.	6.8	.	15.7	.	30.9	.	43
354	-	-	-	-	-	-	-	-	24	19
361	8.9	10.4	2.9	3.4	6.3	7.4	12.2	14.3	865	653
362	.	-	.	-	.	-	.	-	.	9
363	.	-	.	-	.	-	.	-	.	8
364	.	-	.	-	.	-	.	-	.	4
365	11.3	12.5	3.6	3.9	8.0	8.8	15.5	17.1	135	92
366	10.9	12.4	3.5	3.9	7.7	8.7	15.0	16.9	95	74

Total	7.6	7.9	2.6	2.6	5.4	5.6	10.4	10.7

Table A3. Collective wage negotiations, claims and final agreements

year	duration of contract	duration in months	wage claim	date of wage claim	agreement	date of agreement	date of wage increase
1980	1. Feb. 80 / 31. Jan. 81	12	10.5%	27. Dec.	6.8%	14. Feb.	1. Mar.
1981	1. Feb. 81 / 31. Jan. 82	12	8%	12. Dec.	Feb., Mar.: 160 DM; 1. Apr.: 4.9%	29. Apr.	1. May
1982	1. Feb. 82 / 31. Jan. 83	12	7.5%	1. Dec.	Feb.: 120 DM; 1. Mar.: 4.2%	8. Mar.	1. Apr.
1983	1. Feb. 83 / 31. Jan. 84	12	6.5%	17. Dec.	3.2%	6. Apr.	1. May
1984 1985	1. Feb. 84 / 31. Mar. 86	26	3% + 35h	14. Dec.	1. Feb. to 30. Jun. 84: 0%; 1. Jul. to 31. Mar. 85: 3.3%; 1. Apr. 85 to 31. Mar. 86: 2.0% + (3.9% = reduction of working time from 40 to 38.5 h)	29. Jun.	1. Jul.
1986	1. Apr. 86 / 31. Mar. 87	12	7.5%	27. Mar.	Apr.: 230 DM; 1. May: 4.4%	19. May	1. Jun.
1987 1988 1989	1. Apr. 87 / 31. Mar. 90	36			1. Apr. to 31. Mar. 88: 3.7 % 1. Apr. to 31. Mar. 89: 2.0% reduction of working time from 38.5 to 37.5 h 1. Apr. to 31. Mar. 90: 2.5% reduction of working time from 37.5 to 37 h	23. Apr.	1. May
1990	1. Apr. 90 / 31. Mar. 91	12	9% + 35h=12%	12. Dec. 89	Apr., May.: 215 DM; 1. Jun. to 31. Mar.: 6.0% 1. Apr. 93: red. of working time: 37h to 36h 1. Oct. 95: red. of working time: 36h to 35h	4. May	1. Jun.

Table A3. Collective wage negotiations, claims and final agreements (cont.)

year	duration of contract	duration in months	wage claim	date of wage claim	agreement	date of agreement	date of wage increase
1991	1. Apr. 91 / 31. Mar. 92	12	10%	1. Feb.	Apr., May.: 290 DM; 6.7%	7. May	1. Jun.
1992 1993	1. Apr. 92 / 31. Dec. 93	21	not below 6% (3.12.) 9.5% (27.4)	3. Dec.	1. Apr. to 31. Mar. 93: 5.4% 1. Apr. to 31. Dec. 93: 3.0%; reduction of working time from 37 to 36 h (agreed in 1990) reduction of working time to 35h till 1. Oct. 95	19. May	1. Jun.
1994	1. Jan. 94 / 31. Dec. 94	12	5.5%	before 6.12.93	1. Jan. to 31. May.: 0% 1. Jun. to 31. Dec.: 2%	5. Mar.	1. Jun. 94
1995 1996	1. Jan. 95 / 31. Dec. 96	24	6%	before 6. 12. 94	Jan to Apr.: 152.50 DM 1. May to 31. Oct.: 3.4% 1. Nov. 95 to 31. Dec. 96 3.6%	7. Mar.	1. Apr.
1997 1998	1. Jan. 97 / 31. Dec. 98	24			Jan. Mar.: 200 DM 1. Apr. to 31. Mar. 98: 1.5% 1. Apr. to 31. Dec.: 2.5%	5. Dec. 96	1. Jan.
1999	1. Jan. 99 / 29. Feb. 00	14	6.5%	“autumn”	Jan., Feb.: 350 DM + 1% yearly wage 1. Mar. to 29. Feb 00: 3.2%	19. Feb.	1. Mar.
2000 2001	1. Mar. 00 / 28. Feb. 02	24	4%	Nov.	Mar., Apr.: 165 DM 1. May to 30. Apr. 01: 3.0% 1. May to 28. Feb. 02: 2.1%	28. Mar.	1. Apr.

Rem: The wage claim, the date of the wage claim and the date of the final agreement are taken from the “Handelsblatt”, a German business newspaper or from the internet site of the trade unions (Tarifarchiv).

Table A4. Summary statistics (shares in percent)

	1981-1990	1991-2000
expected demand change during the next six months		
demand decrease expected	19.9	21.5
no change expected	65.0	62.7
demand increase expected	15.1	15.8
expected market evolution in the medium run (5 years)		
significant growth	8.0	4.5
unchanged or slight growth or contraction	74.5	79.7
significant contraction	1.9	5.2
missing	15.7	10.6
technical capacity given actual and expected orders within the next 12 months		
own firm:		
not sufficient	6.7	4.6
sufficient	66.9	64.2
more than sufficient	26.4	31.2
stocks of finished products		
too large	14.5	15.4
sufficient	38.1	36.6
too small	4.8	3.9
no stocks	42.5	44.1
exports		
no exports	3.0	2.4

Table A5. Number of firms according to the length of their participation (including periods of non-participation)

Length of participation (m=months/y= years)	West Germany	East Germany	Total
1m	658	1 153	1 811
2m to 12m	741	983	1 724
1< x <= 2y	607	647	1 254
2< x <= 3y	574	557	1 131
3< x <= 4y	482	333	815
4< x <= 5y	455	259	714
5< x <= 6y	439	141	580
6< x <= 7y	336	184	520
7< x <= 8y	270	87	357
8< x <= 9y	242	131	373
9< x <=10y	214	151	365
10< x <=11y	270	166	436
11< x <=12y	221	0	221
12< x <=13y	207	0	207
13< x <=14y	241	0	241
14< x <=15y	233	0	233
15< x <=16y	222	0	222
16< x <=17y	235	0	235
17< x <=18y	200	0	200
18< x <=19y	196	0	196
19< x <=20y	178	0	178
20< x <=21y	184	0	184
21< x <=22y	1 833	0	1 833
Total	9 238	4 792	14 030

Table A6. Number of observed periods according to the length of uninterrupted participation

Length of uninterrupted participation (m=months/y= years)	number of periods	share in %	number of monthly observations	share in %
1m	85 865	48.1	85 865	6.7
2m	26 577	14.9	53 154	4.2
3m	13 649	7.7	40 947	3.2
4m	9 879	5.5	39 516	3.1
5m	6 117	3.4	30 585	2.4
6m	4 512	2.5	27 072	2.1
7m	3 460	1.9	24 220	1.9
8m	2 735	1.5	21 880	1.7
9m	2 196	1.2	19 764	1.6
10m	1 899	1.1	18 990	1.5
11m	1 836	1.0	20 196	1.6
12m	1 391	0.8	16 692	1.3
1< x <= 2y	8 116	4.6	141 189	11.1
2< x <= 3y	3 376	1.9	101 398	8.0
3< x <= 4y	1 767	1.0	74 122	5.8
4< x <= 5y	1 156	0.7	62 503	4.9
5< x <= 10y	2 339	1.2	195 901	15.4
10< x <=15y	766	0.4	111 745	8.8
15< x <=20y	452	0.3	94 499	7.4
20< x <=22y	368	0.2	94 644	7.4
Total	178 456	100	1 274 882	100

Table A7. Number of censored and uncensored spells

Censoring	number of spells	share in %
complete	25 299	44.0
left censored	7 576	13.2
right censored	7 576	13.2
left and right censored	17 071	29.7
Total	57 522	100.0