Price Rigidity in German Manufacturing*

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November, 2004

Preliminary and incomplete!

Abstract:

Price setting in German manufacturing is analysed using a monthly panel of individual price data for more than 2 500 plants 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 a rather atheoretical duration model is estimated. Price changes follow a nonstationary process with lagged duration dependence. Price increases can be explained by a combination of state-dependence and time-dependence. Time-dependence comes in by seasonal effects and by a u-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.

Keywords: price rigidity, duration analysis

JEL-Classification: D43, E31, L11

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* This paper was written as part of the joint Eurosystem „Inflation Persistence (research) Network“ (IPN). My thanks to Ifo Institut, Munich, for giving me access to their data.
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1 Introduction

Price rigidity lies at the heart of the micro foundations of modern macro economic inflation models. Nevertheless there are only few empirical studies on that issue based on micro data and even fewer regarding European countries. With the exception of Carlton (1986) these studies investigate consumer prices at the retail level. The shortcoming of this approach is the neglect of potentially explanatory variables. Though from the perspective of policy makers consumer prices are more interesting than producer prices, most theories on price rigidity are much more suited to producer prices. Perhaps the Carlton paper with its focus on large firms producing a wide range of basic products to a host of customers was to the detriment to producer prices. His data clearly showed that prices and the length of contracts were differentiated according to customers. The present study demonstrates that it is possible to draw interesting conclusions from producer price data. Yet, after presenting a brief description of patterns of price setting of the whole manufacturing sector, it investigates more thoroughly the price setting for investment goods. This is done in a multivariate duration model that includes variables for demand, costs, capacity utilisation, stocks of finished products and price setting of potential competitors. The data source is the monthly business cycle survey for manufacturing from the ifo Institut, a German business research institute. Individual data records are available since 1980. Because of confidentiality restrictions and a change in the questionnaire, the data ends November 2001.

With this dataset it is shown that at the micro level prices follow a nonstationary process with lagged duration dependence. No attempt is made, to measure the effect on the aggregate price level. Several aspects of price setting at the individual level e.g. time dependent versus state dependent price setting and staggering versus synchronisation are investigated.

The paper is organised as follows. The next section introduces 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. A comparison with some of Carlton's results, as far as possible, is included. Sections 3 shows that there is a lot of heterogeneity in the data. Therefore, in sections 4 and 5 analysis is restricted to investment goods, including some durable consumer goods like household appliances. Section 4 describes the wage bargaining process in these industries, which plays a prominent role in the following analysis. In section 5 an empirical duration model is estimated. Section 6 concludes.

2 The Data

The data source is the monthly business cycle survey for manufacturing from the ifo Institut für Wirtschaftsforschung in Munich, from January 1980 to November 2001. A translated version of the questionnaire can be found in annex III. The whole data set covers 1.3 million observations. Firms are asked at plant level. The sample is not random but by purpose. Big plants are overrepresented. The number of participants dropped from about 4 500 in 1980 (monthly average) to 2 500 in 2000. The data set is organised as a panel. Firms are thrown out of the panel if they do not report for a certain time. Tables A1 to A3 in the appendix provide some information on the length of participation.

The somewhat peculiar phrasing of question 7 in the questionnaire (s. annex III) "Allowing for changes in sales conditions, our domestic sales prices (net) for XY in the course of the last month were raised, left unchanged, reduced" was introduced during the early fifties, when researches noticed that every January too much price changes were reported compared to the price index of the national statistical institute. Probably firms reported list prices. Since the introduction of this phrase the official price index and the estimated index from the survey data are roughly in line again.

Plants report for 483 narrow product groups. Industries not covered by the survey are NACE 221 "Publishing" and NACE 37 "Energy" that belonged to other sectors before the introduction of the NACE in Germany. In terms of PPI-weights 94 percent of manufacturing is covered by the survey but half of "Publishing, printing and reproduction of recorded media" is missing. Manufacturing itself covers 83 percent of PPI.

Some qualifications to the degree of disaggregation of product groups 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 and in the manufacture of basic metals, some firms refuse answers for detailed product groups and report only a kind of index, e.g. “compared to last month prices have increased for 30 percent of total sales”. The reason behind is that either the information is too sensitive or the firms say that otherwise they cannot give meaningful results. What makes this remarkable is that these are the industries Carlton focused on. 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.

Further monthly questions concern changes in demand (Q. 4), inventories of finished products (Q. 3). In addition, there is a monthly question on expectations for the next six months on the “business sentiment” (Q. 12). Following other studies, e. g. König and Seitz (1991) the expectations on business sentiment are taken in this study as proxy variable for expected demand. This is not innocuous since the expected business sentiment may include expected changes in profits due to price increases. But to a large extent it is based on already ongoing negotiations (ifo, 1989)

Additionally, there are quarterly quantitative questions on capacity utilisation and once a year it is asked for information on innovation activity. Unfortunately, there is no information on costs in the survey. Aggregated data has to be used instead.

3 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 periods of time. For simplicity, the time period has been divided evenly into 1981 to 1990 and 1991 to 2000, disregarding the years 1980 and 2001. In 2001 the December is missing, in 1980 most of June. To be in line with the other studies within the IPN the approach of Bils and Klenow (2002) has been adopted to measure the duration of a price spell, i. e. the time a price is not changed. The weighted mean duration is calculated as the weighted inverse of the frequency of price changes (s. formula (A1) in annex II). This is also the only way to deal with the questionnaires that give answers only for a share of the total firm, mentioned in the previous section.

3.1 Average price durations

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.

Table 1: Mean duration of price spells (in months) during the eighties and the nineties by type of good

Period	1981-1990	1991 to 2000	Weights
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	7.9	
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). The weights are those of the PPI for the base year 1995.
2. 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 prices of machinery and chemicals including petroleum refinement over a longer time horizon (s. table A4) 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.

Quite volatile prices (less than 4 months) are found for simple, basic products and food that cannot be preserved well. All products with a high degree of nominal price rigidity

(5 quarters and more) are consumer goods, non-durables (CN) and durables (CD). Table A5 in the appendix provides means and medians for three-digit NACE industries.

3.1.1 Comparison with results 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 the United States. 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.

Table 2: Duration of price spells in Germany and the United States (in months)

	United States (Carlton)		Germany (Ifo)	
Product group	Mean Duration Transactions	Mean Duration Price Spells	Median Duration Price Spells	Mean Duration 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

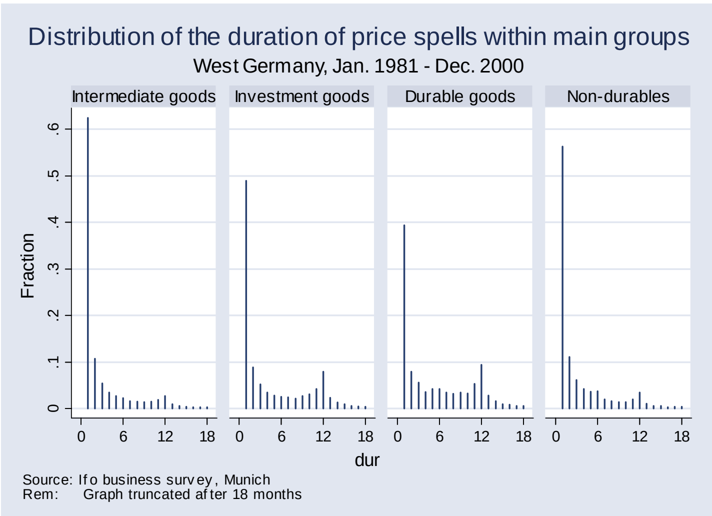
Durations in Germany between 1981 and 1990 are roughly two months shorter than in the United States between 1957 and 1966. The average duration of about half a year for refined petroleum products seems implausible. The large increase in the level and volatility of energy costs since the oil crises in 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 A4. 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 in price durations 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.

For New Zealand, for the period from 1984 to 1995, Buckle and Carlson (2000) find an average duration of prices for manufacturing and building firms of 6.7 months.

3.2 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 biased since short spells are overrepresented due to unavoidable length based sampling (Flinn and Heckman, 1982). But this should have only negligible consequences for the shape of the density, e.g. the number of modes.

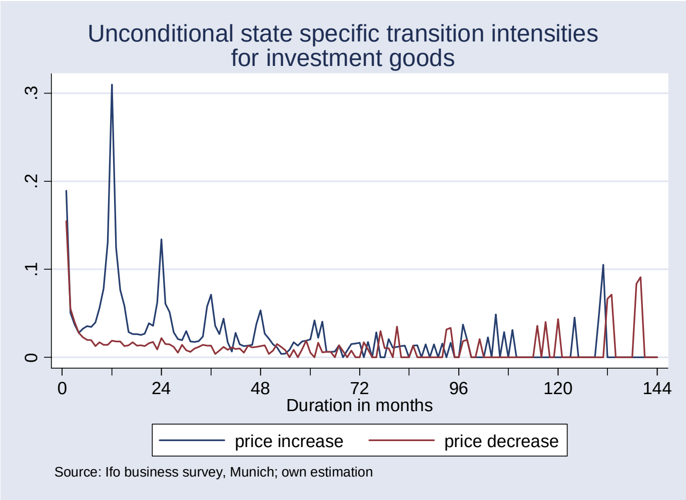
Figure 1



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 (Calvo, 1983) 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 hazard function. In case of a distinction between price increases and price decreases it is called transition intensity (s. appendix, formulas A2 and A3). Figure 2 shows Kaplan-Meier (s. Kalbfleisch and Prentice, 2002) estimates for these intensities for investment goods. Since the Kaplan-Meier estimator is able to handle right-censoring only left censored spells are ignored.

Figure 2:



Out of all prices for investment goods that have not been changed for 12 months, 33% are increased during the 12th 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.

3.3 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. Figures 3 and 4 show examples of typical time-patterns for the time period from January 1980 to November 2001.

Figure 3:

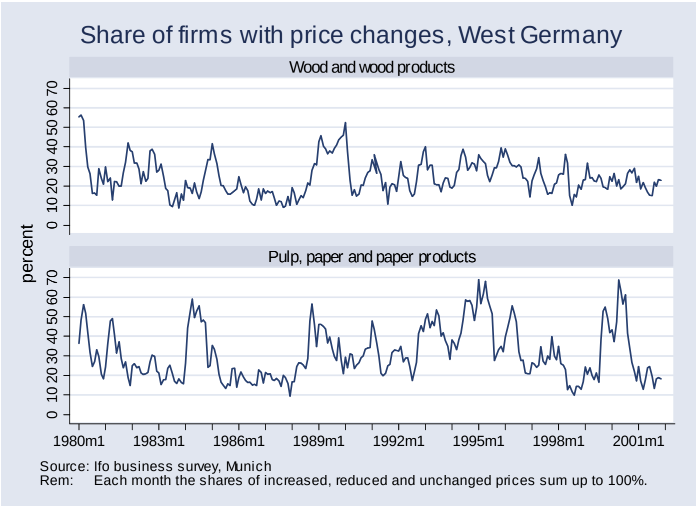
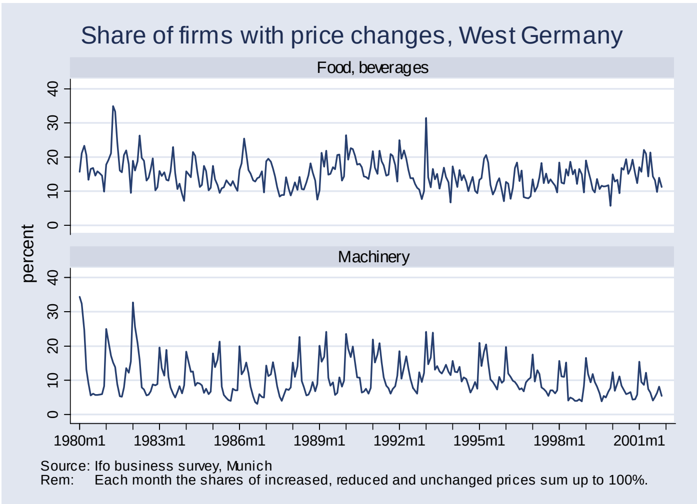


Figure 4:



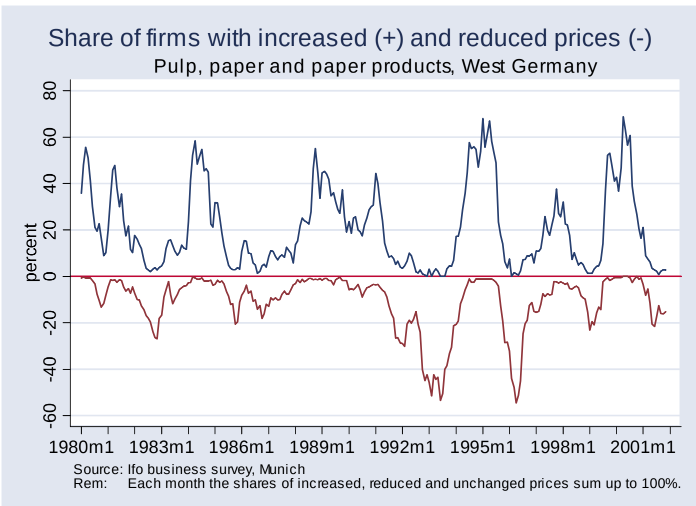
For obvious reasons the pattern of figure 3 shall be called ‘cyclical’, the pattern of ‘Machinery’ in Figure 4 - during the eighties - ‘seasonal’ and the pattern of ‘Food, beverages’ in Figure 4 ‘idiosyncratic’. (Further Figures, Figure A10 to Figure A15, can be found in the appendix.)

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, with years and months taken as proxy variables for cyclical and seasonal effects (see Table A6 in the appendix). The seasonal effect dominates in the investment goods producing industries and in the durable consumer goods producing industries. The individual effect dominates in most of intermediate products and non-durable consumer goods. The cyclical effect dominates in only a few industries but there is no clear pattern.

The analysis of variance is not meant for formal analysis since it is not performed on grouped data but for binary variables that do not follow a normal distribution. Yet, some tentative conclusions can be drawn. In many three digit industries these three effects explain less than 10% of the total variance. That is rather disappointing despite the fact that because of the underlying linear probability assumption errors are not normal and estimation is inefficient. Besides a few industries there seems to be a lot of heterogeneity in the data that is not captured by these simple effects. That is an indication for state dependent price setting.

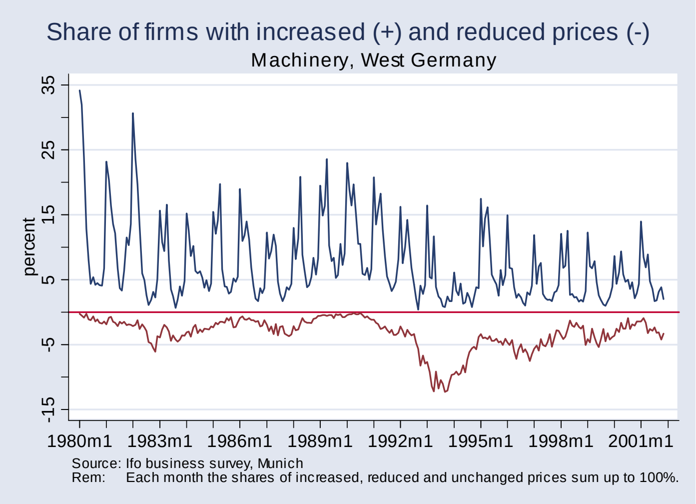
Figures 5 and 6 show strikingly different patterns of price increases and price reductions between industries. Whereas in "Manufacture of pulp, paper and paper products" periods of price increases and price reductions alternate, with frequencies being of the same order, in the investment goods producing industries price increases and price reductions follow a different pattern.

Figure 5:



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.

Figure 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 Figure 6. The strong seasonal pattern of the price increases may be explained by a true unexplained seasonality and by collective wage bargaining that is explained in the next section.

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

In Germany (former FRG) wage setting in the metal-working industries, which include beside the investment goods some additional goods like valves and household appliances, 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

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

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. 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, i.e. 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.

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

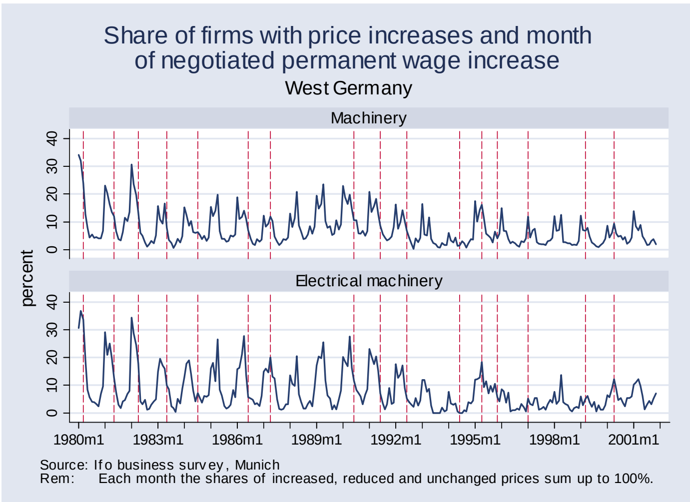
15 May 2002 restart of negotiations and pilot agreement in Baden-Württemberg

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 A7 summarizes the wage bargaining process for the years from 1980 to 2001. Figure 7 shows that price increases take place mainly between January and the month of an increase in payments. Not included in the Figure are the wage increases during long-term contracts.

Figure 7:



During the periods of long-term wage contracts it was comparatively easy for firms to build expectations on the increase in marginal costs. However, Figure 7 shows basically no different pricing pattern during the periods of long-term wage contracts.

5 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. In this section the data is analysed within the framework of a multivariate duration model. The model is atheoretical but it is based on several models discussed in the literature. The analysis is restricted to West-Germany, mainly for practical reasons. In the early nineties there were a lot of drop outs in the data so that the longer spells are probably selective. Ignoring East-German data on the other hand is not selective since its share in total German manufacturing is so small. The wage bargaining process does not apply to East-Germany and their may be additional heterogeneity in the data due to the restructuring after unification and unobserved heterogeneity creates substantial problems for duration analysis.

5.1 Previous models in the literature

One of the earliest models is Taylor's model of staggered contracts (Taylor, 1980). It was developed to explain persistence in the level of unemployment but it can be modified to explain inflation persistence. The idea of staggered contracts is that not all decisions are made at the same time but that there is an overlap of contracts. Firms take into account the wages set by their competitors that will be in effect during their own contracts. They are both forward and backward looking in time. This creates some nominal inertia since shocks are passed from one contract to another.

Assume for simplicity that all contracts have a length of N periods. w_t is the wage of contracts beginning at time t. Small letters denote logs. The (log) aggregate price level p_t is determined by $p_t = \sum_{i=0}^{N-1} \Phi_{tk} w_{t-k}$, where a mark-up of one on nominal wages is applied. $\Phi_{tk} = 1/N$ for $k = 0,1,\ldots,N-1$ is the share of firms at time t that last time have changed price k periods ago. The model is closed by a simple money-demand function.

Taylor's model is already able to generate persistence in the price level even if there is no serial correlation in the error term and even if the driver variables exhibit no persistence. The reason is that by the overlap of contracts previous wages and shocks are transmitted into new contracts. Yet, this model is not able to create persistent inflation (Fuhrer and Moore, 1995). The persistence has to come from the driving variables or the error term. With two period Taylor contracts the price and the wage level are given by

$$\begin{aligned} p_t &= ½\left(w_t - w_{t-1}\right) \\ w_t &= ½\left(w_{t-1} + E_t w_{t+1}\right) + \gamma\, y_{t-1} \end{aligned} \tag{1}$$

where y_t is (log) excess demand at time t[4]. This implies for the inflation rate

$$\pi_t = E_t \pi_{t-1} + \gamma\, y_t\,. \tag{2}$$

Fuhrer and Moore show that Taylor contracts can be modified to generate inflation persistence if one is willing to assume that nominal wages are set by comparing their value in real terms with the value in real terms of previously negotiated wage contracts that are still in effect[5]. Traditional Taylor contracts instead compare nominal wage contracts with previous nominal wage contracts. In a footnote Fuhrer and Moore mention that the real contract price should be defined relative to the prices in effect over the life of the contract but empirically they find no difference. Their contracting results in

$$w_t - p_t = ½\left(w_{t-1} - p_{t-1} + E_t\left(x_{t+1} - p_{t+1}\right)\right) + \gamma\, y_t \tag{3}$$

and

$$\pi_t = ½\left(\pi_{t-1} + E_t \pi_{t+1}\right) + \gamma\, \hat{y}_t \tag{4}$$

What can be learned from the Taylor model and its extension by Fuhrer and Moore is that for inflation persistence both nominal and real rigidity is needed and

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[4] Rearranging yields $p_t = ½\left(p_{t-1} + E_t\, p_{t+1}\right) + \left(\gamma/2\right)\left(y_t + y_{t-1}\right)$

[5] Note that outside the steady-state for wage contracts p_t is the log price deflator of labour income while for price contracts p_t should be the deflator of profits. Depending on the cost function it should cover replacement costs for intermediate inputs, replacement costs for depreciation, the interest rate as "replacement costs" for credits and the earnings of management. There is a further notational

staggering of contracts. The previous discussion has also shown that with producer prices a careful modelling and interpretation of "the aggregate price level" is important.

The Taylor model easily achieves staggering because the time of price (wage) changes is exogenously given. Price setting is time dependent. Sheshinski and Weiss (1977) endogenize the time of a price change. Thus, their model is state-dependent. They consider a monopolistic firm i that produces a non-storable good whose demand depends on its price P_{it} relative to the price of rival products, considered as an aggregate P_t^c. The firm expects the aggregate price level, the price of rival products and its costs of production to increase at a constant rate of inflation π. The firm faces a fixed cost of price adjustment $r\beta$, where β are the real costs of nominal price adjustment and r is the real rate of interest. Under these assumptions and again the steady state assumption that all prices move with the same inflation rate the firm's price follows a periodic form

$$p_{i\tau} = p_{i\tau-1} + \pi k \qquad (5)$$

The duration of the price spell $k = t_\tau - t_{\tau-1}$ is fixed under the above assumptions. The firm's real price $z_{it} = p_{it} - p_t$ moves between two fixed values (s, S), where $S = s + \pi k$[6]. If the real price hits the lower bound s, the nominal price is moved instantaneously so that the new real price amounts to S. The relative magnitude of the price change and the duration of the price spells are related according to

$$k = \frac{S - s}{\pi} \qquad (6)$$

The model of Sheshinski and Weiss has strong implications. First, if a firm increases its price it is by the rate of inflation. Second, if the dates of price changes by firms are uniformly distributed, then the aggregate price level increase continuously at a constant rate, as expected by the firms.

inconvenience since firms should compare their prices with the prices of rival products and not all other products can be treated as rival goods with a common elasticity of substitution.

[6] For more on the solution of this kind of model see Dixit (1993).

Further, notice a crucial difference to Taylor-contracts. Assume for the time being that labour is the only input. Taylor-contracts are long-term contracts. As with the firm's producer price there is a flexible wage and a rigid wage. In the Taylor-model the firm's decision to change price depends on the rigid wage. In the Sheshinksi and Weiss-model it depends on the flexible wage. To be more specific, assume yearly long-run growth of labour productivity to be 3.0 percent and average inflation 1.8 percent and a wage setting rule that set wage growth to the sum of the growth of labour productivity and inflation. This would result in a yearly growth rate for wages of 4.8 percent. The firm in the Sheshinski-Weiss model optimises its price as if wages increased 0.4 percent each month. If the firm decided on its product price on the basis of the rigid wage, either the band of inaction would have to be larger than the pay increase or, in case of a collective wage agreement, all price increases would be synchronised, as with Taylor contracts, real or nominal, and there would be no inflation persistence.

Cecchetti (1985) investigates whether the (s,S)-bands are fixed or vary with the rate of inflation. He finds that "prices changed infrequently relative to changes in the economic environment" and proposes to understand the (s,S)-rule as a short-run rule of thumb, based on long-term expectations held some time in the past. Thus, his model is purely backward looking. His model is similar to Sheshinksi's and Weiss's (s,S)-model. Faced with lump-sum costs of price adjustment a firm changes price if its out-of-equilibrium costs are greater than the adjustment costs. Let p_{it}^{*} be the firm's flexible (log) price, p_{it} its rigid (log) price and $p_{it^{-}}$ the rigid price in the infinitesimal period before time t. If the distance of the flexible price from the rigid price gets too large, $p_{it}^{*} - p_{it^{-}} \geq s_t$, the rigid price is reset to $p_{it} = p_{it}^{*} - S_t$. This implies that the price is changed if $\Delta p_{it}^{*} \geq (s_t - S_0)$. To make his model operational Cecchetti assumes monopolistic competition with demand and cost functions

$$\begin{aligned} Y_{it}^{d} &= \left(\frac{P_{it}}{P_t}\right)^{-\varepsilon} Y_t^{\alpha} \\ C(Y_{it}) &= e^{A+\delta t}\, Y_{it}^{\gamma} \prod_{j=1}^{m} W_{jt}^{h_j} \end{aligned} \tag{7}$$

where P_t is again the aggregate price level, Y_t is total industry sales, δt represents technological change, W_{jt}, $j = 1, \ldots, m$ are nominal input prices of m different inputs and $\alpha, \gamma, \delta, \varepsilon, h_1, \ldots, h_m$ and A are constants.

Solving for the flexible (log) price yields

$$\Delta p_{it}^* = (1-\beta)\Delta p_t + \alpha\beta\,\Delta y_t + \beta\,h_1\,\Delta w_{1t} + \ldots + \beta\,h_m\,\Delta w_{mt} + \beta\delta\,\Delta t + u_{it} \quad (8)$$

where $\beta = 1/(1-\varepsilon+\varepsilon\gamma)$ and u_{it} is an error term. Under Cecchetti's assumption of equal growth rates for the aggregate price level of inputs and the aggregate price level this equation becomes

$$\Delta p_{it}^* = \Delta p_t + \alpha\beta\,\Delta y_t + \beta\delta\,\Delta t + u_{it} \quad (8a)$$

In his equation (1) Cecchetti assumes nominal contracts but this is equivalent to a model with real contracts

$$\begin{aligned} \Pr(y_{it} = 1) &= \Pr\left\{\Delta p_{it}^* > s_t - S_0\right\} \\ &= \Pr\left\{\Delta p_{it}^* - \Delta p_t > s_t - (S_0 + \Delta p_t)\right\} \\ &= \Pr\left\{u_{it} > s_t - (S_0 + \Delta p_t) - \alpha\beta\,\Delta y_t - \beta\delta\,\Delta t\right\} \end{aligned} \quad (9)$$

Therefore with real contracts and positive inflation the band of inaction widens. Cecchetti estimated his reduced form equation with a fixed-effect logit and therefore had to get rid of most of the observations with no price change. To this end he had to aggregate his data to yearly frequency. But with yearly aggregates the questions of staggering versus synchronisation cannot be addressed anymore in a sensible way. This problem can be mitigated by conditioning the probability of a price change at calendar time t_j on not having changed the price since $k = t_j - t_{j-1}$ periods

$$h_{kt_j} = \Pr\left(T = t_j \middle| T \geq k = t_j - t_{j-1}, X(t_j)\right). \quad (10)$$

Dotsey, King and Wolman (1999) use this approach to allow a much more flexible overlap of contracts than the basic Taylor model and to include state dependents in their model. Each period a fraction of firms that have adjusted their price j periods ago adjust endogenously its price. Each firm is confronted with a random fixed labour cost of changing its price. This fixed cost is i.i.d. across firms and over time. The distribution of this fixed cost together with the opportunity costs of not adjusting price determines the fraction of firms changing price. The aggregate price level is given by

$$P_t = \left[\sum_{k=0}^{K-1} \Phi_{kt} \left(P_{t-k}^{*} \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \tag{11}$$

where Φ_{kt} is the fraction of firms at time t charging price P_{t-k}^{*}. This fraction is given by the probability that a price has last been changed k periods ago, S_{kt} [7], times 1 minus the probability that the price changed last time k periods ago is changed at time t, h_{kt}

$$\Phi_{kt} = \left(1 - h_{kt}\right) S_{kt} \tag{12}$$

Since for this study the available price data is qualitative and monthly the duration approach makes the most efficient use of the data. Since the dataset contains a lot of censored spells one has to make the additional assumption that the firms' decision is based solely on information that is available to the firm the month before the actual price change happens.

5.2 Specification of the model

The following duration model tries to incorporate several aspects of price setting, with an emphasise on time versus state dependence, staggering versus synchronisation and competitive behaviour. It is based on a monopolistic firm with a Cobb-Douglas production function. Demand and cost function are given by equation (7). For a list of the variables that are used in the regressions see Tables A8 and A9.

The available individual data is most informative on the demand side. The demand change since the last price change is constructed as the sum of the demand changes where a demand increase compared to the previous month is set to 1 and a demand decrease to -1. This measures the shift in the level of demand. If demand first increases by one unit and then decreases again by one unit demand is at the same level as at the beginning yet over the whole period one additional unit has been produced. Expected business situation for the following six months (up, down, equal) is taken as a proxy for demand expectations. It is not assumed that the firm's expectation is conditional on its own price decision meaning that the answer in the business survey refers to Y but not to Y^d. To be consistent, the price index P has to be referred to the products the firm includes in Y.

The output gap is calculated by subtracting the firm specific mean from the firm specific capacity utilisation. An additional question asks whether technical capacity given actual output and expected orders within the following 12 months is not sufficient, sufficient or more than sufficient. From this variable the net share of domestic competitors with not sufficient, sufficient and more than sufficient capacity is calculated within four-digit industries (according to Nace Rev.1) by ignoring the own firm. This share is split into two variables, depending on whether the number of firms reporting their capacity will not be sufficient is larger than the number of firms reporting their capacity will be more than sufficient or not. The same procedure is applied to the share of firms with price increases and reductions and firms with increased or reduced demand (see equation A14 in annex I)..

Since the data does not contain individual information on costs the construction of the respective variables deserves some comments. Price indices for imported and domestic intermediate inputs have been calculated using input-output tables[8]. A price change of intermediate inputs in the model has been calculated as the log difference of the level of the index at current time to the level of the index preceding the firm's last price change[9]. This as justified as follows. The firm takes its actual costs at the last price calculation that is assumed to have been the month before the last price change and adds the additional costs due to the change in the price of intermediate inputs. It applies a

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[7] The relationship between survivor function and hazard function is $S(t) = \exp\left\{-\int_0^t h(s)ds\right\}$

[8] The weights from the IO-tables that are published every second year have been linearly interpolated to create monthly weights. In 1995 there was a change in the industry classification to Nace and from West-German data to pan German data. The respective price series and IO-weights have been linked in 1995 to back estimate series in Nace classification.

[9] The input price series have been smoothed by a HP-filter.

fixed mark-up on unit costs so that it can be ignored in the calculation of growth rates. The mark-up is large enough to account for volatility in the prices of intermediate inputs. If these input prices c.p. increase too much the product price is raised as in a (s, S)-model. One can either assume that the firm expects the input prices to stay constant or change at the same rate as assumed for the last price calculation. That is the satisficer explanation Cecchetti (1985) used that may be not rational expectations but a second best solution to it. Due to the backward looking it should already create some persistence.

The inclusion of the wages is more complex. In section 4 the potential influence of the collective wage bargaining process was emphasised. In the basic Taylor model the price is increased every time a new wage contract starts and wage contracts have a fixed duration. In this model, because the collective wage bargaining process consists of various steps, it is represented by a set of dummies: one dummy variable for the formal start of a new contract (i.e. the end of the previous contract), another for the month of the actual wage increase, a further dummy for the months in between and a separate dummy for the month of an increase during a long term wage contract, i.e. for a wage increase that was known more than 12 months in advance and that takes place in a year where there are no negotiations and therefore the other collective wage bargaining dummies are zero. Since there is just one collective wage agreement in the industries under scrutiny an overlap of contracts due to wage contracts can only occur if several stages of the wage bargaining process are relevant for price setting.

The dummies do not account for variations in the amount of the wage increase. Therefore an additional variable for wages has to be constructed. There are three sources for aggregate data on wages: the monthly index for collectively negotiated wages, yearly effective wages for two-digit industries from the National Accounts and monthly effective wages for four-digit industries from the Monthly Manufacturing Survey (Monatsbericht im Verabeitenden Gewerbe). The index of negotiated wages does not account for changes in the labour force. It is therefore more rigid than an index for effective wages. On the other hand, the negotiated wage increase is common knowledge to all domestic parties involved in the business activity. Monthly effective wages, even if seasonal adjusted, may be too flexible. They ignore the long term relationship inherent in most labour contracts. As Kimball (1995) put it: “True marginal labor costs are a matter of the additional amount a firm is implicitly promising to pay a worker *someday* in return for working an additional hour." Prices may not rise because people are paid bonuses but bonuses may be paid at the time prices can be raised because demand is high. As an advantage this kind of data includes already adjustment in the labour force as a result of wage increases that cannot be compensated by higher product prices. A major drawback of the available effective wages is a break in the series in 1995. Later, wages are reported for Germany as a whole and according to NACE Rev. 1. Before, wages were reported for West-Germany and according to a different classification that cannot be reconciled with NACE at the two-digit level. Therefore the two-digit industries have to be aggregated even further. This source has the advantage that corresponding data on gross value-added for the calculation of changes in labour-productivity is available which is included in the regression, too.

Wages have been included into the model in two variants. The first one is backward looking and parallels the calculation of the changes in intermediate input prices i.e. the log level shift is calculated. The alternative is forward looking. For every month the cumulative wage rate for the next 12 months compared to the preceding 12 months is calculated[10].

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 duration dependence is specified non parametrically using dummies. Each equation has been estimated by a grouped Cox-model, a Logit-model and a Probit-model. For the respective hazard rates see formula A10 in the annex and for a discussion of the estimation Han and Hausman (1990).

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. By the same token expectations are built shortly before the price change. Contemporaneous effects can only be taken into account if they are not firm

[10] Cumulated wage sum during 12 months over cumulated employment during the same 12 months.

specific, e.g. 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 3 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.

Table 3: 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

Another problem is a potential simultaneity bias if the decision to change a price depends on information of the same month. Then the likelihood for a price change may be overstated already at the start of the spell and understated at its end. For example a price was reduced late in April and this decision was influenced by the demand reduction at the beginning of April that was severer than anticipated. Then this demand reduction in this study does not raise the likelihood of the price reduction in April but it already contributes to the likelihood of the next price change.

5.3 Results

5.3.1 Time dependence

The foremost question is whether the duration model is able to explain the shape of the hazard function, particularly the spikes at 12, 24, 36 months of the transition intensities of the price increases. This is already a test for the Calvo model. Calvo assumes transition intensities that neither depend on duration nor on calendar time nor on the state. Formally

$$h(t, \tau, j) = h \quad \text{for all} \quad t, \tau, j$$

where t is duration since the preceding price change, τ is calendar time and j is the state i. e. price increase or price reduction. The dummies capturing the duration dependence are all statistically significant, see tables A8 and A9 “dummies for the baseline hazard”.

Figures 8 and 9 show that the used variables do not have much impact on the shape of the unconditional transition rates. That means that e.g. 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.

Figure 8:

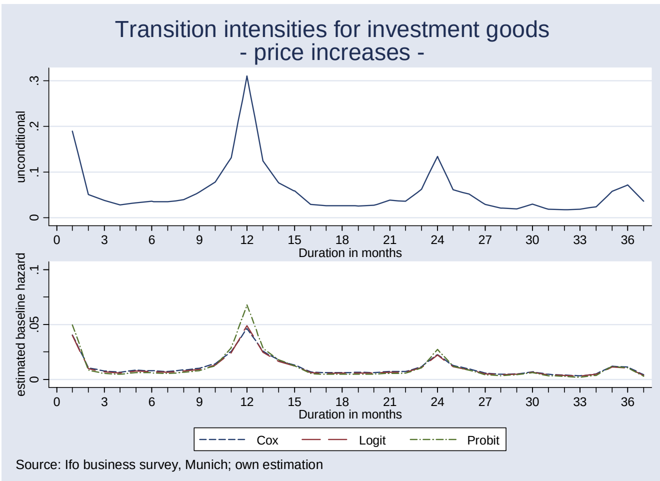
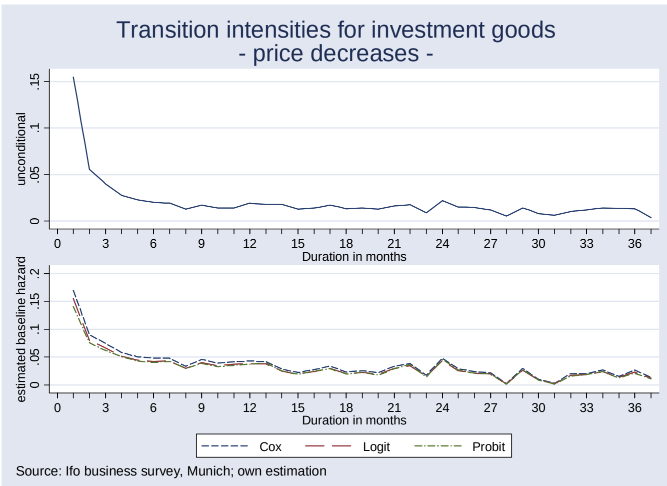


Figure 9:



The estimated baseline hazards are residuals in some way. They summarize the impact of unknown factors in form of duration dependence. Two other forms of residuals are time dummies for months and years. They capture calendar time. Figure 10 shows that prices are changed predominantly in January and February.

Figure 10:

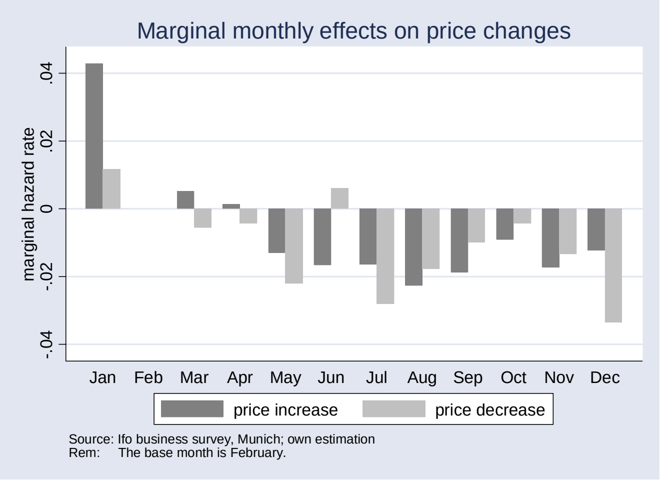
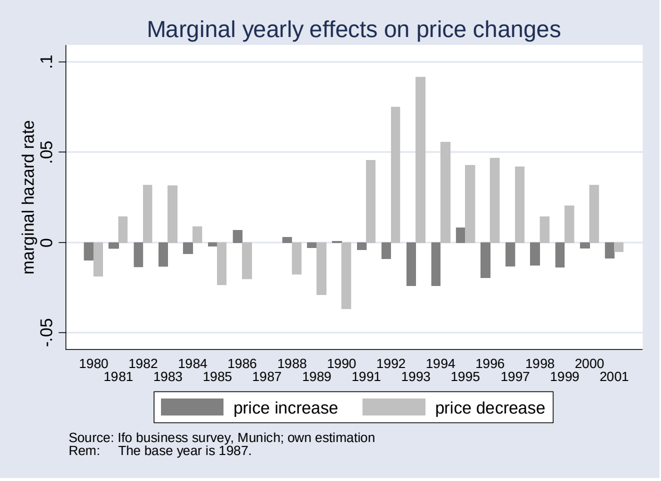


Figure 11 shows that price decreases have been more likely during the nineties than during the eighties and more likely during recessions (1982, 1993). The pattern of the price increases resemble the business cycle, too.

Figure 11:



The monthly and yearly dummies are statistically significant. Thus, at the micro level, prices follow a nonstationary process.

Next, the lagged duration dependence is shown and the dependence on the direction of the preceding price change. A price increase is more likely after a period that equals the length of the preceding price change. The marginal effect is particular high for spells with a length of 12 months. But these are infrequent in the sample. Due to the unavoidable length biased sampling spells with a length of 1 month are much more frequent in the data. A price increase is much more likely, too, if the actual duration deviates by one month from the length of the preceding spell and if the combined length of the preceding spell and the actual duration adds to 12 months.

Table 4: Sample means and marginal effects of the firms' own price setting history on the hazard rate

	Sample mean	Price increase	Price decrease	Price change
Length of the actual price spell and the length of the preceding price spell				
is the same	0.0806	0.0620	-	0.0620
is the same and 1 month	0.0534	-	0.2425	0.2425
is the same and 12 months	0.0050	0.2185	0.2860	0.5045
differ by one month	0.0697	0.0457	0.0270	0.0727
length of the preceding price spell, given that the length of the preceding two price spells adds to 12 months (interrupted 12 months spell)	4.2915	0.0023	0.0021	0.0043
Preceding price change was an increase	0.7695	0.3237	-0.2061	0.1176

Rem: Marginal effects are displayed for significant coefficients only.

That is puzzling at first sight. But suppose, every firm changes its price always after 12 months and that most of the price changes take place during the first quarter of the year. Then some firms would always be price leaders and others always price followers. This could offend competitors.

In the case of the two price spells that have a combined length of 12 months the first spell is very likely set in response to an external shock, it is state-dependent. The complementing spell is set in accordance with a time-dependent rule. In absence of the time-dependent price change the next price change would be farther away and thus the price more sticky.

Finally, a price increase is much more likely after a price increase than a price reduction.

Price decreases show lagged duration dependence. But in contrast to price increases this is statistically significant only in case that the duration amounts to one or twelve months.

5.3.2 Price erosion

The likelihood of a price increase raises with year-on-year CPI inflation. CPI inflation is taken as a proxy for general price inflation. As previously discussed in the steady state all prices should grow at the same pace. To keep its relative price constant the firm had to increase its own price at the same rate as the CPI.

Table 5: Sample means and marginal effects of various prices on the hazard rate

	Sample mean	Price increase	Price decrease	Price change
CPI (log change over the previous year)	0.0249	0.3739	-0.3805	-0.0067
Prices of domestic competitors				
Increasing (contemporaneous)	0.0272	0.1060	-	0.1060
Decreasing (contemporaneous)	0.0115	-0.1488	0.0846	-0.0642
Increasing (preceding month)	0.0284	-0.0195	-0.0839	-0.1035
Decreasing (preceding month)	0.0112	-	-0.0340	-0.0340

Rem: Marginal effects are displayed for significant coefficients only.

A price increase is the more likely the larger the fraction of competitors with rising prices and the less likely the larger the fraction of competitors with price reductions if the price change takes place during the same month. An increase is less likely if competitors have already raised their prices the preceding month. Customers may then have the impression that the firm just jumps on the bandwagon. A synchronised price increase is easier to implement.

5.3.3 State dependence

The impact of collective wage bargaining fits in this explanation quite well. Price increases are more frequent already at the time a new collective wage contract should start even if actual wages are not raised at this moment. During the month preceding the actual wage increase and the month of the actual wage increase price increases are even more likely[11]. Tellingly, the likelihood of a price increase is most effected if there is a negotiated wage increase during a long term wage contract[12].

Table 6: Sample means and marginal effects of cost variables on the hazard rate

	Sample mean	Price increase	Price decrease	Price change
specific months of collective wage bargaining				
formal start of contract	0.0548	0.0376	-0.0273	0.0103
month before month of permanent wage increase (not in the mid of long-term contract)	0.0604	0.0471	-	0.0471
month of permanent wage increase (not in the mid of long-term contract)	0.0632	0.0541	-	0.0541
long term contracts only				
mid-term permanent wage increase	0.0234	0.1154	-	0.1154
Cost indices; log change of the respective index compared to the time of the firm's last price change				
Wages	0.0296	0.1193	-	0.1193
Domestic intermediate inputs	0.0129	-	-	-
Imported intermediate inputs	0.0028	0.0890	-0.2288	-0.1398
share of domestic competitors with processes innovations	0.5139	-	0.0102	0.0102

Rem: Marginal effects are displayed for significant coefficients only.

The impact of an increase in effective wages in contrast to negotiated wages turned out to be more complex than thought. The expected year on year change for the effective wages calculated on the four-digit Nace level were insignificant or significant only at the 10 percent level, depending on the model. On the other hand, effective wages calculated on a broader aggregate and compared to the time of the previous price change were significant with the expected sign. Yet, these wages seem to measure not the firm's own labour costs but the labour cost part of domestic intermediate inputs.

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[11] Sometimes it is hard to decide from the outside which is the month of the actual price change and which is the preceding month, e. g. April 1981 (s. table A7).

[12] E. g. in April 1989 during the contract from April 1987 to March 1990.

The latter turned out to be insignificant. Their growth is highly correlated with the wage increases.[13] The change in the price level of imported intermediate inputs compared to the time of the firms' last price change are significant. Cost changes are passed-through with a lag, the lag depending on the marginal effect of the cost increase, the baseline hazard and the seasonal dummies.

An increase in the level of demand since the firms' last price change does increase the likelihood of a price increase but the marginal effect is much smaller. Yet, the comparison is somewhat distorted since, at least during the eighties, there was an upward trend in costs, and costs are nominal, whereas demand does not show such a trend and demand should be real.

An expected demand increase raises the likelihood of a price increase more than it is reduced by an expected demand decrease. Thus, there is some downward stickiness.

A rise of demand faced by competitors, i. e. a general increase in demand, raises the likelihood of a price increase.

Table 7: Sample means and marginal effects of demand variables on the hazard rate

	Sample mean	Price increase	Price decrease	Price change
Net demand change since the time of the firm's last price change				
more than 4 reductions	0.0727	-0.0275	0.1031	0.0755
4 reductions	0.0306	-	0.1008	0.1008
2/3 "	0.1252	-	0.0515	0.0515
1 "	0.1590	-0.0145	0.0329	0.0184

[13] That is the usual problem with the inclusion of several nominal variables. Here, the atheoretical approach taken reaches its limits. Once it is known that such variables are significant an approach more suited for nonstationary processes should be applied.

no change		-	-	-
1 increase	0.1446	0.0148	-	0.0148
2/3 “	0.1058	0.0143	-	0.0143
4 “	0.0211	0.0235	-	0.0235
more than 4 increases	0.0400	0.0219	-0.0623	-0.0404
Demand of domestic competitors				
Increasing (contemporaneous)	0.0310	0.0313	-	0.0313
Decreasing (contemporaneous)	0.0511	-	-	-
Increasing (preceding month)	0.0297	0.0125	-0.0248	-0.0123
decreasing (preceding month)	0.0512	0.0138	-	0.0138
Expected demand change during the next six months				
demand decrease expected	0.2115	-0.0160	0.0837	0.0677
no change expected	0.6360	-	-	-
demand increase expected	0.1525	0.0406	-	0.0406
Expected market evolution in the medium run (5 years)				
Significant growth	0.0640	-	0.0413	0.0413
slight growth or contraction / unchanged	0.7517	-	-	-
significant contraction	0.0317	-	-	-
missing answers	0.1526	-	0.0213	0.0213

Rem: Marginal effects are displayed for significant coefficients only.

The impact of demand changes should be related to production smoothing. The likelihood of a price increase already raises with the degree of actual capacity utilisation. But the expected capacity utilisation also matters. If a firm thinks its technical capacity, given actual and expected orders within the next 12 months, is not sufficient, it raises its price. But if the aggregate capacity of competitors will not be sufficient, a price increase is even more likely. On the other hand, if it will be more than sufficient, the likelihood of a price increases is reduced. Thus, in the economy, capital can be reallocated between firms.

Table 8: Sample means and marginal effects of capacity utilisation and stocks of finished products on the hazard rate

	Sample mean	Price increase	Price decrease	Price change
log capacity over utilisation	-0.0125	0.0181	-0.0123	0.0058
Technical capacity given actual and expected orders within the next 12 months				
own firm:				
not sufficient	0.0596	0.0347	-	0.0347
Sufficient	0.6587	-	-	-

more than sufficient	0.2817	-	0.0122	0.0122
<u>domestic competitors:</u>				
not sufficient	0.0113	0.0298	-	0.0298
more than sufficient	0.1843	-0.0152	0.0168	0.0016
stocks of finished products				
too large	0.1510	-	0.0228	0.0228
Sufficient	0.3767	-	-	-
too small	0.0458	0.0519	-0.0565	-0.0046
no stocks	0.4265	-0.0081	-	-0.0081

Rem: Marginal effects are displayed for significant coefficients only.

The presentation of results for price increases shall be finalised by looking at the stocks of finished products. If stocks are too small, prices are raised to curb demand. If stocks are too large there is no effect on price increases.

5.3.4 Price reductions

Price decreases respond less pronounced to contemporaneous price increases or reductions than price increases. In case of price reductions there is no need for coordination. On the contrary, if all firms reduce their prices at the same time and by the same amount the effect on demand is only of second order. The reaction of price decreases seems more to be determined by its relative price. If a competitor increases its price then the firms' relative price is lowered without explicit price reduction. The decrease of the likelihood of a price reduction following a price reduction by the competitors in the preceding month may be a signal to the competitors that the firm does not plan to enter into a price war. That somewhat mirrors the bandwagon argument for the lagged price increase. A lagged reaction seems to be understood as a strong signal when the reaction is indeed a action: a price increase lagging competitors' price increases and a price reduction lagging competitors' price reductions. A change in the relative price achieved by passiveness seems to be tolerated. The consequences for staggering are not obvious. Probably the firm lowers its price in response to competitors' price reductions with some delay. This may lead to a diffuse pattern of price reductions that is in line with staggering.

Firms react in the short run with price reductions if competitors introduce new production processes. In the long run they have to adapt their processes. Having experienced a decrease in demand since the last price change pushes firms to reduce their prices. Yet, in an auxiliary regression not presented here it turned out that if the firm faces a demand decrease during the month of the price change, then the coefficients of the past demand reduction get insignificant. The firms' demand expectation for the coming month seems to be based on the evolution of demand since the firms' last price change. Therefore the firm is backward looking with respect to demand, at least in the short run. Unfortunately, in this auxiliary regression the likelihood of a price increase raised too. This may be due to a simultaneity bias that arises if one includes contemporaneous firm specific information in the regression. Firms are more likely to react to a demand decrease with a price reduction than to a demand increase with a price increase. They reduce their prices if they expect the market to grow significantly in the next five years. In the Cox-model they reduce their prices in case of an expected significant contraction, too. In the short and medium run firms seem to be concerned more with market share than with profits. Firms react stronger with price increases on capacity over or under utilisation than with price decreases. They seem less convinced that they can attract customers with price reductions. Prices are sticky downward.

Finally, if stocks of finished products are too large, firms reduce their prices, but if stocks are perceived to be too small, they reduce their prices less likely. Again, the latter reaction is stronger.

6 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 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. At the micro level, price changes follow a nonstationary process with lagged duration dependence.

Competition leads to synchronised price changes. The same applies for collective wage bargaining, particularly during long-term contracts. 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. Trending nominal variables like CPI-inflation, costs of intermediate inputs and wages lead to the lumpy, state-dependent price adjustment predicted by (s,S)-models. Firms seem to be backward-looking to a certain degree in their expectations on future demand changes. Firms change prices to smooth production and stocks of finished products. Firms size does not seem to be important.

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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_{jt}^{+}, f_{jt}^{-} of a price increase or decrease at time t in category j is calculated as

$$f_{jt}^{+} = \frac{\sum_{l\in U_j} p_{lt}^{+}}{\sum_{l\in U_j} p_{lt}^{+} + \sum_{l\in U_j} p_{lt}^{-} + \sum_{l\in U_j} p_{lt}^{0}}$$
$$f_{jt}^{-} = \frac{\sum_{l\in U_j} p_{lt}^{-}}{\sum_{l\in U_j} p_{lt}^{+} + \sum_{l\in U_j} p_{lt}^{-} + \sum_{l\in U_j} p_{lt}^{0}} \qquad \text{(A1)}$$

where U_j is the sample of all units (elements) belonging to category (set) j.

The frequency of a price change f_{jt} at time t in category j is calculated as

$$f_j = f_{Lt}^{+} + f_{Lt}^{-}. \qquad \text{(A2)}$$

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

$$f_j^{w+} = \frac{\sum_{l\in U_L} w_{lt} p_{lt}^{+}}{\sum_{l\in U_L} w_{lt} p_{lt}^{+} + \sum_{l\in U_L} w_{lt} p_{lt}^{-} + \sum_{l\in U_L} w_{lt} p_{lt}^{0}} \qquad \text{(A3)}$$

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

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

$$f_{LT}^{+} = \frac{\sum_{l\in U_L, t\in T} p_{lt}^{+}}{\sum_{l\in U_L, t\in T} p_{lt}^{+} + \sum_{l\in U_L, t\in T} p_{lt}^{-} + \sum_{l\in U_L, t\in T} p_{lt}^{0}}. \qquad \text{(A4)}$$

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

$$d_T^w = \left(f_{LT}^{w}\right)^{-1} \qquad \text{(A5)}$$

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

Median price duration: $$T_{50,LT} = \frac{\ln(0.5)}{\ln(1-f_{LT})} \quad \text{(A6)}$$

Average price duration: $$\overline{T}_{LT} = \frac{1}{\ln(1-f_{LT})} \quad \text{(A7)}$$

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

$$S(t) = P(T \geq t). \quad \text{(A8)}$$

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

$$h(t) = \lim_{dt \to 0} \frac{P(t \leq T < t + dt | T \geq t)}{dt}. \quad \text{(A9)}$$

The hazard function for the grouped Cox model is

$$h^{GrCox}(t) = 1 - \exp(-\exp(t)) \quad \text{(A10)}$$

The logistic distribution is its own hazard function

$$h^{\log it}(t) = \Lambda(t) = \frac{\exp(t)}{1+\exp(t)} \quad \text{(A11)}$$

The hazard function for the normal distribution is

$$h^{probit}(t) = \frac{\phi(t)}{1-\Phi(t)} \quad \text{(A12)}$$

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

$$h_j(t) = \lim_{dt \to 0} \frac{P(t \le T < t + dt, D_j = 1 | T \ge t)}{dt}, \tag{A13}$$

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.

Calculation of the price increases and decreases of competitors:

Let $p_{lt}^+, p_{lt}^-, p_{lt}^0$ be binary variables that denote for example whether the price of item l is higher, lower or the same at time t compared to time $t-1$. Then the frequency f_{ijt}^+, f_{ijt}^- of price increases and decreases of firm i's competitors at time t in category j is calculated as

$$f_{ijt}^+ = \frac{\sum_{l \in U_j^c} p_{lt}^+}{\sum_{l \in U_j^c} p_{lt}^+ + \sum_{l \in U_j^c} p_{lt}^- + \sum_{l \in U_j^c} p_{lt}^0}$$

$$f_{ijt}^- = \frac{\sum_{l \in U_j^c} p_{lt}^-}{\sum_{l \in U_j^c} p_{lt}^+ + \sum_{l \in U_j^c} p_{lt}^- + \sum_{l \in U_j^c} p_{lt}^0}$$

where U_j^c is the sample of all units (elements) belonging to category (set) j save the firm i. From these frequencies the balance is calculated.

$\Delta f_{it} = f_{ijt}^+ - f_{ijt}^-$.

The balance is split into two variables for net increases and decreases

$$s_{it}^+ = \begin{cases} +\Delta f_{it} & if \quad \Delta f_{it} \ge 0 \\ 0 & \quad \Delta f_{it} < 0 \end{cases}$$
$$s_{it}^- = \begin{cases} -\Delta f_{it} & if \quad \Delta f_{it} < 0 \\ 0 & \quad \Delta f_{it} \ge 0 \end{cases} \tag{A14}$$

Annex II - Figures and Tables

Figure A1.

Figure A2.

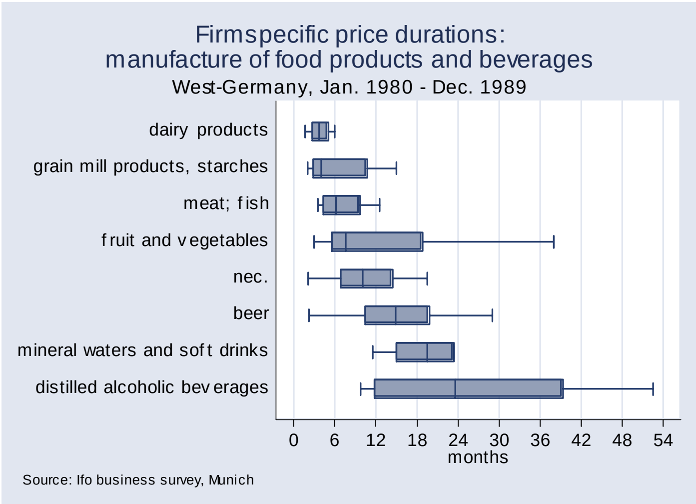


Figure A3.

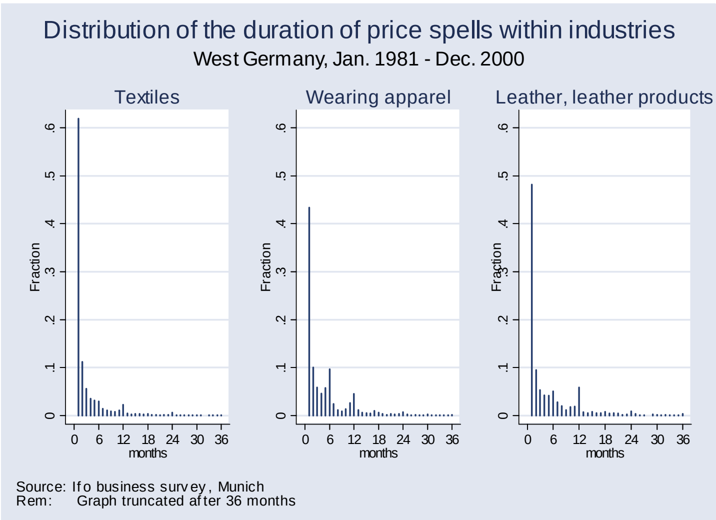


Figure A4.

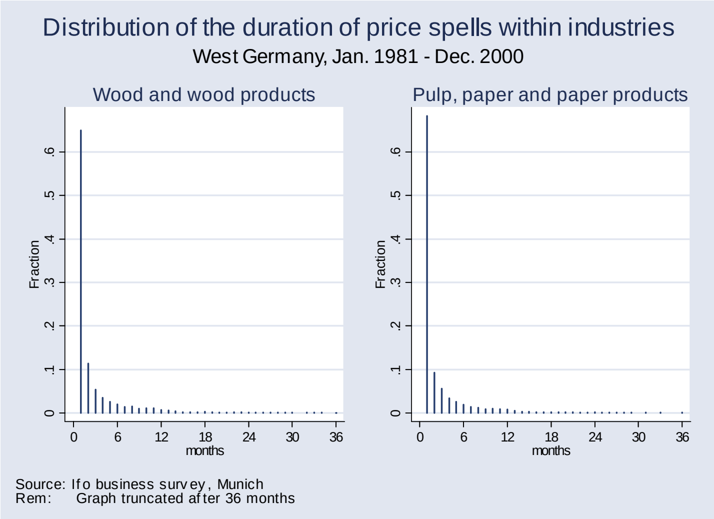


Figure A5.

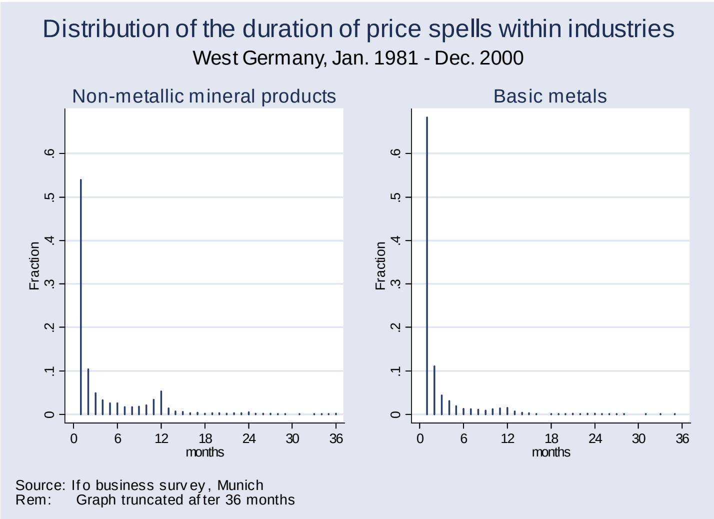


Figure A6.

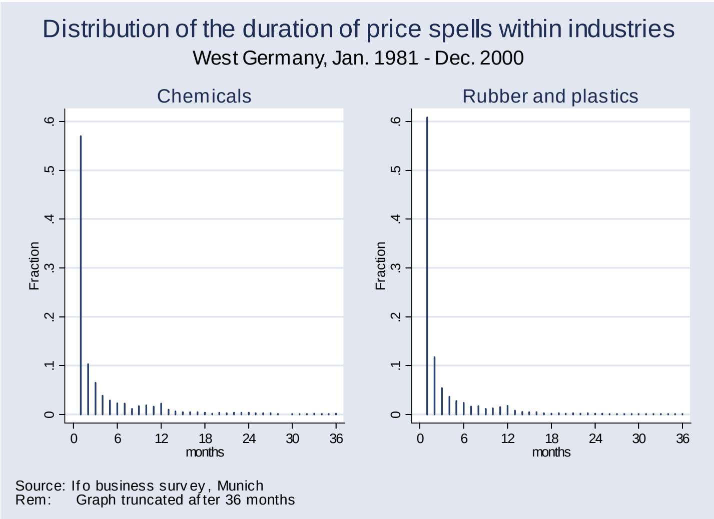


Figure A7.

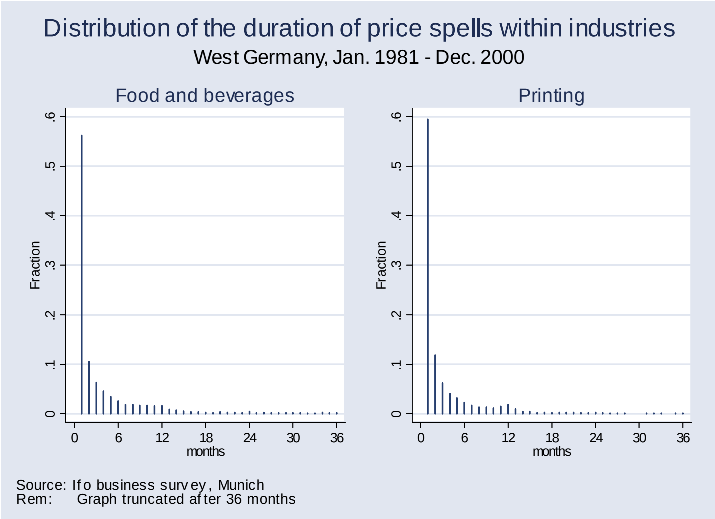


Figure A8.

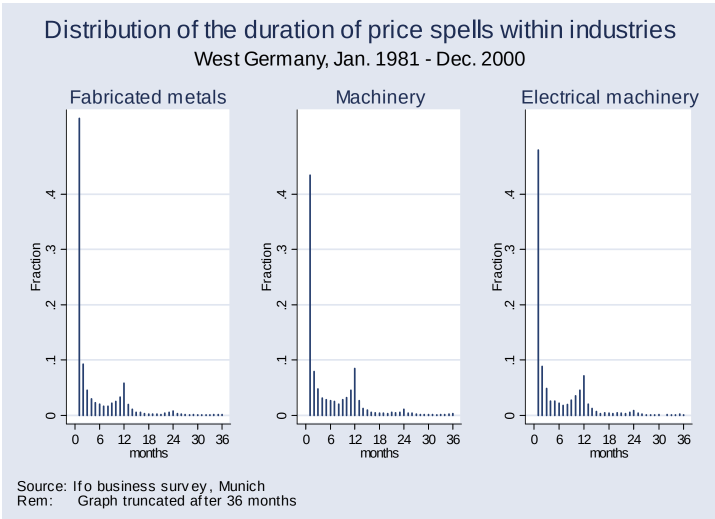


Figure A9.

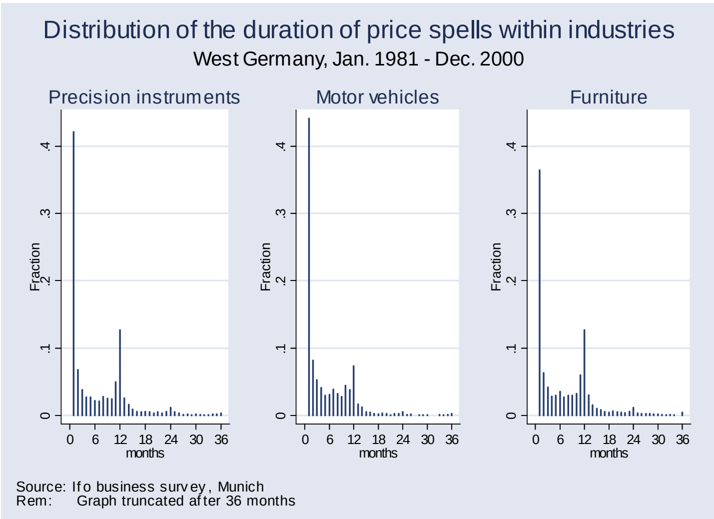


Figure A10.

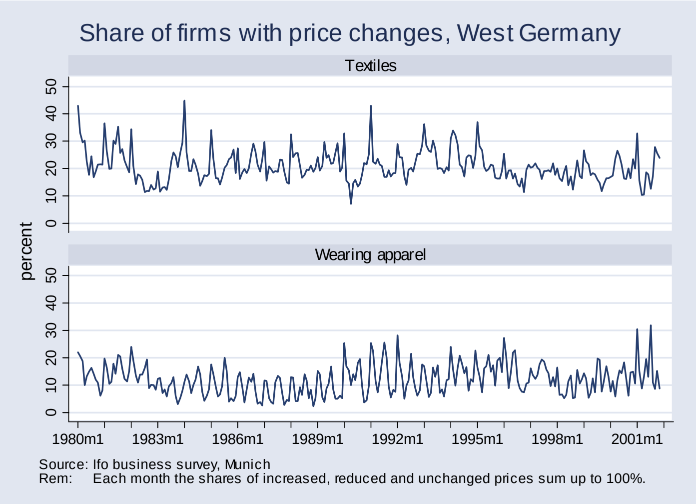


Figure A11.

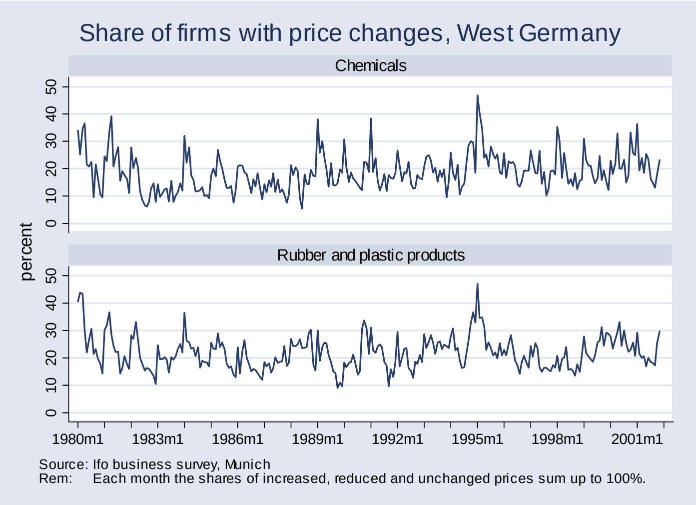
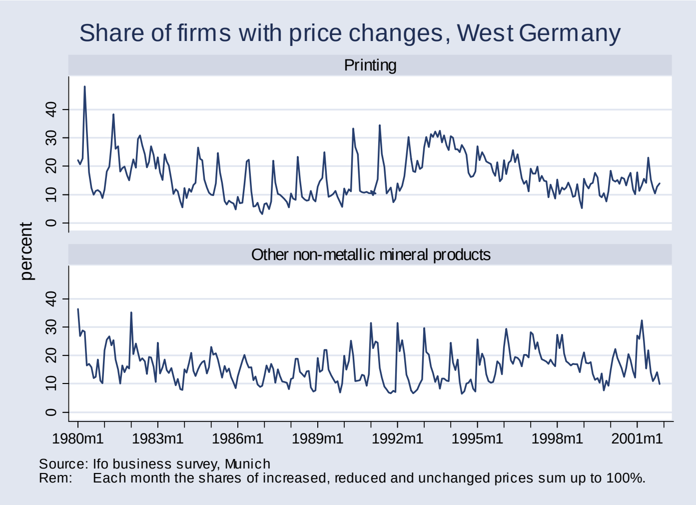


Figure A12.



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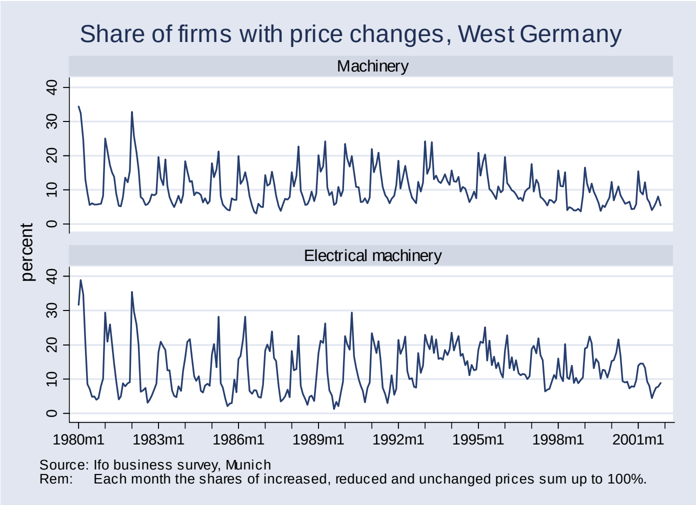
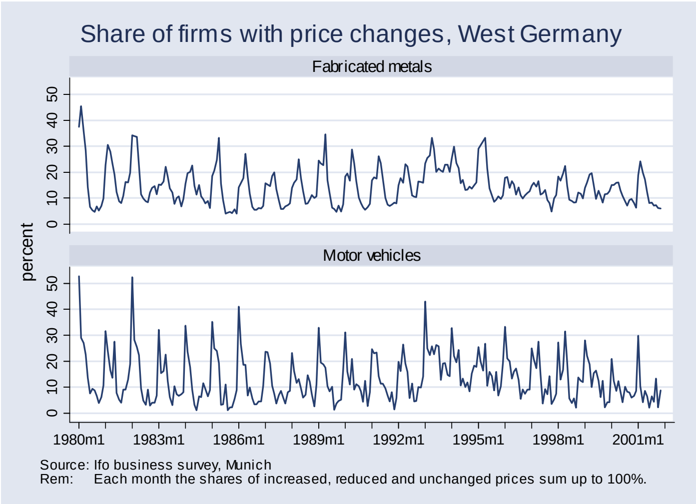


Figure A14.



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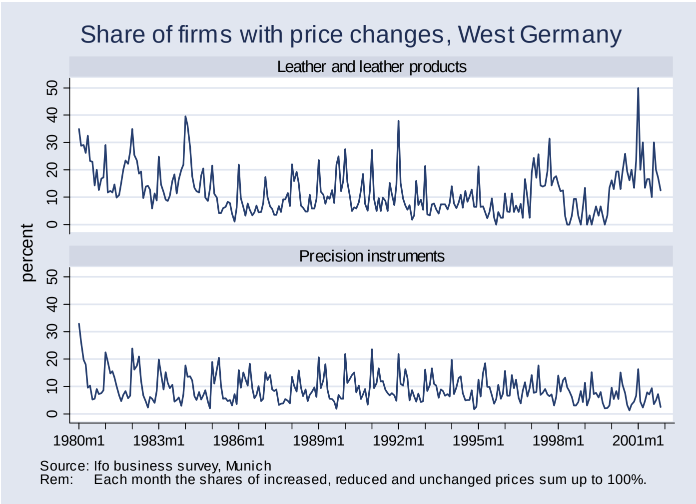

Table A1: Number of firms according to the length of their participation (including periods of non-participation)

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 A2: 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

Table A3: 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 A4: Monthly 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 scheme used by ifo that uses actual weights based on the number of employees.

Table A5: 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

...

Table A5: 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 A6: Analysing the variance of frequency of price changes, mean square errors

Nace	Type of good	individual effect	monthly effect	yearly effect	adj. R-square
151	CN	1.80	0.83	3.08	0.08
152	CN	0.37	0.37	0.51	0.03
153	CN	2.80	0.48	0.35	0.06
155	CN	0.90	1.81	1.16	0.03
156	A	1.93	1.92	1.58	0.08
158	CN	1.31	0.94	0.54	0.08
159	CN	0.46	2.72	0.98	0.04
171	A	3.23	0.75	3.01	0.09
172	A	3.56	2.05	1.22	0.16
173	A	0.56	0.15	0.33	0.06
174	CN	1.85	2.09	0.42	0.14
175	CN	0.42	8.56	0.15	0.29
176	A	0.50	0.17	0.41	0.05
177	CN	1.31	0.75	0.30	0.15
182	CN	0.95	3.73	1.03	0.07
191	CN	1.22	0.68	3.84	0.16
192	CN	0.36	6.14	0.25	0.15
193	CN	0.32	0.75	0.52	0.06
201	A	4.09	3.90	7.65	0.13
202	A	4.91	1.76	1.36	0.20
203	A	1.49	0.75	0.50	0.09
204	A	1.84	0.76	3.38	0.13
205	A	0.11	0.50	0.02	0.11
211	A	2.61	3.13	9.68	0.13
212	A	5.34	2.46	15.2	0.17
222	CN	1.89	15.32	14.95	0.06
243	A	2.49	2.78	1.22	0.15
245	CN	0.36	0.05	0.20	0.10
249	A	2.66	0.92	0.70	0.06
251	A	0.55	1.07	0.94	0.06
2521	A	4.77	0.77	1.65	0.13
2522	A	4.68	1.27	3.27	0.16
2523	A	0.77	1.84	0.45	0.06
2524	A	1.05	6.66	1.47	0.07
261	A	0.74	2.56	0.76	0.07
262	A	0.46	2.18	0.18	0.05
263	A	0.54	1.07	0.39	0.12
264	A	2.48	1.84	2.58	0.11
265	A	0.74	3.32	0.48	0.11
266	A	3.19	1.16	2.22	0.14
267	A	1.27	0.98	0.45	0.07
268	A	7.42	2.25	0.53	0.20

Rem.

The dominating effect is shaded
Basic goods (A), Investment goods (B), Durable consumer goods (CD), Non-durable consumer goods (CN) according to Commission Regulation (EC) No 586/2001
(cont. next page)

Table A6: Analysing the variance of frequency of price changes, mean square errors (cont.)

Nace	Type of good	individual effect	monthly effect	yearly effect	adj. R-square
274	A	12.11	0.81	0.76	0.17
275	A	0.78	9.11	2.16	0.08
281	B	1.60	1.34	2.09	0.08
282	B	2.31	0.18	0.66	0.12
284	A	2.92	8.93	2.06	0.13
286	A	0.62	15.02	0.57	0.07
287	A	1.32	6.13	1.31	0.08
291	B	0.99	15.99	1.26	0.09
292	B	0.80	4.57	0.97	0.07
293	B	0.32	3.22	0.24	0.06
294	B	0.47	4.75	0.45	0.05
295	B	0.68	5.88	0.98	0.07
297	CD	0.80	2.87	0.86	0.10
300	B	0.66	0.45	0.29	0.11
311	B	0.80	8.08	0.91	0.07
312	A	0.58	7.21	0.28	0.08
313	A	1.15	1.81	0.99	0.07
315	A	1.07	4.81	0.49	0.09
321	A	1.80	2.07	0.86	0.09
322	B	0.29	0.39	0.40	0.04
323	CD	0.39	0.64	0.66	0.06
331	B	0.62	1.16	0.20	0.06
332	B	0.51	5.25	0.27	0.06
334	CD	0.30	1.29	0.24	0.04
335	CD	0.29	0.28	0.22	0.03
341	B	0.21	0.65	0.10	0.03
343	B	0.76	10.94	0.60	0.10
35	B	0.90	0.09	0.24	0.07
361	CD	0.52	10.68	0.85	0.06
365	CN	0.35	11.42	0.08	0.26
366	CN	0.25	1.18	0.21	0.05

Rem.

The dominating effect is shaded

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

Table A7: 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 A7: 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.
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 A8: Duration model for price increases

Explanatory variable	Grouped Cox model		Logit model		Probit model	
			Costs			
Specific months of collective wage bargaining						
formal start of contract	0.1876	(0.0326)***	0.2016	(0.0375)***	0.1036	(0.0200)***
month before month of permanent wage increase (not in the mid of long-term contract)	0.2360	(0.0378)***	0.2499	(0.0424)***	0.1243	(0.0220)***
month of permanent wage increase (not in the mid of long-term contract)	0.2710	(0.0391)***	0.2844	(0.0435)***	0.1347	(0.0224)***
long term contracts only						
mid-term permanent wage increase	0.4960	(0.0518)***	0.5698	(0.0601)***	0.2930	(0.0319)***
Cost indices; log change of the respective index compared to the time of the firm's last price change						
Wages	2.0934	(0.5273)***	2.3734	(0.5794)***	1.0099	(0.2868)***
Domestic intermediate inputs	2.7165	(1.5424)*	2.2371	(1.6743)	0.3449	(0.8052)
Imported intermediate inputs	1.4828	(0.4864)**	1.7709	(0.5328)**	0.9583	(0.2611)***
share of domestic competitors with processes innovations	-0.0377	(0.0746)	-0.0500	(0.0834)	-0.0362	(0.0420)
			Demand			
Net demand change since the time of the firm's last price change						
more than 4 reductions	-0.1487	(0.0494)**	-0.1630	(0.0541)**	-0.0664	(0.0267)**
4 reductions	-0.0686	(0.0652)	-0.0611	(0.0716)	-0.0150	(0.0351)
2/3 “	0.0157	(0.0373)	0.0235	(0.0408)	0.0189	(0.0201)
1 “	-0.0684	(0.0293)**	-0.0837	(0.0325)**	-0.0464	(0.0166)**
no change	-	-	-	-	-	-
1 increase	0.0658	(0.0261)**	0.0820	(0.0298)**	0.0502	(0.0156)**
2/3 “	0.0781	(0.0361)**	0.0791	(0.0399)**	0.0422	(0.0199)**
4 “	0.1099	(0.0639)*	0.1284	(0.0724)*	0.0717	(0.0368)*
more than 4 increases	0.1165	(0.0540)**	0.1200	(0.0602)**	0.0673	(0.0302)**
Demand of domestic competitor						
Increasing (contemporaneous)	0.5419	(0.1288)***	0.6229	(0.1468)***	0.3448	(0.0766)***
Decreasing (contemporaneous)	0.1372	(0.1258)	0.1525	(0.1390)	0.0674	(0.0703)
Increasing (preceding month)	0.2218	(0.1317)*	0.2491	(0.1484)*	0.1311	(0.0771)*
Decreasing (preceding month)	0.2319	(0.1308)*	0.2740	(0.1446)*	0.1457	(0.0729)**
Expected demand change during the next six months						
demand decrease expected	-0.0770	(0.0267)**	-0.0931	(0.0295)**	-0.0606	(0.0148)***
no change expected	-	-	-	-	-	-
demand increase expected	0.1871	(0.0242)***	0.2173	(0.0275)***	0.1104	(0.0144)***

Table A8: Duration model for price increases (cont.)

Explanatory variable	Grouped Cox model		Logit model		Probit model	
			Capacity utilisation			
log capacity over utilisation	0.3287	(0.0700)***	0.3607	(0.0773)***	0.1817	(0.0389)***
Technical capacity given actual and expected orders within the next 12 months						
own firm:						
not sufficient	0.1658	(0.0334)***	0.1872	(0.0385)***	0.0999	(0.0204)***
sufficient	-	-	-	-	-	-
more than sufficient	0.0145	(0.0243)	0.0130	(0.0270)	0.0057	(0.0136)
domestic competitors (share):						
not sufficient	0.5145	(0.2421)**	0.5921	(0.2746)**	0.3180	(0.1433)**
more than sufficient	-0.2601	(0.0934)**	-0.3019	(0.1035)**	-0.1552	(0.0524)**
			Relative Prices			
CPI (log change over the previous year)	6.5726	(1.9040)**	7.4353	(2.1426)**	4.1236	(1.1141)***
Prices of domestic competitosr						
Increasing (contemporaneous)	1.6430	(0.1239)***	2.1076	(0.1529)***	1.2081	(0.0834)***
Decreasing (contemporaneous)	-2.9378	(0.5655)***	-2.9595	(0.5929)***	-1.3563	(0.2709)***
Increasing (preceding month)	-0.3105	(0.1401)**	-0.3888	(0.1639)**	-0.1764	(0.0879)**
Decreasing (preceding month)	-0.1871	(0.5151)	-0.1743	(0.5507)	-0.0598	(0.2562)
			History of the firm's own price setting			
preceding price change was an increase	1.3569	(0.0370)***	1.4248	(0.0388)***	0.6287	(0.0172)***
length of the actual price spell and the preceding price spell						
is the same	0.2962	(0.0660)***	0.3231	(0.0709)***	0.1671	(0.0352)***
is the same and 1 month	-0.1197	(0.0751)	-0.1089	(0.0820)	-0.0482	(0.0418)
is the same and 12 months	0.6772	(0.0863)***	1.0025	(0.1075)***	0.6510	(0.0600)***
differ by one month	0.2258	(0.0385)***	0.2426	(0.0422)***	0.1257	(0.0214)***
length of the preceding price spell, given that the combined length of the preceding two price spell adds to 12 months	0.0407	(0.0022)***	0.0450	(0.0025)***	0.0224	(0.0012)***
Constant	-3.1879	(0.0832)***	-3.1731	(0.0917)***	-1.6477	(0.0457)***

Table A8: Duration model for price increases (cont.)

Explanatory variable	Grouped Cox model		Logit model		Probit model	
stocks of finished products						
too large	0.0300	(0.0296)	0.0297	(0.0331)	0.0127	(0.0168)
sufficient	-	-	-	-	-	-
too small	0.2246	(0.0363)***	0.2739	(0.0422)***	0.1561	(0.0225)***
no stocks	-0.0411	(0.0226)*	-0.0464	(0.0253)*	-0.0221	(0.0130)*
Exports						
no exports	-0.0451	(0.0585)	-0.0571	(0.0647)	-0.0276	(0.0326)
employees in product group						
less than 50	-0.0182	(0.0275)	-0.0153	(0.0306)	-0.0045	(0.0156)
50 and more						
Industry						
nace291	0.1960	(0.0286)***	0.2176	(0.0323)***	0.1079	(0.0167)***
nace292	0.0953	(0.0372)**	0.1001	(0.0414)**	0.0450	(0.0211)**
nace293	0.2474	(0.0487)***	0.2788	(0.0546)***	0.1497	(0.0281)***
nace294	-0.1175	(0.0387)**	-0.1152	(0.0425)**	-0.0473	(0.0212)**
nace295						
nace297	0.0725	(0.0504)	0.0809	(0.0563)	0.0417	(0.0288)
nace300	-0.7399	(0.2088)***	-0.8059	(0.2236)***	-0.3616	(0.0995)***
nace311	0.1754	(0.0342)***	0.1889	(0.0383)***	0.0880	(0.0197)***
nace313	0.2403	(0.0583)***	0.2850	(0.0660)***	0.1592	(0.0336)***
nace315	0.1501	(0.0499)**	0.1501	(0.0566)**	0.0755	(0.0295)**
nace321	0.1318	(0.0514)**	0.1280	(0.0578)**	0.0456	(0.0299)
nace322	-0.3762	(0.1407)**	-0.4234	(0.1500)**	-0.2003	(0.0704)**
nace323	-0.3679	(0.0960)***	-0.3907	(0.1024)***	-0.1823	(0.0478)***
nace334	-0.0616	(0.0636)	-0.0547	(0.0695)	-0.0237	(0.0345)
nace335	0.1125	(0.1242)	0.1270	(0.1382)	0.0539	(0.0705)
nace341	0.2861	(0.0772)***	0.3767	(0.0872)***	0.2238	(0.0445)***
nace343	0.1368	(0.0469)**	0.1450	(0.0535)**	0.0591	(0.0279)**
nace35	0.3749	(0.0843)***	0.4309	(0.0948)***	0.2144	(0.0490)***
year						
1980	-0.1926	(0.1214)	-0.2261	(0.1368)*	-0.1145	(0.0710)
1981	-0.0758	(0.1242)	-0.0722	(0.1407)	-0.0382	(0.0735)
1982	-0.3009	(0.1111)**	-0.3209	(0.1250)**	-0.1595	(0.0645)**
1983	-0.2855	(0.0851)**	-0.3178	(0.0955)**	-0.1675	(0.0489)**
1984	-0.1224	(0.0717)*	-0.1389	(0.0804)*	-0.0733	(0.0413)*
1985	-0.0276	(0.0683)	-0.0425	(0.0764)	-0.0302	(0.0392)
1986	0.1261	(0.0577)**	0.1284	(0.0640)**	0.0556	(0.0327)*
1987	-	-	-	-	-	-
1988	0.0543	(0.0633)	0.0547	(0.0706)	0.0199	(0.0361)
1989	-0.0508	(0.0755)	-0.0607	(0.0853)	-0.0369	(0.0442)
1990	0.0135	(0.0747)	0.0139	(0.0843)	0.0015	(0.0437)
1991	-0.0732	(0.0842)	-0.0847	(0.0949)	-0.0591	(0.0493)
1992	-0.1626	(0.0951)*	-0.2022	(0.1068)*	-0.1198	(0.0550)**
1993	-0.5635	(0.1012)***	-0.6468	(0.1123)***	-0.3572	(0.0567)***
1994	-0.5864	(0.0929)***	-0.6509	(0.1022)***	-0.3361	(0.0503)***
1995	0.1432	(0.0694)**	0.1543	(0.0774)**	0.0735	(0.0394)*
1996	-0.4474	(0.0837)***	-0.4881	(0.0911)***	-0.2490	(0.0444)***
1997	-0.2697	(0.0887)**	-0.3129	(0.0970)**	-0.1833	(0.0476)***
1998	-0.2304	(0.0825)**	-0.2968	(0.0903)**	-0.1790	(0.0446)***
1999	-0.2807	(0.0862)**	-0.3263	(0.0937)***	-0.1851	(0.0457)***
2000	-0.0367	(0.0806)	-0.0674	(0.0897)	-0.0581	(0.0457)
2001	-0.1694	(0.0877)*	-0.1958	(0.0961)**	-0.1105	(0.0480)**
strike	-0.4352	(0.1495)**	-0.4364	(0.1552)**	-0.1970	(0.0698)**

Table A8: Duration model for price increases (cont.)

Explanatory variable	Grouped Cox model		Logit model		Probit model	
Month						
January	0.5711	(0.0398)***	0.6481	(0.0454)***	0.3217	(0.0238)***
February						
March	0.0912	(0.0461)**	0.0997	(0.0515)*	0.0410	(0.0270)
April	0.0056	(0.0398)	0.0264	(0.0448)	0.0158	(0.0233)
May	-0.2797	(0.0427)***	-0.2981	(0.0471)***	-0.1564	(0.0240)***
June	-0.3857	(0.0603)***	-0.4049	(0.0653)***	-0.2079	(0.0323)***
July	-0.3636	(0.0489)***	-0.3976	(0.0529)***	-0.2226	(0.0261)***
August	-0.5568	(0.0548)***	-0.5968	(0.0585)***	-0.3155	(0.0282)***
September	-0.4437	(0.0720)***	-0.4661	(0.0762)***	-0.2523	(0.0362)***
October	-0.1692	(0.0489)**	-0.2033	(0.0533)***	-0.1387	(0.0267)***
November	-0.3955	(0.0504)***	-0.4235	(0.0543)***	-0.2291	(0.0268)***
December	-0.2671	(0.0635)***	-0.2808	(0.0681)***	-0.1585	(0.0336)***
dummies for the baseline hazard						
tt2	-1.3376	(0.0452)***	-1.4572	(0.0484)***	-0.7459	(0.0240)***
tt3	-1.6835	(0.0509)***	-1.8154	(0.0537)***	-0.9023	(0.0255)***
tt4	-1.8270	(0.0609)***	-1.9475	(0.0634)***	-0.9546	(0.0290)***
tt5	-1.5978	(0.0617)***	-1.7082	(0.0645)***	-0.8470	(0.0302)***
tt6	-1.6382	(0.0613)***	-1.7501	(0.0642)***	-0.8662	(0.0302)***
tt7	-1.7428	(0.0673)***	-1.8571	(0.0703)***	-0.9096	(0.0326)***
tt8	-1.5655	(0.0663)***	-1.6827	(0.0699)***	-0.8379	(0.0334)***
tt9	-1.3916	(0.0582)***	-1.5106	(0.0623)***	-0.7589	(0.0308)***
tt10	-1.0511	(0.0552)***	-1.1583	(0.0598)***	-0.5948	(0.0304)***
tt11	-0.4710	(0.0517)***	-0.5177	(0.0574)***	-0.2539	(0.0303)***
tt12	0.1420	(0.0500)**	0.2065	(0.0571)***	0.1564	(0.0308)***
tt13	-0.4590	(0.0644)***	-0.5037	(0.0708)***	-0.2549	(0.0370)***
tt14	-0.8527	(0.0838)***	-0.9176	(0.0900)***	-0.4524	(0.0450)***
tt15	-1.1462	(0.0953)***	-1.2310	(0.1014)***	-0.5929	(0.0491)***
tt16	-1.8046	(0.1379)***	-1.9026	(0.1426)***	-0.9046	(0.0635)***
tt17	-1.9181	(0.1572)***	-2.0264	(0.1623)***	-0.9587	(0.0713)***
tt18	-1.8927	(0.1506)***	-1.9964	(0.1556)***	-0.9418	(0.0689)***
tt19	-1.8619	(0.1538)***	-1.9674	(0.1590)***	-0.9441	(0.0712)***
tt20	-1.8756	(0.1636)***	-1.9815	(0.1692)***	-0.9359	(0.0752)***
tt21	-1.7235	(0.1391)***	-1.8436	(0.1455)***	-0.9016	(0.0683)***
tt22	-1.7551	(0.1482)***	-1.8660	(0.1547)***	-0.8846	(0.0707)***
tt23	-1.2587	(0.1309)***	-1.3508	(0.1389)***	-0.6552	(0.0676)***
tt24	-0.5866	(0.1004)***	-0.6148	(0.1108)***	-0.2746	(0.0574)***
tt25	-1.1833	(0.1393)***	-1.2607	(0.1479)***	-0.6076	(0.0719)***
tt26	-1.4612	(0.1725)***	-1.5562	(0.1810)***	-0.7428	(0.0853)***
tt27	-1.9596	(0.2089)***	-2.0822	(0.2165)***	-0.9876	(0.0974)***
tt28	-2.1951	(0.2608)***	-2.2938	(0.2666)***	-1.0652	(0.1132)***
tt29	-2.1202	(0.2689)***	-2.2117	(0.2755)***	-0.9918	(0.1153)***
tt30	-1.7854	(0.2224)***	-1.8700	(0.2300)***	-0.8586	(0.1023)***
tt31	-2.2110	(0.2784)***	-2.3124	(0.2851)***	-1.0601	(0.1209)***
tt32	-2.3501	(0.3118)***	-2.4517	(0.3182)***	-1.1114	(0.1320)***
tt33	-2.5299	(0.3)***	-2.6604	(0.3067)***	-1.2500	(0.1316)***
tt34	-2.1116	(0.2640)***	-2.2180	(0.2714)***	-1.0259	(0.1180)***
tt35	-1.2385	(0.1880)***	-1.3156	(0.2014)***	-0.6149	(0.0985)***
tt36	-1.2900	(0.1812)***	-1.3863	(0.1943)***	-0.6564	(0.0966)***
tt37	-2.2873	(0.1425)***	-2.4038	(0.1516)***	-1.1025	(0.0696)***
Number of observations		159366		159366		159366
Pseudo R-squared		-		0.190		0.188
Log-Likelihood		-35594		-35562		-35647

Standard errors in parenthesis.

*** significant 1% level, ** significant 5% level, * significant 10% level

Table A9: Duration model for price decreases

Explanatory variable	Grouped Cox model		Logit model		Probit model	
			Costs			
Specific months of collective wage bargaining						
formal start of contract	-0.1207	(0.0561)**	-0.1612	(0.0650)**	-0.0910	(0.0322)**
month before month of permanent wage increase (not in the mid of long-term contract)	-0.0112	(0.0565)	-0.0113	(0.0657)	-0.0156	(0.0326)
month of permanent wage increase (not in the mid of long-term contract)	-0.0477	(0.0572)	-0.0447	(0.0663)	-0.0315	(0.0327)
long term contracts only						
mid-term permanent wage increase	0.0325	(0.0869)	0.0559	(0.1028)	0.0125	(0.0511)
Cost indices; log change of the respective index compared to the time of the firm's last price change						
Wages	-0.2067	(0.7965)	0.0722	(0.8630)	0.2833	(0.3923)
Imported intermediate inputs	-4.6762	(0.7884)***	-4.5511	(0.8352)***	-1.7992	(0.3599)***
share of domestic competitors with processes innovations	0.1811	(0.0895)**	0.2021	(0.1040)*	0.0868	(0.0520)*
			Demand			
Net cumulated demand change since the time of the firm's last price change						
more than 4 reductions	0.4956	(0.0801)***	0.5147	(0.0849)***	0.2242	(0.0375)***
4 reductions	0.4769	(0.0930)***	0.5044	(0.0996)***	0.2318	(0.0455)***
2/3 "	0.2531	(0.0503)***	0.2718	(0.0552)***	0.1401	(0.0264)***
1 "	0.1284	(0.0313)***	0.1776	(0.0381)***	0.1079	(0.0198)***
no change	-	-	-	-	-	-
1 increase	-0.0174	(0.0418)	-0.0198	(0.0479)	-0.0109	(0.0238)
2/3 "	-0.0654	(0.0670)	-0.0325	(0.0707)	0.0035	(0.0322)
4 "	-0.1555	(0.1634)	-0.1150	(0.1680)	-0.0053	(0.0702)
more than 4 increases	-0.4256	(0.1418)**	-0.3949	(0.1451)**	-0.1610	(0.0599)**
Demand of domestic competitors						
Increasing (contemporaneous)	-0.1347	(0.2042)	-0.0925	(0.2331)	-0.0319	(0.1149)
Decreasing (contemporaneous)	0.2467	(0.1496)*	0.2492	(0.1777)	0.1132	(0.0887)
Increasing (preceding month)	-0.3831	(0.2086)*	-0.4937	(0.2364)**	-0.3080	(0.1164)**
Decreasing (preceding month)	0.0940	(0.1542)	0.1507	(0.1845)	0.0721	(0.0921)
Expected demand change during the next six months						
demand decrease expected	0.3428	(0.0293)***	0.4262	(0.0345)***	0.2378	(0.0173)***
no change expected	-	-	-	-	-	-
demand increase expected	-0.0572	(0.0405)	-0.0702	(0.0457)	-0.0370	(0.0222)*
Expected market evolution in the medium run (5 years)						
Significant growth	0.1720	(0.0505)**	0.2204	(0.0597)***	0.1094	(0.0297)***
slight growth or contraction / unchanged	-	-	-	-	-	-
Significant contraction	0.1017	(0.0510)**	0.0983	(0.0628)	0.0452	(0.0328)
missing answers	0.0982	(0.0354)**	0.1169	(0.0421)**	0.0621	(0.0213)**

Table A9: Duration model for price decreases (cont.)

Explanatory variable	Grouped Cox model		Logit model		Probit model	
			Capacity utilisation			
log capacity over utilisation	-0.1886	(0.0721)**	-0.2452	(0.0873)**	-0.1515	(0.0447)**
Technical capacity given actual and expected orders within the next 12 months						
Own firm:						
not sufficient	0.0600	(0.0643)	0.0440	(0.0737)	-0.0041	(0.0362)
Sufficient	-	-	-	-	-	-
more than sufficient	0.0439	(0.0283)	0.0679	(0.0334)**	0.0446	(0.0168)**
domestic competitors (share):						
not sufficient	-0.4550	(0.5082)	-0.6643	(0.5699)	-0.3841	(0.2695)
more than sufficient	0.2355	(0.1133)**	0.3345	(0.1329)**	0.2072	(0.0662)**
			Relative Prices			
CPI (log change over the previous year)	-6.5903	(3.2999)**	-7.5678	(3.7583)**	-4.0409	(1.8167)**
Prices of domestic competitors						
Increasing (contemporaneous)	-0.6207	(0.3678)*	-0.6640	(0.4046)	-0.3173	(0.1871)*
Decreasing (contemporaneous)	1.1663	(0.2881)***	1.6824	(0.3572)***	0.9288	(0.1883)***
Increasing (preceding month)	-1.4292	(0.3761)***	-1.6688	(0.4155)***	-0.8807	(0.1923)***
Decreasing (preceding month)	-0.5395	(0.2963)*	-0.6760	(0.3592)*	-0.3099	(0.1909)
			History of the firm's own price setting			
preceding price change was an increase	-2.4402	(0.0382)***	-2.5244	(0.0396)***	-1.1134	(0.0169)***
length of the actual price spell and the preceding price spell						
is the same	0.1145	(0.0785)	0.1224	(0.0862)	0.0759	(0.0434)*
is the same and 1 month	0.4524	(0.0856)***	0.6537	(0.0968)***	0.3997	(0.0499)***
is the same and 12 months	0.8022	(0.3044)**	0.8278	(0.3148)**	0.3116	(0.1332)**
differ by one month	0.1378	(0.0541)**	0.1472	(0.0590)**	0.0771	(0.0292)**
length of the preceding price spell, given that the combined length of the preceding two price spell adds to 12 months	0.0389	(0.0035)***	0.0410	(0.0038)***	0.0183	(0.0018)***
Constant	-1.6797	(0.1062)***	-1.6937	(0.1220)***	-1.0753	(0.0603)***

Table A9: Duration model for price decreases (cont.)

Explanatory variable	Grouped Cox model		Logit model		Probit model	
stocks of finished products						
too large	0.0836	(0.0347)**	0.1247	(0.0410)**	0.0866	(0.0205)***
sufficient	-	-	-	-	-	-
too small	-0.3103	(0.0866)***	-0.3537	(0.0947)***	-0.1868	(0.0448)***
no stocks	-0.0187	(0.0329)	-0.0123	(0.0381)	-0.0047	(0.0187)
exports						
no exports	0.2513	(0.0543)***	0.3113	(0.0663)***	0.1678	(0.0346)***
employees in the product group						
Less than 50 employees	-0.1202	(0.0387)**	-0.1372	(0.0450)**	-0.0733	(0.0223)**
50 or more employees	-	-	-	-	-	-
Industry						
nace291	-0.0347	(0.0461)	-0.0306	(0.0530)	-0.0166	(0.0258)
nace292	0.1880	(0.0454)***	0.2186	(0.0537)***	0.1215	(0.0270)***
nace293	-0.2039	(0.1064)*	-0.1987	(0.1160)*	-0.0953	(0.0524)*
nace294	-0.1407	(0.0581)**	-0.1583	(0.0668)**	-0.0746	(0.0323)**
nace295	-	-	-	-	-	-
nace297	-0.1671	(0.0902)*	-0.1612	(0.0997)	-0.0720	(0.0464)
nace300	0.1691	(0.1119)	0.2615	(0.1296)**	0.1933	(0.0663)**
nace311	0.0802	(0.0445)*	0.0951	(0.0520)*	0.0492	(0.0260)*
nace313	0.2290	(0.0607)***	0.3604	(0.0740)***	0.2386	(0.0378)***
nace315	0.1977	(0.0767)**	0.2025	(0.0898)**	0.0859	(0.0445)*
nace321	0.3861	(0.0532)***	0.5093	(0.0648)***	0.2867	(0.0334)***
nace322	-0.0551	(0.1067)	0.0061	(0.1250)	0.0438	(0.0636)
nace323	0.1236	(0.0789)	0.2073	(0.0901)**	0.1371	(0.0446)**
nace334	-0.5124	(0.1294)***	-0.5379	(0.1388)***	-0.2544	(0.0626)***
nace335	-0.1649	(0.1601)	-0.2119	(0.1802)	-0.1278	(0.0896)
nace341	-0.9751	(0.3399)**	-0.9920	(0.3590)**	-0.3565	(0.1405)**
nace343	0.1947	(0.0579)**	0.2912	(0.0685)***	0.1720	(0.0342)***
nace35	-0.4139	(0.1434)**	-0.5194	(0.1585)**	-0.2692	(0.0747)***
year						
1980	-0.0951	(0.2149)	-0.1600	(0.2431)	-0.1272	(0.1180)
1981	0.1419	(0.2210)	0.1115	(0.2511)	0.0460	(0.1210)
1982	0.2201	(0.1807)	0.2372	(0.2071)	0.1131	(0.1008)
1983	0.2147	(0.1311)	0.2351	(0.1502)	0.1403	(0.0732)*
1984	0.0697	(0.1147)	0.0697	(0.1310)	0.0421	(0.0637)
1985	-0.1987	(0.1192)*	-0.2079	(0.1343)	-0.0879	(0.0641)
1986	-0.1736	(0.0964)*	-0.1738	(0.1085)	-0.0739	(0.0515)
1987						
1988	-0.1269	(0.1026)	-0.1505	(0.1158)	-0.0752	(0.0561)
1989	-0.2566	(0.1496)*	-0.2607	(0.1654)	-0.0974	(0.0771)
1990	-0.3491	(0.1548)**	-0.3376	(0.1703)**	-0.1514	(0.0792)*
1991	0.2965	(0.1465)**	0.3281	(0.1666)**	0.1573	(0.0807)*
1992	0.4090	(0.1438)**	0.5107	(0.1664)**	0.2883	(0.0812)***
1993	0.4709	(0.1353)**	0.6047	(0.1561)***	0.3636	(0.0766)***
1994	0.3499	(0.1117)**	0.3934	(0.1290)**	0.2088	(0.0639)**
1995	0.2771	(0.0947)**	0.3107	(0.1100)**	0.1452	(0.0547)**
1996	0.2823	(0.0873)**	0.3367	(0.1023)**	0.1973	(0.0510)***
1997	0.2531	(0.0981)**	0.3059	(0.1144)**	0.1709	(0.0570)**
1998	0.0789	(0.0891)	0.1116	(0.1032)	0.0711	(0.0516)
1999	0.1254	(0.0826)	0.1554	(0.0964)	0.0832	(0.0486)*
2000	0.2176	(0.1093)**	0.2374	(0.1245)*	0.1038	(0.0616)*
2001	-0.0408	(0.1176)	-0.0434	(0.1347)	-0.0238	(0.0661)
strike	0.1173	(0.1246)	0.1108	(0.1438)	0.0437	(0.0712)

Table A9: Duration model for price decreases (cont.)

Explanatory variable	Grouped Cox model		Logit model		Probit model	
Month						
January	0.0536	(0.0640)	0.0912	(0.0737)	0.0597	(0.0361)*
February						
March	-0.0459	(0.0711)	-0.0464	(0.0827)	-0.0165	(0.0409)
April	-0.0395	(0.0623)	-0.0348	(0.0717)	-0.0048	(0.0352)
May	-0.1742	(0.0604)**	-0.1910	(0.0696)**	-0.0853	(0.0341)**
June	0.0345	(0.0732)	0.0477	(0.0847)	0.0304	(0.0417)
July	-0.2413	(0.0614)***	-0.2487	(0.0706)***	-0.0912	(0.0346)**
August	-0.1595	(0.0617)**	-0.1518	(0.0711)**	-0.0387	(0.0348)
September	-0.0970	(0.0752)	-0.0828	(0.0873)	-0.0114	(0.0432)
October	-0.0450	(0.0615)	-0.0351	(0.0712)	0.0123	(0.0352)
November	-0.1180	(0.0620)*	-0.1122	(0.0716)	-0.0244	(0.0353)
December	-0.2619	(0.0794)**	-0.3029	(0.0914)**	-0.1289	(0.0455)**
dummies for the baseline hazard						
tt2	-0.6793	(0.0537)***	-0.7413	(0.0594)***	-0.3604	(0.0303)***
tt3	-0.8751	(0.0560)***	-0.9547	(0.0617)***	-0.4626	(0.0311)***
tt4	-1.1327	(0.0657)***	-1.2153	(0.0712)***	-0.5635	(0.0344)***
tt5	-1.2778	(0.0756)***	-1.3740	(0.0809)***	-0.6429	(0.0384)***
tt6	-1.3301	(0.0820)***	-1.4197	(0.0872)***	-0.6691	(0.0406)***
tt7	-1.3321	(0.0860)***	-1.4173	(0.0914)***	-0.6464	(0.0419)***
tt8	-1.6974	(0.1089)***	-1.7969	(0.1137)***	-0.8094	(0.0497)***
tt9	-1.3830	(0.0987)***	-1.4755	(0.1042)***	-0.6892	(0.0470)***
tt10	-1.5393	(0.1118)***	-1.6378	(0.1171)***	-0.7666	(0.0521)***
tt11	-1.4726	(0.1181)***	-1.5663	(0.1237)***	-0.7379	(0.0557)***
tt12	-1.4473	(0.1265)***	-1.5345	(0.1329)***	-0.7083	(0.0594)***
tt13	-1.4672	(0.1387)***	-1.5466	(0.1454)***	-0.6840	(0.0635)***
tt14	-1.8756	(0.1768)***	-1.9804	(0.1827)***	-0.8834	(0.0774)***
tt15	-2.1177	(0.2034)***	-2.2327	(0.2094)***	-1.0007	(0.0867)***
tt16	-1.9077	(0.1973)***	-2.0099	(0.2039)***	-0.8912	(0.0849)***
tt17	-1.6848	(0.1807)***	-1.7898	(0.1882)***	-0.8186	(0.0821)***
tt18	-2.0680	(0.2216)***	-2.1807	(0.2283)***	-0.9889	(0.0952)***
tt19	-1.9826	(0.2270)***	-2.0870	(0.2342)***	-0.9206	(0.0959)***
tt20	-2.1247	(0.2506)***	-2.2439	(0.2574)***	-1.0300	(0.1078)***
tt21	-1.7013	(0.2069)***	-1.8003	(0.2153)***	-0.8215	(0.0930)***
tt22	-1.5624	(0.2079)***	-1.6463	(0.2167)***	-0.7155	(0.0921)***
tt23	-2.3781	(0.3094)***	-2.4971	(0.3159)***	-1.1151	(0.1264)***
tt24	-1.3256	(0.1995)***	-1.3947	(0.2095)***	-0.6127	(0.0920)***
tt25	-1.8488	(0.2689)***	-1.9415	(0.2777)***	-0.8506	(0.1153)***
tt26	-2.0277	(0.2988)***	-2.1331	(0.3073)***	-0.9611	(0.1282)***
tt27	-2.1301	(0.3258)***	-2.2338	(0.3341)***	-0.9784	(0.1350)***
tt28	-4.4236	(1.0033)***	-4.5718	(1.0063)***	-1.9565	(0.3389)***
tt29	-1.8248	(0.2893)***	-1.9241	(0.2999)***	-0.8492	(0.1272)***
tt30	-2.9001	(0.5072)***	-3.0176	(0.5135)***	-1.2911	(0.1877)***
tt31	-4.2577	(1.0038)***	-4.3969	(1.0073)***	-1.8820	(0.3413)***
tt32	-2.2079	(0.3645)***	-2.3360	(0.3742)***	-1.0711	(0.1568)***
tt33	-2.2007	(0.3886)***	-2.3110	(0.3980)***	-1.0086	(0.1592)***
tt34	-1.9219	(0.3460)***	-2.0258	(0.3575)***	-0.9033	(0.1502)***
tt35	-2.4968	(0.4572)***	-2.6161	(0.4663)***	-1.1688	(0.1856)***
tt36	-1.9355	(0.3660)***	-2.0487	(0.3779)***	-0.9634	(0.1651)***
tt37	-2.5832	(0.1816)***	-2.7171	(0.1908)***	-1.2104	(0.0813)***
Number of observations	159366		159366		159366	
Pseudo R-squared	-		0.364		0.355	
Log-Likelihood	-18165		-18213		-18476	

Standard errors in parenthesis.

*** significant 1% level, ** significant 5% level, * significant 10% level

Annex III – Questionnaire ifo business cycle survey

Ifo Institute
for Economic Research

Ifo Business Survey
Manufacturing

The questions refer to the product printed below (in the following named XY). Please mark the appropriate box.

Your answers will be treated as **strictly confidential**. Statutory data protection is fully guaranteed.

ID No

January **2002** Please see also the **reverse**

Product (XY):

Present situation and trends

(1) We consider our present **business situation** for XY as being

good
satisfactory
poor.

(2) Our domestic **production activity*** for XY in the past month has

strengthened
remained unchanged
weakened.
No significant domestic production.

(3) We consider our present stock of unsold **finished products** of XY as being

too small
satisfactory (usual seasonal stock)
too large.
Stockpiling not customary.

(4) **Demand conditions** for XY in the past month have

improved
remained unchanged
worsened.

(5) Our **orders on hand** (domestic and foreign, *in terms of value*) for XY have in the course of the past month

increased
remained largely unchanged or not customary
decreased

* Disregarding differing number of days per month and seasonal fluctuations.

(6) We consider our present **orders on hand** for XY as being

	total orders	export orders
relatively large		
adequate (usual seasonal stock) or not customary		
too small		
We do not export XY.		

(7) Allowing for changes in sales conditions, our **domestic sales prices** (net) for XY in the course of the last month were

raised
left unchanged
reduced.

Expectations for the next 3 months

(8) Our domestic **production activity*** regarding XY will presumably increase

remain largely unchanged
decrease.
No significant domestic production.

(9) Allowing for changes in sales conditions, our **domestic sales prices** (net) for XY will presumably

rise
remain largely unchanged
fall.

(10) Taking into account export contracts already concluded and negotiations in progress, the volume of our **export business** regarding XY will presumably

increase
remain largely unchanged
decrease.
We do not export XY.

(11) **Persons employed*** (domestic enterprises only)
The number of employees producing XY will

increase
remain largely unchanged
decrease.

Expectations for the next 6 months

(12) As regards the business cycle***, business conditions** for XY will

tend to improve
remain largely unchanged
tend to worsen.

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* Disregarding differing number of days per month and of seasonal fluctuations.

Special questions *(January, April, July, October)*

(**A1**) **At present,** our **orders on hand** for XY correspond to a production period of

No orders on hand	up to about ... month(s)											If more than 10 months, please indicate number
	½	1	2	3	4	5	6	7	8	9	10	

(A 2) **At the end of last month**, orders on hand came to

No orders on hand	up to about ... month(s)											If more than 10 months, please indicate number
	1/2	1	2	3	4	5	6	7	8	9	10	

(B 1) **Capacity utilisation** in respect of the production of XY (standard full utilisation = 100 %) **at present** amounts to up to ... %

30 40 50 60 70 75 80 85 90 95 100 more than 100 %, namely:

(B 2) **In the past month** it was .... %

30 40 50 60 70 75 80 85 90 95 100 more than 100 %, namely:

(C) In the light of our *present* orders on hand and the new orders *expected* for the next 12 months, we consider our present **technical capacity** for XY as being

more than sufficient

sufficient
not sufficient.

(D1) Our domestic **production activity** is at present being hampered

Yes No

(D2) **If yes,** by which factors:

Not enough orders
Lack of skilled labour
Lack of raw materials and/or primary products

Insufficient technical capacity

Financing squeeze
Other factors

(E) **Competitive conditions** of our firm for XY in the last 3 months – compared with the previous 3 months – have developed as follows

	Domestic market	***Foreign markets***	
	within	outside	the European Union
Improved			
Remained unchanged			
Worsened			
We do not export XY			

Special questions *(February, May, August, November)*

(A) **Stocks of raw materials and primary products**

Our stocks of raw materials and primary products essential for the production of XY will at present last for a

No stocks	Less than 1/2	production of ... **weeks****							
		½	1	2	3	4	5	6	more than 6 weeks, namely

** In terms of the present production volume.

(B) **Stocks of finished products**

Our stocks of unsold finished products of XY at present correspond to a

No stocks	Less than ½	production of ... **weeks****							
		1/2	1	2	3	4	5	6	More than 6 weeks, namely

** In terms of the present production volume.

(C) **Innovations**[14]

(1) We assume that the market for XY in the **medium run** (about 5 years), ie excluding purely cyclical fluctuations, will

	Germany	Abroad	Total	
grow significantly				(1)
grow slightly				(2)
remain unchanged				(3)
contract slightly				(4)
contract significantly				(5)

(2) Innovations regarding the production of XY in **2001** in our firm were

	Product	Production
completed		
discontinued		
planning completed		
still in planning		
not planned.		

(3) In terms of their total turnover, the following phases applied in 2001 to our products of the product range XY (estimates will do):

Phase of market introducution (Innovation)	..... %
Growth phase	..... %
Stagnation phase	..... %
Contraction phase	..... %

[14] Innovations mean new developments and major improvements in the product and/or production.

Special questions *(March, June, September, December)*

(A1) We are currently working overtime

Yes No

(A2) **If yes**, more than is customary

Yes No

(B1) We are currently working **short time**

Yes No

(B2) We will presumably **work short time** within the next 3 months

Yes No

(A) In the light of foreseeable sales trends for XY, we consider that our present staff numbers for the **next 12 months** will be

- too large (e. g. reduction in staff numbers necessary)
- appropriate
- too small (e. g. additional persons must be employed)

(B) In 2001 our enterprise generated its **turnover** at the following **production sites:** (estimates will do)

		In % of total turnover
Own production		
- in Germany		%
- abroad		%
Contract production		
- in Germany		%
- abroad		%
Additional purchases of merchandise		
- in Germany		%
- abroad		%
Total turnover	**100 %**	