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The Price-Setting Behavior of Austrian Firms: Some Survey Evidence

Claudia Kwapil
Oesterreichische Nationalbank

Josef Baumgartner
Austrian Institute of Economic Research

Johann Scharler
Oesterreichische Nationalbank

Abstract

This paper explores the price-setting behavior of Austrian firms based on survey evidence. Our main result is that customer relationships are a major source of price stickiness in the Austrian economy. We also find that the majority of firms in our sample follows a time-dependent pricing strategy. However, a substantial fraction of firms deviates from time-dependent pricing in the case of large shocks and switches to a state-dependent pricing strategy. In addition, we present evidence suggesting that the price response to various shocks is subject to asymmetries.

Keywords: Price-setting behavior, price rigidity
JEL codes: C25, E30

Non-Technical Summary

Nominal rigidities play a key role in most macroeconomic models used for the analysis of monetary policy. The existence of sticky prices gives the central bank leverage over the real interest rate, which allows monetary policy to influence real economic activity. Although the importance of rigidities for the monetary transmission mechanism appears to be well accepted, a better understanding of the nature of the frictions seems to be crucial since the optimal macroeconomic policy depends on the sources and characteristics of these rigidities. Moreover, the analysis of nominal frictions is particularly relevant in the case of a monetary union since different degrees of price stickiness in the member countries might give rise to cross-country differences in the transmission mechanism.

The economic literature distinguishes between two different kinds of price setting policies. Firms following a time-dependent pricing rule can change their prices only at specific time intervals, while firms applying state-dependent pricing can change their prices whenever they like, especially if the economic environment changes. These two pricing policies have different consequences for price adjustments following an economic disturbance. Under a state-dependent rule, the firm changes its prices instantaneously after a shock (given that the shock is large enough), while with a time-dependent pricing policy it has to wait for the next opportunity. We find evidence that the firms in our sample follow time-dependent as well as state-dependent pricing strategies. Under normal circumstances around 70% of the firms apply time-dependent pricing. However, in the face of major shocks almost half of the firms deviate from this strategy and set their prices according to the state of the economy. Comparing this share with evidence from other countries suggests that the share of firms following state-dependent pricing rules in response to large shocks (56 percent) is relatively small in Austria, which suggests that real effects of monetary policy should (ceteris paribus) be stronger.

Furthermore, our results suggest that price setting takes place at two stages. First, firms review their prices to check whether they are at the optimal level or they need to be changed. Second, if firms find out that the price deviates from its optimal level, they need to decide whether to change the price or not. We find evidence that there are obstacles to price adjustments at both stages. However, the contest of the theories about price stickiness reveals that the main obstacles to price adjustment seem to lie at the second stage of price setting. Thus, informational costs, which are important at the reviewing (first) stage of price setting, do not seem to be among the most important obstacles to price changes. The fear that a price adjustment could jeopardize customer relationships (expressed in the theories on implicit and explicit contracts) seems to be a much more important explanation for sticky prices.

Finally, we investigate the reaction of prices to (cost and demand) shocks. The average time lag between a shock and the price adjustment is four to six months. Furthermore, we observe that firms react asymmetrically to cost and demand shocks. Prices are more sticky downwards than upwards in the face of cost shocks as more firms react more quickly to cost-push shocks than to decreasing cost shocks. In the case of large demand shocks, however, the opposite is true. Prices are more sticky upwards than downwards, because more firms react to receding demand than to increasing demand. If we interpret a monetary shock as a demand shock, it follows that monetary policy should have an asymmetric impact on the Austrian economy.

1. Introduction

Nominal rigidities play a key role in most macroeconomic models used for the analysis of monetary policy. In what appears to be the workhorse model for monetary policy evaluation, the fact that prices are sticky gives the central bank leverage over the real interest rate, which allows monetary policy to influence economic activity via aggregate demand.[1]

Although the importance of rigidities for the monetary transmission mechanism appears to be well accepted, a better understanding of the nature of the frictions that lead to monetary non-neutrality in the short run seems to be crucial for the conduct of monetary policy since the optimal macroeconomic policy depends on the sources and characteristics of these rigidities. Moreover, the analysis of nominal frictions is particularly relevant in the case of a monetary union since different degrees of price stickiness in the member countries might give rise to cross-country differences in the transmission mechanism.

In this paper we investigate price stickiness in Austria. We follow the seminal work of Blinder et al. (1998) and analyze survey evidence focusing on the price-setting behavior of Austrian firms.[2] Conducting a survey has the advantage that it allows to confront actual decision makers with the chain of reasoning that a specific theory of price stickiness describes. This appears to be an important advantage over assessing theories according to whether or not their testable implications are consistent with the data since most theories share virtually the same prediction, namely that prices are sticky.[3]

The purpose of this paper is threefold. First, we present some stylized facts on price setting in Austria. In particular, we study the question whether firms follow a time-dependent or state-dependent pricing policy. Second, we try to discriminate between different explanations of price stickiness advocated in the literature. This appears to be an interesting and important issue since the sources of price stickiness matter for the conduct of monetary policy. And finally, we analyze how firms react to shocks that hit the economy.

We find that time-dependent and state-dependent pricing strategies are prevalent among the firms in our sample. Approximately 70% of the firms follow a time-dependent pricing strategy under normal circumstances. However, around 50% of these firms deviate from time-dependent pricing in the case of large shocks. Moreover, firms tend to react asymmetrically to shocks. While more firms adjust their prices in reaction to increasing costs than to decreasing costs, the opposite is

[1] See for instance Clarida et al. (1999).
[2] For similar studies focusing on other countries see Apel et al. (2001), Aucremanne and Druant (2004), Fabiani et al. (2004b), Hall et al. (1997), Hoeberichts and Stokman (2004), Loupias and Ricart (2004), Martins (2004), Wied-Nebbeling (1985).
[3] See Blinder (1991).

true in the case of large demand shocks. More firms react to receding demand than to increasing demand. Overall, the average time lag between a shock to either demand or costs and the price adjustment lies in the range between four and six months. Finally, we find that the main explanation for sticky prices is the customer relationship. Firms shy away from price adjustments (especially in response to demand shocks) because they do not want to jeopardize their customer relationships. Firms that sell mostly to regular costumers are less likely to react to shocks by adjusting prices.

The remainder of the paper is organized as follows: Section 2 briefly discusses the conduct of our survey. Section 3 focuses on price reviews and price changes while section 4 investigates the explanatory content of various theories of price stickiness for our data set. Section 5 deals with time lags relevant for price adjustments after shocks and section 6 summarizes and concludes the paper.

2. The Survey

2.1 Implementation of the Survey

When compiling the questionnaire, we drew upon the experience of Blinder et al. (1998) for the U.S.A., Hall et al. (1997) for the U.K., Apel et al. (2001) for Sweden, Wied-Nebbeling (1985) for Germany and Fabian et al. (2004b) for Italy. However, the empirical designs of these studies show some differences. Blinder et al. 1998 used a sample of 200 private firms, which were surveyed in face-to-face interviews. The other studies used (much) larger samples with fill-in type of questionnaires. The Austrian survey was carried out as a fill-in questionnaire as well, and was sent as a supplement with the monthly WIFO Business Cycle Survey (BCS) in January 2004. In total, we contacted a sample of 2427 firms from the manufacturing and industry-related service (hereinafter referred to as services) sectors by mail, and 873 firms participated in the survey.[4] Thus, we obtained an overall response rate of 36%, which can be regarded as high given the complexity of the issue and the length of the questionnaire.[5]

As shown in chart 2 and table A1 in the Appendix, the response rates vary considerably across sectors and according to firm size. More manufacturing firms participated in the survey than service sector firms, and we recorded above-average participation of small firms (with less than 100 employees) whereas very large firms tended not to answer the questionnaire.

[4] We mailed the questionnaires to the decision makers of the firms (firm owners, CEOs or assistants of CEOs). In the first week of February 2004 a reminder letter was sent to approximately 1800 firms which had not responded by the end of January.

[5] The questionnaire consists of 13 sets of questions adding up to 79 detailed questions.

When asking about price setting, one has to deal with the issue that many firms sell several types of goods in different (domestic or foreign) markets. In order to operationalize this issue, we asked the respondents to refer to their main product or service (in terms of turnover) on their main market. This should avoid the problem that the respondents lose the focus and switch between different products when answering the questionnaire. We also decided to exclude some sectors a priori because the concept of a main product was less suitable for them (e.g. construction, retailing) as pointed out by Hall et al. (1997). In addition, some sectors had to be disregarded because they are not included in the WIFO BCS sample. Overall, the included sectors represent 42% of Austria's value added in 2001.[6]

The WIFO BCS sample was established as a stratified sample in the 1970s and has been re-stratified several times since then. As can be seen from chart 2 in the Appendix the sample and the response show a bias: industrial (intermediate goods-producing) and large (well-established and successful) firms are over-represented in terms of number of firms and employees, which is a common characteristic in longitudinal data sets of this kind.[7] To correct for these effects, we post-stratify the answers according to the sector of activity and the size class each firm belongs to (see table A1 in the Appendix for details on the post-stratification weights).

The questionnaire collects different types of information about the participating firms. In the first part, Questions A1 to A8 inquire several characteristics of the responding firms (e.g. main product, turnover shares, market and client structures). According to this information, 80% of the firms in our sample operate mainly in the domestic market[8]. Approximately three quarters of the respondents deal primarily with other firms. Just 7% deal directly with consumers and 5% report to have the government as their main customer. Moreover, 87% of the respondents achieve more than 60% of their turnover with regular customers.[9] These numbers indicate that our results focus on producer prices and that an environment of imperfect competition might be a good proxy for the market situation our firms operate in as they mainly deal with regular customers.

The price-setting process is the focus of Questions B1 to B7. To assess the importance of different theories about sticky prices, eleven theoretical concepts were translated into questions in everyday language (Questions B8 and B9). In Question B11 we ask about the reasons for price changes (e.g. labor costs, intermediate-good price changes). Finally, the issues of asymmetries of price

[6] The following sectors are covered in our survey: manufacturing (15, 17 to 36) and some industry-related services (60, 63, 70 to 74, 90). Codes in parentheses correspond to the NACE 2-digit classification.

[7] In the sample no newly founded firms are represented. In addition, firms which did not respond four times in a row (e.g. because of bankruptcy) are excluded form the BCS.

[8] The Austrian market is regarded as their main market, if they earn more than 60% of their turnover there.

[9] A selection of these results is reported in Appendix A, tables A2 to A5.

adjustments (increases vs. decreases), price reactions to different kinds of shocks (demand vs. cost shocks) and the influence of the size of a shock (small vs. large shocks) are addressed in Question B10.

According to the answers to Question B1, about 82% of the respondents are able to set prices by themselves. We restrict the analysis discussed in the following sections to these 715 firms.[10]

2.2 Economic Conditions

When filling in the questionnaire, the respondents were asked to answer either in a general way (i.e. how they usually react) or by indicating how they acted in the last years. Thus, their responses are a snapshot depending, among other things, on the economic situation in Austria at the time the survey was conducted.

In the following we briefly sketch the macroeconomic conditions at the time of the survey (for details see table A6 in the Appendix). Caused by an international business cycle downturn, economic growth in Austria lost its momentum after 2000. Following growth rates (in real terms) well above 3%, the economy slowed down markedly to rates below 1%. Inflation was on the rise until May 2001 (3.4%) and declined afterwards to 0.8% in 2003.

3. Price-Setting Behavior of Austrian Firms

3.1 Time-Dependent versus State-Dependent Pricing Rules

In this section we investigate the price-setting strategy of firms. The idea that economic agents cannot or do not want to change prices and wages instantaneously after shocks was introduced in the economic literature in different ways. Fischer (1979) as well as Taylor (1979, 1980) use the idea of nominal long-term labor contracts in order to inject an element of stickiness into the behavior of nominal wages. Blanchard (1983, 1986) for example applies the idea of monopolistic competition in the goods and labor markets, which creates an adjustment process of wages and prices that takes some time. This enables them to model nominal shocks having an effect on the short run behavior of output. Consequently, they argue that monetary policy can affect real output in the short run, rational expectations notwithstanding. Modeling the timing of wage and price changes is crucial to the real effects of nominal disturbances and is thus one of the cornerstones in New Keynesian macroeconomics.

The time interval of the nominal contracts modeled e.g. by Fischer (1977) and Taylor (1979, 1980) is fixed exogenously and the length is known in advance.

[10] The alternative answers were that e.g. the parent company, the main client or a regulatory authority determines prices.

Calvo (1983) introduces a stochastic element in the price-setting behavior by assuming that each price setter is allowed to change the price following a random signal. These models have in common that the agents cannot change their prices whenever they like, but have to hold prices constant for a (known or unknown) period of time. They are using a time-dependent pricing rule, where the time between successive price revisions cannot be chosen by the firm.

The second strand of literature follows a different line of argument on price adjustments. Firms use state-dependent pricing rules like the (s, S) price adjustment policy in the tradition of Barro (1972) developed further e.g. by Sheshinski and Weiss (1977). Whenever a price setter adjusts his or her price, he or she sets it such that the difference between the actual and the optimal price equals some target level S. The economic agent then keeps the nominal price at this level until the difference between the actual and the target level reaches the trigger level s, which induces an adjustment in the nominal price level. In these models the intervals between price adjustments depend on the nature, the direction as well as the frequency of shocks.

These two pricing policies have different consequences for price adjustments following an economic disturbance. Thus, they have different implications for the transmission of nominal shocks to the real economy. Under a state-dependent rule, the firm changes its prices instantaneously after a shock (given that the shock is large enough), while with a time-dependent pricing policy it has to wait for the next opportunity. If one economy faces a higher share of firms operating time-dependent pricing rules than another economy, then – all other things being equal – this could translate into a higher real effect of (large) nominal shocks in the short run. Consequently, the effect of monetary policy on the real economy is sensitive to the share of firms using time-dependent and state-dependent pricing policies.[11]

These concepts of pricing rules are difficult to explain in a questionnaire. Especially because it might be the case that firms are just able to adjust their prices at exogenous dates (as in the time-dependent rule described above) but because in the last years no shocks occurred that would have warranted a price change, the firms did not change their prices at these predefined time intervals. Thus, they might not agree to the statement that they change their prices regularly. That is why we did not ask whether they follow state-dependent and time-dependent pricing rules. Instead, we asked which strategy the firms follow when reviewing their prices (Question B6a). Following Apel et al. (2001), we allowed the respondents to choose from the following answers:

(1) the firm reviews the price regularly,

[11] In the case of shocks which are too small to guarantee that the difference between the actual price and the optimal price becomes large enough to trigger a price change for all firms following a state-dependent pricing strategy, it is not clear-cut whether a time-dependent or a state-dependent rule entails more flexible prices.

(2) the firm reviews the price on specific occasions,
(3) in general the firm reviews its price regularly and also on specific occasions,
(4) for other reasons and lastly
(5) the firm never checks prices without changing them.

We interpret the answer category (1) as a time-dependent rule, (2) as a state-dependent rule and (3) as normally time-dependent with a switch to a state-dependent regime if sufficiently significant changes occur.

Table 1: Price-Reviewing Strategies Followed by Austrian Firms

	Frequency	Percent
time-dependent	265.25	38.06%
state-dependent	178.73	25.64%
time- and state-dependent	210.24	30.16%
other reasons	28.45	4.08%
no review without change	14.33	2.06%
Total	697.00	100.00%

According to our results, which are presented in table 1, price reviews seem to be a common practice in the firms' pricing strategies. Nearly 98% of the respondents apply one of the above-mentioned reviewing strategies without necessarily changing their prices. Furthermore, our results suggest that both state-dependent and time-dependent strategies are pursued by Austrian firms.[12] Under normal conditions (in the absence of major shocks) approximately 68% of the firms carry out price reviews at constant time intervals, while approximately 26% conduct price reviews on specific occasions. This is in line with the results in Blinder et al. (1998) for the U.S.A., Apel et al. (2001) for Sweden and Aucremanne and Druant (2004) for Belgium, who find that approximately two thirds of the companies follow time-dependent and one third state-dependent reviewing strategies under normal circumstances.[13]

However, the picture changes considerably when we allow for shifts in the reviewing policies. Approximately 30% of the Austrian firms will alter their behavior in response to specific events and will change to state-dependent reviewing. When significant changes occur, 38% of the firms stick to their practice of checking their prices regularly, while nearly 56% apply state-dependent price reviews. Comparing this share with the results from other euro area countries, we

[12] There are no statistically significant differences in the share of firms following the pricing strategies as reported in table 1 across e.g. size classes, sectors, export share.

[13] The results in the literature mentioned above vary between 59% and 66% for firms following a time-dependent rule and between 30% and 34% for firms following a state-dependent reviewing strategy.

find country-specific differences. While the share of firms applying state-dependent reviewing in the face of exceptional circumstances is 54% in Italy (see Fabiani et al. (2004b)) and 56% in Austria, it amounts to 61% in France (see Louipas and Ricart (2004)), 64% in the Netherlands (see Hoeberichts and Stokman (2004)) and Portugal (see Martins (2004)) and 74% in Belgium (see Aucremanne and Druant (2004)). In the light of our above considerations, these results would suggest that in response to major shocks prices should respond more flexibly in Belgium, the Netherlands, Portugal and France than in Austria and Italy.

In Question B11 we asked the firms what factors actually drove price adjustments in recent years. One of the twelve answer categories the firms could choose from was "We raise prices at regular intervals". Combining the answers from this question with the information about whether the firms follow a time-dependent or a state-dependent reviewing policy results in the following picture: While 54% of the firms applying a time-dependent rule agree to the statement "We raise prices at regular intervals"[14], this is just true for 23% of the firms conducting state-dependent reviews. This statistically significant difference (at the 1% level) suggests that there is a connection between time-dependent reviews and time-dependent price changes, as we assumed above.

To conclude, we find evidence that the firms' reviewing strategies can indeed be used as proxies for time-dependent and state-dependent pricing rules. The results indicate that both types of price-setting strategies are prevalent among Austrian firms. Furthermore, we infer from the literature that the effect of monetary policy on the real economy is sensitive to the relative share of firms following time-dependent and state-dependent approaches. In Austria a comparatively smaller share of firms (56%) applies state-dependent pricing rules in response to major shocks, which suggests that the effect of significant monetary policy shocks on the real economy should be larger in Austria than in countries having a higher share of state-dependent price setters – all other things being equal.

3.2. How Often Do Firms Review Their Prices?

Those firms which indicated that they conduct periodic price reviews, applying a time-dependent pricing strategy, were asked at which intervals they review their prices (Question B6b). As shown in table 2, 25.5% of the firms carry out their price reviews at a yearly frequency, 17.5% half-yearly and 28.4% quarterly. Thus, the median firm reviews the price of its main product quarterly, which is also the mode meaning that a quarterly review is the most typical practice.

[14] The respondents could choose from four answers: (1) describes us very well, (2) applicable, (3) inapplicable and (4) completely inapplicable. We assume that firms ticking answer (1) or (2) agree to the statement, while the other firms are assumed to disagree.

Table 2: Frequency of Price Reviews

	Frequency	Percent
less frequently than yearly	2.74	0.9%
yearly	79.66	25.5%
half-yearly	54.48	17.5%
quarterly	88.52	28.4%
monthly	69.11	22.2%
weekly	12.36	3.9%
daily	5.13	1.6%
Total	312.00	100.0%

Given the observed differences in the reviewing behavior, we look for a pattern explaining the diverse frequencies of price reviews. However, a Chi-square test analyzing the equality of distribution over the frequency classes with respect to some firms' characteristics (e.g. market share, export share, share of explicit contracts) does not suggest any relationship at conventional significance levels. There is, however, one exception: the industrial grouping the firm belongs to.[15] Comparing the share of firms in different industries that review their prices more frequently than monthly (see table A8), we find that this share is 44% and 49% in the intermediate goods and capital goods sector, respectively, and below 25% in all the other sectors (consumer durables, consumer non-durables and services). A t-test analyzing the equality of proportions indicates a statistically significant difference in the reviewing behavior in these industries (at the 5% level), with firms in the intermediate goods and the capital goods sector reviewing their prices more frequently.

The majority of firms does not check prices continuously but at discrete time intervals. This could have several reasons. For one thing, this could be related to the (potentially sporadic) arrival of information. Thus, it might be possible that it does not make sense for firms to review their prices more often, as no additional information would be available.[16] For another, there are costs associated with price

[15] In distinguishing between the industrial groupings, we follow the European Commission that splits the manufacturing sector into four groups: firms producing consumer non-durables, consumer durables, intermediate goods and capital goods. Furthermore, our sample comprises manufacturing-related services, which we add as a fifth category to our definition of industrial groupings.

[16] Kashyap (1995) rejects this hypothesis. He observes differing reviewing behavior also with regard to products having similar cost and demand characteristics. However, if products are alike, then the arrival of the necessary information should be correlated as well.

reviews. If there are informational costs, then it might be optimal for firms to forego the most topical information instead of incurring these costs.

3.3 How Often Do Firms Change Their Prices?

The respondents were asked (Question B7) "How often do you change the price of your main product on average in a given year?" Table 3 reports that 22.1% of the firms answered that they do not change their prices at all, 54.2% change their prices once a year and 13.9% do it 2 to 3 times a year.[17] Thus, 90% of the firms adjust their prices less frequently than quarterly. The median firm changes its price yearly and also the mode of this distribution lies at the yearly frequency. Just around 10% of the firms change their prices more often than 3 times a year. These results are in line with Apel et al. (2001), Blinder et al. (1998) and Hall et al. (1997) as well as with the results of eight euro area countries described in Fabiani et al. (2004a), all of whom also find that the modal number of price changes per year lies at the yearly frequency.

Table 3: Frequency of Price Changes

	Frequency	Percent
0	69.03	22.1%
1	169.01	54.2%
2–3	43.44	13.9%
4–11	24.07	7.7%
12–49	3.72	1.2%
more than 50	2.73	0.9%
Total	312.00	100.0%

As in the case of price reviews, we are interested in finding a pattern explaining the difference in the behavior of adjusting prices. Again the sector the firms operate in explains some of the difference in the frequency of price changes. A Chi-square test analyzing the equality of distribution over the frequency classes rejects the null hypothesis at the 5% level. This result points into the same direction as the result on price reviews. Firms in the intermediate and capital goods-producing sectors change their prices more frequently (see table A7).

[17] The results shown in table 3 refer to a sample of firms that answered Question B6b and Question B7.

3.4 The Relation between Price Reviews and Changes

Price changes occur considerably less frequently than price reviews. As shown in table 4 nearly 30% of the firms review their prices monthly or more frequently, while just around 2% of the firms change their prices at that frequency. The median firm reviews its price quarterly and adjusts its price once a year.

Table 4: Cumulated Frequency Distribution of Price Reviews and Price Changes

	Review	Price change
weekly or more frequently	5.5%	0.9%
monthly or more frequently	27.7%	2.1%
quarterly or more frequently	56.1%	9.8%
half-yearly or more frequently	73.6%	23.7%
yearly or more frequently	99.1%	77.9%

Furthermore, we find a strong association between the frequency of price reviews and changes. A firm that reviews its price more often is also more likely to change its price at smaller time intervals. A test for association is significant at the 0.01% level.

The results suggest that price setting takes place at two stages. First, the firms review their prices to check whether they are at the optimal level or they need to be changed. They do that at discrete time intervals and not continuously. Thus, some kind of stickiness can already be observed at the first stage of price setting. Second, once the price review has taken place, firms might change their prices. However, they do so considerably less frequently than they review the prices. Prices are possibly left unchanged because there are no reasons to change them. But perhaps prices remain unchanged because, even once firms have decided to incur the informational costs of the review, they think that there are additional costs of changing the price, which prevents the price adjustment. We will discuss the possible sources of these costs in section 4.

4. Why Do Firms Prefer Not to Change Prices?

4.1 Theories Explaining Price Stickiness

In the economic literature we find manifold explanations for sticky prices. These range from physical menu costs to pricing points and implicit contracts, to name but a few. As Blinder (1991) points out, however, it is difficult to evaluate which of these theories come close to the real world's obstacles to changing prices (one

problem being observational equivalence). Thus, Blinder started to apply the interview method as a new way of finding out about the empirical relevance of different theories. He explained selected theories to managers in face-to-face interviews and assumed that they would recognize the line of reasoning when it came close to their way of thinking. We apply Blinder's methodology to Austrian firms.

We confronted managers with eleven theories, which we chose taking into account their relevance in the economic literature and their rankings in the surveys already conducted (Apel et al. (2001), Blinder et al. (1998), Fabiani et al. (2004b) and Hall et al. (1997)). In the following we will give a short description of all eleven theories.[18]

1. *Coordination failure:* It might not be attractive for a firm to change its price since a change would not only affect customers but also competing firms. After a shock a firm might want to change its price, but only if the other firms change their prices, too. If the firm is the only one to increase its price, it might stand to lose customers. At the same time, a single-handed price reduction might spark a price war, which could in the end be detrimental to the firm's profits.[19] Thus, it might be preferable to a firm to stick to its price as long as none of its competitors moves first. Blinder et al. (1998) call this "following the crowd". Without a coordinating mechanism which allows the firms to move together the prices might remain fixed.
2. *Explicit contracts:* Some of the theories explaining price stickiness were first applied to the labor market, which is for example true for explicit contracts fixing wages (e.g. see [14]). However, this idea can as well be applied to the product market. Firms have contractual arrangements with their customers, in which they guarantee to offer the product at a specific price. An explanation why firms might engage in such agreements is that they want to build up long-run customer relationships. This should discourage customers from shopping elsewhere, stabilizing the firm's future sales. Customers are attracted by a constant price because it helps to minimize transaction costs (e.g. shopping time). Thus, customers focus on the long-run average price rather than on the spot price. As will be described in section 2, explicit contracts are indeed widely used by Austrian firms.
3. *Pricing points:* Some firms set their prices at psychologically attractive thresholds. Especially in the retailing sector we observe prices of, for example, EUR 99.50 instead of EUR 100.00. This suggests that there are non-continuities in the demand curve. Firms choose such pricing points because increasing the price above these thresholds would decrease demand

[18] Here, we stick to the sequence with which they appear in the questionnaire.
[19] This outcome depends crucially on the assumptions of the non-cooperative game. One example of such a set-up is described in Stiglitz (1984).

disproportionately. Customer behavior of this kind can cause price stickiness. In the face of small shocks calling for small price changes firms might not want to react (at least not immediately); instead they rather postpone price adjustments until new events justify a large price change to the next pricing point.

4. *Price readjustments:* This explanation for sticky prices is based on the idea that firms regard the shock they are faced with as temporary. Thus, they assume that the optimal new price will be short-lived as well, and they will have to readjust the price in the opposite direction within a short time period. This theory shares characteristics with the idea of explicit contracts as both rely on the assumption that frequent price changes are detrimental to customer relationships.
5. *Menu costs*: The act of changing prices might be costly. Sheshinski and Weiss (1977) motivate this idea with companies selling through catalogs because printing and distributing new catalogs generates non-negligible costs. Thus, a company facing these costs will change its prices less frequently than an otherwise identical firm without such costs. Akerlof and Yellen (1985) and Mankiw (1985) show that even "small" costs of changing prices can lead to nominal rigidities having "large" macroeconomic effects. In the following we will use the term menu cost in the narrow sense of focusing on the physical cost of changing prices, and not in a broad sense as suggested by Ball and Mankiw (1994).
6. *Cost-based pricing*: It is assumed that costs are an important determinant in a firm's pricing decision and that if costs do not change, prices will not change either. Basically, this means that prices do not change because other prices (costs of inputs) do not change. However, the argument goes further. As products pass through different stages of production, a (demand or cost) shock somewhere in the production chain will take some time until it is propagated further up the chain and finally to the consumers. Thus, even small lags in the adjustment process of a single firm can add up to long lags, when we take into account the whole chain of production.
7. *Non-price competition:* Another possibility why prices are sticky is that firms prefer to react to shocks by changing features of the product other than the price. For example, instead of increasing the price, they could extend delivery times and/or reduce the level of service.
8. *Quality signal:* This question dealing with the quality of the product is related to the above question about non-price competition. However, it reverses the line of argument. It assumes that firms do not decrease the price of their product because customers might wrongly interpret the price decrease as a reduction in quality. Thus, they prefer to hold their nominal prices constant.
9. *Kinked demand curve:* The demand curve the firm faces has a break in the sense that the firm loses many customers when it increases the price. However,

it will not gain many customers if it reduces the price. This theory – like the idea of coordination failure – is based on interactions between firms. The firm assumes that if it raises the price, no other firm will follow and it will lose market share. Moreover, it assumes that if it decreases the price, all competitors will follow suit and it will not gain customers. Thus, it might prefer to hold its price constant.

10. *Implicit contracts:* This theory is based on a similar line of reasoning as the explicit contract theory but it goes one step further. Both theories assume that firms want to build up long-run customer relationships in order to make their future sales more predictable. In contrast to explicit contracts, however, implicit contracts try to win customer loyalty simply by changing prices as little as possible. Okun (1981, p.151) puts it like that: "Continuity and reliability are vital to all these arrangements. But because firms are subject to cost increases that they cannot control, they cannot maintain and realistically pledge constancy of price over an indefinite horizon." This is why Okun (1981) distinguishes between price increases due to cost shocks and those that are due to demand shocks. He argues that higher costs are an accepted rationale for rising prices, while increases in demand are viewed as unfair. Consequently, firms hold prices constant in the face of demand shocks, as they do not want to jeopardize customer relationships. They only adjust prices in response to cost shocks.
11. *Information costs:* As already mentioned above, Ball and Mankiw (1994) suggest a broader use of the term menu costs, in the sense that it includes more than just the physical costs of changing prices. In particular they argue that "the most important costs of price adjustment are the time and attention required of managers to gather the relevant information and to make and implement decisions" (Ball and Mankiw 1994, p. 142). In the following, we will call these costs information costs. The distinction between physical menu costs and information costs enables us to investigate their relative importance in pricing decisions.

4.2 How Relevant Are these Theories in Practice?

This section focuses on the insights we gain from confronting managers with the potential causes for sticky prices we described above. In Questions B8a and B9 we asked: "If there are reasons to increase the price of your main product, which of the following factors might prevent an immediate price adjustment?"[20] The list following this question contained the eleven theories mentioned above, explained as simple as possible in layman's language. For every theory the respondents could choose from four answer categories (4 if they agree very much and 1 if they

[20] In section 3 we deal with the question about price decreases.

disagree very much with the statement). Table 5 ranks the theories according to their mean scores (in column 1) and gives their standard errors (SE in column 2).

According to our results, implicit and explicit contracts are the explanations for sticky prices which were cited most frequently by the respondents. Both theories earned on average a grade of more than three and as their mean scores are very close, we should regard both theories as the winners of this contest. Column 3 and 4 give the results of testing the null hypothesis that the theory's mean score is equal to the score of the theory ranked just below it. This indicates that the mean scores of the two winners are too close to be – in a statistical sense – regarded as different from each other.

Taking a closer look at the mean scores of all theories, we can divide the participants of the contest into two groups. The first five theories earned average grades well above two, while the other six theories received a lower level of support with mean scores well below two. Column 5 contains an alternative way of ranking the theories, reporting a measure of how many respondents agree to the respective theory. It gives the fraction of respondents rating the theory as "applicable" or higher (grades 3 and 4). This way of ranking distinguishes between the two groups of theories even more clearly. While the first five theories are regarded as applicable by more than 50% of the respondents, the "tier two" group of theories received support from less than 15% of the firms.

This way of ranking the theories gives almost the same sequence of the theories' relevance as the ranking according to the mean scores.[21] Besides explicit and implicit contracts, the top group in the contest comprises cost-based pricing, kinked demand curve and coordination failure.

The results indicate that many firms refrain from changing their prices frequently because they have written contracts or implicit agreements to build up long-term customer relationships in order to safeguard tomorrow's sales. In line with this reasoning, we find an association (at the 10% level) between the firms agreeing to the implicit contract theory (rating it with 3 and 4) and those having a high share of regular customers (which was inquired in Question A8). 85% of all respondents have a high proportion of regular customers accounting for more than 70% of their sales.

[21] There is just one exception, namely menu costs would rank sixth under this criterion and information cost would rank seventh.

Table 5: Relevance of Theories Explaining Upward Price Stickiness

		(1) Mean	(2) SE	(3) t-Stat	(4) H_O	(5) Consent	(6) Blinder	(7) Fabiani	(8) Apel	(9) Hall
1	Implicit contracts	3.04	0.05	0.52		77.37%	4	1	1	5
2	Explicit contracts	3.02	0.06	4.05	***	73.42%	5	2	3	1
3	Cost-based pricing	2.72	0.06	0.77		67.56%	2	3	2	2
4	Kinked demand curve	2.69	0.05	3.47	***	62.77%	-	-	4	-
5	Coordination failure	2.47	0.06	12.86	***	52.86%	1	4	-	3
6	Information costs	1.61	0.04	2.00	**	12.21%	-	9	13	-
7	Menu costs	1.52	0.06	0.25		13.39%	6	8	11	11
8	Non-price competition	1.49	0.05	0.73		11.19%	3	7	-	8
9	Price readjustments	1.42	0.04	2.34	**	8.42%	-	5	-	-
10	Pricing points	1.32	0.04	-		7.98%	8	10	7	4
11	Quality signal	-	-	-						

Notes to Table 5: ***(**)[*] stands for significant at the 1% (5%) [10%] level. The null hypothesis referred to in column 4 is that the theory's mean score (given in column 1) is equal to the score of the theory ranked just below it.

Just 4 firms out of 703 having answered this question say that they do not have regular customers at all. It seems that regular customers are a common phenomenon preventing frequent price changes.

In Question B2 we asked the firms whether they have explicit contracts in place. We observe a very clear association between the firms with such arrangements and those agreeing to the explicit contract theory as an explanation for price stickiness (the test being significant at the 1% level). This indicates that the responses throughout the questionnaire seem indeed to be consistent. Approximately 75% of all respondents have written arrangements with their customers and the most typical practice is a contract length of one year: 21% of the firms have price agreements valid for less than one year, 68% for one year and 11% for more than one year.

Columns 6 to 9 in table 5 show the ranking of the eleven theories in other surveys. (Column 6 refers to the results in Blinder et al. (1998) for the U.S.A., column 7 to Fabiani et al. (2004a) for an average of the results from nine euro area countries, column 8 to Apel et al. (2001) for Sweden and column 9 to Hall et al. (1997) for the U.K.) There are, however, some difficulties in comparing these rankings. The questionnaires cover different theories, and moreover the number of theories varies. Furthermore, the other surveys contain theories which are not covered by the Austrian questionnaire. However, we tried to deal with this problem by including the four best performing theories of all other surveys in our questionnaire. Nonetheless, this comparison points out that all the theories ranking first and second in the other surveys are within our top group of theories.[22]

The theories ranking in our "tier two" group include prominent candidates like physical menu costs. Although they are a favorite explanation for price stickiness in the theoretical literature, they seem to be less important in practice. It should be kept in mind, however, that this survey only covers firms operating in the manufacturing industry and in the industry-related service sector. Thus, it includes mostly firms dealing with other firms. Less than 10% of the respondents have final consumers as their main customers. This might be an explanation why theories like pricing points and non-price competition are not regarded as good explanations for price stickiness.[23]

To conclude, we want to go back to section 4. There we discuss the possibility that price setting might take place at two stages. At the first stage, the firms review their prices to find out whether they are still optimal, and at the second stage, they decide whether the circumstances allow for a price change. In section 4 we infer from our results that there seem to be impediments to price adjustments at both

[22] There is one additional explanation among our best performers, namely the kinked demand curve, which was just considered by Apel et al. (2001).

[23] A test for association clearly points out (at the 5% significance level) that firms dealing mainly with consumers and retailers prefer the theory of pricing points much more than the other firms.

stages. However, we were not able to pinpoint which obstacles are regarded as more relevant by the respondents. The explanation for price stickiness ranking sixth in Table 5 and labeled information costs might help answer this question. This theory focuses on the costs associated with gathering information relevant for pricing decisions. In short, this theory deals with the reviewing (first) stage of our two-stage approach. Obviously, these costs exist as more than 12% of the firms regard these costs as relevant (see table 5, column 5). However, as information costs just rank in the "tier two" group of theories, the majority of the firms regard other impediments as more important.[24] Thus, our results indicate that the main obstacles to adjusting prices to their optimal level (implicit and explicit contracts) are associated with the second stage of price setting and are related to the wariness of the firms to change prices in order not to jeopardize the relationships with their regular customers.

4.3 More about Price Stickiness

In addition to the questions about theories explaining price stickiness in the upward direction, we also investigate the reasons for downward price stickiness. We posed two separate questions (B8a and B8b) according to the direction of the price change for all but four theories. One exception is the implicit contract theory, which is just related to price increases (B9b). Furthermore, we explained the idea of the kinked demand curve in one question (B9a) as it is related to price increases and decreases at the same time. The question on information costs is related to price reviews in general rather than changes, thus we packed it into one question as well (B9c). Finally, the theory of quality signals is only relevant for price decreases (B8b).[25] The other seven theories were dealt with in two separate questions.

The ranking of the theories is surprisingly similar regardless of the direction of the price change. Also in the case of downward rigidity, we find implicit contracts ahead of explicit contracts ranking first and second, respectively. The top group comprises exactly the same theories, all receiving mean scores well above two. Within the "tier two" group the rankings changed only slightly. The similarity of the ranking is also confirmed by the rank correlation coefficient, which is 0.88. (For detailed results about the theories' ranking in the case of downward rigidity see table A9 in Appendix A.)

[24] The theory of information costs was also considered by Apel et al. (2001), Aucremanne and Druant (2004) and Martins (2004). There, the degree of recognition was very low as well, and it ranked last in the Swedish and the Portuguese case and took the penultimate rank in the Belgian results.

[25] This explains why table 5 does not contain results about quality signals.

Table 6: Rank Correlations of Motives for Upward Price Stickiness by Sector

	Consumer durables	Intermediate goods	Capital goods	Services
Consumer non-durables	0.82	0.79	0.76	0.79
Consumer durables	–	0.93	0.94	0.96
Intermediate goods	–	–	0.87	0.90
Capital goods	–	–	–	0.94

Apart from the direction of the price change, we want to investigate whether the rankings of the eleven theories vary across industrial sectors (see table A10).[26] In all sectors the theory about implicit contracts ranks first or second and that about explicit contracts ranks first, second or third. Furthermore, the top group (top five theories) comprises the same theories in all sectors. In short, the main message is the same for all industrial groupings. Table 6, which displays the rank correlation coefficients between the five main industrial groupings, supports the above conclusion that the rankings are indeed very similar. The correlation coefficients vary between 0.76 and 0.96 and are generally at a high level.

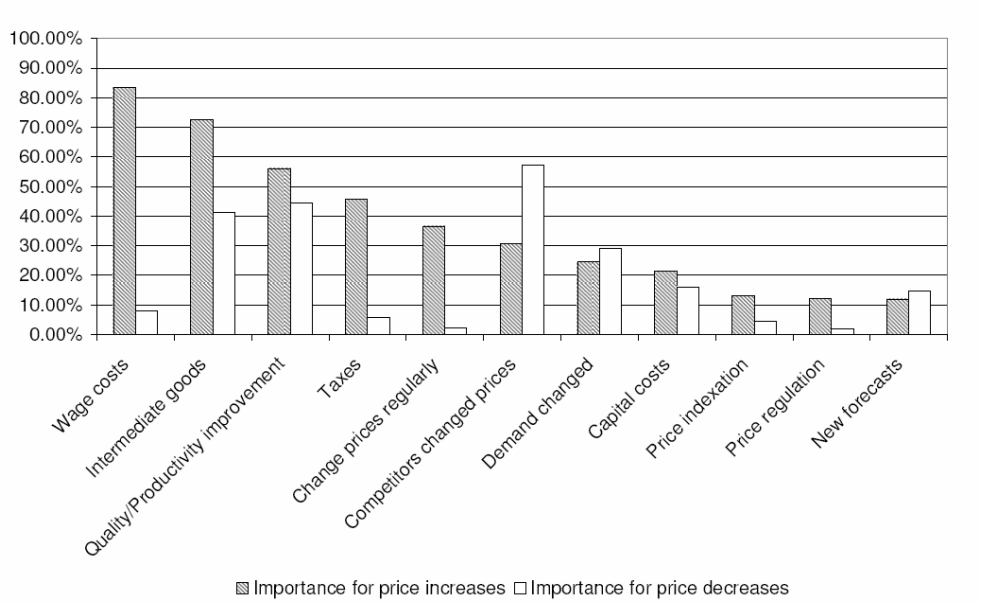
5. Price Adjustments

5.1 What Is Driving Price Changes?

This section deals with price adjustments, shedding light on the questions about what drives prices, how prices respond to different kinds of shocks and the length of these time lags. Regarding the first question about the driving forces of price changes, the respondents were given a list of potential factors and were asked "Which of the factors were relevant for price increases/decreases of your main product in recent years?" (Question B11a for increases and B11b for decreases). As with other questions, the respondents could indicate the importance ((4) very important, (3) important, (2) not important and (1) completely unimportant) of a single factor. Chart 1 summarizes the results and gives the percentage of respondents indicating that a factor was important (4 and 3) in their pricing decision.

[26] As the results are very similar for upward and downward price rigidity, we report just the findings with regard to impediments to price increases.

Chart 1: Importance of Factors Driving Prices Upwards and Downwards



83% and 70% of the respondents report that wage costs and costs of intermediate goods, respectively, were important driving forces to raise prices. By contrast, the two most important reasons for price decreases were changes in competitors' prices (57%) and the improvement in productivity (44%). As shown in chart 1, for most of the factors the proportion of respondents indicating that this factor is important for their pricing decision is higher for price increases than for price decreases. However, there are three exceptions that are more relevant for price decreases than for increases: A change in the competitor's price is far more important for a decision to decrease prices than to increase them, whereas a change in the demand conditions and in forecasts are slightly more important for downward than for upward revisions. Thus, the results suggest that price increases and decreases are driven by different factors. While mainly cost factors drive prices up, mainly market factors are responsible for price reductions. We share this finding with Fabiani et al. (2004a), who find the same pattern of asymmetries for nearly all euro area countries covered by their work.

5.2 Time Lag of Price Reactions

In order to investigate the issue of price stickiness further, we analyze the time lag of price adjustments. Thus, we included Question B10 "If the demand for your main product rises slightly, how much time passes before you change prices?" We

asked eight questions along these lines in order to distinguish between large and small, positive and negative as well as cost and demand shocks.[27] First, the firms were asked to indicate whether they change prices in reaction to shocks or not. If they change prices in reaction to a specific shock, they were then requested to give us the number of months elapsing before the price change is executed.

The results are summarized in table 7, which shows in the first column the fraction of firms holding their prices constant in response to a shock. Furthermore, the second column gives the mean of the number of months that elapse between the occurrence of the shock and the price reaction.

Table 7: Price Reactions after Shocks

Type of shock	(1) Fraction of firms holding the price constant	(2) Mean lag of price reaction	(3) Blinder's mean lag
Small positive demand shock	82%	6.1	
Large positive demand shock	63%	4.6	2.9
Small negative demand shock	82%	4.6	
Large negative demand shock	52%	3.6	2.9
Small cost-push shock	38%	4.8	
Large cost-push shock	8%	3.8	2.8
Small decreasing cost shock	71%	4.8	
Large decreasing cost shock	38%	4.2	3.3

The average time lag of price reactions after shocks is four to six months. The answers range from a price adjustment within the same month to a time span of 24 months. The distribution is thus skewed to the right and the median firm waits for three to four months until it changes its price.[28] An adjustment process of one to two periods in macro models for Austria using quarterly data seems to be justified on the ground of our results. A comparison with the results from Blinder et al. (1998) – which are shown in column three in Table 7 – indicates that the mean lag with which Austrian firms react to shocks seems to be slightly longer than that of U.S. firms. Blinder's survey reveals that the average time lag is approximately three months.

[27] We did not, however, distinguish between temporary and permanent shocks.

[28] In reaction to a small positive demand shock the median firm's response time is four months. For all other shocks the time lag is three months.

We draw the following conclusions, which are all statistically significant at the 5% level (the results of all the tests are shown in the tables A11 to A16 in Appendix A):

- Comparing small and large shocks (pair wise according to the direction and the source of the shock), table 7 reveals that more firms change their prices in reaction to large shocks than to small shocks. Moreover, the firms react more quickly to large than to small shocks.
- In the case of large demand shocks, we find evidence that more firms adjust their prices in response to a drop in demand than to an increase in demand. We did not ask explicitly whether firms adjust their prices upwards or downwards. However, we assume that firms reduce their prices in response to shrinking demand and increase the prices in response to boosted demand. The answers to question B13, where we investigate how firms react to demand shocks (e.g. with price or with output changes), justify this assumption as not one single firm indicated that it would increase prices in the face of falling demand. Thus, we conclude that prices are on average more flexible downwards than upwards in the face of large demand shocks.
- With regard to cost shocks, the opposite is true. In the case of cost shocks (regardless of the size), more firms react to a cost-push shock than to decreasing costs. Moreover, these firms react more quickly to an upward cost shock than to a downward shock. Thus, the results indicate that prices seem to be more flexible upwards than downwards in the face of cost shocks. We share this conclusion with Blinder et al. (1998), who find that price decreases come at a half-month longer lag than price increases.
- Finally, we observe that significantly more firms react to cost shocks than to demand shocks (regardless of the size and the sign of the shock).

To conclude, our results partly contradict the commonly held belief that prices adjust more rapidly upward than downward. In fact, the degree and direction of price rigidity seems to depend on the source of the shock. In the face of significant demand shocks, prices are more sticky upwards, while they are more sticky downwards in the face of significant cost shocks. Moreover, prices are on average more rigid in response to shifts in demand than to cost shocks.

5.3 Factors Explaining Price Reactions after Shocks

In this section probit regressions are estimated to gain some additional insights on how firms react to shocks and thus on the sources of price stickiness in Austria. In particular, we try to link the reaction of firms to demand and cost shocks to various firm characteristics and answers from the questionnaire.

The dependent variable in our regressions records whether a firm has indicated in the survey that it reacts to shocks by adjusting prices or not (as described in section 2). We analyze the reaction of firms in our sample to positive and negative

demand as well as cost shocks. Moreover, we also distinguish between small and large shocks. The different types of shocks will be dealt with separately in our analysis.

For all the estimations carried out in this section, the dependent variable y_i can take on two values. Let y_i be equal to unity if a firm has indicated that it changes its price in response to a given shock, and zero otherwise. For this type of dependent variable, a probit model represents an appropriate framework. In general, the model can be written as

$$P(y_i = 1) = \Phi(x_i \beta) \tag{1}$$

where β is a vector of coefficients, x_i is a vector of explanatory variables and $\Phi(\cdot)$ denotes the cumulative normal distribution function.

Following Small and Yates (1999), we start by including proxies for the overall degree of competitiveness, such as the market share of the firm and the number of competitors, as explanatory variables. We also include a variable that indicates the shape of the marginal cost curve since a flat marginal cost curve can be an explanation for constant prices in response to demand shocks if we assume constant mark-ups. Since the relationship between firms and customers might be important, we include the percentages of sales to regular customers and to consumers. Customers may incur search and information costs to make optimal purchases, and these costs might in turn influence the price-setting behavior of producers. Moreover, costumer relationships may be more important when dealing with consumers as opposed to other firms (or the government).

Pricing to market has also been emphasized as a potential source of price stickiness. If firms are active in foreign markets, they may price to market, that is, set a price that reflects foreign market conditions.

The variables are constructed as follows: For market share we construct a dummy variable ($market$) that takes on the value unity if the market share of the main product is above 30%, and zero otherwise.

The number of competitors ($comp$) is also a dummy that takes on the value unity if a firm has at least five competitors, and zero otherwise. The slope of the marginal cost curve is captured by the dummy mc that takes on the value unity if the firm has indicated that it faces constant marginal costs in question B5 of the questionnaire, and zero otherwise.

Furthermore, we include the fraction of sales achieved through regular customers ($regular$) and the percentage of sales that is generated by selling directly to consumers (con).

We also explore whether the probability of a price change is influenced by explicit contracts and menu costs. For this purpose, we create the dummy variable

explicit that takes on the value unity if firms make arrangements that guarantee a specific price for a certain period of time. Similarly, *menu* is a dummy that indicates whether respondents rated menu costs as applicable or higher (grades three or four) for preventing price increases and price reductions. In addition, we include the variable *export*, which is the share of turnover of the main product generated outside of Austria.

Finally, we include a set of dummies to capture industry and firm size effects. Firm size is continuous and measured by the number of employees, *emp*. The dummy variable *service* takes on the value unity for firms in the service sector, and zero otherwise.

Table 8 shows the results for large demand shocks. From the included proxies for the overall degree of competitiveness, only the number of competitors turns out to be significantly different from zero. It appears that firms having at least five competitors are more likely to adjust prices in reaction to large demand shocks regardless of the sign of the shock. We also find that firms with a large fraction of regular customers are less likely to adjust their prices, whereas firms with a large export share are characterized by a higher probability of reacting to large demand shocks.

In the case of small shocks to demand, the picture is somewhat different as can be seen in table 9. The fraction of regular customers is still highly significant and negative for both decreases and increases in demand. However, for small negative demand shocks, sales to consumers and the shape of the marginal cost curve are also significantly and negatively related to the probability of a price adjustment. Hence, we find some evidence in favor of asymmetries in the reaction to positive and negative demand shocks.

Table 8: Results from Probit Regressions with the Price Reaction to Large Demand Shocks as Dependent Variable

	y = 1 if firms react to a large increase in demand				y = 1 if firms react to a large decrease in demand			
Variable	Coef.		St. Err.	p-val	Coef.		St. Err.	p-val
market	-0.3396		0.2151	0.12	-0.0027		0.2179	0.99
comp	0.4472	**	0.2025	0.03	0.5658	***	0.2076	0.01
mc	0.0028		0.1687	0.99	0.0921		0.1725	0.59
con	-0.0017		0.0035	0.64	0.0017		0.0043	0.69
regular	-0.0120	***	0.0043	0.01	-0.0196	***	0.0051	0.00
export	0.0066	***	0.0027	0.01	0.0052	*	0.0028	0.06
explicit	0.2216		0.2024	0.27	0.0660		0.2085	0.75
menu	-0.1871		0.3046	0.54	-0.1246		0.2876	0.67
service	0.0123		0.1670	0.94	-0.1867		0.1726	0.28
emp	-0.0001		0.0004	0.73	0.0001		0.0004	0.77
constant	0.1675		0.4498	0.71	1.0596	**	0.4974	0.03
Obs	476				434			
F (10,466)	2.95				3.05			
Prob > F	0.0013				0.0009			

Notes to Table 8: ***(**)[*] *stands for significant at the 1% (5%) [10%] level.*

Table 9: Results from Probit Regressions with the Price Reaction to Small Demand Shocks as Dependent Variable

	y = 1 if firms react to a small increase in demand				y = 1 if firms react to a small decrease in demand			
Variable	Coef.		St. Err.	p-val	Coef.		St. Err.	p-val
market	0.0787		0.2514	0.75	0.0331		0.2417	0.89
comp	0.4117		0.2541	0.11	0.1616		0.2174	0.46
mc	–0.1534		0.1870	0.41	–0.4064	**	0.1857	0.03
con	–0.0061		0.0042	0.14	–0.0080	**	0.0036	0.03
regular	–0.0144	***	0.0046	0.00	–0.0168	***	0.0042	0.00
export	0.0029		0.0031	0.35	–0.0016		0.0028	0.55
explicit	–0.1224		0.2181	0.58	0.1284		0.2151	0.55
menu	–0.1832		0.2959	0.54	0.0317		0.3199	0.92
service	–0.0373		0.1882	0.84	–0.0853		0.1807	0.64
emp	–0.0001		0.0004	0.69	–0.0001		0.0004	0.86
constant	0.0120		0.4945	0.98	0.5999		0.4330	0.17
Obs	490				498			
F (10,466)	1.75				2.50			
Prob > F	0.0679				0.0061			

Notes to table 9: $^{***(**)[*]}$ *stands for significant at the 1% (5%) [10%] level.*

Next, Tables 10 and 11 show the results for cost shocks. For increases in costs, none of our explanatory variables turns out to be different from zero at conventional significance levels. For decreases in costs, however, we find that firms in the service sector are more likely to react by changing prices. Moreover, in case of large decreases in costs, firms with a high share of sales to consumers are more likely to adjust their prices.

As a robustness check we have repeated all our calculations with an alternative definition of the dependent variable. In particular, we have defined $y_i = 1$ if the firm has indicated that it changes its price within a period of three months after the shock, and $y_i = 0$ otherwise. Moreover, we have estimated different versions of our regressions, which include only one indicator of the overall degree of competitiveness, that is, either *market* or *comp*. However, our results are robust to these modifications.[29]

[29]Detailed results are available upon request.

Table 10: Results from Probit Regressions with the Price Reaction to Small Cost Shocks as Dependent Variable

	y = 1 if firms react to a slight increase in costs				y = 1 if firms react to a slight decrease in costs			
Variable	Coef.		St. Err.	p-val	Coef.		St. Err.	p-val
market	–0.0151		0.2050	0.94	–0.1395		0.2238	0.53
comp	–0.0792		0.1979	0.69	0.0892		0.2278	0.70
mc	–0.1921		0.1681	0.25	0.2597		0.1767	0.14
con	–0.0034		0.0037	0.37	0.0022		0.0045	0.63
regular	–0.0045		0.0041	0.27	0.0048		0.0048	0.32
export	0.0013		0.0025	0.62	0.0007		0.0028	0.80
explicit	0.2213		0.1968	0.26	0.0433		0.1903	0.82
menu	–0.3542		0.2718	0.19	–0.0125		0.2651	0.96
service	0.1155		0.1670	0.49	1.3304	***	0.1785	0.00
emp	–0.0004		0.0003	0.29	–0.0005		0.0004	0.20
constant	0.7798	*	0.4265	0.07	–1.0175	**	0.4878	0.04
Obs	487				502			
F (10,466)	0.76				7.80			
Prob > F	0.6721				0.0000			

Notes to table 10: ***(**)[*] *stands for significant at the 1% (5%) [10%] level.*

Table 11: Results from Probit Regressions with the Price Reaction to Large Cost Shocks as Dependent Variable

	y = 1 if firms react to a marked increase in costs				y = 1 if firms react to a marked decrease in costs			
Variable	Coef.		St. Err.	p-val	Coef.		St. Err.	p-val
market	–0.0525		0.2100	0.80	–0.3566		0.2228	0.11
comp	0.3405		0.2261	0.13	0.1586		0.2096	0.45
mc	–0.2853		0.2913	0.33	–0.0518		0.1879	0.78
con	0.0055		0.0048	0.25	0.0114	**	0.0037	0.00
regular	0.0044		0.0039	0.26	0.0098		0.0047	0.03
export	–0.0020		0.0036	0.58	–0.0023		0.0027	0.40
explicit	–0.3227		0.3113	0.30	0.1654		0.2339	0.48
menu	–0.4677		0.3420	0.17	–0.3212		0.3173	0.31
service	0.3175		0.2935	0.28	0.7369	***	0.1952	0.00
emp	0.0001		0.0004	0.84	0.0001		0.0003	0.65
constant	1.2206	**	0.3934	0.00	–0.4474		0.4611	0.33
Obs	491				476			
F (10,466)	3.07				4.74			
Prob > F	0.0009				0.0000			

Notes to table 11: $^{***(**)[*]}$ *stands for significant at the 1% (5%) [10%] level.*

In short, we find that in case of demand shocks, a high share of regular customers decreases the probability of a price change. This is true regardless of the size and the sign of the shocks, which makes it the most robust finding of our analysis. Since implicit contracts are likely to play an important role when firms deal with regular customers, this outcome is also consistent with the findings reported in section 4 indicating that implicit contracts are a key explanation for price stickiness in our sample. In case of large demand shocks, a higher number of competitors increases the probability of a price adjustment. Furthermore, firms with a higher share of exports are more likely to change their price in response to big demand shocks. In the case of cost-push shocks, there is no statistical evidence for any difference in the pricing behavior across the firms in our sample. This suggests that a rise in costs triggers a similar response by all firms in the economy. Note that this is in line with the result that 92% of all firms adjust their prices in response to a large cost-push shock as reported in table 7. For a decrease in costs, we find that the service sector is more likely to react with a price adjustment.

Note, however, that our results should be interpreted with some caution since the fit of our equations and the statistical levels of significance are not always satisfactory. This is particularly true for cost shocks.

6. Summary

We find evidence that the firms in our sample follow time-dependent as well as state-dependent pricing strategies. Under normal circumstances around 70% of the firms apply time-dependent pricing. However, in the face of major shocks almost half of the firms deviate from this strategy and set their prices according to the state of the economy. Comparing this share with evidence from other countries suggests that the share of firms following state-dependent pricing rules in response to large shocks (56%) is relatively small in Austria, which suggests that real effects of monetary policy should (ceteris paribus) be stronger.

Furthermore, our results suggest that price setting takes place at two stages. First, firms review their prices to check whether they are at the optimal level or they need to be changed. Second, if firms find out that the price deviates from its optimal level, they need to decide whether to change the price or not. We find evidence that there are obstacles to price adjustments at both stages. However, the contest of the theories about price stickiness reveals that the main obstacles to price adjustment seem to lie at the second stage of price setting. In contrast to the suggestion of Ball (1994), informational costs, which are important at the reviewing stage of price setting, do not seem to be among the most important obstacles to price changes. The fear that a price adjustment could jeopardize customer relationships (expressed in the theories on implicit and explicit contracts) seems to be a much more important explanation for sticky prices. The implicit contract theory, which was heavily recognized by our respondents, suggests that customers regard price adjustments in response to cost shocks as fairer than price adjustments in response to demand shocks. This finding ties in with Rotemberg (2002), who also argues that fairness is an important driving force in customers' decisions.

Finally, we investigate the reaction of prices to (cost and demand) shocks. The average time lag between a shock and the price adjustment is four to six months. Furthermore, we observe that firms react asymmetrically to cost and demand shocks. Prices are more sticky downwards than upwards in the face of cost shocks as more firms react more quickly to cost-push shocks than to decreasing cost shocks. In the case of large demand shocks, however, the opposite is true. Prices are more sticky upwards than downwards, because more firms react to receding demand than to increasing demand. If we interpret a monetary shock as a demand shock, it follows that monetary policy has an asymmetric impact on the Austrian economy. The price reaction after a significant contractive monetary policy shock should thus be more pronounced than after a significant expansionary monetary

policy shock. Note, however, that although the number of firms reacting to a demand shock with a price adjustment differs significantly with respect to the direction of the shock, this does not necessarily mean that this translates into a meaningful difference in economic terms as well. It could be that the differences we observe in our sample are too small in order to matter economically.

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Appendix: Tables and Charts

Table A1: Post-Stratification Weights and Response Rates

Strata			Population		Respondents		Weights	Response rate
h	Sector	Size	Z_h	$(Z_h/Z)*100$	z^r_h	$(z^r_h/z_r)*100$	w_h	$(n^r_h/n^g_h)*100$
1	Food and beverages (15)	1	41,749	5.01	1,711	1.29	1.149	45.9
2		2	28,346	3.40	6,583	4.96	0.203	33.9
3	Textiles, leather (17-19)	1	13,391	1.61	1,019	0.77	0.619	29.9
4		2	19,403	2.33	5,619	4.23	0.163	33.3
5	Wood products (20)	1	18,632	2.24	1,656	1.25	0.530	47.9
6		2	13,863	1.66	2,506	1.89	0.261	23.3
7	Paper products (21-22)	1	18,978	2.28	678	0.51	1.318	21.3
8		2	20,433	2.45	8,758	6.60	0.110	39.3
9	Coke, chemicals (23-25)	1	16,544	1.99	966	0.73	0.807	33.7
10		2	35,425	4.25	10,034	7.56	0.166	34.0
11	Mineral products (26)	1	11,655	1.40	1,352	1.02	0.406	46.6
12		2	15,144	1.82	4,938	3.72	0.144	33.3
13	Metal products (27)	1	3,543	0.43	358	0.27	0.466	42.1
14		2	27,358	3.28	9,957	7.50	0.129	47.8
15	Fabricated metal (28)	1	36,982	4.44	1,819	1.37	0.958	35.4
16		2	29,644	3.56	9,894	7.45	0.141	34.1
17	Machinery (29)	1	21,810	2.62	1,369	1.03	0.750	30.7
18		2	36,578	4.39	20,063	15.11	0.086	39.8
19	Machinery equipment (30-33)	1	16,683	2.00	1,151	0.87	0.683	41.2
20		2	41,550	4.99	8,727	6.57	0.224	36.2
21	Vehicles (34-35)	1	4,001	0.48	75	0.06	2.513	18.8
22		2	14,868	1.78	18,874	14.22	0.037	48.5
23	Manufacturing (36)	1	25,090	3.01	1,085	0.82	1.089	44.4
24		2	13,372	1.60	5,696	4.29	0.111	50.0

Notes to Table A1 see next page.

Table A1 continued: Post-Stratification Weights and Response Rates

	Strata		Population		Respondents		Weights	Response rate
h	Sector	Size	Z_h	$(Z_h/Z)*100$	z_h^r	$(z_h^r/z_r)*100$	w_h	$(n_h^r/n_h^g)*100$
25	Transport (60,63)	1	63,696	7.64	906	0.68	3.311	32.9
26		2	24,370	2.92	695	0.52	1.651	35.7
27	Real estate, renting, etc (70-73)	1	30,682	3.68	739	0.56	1.955	27.4
28		2	11,515	1.38	1,337	1.01	0.406	38.1
29	Business activities (74)	1	117,488	14.10	2,185	1.65	2.532	36.8
30		2	54,767	6.57	1,751	1.32	1.473	14.8
31	Sewage and refuse (90)	1	4,345	0.52	149	0.11	1.373	18.9
32		2	1,307	0.16	110	0.08	0.560	33.3
			Z		z_r			
	Total		833,210	100.00	132,760	100.00	26.3	*36.0*

Notes to Table A1: Source: Social security accounts, WIFO BCS and PSB Survey. Sectors: NACE 2-digit sectors (or the sum of them). Size 1: Firms with less than 100 employees. Size 2: Firms with 100 or more employees.
Z_h number of employees in the population in stratum h, Z number of employees in the population, z_h^r number of employees of the responding firms in stratum h, z^r number of employees of the responding firms.
$w_h = \frac{Z_h/Z}{z_h^r/z_h}\rho$ is the post-stratification weight for stratum h, with $\rho = 3.38$ being a constant re-scaling factor to assure that the total number of firms after post-stratification equals $N = 873$, the total number of respondents.
n_h^r number of firms that responded in stratum h, n_g^h number of firms in the gross sample in stratum h.

Table A2: Question A3: What Share of Your Turnover Is Generated in Austria?

	Frequency	%
0%	9.93	1.44
1% – 19%	33.96	4.91
20% – 39%	38.23	5.53
40% – 59%	55.19	7.99
60% – 79%	66.73	9.66
80% – 99%	232.94	33.71
100 %	254.02	36.76
	691.00	100.00

Table A3: Question A4: What Percentage of Sales Do You Generate by Selling Your Main Product to...?

	Frequency	Percent
wholesalers	67.77	9.74
retailers	29.19	4.19
within group	32.80	4.71
other companies	381.09	54.75
government	35.05	5.04
consumers	51.89	7.46
no main customer	77.30	11.11
others	20.91	3.00
	696.00	100.00

Notes to table A3: The main customer is defined as generating more than 50% of the sales of the company.

Table A4: Question A6: How Many Competitors Do You Have for Your Main Product on Its Most Important Market?

	Frequency	Percent
none	10.46	1.47
fewer than 5	114.14	16.03
between 5 and 20	286.39	40.22
more than 20	301.01	42.28
	712.00	100.00

Table A5: Question A8: What Percentage of Sales Do You Achieve through Regular Customers?

	Frequency	Percent
0% – 20%	14.98	2.13
21% – 40%	24.99	3.56
41% – 60%	52.38	7.45
61% – 80%	254.57	36.21
81% – 100%	356.08	50.65
	703.00	100.00

Table A6: Macroeconomic Indicators for Austria 1999 to 2003

	1999	2000	2001	2002	2003
	Annual changes in%				
Gross domestic product	3.3	3.4	0.7	1.2	0.8
Consumer price index	0.6	2.3	2.7	1.8	1.3
Real wages per capita	1.0	1.0	–0.8	1.0	0.5
Unemployment rate (in %)	4.0	3.7	3.6	4.2	4.3
Fiscal balance (in % of GDP)	–2.2	–1.5	0.3	–0.2	–1.1

Notes to table A6: Source: WIFO Database.

Table A7: Frequency of Price Changes in Different Sectors (in %)

Number of price changes per year	0	1	2–3	4–11	12–49	50–
Total	22.1	54.2	13.9	7.7	1.2	0.9
Consumer non-durables	5.9	71.7	17.4	1.8	0.0	3.2
Consumer durables	0.6	75.5	23.9	0.0	0.0	0.0
Intermediate goods	4.1	55.1	24.9	14.1	0.4	1.4
Capital goods	6.4	53.8	25.3	8.7	2.9	2.9
Services	35.3	48.3	7.3	7.6	1.5	0.0

Table A8: Frequency of Price Reviews in Different Sectors (in %)

Frequency of price reviews	daily	weekly	monthly	quarterly	half-yearly	yearly	less frequently
Total	1.6	3.9	22.2	28.4	17.5	25.5	0.9
Consumer non-durables	0.6	7.9	14.9	27.7	18.5	30.4	0.0
Consumer durables	0.0	0.0	0.8	73.0	1.6	24.6	0.0
Intermediate goods	2.8	3.7	37.5	21.0	15.7	19.3	0.0
Capital goods	6.1	3.9	39.0	33.4	6.6	11.0	0.0
Services	1.0	3.6	18.4	26.3	20.7	28.5	1.5

Table A9: Relevance of the Theories Explaining Downward Price Stickiness

Table A9: Relevance of the theories explaining downward price stickiness

		(1) Mean	(2) SE	(3) t-Stat	(4) H_O	(5) Consent	(6) Blinder	(7) Fabiani	(8) Apel	(9) Hall
1	Implicit contracts	3.04	0.05	1.78	*	77.37%	4	1	1	5
2	Explicit contracts	2.94	0.06	2.92	***	70.53%	5	2	3	1
3	Kinked demand curve	2.69	0.05	2.60	***	62.77%	-	-	4	-
4	Cost-based pricing	2.49	0.06	4.60	***	57.27%	2	3	2	2
5	Coordination failure	2.13	0.06	1.68	*	35.68%	1	4	-	3
6	Non-price competition	1.98	0.07	0.87		33.50%	3	7	-	8
7	Quality signal	1.88	0.06	2.94	***	23.42%	12	6	-	10
8	Price readjustments	1.70	0.06	1.15		21.33%	-	5	-	-
9	Information costs	1.61	0.04	2.04	**	12.21%	-	9	13	-
10	Menu costs	1.52	0.06	4.91	***	13.32%	6	8	11	11
11	Pricing points	1.24	0.03	-		5.27%	8	10	7	4

Notes to Table A9: ***(**)[*] stands for significant at the 1% (5%) [10%] level. The null hypothesis referred to in column 4 is that the theory's mean score (given in column 1) is equal to the score of the theory ranked just below it.

Table A10: Differences in the Theories' Ranking According to the Sectors the Firms Operate in

	Total	Consumer non-durables	Consumer durables	Intermediate goods	Capital goods	Services
Implicit contracts	1	1	2	2	2	1
Explicit contracts	2	2	1	1	3	2
Cost-based pricing	3	4	3	3	1	4
Kinked demand curve	4	5	4	4	4	3
Coordination failure	5	3	5	5	5	5
Information costs	6	7	6	7	6	6
Menu costs	7	8	7	8	8	8
Non-price competition	8	10	8	9	7	7
Price readjustments	9	9	9	6	9	9
Pricing points	10	6	10	10	10	10
Quality signal	–	–	–	–	–	–

Table A11: Comparison between Small and Large Shocks with Respect to the Fraction of Firms Holding the Price Constant

Type of shock	Fraction of firms holding the price constant	t-statistics	
Small positive demand shock	82%	7.52	***
Large positive demand shock	63%		
Small negative demand shock	82%	11.05	***
Large negative demand shock	52%		
Small cost-push shock	38%	10.09	***
Large cost-push shock	8%		
Small decreasing cost shock	71%	8.77	***
Large decreasing cost shock	38%		

Notes to Table A11: Ho = No difference between the fractions with respect to large and small shocks. ***(**)[*] *stands for significant at the 1% (5%) [10%] level.*

Table A12: Comparison between Small and Large Shocks with Respect to the Mean Lag

Type of shock	Mean lag	t-statistics	
Small positive demand shock	6.1	5.22	***
Large positive demand shock	4.6		
Small negative demand shock	4.6	4.50	***
Large negative demand shock	3.6		
Small cost-push shock	4.8	5.86	***
Large cost-push shock	3.8		
Small decreasing cost shock	4.8	4.15	***
Large decreasing cost shock	4.2		

Notes to Table A12: Ho = No difference between the means with respect to large and small shocks. ***(**)[*] *stands for significant at the 1% (5%) [10%] level.*

Table A13: Comparison between Positive and Negative Shocks with Respect to the Fraction of Firms Holding the Price Constant

Type of shock	Fraction of firms holding the price constant	t-statistics	
Small positive demand shock	82%		
Small negative demand shock	82%	0.00	
Large positive demand shock	63%		
Large negative demand shock	52%	3.79	***
Small cost-push shock	38%		
Small decreasing cost shock	71%	–9.98	***
Large cost-push shock	8%		
Large decreasing cost shock	38%	–9.39	***

Notes to Table A13: Ho = No difference between the fractions with respect to positive and negative shocks. ***(**)[*] *stands for significant at the 1% (5%) [10%] level.*

Table A14: Comparison between Positive and Negative Shocks with Respect to the Mean Lag

Type of shock	Mean lag	t-statistics	
Small positive demand shock	6.1		
Small negative demand shock	4.6	–1.48	
Large positive demand shock	4.6		
Large negative demand shock	3.6	0.61	
Small cost-push shock	4.8		
Small decreasing cost shock	4.8	–2.40	**(1)
Large cost-push shock	3.8		
Large decreasing cost shock	4.2	–5.05	***

Notes to Table A14: Ho = No difference between the means with respect to positive and negative shocks. ***(**)[*] *stands for significant at the 1% (5%) [10%] level. (1) The mean lags reported in this table are averages over the whole sample. The t-tests, however, only take those firms into account that have answered both questions. Thus, the means used for the t-test can deviate from the means reported in the table.*

Table A15: Comparison between Cost and Demand Shocks with Respect to the Fraction of Firms Holding the Price Constant

Type of shock	Fraction of firms holding the price constant	t-statistics	
Small positive demand shock	82%	15.93	***
Small cost-push shock	38%		
Small negative demand shock	82%	4.03	***
Small decreasing cost shock	71%		
Large positive demand shock	63%	16.58	***
Large cost-push shock	8%		
Large negative demand shock	52%	4.06	***
Large decreasing cost shock	38%		

Notes to Table A15: Ho = No difference between the fractions with respect to cost and demand shocks. ***(**)[*] *stands for significant at the 1% (5%) [10%] level.*

Table A16: Comparison between Cost and Demand Shocks with Respect to the Mean Lag

Type of shock	Mean lag	t-statistics	
Small positive demand shock	6.1	1.25	
Small cost-push shock	4.8		
Small negative demand shock	4.6	–0.67	
Small decreasing cost shock	4.8		
Large positive demand shock	4.6	4.39	***
Large cost-push shock	3.8		
Large negative demand shock	3.6	–2.08	**
Large decreasing cost shock	4.2		

Notes to Table A16: Ho = No difference between the means with respect to cost and demand shocks. ***(**)[*] *stands for significant at the 1% (5%) [10%] level.*

Chart A: Comparison of Population, Sample and Respondent Characteristics