Currency Changeovers as Natural Experiments

Inaugural-Dissertation
zur Erlangung des Grades

Doctor oeconomiae publicae (Dr. oec. publ.)

im Jahr 2006
an der Ludwig-Maximilians-Universität München
vorgelegt von

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Promotionsabschlussberatung: 26. Juli 2006

MEINER FAMILIE

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Acknowledgments

I would like to thank my supervisor Ray Rees for his many helpful comments on my research and for his encouragement. I owe a lot to Guido Tabellini, my second supervisor, for his support. The idea for working on this subject came up when I was a teaching assistant for his course in Monetary Economics at Università Bocconi. Joachim Winter completes my thesis committee and I am very grateful for his comments and suggestions.

I have benefited a lot from discussions with many people. Among these I would like to mention Alberto Alesina, Maria Bejan, Alberto Bisin, Tobias Böhm, Fabio Canova, Efrem Castelnuovo, Francesco Corielli, Nobu Kiyotaki, John Lovelock, Ulf Söderström, Antonella Trigari, Silke Übelmesser and in particular Giuseppe Cappelletti, Julius Moschitz, Stephan Maier, and Richard Schmidtke. Monika Schnitzer who guided me through a difficult part of my thesis deserves special thanks. Completing this dissertation would not have been possible without Tobias Böhm; I would like to thank him for his help. I also would like to thank Angela Baldassarre, Giuseppe Ferraguto, Irmgard von der Herberg, Andreas Irmen, and Lorenza Negri.

During my dissertation I had the chance to spend several semesters at Università Bocconi. I am grateful to IGIER and Università Bocconi for the support and for providing such a stimulating research environment.

Chapter 1

Introduction

A currency changeover can be viewed as a natural experiment with the absolute price level as the exogenously changing variable. Given that the absolute price level changes fast (overnight) it is a good assumption that real variables, such as production costs, technology, or preferences are constant. Under this assumption, any change in relative prices is then caused by the initial change of the absolute price level. This "experiment" allows us to answer questions for which giving an answer would otherwise be difficult or in some cases not possible. This dissertation considers four such questions.

At a currency changeover firms have to change absolute but not necessarily relative prices. The first and most obvious question is then whether a changeover can affect relative prices.

A second question is whether supply and demand functions are homogeneous of degree zero in prices. The first two questions are related but not equivalent.

A third question for which a currency changeover provides an answer is whether menu costs are large enough to explain the price stickiness we observe in the data. At a currency changeover firms have to reprint their "menu" independently of whether or not they change prices. When changing menus is costly firms postpone price changes in the run-up to the changeover and try to make the price changes coincide with the changeover. This behaviour will be reflected in the data and is testable.

The fourth question I address is about the multiplicity of equilibria in oligopolistic price setting. Oligopoly theory suggests that in certain markets the prevailing price may not be unique and that other prices, too, constitute equilibria. This multiplicity is, however, difficult to observe. Prices are relatively stable and observing a price change, it is often very difficult to identify its underlying reason. A currency changeover provides a nice instance where the multiplicity predicted by the theory is revealed.

The episode I am looking at is the Euro changeover in January 2002. From a historical perspective, the Euro changeover is exceptional in that the currencies that were replaced were stable. Most changeovers are done to replace unstable currencies, in order to end hyperinflations for example. An event similar to a changeover was the decimalisation of the British currency in 1971. I will return to the decimalisation in the United Kingdom in the discussion at the end of the dissertation.

In the "experiment" described above the change in the exogenous variable, the absolute price level, is not as isolated as one might expect but triggers itself changes

of other variables and these variables might themselves affect relative prices. For example, consumers might initially be confused by the unfamiliarity of coins and banknotes and firms might try to take advantage of this by temporarily increasing prices. What makes the Euro changeover especially interesting is that the 12 Euro-countries adopted different price setting regulations so that the degree to which other variables were affected varied from country to country. This heterogeneity helps in understanding the impact on relative prices and provides a nice opportunity to find the "optimal" policy.

The next chapter contains the central article of this dissertation. The article presents the data, describes the instruments a country can use to regulate prices and identifies the main forces that affect prices. In chapter 3, I show that menu costs can explain neither the persistent increase of some prices nor why prices are sticky in general. Chapter 4 studies a theoretically interesting mechanism that explains why some of the price changes appear to be persistent. In the discussion that concludes the dissertation I will answer the four questions asked above. The discussion also provides a short summary of the main findings and propositions of the dissertation.

Chapter 2

Price Setting Behaviour and Price Setting Regulations at the Euro Changeover

Abstract

The goal of this paper is twofold. First, I document the impact of the Euro changeover on (relative) prices. The impact was mostly transitory, where prices returned to their pre-changeover level within a few weeks. But in some industries, especially services, the impact appears to be persistent. The second goal of the paper is normative. The impact differs widely across Euro-countries and there are some countries where price setting at the changeover does not appear to be much different from other periods. Focusing on Austria and Germany, I argue that the reason for this is the way in which the countries regulated price setting at the changeover. A theoretical discussion about transitory and persistent non-neutralities of a currency changeover is provided.

2.1 Introduction

This paper documents the impact of the Euro changeover on prices. The impact on the overall price level is negligible, but at a more disaggregate level the effect is somewhat surprising. Prices in several industries increased sharply with the changeover. Most returned to their pre-changeover level after a few weeks but some, especially services prices, seem to have stabilized at a higher equilibrium. The impact differs widely across countries and there are some countries where price setting at the changeover does not appear to be much different from other periods. I argue that these differences can be explained by the way in which the countries regulated price-setting during the changeover. The main proposition of this paper is that both the transitional and the persistent price increases may have been avoided with different price setting regulations.

In this paper I will focus on Austria and Germany. These two countries appear to occupy the extreme ends of the range of different price setting regulations.[1] Austria was the first country in Europe to introduce a generalized dual pricing obligation. Technical infringements of this obligation or failing to use proper conversion

[1] According to the measure used by Hobijn et al (2004), the impact in Austria was one of the lowest of the 12 Euro countries and the impact in Germany was stronger than in any of the other 12 countries.

rates and thereby disguising price increases were indictable. The German authorities deemed the existing regulations and the goodwill of retailers sufficient. Unlike in other countries, no implicit threat of regulatory action if minimum "benchmark" targets concerning dual pricing are not met were foreseen. In Belgium and the Netherlands, for example, the terms of the "Code of Conduct" provided that dual pricing is voluntary but might become mandatory if dual pricing practices were not taken up on a widespread basis by retailers. With hindsight it can be said that the existing price setting regulations in Germany discouraged the use of dual price tags.

Table 1: PRICE SETTING REGULATIONS

	AUSTRIA	GERMANY
Euro Changeover	January 1st 2002	
transition period (payments in both currencies)	2 months January 1st - February 28th 2002	
period of compulsory dual pricing	5 months 2001:10 - 2002:02	---
dual pricing possible		
- in 2001	yes	yes
- after transition period	yes	no
replacement period	> 12 months	< 2 months

Table 1 presents the time schedule of the changeover and important regulatory details of both countries. The Euro was introduced on January 1st 2002. Following the changeover was a two-month transition period in which payments could be made in both currencies. The period of compulsory dual pricing in Austria started three months before the changeover and finished with the end of the transition period. Retailers were free to denote prices in both currencies after the transition period if they wished to do so. As already mentioned above, dual pricing was not compulsory in Germany, though retailers were free to do so before the changeover. Subsequent to the transition period all prices had to be denoted in Euros.

At a currency changeover all price tags have to be replaced eventually. I refer to the time span in which this happens as "replacement period". Given that in Austria voluntary dual pricing was possible after the transition period, the replacement period was quite long. In Germany, prices denoted in Marks, the legacy currency, were not allowed after the transition period. The replacement period comprised therefore at most two months. By switching directly from Mark to Euro prices firms were able to avoid the trouble of printing dual price tags and only firms that put up the effort of printing dual prices were able not to replace price tags exactly at the changeover. In some sectors it appears that price tags have been replaced within only a few days after the changeover. The duration of the replacement period may play a role in how

a changeover affects relative prices.

Considering the intense discussions about the impact of the Euro changeover on prices in the media and in the public in general, there is relatively few work on this subject. Some central banks reported the impact on specific items and the overall price level (Bundesbank 2002 and 2004, De Nederlandsche Bank 2002). The following papers cover various aspects of the changeover: for menu costs see Hobijn, Ravenna and Tambalotti (2004) and also Gaiotti and Lippi (2005); for price perception see Mastrobuoni (2004). Baye, Gatti, Kattuman and Morgan (2004) is about the effect of the changeover on competition between online retailers. Unlike the present paper, many of the papers above use data sets that were not compiled by the official bureaus. A book worth mentioning is Lippi (2005) who embraces various aspects of the changeover.

Before presenting the data, it is useful to provide a short reflection about possible sources of temporary non-neutrality of a currency changeover. This will be done in the next section. The data are presented in Section 3. Section 4 then tries to answer the question how a currency changeover may have persistent non-neutral effects. Policy lessons that can be drawn from the Euro changeover are summarized in section 5. A summary in section 6 concludes the paper.

2.2 Theory: Transitory Non-Neutrality

A currency changeover is not necessarily a nominal event that keeps relative prices untouched. For the short run several sources of non-neutrality can be identified. The purpose of this section is to present and discuss these sources.[2] The section also serves to clarify the approach I take in the succeeding section, that is, to clarify why I search for certain patterns in the data and why these patterns emerge.

Menu costs, i.e. the costs of changing price tags or "menus" are one of the more obvious sources of temporary non-neutrality. In fact, most of the literature that followed the first reports of a "jump" in restaurant prices concentrated on menu costs.[3] When menu costs are high, firms will try to postpone price adjustments in the run-up to the changeover and will try to make the price changes coincide with the changeover. Price changes that were originally planned shortly after the changeover will be anticipated. This behaviour - postponing and anticipating - will lead to a "jump" of the index at the changeover and to periods of reduced adjustments before and after as illustrated in figure 2.1. The important point here is that menu costs can explain why prices jump at a currency changeover, but only to the extent that the

[2] In this discussion I refer to changeovers where the currency that is being replaced is "stable". Changeovers that replace unstable currencies, to end hyperinflations for example, have real effects that are already well known and well documented.

[3] Angelini and Lippi (2005) and Hobijn, Ravenna and Tambalotti (2004) argue that standard sticky price models predict a spike in inflation similar to what was observed in the data.

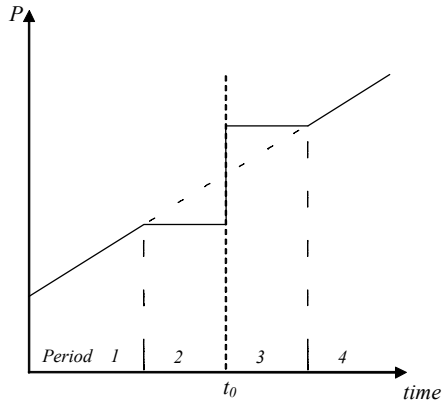

FIGURE 2.1. The effect of menu costs on an increasing price index. The changeover takes place at t_0.

jump is accompanied by a period of reduced adjustments before or after the jump. If there is no sign of a reduced adjustment or if the increase is not merely transitory, the series must jump for other reasons.

Another source of temporary non-neutrality is rounding. Retailers often sell goods at pricing points, such as 1.99 or 24.90. A typical price for a service such as a cup of coffee or dry cleaning is 3.20. Converting these prices at the official exchange rate often makes them less attractive so that sellers will round prices up or down to the next pricing point. This rounding leads to intense adjustments at the changeover, but movements of price *indices* cannot be attributed to rounding alone. Rounding, however, will play a central role in the mechanism that lead to the persistent price increases.

Two other sources of non-neutrality can be identified: the "initial confusion" and one that may be called "increased awareness". The introduction of unfamiliar coins and banknotes and the changing of all nominal prices lead to some confusion among consumers, at least initially. Firms might try to take advantage of this confusion by temporarily raising prices. This is the same kind of confusion tourists experience when traveling to countries with a different currency. In some sense, this confusion temporarily raises firms' market power. But there is another effect that temporarily pushes firms' market power in the opposite direction. At and around changeovers, the public is very attentive to price increases, and during the Euro changeover the media showed many reports about unjust price increases or "Euro profiteering". This "increased awareness" makes it difficult for firms to take advantage of the changeover and in some cases it might even be strong enough to induce firms to reduce prices.

Here it is important to understand that the increased awareness affects small and large sellers differently. If a company like a large retailer or a restaurant chain increases prices at a changeover there is some chance that the media will report on it. Small sellers like independent restaurants, in contrast, do not have to fear to read their names in a newspaper article as much as, say, McDonald's or Pizza Hut. The phenomenon that the increased awareness affects some firms and others not, will be dubbed the "newspaper effect".

In the next section where I present the data two patterns emerge. The first one provides support for the newspaper effect. The second pattern is somewhat surprising because none of the four sources of non-neutrality mentioned above is able to predict it. It will be this second effect that leads to an explanation for the persistent price increases at the Euro changeover.

2.3 Data

The Euro changeover did not affect all prices uniformly. There are some prices that increased, a few prices decreased and most prices were unimpressed by the changeover. The increases were mainly transitory where prices returned to their pre-changeover level or trend after a few months, but there are some prices that appear to have increased persistently.

In this section we will see that the impact on prices is not random but follows certain patterns. One such pattern was already mentioned in the previous section: the newspaper effect which suggests that large sellers and chains tend to hesitate before taking advantage of the changeover, while smaller shops may be more inclined to raise prices. We will also see that a second pattern emerges. Services prices are the most heavily affected, but here, too, there are some services that were unaffected by the changeover. The factor that appears to explain the differences within the services sector is the degree of standardization. Prices of fairly standardized services such as going to the cinema increased sharply with the changeover, while prices of less standardized services like gardening services were unaffected.

The next subsection describes the data. Then there are two subsections on Germany followed by an account of the Austrian experience. A summary of the findings conclude the data section.

2.3.1 Data Description

To estimate the impact of the Euro changeover on prices I use the individual series of the consumer price index (CPI) baskets. In Austria the consumer price index is based on 618 items and in Germany on 686. For both countries, the data set is "complete" in the sense that I have data on all series that enter the baskets. Not all European countries publish the complete set of series that enter the baskets and, unfortunately,

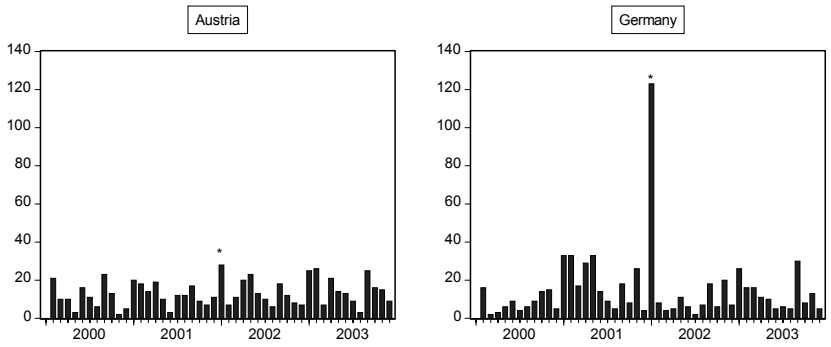

FIGURE 2.2. Histograms of the maximum price increases in Austria and Germany. The vertical axis shows the number of series in the CPI baskets that have their maximum increase in the month given on the horizontal axis. The Euro changeover is denoted by an asterisk *.

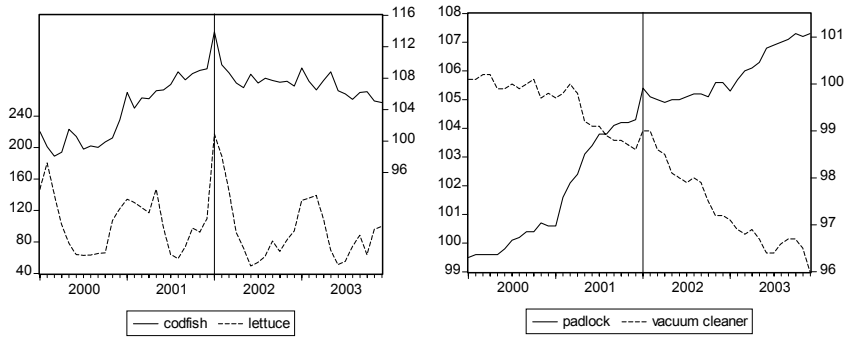

FIGURE 2.3. Four examples of items with a spike at the changeover (data from Germany, changeover denoted by the vertical line).

in many countries the Euro changeover coincided with a revision (rebase) of the baskets which often greatly reduced the number of available series.[4] Austria and Germany, revised their CPI baskets in the beginning of 2000. The data are monthly, indexed, and cover the 48 months from January 2000 to December 2003. The Euro changeover was in January 2002 so that the sample includes 24 months before and 24 months after the changeover.

The histograms in figure 2.2 give a first impression of the impact of the Euro changeover on prices. The histograms show the number of items that have their maximum increase in a given month. In Germany, the maximum increase occurs surprisingly often at the changeover, while in Austria the changeover seems not to have had an effect. Most of the series that increased sharply in Germany returned to their pre-changeover level within a few weeks. Figure 2.3 shows four examples. The prices shown are for codfish, lettuce, padlocks and vacuum cleaners. The changeover month is denoted by a vertical line. All four series display a pointed upward spike at the changeover.

Table 2: FRUIT AND VEGETABLES

	AUSTRIA	GERMANY
lettuce	58%	98%
cauliflower	47%	71%
grapes	45%	58%

Table 2 shows the three items that increased most at the changeover in the Austrian basket. The items are lettuce, cauliflower, and grapes. All three prices increased by more than 40% between December 2001 and January 2002. An increase of 40% is relatively large but not unusual for fruit and vegetables which are highly sensitive to weather conditions. It is interesting that in Germany the prices of the same items increased considerably more than in Austria.[5]

2.3.2 The Immediate Impact in Germany

The histograms in figure 2.2 already indicate that in Germany many prices increased sharply with the changeover. This subsection will have a closer look at the magnitude of the impact in the overall basket and in several sub-groups or categories. As already mentioned before, the objective is to find patterns in the data that help to explain the price movements. I would like to emphasize that the patterns are often only

[4] Ireland, for example, rebased its basket in January 2002. The Irish basket contains 613 individual items of which only 224 are available for the 2000 - 2003 period. During the rebase many expenditure categories were redefined by combining or splitting up existing categories. This is the reason why only very few series are available.

[5] The 98% increase of the price for lettuce in Germany is remarkable. For lettuce I was able to get data starting with the German unification in 1990. An increase of more than 75% occurred only twice in these more than 150 observations.

anecdotal. To test rigorously for the newspaper effect, for example, one would need detailed information about the sellers' type; information about whether a seller is independent with at most a few branches or belongs to a large chain. Somewhat unfortunate for this study, the CPI basket is not structured by types of sellers but by types of goods and information about sellers may only be obtained in a few isolated cases. Nonetheless, the patterns that emerge - even if only anecdotal - are suggestive.

The immediate impact of the changeover will be measured by the z-score (standard score). The z-score is defined as $z_i = \frac{x_i - \bar{x}}{s_x}$, where x_i is the observation at issue, $\bar{x}$ is the mean and s_x the standard deviation of the vector of observations x. The z-score, thus, takes into account the overall volatility and the overall trend of a series. By construction, the mean of z_i equals zero.

Table 3: THE Z-SCORE

	increase at changeover	average inflation	standard deviation	**z-score**
lettuce	98%	2.65	28	**3.41**
ice cream	1.87%	0.12	0.29	**6.05**

Table 3 illustrates the advantage of using standardized values instead of absolute changes. The price of lettuce increased by 98 percent between December 2001 and January 2002 and ice cream (taken in a restaurant) increased by 1.87 percent.[6] To make these two numbers comparable, one need to take into account that lettuce is considerably more volatile than ice cream. This is what the z-score does. The z-score of lettuce is 3.41 and the z-score of ice cream 6.05. In words, inflation of lettuce at the changeover is 3.41 standard deviations above the average inflation rate of lettuce. Still, in both cases the impact of the changeover is high, but the z-score makes clear that the impact on ice cream was stronger than the impact on lettuce.[7]

[6] The indices of lettuce and ice cream are shown in figures 2.3 and 2.4, respectively.

[7] A different way to estimate the immediate impact would be to regress inflation on a changeover dummy and other variables as will be done in subsection 3.3. The immediate impact can then be estimated by the significance of the changeover dummy. The results of the estimation are similar to the one presented here.

Table 4: THE IMMEDIATE IMPACT IN GERMANY

	obs	z > 3			inflation
		2002:01	mean (Jan.)	mean (sample)	2002:01
all items	686	**111**	26,5	21,2	1.1%
bread (bakery)	5	**5**	0	0,1	1.2%
bread (retailer)	4	**0**	0	0,1	0.3%
restaurants (all types)	14	**14**	0	0	2.1%
dining cars (railway)	2	**0**	0	0,4	0.0%
services (standardized)	35	**32**	0	0	2.0%
services (not standard.)	7	**0**	0	0,1	0.1%
groceries	124	**8**	2,5	1,5	0.2%

Table 4 shows the z-scores and other information for the whole CPI basket (all items) and several other categories. The second column (obs) gives the number of observations in each category. Columns 3 to 5 provide information about the number of items that have a z-score greater than 3. The averages are calculated without taking into account the changeover month. Column 6 shows the average inflation at the changeover for a given category. Note that this is not a weighted average. The price increase of 1.1 percent of all items overstates the actual inflation rate. The weighted average (the official CPI inflation) at the changeover is only 0.39 percent.

The Newspaper Effect: I first encountered evidence for the newspaper effect studying the restaurant data. The German restaurant industry is dominated by small, often family owned businesses. There are larger chains like McDonald's or Pizza Hut, but unfortunately the CPI basket does not treat these chains separately. McDonald's Big Macs, for example, are included in meat dishes. The German CPI basket contains 16 restaurant series; half of them meals and the other half beverages. Two of the 16 series cover meals and beverages taken in dining cars of the German railway company (Deutsche Bahn). The company that caters the dining cars is owned by the Deutsche Bahn itself and is the sole supplier; and just as the newspaper effect predicts, these two indices did not increase during the changeover (see table 4). All other 14 indices increased sharply with the changeover (see for example figure 2.4 on page 18).

Another category that provides some hints about the newspaper effect is bread. The German CPI basket contains 9 different series for bread. Five of them increase significantly with the changeover and the other 4 remain constant. The answer to this diverging behaviour is given in the definition of these series. The four series that remain constant contain the term "package" in the series description. In Germany, bread is sold mostly in bakeries and similar to the restaurant industry, there are only

a few bakery chains. Most bakeries are independent with a few branches. Bakeries sell bread either by piece (e.g. bread rolls) or weight (e.g. loafs). Grocery stores sell bread as well but generally in packaged form. Presuming that the term "package" distinguishes bread sold in bakeries from bread sold through retailers, the differing impact can be explained by the newspaper effect.

Table 5: THE NEWSPAPER EFFECT

category	mean (z)	max (z)	min (z)
bread (bakery)	4,4	4,7	4,1
bread (retailer)	0,7	2,5	-1,6
restaurants (all types)	6,05	6,4	5,5
dining cars (railway)	-0,25	-0,17	-0,3

Table 5 provides more information about the newspaper effect. Bread sold in bakeries increased by 4.4 standard deviations at the changeover while bread sold through retailers by only 0.7 standard deviations. In the case of restaurants the effect is even stronger. The two dining car series have a mean z-score of -0.25 whereas the other restaurant series have a mean z-score above 6. Again, I would like to emphasize that given the small number of observations the evidence for the newspaper effect, even if surprising, is only anecdotal.

Another observation is worth mentioning. During the changeover some newspapers and TV stations ran price comparison studies in which they reported whether prices increased or decreased. Nearly all studies covering groceries included the three items milk, butter and sugar. All three are fairly homogeneous and are one of the most frequently bought products in the CPI basket. Prices of all three items decreased significantly at the changeover.[8] Milk, butter and sugar are fairly obvious items to include in these price comparison studies which probably triggered the decreases. Prices for groceries in general stayed basically constant. There are a few items that increased significantly (see Table 4), but overall the claim of retailers that they have not increased prices at the changeover appears to be correct.

The Degree of Standardization: In the services sector a second pattern emerges. As already mentioned above, the services sector is the most heavily affected one. But here too, the impact is not uniform. There are some services prices that increased significantly and even persistently and there are some that appear unaffected by the changeover. The factor that seems to shape the pattern is the degree of standardization. What I mean by "standardization" becomes clearer when I give some examples.

A typical example for a standardized service is restaurant services. Other examples are dry cleaning services, language courses, going to the cinema or repairing

[8] Between December 2001 and January 2002 butter decreased by 2.40%, sugar by 1.06% and UHT milk by 1.40%. Fresh milk increased slightly by 0.18%.

shoes. Typical non-standardized services are gardening services, removals or laying and polishing parquet. Standardization refers to several characteristics. The first is that the consumer faces relatively low uncertainty when purchasing the product. To most consumers it does not make much difference in which cinema they watch a movie. The situation is similar for restaurants or dry cleaners. Being standardized also means that consumers (and competitors) usually have a fairly good idea about prices of these items. By law, German restaurants, dry cleaners or hairdressers have to display prices well visible from outside the shop. Gardening services are neither standardized nor are prices easily observable. A third characteristic of standardized services is that they are generally sold at pricing points like 1.70 for a cup of coffee or 6.- for a cinema ticket. The last important characteristic of standardized services is that they are often produced by small shops. I will come back to these characteristics in section 4.

While separating the different types of bread is straightforward, splitting the services sector in standardized and non-standardized is not easy and a certain subjectivity remains. To be as objective as possible, I split the services sector into three groups. The first group contains standardized services, the second contains non-standardized services and the third group contains all services where assigning one of the two labels provided difficulties.

An example where I had difficulties assigning one of the two labels is car maintenance services. Fixing breaks, for example, has some characteristics of a standardized service, but painting the front wing does not appear very standardized. In fact, the index of fixing breaks resembles somewhat the prices of restaurants with a sharp and apparently persistent increase at the changeover, while the price of painting the front wing seems unaffected by the changeover. To avoid any data fishing, car maintenance services are not assigned any of the two labels.

Table 4 shows that 32 of the 35 standardized services have a z-score above 3. On average, prices of these services increase by 2 percent. None of the non-standardized services, in contrast, has a z-score above 3 and prices increased by only 0.1 percent. In the next section we will see that the impact on standardized services is not only transitory as in the case of vegetables for example. Standardized services appear to have increased persistently.

2.3.3 The Persistent Impact in Germany

Figure 2.4 shows the indices of music CDs, ice cream, dry cleaning services, and wine taken in a restaurant. All four indices increased at the changeover and appear to have stabilized at a higher equilibrium. I estimate the persistency of the impact with the following model.

$$\pi_t = \beta_1 + \beta_2 d_2(i) + \beta_3 d_3(i) + u_t \tag{2.1}$$

Where π_t is the inflation rate of a single item (no system approach) in period t calculated as $\pi_t = \frac{p_t - p_{t-1}}{p_{t-1}} \times 100$. The first dummy, $d_2(i)$, takes the value 1 in month i

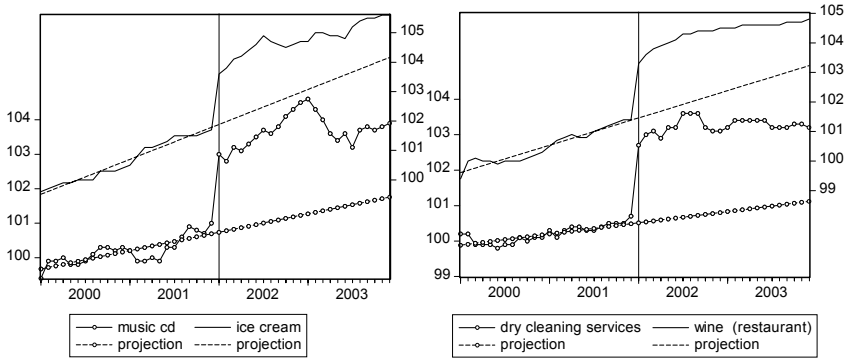

FIGURE 2.4. Four prices that appear to have increased permanently with the changeover (denoted by the vertical line). The dashed lines are linear projections using the first 24 observations.

and zero otherwise, the second dummy, $d_3(i)$, takes the value $\frac{1}{11}$ in the eleven months subsequent to i. The index i runs from 1 to 36.

Consider the case where $i = 24$. In this case $d_2(i)$ captures the immediate impact of the Euro changeover on inflation. If, for example, the price of an item increases with the changeover, the coefficient β_2 will be positive. In case the price of this item returns to its pre-changeover level, inflation will be below trend in some of the months following the changeover. This second effect will be captured by $d_3(i)$. Testing whether the impact was persistent I test whether the sum $|\beta_2 + \beta_3|$ is significantly different from zero. If the index returns until the end of 2002 (11 months), the impact will be called transitory, otherwise persistent. Estimation is by OLS.

Table 6: THE PERSISTENT IMPACT IN GERMANY

Model: $\pi_t = \beta_1 + \beta_2\, d_2(i) + \beta_3\, d_3(i) + u_t$

H0: $|\beta_2| > 0$ and $|\beta_2 + \beta_3| = 0$

	obs	persistent increase		
		2002:01	mean (January)	mean (sample)
all items	686	58	24	10
services (all)	86	34	0.5	0.3
services (stand.)	35	32	0	0
restaurants	14	14	0	0

Table 6 summarizes the estimation results for the persistent impact. For 58 of the 686 items in the overall basket I cannot reject the hypothesis of a persistent increase.

This is more than twice the January average of 24. Again, it is the services sector that surprises. Nearly all standardized services increase persistently and considering only restaurant prices (leaving out the two dining car series) we see that none of the 14 indices had returned to its pre-changeover by the end of 2002.

In the estimations above, an increase is considered transitory if the index returns within the 11 months following the changeover, that is, within the period from February until December 2002. Reducing this period to, say, 6 months, increases the number of persistent effects. Extending the period has the opposite effect. The choice of 11 months was made so that the test can be run for 2001, 2002 and 2003 separately ($i = 12,\ 24,$ and 36). There is some arbitrariness in this choice, but 11 months seem long enough for transitory increases to level off. Figure 2.4 shows that there are some series that even two years after the changeover appear to be above their pre-changeover trend.

A few words about the tradable (as opposed to services) goods for which the impact appears to be persistent. The persistent effect of the changeover on tradable goods is not as obvious as in the case of services, or as music CDs in figure 2.4 suggest. Music CDs seem to be an exception. Table 4 shows that the changeover had a persistent effect on 24 ($= 58 - 34$) tradable goods' prices (about half of them decreased at the changeover). Compared to the January average (24 as well) this number is not surprising. Prices at such a disaggregate level are often quite volatile and changes in trends that make the test statistic significant occur frequently. My impression in the case of tradable goods is that the changes in trend only happened by coincidence at or around the changeover and that no causal link between the two events can be made. With the exception of music CDs the effect of the Euro changeover on tradable goods was at most temporary.

The model in equation (2.1) can also be used to estimate the immediate impact of the changeover. Setting $i = 24$, the dummy β_2 captures all "unusual" price movements between January 2001 and December 2002. For nearly a third of the items in the CPI basket the model shows a noticeable effect of the changeover. Of the 686 series in the CPI basket, 189 increase significantly and 22 decrease significantly. These estimates underline the results of section 3.2.

2.3.4 The Austrian Experience

Assessing the impact in Austria is somewhat more complicated than in Germany. In Austria, firms were required to denote prices in two currencies for the five-month period from October 2001 until February 2002. Unlike in Germany, the actual changeover in January is not such a prominent point in time in Austria and two other dates might have taken its place: the beginning or the end of the five-month period of compulsory dual pricing. It is possible that in Austria the impact of the

changeover was just as high as in Germany, but that instead of a single jump the impact spread out over several months. I will address these issues in turn.

Table 7: THE IMMEDIATE IMPACT IN AUSTRIA

						GERMANY	
	obs	**z > 3**			inflation	obs	z > 3
		2002:01	mean (Jan.)	mean (sample)	2002:01		2002:01
all items	618	**27**	56	22,0	0.6	686	111
services (standardized)	62	**6**	1	1	0.6	35	32
services (not standard.)	8	**0**	0	0,1	0.8	7	0
restaurants (all types)	28	**5**	0,5	0	0.6	14	14
fast food	1	**0**	0	0	-5.5	2	0

Table 7 shows the immediate impact of the changeover in Austria. The two rightmost columns repeat the results for the German basket from table 4. Of the 618 series in the Austrian CPI basket, 27 have a z-score above 3. This is below the January average of 56. Recall that in Germany this number was more than five times as high as the January average. None of the eight non-standardized services is affected by the changeover. Six (of which five are restaurant series) of the 64 standardized services have a z-score above three, which is above the January average.

The Austrian restaurant sector is interesting. The Austrian basket contains one series called "fast food" (using the English term). This series covers the (mainly American) fast food companies and is the only one in Austria to which the label "chain" can be attributed. The "fast food" series in Austria is like the mirror image of the German restaurant series. In the two years before the changeover the series is constant, then at the changeover it suddenly decreases by more than 5 percent. In the following months it increases and reaches its pre-changeover level around 16 months later. The fast food series is the example that I mentioned in the discussion about the "increased awareness" in section 2. The movement of this series gives the impression that the changeover induced fast food firms to actually reduce their prices. Anticipating the strong coverage of price changes in the media, the Austrian fast food chains took the opportunity to make good publicity by reducing prices.

There is some evidence that fast food chains in Austria were not the only ones that tried to make good publicity by reducing prices. The histograms in figure 2.5 show the number of items that have their largest *decrease* in a given month (figure 2.2 showed the largest *increase*). In Austria, the changeover month is the most likely month for the largest decrease to take place. In Germany, the effect is less visible suggesting that firms viewed the opportunity to make good publicity less valuable.

The other 28 restaurant series in Austria do not show any common pattern. Five of 28 have a z-score above 3 at the changeover and one (coffee) decreases, though not

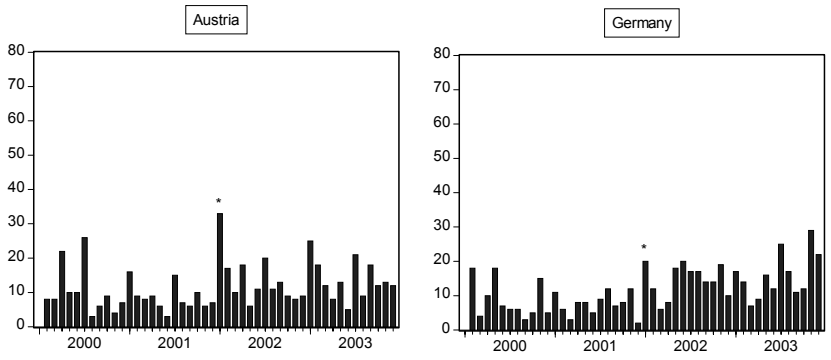

FIGURE 2.5. Histograms of the maximum price decreases in Austria and Germany. The vertical axis shows the number of series in the CPI baskets that have their largest decrease in the month given on the horizontal axis. The Euro changeover is denoted by an asterisk *.

significantly. Recall that in Germany all restaurant series had a z-score above 5 at the changeover.

The beginning and the end of the five month period of compulsory dual pricing are not conspicuous. This was already suggested by the histogram of the maximum increases (figure 2.2). Nonetheless there are a few noteworthy "anomalies" in the five month interval around the changeover. One series (language courses) jumps up by 5% at the beginning of the five month period, though the impact does not appear persistent. Hairdressing increases somewhat out of the blue one month before the changeover. The increases are not big (around 1 percent) but appear to be persistent.

Persistent increases at the changeover in January 2002 are practically absent in Austria. In the overall basket with 618 series, 14 appear to have increased persistently at the changeover; the January average equals 14 as well. Of the 64 standardized services two increase and one (fast food) decreases persistently.

The last question that needs to be answered is whether the impact in Austria is simply not observable because it spread over several months around the changeover. I test this hypothesis with the following model

$$\pi_t = \beta_1 + \beta_2 d_2 + u_t.$$

Where d_2 is now a dummy that takes the value 1 during the five month period of compulsory dual pricing and zero otherwise. I restrict the test to the restaurant sector. In Germany this was the most heavily affected sector and if we find any impact in Austria it is likely to find it there. Nonetheless, the results are robust and

do not change when I run the test for all standardized services. Also, allowing d_2 to cover more than five months does not alter the results.

Table 8: THE "EXTENDED" IMPACT IN AUSTRIA

Model: $\pi_t = \beta_1 + \beta_2 d_2 + u_t$

Estimates for β2

	AUSTRIA observations: 28		GERMANY observations: 14	
	point estimates	t-statistics	point estimates	t-statistics
mean	0.5	0.5	2.5	3.6
max	2.4	2	3.1	4.2
min	-1.4	-1.1	2	2.9

Table 8 shows the estimation results for the "extended" impact. During the five months around the changeover, restaurant prices in Austria appear to have increased above average, though not significantly on average. The mean t-statistic is 0.5 and for only two of the 28 restaurant series the estimate for β_2 is significant. Some prices appear to have decreased during these five months (coffee and chocolate cakes), though in both cases not significantly. In Germany, the dummy β_2 is significant for all 14 restaurant series. The mean t-statistic for Germany is seven times as large as the Austrian mean (3.6 versus 0.5). Concerning the point estimates, there is only one item in Austria (beefsteak) that comes close to the mean in Germany. All other 27 point estimates are below the lowest German estimate.

To sum up, there is no evidence that the Austrian regulations disguised the impact by extending it over several months. The price increases we observe in Germany appear to be absent in Austria.

2.3.5 Summary of the Findings

In Germany, many prices increased significantly with the Euro changeover. In most cases the impact was only transitory, but there are a few series that appear to have increased persistently. The services sector is the most heavily affected one. Persistent increases are virtually limited to the services sector. Two patterns emerge. First, there is some evidence that larger firms (especially chains) were less inclined to take advantage of the changeover by increasing prices. In some cases, larger firms even appear to have taken the opportunity to lower prices, probably to make good publicity. The phenomenon that the price setting environment differed between smaller and larger firms was dubbed the "newspaper effect". The second pattern concerns services prices. Here, the services most affected are relatively standardized like restaurant services or going to the cinema. Less standardized services appear to be unaffected

by the changeover.

In Austria both the transitory and the persistent increases are practically absent. There are a few prices that increased in the months around the changeover, like language courses or hairdressing, but these appear to be isolated.

A last comment about menu costs is necessary. As illustrated in figure 2.1 on page 4, menu costs can in theory explain why prices or price indices "jump" at a currency changeover. The movements we have seen in this section, however, cannot be explained by menu costs. This for two reasons. First, menu costs cannot explain persistent increases as we observed in restaurant prices, for example. Second, and more importantly, menu costs can only explain a jump up to the extent that the jump is accompanied by periods of reduced adjustments. If there are no periods of reduced adjustments, the series must jump for other reasons.

To understand whether firms worry about menu costs when setting prices, one could, for example, search for a period of reduced adjustment before the changeover. At the changeover firms have to reprint their menu anyway, so that they would not change prices in the run-up to the changeover if this is costly. Observing that the index is flat for, say, six months, one may conclude that menu costs can explain a six-month price stickiness. In chapter 3 of this dissertation I use this idea to answer the question whether menu costs are large enough to explain why firms are so reluctant to change prices.

On the whole, the evidence for menu costs is weak. The services sector is one of the few sectors where we can observe price indices that are flat for one or two months before the changeover. Given the relatively low inflation in the services sector, a postponing of one or two months would explain a "jump" of maybe 0.2 or 0.3 percent. The increases of 2 percent in the services sector are too large to be explained by menu costs. In most other sectors, the evidence for menu costs is even weaker. With the exception of the services sector, price changes are just as frequent in the run-up to the changeover as during other periods. The reluctance of firms to change prices appears to be caused by reasons other than menu costs.

2.4 Theory: Persistent Non-Neutrality

The persistency of the price increases in the services sector suggests a change in equilibria in these markets. The question that arises is how a currency changeover can trigger such a change. I will argue that the upward jump in services prices is the result of a collective rounding up. As already noted in section 2, rounding by itself cannot explain the change of a price *index* and other factors have to play a part in the mechanism. In the discussion below, a coffee shop will take the place of the representative service firm. I will start with an example demonstrating the role of pricing points.

Consider a coffee shop that sells coffee at a price of 3.20 Marks before the changeover. Converting this price at the official exchange rate of 1.95583 Marks per Euro yields a price of around 1.64 Euros. If, for whatever reason, the coffee seller finds this price unattractive he can either round up or down to the next pricing point. Rounding down to 1.60 Euros implies a price reduction of 2.2 percent and rounding up to 1.70 implies a price increase of 3.7 percent.

With this example I want to make two points. First, for the individual coffee seller increases or decreases of several percentage points are not unusual; pricing points force sellers to change prices in relatively large steps. Second, a price change from, say, 1.64 to 1.70 is not a change from an equilibrium price to another equilibrium price, but from a price that, due to the conversion, lost its equilibrium status to a price that only gained an equilibrium status with the conversion. In this sense, one may speak of a "destabilization" of a currency changeover of markets in which goods are sold primarily at pricing points.

Pricing points are common in the grocery or clothing sector as well, so why were only services affected? And why was the rounding predominantly upward? Here it helps to recall the services whose prices increased. The sector most heavily affected was the restaurant sector. Other examples are dry cleaning services, hairdressing, going to the cinema or repairing shoes (replacing heels and resoling). Also recall that the indices for these items increased by around 2 percent at the changeover.

The services whose prices increased have several characteristics in common. First, they are sold at pricing points. Second, they are often produced by small and independent firms; larger chains exist but are not the norm. Third, these services are relatively easy to substitute, or using the terminology of section 3, these services are standardized. Fourth, sellers of these services have to place information about the prices they charge in the shop windows, well visible from outside the shop. The last characteristic is that firms providing these services operate in relatively small markets. This point needs some explanation. There are numerous restaurants or coffee shops in a city. A coffee shop in downtown, however, does not compete with one at the airport. The relevant market for these firms is relatively small with a "manageable" number of competitors. The market structure in these cases is best described as a local oligopoly.

The last three characteristics, the standardization, the availability of price information and the small number of players are typical for markets that are prone to collusive behaviour.[9] The fact that these services are relatively standardized makes communication via prices uncomplicated, so that collusion may in fact be only tacit. In addition, the nature of services contributes to the collusive predisposition of these markets. Services are neither storable nor easy to transport and lumpiness or infrequent product purchases are difficult to imagine. The obligatory posting of prices in shop windows makes secret price cutting complicated.

[9] See for example Scherer (1980) or Tirole (1988).

Players in collusive markets of this type might tacitly consent that rounding down is an unlikely response to the loss of the old equilibrium price. In case they already price above marginal costs they might view it a good chance to slightly increase prices; and in case they price at marginal costs, they might see it a good possibility to attempt collusion. Going back to the example, remember that the price of 1.70 was not a feasible equilibrium price before the changeover, so the question why firms have not coordinated on this price before is not relevant. It is unlikely that increasing the price of coffee from 1.64 to 1.70 would reduce demand in such a way that the increase cannot be justified. The collectivity of the move might also facilitate the decision to round up; collectively rounding up keeps relative prices in this market constant.

There are more reasons to expect firms to round up and not down. The temporary rise in market power described in section 2 is one reason. Even if only temporary, this rise contributes to the tendency to set a higher price. A different reason is menu costs. As noted before, the evidence for menu costs is weak but not entirely absent. Of the 35 standardized services in Germany, only one displays a downward trend so that menu costs as well contribute somewhat to the tendency to round up. Finally, for a small coffee shop the advantages of rounding down are not large. Unlike a large chain, a coffee shop is not in the position to make good publicity by reducing prices (newspaper effect). Or, looking at it from the other side, a small coffee shop does not have to fear to make bad publicity by slightly increasing prices. For small shops, there is a good chance that both the rounding up and the rounding down of a few percentage points will go unnoticed.

The last question that needs to be addressed is why we do not observe this collective rounding up in Austria. The answer to this question will be given in the next section on policy implications.

2.5 Policy Implications

Austria successfully prevented the changeover from having a noticeable impact on prices. The main proposition of this paper is that Germany could have avoided the impact with a different policy. This section presents in some detail the Austrian policy and points out where it differed from the German policy. Drawing on the experience in these two countries, a few general comments on which policies seem desirable will be given.

Austria was the first country in Europe to introduce a generalized dual pricing obligation. The law required dual pricing in principle for all goods and services. This not only covered goods displayed in shop windows, showrooms or vending machines, but also advertising material, cost estimates, tenders, bills and receipts. A wide range of exemptions, however, was foreseen. Less strict regulations applied, for example, to all commercial enterprises and shops employing less than 10 persons on a full-time basis.

The dual pricing obligation started three months before the changeover and was in force as long as the Austrian Shilling was accepted as legal tender (28 February 2002), but the law foresaw an option to extend this period until the end of 2002. Technical infringements of this obligation carried fines of around 1400.- Euros. Failing to use proper conversion rates and thereby disguising price increases was considered "excessive pricing" and could be fined with around 7000.- Euros. In cases of repeated infractions, fines of more than 14 000.- Euros could have been imposed.

Monitoring the dual pricing obligation was the responsibility of the district authorities. On site checking and controlling was carried out by existing inspectors. The Federal Ministry of Economy that headed the "Euro-price commission" evaluated the inspectors' reports and organized necessary amendments. In addition to these official inspections, several other initiatives were started. Newspapers and TV stations ran "Euro-observatories" and consumer interest groups lobbied hard to wrest "fair play guarantees" from large retailers. In fact, one retailer (30% market share) pledged to always round down when converting and another retailer guaranteed not to raise prices of its products during the five month period of compulsory dual pricing (excluding seasonal products).

Several "Euro hotlines" were set up where consumers could ask for information, convey violations of the dual pricing obligation and report price increases. One consumer interest group even set up a black list on its homepage where consumers could name firms that took advantage of the changeover and raised prices. This black list, however, was controversial.

A few comments about the Austrian regulations are necessary. It has been claimed that Austrian firms were not allowed to increase prices at the changeover. This is not correct. The regulations only state that increases above an "economically justified" price level are not consented. The term "economically justified" is not specified so that the regulation is fairly vague at this point. The vagueness is deliberate and made to assure that firms could flexibly react to market fluctuations. It is important to note that none of the price increases we observed in Germany would have resulted in any legal action if they had happened in Austria. From a purely legal stance, the part of the regulations dealing with price increases is unnecessary, but its psychological effect should not be underestimated. This takes me to my main point. Apart from the handling of dual pricing, the German regulations did not differ much from the Austrian. Austria, however, created an environment that prevented firms from setting prices as did their German counterparts.

Here it helps to recall two of the sources of non-neutrality of section 2, the initial confusion and the increased awareness. The initial confusion refers to the difficulties consumers have initially because of the unfamiliarity of the new banknotes and coins and because of the changing of all nominal prices. The increased awareness refers to the greater attention of consumers and the media to price movements during the

changeover. By introducing a period of compulsory dual pricing, Austria granted consumers more time to adjust to the new "framing" and thus reducing the initial confusion as far as possible.

Regarding the second source of non-neutrality, it seems that the increased awareness in Austria was greater than in Germany. All the initiatives listed above contribute to the awareness: the setting up of hotlines, the monitoring of prices by both private and public institutions and the passing of special regulations for the conversion of prices. Even if not enforceable, simply threatening fines can have a disciplining effect. The evidence we found in section 3 for the newspaper effect shows that in Germany, too, retailers were concerned about the increased awareness, but in general, the public concerns about price increases at the changeover were not taken very seriously by the authorities. It seems typical that the Federal Ministry of Consumer Protection set up a hotline only after the actual changeover when complaints already cropped up.

Having in mind the different price setting behaviour and the different price setting regulations in Austria and Germany, the following policies seem desirable. First, a generalized dual pricing obligation appears necessary. Dual pricing helps people to get acquainted with the new currency and would prevent firms from trying to take advantage of the initial confusion. The Austrian example shows that even a relatively short period of mandatory dual pricing is effective.

Second, to make the transition from one regime to the other as gradual as possible and to avoid the collective changing of prices within a short period of time the replacement period should extend over several months (see table 1 on page 2). This can most easily be achieved by allowing firms to voluntarily follow dual pricing practices before and after the period of mandatory dual pricing. As argued in the previous section, the collective changing of new menus within a short period of time might have facilitated the decision to round up.

Third, it appears useful to set up price observatories and hotlines in order to create an environment where firms are less inclined to take advantage of the initial confusion and where the public awareness is such that even small restaurants consider it as an advantage not only to round up.

2.6 Conclusion

The first goal of this paper was to show that a currency changeover is not necessarily a nominal event that keeps (relative) prices unaffected. Some temporary effect on prices should probably be expected, but the impact of the Euro changeover on prices in Germany surprises. It surprises first, because of the extent of the temporary price increases - nearly a quarter of the items in the CPI basket increased significantly at the changeover - and second because some prices appear to have increased persistently.

Regarding the transitory price increases, two factors seem important. The first is that many firms tried to take advantage of the confusion that arises with the introduction of unfamiliar coins and banknotes and with the changing of all nominal prices. This initial confusion is probably the best explanation for the transitory increases. A second factor that seems important is that during the changeover the media and the public in general were very attentive to price movements. Newspapers and TV stations often ran "price observatories" to report unjust price increases. This increased awareness makes it difficult for firms to take advantage of the initial confusion and discouraged especially the larger firms and chains to do so. Another factor that might temporarily affect prices is menu costs. The evidence for menu costs, though, is relatively weak.

The persistent price increases appear to be caused by a combination of of several factors. Persistent price increases are basically limited to the services sector. A typical example is restaurants. Large restaurant chains, however, appear to have kept prices constant or in some cases even reduced them at the changeover. Other sectors in which prices increased persistently include dry cleaning services, going to the cinema and hairdressing.

Three factors are central to explaining the persistency of the price increases. First, as argued in the paper, the markets for these services are prone to collusive behaviour. Second, these services are sold at pricing points, like 1.70 Euros for a cup of coffee or 6 Euros for a cinema ticket. Converting these prices at the changeover often makes them less attractive so that the firms have to round up or down to the next pricing point. Collusion and rounding alone cannot explain the price increases and a third factor is necessary. Here it seems that this third factor was simply a high incentive to round up. There is evidence that especially smaller firms caused the upward jump in the price indices, while larger firms appear to have kept prices constant on average or have even reduced them. However, Austria showed that it is possible to create an environment in which the smaller shops, too, have incentives not only to round up. This takes me to the second goal of the paper.

The second goal of the paper is normative. In Austria, both the transitory and the persistent increases are practically absent. This paper argues that the impact in Germany could have been avoided with different price setting regulations. Austria succeeded in creating an environment that prevented both the transitory and the persistent price increases we observed in Germany. Unlike Germany, Austria required firms to dual price for a period of several months. In addition, special regulations were adopted for the correct conversion of prices and both private and public institutions monitored prices in the months around the changeover. These and several other measurements created an environment that helped in making the Euro changeover an essentially nominal event keeping relative prices constant.

2.7 Literature

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Chapter 3

Do Menu Costs Make Prices Sticky?

Abstract

This paper studies whether menu costs are large enough to explain why prices are sticky. Without actually estimating menu costs, we can infer their significance indirectly, drawing on the fact that currency changeovers reduce the cost of changing prices to zero: at a currency changeover firms have to reprint their "menu" independently of whether or not they change prices. When changing menus is costly firms postpone price changes in the run-up to the changeover and try to make the price changes coincide with the changeover. This behaviour will be reflected in the data. Using disaggregate price data from the Euro changeover, we argue that menu costs can explain a stickiness of at most 20 days. The only sector where menu costs do appear to play a significant role is the services sector.

3.1 Introduction

A currency changeover can be viewed as a natural experiment where firms are required to change their menus (price tags) independently of whether they change prices. The fact that menus have to be reprinted anyway reduces the cost of changing prices to zero. This paper exploits these "zero menu costs" to infer the importance of menu costs in firms' price-setting decisions.

To understand how the zero menu costs affect price-setting, consider a market in which firms are price setters, and suppose that the market price has a trend as in Figure 3.1a. If changing prices is costly, firms do not adjust every period but will keep their prices constant for some time and then make a larger adjustment. The individual firm's price will increase in steps, but aggregating over many firms conceals the steps, making the index smooth as in the figure. Now suppose that there is a currency changeover at time t_0 (see Figure 3.1b). At t_0 firms have to reprint their menu independently of whether they change their price. The cost of changing prices is therefore zero. This means that in order to save costs firms will postpone price adjustments to make the price changes coincide with the changeover. Postponing price changes makes the index flat for some time before the changeover. Similarly, after the changeover, firms will anticipate their price changes, thus making the index flat for some time after t_0. This behaviour, then, leads to a "*jump*" of the index at

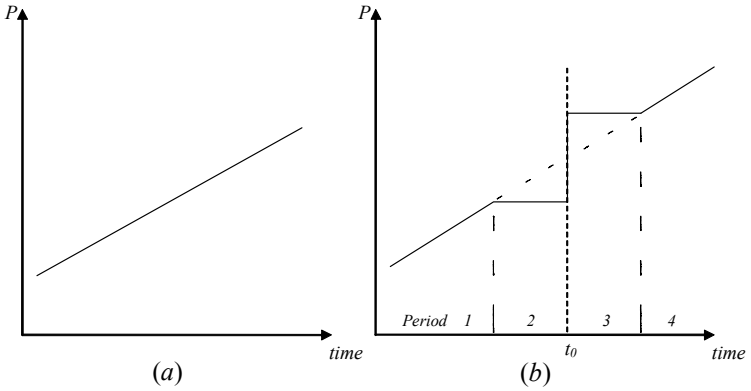

FIGURE 3.1. This figure shows the effect of a currency changeover on an increasing price level. The changeover takes place at t_0. Period 2 (3) is defined as the period immediately before (after) the changeover where we expect the index to be flat.

the changeover and to flat segments immediately before and after the changeover.[1]

The important point is that the lengths of the flat segments are functions of menu costs: the larger menu costs, the longer the flat periods. Observing that the index is flat for, say, six months, we could conclude that menu costs can explain a six-month stickiness.[2] There are several conditions or assumptions underlying Figure 3.1b that have not yet been made explicit. These conditions will be addressed in the next sections. Before concluding the introduction, we give a short review of the related literature and define the terms "stickiness" and "menu costs".

The idea that menu costs are an important cause of money non-neutrality has some intuitive appeal for a number of goods (for example restaurants). Empirical support for the menu cost assumption is mixed, though. The literature on menu costs can be divided into three groups. Papers in the first group estimate the magnitude of menu costs directly. The second group provides indirect evidence on menu costs by studying firms' price-setting behaviour and the history of prices of individual items. The third group includes survey studies.

Levy, Bergen, Dutta and Venable (1997) estimate directly the magnitude of menu costs. The key insight from this study is that menu costs are large enough to be regarded a non-trivial factor in the price-setting process of firms. Levy et al., for

[1] Upward and downward leaps at the changeover are so common that it is useful to have a name for this. Any pronounced change of an index at the changeover will be referred to as a "*jump*".

[2] The size of the *jump* is a function of menu costs as well, but many prices jumped at the changeover for reasons other than menu costs. The size of the *jump* can, therefore, not be used as an indicator of menu costs. This becomes clear in the next section.

example, estimate that menu costs make up around 0.7% of revenues of U.S. supermarkets (more than $100,000 per year per store). These studies combined with the important theoretical contribution by Mankiw (1985) provide probably the strongest support for the menu cost assumption.[3] Mankiw argued that the cost to a monopolistic competitive firm of a slightly mis-set price is only of second order. Small menu costs are then enough to inhibit a continuous adjustment of prices. A drawback of the papers in this group is that an estimate of the magnitude of menu costs does not reveal how long menu costs constrain firms to hold back price adjustments. These studies remain inconclusive on the time-span a firm keeps its price constant because of menu costs.

The papers in the second group are not directly concerned with menu costs but reveal information about menu costs indirectly. The evidence of most of the papers in this group does not lend support for the menu cost assumption. The fact that the markets that are investigated are usually quite narrow and are determined mostly by data availability might explain why the menu cost assumption still enjoys presumably unjustified popularity. Kashyap (1995) studies the history of prices for several items in mail order catalogs over a period of over 35 years. He reports that when prices change, the sizes of the changes are widely dispersed. Both large and small changes occur for the same item, and the size of these changes does not closely depend on overall inflation. He argues that models that generate price rigidity by assuming menu costs cannot explain these data. Lach and Tsiddon (1996), though, claim that such small changes can be expected in a multiproduct firm when menu costs have a firm-specific component. Lach and Tsiddon find support for the menu cost assumption in their data set. Cecchetti (1986) studies the prices of newsstand magazines, he argues that menu costs are an adequate description of price adjustment. Davis and Hamilton (2003), investigating gasoline prices, argue that the stickiness they find in their data is unlikely to be generated by menu costs.

The third group are survey studies on how firms set their prices. See for example Blinder (1991), Hall, Walsh and Yates (1999) and Apel, Friberg and Hallsten (2002). These studies have probably contributed most to our understanding of the price-setting process of firms. Rather than construct new models or econometric tests, these authors survey business people about their price-setting practices and their opinions of academic theories. One of the question firms were asked was: "Are you reluctant to change your price because of X?", where X is a theory of price stickiness economists use in their theoretical work. Menu costs receive only fairly low support in these surveys. For a thorough methodological discussion of the strengths and weaknesses of survey studies, see Blinder et al. (1998).

At this point, it is necessary to define the terms "stickiness" and "menu costs". In the literature both terms are used with varying connotations. By "stickiness"

[3] Two other important contributions are Akerlof and Yellen (1985) and Blanchard and Kiyotaki (1987).

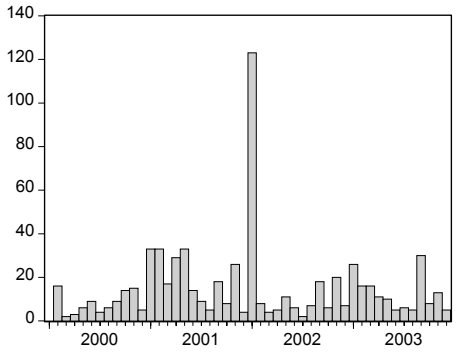

FIGURE 3.2. This figure plots a frequency distribution of the highest increases. By far the most likely month in which the series increase most is January 2002 (euro changeover).

we understand the apparent reluctance of firms to change prices. It is often argued that firms keep their prices constant for several months. Apel et al. (2001), Kashyap (1995), Carlton (1986) and Blinder (1991) report a median spell of around 12 months. By "menu costs", we understand the physical cost of changing menus or price tags. Here we follow Levy et al (1997). The cost of the decision making process, sometimes called "managerial costs" (see Levy et al., 1997; and Apel et al., 2001) is, therefore, not included.

The remainder of the paper is organized into four sections. The next section presents the data. In section 3 we discuss the conditions underlying Figure 3.1 and other theoretical points that are important to understand the estimation procedures. The estimation procedures and the findings are shown in section 4. A conclusion summarizes the findings.

3.2 The Data

In this section we present the data. The data set contains the 686 individual series of the basket of the German consumer price index. The data are indexed, monthly and cover the 48 months from January 2000 to December 2003. The euro changeover was in January 2002. There are two reasons why we concentrate on the German data. The first reason is that it is one of the larger sets available, and the second (and more important) reason is that price-setting in Germany was regulated in a way that allows us to bypass one of the difficulties of our approach. This last point is addressed in some detail in the next section.

The euro changeover turned out not to be a mere nominal occurrence that kept relative prices equal. Several prices increased with the changeover, most only temporarily, but some seem to have increased permanently. This section documents these

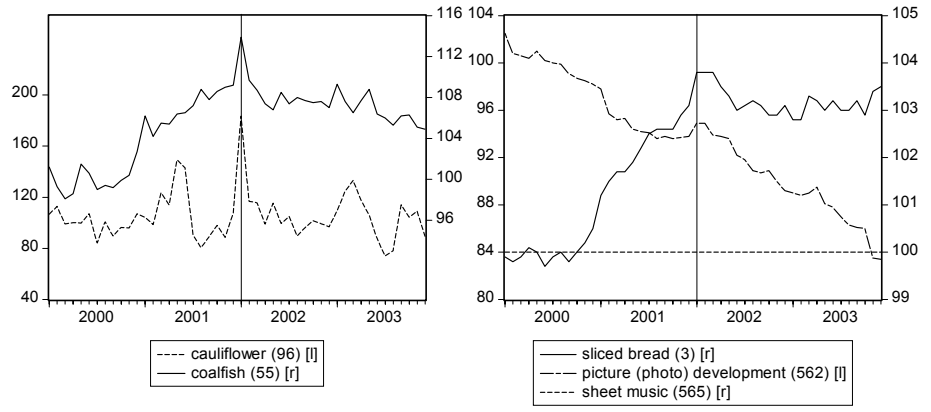

FIGURE 3.3. This figure shows series with a spike at the changeover. The changeover is denoted by the vertical line. Sheet music is the only series that is constant over the whole sample period. The numbers in brackets refer to the series numbers in the CPI basket. The 'r' ('l') stands for right (left) hand scale.

phenomena.

Figure 3.2 shows a frequency distribution of the highest increases in the data. For each series we calculated in which of the 48 months it increased most. The distribution we found is shown in this figure. By far the most likely month in which the highest increase took place is January 2002, the month of the changeover. Interestingly, January 2002 is also one of the most likely months of the highest *decreases*. Price-setting seems to have been particularly intense around the changeover. As noted in the introduction, menu costs can explain why prices jump at a currency changeover. Menu costs thus could explain the high column in the histogram in Figure 3.2, but it happened that the high column was caused by two other phenomena:

(1) Figure 3.3 shows several indices with a spike at the changeover (denoted by a vertical line). These prices increased with the changeover and then returned to their pre-changeover level after some weeks. Most of the items with a spike are fruit and vegetables, and bad weather conditions might have contributed to these spikes.[4] But bad weather is not an explanation for all items, and the recurrence of these spikes in the data is striking. (2) Another phenomenon is shown in Figure 3.4. There are some prices that seem to have increased permanently with the changeover. The figure shows the prices of dry cleaning services and foreign language courses. Both indices jump by 3 to 4 percent at the changeover and do not return to their pre-changeover level. The dashed lines are forecasts with confidence intervals.[5] In the second chapter of this

[4] See for example ECB (2002, April).

[5] The forecasts are generated by assuming that the index follows an AR(1) process.

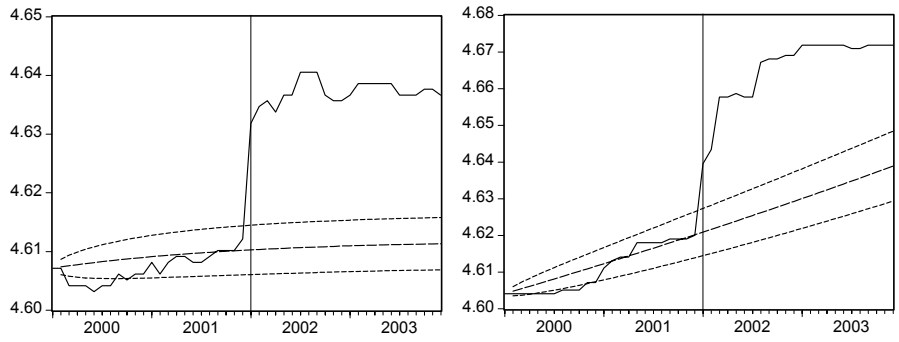

FIGURE 3.4. Dry Cleaning Services (left) and Foreign Language Courses (right), two prices that appear to have increased permanently with the euro changeover. The dashed lines are forecasts with confidence intervals. Units are in logs.

dissertation I find that 58 of the 686 series in the basket have increased persistently; 34 of these indices are services. This chapter also discusses the factors that may affect prices at a currency changeover.

It is important to understand that menu costs can explain why prices jump at a currency changeover but only to the extent that the *jump* is accompanied by a period of reduced adjustments before or after. If there is no sign of a reduced adjustment or if there is simply a spike as in Figure 3.3, the series must jump for other reasons. Similarly, menu costs cannot explain why some prices increased permanently, but menu costs may have played a role in the mechanism that led to these increases. Increases like the ones in Figure 3.4 are the reason why we cannot take the size of the *jump* as a measure of menu costs.

3.3 Some Theory

The decision of a firm to change its price depends both on the cost of doing so (the menu cost) and the cost of not doing so (the opportunity cost, the foregone profit for example). Let k be the cost of changing a price and x be the cost of not changing. A firm will adjust whenever $k < x$. As already mentioned in the introduction, Levy et al. (1997) provide estimates for k, but x is not observable. Since x is not observable, it was important to get at least some theoretical properties of it. This was Mankiw's (1985) contribution. Mankiw showed that x is only of "second order" for a monopolistic competitive firm. That is, not adjusting when the price is slightly mis-set only reduces the firm's profits marginally. Small costs of changing prices (a small k) are then enough to cause prices to be sticky. Mankiw's work and the empirical studies on menu costs showed that menu costs are a potentially important

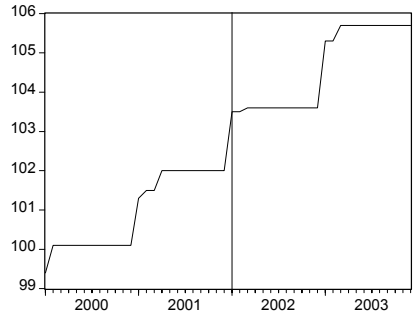

FIGURE 3.5. Chimney Sweeping (260), an example of an administered price.

source of money non-neutrality. But concerning the time-span a firm keeps its price constant because of menu costs, these studies remain inconclusive. In the introduction we argued that information about the time-span can be retrieved from the way firms set their prices around a currency changeover. The pattern we expect prices to follow is depicted in Figure 3.1b. Underlying this figure are several assumptions that we now make explicit. Observing, for example, that a price does not follow the pattern of Figure 3.1b does not necessarily imply that menu costs do not make prices sticky. We will first state the conditions and then discuss them in turn.

The following three conditions have to be met so that we can, at least theoretically, expect an index to follow the characteristic pattern of Figure 3.1b and to reveal the information in which we are interested.

1. Prices are set by firms.

2. All firms reprint their menus at the changeover.

3. The index has a trend.

The first condition has two implications. First, it makes clear that we need firms to have some degree of market power. To be able to postpone or anticipate intended price adjustments, firms have to have some discretion in their price-setting. In a perfectly competitive world, prices would not follow the characteristic pattern of Figure 3.1b. We will assume that in none of the markets we look at, firms are pure-price takers. The second implication of the first condition is that it excludes all administered prices. Examples of administered prices are prices for public transport, many health care products and various fees. Figure 3.5 shows the fee for chimney sweeping. Chimney sweeping is municipally controlled. The price jumps at the changeover and is constant in the months before and after. These fees, and taxes in general, are often changed at the turn of the year and kept constant for several months, which generates this

pattern. Changing these prices might be as costly as changing non-administered prices, but the decision to change these prices is unlikely to be influenced by menu cost considerations. We will therefore not include these types of series in our analysis.

Condition 2 is the most difficult to be fulfilled. It is because of this condition that we have to work with data from Germany. There are two reasons why firms might not have to reprint their menu at the changeover. First, some items in the basket do not have "menus", like housing rents or insurance contract. For these items, a currency changeover can be viewed as a pure nominal occurrence. The second reason why firms might not have to reprint their menu at the changeover is "double price tags". Double price tags are tags on which the price is denoted in two currencies, in our case Deutschmarks and euros. In deriving Figure 3.1b we argued that all firms had to reprint their menus at the changeover. We implicitly assumed that, before the changeover, prices had to be denoted in the old and after the changeover in the new currency and that double price tags were not possible. In Germany, as in most European countries, there was no legal obligation to have double price tags, but some firms followed this policy.

Suppose a firm changes its price a few months before the changeover and decides to indicate the price in both the new and the old currency. Then, at the changeover, this firm does not have to reprint its tag (menu). For firms that put two prices on their tags, the cost of changing prices is not zero at the changeover, and we can neither expect the index to jump nor to be flat around the changeover. The problem caused by double price tags makes the approach taken in this paper difficult to pursue. Our central argument in deriving Figure 3.1b was that the cost of changing prices at the changeover is zero. If this is not the case, drawing any conclusion about menu costs is problematic. Using the German data set provides a way out when we modify the hypothesis slightly.

Price-setting in Germany was regulated in the following way. Until the introduction of euro coins and banknotes, prices had to be denoted in marks. To make people acquainted with the new currency, double price tags were encouraged by the authorities but were not compulsory. With the changeover, prices had to be denoted in euros. There was a two-month transition period in which payments could be made both in euros and marks. In this transition period double price tags were still allowed but only until February 28th 2002. This means that all menus (tags) had to be reprinted in the two months transition period.[6]

Instead of the short interval that we assumed in deriving Figure 3.1b, there was a two-month period in which all menus had to be reprinted. This is illustrated in Figure 3.6. The transition period is between t_0 and t_1. As before, we expect the index to be flat for some time before the changeover, but no prediction can be made about when exactly the *jump* will occur. The *jump* might occur with the changeover, that is, in January, 2002; or in the following two months. In the next section we will see

[6] For more about the legal aspects of price setting at the euro changeover, see Raabe (2003).

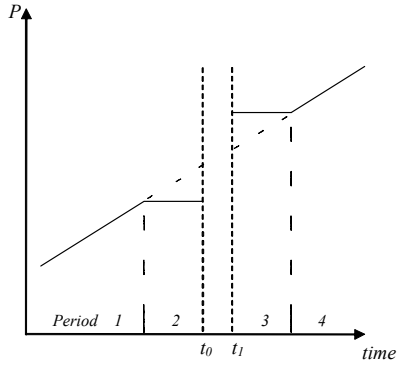

FIGURE 3.6. This figure shows the modified hypothesis. The transition period in which all firms have to reprint their menus is between t_0 and t_1. No prediction about when exactly the *jump* will occur can be made.

that the most likely date of the *jump* is still January 2002, as illustrated in Figure 3.1b.

Condition 3 is a technical condition on the shape of a series. This condition is necessary because firms can only postpone or anticipate price adjustments if the price has a trend. Figure 3.3 shows the index for sheet music, which is constant over the whole sample period. Firms selling sheet music could neither anticipate nor postpone price adjustments even if they would have liked to do so.

In the next section, we will clear the data from items that do not meet the three conditions above. Before doing this, two points deserve clarification. The first concerns the heterogeneity of firms. This point is central for this paper in that it provides the rationale or the justification for our approach. The other point clarifies what the menu cost theory predicts. This last point is important in understanding our choice of estimation procedure.

Consider again the price of a foreign language course (Figure 3.4). Note that this price increases in three steps: a first, marked increase with the changeover in January, a second smaller increase in February, and another marked increase in March. The increases, thus, coincide with the transition period in which all menus had to be replaced. The stepwise increase might be a sign of an issue we have not addressed yet. The goods combined in a single expenditure category (item) are not homogeneous and are collected at different types of selling establishments in different geographical areas. Their prices are therefore likely not to display identical movements. It could be that the stepwise increase of the price of foreign language courses happened because all firms increased their prices in each of the three months. But given the

heterogeneity and especially if there are menu costs, it is more likely that a fraction of firms increased in January and others later on. Because of the heterogeneity it is, in general, difficult to extract information from aggregate data about individual firms. The interesting aspect of a currency changeover is that it breaks this heterogeneity. All firms, regardless of where they are located and regardless of what they produce have to reprint their menus in the transition period. And all firms can, if they wish, save costs by postponing their price adjustments.

In the introduction, we argued that firms will postpone and anticipate price changes in order to save the menu costs at the changeover. This, we argued, leads to a *jump* at the changeover and to the flat periods before and after. However, there is an additional point to be considered. A firm that finds it necessary to adjust its price again shortly after the changeover will do so independently of whether it already adjusted at the changeover. This firm cannot save costs by not adjusting. The menu cost theory, thus, predicts that firms will anticipate but does not predict that the index is necessarily flat after the changeover. This means that the distinction between "spikes" (see Figure 3.3) and menu costs is not always clear-cut.

3.4 The Findings

In this section we will first clear the data from series that do not meet the conditions outlined in the previous section. Then we will present two estimation procedures and the findings. The first procedure allows us to get detailed information about how price-setting in the various sectors is affected by menu costs. The second procedure confirms the findings of the first.

Recall that some of the items in the CPI basket do not meet the conditions of section 3. In the CPI basket, 66 items are administered (violating condition 1), and 10 are either housing rents or insurance contracts (violating condition 2). In selecting which prices are administered, we follow the definition of the German statistical office. More information is given in the appendix. The 76 series we drop have a weight of more than 35% in the basket. This leaves us with 610 of the original 686 series.

The condition that the series included in the study have a trend (condition 3) turned out to be particularly difficult to deal with. We were unable to find any objective criterion to interpret "having a trend". Especially in choosing the length and the position of the interval in which we require a series not to be constant we ran the risk of being entirely arbitrary. The only index that is constant over the whole sample period is sheet music (shown in Figure 3.3). All other series display at least some variation, and the decision to keep or remove them is much less obvious. We decided, therefore, to keep all series and thus ignore this condition.

3.4.1 First Estimation Procedure

After having cleared the data of items that do not meet the conditions outlined in the previous section, we can now describe our first estimation method. The path we expect an upward trending series to follow is depicted in Figure 3.6. In translating this figure into testable predictions, we will keep these predictions deliberately vague. We cannot predict, for example, the exact size of the *jump* or when exactly the *jump* will occur. But the menu cost theory has two clear implications for the path. The first is that the series should have a pronounced *jump* in the transition period, where "pronounced" will be specified later. The second implication is that, before the changeover, there should be a period where firms do not change prices, which keeps the index flat. By our choice of how we translate Figure 3.6 into testable predictions, we constrain ourselves to rely on descriptive statistics when testing the hypothesis. The word "significant" is, therefore, to be understood only in an economic sense.

A comment on our choice of estimation procedure is in order. The main reason why we have chosen the procedure above is that, from a theoretical point of view, all the information we need can be retrieved from the shape of the single series. The reason why we rely only on descriptive statistics is that the way prices reacted to the change in the currency makes a more precise prediction for the shape difficult. In section 2 we have seen that price-setting was very intense at the changeover, with several series with a spike and a few that seem to have increased permanently. There is also the possibility to set up a structural model that explains the paths of prices in terms of other variables. One difficulty with this approach is that, in the short period we consider (the few months around the changeover), observable variables such as output or wages do not vary sufficiently to make an estimation feasible.

For the *jump*, we will use two definitions. According to the first definition, a series is said to "jump" if the change in January, 2002 is an outlier, that is, more than 2 standard deviations away from the mean of first differences. Since the theory does not predict when exactly the *jump* will occur, the second definition also includes series that jump later in the transition period.[7] The first definition is, thus, nested in the second.

According to the first definition, 154 of the 610 series jump at the changeover (181 according to the second definition). The monthly average of the number of outliers in the whole sample is 33. This confirms that January, 2002 was "special" in the sense that price-setting was more intense than in other months. But it also means that most of the 610 series were not affected by the changeover. This is also the impression one gets from visually inspecting the series. Besides the cases described in section 2, the general impression one gets from studying the series is that, for the

[7] The results are robust to changes in how exactly we interpret the *jump*. A change from 2 to 1.5 standard deviations in the definition, for example, does not alter the results. The appendix gives a more precise account of definition 2.

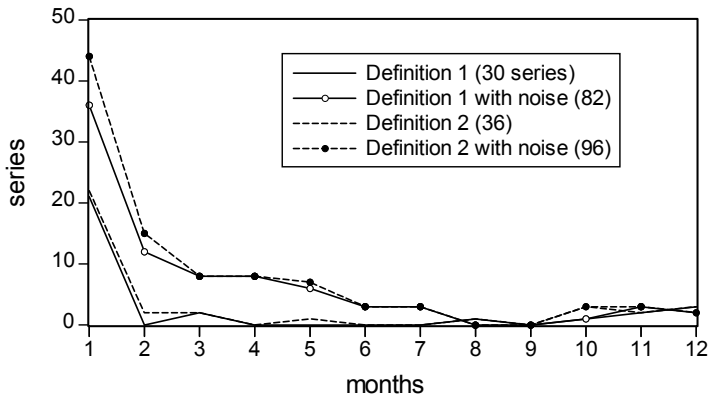

FIGURE 3.7. This figure shows the number of series (vertical axis) that are flat before the *jump* for the number of months given on the horizontal axis. "Definition" refers to how we define the *jump* and "noise" is specified in the text. The total number of series we found with the different definitions is given in brackets.

majority of indices, price-setting at and around the changeover was not different from other periods. Of these 154 series, 30 are flat before the *jump* (36 with the second definition). In other words, 30 follow the characteristic pattern of Figure 3.1, which is quite a small number. Interestingly, nearly half of the 30 series are services, while in the full sample of 610 series, only 75 (12 percent) are services. With 6 series the restaurant sector is especially well represented.

Allowing for Noise in the Data: One problem with what we have done so far is that we required the indices to be perfectly constant before the *jump*. Consider again the index of foreign language courses in Figure 3.4. This index jumps with the changeover and is fairly flat before the *jump* for several months. But it is not exactly flat. Problems in the collection of the data might, for example, introduce "noise" in the reported figures. We will now allow for some noise in the sense that we allow a series to vary by $\pm$ 0.1 index points and still consider it "flat". The data are published with a precision of one decimal place so that the smallest possible variation is 0.1 index points.

Allowing for noise, we find that 82 (instead of 30) series are flat before the *jump*. Using definition 2, this number increases to 96 (instead of 36). The result is shown in Figure 3.7. This figure shows on the vertical axis the number of series that are flat before the *jump* for the period of months given on the horizontal axis. Three points are worth mentioning. First, both definitions lead to almost the same results. This means that most price adjustments were already carried out in January, confirming our impression above. Second, when allowing for noise the number of items for which

menu costs seem to be high increases considerably. This point will be addressed again in the next paragraph. Third, the stickiness these series display is generally fairly short. Around two thirds of the series stay flat for only one or two months, and only very few stay flat for more than 6 months.

Summarizing what we have found so far, we have to conclude that menu costs in general cannot explain why firms are so reluctant to change prices. There are only very few items for which menu costs seem significant, and it is likely that the numbers above overstate the importance of menu costs. Consider the group of 96 items that we found using the second definition and allowing for noise. When allowing for noise, we had to allow for price changes of up to 0.1 index points. This was because the data are published only with a precision of one decimal place. A change of 0.1 index points is approximately a change of 0.1 percent, and for many series a change of this size within one month is quite large. To get an idea, nearly half of the 96 series change on average by less then 0.1 index points per month. In these cases, it is difficult to call a variation of $\pm$ 0.1 "noise". Another reason why the number 96 is likely to overstate the true effects of menu costs is that the shapes of some of the series look more like "spikes" as in Figure 3.3. At the end of section 3, we noted that the distinction between spikes and menu costs is not always clear-cut. We decided to keep all of the 96 series but want to mention that some of them do not appear to be shaped by menu costs.

More Statistics: Despite these problems, a closer look at the 96 series we found with definition 2 and allowing for noise is revealing. Again, the number of services is disproportionately high with 36 percent in the group of 96 and only 12 percent in the original sample of 610 series. Somewhat striking is the restaurant sector: 12 of the 16 series appear in the group of 96. On average, these series stay flat for 2.8 months before the changeover.[8] For other sectors it is difficult to detect a pattern. Furniture and musical instruments might be worth mentioning. For furniture, 10 of the 21 items in the sector appear with an average stickiness of 2.5 months, and the four musical instruments are all flat for one month before the *jump*. The average stickiness in the group of 96 is 3.1 months, and the median is 2 months. As Figure 3.7 illustrates, the distribution is highly skewed with most series flat for one or two months and only a few for more than 6 months. Examples of items that are flat for more than 6 months are newspapers, cigarettes, tobacco and foreign language courses. It would be interesting to know the weight of the 96 series in the basket. Unfortunately, the German statistical office does not publish the weights of the individual series, but Austria does. Assuming that consumption patterns in both countries are similar, we find that the 96 series have a weight of 19.1 percent in the CPI basket.

Another interesting statistic we can calculate is an "average stickiness" attributable to menu costs. Remember that for the series that do not appear in the group

[8] The restaurant sector includes series 593 - 608.

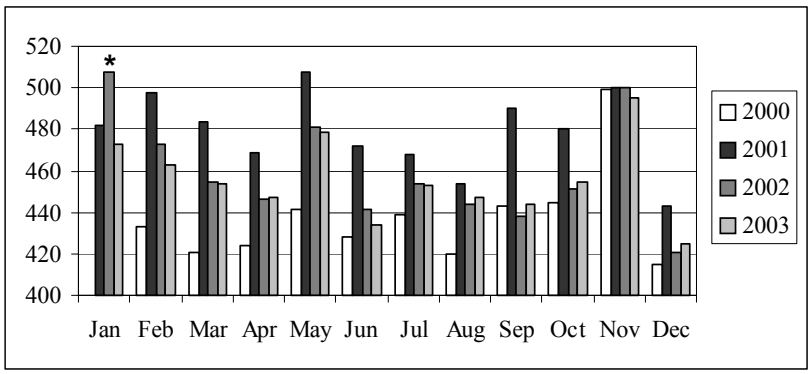

FIGURE 3.8. Each column in this figure shows the number of indices whose value changed with respect to the previous month. The euro changeover is indicated by a '*'.

of 96, menu costs might still be significant, but they are just not high enough to be detected with monthly data. The data are collected around mid-month, and the euro changeover was at the beginning of the month. Assigning a stickiness of 15 days to the series that were not detected with our procedure and using the stickiness we estimated for the other 96 series, we find that the (weighted) average stickiness that can be explained by menu costs is 20 days. The stickiness of 12 months that other studies report (see introduction) does not seem to be caused by menu costs.

This statistic should be used with caution. First, there are substantial differences between sectors. For the restaurant sector, menu costs seem to be much higher. Second, the 15-day-stickiness is an upper bound; a lower number is likely. Third, this statistic is based on the group of 96 and thus likely overstates the effect of menu costs for the reasons outlined in the previous subsection. Also, we had again to use the Austrian weights, which might introduce distortions. Here it seemed appropriate to weight each series so that items that are more important in the CPI basket receive a higher weight in this statistic.

3.4.2 Second Estimation Procedure

Before concluding this section, we want to present a slightly different method that confirms our findings so far. When menu costs are high, firms should not change prices in the run-up to the changeover as much as they change prices in other months. Similar to what we did above, the measure is by how much a series changed from one month to the other. Unlike above, however, we do not require the series to jump, and to see whether price-setting was different in the run-up to the changeover, we compare the months before the changeover with their corresponding months of the other years. By doing this, we automatically take care of any seasonality. Consider

Figure 3.8. Each column in this figure gives the number of items whose value changed with respect to the previous month. In January, 2002 (euro changeover, indicated by a '*'), for example, 508 of the 610 series had a different value than in December, 2001. Not surprisingly, no other column is higher than January, 2002. Following the reasoning above, we expect the columns before the changeover to be lower if menu costs are high. But for eleven consecutive months, the columns in 2001 are at least as high and most of the time even higher than the columns of the other years. This outcome is somewhat unexpected, but it confirms our findings above. Firms changed prices in the run-up to the changeover at least as much as in other periods. It is unlikely that menu costs play a significant role in the price-setting decision of firms.

3.5 Conclusion

In this paper we studied whether menu costs are large enough to make prices sticky. Instead of estimating menu costs, we infered their significance by indirectly exploiting the fact that at a currency changeover firms have to reprint their menu independently of whether they change prices. In this sense currency changeovers are natural experiments where all firms change menus independently of what and where they produce. When changing menus is costly, firms will postpone price adjustments in the run-up to the changeover and will try to make the price changes coincide with the changeover. This behaviour will be reflected in the data.

Using disaggregate data from the euro changeover, we found that menu costs can only account for a stickiness of around 20 days. Interestingly, the only sector where menu costs seem to be significant is the restaurant sector. The restaurant sector is the sector for which economists always found the menu cost assumption most plausible (at least judging by their choice of words). But even there, menu costs cannot explain a stickiness of more than three months. There are a few goods where menu costs can account for a stickiness of several months. However, as a general explanation for why firms are so reluctant to change prices, menu costs do not seem to be high enough.

3.6 Appendix

3.6.1 Defining Administered Goods

The 1998 report of economic advisors to the German government (*Sachverständigenrat*) distinguishes four different groups of administered prices according to the degree of government intervention. In the first group (39 items), "directly administered prices", prices are set directly by the authorities, such as public transportation or chimney sweeping. In the second group (27 items), "partly administered prices", the authorities have a "substantial influence" on price-setting. Examples are district heating and many health care products. Items in the third group, "quasi-administered prices", are subject to special excise duties such as tobacco and liquor. The fourth

group, "indirectly administered prices", comprises several agricultural products that are subject to the Common Agricultural Policy of the European Union. For more on this, see "Methodological Explanations" of the *1998 Annual Report of the Sachverständigenrat*. In section 4 we only removed items of group 1 and 2. For the items in the other groups, the degree of government intervention seems small enough for our purpose.

3.6.2 Defining the *Jump*

According to definition 1, a series "jumps" if the difference between January, 2002 and December, 2001 is more than 2 standard deviations away from the mean of first differences. According to definition 2, a series "jumps" if January, February or March, 2002 are outliers. Not many series jump in February or March. Some series jump in more than one month. An example is foreign language courses (shown in Figure 3.4). There is also the theoretical possibility that none of the differences in the three months is large enough to be detected but that only the combined effect of the three months is an outlier. To catch these, we make the data "quarterly" by dropping all the months except December, March, June, and September. In this case a series is said to jump if the difference between December, 2001 and March 2002 is an outlier according to our usage above. Three of the 181 series that jump according to definition 2 fall under this last category.

3.7 Literature

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Chapter 4

Can "Price-Stickiness" Explain the Persistent Increase in Services Prices at the Euro Changeover?

Abstract

The central assumption of this paper is that the transitory and the persistent price increases we observed at the Euro changeover have the same underlying cause: firms trying to take advantage of the confusion among consumers that comes with the introduction of a new and unfamiliar currency and the changing of all nominal prices. The hypothesis is that services prices only appear to have increased persistently because firms in these sectors tend to keep their prices unchanged for several months. The trade off these firms face is between the short run gains from taking advantage of the confusion and the losses in future months when the confusion disappeared but prices are still above the "optimum". Simulations of the model show that price stickiness may have contributed to the increase but is not enough to explain the magnitude we observe in the data.

4.1 Introduction

In this note I present a model that tries to explain the persistent increase of services prices at the Euro changeover. The central assumption is that services prices are "sticky" in the sense that firms keep prices constant for several months.

In Germany nearly a third of the 686 series in the CPI basket increased with the introduction of Euro coins and banknotes. Almost all of these returned to their pre-changeover level after a few weeks but some, especially services prices, appear to have increased persistently. Several explanations for this phenomenon, such as menu costs or a multiplicity of equilibria, have been suggested. This note takes a different approach and argues that price stickiness can explain the persistent increase or at least that price stickiness contributed to this phenomenon.

For restaurant menus, price stickiness is well documented; see for example the paper by Gaiotti and Lippi (2005). Lünnemann and Mathä (2005) report that services prices in general are less flexible than prices of non-services. One of the reasons for this is that services are fairly labour intensive and wages do not fluctuate. In this note I will simply assume that services prices are set for several months without specifying why this might be.

The introduction of a new and unfamiliar currency and the changing of all prices may lead to some confusion on the side of consumers and firms might try to take advantage of this by raising prices. The "initial confusion" argument is reasonable and is the standard explanation for the transitory price increases. Here it is important to note that this explanation does not imply that firms actually succeeded in fooling their customers, only that they tried to do so.

Aim of this paper is to see how sticky-price firms optimally set prices given the initial confusion and given that they have to keep their prices constant for several months. For these sticky-price firms the short run gains arising from increasing prices at the changeover come with losses in future months when the initial confusion disappeared but prices are still above the "optimum". The important point is that the future losses are discounted so that a small increase is likely to be profitable. The question is only whether the 2 percent increase we observe in the data can be explained by reasonable assumptions on the preference parameters and on technology.

To answer this question the model presented in the next section is simulated in section 2. Comments on the assumptions and their plausibility conclude this note.

4.2 The Model

The model is based on a version of Dixit and Stiglitz's (1979) model of monopolistic competition. In this paper I am interested in how a single firm optimally sets its price given the prices set by other firms in the same sector and given economy-wide variables such as overall output, the overall price level and the wage rate. To model this situation the usual Dixit-Stiglitz model is amended so that in this paper the economy consists of a continuum of sectors and each sector consists of a continuum of firms.

4.2.1 The Household's Problem

The representative household maximizes utility

$$U = U\left(C_0, C\right),$$

where C_0 is an unproduced good and C is a basket of sectors and is given by

$$C = \left(\int_0^1 C\left(s\right)^{\frac{\sigma-1}{\sigma}} ds \right)^{\frac{\sigma}{\sigma-1}}.$$

The basket, thus, takes the form of a symmetric CES with $C\left(s\right)$ being the amount of consumption coming from sector s. The elasticity of substitution between the different sectors is given by $\sigma > 1$. The sectors are indexed by $s \in [0, 1]$. Each sector is a basket of goods and takes the form of a symmetric CES as well.

$$C(s) = \left(\int_0^1 C(s,g)^{\frac{\gamma-1}{\gamma}} \, dg \right)^{\frac{\gamma}{\gamma-1}}$$

The goods within a sector are indexed by $g \in [0,1]$ and the elasticity of substitution between goods is given by γ. Each good, or each firm producing it, is thus identified by the two indices s and g. The variable $C(s,g)$ is the amount the household consumes of good g in sector s. The variable $C(s)$ is the demand for goods from sector s. I will assume that goods within a sector are better substitutes than sectors, so that $\gamma > \sigma$. See Matsuyama (1995) for a discussion of this point.

The representative household holds ownership shares of all profit-making firms, the budget constraint of the household is then given by

$$E \equiv C_0 P_0 + \int_0^1 \int_0^1 P(s,g) C(s,g) \, dg ds = WN + \Pi.$$

Where W is wage income, N is labour supply and Π are profits. $P(s,g)$ denotes the price of good $C(s,g)$. Expenditures, E, are given by the expenditures for the unproduced good ($C_0 P_0$) and by the double integral over all differentiated sectors and goods. The optimization problem of the household yields the following demand for good $C(s,g)$

$$C(s,g) = \left(\frac{P(s,g)}{P(s)} \right)^{-\gamma} \left(\frac{P(s)}{P} \right)^{-\sigma} C, \tag{4.1}$$

which differs from the standard demand arising from Dixit-Stiglitz preferences only in the additional price ratio $\left(\frac{P(s,g)}{P(s)} \right)^{-\gamma}$. The overall price level P and the sector price level $P(s)$ are

$$\begin{aligned} P &= \left(\int_0^1 \left(P(s)^{1-\sigma} \right) ds \right)^{\frac{1}{1-\sigma}} \\ P(s) &= \left(\int_0^1 \left(P(s,g)^{1-\gamma} \right) dg \right)^{\frac{1}{1-\gamma}}. \end{aligned}$$

4.2.2 The Problem of the Firm

Flexible Prices, No Confusion: To illustrate how this model differs from the usual Dixit Stiglitz model of monopolistic competition, I will first look at the firm's problem assuming that firms can adjust their prices every period and that households are perfectly aware of the true price. Firms maximize profits (π) taking into account the demand for their goods $C(s,g)$ given by equation (4.1).

$$\pi = P(s,g) C(s,g) - WN(s,g)$$

The production function is given by

$$Y(s,g) = N(s,g)^{\frac{1}{\alpha}}$$

where $\alpha > 0$ is a scale parameter. With $\alpha > 1$ the production function exhibits decreasing returns to scale. Solving this optimization problem we get the firm's reaction function.

$$\left.\frac{P(s,g)}{P}\right|_{\substack{\text{flex. prices}\\ \text{no confusion}}} = \left(\frac{\alpha\gamma}{\gamma-1}\frac{W}{P}\left(\frac{P(s)}{P}\right)^{(\sigma-\gamma)(1-\alpha)} Y^{\alpha-1}\right)^{\frac{1}{1-\gamma(1-\alpha)}} \tag{4.2}$$

Equation (4.2) gives the firm's optimal price in terms of real marginal costs (W/P), the sector price level ($P(s)/P$) and the overall output (Y). Note that with constant returns to scale ($\alpha = 1$) this equation reduces to the familiar $P(s,g) = \frac{\gamma}{\gamma-1}W$. With constant returns to scale the individual firm's price is simply a mark-up over marginal costs and is independent of the prices set by other firms in the same sector.

Sticky Prices, Confusion: In this section two additional assumptions are made. First, firms expect households to be confused and therefore to underestimate the true price by a factor $\phi \in]0,1]$, so that

$$P_\phi(s,g) = \phi P(s,g)$$

where $P_\phi(s,g)$ is the price households believe to pay and $P(s,g)$ is the true price. The demand of the confused consumers is given by

$$Y_\phi(s,g) = \left(\frac{P_\phi(s,g)}{P(s)}\right)^{-\gamma}\left(\frac{P(s)}{P}\right)^{-\sigma} Y. \tag{4.3}$$

I assume that the confusion lasts for $m \geq 1$ periods and that it exists in only a few sectors of the economy, so that the effect on the household's budget constraint can be ignored. The second assumption is that firms keep their prices constant for $n \geq 1$ periods. The maximization problem of the firm is then given by

$$\begin{aligned}\max_{P(s,g)} \pi \;=\; & \sum_{i=1}^{m} D(i,m)\left[P(s,g)\,Y_\phi(s,g) - WN\left(Y_\phi(s,g)\right)\right] \\ & + \sum_{i=m+1}^{n} D(i,n)\left[P(s,g)\,Y(s,g) - WN(s,g)\right].\end{aligned}$$

Where the first summation denotes profits over the m periods in which households are confused and the second summation denotes profits over the $n-m$ periods in which households are aware of the actual price. $D(i,m)$ and $D(i,n)$ are discount

factors that I will discuss below. Solving the firm's problem we find that the optimal price $\frac{P(s,g)}{P}$ is a mark-up over the price set when there is no confusion and prices are flexible.

$$\frac{P(s,g)}{P} = \underbrace{\left(\frac{B_m\phi^{-\alpha\gamma}+B_n}{B_m\phi^{-\gamma}+B_n}\right)^{\frac{1}{1-\gamma(1-\alpha)}}}_{\substack{\text{confusion mark-up}\\ \mu}} \times \left.\frac{P(s,g)}{P}\right|_{\substack{\text{flex. prices}\\ \text{no confusion}}} \tag{4.4}$$

Equation (4.4) is the central equation of this paper. It shows how consumers' confusion allows firms to temporarily increase their prices above the no-confusion price which is given in equation (4.2).

Consider the mark-up in equation (4.4). Assuming strictly decreasing returns to scale ($\alpha > 1$), the mark-up is equal or greater than one ($\mu \geq 1$). Without confusion ($\phi = 1$), the mark-up equals one and as the confusion rises (decreasing ϕ) the mark-up increases.

Two weights appear in the confusion mark-up, B_m and B_n. B_m is the weight of the periods in which households are confused. Assuming exponential discounting B_m is given by

$$B_m = \sum_{i=0}^{m} D(i,m) = \sum_{i=0}^{m} \beta^i.$$

The longer households are confused the larger the weight B_m and the larger the mark-up. Assuming that households are confused only in the first period (month) after the changeover, B_m equals 1. The other weight, B_n, arises from price stickiness. Assuming exponential discounting B_n is given by

$$B_n = \sum_{i=m}^{n} D(i,n) = \sum_{i=m}^{n} \beta^i.$$

The longer firms need to keep their prices constant the larger B_n and the smaller the mark-up. This is intuitive. Firms weigh the gains of increasing prices against the losses. The gains arise only in the beginning when households are confused. As soon the initial confusion is over, firms having set the price higher to take advantage of the initial confusion will incur losses. The longer prices are fixed, the higher these losses.

4.3 Simulation Exercise

Given that the losses are discounted it is likely that even sticky-price firms will increase prices slightly to take advantage of the initial confusion. The question is whether the

model can generate the sizable increases we observe in the data with reasonable assumptions on the preference and technology parameters. This section tries to answer this question. The parameters to be specified and the values assumed are:

- $\alpha = 1.1$, scale parameter in production function; $\alpha > 1 \rightarrow$ decreasing returns to scale
- $\gamma = 5$, elasticity of substitution between different goods
- $\phi = 0.8$, "confusion parameter"
- $B_m = 1$, weight of periods in which consumers are confused
- B_n, weight, assuming a price stickiness of n periods
  - $B_0 = 0$, assuming flexible prices
  - $B_{12}^{hyp} = 5$, assuming 12-month-stickiness and hyperbolic discounting
  - $B_{12}^{\exp} = 8$, assuming 12-month-stickiness and exponential discounting

For values of α and γ I follow Blanchard and Kiyotaki (1988). An elasticity of substitution (γ) of 5 seems reasonable for items within the same sector, but the elasticity of substitution between different sectors should be smaller, somewhere around 2. An estimate for ϕ can be calculated from the transitory increases. Recall that prices in many sectors increased significantly at the changeover, prices of vegetables even by more than 20% (seasonally adjusted). To generate increases of this size I need to set $\phi = 0.8$, that is, firms expect households to underestimate the true price by 20 percent.

Setting $B_m = 1$ means that consumers are confused only in the first period after the changeover, that is, $m = 1$. This is a fairly conservative assumption; a higher B_m would help me to increase the effect I want to generate. From the data it is not clear whether firms expected the confusion to last one month or longer. What we observe is that most prices returned after one month, but the return after one month might simply be driven by the fact that firms realized that they had underestimated consumers' ability to observe the correct price.

I distinguish between three different B_ns. The longer firms have to keep prices constant, the higher will be B_n. With $B_n = 0$, prices are flexible. $B_{12}^{\exp} = 8$ presumes 12-month-stickiness and exponential discounting and a $B_{12}^{hyp} = 5$ presumes 12-month-stickiness and hyperbolic discounting. Hyperbolic discounting is modelled as $\beta\delta-$discounting, following Phelps and Pollock (1968). See also the papers by Laibson (1984, 1997). The formula used is

$$B_{12}^{hyp} = \beta \sum_{i=m}^{12} \delta^i$$

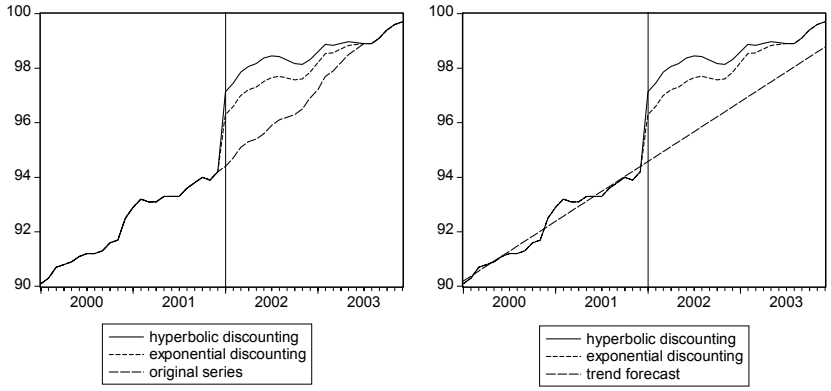

FIGURE 4.1. The effect of confusion assuming that prices are sticky. Prices rise sharply at the changeover (denoted by a vertical line) and then return gradually to their pre-changeover path. The figure on the right hand side shows the two simulated series with a linear forecast. Here the increase seems to be permanent even though it is not.

with $\beta = 0.7$ and $\delta = 0.923$. Hyperbolic discounting puts a particularly large weight on current period utility or profit, ignoring somewhat future losses and thus making the consumption plans time inconsistent. Hyperbolic discounting, however, describes actual behaviour better than exponential discounting (see for example Frederick, Loewenstein and O'Donoghue 2002). More comments about hyperbolic discounting below.

The price increases the model predicts for the parameters above are:

- 7.72% increase if prices are flexible ($\mu = 1.0772$)
- 2.96% increase with prices sticky for 12 months and hyperbolic discounting ($\mu = 1.0296$)
- 2.16% increase with prices sticky for 12 months and exponential discounting ($\mu = 1.0216$)

The model predicts that a firm that can adjust prices every period should increase its price by 7.7%. A firm that keeps its price constant for 12 months should increase its price by 2.16%. This is below the three percent we observe in the data, but assuming hyperbolic discounting the model predicts an increase of just about 2.96% which is close to the 3% we observe in the data.

The figure illustrates the simulation exercise. To generate the figure I took a series (cinema tickets in the early 90s) from the German CPI basket to feed the model above. The model predicts a price increase of 2.16% (exponential discounting) and 2.96% (hyperbolic discounting) at the changeover. After 12 months the price index returns to its pre-changeover path. The reason why in the figure the series does not drop down after 12 months is that only the *average* stickiness is assumed to be 12 months. I assume that $\frac{1}{12}$ of the prices return after six months, another $\frac{1}{12}$ after seven and so on. The longest stickiness is 18 months. With this assumption the series does not drop after twelve months but returns gradually to their pre-changeover trend. After 18 months the series fully returned to its pre-changeover level, as can be seen in the left hand panel of the figure. The assumption that prices return successively and not all bunched in the same period seems reasonable.

The right hand panel shows the two simulated series and a linear forecast based on the first 24 observations. The original series (cinema tickets) was deliberately chosen so that the increase in the right hand panel looks permanent even though it is not. I did this to illustrate the difficulty to distinguish between permanent increases (caused by a change in equilibria for example) and increases that last several months. Only if we knew how the index had developed without the changeover a definite answer to the question can be given.

4.4 Conclusion

The idea of this paper was to see how sticky-price firms optimally set their prices at the changeover given the initial confusion and given that they have to keep their prices constant for several months. The paper claims that both the transitory and the persistent increases might eventually be caused by the same cause: firms trying to take advantage of the initial confusion that comes with the introduction of a new currency. From a policy perspective the argument that both the transitory and the persistent increases have the same underlying reason is interesting because it implies that a policy that prevents the transitory increases would also prevent the persistent increases.

The simulation exercise showed that the model is capable to generate persistent price increases of around three percent, similar to the ones we observe in the data. However, the simulation is based on several assumptions that I now want to review.

The assumption that prices in the services sector are "stickier" than in other sectors is probably the least problematic assumption of the paper. Hyperbolic discounting does not seem too far-fetched for services firms that are often small family-owned businesses. The simulation presumed a confusion parameter ϕ equal to 0.8 which implied that consumers underestimate the actual price by 20%. This seems quite high, especially because consumers generally have a fairly good idea about services prices. However, even with $\phi = 0.8$ the model was able to generate transitory increases of

only 7.7%. This illustrates how difficult it is to explain prices hikes of more than 20% (seasonally adjusted) in the fruit and vegetable sector.

The strongest and most problematic assumption is that firms are ignoring the incentives of their competitors to increase prices as well. In section 1 I assume that the individual firm that tries to take advantage of the initial confusion by slightly increasing its prices does not expect other firms in the same sector to do so as well. If instead the firm expects the whole sector to take advantage of the initial confusion, the demand function (equation 4.3) reads

$$Y_{\phi}(s,g) = \left(\frac{P_{\phi}(s,g)}{P_{\phi}(s)}\right)^{-\gamma}\left(\frac{P_{\phi}(s)}{P}\right)^{-\sigma} Y, \tag{4.5}$$

where $P_{\phi}(s) = \phi P(s)$. With this change, the reaction function (equation 4.4) is unchanged except that then all the $\gamma's$ are replaced by $\sigma's$. Assuming that goods within a sector are better substitutes than sectors ($\gamma > \sigma$), the increase caused by the initial confusion is *lower* than what I reported in section 2. Setting $\gamma = 2$ (before we had $\sigma = 5$), the model predicts an increase of 0.9% (before we had 2.96%) assuming 12-month-stickiness and hyperbolic discounting. It is difficult to believe that firms did not expect other firms to take advantage of the initial confusion as well.

The mechanism described in this note might have contributed to the increase in services prices at the changeover, but does not seems large enough to be the sole explanation for this phenomenon.

4.5 Literature

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Chapter 5

Discussion

I would like to conclude the dissertation by answering the four questions that were asked in the introduction. For all the issues addressed in this discussion I will indicate where in the previous three chapters more information can be found. I will start by summarizing the impact of the Euro changeover on prices. Then, answering the questions I will go into some detail about the factors that may make a currency changeover a non-neutral event.

5.1 The Effect of the Euro Changeover on Prices

The impact of the Euro changeover on the overall price level was negligible, but at a more disaggregate level the effect is somewhat surprising. Prices in several industries increased sharply with the changeover. Most returned to their pre-changeover level after a few weeks but some, especially services prices, seem to have stabilized at a higher equilibrium. The impact differs widely across countries and there are some countries where price setting at the changeover does not appear to be much different from other periods. In chapter 2, I argue that these differences can be explained by the way in which the countries regulated price setting at the changeover. One of the more effective regulatory instruments is dual pricing, where price tags carry prices in both the new and the old currency. In countries that made dual pricing compulsory, the impact of the changeover on prices appears greatly reduced and sometimes even absent. Chapter 2 describes more instruments a country can use to regulate price setting at a changeover.

5.2 The "Experiment"

1. Can a Currency Changeover Affect Relative Prices?

The answer is yes, a currency changeover can affect relative prices. It is interesting that the impact was not only transitory but appears persistent in some cases. Two main forces seem to be at work. The first force may be called "initial confusion". The introduction of unfamiliar coins and banknotes and the changing of all nominal prices lead to some confusion among consumers and firms might try to take advantage of this. This confusion is probably the best explanation for the transitory price increases we observed in some countries. Here it is important to note that this explanation does not require households to actually be confused. All that is needed for prices to increase is that firms believe that households are confused.

The second force may be called an "increased awareness". At the time of the changeover the public was quite concerned about increasing prices and the media showed many reports about how firms converted prices. This increased awareness made it difficult for firms to take advantage of the changeover and in some cases it appears to have induced firms to lower prices.

In a sense, the initial confusion temporarily increases firms' market power while the increased awareness decreases it. The two forces are, however, not symmetric. For smaller firms it is somewhat easier to take advantage and increase prices while for larger firms this move bears some risk. Larger firms have a much higher probability to find their names in a newspaper report. There is evidence that larger companies avoided increasing prices at the changeover.

The two forces I just described, the initial confusion and the increased awareness, only explain the transitory price changes. Below, when answering the question about multiple equilibria I will describe a mechanism that explains the persistent price changes.

2. Are Supply and Demand Functions Homogeneous of Degree Zero in Prices?

This question is related but not equivalent to the question of whether a currency changeover can affect relative prices. The answer to this question is yes. Irrespective of the effect on relative prices, an appropriate reading of the data confirms the "homogeneity postulate".

In order to understand my answer it helps again to think in terms of an experiment as described in the introduction, with the absolute price level as the exogenously changing variable. Our basic models of consumer and firm behaviour predict that supply and demand functions are homogeneous of degree zero in prices. Multiplying prices by some factor k will not affect agents' behaviour; what counts are relative prices. There is, however, a difference between a currency changeover and the thought experiment of multiplying all prices by a factor k. In practice, multiplying prices by some factor is not an isolated event but triggers other variables to change as well. The initial confusion that induced firms to temporarily increase prices is a good example.

It is not surprising that many people felt confused by the sudden change of all nominal prices, but the confusion is an avoidable side-effect of a changeover, at least to some degree. By introducing a period of compulsory dual pricing, consumers are granted more time to adjust to the new "framing" which reduces the confusion. Speaking in terms of the experiment, dual pricing reduces the effect on other variables and helps in making the change in the absolute price level an increasingly isolated event. Countries like Austria that made dual pricing obligatory did not experience a notable effect of the changeover on relative prices, lending support to the homogeneity postulate.

3. Do Menu Costs Make Prices Sticky?

The answer to this question is no. Menu costs are not large enough to explain why firms tend to keep prices constant for several months. If menu costs were high, firms would not change prices in the run-up to the changeover but would postpone the price adjustments in order to make the price change coincide with the changeover. In the data we do, however, not observe that firms postponed price changes.

Recently, it has been argued that the upward jump in restaurant prices at the changeover can be explained by menu costs (see for example Hobijn et al. 2006). The data do not support this hypothesis. First, as outlined in chapter 3, the impact on restaurant prices appears to be persistent but menu costs can only explain a transitory effect. Second, menu costs can only explain a jump in prices if the jump is accompanied by periods of reduced adjustments. If there are no periods of reduced adjustments (postponing or anticipating), the jump must have other causes. This argument has been mentioned above. Third, with menu costs it is difficult to explain why larger firms like McDonalds' decreased prices at the changeover. There seems to be more to the upward jump in restaurant prices than menu costs.

4. Are There Multiple Equilibria in Oligopolistic Price Setting as the Theory Predicts?

The answer to this question is yes. This is certainly not a ground-breaking new insight but it is interesting that a currency changeover provides an instance where this multiplicity is revealed.

The reason I talk about multiple equilibria is that some of the prices that increased appear to have stabilized at the higher level. The prices that increased persistently are mainly prices of services such as restaurants, coffee shops, or repair services; industries that can be described as oligopolistic. The question is what triggered the change. In Chapter 2, I argue that the fact that these services set prices at pricing points or "threshold" prices leads to a destabilization of the old equilibrium. The following example illustrates the point.

Before the changeover, a typical price for a cup of coffee in Germany was 3.20 Marks. Converting this price at the official exchange rate yields a price of 1.64 Euros which, given the custom to price at pricing points, forces firms to search for a new price. Normally, one would expect about half of the firms to round up to 1.70 and the rest to round down to 1.60 but the decision at the changeover is not random. Here, the two forces described above, the initial confusion and the increased awareness, affect again firms' decisions. Larger firms will avoid price increases while smaller firms are more likely to regard the changeover as an opportunity to increase prices. Larger firms - anticipating the strong coverage in the media - have the opportunity to make good publicity by lowering prices.

Pricing points are common not only in the services sector but in other sectors such as retailing as well. The question that arises then is why we have not seen any

persistent price changes in sectors other than the services sector.

A possible answer is that pricing services is different from pricing non-services. There seems to be some evidence in favour of this view. Research on services marketing stresses that for firms it is more difficult to price services than to price non-services (Zeithaml and Bitner, 2003). The difficulty arises from the fact that in the services industry production costs are to a large extent fixed costs. Marginal costs are often no helpful signal in the pricing decision of services firms. Think about the marginal costs of producing a cup of coffee or the cost of filling an empty seat in a train. Given this difficulty, other signals such as the industry average price might become relatively more important, leading to interesting pricing strategies and possibly reinforcing the destabilizing effect of a changeover.

In order to explain why we only observe persistent price changes in the services sector and not in the retail sector it is, however, not necessary to argue that price setting of services is different. Competition is another argument. Margins in the retail sector are typically low and in such a situation the only viable way for retailers is to play "mixed" strategies where some prices are rounded up and others down, leaving the index unaffected.

A different explanation for the persistent increase is given in chapter 4. The hypothesis of the chapter is that services prices only appear to have stabilized at a higher equilibrium because firms in these sectors tend to keep their prices unchanged for several months. The trade off these firms face is between the short run gains from taking advantage of the confusion and the losses in future months when the confusion disappeared but prices are still above the "optimum". Simulations of the model show that price stickiness may have contributed to the increase but is not enough to explain the magnitude we observe in the data.

5.3 Conclusion

An issue that I did not address in the articles but one that seems worth mentioning at the end is people's perception of how prices changed since the Euro was introduced. In all twelve Euro-countries consumers had the impression that prices increased sharply with the changeover; an impression that cannot be confirmed by the data. With the changeover the gap between actual and perceived inflation widened significantly in Europe and there are concerns that this gap will eventually have real effects.

It is interesting that the change in the absolute price level can have such a peculiar impact on people's impressions. When writing about the decimalisation of Britain's currency, N.E.A. Moore (1973, p.226) already observed this phenomenon.

> Our results strongly imply that consumers tend to notice and remember increased prices much better than stable or falling prices, and they are

> inclined to judge changes in the general price level by the former rather than by the latter.

I am not sure, however, whether this misperception is an unavoidable side-effect of a currency changeover. A good policy should be able to prevent people from getting false impressions. Understanding what causes these impressions and designing policies to prevent them will be an interesting challenge. The first step is surely to avoid the impact on relative prices as we have seen in Germany, for example.

Looking back and recalling the various factors that affect relative prices at a changeover such as the initial confusion among consumers and the increased awareness it is not that surprising anymore that a currency changeover may affect relative prices. Only the magnitude of the impact in some countries is still somewhat puzzling.

A currency changeover provides a nice opportunity to find answers to questions that are often unrelated and sometimes unexpected. When I started working on this subject, I was not aware that a changeover could tell us something about multiple equilibria in price setting and it is likely that more detailed data and data from more countries offer new opportunities.

5.4 Literature

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Ich versichere hiermit eidesstattlich, dass ich die vorliegende Arbeit selbständig und ohne fremde Hilfe verfasst habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sowie mir gegebene Anregungen sind als solche kenntlich gemacht.

Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht.

Datum: _____

Unterschrift: _____

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6. März 2006