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Inflation Smoothing and the Modest Effect of VAT in Germany

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European Department

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Abstract

Increases in German core inflation following the 2007 VAT hike were smaller than expected,
leading to speculation about delayed inflationary effects. This paper argues to the contrary
that price increases in advance of the VAT hike explain the small increase upon
implementation. We find that core inflation rose by 0.36 percentage point in the run up and
by a further 0.40 percentage point at the time of the VAT hike. Cumulatively, the tax hike
contributed to two thirds of the increase in core inflation in 2006-07 at an estimated pass-
through of 73 percent. Most of the increase in 2006 was of general nature, while about one
sixth can be attributed to durable goods and items with low degree of competition.

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I. Introduction

Germany's 3 percentage point increase in the value-added tax (VAT) rate in January 2007 was one of the largest such hikes in industrial countries. The size of the increase and the long announcement period—about 13 months—heightened uncertainty about its likely impact on inflation. The rate hike took also place amidst a nascent economic recovery, rapid gains in employment, and rising oil and food prices. Taken together these developments raised the specter of compounding inflationary pressures with lasting consequences for price stability, yet the actual increase was much lower than feared.

Understanding the inflationary effects of Germany's VAT hike is also of interest from an international perspective. Because many advanced economies have experienced eroding direct tax bases as labor and capital have become more mobile (e.g. EU Commission 2006), many governments are considering a shift towards higher indirect taxation. Understanding the macroeconomic implications of such a move is hence key to assessing the success of this strategy. Most studies, which have addressed this question, could not draw information from actual experiences and hence relied on the analysis of expectations or known behavior (Bundesbank, 2006, Royal Bank of Scotland, 2006) or focused on effect on headline inflation (Bundesbank, 2008), which was overlaid by ongoing food and energy-price developments.

Increases of core inflation in Germany in 2007 turned out to be more modest than expected, but some observers remained concerned throughout 2007 that the inflationary effects could have been delayed (e.g. Bundesbank, 2007, May bulletin, p. 54). We argue to the contrary. The effects of the VAT rate increase were largely complete soon after implementation, because price increases were phased in already during 2006 in anticipation of the VAT hike. We call this effect "inflation smoothing". As consumers brought purchases forward to avoid the higher expected prices in 2007, suppliers were able to increase prices incrementally to take advantage of the greater demand. This was especially the case for durable goods.

Because of this anticipatory behavior, prices rose more gradually than anticipated. This also explains why core inflation in 2007 after January did not rise by as much as anticipated. Overall, we find that the pass-through of higher VAT rates to consumers was rather limited. However producers of items where demand was captive, such as durable goods, were able to take advantage of consumption shifting.

We have reached these conclusions by using the following empirical strategy. We explore whether the inflation dynamics among CPI items liable to the VAT hike differs from the dynamics of non-VAT items prior and post implementation. The paper argues that any systematic inflationary discrepancies between these two items, which cannot be accounted by several key factors, such as shifts in demand, time-specific and seasonal effects, administrative or policy one-off effects are likely due to the announcement of the VAT hike. Similarly, any systematic difference at the time of implementation and post implementation provides information about the pass-through or lagged price increases.

A key feature of this study is a focus on core inflation. The interest in using core rather than headline inflation is twofold. First, VAT is primarily affecting core inflation, as it is not applied to a vast majority of food prices, and some energy prices. Second, at least in Germany, core inflation remains a good indicator of underlying inflation (see text chart below) and hence serves well in gauging changes in inflation expectations.

Earlier studies on the inflation effect of VAT or other sales tax changes focused on selective price increases and tax shifting in advanced economies (Katz and Rosen 1985; Stern 1987; and Besley 1989). A more recent study focused on the asymmetric price responses to VAT changes in France (Carbonnier, 2007). Therefore little is known about inflation effects during the announcement period. Our study presents a simple, systematic way of looking at the announcement effects of a large VAT hike. Theoretical models of inflation (Mankiw and Reiss, 2002) and imperfect competition pinned down the intuition, while the results are consistent with the empirical findings from price setting literature and other recent findings of the effect of VAT on inflation in Germany (Royal Bank of Scotland, 2006, Bundebsank, 2008). Our empirical results explains well the stylized facts, and are robust to different specification and estimation methods.

The paper is structured as follow. Section II discusses inflation and demand developments around the time of the VAT hike and outlines the plan of our empirical analysis. Section III calculates the rise in core inflation due to the VAT increase, identifying the timing of the increase and the products that experienced higher-than-average price increases. Section IV concludes.

II. Stylized Facts and Rationale for Inflation Smoothing

The 2007 VAT hike offers a unique opportunity to analyze price setting behavior in the context of a large known price shock. The stylized facts presented below show that a significant part of the inflation effect may have occurred in the period prior to the hike. This is surprising, but consistent with the notion that the inflation effects were muted, because price effects may have been spread out over a longer period of time. The reasons for price increases in advance of the hike are discussed below. They could either be related to the observed pattern of consumption shifting in an environment of limited competition or they may be explained by price setting behavior in the context of an anticipated and known price shock.

Stylized facts

The VAT hike was announced in December 2005 and ratified by Parliament in mid 2007. The tax hike was to affect all items liable to the standard rate of 16 percent and hence did not affect items under the reduced rate such as basic food or books and entertainment. At a full and immediate pass-through the VAT rate increase would have implied a 2.6 percentage point jump in prices of the affected items. With three-fifths of the items in the consumer price index (CPI) basket affected (the VAT items), the full impact on the consumer price index would have been 1.4 percentage points (Bundesbank, 2006). However not all

producers were expected to pass on the VAT increase fully to consumers, so that the actual effect was assumed to be smaller (Royal Bank of Scotland, 2006).
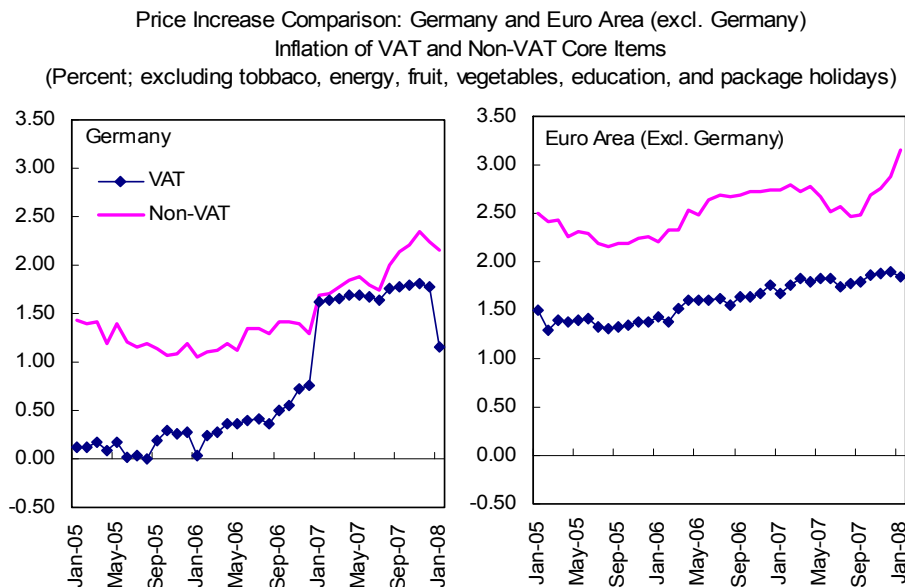
Ex post, the following developments transpired:

- Core inflation rose steadily in 2006 and then jumped in January 2007. Throughout 2007, a further rise occurred in April due to administrative increases in education costs. Importantly, once this special effect is taken into account, core inflation in the second half of 2007 declined significantly, pointing to a base effect related to price increases in the second half of 2006. Throughout the year though, trends in headline inflation overshadowed these more subtle trends. The large increase oil and food prices worldwide in September 2007 dominated inflation trends, but is unrelated to the VAT hike.

HICP Inflation Rates Germany
(Annual Percent Change)

Overall

Core without energy and food
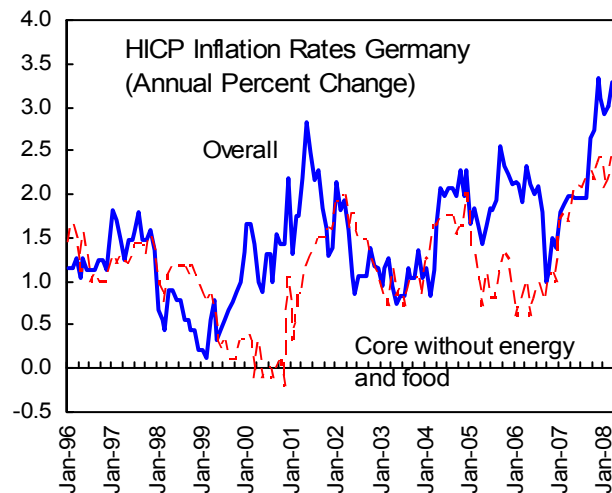
- Another key stylized fact relates to German specific price developments in 2006. A comparison of German and euro area wide inflation data shows that German prices in 2006 rose more rapidly than prices of a comparable basket of goods and services, especially so for VAT items.

Price Increase Comparison: Germany and Euro Area (excl. Germany)
Inflation of VAT and Non-VAT Core Items
(Percent; excluding tobbaco, energy, fruit, vegetables, education, and package holidays)

Germany

VAT
Non-VAT

Euro Area (Excl. Germany)

- Developments in inflation were mirrored by developments on the demand side. German households engaged in intertemporal consumption shifting by bringing purchases forward. Consumption increased 2.2 percent in the last quarter of 2006 over the same period of the previous year. This increase was the strongest in December and more pronounced for cars and other durables than for other goods and services. As a result consumption contracted by 0.5 percent in the first quarter of 2007 (both figures in annualized terms).
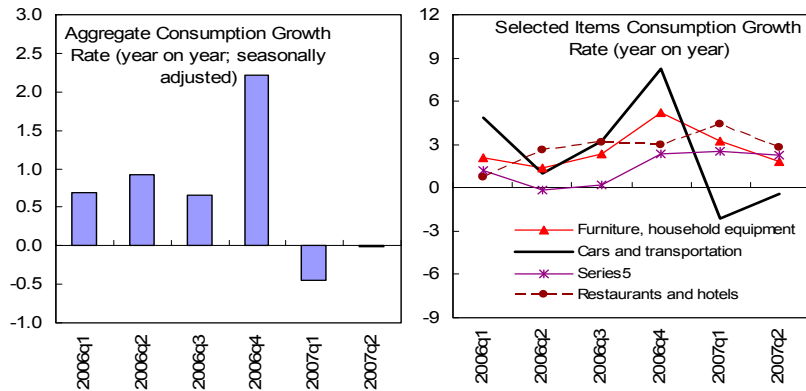
Taken together the above stylized facts suggest a link between change in core inflation in 2006 and the anticipated VAT rate increase. However, a recovering economy could have also contributed to the increase in prices 2006:

- Throughout 2006 and 2007 the output gap closed or moved into positive territory and was accompanied by strong employment growth. Output grew faster than in the euro area and was mainly driven by domestic investment activity and gains in net export.

- Another potential explanation could have been a special 2006 World Cup effect, which may have given a boost to service sector demand and potentially affected price increases.

Both hypotheses will be explored in the empirical section. However before turning to the econometric analysis, we first present the incentives for price smoothing.

Rationale for inflation smoothing

The long announcement period of the VAT hike offers different reasons why inflation increased prior to the actual implementation of the rate change. Rather than deriving and testing a specific model, this section lays out two different rationales, which are later tested.

Staggered price setting due to sticky information. In this model firms continuously update their information sets regarding aggregate demand conditions and competitors' prices. Since not all firms adjust their prices every period, because gathering information and altering

prices is costly, price adjustments are staggered (Mankiw and Reis, 2002).[1] As a result the announcement of the VAT hike could lead to larger than otherwise planned increases—especially if intervals between price adjustments are large—since this minimizes the chances that prices are misaligned in the period after the VAT hike implementation. If this motive dominates for a large number of firms, CPI inflation should increase before the tax hike. However, the opposite could also occur: if firms can change prices frequently, a postponement of price increases until implementation may be optimal. Hence in this sticky information model, announcement matters for the path of output and inflation, and the announcement may create different incentives for price adjustment, and an inflation smoothing path.[2] Moreover, in this model vigorous economic activity is positively correlated with rising inflation. Hence, it is important to test both these hypotheses and see how much of the 2006 price increase is due to the VAT announcement, rather than to the output gap closing.

Recent empirical research on price setting behavior gives some indications that price setting is sluggish, as this staggered price model would require. Dhyne and others (2005) find that the frequency of price changes in Germany is among the lowest across for all five types of products studied, among ten Euro area countries (Austria, Belgium, Germany, Spain, Finland, France, Italy, Luxembourg, Netherlands, Portugal). Price changes in Germany last two years, and are ten percent on average. However, as there is also evidence that the frequency of price changes is variable, and increases due to major economic events, one needs to study another rationale for inflation smoothing besides staggered price setting which leads to sluggish prices. For example, price changes increased considerably before the introduction of the euro currency, and in the run up to the 2007 VAT hike. As the frequency of price changes increased differently for goods (in the second half of 2006), than for services (in January 2007, Bundesbank, 2007), one needs to test also for imperfect competition and consumption shifting.[3]

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[1] Firms also care about the overall price level and, therefore, need to consider what information other firms have. Even an informed firm will not adjust its price much to the change in aggregate demand until many other firms have also learned of it.

[2] Every firm sets its price every period, but firms gather information and recompute optimal prices slowly over time. In each period, a fraction of firms obtains new information about the state of the economy and computes a new path of optimal prices. Other firms continue to set prices based on old plans and outdated information. Information arrival is assumed to be analogous to the adjustment assumption in Calvo (1983): each firm has the same probability of being one of the firms updating their pricing plans, regardless of how long it has been since its last update. Therefore the price x_t set by a firm at time t is a weighted average of current and expected future values of the target price p* which can be summarized as: $x_t = \alpha * \Sigma_j^{\infty} \beta_j E_t p_{t+j}*$ where α and β_t are functions of the exogenous adjustment probability and a discount factor. If therefore the expected future target prices rises due to an exogenous shock—such as the announcement of a VAT hike, firms who have the opportunity to adjust prices before its actual implementation will already adjust towards the new target price in order to minimize the expected difference between the new future target price and the actual price, in order to avoid a too low a price after the VAT is implemented. Hence firms increase the prices when an opportunity arrives, and a fraction of firms will change prices each period, leading to an inflation smoothing effect.

[3] This rise in frequency of price increases in goods associated with the VAT hike was about eight percent in the second half of 2006, and ten percent in January 2007, compared to below five percent for the period 2003-2005.

Imperfect competition and consumption smoothing. During the announcement phase, firms may be able to take advantage of intertemporal consumption shifting by consumers. This requires that competition is limited and suppliers face a downward sloping demand curve. The reason is as follows: since consumers anticipate that part of any tax increase will be passed on to them, the announcement of the VAT hike will generate a temporary shift in demand.[4] This rise in demand allows firm to extract a higher rents via higher prices. These effects should be larger the lower the competitive conditions and the larger the shift in demand (e.g. durable goods versus perishable goods).

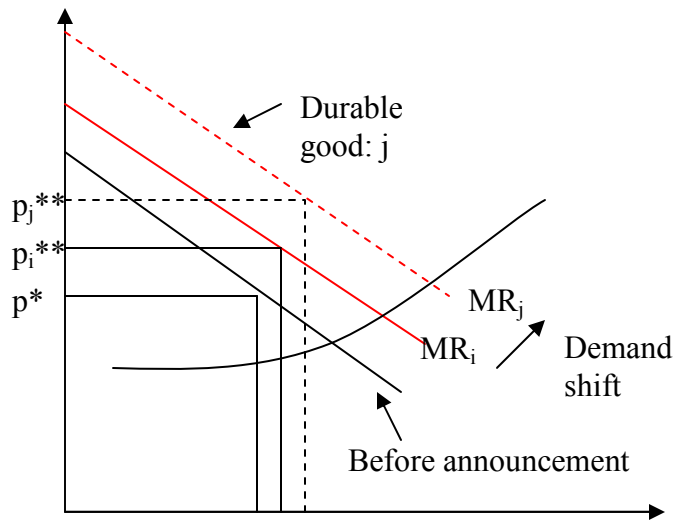Figure 1. Monopolistic Pricing and the Effect of Consumption Shifting

Figure 1 illustrates this conjecture. Assume p^* depicts the price of a consumer good prior to the announcement of the VAT hike. Assume further that the demand curve for an individual firm is downward sloping since is supplied under monopolistic competition. The announcement of the VAT hike leads to consumption smoothing and hence shifts the demand curve for item i out during the announcement period. The new equilibrium price for this commodity rises to p_i^{**} as firms charge the higher monopolistic price. Using the same argument, the price increase during the announcement period is larger for items which experience larger demand shifts, such as less frequently purchased durable goods j—as

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Price decreases occurred more often as well; an increase of seven percent in the frequency of price decreases was observed in January 2007.

[4] The intertemporal effect of a change in VAT can be illustrated by the Euler equation which shows that if in the future the VAT rate is higher, the household will bring forward spending by choosing a higher value for consumption today:

$$\beta R_t E_t \left[\frac{u_C\left(C_{t+1}, 1-N_{t+1}\right)}{u_C\left(C_t, 1-N_t\right)} \frac{\left(1+\tau_t^C\right)P_t}{\left(1+\tau_{t+1}^C\right)P_{t+1}} \right] = 1$$

depicted by the new equilibrium price p_j**—or in environment with less competition which would be reflected by a steeper demand curve (not shown). On the other hand, in an environment of high competition, advanced price increases may be small and the pass-through to consumers more limited (Carbonnier, 2007).[5]

Both explanations provide a rationale for inflation smoothing. The sticky information model of staggered price setting assumes that firms can change prices only infrequently. Hence high costs of altering prices may lead to some smoothing of the price effect. The second explanation on the other hand relies on the interaction of consumption shifting and elastic individual demand curves. Both these explanations are plausible and are explored by testing for differentiated price effects with respect to the degree of competition and the size of the demand shock

III. Empirical Analysis

This section explores whether the inflation dynamics among CPI items liable to the VAT hike differs from non-VAT items prior and post implementation. The paper argues that any systematic inflationary discrepancies between these two groups of CPI items prior to 2007, which cannot be accounted by standard explanatory factors, are due to the announcement of the VAT hike. Similarly, differences in inflation rates between VAT and non-VAT items at the time of implementation and post implementation provide information about the passthrough and delayed price increases.

Empirical strategy and data

To test the above hypotheses we develop a monthly panel of annual inflation rates for two-digit items of the harmonized consumer price index (HICP) in Germany covering the period 2005m1 to 2008m1.[6] The empirical specification models the inflation rate for commodity i of the HICP basket at time t. The annual inflation rate for an commodity item, $\dot{p}_i^t$, is estimated both as a static and a dynamic panel (with lagged inflation $p_{t-1,i}$):

$$p_{t,i} = f(p_{t-1,i}, X_{it}, Y_{i,}, Z_t \; G_{\Sigma j,})$$

controlling for three types of effects: time varying item specific effects (X_i such as euro are wide inflation trends), individual and time fixed effects (Y_i, Z_t such as aggregate demand pressures). The hypothesis of a VAT announcement effect is estimated by including a group

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[5] Carbonnier (2007) showed that in a closed oligopoly the benefits of a VAT decrease—e.g. effects of France 1987 VAT cut for the primary automobile market—are only partly passed on to consumers (less than fifty percent), with the producers enjoying the rest. He also shows that under competitive condition, such as in the household repairs services market, the 1999 VAT decrease was passed through to consumers by seventy seven percent. Most of these pass through happened primarily in the first two months of the tax reform.

[6] As of January 1st 2008 HICP data have been rebased to 2005=100, and back calculated only for a few years.

specific effect $G_{\Sigma j}$, which aim to capture the tax policy announcement effects on items liable to the VAT hike (Σ_j).

Two digit level data were chosen because they allow sufficient differentiation in inflation dynamics price setting behavior across items. At the same time they are sufficiently aggregated to facilitate the estimation of effects on aggregate core inflation. Table A1 in the appendix lists all 53 commodity items with their respective HICP weights and whether they are considered durable and affected by the VAT hike. The values for the latter measure vary between 0 and 1 depending on the share of goods within a specific commodity item, which are affected by the VAT hike. Since the study focuses on core inflation the two energy related items 19 and 32 were dropped from the analysis. Furthermore, given their high volatility seasonal goods (fruit, vegetable, package holidays), and tobacco were dropped leaving a total of 45 items with a weight of 80 percent of the overall HICP.

An important objective of our study is to trace out the effects of the VAT hike on *aggregate* core inflation. This is done by estimating different inflation trends for VAT items and non-VAT items. Since individual item-inflation rates are aggregated into the HICP index based on individual weights, the estimation approach needs to be cognizant of the aggregation method. Hence, in order to arrive at an aggregate measure the empirical model estimates weighted inflation rates. By weighing the inflation rates of each individual item by its weight in the HICP basket, an average VAT group effect is estimated which avoids being driven by inflation trends of items with small weights.[7] The rationale for this approach and the definition of the dependent variable are discussed in the appendix.

We use the following general control variables in our model:

- **Euro area wide inflation effects.** To control for regional inflation trends, item by item inflation rates were computed for the euro area excluding Germany. This was achieved by aggregating country level 2-digit HICP data to a synthetic aggregate index. The empirical specification includes euro area specific inflation variables for each HICP item separately and hence measures for each item price effect emanating from the euro area.

- **Time trend.** This variable controls for common economy wide inflation pressures as reflected in the buoyancy of the German economy beginning in 2005 as German growth began to exceed Euro area trends. The final specifications presented in this paper include a linear trend with an increasing value for each month of the sample. Other specifications (trend squared) were explored, but were not statistically significant.

- **Monthly time dummies and idiosyncratic shocks.** To allow for seasonal and time specific effects dummy variables for each month were introduced. In addition all

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[7] This can be exemplified through a simple example.

specifications include control variables for two specific effects: administrative price changes for education services in April of 2007 and medical services in January 2006.

Since we are primarily interested in the inflation experiences resulting from the VAT hike we introduce the following specific variables.

- **VAT effects.** We allow for inflation rates to vary across VAT and non VAT items. We use several dummies to differentiate between the announcement effect (*VAT 06 trend)*, the actual implementation (*VAT 07 implementation)*, and any other post implementation effect (*VAT 07 trend).* In addition, the fixed effect and GMM models test for time-invariant differences in inflation rates.[8] The *VAT 2006 trend* tests whether price increases accelerated towards the end of the announcement period reflecting the fact that demand shifting was likely to occur at the end of the year, as theory would suggest.[9]

- **Durable goods**. As a measure for a large demand shifting component during the run-up period of the VAT hike, a dummy variable for durable goods was added in the year 2006 (see appendix for definition).

- **Price setting power.** A key challenge for developing such a measure is that items in the CPI basket cannot directly be linked to sectoral measures of competitiveness. To circumvent this problem we relied on the observed price setting behavior during the euro-currency adoption in January of 2002. At this time all prices had to be converted from DM to euros offering an opportunity to exploit price setting power. As Bundesbank (2007) shows this transition led to a significant variation of positive and negative price adjustments (Figure 2). We surmise that large positive increases signal price setting power and hence the absence of competitive conditions.[10] Our measure of the competition is the rate of the inflation rate increase between December 2001 and January 2002 for price movements which were above the 75th percentile of price increases.

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[8] *VAT 06 trend* takes a value of one for VAT items in January 2006, and then increases monthly by one until December 2006. *VAT 07 implementation* takes the value of one for VAT items in January 2007 only—the month in which the rate increases came into force—. *VAT 07 trend* takes a value of one for VAT items in January 2007 and increases monthly by one until December 2007.

[9] There is no a priori reason to use a VAT trend variable for the announcement period 2006. Rather the choice of using a trend was the based on the goodness of fit among alternative empirical specifications.

[10] A currency conversion should not lead to a change in prices, because, as Hoffman and Kurz-Kim (2006) note, because otherwise prices are costly to change (the menu-cost hypothesis). Therefore, we surmise that large positive increases during that period signal price setting power.

Figure 2. Germany. Frequenycy of price changes in Germany
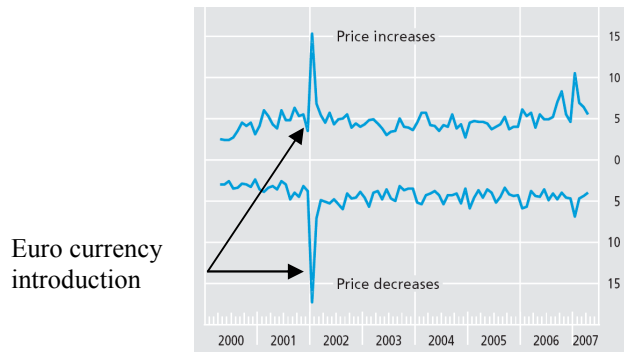
Source : Bundesbank

Baseline results

The first two columns of table 1 present the results from a fixed effects model estimating annual inflation rates at the 2 digit level. All models include a trend variable, monthly time dummies, euro area inflation trends for all 45 items, and dummies for two item specific administrative price changes (education and health care services as discussed above). The time trend has a positive and significant effect and hence provides evidence in support of a general acceleration of inflation, possibly picking up the closing output gap and a gradual tightening of the labor market.

Of main interest are, however, the estimated group differences between VAT and non-VAT items. The main assumption underlying the various VAT dummies is that each individual items has been assigned to one of two groups depending on whether is liable to the VAT hike or not. The estimation yields the following findings:

- The *VAT 06 trend* variable has a positive and significant effect throughout all specifications. This implies that in addition to a general acceleration of inflation, the inflation rate increased more strongly among VAT items (after controlling for item specific, time specific, and euro area wide effects). We interpret this result as evidence for an anticipatory inflation smoothing effect.

- The *VAT 07 implementation* dummy shows a strong and positive effect and measures the impact of the VAT hike on inflation upon implementation.

In specification (2) of table 1 we estimate the hypothesis whether the VAT led to a delayed pass-through to consumers. This is done by estimating the difference in inflation rates between VAT and non-VAT items through the inclusion of a VAT-trend variable for the year 2007. The model firmly rejects this hypothesis and hence offers no support for a post implementation effect.

Residual tests for autocorrelation indicated evidence of serial correlation of residuals. We therefore proceeded to estimate a dynamic panel specification. The results based on GMM estimation are reported in columns (3) and (4) of table 1. We find that inflation is highly persistent but the main results pertaining to the VAT effect remain unchanged. The VAT trend variable for 2006 remains significant and there is no evidence of a delayed increase of prices after the VAT hike implementation.

To summarize, we find evidence that inflation is low in Germany, it grew more rapidly than in the Euro area for VAT items from 2005 until end-2007, particularly due to the VAT (its implementation and of the announcement effect, what we call inflation smoothing.

Table 1. Determinants of German Core Inflation: discrepancies between VAT and non-VAT items

Dependent variable: HICP-weighted inflation rate of 45 two-digit items of the index; sample January 2005 - January 2008

	(1)	(2)	(3)	(4)
Constant	0.001 (-0.14)	0.001 (-0.11)	-0.010 (-3.48)**	-0.010 (-3.39)**
Lagged HICP weighted inflation			0.76 (17.70)**	0.77 (17.80)**
Euro area 1/				
Item-by-item	Y	Y	Y	Y
Trend	0.001 (2.50)*	0.001 (2.47)*	-0.00003 (-0.21)	-0.0001 (-0.52)
VAT effect dummies				
VAT 06 trend	0.001 (2.92)**	0.001 (2.92)**	0.001 (2.09)*	0.001 (2.07)*
VAT 07 implementation	0.020 (6.73)**	0.020 (5.28)**	0.010 (1.8)	0.003 (0.80)
VAT 07 trend		-0.0002 (-0.36)		0.0004 (0.7)
VAT Dummy			0.020 (4.93)**	0.020 (4.91)**
Estimation 2/	FE	FE	GMM	GMM
Monthly dummies	Y	Y	Y	Y
Price shocks 3/	Y	Y	Y	Y
VAT dummy			Y	Y
Test for no residual autocorrelation	Rej.	Rej.	Not Rej.	Not Rej.
R-squared	0.68	0.68	0.68	
Obs.	1665	1665	1665	1665
Number of groups	45	45	45	45

Absolute value of z statistics in parentheses. * significant at 5 percent; ** significant at 1 percent.

1/ Excluding Germany,
2/ FE=fixed effects, GMM=generalized method of moments,
3/ Education fees in April 2007 and medical services in January 2006.

Exploring the inflation smoothing hypothesis

To more firmly establish the of the announcement effect and to refine our explanation, we test several other specifications by exploring other reasons why the inflation rate of VAT items increased faster than that of non-VAT items. The main results are presented in Table 2.

In a first step we address the question whether prices could have increased in 2006 as a result of a World Cup related demand effect. We introduce a *World Cup 06* dummy variable to control for higher inflation in May and June of 2006. The results in column (1) show no measurable effect on inflation. We also test a second dummy variable, column (2), measuring for hikes in restaurant and hotels items during that period. This variable picks up significant prices increased during the 2006 World Cup, but its effect does not explain away the positive effect of the 2006 VAT trend variable, which remains significant.

In the next three models we provide indirect tests of our hypothesis that inflation in 2006 was influenced by a captured demand effect. We have done so as follows:

- By adding a dummy variable for *durable goods* in 2006 in specification (3) we estimate whether price increases in this group of items were more pronounced. We find a positive and statistically significant effect, which supports the claim that price increases in 2006 were concentrated in items which experienced larger increases in demand. Further test showed that the price increases were concentrated at year-end (not shown).

- We also test separately whether inflation increases among VAT items were related to a supplier's *price setting power*. Column (3) of Table 2 shows the results from including our measure of high price setting power derived from the 2002 euro currency introduction.[11] Its effect on inflation is positive and significant.

The remaining two specifications show results from including all three variables (a general VAT 2006 trend, durability and price setting power) using fixed effects and a dynamic panel estimator. All variables remain positive and significant in the fixed effects model (col 5). We also performed a dynamic panel estimation. In this specification only the VAT trend variable has a statistically significant effect. The high standard errors of the other two variables indicated the presence of multicollinearity. We therefore tested for the joint significance of all three variables and obtained a $\chi^2 = 8.5$ rejecting the null of no effect with a p value of 3 percent.

The qualitative results of our specification can therefore be summarized as follows: we find evidence of an acceleration of the inflation rate in all VAT items in 2006, of jump increase in January 2007, but no empirical support of delayed price increases throughout 2007. Focusing on the 2006 effect we find that among VAT items inflation accelerated faster among durables and items in less competitive markets, indicating that rent extraction may have been a

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[11] This dummy takes a value of one for the items where the rate of the inflation increase between December 2001 and January 2002 was more than the median price increase.

motive. In a next step we explore the quantitative implications of these findings on aggregate core inflation in Germany.

Table 2. Determinants of German Core Inflation: Inflation Smoothing, VAT and other German specific shocks
Dependent variable: HICP-weighted inflation rate of 45 two-digit items of the index; sample January 2005 - January 2008

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.010	0.000	0.001	-0.001	-0.001	-0.01
	(-0.14)*	(-0.04)	(-0.20)	(-0.22)	(-0.23)	(-3.47)**
ΔP_{t-1}						0.76
						(17.4)**
Euro area 1/						
Item-by-item	Y	Y	Y	Y	Y	Y
Trend	0.001	0.001	0.001	0.001	0.001	
	(2.50)**	(2.50)*	(3.21)**	(3.19)**	(2.50)*	
World Cup 06						
Month dummy	0.000					
	(-0.43)					
Restaurant/ Hotel dummy (during W-cup)		0.020 (1.46)	0.020 (1.60)	0.020 (1.59)	0.020 (1.57)	0.020 (17.9)**
VAT effect and other dummies 2/						
VAT 06 trend	0.001	0.001			0.001	0.0005
	(2.92) **	(2.87)**			(2.14)*	(1.79)*
Durable goods			0.010		0.010	0.002
			(2.34)*		(2.19)*	(1.43)
Price setting power				0.020	0.020	0.003
				(3.05)**	(2.88)**	(1.09)
VAT 07 implementation	0.020	0.020	0.020	0.020	0.020	0.005
	(6.73)**	(6.73)**	(6.41)**	(6.28)**	(6.76)**	(1.80)*
Estimation 3/	FE	FE	FE	FE	FE	GMM
Monthly dummies	Y	Y	Y	Y	Y	Y
Price shocks 4/	Y	Y	Y	Y	Y	Y
Test for no residual autocorrelation	Rej.	Rej.	Rej.	Rej.	Rej	Not Rej.
R-squared	0.68	0.68	0.68	0.68	0.68	…
Obs.	1665	1665	1665	1665	1665	1665
Number of groups	45	45	45	45	45	45

Absolute value of z statistics in parentheses. * significant at 5 percent; ** significant at 1 percent.

1/ Excluding Germany,
2/ A test for the hypothesis that the parameters estimates of the three variables VAT 06 trend, durable goods, and price setting power in specification (5) are jointly zero produces a chi-square statistics: Chi^2(3) = 8.545 with a p-value of 0.0360 rejecting the null hypothesis of no-significance.
3/ FE=fixed effects, 4/ Education fees in April 2007 and medical services in January 2006.

Aggregate inflation effects

The estimated coefficients in Table 2 column 5[12] can now be used to decompose the observed increase in aggregate inflation in VAT related and other effects. As mentioned above we excluded other factors, such as energy and food price inflation from the analysis.

Since we are exclusively interested in the effect of the acceleration of VAT items versus non-VAT items we first need to determine how the estimated parameters of the VAT-group-dummies can be translated into an impact measure on the aggregate HICP core inflation rate. A first step in this process is obtaining an interpretation of the units of the estimated parameters associated with the VAT-dummies in Tables 1 and 2. Since these parameters are associated with the group of VAT items, they measure the average inflation effect of these items. As appendix 1 explains, since we weighed each item's inflation rate by its weight in the HICP basket, the estimated coefficient measures the weighted average effect of all included VAT items on core inflation. Therefore in order to arrive at a measure for the impact on aggregate CPI, the coefficients from Tables 1 and 2 need to be multiplied by the number of VAT items.[13] Once we have obtained these estimates we can then compute the predicted inflation path with and without the VAT effects related to the tax hike. Using the parameters in column 5 of table 2 we obtain the following results:

Table I-3. Decomposition of Core Inflation as Predicted by the Model[1]

	2006 Annual average[2]	2007 Annual average[3]
Actual increase	0.35	1.00
Total model	0.41	0.73
VAT	0.36	0.40
Durables	0.03	…
Price setting power	0.03	…
General increase	0.30	…
Non–VAT	0.05	0.33
Residual	-0.06	0.27
Memorandum item:		
Inflation pass-through	0.24	0.49

[1]Based on coefficients of specification (5) in Table 2.
[2]Difference in core inflation between December 2006 and January 2006.
[3]Difference in core inflation between December 2007 and January 2007.

- The model accounts for a significant share of the actual aggregate increase in core inflation in 2006 and 2007.

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[12] Best fit specification.

[13] A simulation exercise confirming this interpretation is available upon request by the authors.

- The model predicts an increase in core inflation due to VAT items of a total of 0.76 percentage point in 2006 and 2007, with 0.36 percentage points in 2006 and 0.40 percentage point in 2007 concentrated upfront at the time of implementation (January 2007).

- In 2006 core inflation is estimated to have increased by 0.41 percentage point in 2006, and by 0.73 percentage points in 2007, for a total of 1.15 percentage points. Two thirds of the predicted increase in core inflation was VAT related.

- Among VAT items, durable goods and items in markets with imperfect competition accounted for a 0.06 percentage point of the increase in core inflation in 2006.That is one sixth of the estimated VAT drive increase (0.36 percentage point) in 2006.

These findings translate into an estimated cumulative pass-through rate of the VAT hike to core inflation of 73 percent.14 Knowing the timing of the increase, this pass-through rate can be broken down further, to an average 24 percent in 2006 and 49 percent in 2007 (primarily January). Our estimates hence imply that although core inflation appeared to not have increased by much in January 2007, the pass-through of the VAT hike was still substantial when VAT related price increases in 2006 are taken into account. This inflation smoothing effect may also explain why there was little further increases among VAT items in the aftermath of the tax rate hike.

IV. Conclusion

Increases in core inflation following the 2007 VAT hike were smaller than expected, initially constituting a puzzle and leading to speculation about delayed inflationary effects. This paper explored the extent of the inflation increase generated by the anticipation of the VAT increases (inflation smoothing), and its explanations.

An increase in inflation in VAT items contributed 0.36 percentage point to core inflation in anticipation of the actual implementation, and a further 0.73 percentage point increase upon its implementation in 2007. As consumer demand increased in 2006, producers were able to raise their prices, more so in durable goods. Accordingly, the extent of the increase in January 2007 was more muted (0.4). Cumulatively, the VAT effect was equivalent to a pass-through of 73 percent.

The results of the paper have a few interesting implications. First, the inflationary profile of a large tax hike is likely affected by the length of the announcement period. Price adjustment in advance of the VAT hike help smooth the inflation profile and thereby can avoid large spikes which create risks of triggering second round effects. The incentives for inflation smoothing also appear to be linked to the degree of intertemporal consumption shifting with items experiencing larger demand increases being affected more. Understanding these channels is important since several countries have expressed intention to increase indirect taxation.

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[14] The passthrough computation takes account of the fact that our sample excludes many non-VAT items.

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Appendix

I. Data

All 53 commodity items with the respective HICP-weights are used. Since the study focuses on core inflation, the two energy-related items, 19 and 32, were dropped from the analysis, even though they are subject to VAT increases. Furthermore, given their high volatility, seasonal goods (fruit, vegetable, and package holidays), and tobacco were dropped from the analysis, leaving a total of 45 items with a total HICP weight of 80 percent.
Include table each group inflation.

II. Method

We estimated inflation in VAT items relative to non-VAT items. Therefore, the difference between the inflation rates in VAT and non-VAT items would give us exactly the role played by the VAT in raising certain prices, since we assume that inflationary trends due to common shocks, or common cyclical conditions to those in the euro area.[15] In fact, we trace inflation in any individual item over time and relative to items not exposed to the VAT hike: during the announcement period, the implementation and post-implementation, after controlling for time dummies, and commodity-specific items (goods are durables, or sold in a competitive market). The data used for the empirical analysis are from the monthly HICP at the two-digit level. We use random-effect models, which fit the data better than fixed-effects model. Moreover, intuition will imply different price increases per item, depending on the market, and type of goods.

The annual inflation rate for any commodity item $\dot{p}_i^t$, in the German CPI is

$$\dot{p}_i^t = \alpha_1 + \alpha_2 \dot{p}_{i,Euro}^t + \alpha_{3t} Vat_i^t + \Sigma_j \alpha_{jt} Z_j^t$$

where $\dot{p}_i^t$ —the dependent variable, the inflation rate of the item —is computed as

$\dot{p}_i^t = w_i(\dfrac{P_i^t}{P_i^{t-12}} - 1)$; P_i^t is the index of item i at time t, w_i is the weight in the aggregate HICP index.[16]

- α_2 controls for general price increases due to common shocks or common cyclical conditions, as in the euro area during this period;

- α_3 measures the effect of the VAT and is elaborated in various ways, to control for timing (see main text); and

- α_j measures the effect of control variables and is elaborated in various ways, to control for different commodities issues (see main text).

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[15] In the euro area, inflation of VAT and non-VAT items moved similarly in this period, and the difference in inflation rates among these items was relatively constant. In Germany, however, we observe the rate of inflation of VAT items accelerated during 2006 only.

[16] Since we are interested in the impact of the VAT hike on the aggregate HICP inflation rate, we use weighted inflation rates.

III. Calculating The Effect on Core Inflation

We calculate the model-predicted inflation rate, and to obtain the values in Table 3 we go through the following steps:

  a. We take the actual value for each variable described above, in each month, and we multiply it, by its estimated coefficient presented in Table 2, specification (5), and by the number of the items in this group (VAT and non-VAT).[17]

  b. We sum these components to obtain predicted inflation rates for each month (annual rates).

  c. To calculate the 2006 overall effect, we take the difference between the predicted values of the core inflation rate between the months of December and January 2006. The 2007 overall effect was calculated in the same manner.

  d. To calculate the 2007 implementation effect, we take the difference between the average predicted core inflation rates of the first three months of 2007 and the last three months of 2006.[18]

  e. To calculate the contributions of the VAT items to the 2006 overall effect, or to the 2007 implementation effect, we follow steps c and d, respectively, but only for the *VAT* items in core inflation.

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[17] By multiplying the group average effect by the total number of items, we obtain the aggregate inflation effect of the VAT items as a group. The aggregate HICP core inflation rate is defined as the weighted sum of all individual items. A coefficient attached to a dummy variable captures the group effect of a subset of items scaled by their weight in the aggregate core index.

[18] If one takes the differences between the January 2007 and December 2006 rates the results are similar.

Table A1. HICP commodity items, weights, and classification.

	Weight	Durable	VAT	Price setting power
1 cp011 Food	99.6	0	0.0	1
2 cp0111 Bread and cereals	19.2	0	0.0	0
3 cp0112 Meat	25.3	0	0.0	0
4 cp0113 Fish and seafood	3.5	0	0.0	1
5 cp0114 Milk, cheese and eggs	15.7	0	0.0	0
6 cp0115 Oils and fats	3.0	0	0.0	0
7 cp0116 Fruit	9.8	0	0.0	1
8 cp0117 Vegetables	10.3	0	0.0	1
9 cp0118 Sugar, jam, honey, chocolate and confectionery	8.6	0	0.0	0
10 cp0119 Food products n.e.c.	4.3	0	0.0	0
11 cp012 Non-alcoholic beverages	13.8	0	1.0	0
12 cp021 Alcoholic beverages	18.5	0	1.0	0
13 cp022 Tobacco	32.2	0	1.0	1
14 cp031 Clothing	45.7	0	1.0	0
15 cp032 Footwear including repair	10.7	0	1.0	0
16 cp041 Actual rentals for housing	108.2	0	0.6	0
17 cp043 Maintenance and repair of the dwelling	12.6	1	0.5	0
18 cp044 Water supply and miscellaneous services relating to the dwelling	36.5	0	0.5	0
19 cp045 Electricity, gas and other fuels	66.9	0	1.0	0
20 cp051 Furniture and furnishings, carpets and other floor coverings	36.7	0	1.0	0
21 cp052 Household textiles	5.0	0	1.0	0
22 cp053 Household appliances	11.1	1	1.0	0
23 cp054 Glassware, tableware and household utensils	5.4	0	1.0	0
24 cp055 Tools and equipment for house and garden	6.0	0	1.0	0
25 cp056 Goods and services for routine household maintenance	8.6	0	0.8	0
26 cp061 Medical products, appliances and equipment	21.2	1	0.4	0
27 cp062 Out-patient services	17.3	0	0.0	0
28 cp063 Hospital services	7.7	0	0.0	0
29 cp071 Purchase of vehicles	41.2	0	1.0	0
30 cp072 Operation of personal transport equipment	91.6	0	1.0	1
31 cp0721 Spares parts and accessories for personal transport equipment	5.8	0	1.0	0
32 cp0722 Fuels and lubricants for personal transport equipment	44.0	0	1.0	1
33 cp0723 Maintenance and repair of personal transport equipment	27.9	0	1.0	0
34 cp0724 Other services in respect of personal transport equipment	13.9	0	1.0	0
35 cp073 Transport services	23.7	0	0.3	0
36 cp081 Postal services	3.0	0	0.3	0
37 cp082 Telephone and telefax equipment	1.0	1	1.0	0
38 cp083 Telephone and telefax services	20.4	0	0.9	0
39 cp091 Audio-visual, photographic and information processing equipment	15.8	0	1.0	0
40 cp092 Other major durables for recreation and culture	1.8	1	0.8	0
41 cp093 Other recreational items and equipment, gardens and pets	19.8	0	0.4	0
42 cp094 Recreational and cultural services	26.8	0	0.0	0
43 cp095 Newspapers, books and stationery	22.1	0	0.0	0
44 cp096 Package holidays	26.5	0	1.0	0
45 cp10 Education	7.8	0	0.0	1
46 cp111 Catering services	41.8	0	0.9	1
47 cp112 Accommodation services	12.8	0	0.5	0
48 cp121 Personal care	21.3	0	0.8	0
49 cp123 Personal effects n.e.c.	9.2	0	0.5	0
50 cp124 Social protection	12.8	0	0.0	0
51 cp125 Insurance	28.1	0	1.0	0
52 cp126 Financial services n.e.c.	4.6	0	1.0	0
53 cp127 Other services n.e.c.	4.5	0	0.5	1
	1000.0			

Source: Author's calculations. The core index excludes items 1, 7,8 13, 19, 30, 32, and 44.