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REGULATED AND SERVICES' PRICES AND INFLATION PERSISTENCE

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1 This paper is part of a research project within the Eurosystem Inflation Persistence Network (IPN). We would like to thank Vitor Gaspar, an anonymous referee, the IPN members, as well as the discussants Matteo Ciccarelli and Jim Stock at the Eurosystem inflation persistence network conference in Frankfurt for their helpful comments and constructive criticism. The views expressed in this paper are personal views of the authors and do not necessarily reflect those of the Banque centrale du Luxembourg or the Eurosystem.

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The Eurosystem Inflation Persistence Network

This paper reflects research conducted within the Inflation Persistence Network (IPN), a team of Eurosystem economists undertaking joint research on inflation persistence in the euro area and in its member countries. The research of the IPN combines theoretical and empirical analyses using three data sources: individual consumer and producer prices; surveys on firms' price-setting practices; aggregated sectoral, national and area-wide price indices. Patterns, causes and policy implications of inflation persistence are addressed.

The IPN is chaired by Ignazio Angeloni; Stephen Cecchetti (Brandeis University), Jordi Galí (CREI, Universitat Pompeu Fabra) and Andrew Levin (Board of Governors of the Federal Reserve System) act as external consultants and Michael Ehrmann as Secretary.

The refereeing process is co-ordinated by a team composed of Vítor Gaspar (Chairman), Stephen Cecchetti, Silvia Fabiani, Jordi Galí, Andrew Levin, and Philip Vermeulen. The paper is released in order to make the results of IPN research generally available, in preliminary form, to encourage comments and suggestions prior to final publication. The views expressed in the paper are the author's own and do not necessarily reflect those of the Eurosystem.

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CONTENTS

Abstract:

This paper analyses the degree of price rigidity and of inflation persistence across different product categories with particular focus on regulated prices and services for the individual EU15 countries, as well as for the EU15 and the euro area aggregates. We show that services and HICP sub-indices considered being subject to price regulation exhibit larger degrees of nominal price rigidities, with less frequent but larger price index changes as well as stronger asymmetries between price index increases and decreases. With regard to what extent services and regulated prices contribute to the degree of overall inflation persistence, we find that, for most of the EU15 countries as well as for the EU15 and the euro area aggregates, excluding services from the full HICP results in a reduction in the measured degree of inflation persistence; for regulated indices such an effect is also discernible, albeit to a lesser extent.

Keywords: Price rigidity, inflation persistence, regulated prices, services

JEL classification: E31, C22, C23, C43

Non-technical summary

The recognition of the importance of sticky or rigid prices for the real effects of monetary policy has stimulated a large body of both theoretical and empirical research on why prices do not respond immediately to changes in supply and demand conditions. Not much research is devoted to the part of the economy where products and services are subject to some form of price regulation (such as utilities, public transportation, education, communication) notwithstanding that the consideration of regulated and service-related prices seems to be of particular relevance for the analysis of nominal price rigidities and inflation persistence.

While rigidities may generally be caused by hierarchical delays due to bureaucracy, in regulated sectors, an additionally contributing factor may relate to the institutional process required to adjust prices. Service-related sectors do not only tend to be particularly labour-intensive, but labour contracts typically lay down nominal wages for relatively long periods of time; hence service-related sectors may disproportionately be affected by explicit nominal contracts. Indeed, recent micro price evidence for the U.S. and the euro area suggests that services exhibit larger price rigidities than other sectors. With regard to regulated prices, recent evidence from the U.S. suggests that they are a potentially important source of nominal price rigidity in the economy. CPI and that significant inertia in aggregate price adjustments exists due to regulation.

This paper adds to this line of research and investigates both the degree of price (index) rigidity and the implications for aggregate inflation persistence. In doing so, we use data on 94 price indices for 15 individual EU countries plus the EU15 and the euro area aggregates. We calculate different indicators of price rigidity. The focus is to analyse how services' and regulated indices compare to other categories in terms of price rigidity as well as key properties of the inflation process. Furthermore, we analyse to what extent the in/exclusion of regulated and services' price indices affect the measured overall degree of inflation persistence (as measured by the sum of autoregressive coefficients).

The following main results emerge: First, regulated prices show strong signs of nominal price rigidities relative to other price indices. This statement extends to services, albeit to a slightly lesser extent. Large differences do not only exist across categories, but also within the services and regulated prices categories, with few indices revealing very strong rigidities (e.g. "postal services"). Substantial heterogeneity is also revealed with respect to nominal price rigidities of regulated and services' indices across countries. This is the case both in absolute terms as well as relative to other categories.

Second, there is substantial degree of nominal downward rigidity for regulated and services' indices. In addition, regulated services as well as non-regulated services show a marked seasonal pattern of

price adjustments, with price adjustments being relatively more frequent in January in particular, but also in April, July and October.

Third, the average duration and average size of price index changes are positively related to each other. On average, price index changes are larger for regulated prices and services. This holds for both price increases and decreases.

Fourth, services and regulated prices reveal a higher average inflation rate than non-services and freely determined prices, respectively. In addition, service price inflation tends to vary less than the inflation rates observed for non-services' prices. In general, the correlation between the inflation rates of services and non-services is poor. In general, regulated price inflation is even negatively correlated with that of non-regulated prices.

Fifth, autoregressive univariate estimation results based on q-o-q inflation rates suggest that for most of the EU15 countries, excluding services from the full HICP results in a reduction in the measured degree of inflation persistence. This extends to the EU15 and the euro area aggregates. A similar effect is discernible for regulated indices, albeit to a lesser extent.

I. Introduction

The recognition of the importance of sticky or rigid prices for the real effects of monetary policy has stimulated a large body of both theoretical and empirical research on why prices do not respond immediately to changes in supply and demand conditions.[1] Not much research is devoted to the part of the economy where products and services are subject to some form of price regulation (such as utilities, public transportation, education, communication) notwithstanding that the consideration of regulated and service-related prices seems to be of particular relevance for the analysis of nominal price rigidities and inflation persistence.

Blinder's (1994) survey, for example, identifies hierarchical delays due to bureaucracy that can cause prices to respond slowly and erratically to market forces. In regulated sectors, an important explanatory factor for price rigidities may relate to the institutional process required to adjust prices, which could also involve a rate review agency (e.g. Dexter et. al, 2004). Also, service-related sectors do not only tend to be particularly labour-intensive, but labour contracts typically lay down nominal wages for relatively long periods of time; hence service-related sectors may disproportionately be affected by explicit nominal contracts.

Recent micro price evidence for the U.S. and the euro area suggests that services exhibit larger price rigidities than other sectors (e.g. Bils & Klenow, 2002; Dhyne et al., 2004). With regard to regulated prices, Dexter et al. (2004) report that they are a potentially important source of nominal price rigidity in the economy. They show that regulated prices represent a non-trivial part of the overall U.S. CPI and that significant inertia in aggregate price adjustments exists due to regulation. The results based on impulse response functions indicate that regulated price series exhibit a lag of two quarters in addition to any stickiness that exists in the freely determined sector.

Despite the reported inertia for services' and regulated prices, the link between high inertia and high inflation persistence remains vague. Clark (2003) reports no material differences with respect to the persistence of durables, non-durables and services for U.S. data. Bilke (2005), using French CPI data, finds that services and industrial goods are more persistent than energy and food products, which is broadly in line with French services prices exhibiting longer price durations as reported by Baudry et al. (2004). In contrast, Cecchetti & Debelle (2004) find a negative relationship between price duration and inflation persistence. Also, most of the existing empirical papers analyse either price rigidities using micro price data or alternatively use highly aggregate data to analyse the degree of inflation persistence, but rarely they do both.

[1] See for example Blinder (1994) who collected empirical evidence and theoretical microeconomic rationales for sticky prices and provided a classification scheme for 12 categories of sticky price theories.

This paper investigates both the degree of price rigidity and the implications for aggregate inflation persistence using a single data set. While contrasting the differences among sectors, we focus on services and regulated price indices; for which rigidities are reported to be most prevalent. In doing so, we use data on 94 individual price indices for 15 individual EU countries plus the EU15 and the euro area aggregates. We calculate different indicators of price (index) rigidity, both upward and downward. Using price indices serves several purposes. Firstly, index data are readily available across all EU15 countries. The data is largely harmonised and of good quality, and hence facilitates a cross-country study for all individual EU15 countries, which is barely possible using individual price records (see Dhyne et al., 2004 for an unprecedented effort using micro price data in this respect though). Secondly, disaggregate index data provide an essential link between inflation persistence in macro models and price rigidities in micro price studies. As we will show, many results obtained in recent micro price studies also emerge from index data.

The remainder of the paper is organised as follows: section II briefly describes the data and research methodology, section III presents empirical results with regard to the degree of nominal price index rigidities across sectors and countries, and section IV explores whether the (in-/ex-)clusion of service-related and regulated prices in/from the HICP affect the measured degree of overall inflation persistence. Section V concludes.

II. Data and Methodology

The underlying price index data are publicly available and taken from the Eurostat New Cronos database. The database comprises the HICP for the individual EU15 countries plus the EU15 and euro area aggregates. As we consider price indices rather than individual prices, some of our results may not be immediately comparable with figures reported in other recent empirical studies on micro pricing behaviour in the euro area. Given that price indices are constructed as chained averages, it cannot be excluded that the behaviour of price indices may differ from that of individual prices.[2] However, index data provide a unique possibility to analyse price (index) rigidity and inflation persistence by means of a single data set. While values of certain indicators of price rigidity may differ in absolute terms, we find that the main conclusions from micro price studies are unaltered by the usage of index data. This holds in particular with respect to services' and regulated prices relative to unregulated goods' prices.[3]

Throughout the paper, the country abbreviations adopted by Eurostat will be used. These are: be-Belgium, dk-Denmark, de-Germany, gr-Greece, es-Spain, fr-France, ie-Ireland, it-Italy, lu-

[2] Similar to cross-country micro price studies in general, small differences in measured price rigidity and inflation persistence across countries and sectors may emanate from differences in the data collection practices of the respective National Statistical Institutes (e.g. the number of price series from which an index is constructed).

[3] Henceforth, rigidity of "price indices" is interchangeably referred to as rigidity of "prices".

Luxembourg, nl-the Netherlands, at-Austria, pt-Portugal, sf-Finland, sv-Sweden and uk-the United Kingdom, plus EA-euro area and EU15-European Union. The data focuses on the 94 most disaggregated HICP sub-indices and covers, due to reasons of data availability, the period from January 1995 to May 2004.

HICP sub-indices are classified into the broad categories "non-processed food", "processed food", "durables", "non-durables", "energy" and "services" in accordance with the classification scheme adopted by Eurostat. A detailed description of the different categories and their constituent sub-indices is presented in the appendix in Table A1. In addition, we distinguish between indices for which prices are thought to be freely determined and indices thought to be subject to a substantial degree of price regulation. This distinction is complicated by the fact that there is a large variety of administrative measures to be considered and some of the measures apply at the local or regional level or relate to a subset of prices only. In addition, there is no consensus about what is considered regulated pricing and reliable quantitative estimates about the degree to which sectors and indices affected by regulation are unavailable (e.g. ECB, 2003a, 2004).

A second best solution is therefore to identify the sub-indices that are heavily influenced by price regulation. In this paper, we consider regulated the HICP sub-indices proposed in ECB (2003a,b). To these indices, we add another 2 indices that by and large relate to prices not falling into the ''private, for-profit, unregulated'' sector, namely, "cp0732 passenger transport by road" and "cp0942 cultural services".

Table 1 presents the indices in question, which henceforth will be referred to as "regulated price indices". All indices considered subject to price regulation fall into the category of "services". Using EU15-wide weights for 2002, they represent about 7 percent of the overall HICP. This may be considered a rather narrow definition of regulated prices, also as Dexter et al. (2004) conclude that regulated prices may account for as much as 30% of the overall US CPI. Despite this smaller weight in the EU15 HICP basket, there are some similarities with regard to the price indices being regarded subject to price regulation.[4] Both their paper and our paper consider "education", "entertainment" and "public transport services" as indices subject to a high degree of price regulation.

[4] The regulated indices selected in Dexter et al. (2004) were "*Dairy products*", "*Alcoholic beverages*", "*Residential rents*", "*Tenant's insurance*", "*Household insurance*", "*Fuel and other utilities*", "*Motor fuel*", "*Other transportation services*", "*Public transportation*", "*Medical care*" and "*Personal education services*".

III. Evidence on price rigidity across countries and categories

A. Frequency of changes and implied durations

Overall, the median frequency of price index changes across both countries and sub-indices is approximately 80 percent, implying a median duration of about 1.2 months.[5] Non-processed food shows the largest frequency of prices changes (with both the average and the median close to 1), which is in line with empirical evidence from numerous recent micro CPI price studies. This is followed in decreasing order by processed food, durables, energy and non-durables. For these categories, the median price change frequency exceeds 0.8, while services' prices change in 3 out of 5 months only (see Table 2).

Both the high and low frequency of price changes for non-processed food and services seem generally to be very robust features across several recent micro CPI studies (e.g. Bils & Klenow, 2002; Dhyne et al., 2004). The latter is also confirmed by new survey evidence (e.g. Fabiani et al., 2004). In fact, the price change frequency of indices other than services, henceforth named "non-services", is around 50 percent larger than that for services (i.e. ~0.9 vs. ~0.6). A further distinction between "non-regulated services" and "regulated services" reveals that the median frequency of price changes is particularly low for services subject to price regulation (~0.4). Furthermore, at the lower end of the price change frequency distribution (i.e. the 5%ile and 25%ile), the implied median durations seem to be particularly long for services (whether regulated or not).

Figure 1 and Figure 2 show that the categories of regulated and non-regulated services are not characterised by an even distribution of long (median) price durations. For 2 out of 11 regulated services and for 17 out of 29 non-regulated services, the median duration is <2 months. For some services, price changes are observed almost every month (e.g. "accommodation services", "package holidays" and "restaurants, cafés and the like"). There are some indices within both services in general and regulated services in particular that reveal median price durations of ~3 months or longer. For non-regulated services, these are "other purchased transport services" (~3.0 months), "combined passenger transport" (~4.4 months), "insurance linked to health" (~4.9 months) and "other insurance" (~6.7 months) (see Figure 2). For regulated services, these are "passenger transport by railway" (~5.1 months), "refuse collection" (~5.6 months) and "sewerage collection" (~6.7 months). An extremely long median duration is detected for "postal services" where price indices approximately change once a year only.[6]

[5] Detailed information for all country index combinations is available from the authors upon request.

[6] Note that the implied durations for very rigid indices may react very sensitively to small modifications to the sample period.

Comparing countries, the median duration is highest in Luxembourg (~1.7 months) followed by Italy (~1.5 months) and Germany (~1.5 months), while it is lowest for the United Kingdom (~1.1 months) and Portugal (~1.1 months). There are some striking regularities across the EU15 countries; non-processed food always appears as the category with the shortest median duration, while regulated services exhibit the longest median duration for 12 out of 15 individual EU countries. In Belgium, Denmark, Luxembourg, the Netherlands and Austria, the median price duration for regulated services is almost six months or longer, while for the other countries (with the exception of Ireland and Finland) and the EU15 and the EA aggregates the duration is <= 3 months (see Table 2).

The comparison either between non-regulated vs. regulated services or between services vs. non-services reveals striking differences with respect to their degree of rigidity (see Table 3). The median duration is always larger for services than for non-services. This is the case for all 15 individual EU countries. For 8 out of 15 countries the median difference exceeds 1 month. With regard to the duration of regulated versus non-regulated services, Belgium, Denmark, Ireland, the Netherlands and Austria do not only show both the largest relative discrepancies (>= 2 times as large), but are also among those countries with the highest rigidity for regulated services in absolute terms (median duration ~6.5, ~5.8, ~3.3, ~5.9 and ~5.6 months, respectively). With ~7.5 and ~4.7 months, both the most rigid regulated and non-regulated services are, however, found in Luxembourg. This extends to services combined; the largest rigidities are, again, observed for Luxembourg followed by Denmark (~5.5 and ~3.4 months).

As a general observation, the discrepancy between the price rigidities is smaller between services and non-services than between regulated and non-regulated services. For Germany, Spain, France and the UK, the distinctions of regulated vs. non-regulated and of services vs. non-services are of minor relevance. For Italy, the differences in the median duration of services and non-services are of a larger magnitude than the differences between regulated and non-regulated services.

Hence, the observation of a longer median duration for regulated indices than for services at the aggregate level is driven by exceptionally long median durations of regulated indices in a number of smaller EU15 countries. It cannot be excluded though that country-specific results for selected single indices may be influenced by the number of underlying price quotes. Correspondingly, for most of the larger EU15 economies as well as the EU15 and the euro area aggregates, the median duration does not seem to differ in any substantive way between services, regulated indices and unregulated non-services; this is likely to be due to aggregation. This suspicion is confirmed when ranking the most rigid indices. Table 4 and Table 5 list the most rigid indices in absolute terms; none of the indices of the two country aggregates, the EU15 and the euro area, is among the 100 most rigid indices. The

most rigid price index is “insurance linked to transport” in Luxembourg. Second and third place go to “other purchased transport services” in Austria and to “hospital services” in Finland (all exceeding 40 months).

For almost 100 indices, the implied duration exceeds 6 months. Hence, this gives a flavour about the true extent of the price rigidity for some indices, which is not captured by looking at the median across countries or indices. Next, we compare the ranking of sectors and countries among the most rigid 100 indices. Luxembourg’s share of the most rigid 100 indices is 18 percent, followed by Belgium and Austria with 10 percent (see Table 5). Also, with 50 and 37 indices, regulated and non-regulated services account for 87 of the 100 most rigid indices. The most prominent index is “postal services” with 13 appearances in the “top” 100, followed by “sewerage collection”, “passenger transport by railway” and “refuse collection”.

Fact 1: Services, whether regulated or not, are more rigid than other indices.

B. Average size of price changes

Regulated services do not only feature prominently with regard to nominal price rigidities, but also with regard to the size of absolute price changes. Figure 3 demonstrates that, in general, price changes of regulated services occur not only less frequently, but when they occur they are larger as well (2.3%). The second ranked category is non-processed food (1.9%). At the other end of the scale, processed food and non-durables show the smallest average absolute price changes (0.6% and 0.9%). Durables, non-regulated services and energy figure in the mid-range. Among the regulated services themselves, there is substantial heterogeneity in terms of the average size of price changes. Values in excess of 2 percent are observed in increasing order for “passenger transport by railway”, “dental services”, “sewerage collection”, “refuse collection”, and “postal services” (see Figure 4).

Fact 2: Regulated services exhibit on average larger absolute price changes than other indices.

More generally, we observe that longer average durations coincide with larger average changes in the price index. The correlation coefficient between duration and the size of average absolute price changes across all country-index combinations is 0.46. With correlation coefficients of 0.50 and 0.49 compared to 0.29, this relationship is stronger for both regulated and non-regulated services than for non-services. Figure 5 illustrates not only that the average size of price changes increases as the duration increases, but also that for longer price durations the average absolute price change is larger for regulated than for non-regulated services.

Fact 3: Duration and the size of average absolute price changes are positively related to each other.

Table 6 and Table 7 illustrate country-specific differences between regulated and non-regulated indices with respect to the average size of price changes. In 10 EU15 countries, the average price change is larger for regulated than for non-regulated services. The largest (relative) differences are observed for Ireland, Luxembourg and the Netherlands, with average price changes for regulated services being almost three times as large as price changes for non-regulated services. Table 6 and Table 7 further illustrate the differences with respect to the average price change between services and non-services. For all individual EU15 countries except for France, the average price change is larger for services than for non-services. Large (relative) differences are obtained for Germany, Spain, Ireland, Luxembourg, the Netherlands, Austria and Portugal, where the average price change for services is almost double the size of the average price change for non-services or larger.

C. Asymmetries in frequency of upward and downward price changes

A key outcome of the studies of individual consumer prices for euro area countries is the finding of a high degree of downward nominal rigidity for services relative to other types of products. As reported by Dhyne et al. (2004), this is in particular the case for regulated prices, which show lower probabilities of price changes as well as lower probabilities of price increases and decreases. The higher degree of nominal downward rigidity is also reflected by the ratio between price increases and decreases, which is reported to be roughly 60:40 overall and 80:20 for services.

This feature of stronger asymmetry also emerges from price index data. We find that the ratio between price increases and decreases is roughly 60:40 for durables, non-processed food and energy, while it is about 80:20 and 90:10 for non-regulated and regulated services (see Figure 6). Again, within the group of regulated services, one observes substantial differences with respect to the relative importance of price increases and decreases (see Figure 7). For “cultural services”, the share of price increases in the total number of price changes is roughly 80 percent. On the contrary, the share of price increases exceeds 90 percent for “sewerage collection”, “education”, “social protection” and “hospital services” (in increasing order). As a matter of fact, 125 out of the 1526 indices examined reveal a ratio of price increases to decreases equivalent to 1:0; ~90 percent of which are services (47 regulated services and 65 non-regulated services).

In addition, across all countries and country aggregates, the asymmetry in the frequency of price increases relative to decreases is more pronounced for regulated services than for non-regulated services (see Figure 8). Again, this also applies to the distinction between services and non-services. For non-services, the ratio of price increases to decreases ranges from roughly 55:45 (the United Kingdom) to 79:21 (Italy). In the case of regulated services, the corresponding interval ranges from

79:21 (Belgium) to 98:2 (Spain). For non-regulated services, the range extends from 75:25 (Germany) to 88:12 (the United Kingdom). The difference in the asymmetry between price increases and price decreases varies substantially across countries. In Luxembourg, the ratio of price increases to decreases is 87:13 for non-regulated services versus 84:16 for regulated services; thus they differ only marginally. In the cases of Denmark, Germany, Spain, Ireland and Portugal, the share of price increases differs by more than 10 percentage points between regulated and non-regulated services. In the case of services, the difference in the relative importance of price increases is particularly pronounced for the United Kingdom (55:45 for non-services versus 89:11 and 86:14 for non-regulated and regulated services) and Denmark (62:38 for non-services versus 84:16 and 95:5 for non-regulated and regulated services).

Fact 4: Regulated indices and services are more downward rigid than other indices

D. Asymmetries in the size of upward and downward price changes

Turning to the average size of price increases and decreases, for all indices except for durables, price increases are larger than price decreases. Moreover, there are no obvious differences between non-regulated services and other non-regulated categories. In contrast, regulated indices reveal larger adjustments, which are not necessarily less symmetric than for other product types (e.g., energy, non-durables). This is illustrated in Figure 9.

Fact 5: In general and for regulated services in particular, price increases are on average larger than price decreases.

A closer look at regulated services reveals that this observation is due to very few indices though, as both the absolute size of price adjustments and the extent to which average price increases exceed price decreases differ substantially across regulated indices. Average price increases exceeding 2 percent are observed for "sewerage collection" (3.2 percent), "refuse collection" (4.3 percent) and "postal services" (5.6 percent) only. In terms of the average size decrease, regulated services do not display any substantial differences to the average of other non-regulated categories, the notable exception being "dental services" which is largely due to a change in the legislative framework governing the reimbursement of private outlays in Luxembourg.

The largest asymmetry between the size of price increases and decreases (in relative terms) is found for "hospital services" with the average price increases being five times as large as the average size decrease. A cross-country comparison reveals further that, for non-regulated indices, the relative differences between average price increases and decrease are rather small in magnitude, while this is not the case for regulated indices. For the latter indices, for most countries the average price increases

are larger than price decreases. A particular large asymmetry is found for Ireland with an average increase of 6.3 percent vs. an average decrease of 0.7 percent.

E. Intra-year pattern of price index changes

Further differences between regulated and freely determined indices are observed with respect to the timing of price changes within a given year. Figure 10 illustrates that increases in regulated services are particularly prominent in January. More 20 percent of all price changes take place in January. In addition, almost all adjustments relate to price increases. Furthermore, the timing of price changes seems to follow a quarterly pattern, as high frequencies of price changes are also observed in April, July and October. On the contrary, price adjustments for regulated services' indices are particularly infrequent in December (with about 4 percent of all prices changes).

Fact 6: Regulated price changes follow a quarterly pattern and change by far most frequently in January.

F. Panel data regressions on price rigidities

Next, we report the results of panel data regressions with country-specific fixed effects to identify significant differences in nominal rigidities (frequency of price changes and duration), the average absolute size of price changes, as well as asymmetries, in both frequency and size, between up- and downward price rigidities across different categories (see Table 8 and Table 9). The following regressions were estimated for the different dependent variables listed above: $y_{i,j} = \alpha_j + \beta_k \sum_{k=1}^{K} x_k + \varepsilon_{i,j}$,

where $y_{i,j}$ refers to the demeaned dependent variable of price index i in country j (i.e. $y_{i,j} = Y_{i,j} - \overline{\overline{Y}}$), while a_j and β_k refer to the subsumed country fixed effect and to the coefficient of the respective HICP category k included in the estimation.

The estimation results show that non-processed and processed food, and non-durables and durables exhibit a significantly larger than overall average frequency of price changes, while both regulated and non-regulated services exhibit the opposite. Non-processed food products exhibit larger absolute, upward and downward price adjustments, which exemplifies the large price volatility in this product category. In addition, the relatively high degree of price flexibility in this sector is also revealed by the lower than average asymmetry between the price increase and decrease frequencies. The opposite can be said for processed food and non-durables, which display a smaller size of absolute price changes and of price increases and decreases. Hence, processed food and non-durables prices change more frequently than the average, but the absolute size of the changes as well as the size of the price changes in either direction is smaller than the average. Energy products do not show any significant deviations from the sample mean in terms of the frequency of price adjustments. However, the size of

the price increases and decreases is larger, while the price increase and decrease frequencies are lower and larger than the sample average. This is to say that the direction of the price changes is less asymmetric than the average.

In contrast, regulated and non-regulated services do not only exhibit significantly more than average nominal price rigidity in general, but also a larger degree of nominal downward rigidity. This is as the price change frequency is lower and the asymmetries between price increases and decreases are larger than on average. Non-durables are the only other non-services' category with a significantly higher than average asymmetry of price changes. Furthermore, the estimated coefficients are significantly larger for regulated than for non-regulated services, indicating that the presence of rigidities is even more prominent for the latter (see also Table 9). Regulated services differ from non-regulated services in that they also show a significantly larger size of price changes and price increases relative to the average. This is a feature that is only shared with non-processed food. However, non-processed food displays a high degree of price volatility due to the relatively more frequent and sizeable downward adjustments.

The results above reported are broadly in line with those reported in recent euro area wide cross-country study using CPI micro price data (see Dhyne et al., 2004). Similar to our above findings, they report that regulated prices have significantly lower probabilities to change than prices of services, which in turn show a lower price change probability than the prices of other categories. This finding extends to the respective probabilities to observe price increases and decreases. In addition, they report services to exhibit significantly larger price increases and decreases than processed food and energy products, while the opposite applies to some extent with regard to industrial goods and unprocessed food. Hence, their results are largely coherent with those obtained using index data, as our results suggest that regulated prices are significantly more rigid, both in general and downward in terms of the frequency of price adjustments, than non-regulated indices. In contrast though, our results also suggest that regulated indices exhibit larger upward and downward sizes of price changes than non-regulated indices.

IV. How is aggregate inflation persistence affected by the observed rigidity of regulated and services' prices?

In section 3, we reported a low frequency of price changes for services and regulated indices in particular. As administrative measures can delay and add noise to the response of prices to changes in cost and demand conditions, we address the question on how the observed stickiness of regulated and services' prices translates into inflation persistence. A simple way to do this is by comparing the degree of inflation persistence of individual regulated and services' price indices to that of other

indices. This is the approach pursued in a preceding paper (see Lünnemann & Mathä, 2004), in which services did on average not turn out be more persistent than other indices.

In this paper, we are interested in exploring the contribution of the most rigid sectors "services" and "regulated services" to the measured degree of *aggregate* HICP inflation persistence. Hence, we estimate persistence measures for the HICP aggregates "HICP official", "HICP ex services", "services", "HICP ex regulated services" and "regulated services". The adjustment speed as measured by the first order correlation of inflation can be downward biased in the presence of lumpy price adjustments as shown by Caballero & Engel (2003). This is the reason why in our analysis, we prefer to compare the aggregate index with those indices excluding lumpy price adjustments.

With respect to the impact of services on overall inflation persistence, we use the official price indices for services and non-services, as published by Eurostat. Table 10 reports summary statistics of the inflation rate for the full HICP, for services and for non-services, which are computed as simple averages of log differences of monthly price indices, which beforehand were adjusted for seasonality using X-12. Table 10 illustrates that, for all countries and country aggregates, the average inflation rate is lower for non-services than for services. Eliminating services from the full HICP would result in a decline in the average q-o-q inflation rate by approximately 0.1 percentage points. On average, the q-o-q inflation rates for services exceed HICP inflation by approximately 40 to 50 percent. In addition, q-o-q inflation rates tend to be less volatile for services than for non-services. Moreover, the correlation between inflation for services and non-services inflation is rather modest, exceeding 30 percent only in Greece, Ireland, Spain and Italy. In Belgium, Denmark and Germany, the correlation is negative even.

With respect to regulated price indices a different approach is to be adopted, as Eurostat does not publish an official price index for regulated prices. Thus, we construct an aggregate index based on the data of the 11 individual indices considered subject to price regulation. This index compiles the individual HICP sub-indices according to the chaining methodology adopted by Eurostat. It takes into account time varying weights and, for each country, can be expressed as: $P_t = P_{t-1} \cdot \sum_{i=1}^{I} \frac{w_{i,t} \cdot p_{i,t}}{p_{i,dec\,t-1}}$, where P_t refers to the aggregate price index at time t, while $w_{i,t}$ and $p_{i,t}$ refer to the weight of sub index i at time t in the overall HICP of the respective country and its index value. $p_{dec,t-1}$ refers to the December value of the preceding year but not earlier than 1996. The chaining is essential due to time- varying sub-index weights, and as for several sub-indices data became available during the course of the period under investigation only. For example, in 2000, a number of national statistical institutes started to publish price indices, which are considered to be subject to price regulation.[7]

[7] See also ECB (2004) on this point.

Table 11 below compares both the summary statistics for the "HICP official" versus the "HICP constr." and for regulated prices to those for which prices are freely determined. Firstly, there is a close correspondence between the two HICP measures, indicating the appropriateness of the chosen approach to obtain a constructed index for regulated price indices. Table 11 further illustrates that for all countries and country aggregates except Belgium, the average inflation rate is higher for regulated indices than for non-regulated indices. For the US, a similar result is reported by Dexter et al. (2004). Given their relatively small weight, eliminating regulated prices from the HICP would, on average, reduce overall inflation by a small amount only (<0.1 percentage point reduction in the annualised inflation rate). In general, inflation rates for regulated prices tend to exceed the levels observed for unregulated prices not only on average, but also in terms of percentiles. Contrary to services and relative to the level of inflation, regulated prices do not display a smaller volatility of inflation. Dexter et al. (2004) observe that regulated inflation deviates more from the overall U.S. CPI than does the freely determined counterpart. Similarly, in our case, the correlation between regulated price inflation and HICP inflation is poorer than between unregulated inflation and overall HICP inflation. This holds for all countries. For 8 out of 15 countries as well as for the two country aggregates, the correlation between regulated price inflation and unregulated price inflation is negative even.

Fact 7: Regulated prices and services exhibit larger inflation rates than other indices.

Our principal interest in the inflation series for services' and regulated prices is whether the detected larger nominal price rigidities for regulated and services' indices translate into a higher degree of inflation persistence. To answer this question, we estimate for the euro area and for the EU15 aggregate the following equation for 6 aggregate inflation series *i* related to the following price indices, the "HICP official", the "HICP constr.", "HICP ex services", "services", "HICP ex regulated" and "regulated". A fixed lag length of 4 quarters is applied to all estimations. The estimations take the following form:

$$\pi_{i,t} = c_i + \rho_i \pi_{i,t-1} + \sum_{k=1}^{K-1} \beta_{i,k} \Delta\pi_{i,t-k} + \sum_{l=2}^{4} D_i + \varepsilon_{i,t} \ ,$$

where $\pi_{i,t}$ refers to the quarterly inflation rate in quarter t of the respective HICP aggregate i. D_i refers to quarterly fixed effects to take account of seasonal inflation patterns. The associated t-statistics are based on heteroskedasticity consistent standard errors.

For the majority of countries, the sum of autoregressive coefficients is larger for services than for the HICP ex services (except for Belgium, Spain, the Netherlands, Sweden and the United Kingdom). The discrepancy in terms of inflation persistence becomes particularly pronounced at the level of the EU15 as well as for Greece, France, Ireland and Italy (~0.4 each). Table 12 illustrates further that, in most

countries (apart from Denmark, Germany, the Netherlands and the United Kingdom), eliminating all services from the HICP would deflate the sum of autoregressive coefficients. The reduction in ρ exceeds 0.25 for Greece, France, Ireland and Finland, but for most of the countries the gap is close to 0.1. For the euro area as such, the exclusion of services from the HICP reduces the sum of autoregressive coefficients by 0.09. The corresponding reduction for the EU15 is 0.16.

How do regulated prices affect the measured overall degree of persistence? For the purpose of this comparison, we estimate the sum of the autoregressive coefficients for the aggregates "HICP constr.", the "HICP ex regulated" and "regulated". Firstly, we notice the close correspondence between the "HICP official" and the "HICP constr.". For most countries, with the slight exception of the United Kingdom, the estimated persistence parameters differ only marginally. In all countries except the United Kingdom, the difference is less than 0.05 (see Table 12).

For 8 EU15 countries as well as for the EU15 and euro area aggregates, the measured degree of persistence is lower for the index encompassing non-regulated indices (i.e. "HICP ex regulated") than for the "HICP constr.". In contrast, for only 6 out of 15 countries as well as the EU15, it is the case that the persistence of the "HICP constr." is lower than the persistence of the index "regulated". A similar picture emerges for the comparison between the aggregate indices "HICP ex regulated" and "regulated". The latter two results may, however, also relate to the small weight of regulated prices in the full HICP according to the definition adopted in this paper.

Fact 8: The exclusion of services and regulated indices tends to reduce the aggregate inflation persistence.

These estimates suggest that services, though not necessarily revealing a stronger degree of inflation persistence at the disaggregate level reported elsewhere, may affect the measured degree of inflation persistence at the aggregate level. While this may not hold for all countries individually, in summary though, excluding services and regulated indices from the full HICP tends to reduce the measured degree of inflation persistence.

V. Summing Up

This paper provides empirical evidence on the degree of nominal price rigidities for different HICP categories across individual EU15 countries, as well as the EU15 and euro area aggregates. The focus is to analyse how services' and regulated indices compare to other categories in terms of price rigidity as well as inflation persistence. Furthermore, we analyse whether the in/exclusion of regulated and services' price indices affect the measured overall degree of inflation persistence (as measured by the sum of autoregressive coefficients).

The following main results emerge: First, regulated prices show strong signs of nominal price rigidities relative to other price indices. This statement extends to services, albeit to a slightly lesser extent. In particular, large differences do not only exist across categories, but also within the services and regulated prices categories, with few indices revealing very strong rigidities (e.g. "postal services"). A substantial heterogeneity is also revealed with respect to nominal price rigidities of regulated and services' indices across countries. This is the case both in absolute terms as well as relative to other categories.

Second, there is substantial degree of nominal downward rigidity for regulated and services' indices. In addition, regulated services as well as non-regulated services show a marked seasonal pattern of price adjustments, with price adjustments being relatively more frequent in January in particular, but also in April, July and October.

Third, the average duration and average size of price index changes are positively related to each other. Given that there is a price index change in a particular month, the average price index change is larger for regulated prices and services. This holds for both price increases and decreases.

Fourth, services and regulated prices reveal a higher average inflation rate than non-services and freely determined prices, respectively. In addition, service price inflation tends to vary less than the inflation rates observed for non-services' prices. In general, the correlation between services' and non-services' inflation rates is poor. Regulated price inflation is even negatively correlated with that of non-regulated prices.

Fifth, autoregressive univariate estimation results based on q-o-q inflation rates suggest that for most of the EU15 countries, excluding services from the full HICP results in a reduction in the measured degree of inflation persistence. This extends to the EU15 and the euro area aggregates. A similar effect is discernible for regulated indices, albeit to a lesser extent.

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Tables and figures

Table 1:

HICP sub-indices of prices considered subject to regulation

Code	HICP Sub-Index	Weight in 2002 in ‰
cp0442	Refuse collection	5.45
cp0443	Sewerage collection	4.71
cp0621_0623	Medical services, paramedical services	9.22
cp0622	Dental services	6.40
cp063	Hospital services	6.70
cp0731	Passenger railway transport	4.15
cp0732	Passenger transport by road	5.12
cp081	Postal services	1.98
cp0942	Cultural services	14.62
cp10	Education	9.61
cp124	Social protection	8.31
Total at most disaggregate level		76.3

Note: Weights for the EU15.

Table 2:

Distribution of price change frequencies across countries and sectors

Country	**# Indices**	**Average**	**Std.dev**	**5%ile**	**25%ile**	**Median**	**75%ile**	**95%ile**	**Impl.median duration**
European Union 15	94	0.86	0.12	0.67	0.80	0.88	0.96	0.99	1.14
Euro Area	94	0.83	0.13	0.61	0.77	0.86	0.91	0.99	1.17
Belgium	88	0.63	0.29	0.12	0.47	0.71	0.87	0.98	1.42
Denmark	92	0.61	0.30	0.10	0.31	0.74	0.87	0.97	1.36
Germany	93	0.67	0.22	0.14	0.56	0.66	0.79	0.99	1.51
Greece	88	0.66	0.29	0.11	0.44	0.78	0.90	0.99	1.29
Spain	83	0.80	0.21	0.17	0.77	0.87	0.93	0.98	1.15
France	92	0.78	0.22	0.27	0.75	0.85	0.90	0.98	1.18
Ireland	92	0.72	0.27	0.17	0.53	0.85	0.93	0.97	1.17
Italy	88	0.62	0.27	0.15	0.35	0.66	0.86	0.96	1.52
Luxembourg	91	0.53	0.30	0.05	0.21	0.60	0.82	0.92	1.67
Netherlands	89	0.68	0.29	0.09	0.42	0.77	0.90	0.99	1.30
Austria	91	0.67	0.31	0.11	0.42	0.79	0.93	0.98	1.26
Portugal	88	0.78	0.24	0.22	0.66	0.89	0.94	0.97	1.12
Finland	92	0.64	0.29	0.14	0.36	0.77	0.89	0.98	1.30
Sweden	88	0.73	0.28	0.13	0.54	0.85	0.95	0.98	1.17
United Kingdom	83	0.85	0.20	0.40	0.85	0.93	0.97	0.99	1.08
Sector									
non-services	902	0.80	0.19	0.34	0.75	0.87	0.94	0.99	1.15
non-processed food	*68*	*0.96*	*0.05*	*0.84*	*0.94*	*0.97*	*0.98*	*1.00*	*1.03*
processed food	*187*	*0.82*	*0.17*	*0.39*	*0.80*	*0.87*	*0.92*	*0.96*	*1.15*
non-durables	*170*	*0.76*	*0.21*	*0.26*	*0.68*	*0.82*	*0.89*	*0.99*	*1.21*
durables	*389*	*0.80*	*0.16*	*0.46*	*0.74*	*0.86*	*0.92*	*0.98*	*1.17*
energy	*88*	*0.71*	*0.29*	*0.15*	*0.49*	*0.84*	*0.96*	*0.99*	*1.19*
services	624	0.57	0.30	0.09	0.31	0.63	0.86	0.98	1.58
non-regulated services	*440*	*0.62*	*0.29*	*0.12*	*0.36*	*0.71*	*0.88*	*0.98*	*1.42*
regulated services	*184*	*0.46*	*0.30*	*0.08*	*0.15*	*0.45*	*0.71*	*0.92*	*2.23*
Total	**1526**	**0.71**	**0.27**	**0.14**	**0.54**	**0.81**	**0.91**	**0.98**	**1.23**

Table 3:
Median duration of no price change across categories and countries

Country	Total	non-services	non-processed food	processed food	non-durables	durables	energy	services	non-regulated services	regulated services
EU	1.14	1.14	*1.03*	*1.18*	*1.16*	*1.13*	*1.07*	1.14	*1.10*	*1.18*
EA	1.17	1.17	*1.04*	*1.30*	*1.17*	*1.17*	*1.10*	1.17	*1.14*	*1.24*
be	1.42	1.26	*1.02*	*1.18*	*1.28*	*1.56*	*1.13*	2.33	*1.53*	*6.50*
dk	1.36	1.19	*1.04*	*1.19*	*1.21*	*1.19*	*2.17*	3.37	*2.60*	*5.78*
de	1.51	1.44	*1.04*	*1.44*	*1.45*	*1.53*	*1.11*	1.53	*1.47*	*1.72*
gr	1.29	1.17	*1.00*	*1.09*	*1.32*	*1.24*	*1.51*	2.26	*2.21*	*2.26*
es	1.15	1.14	*1.04*	*1.14*	*1.14*	*1.15*	*1.55*	1.20	*1.17*	*1.24*
fr	1.18	1.15	*1.04*	*1.18*	*1.18*	*1.14*	*1.25*	1.25	*1.20*	*1.43*
ie	1.17	1.12	*1.06*	*1.17*	*1.12*	*1.10*	*1.60*	1.53	*1.35*	*3.33*
it	1.52	1.23	*1.03*	*1.17*	*1.31*	*1.62*	*1.16*	2.24	*2.43*	*1.69*
lu	1.67	1.27	*1.06*	*1.20*	*1.41*	*1.53*	*1.35*	5.54	*4.67*	*7.47*
nl	1.30	1.14	*1.03*	*1.11*	*1.29*	*1.15*	*2.38*	2.18	*1.47*	*5.89*
at	1.26	1.12	*1.05*	*1.08*	*1.25*	*1.19*	*1.86*	2.20	*1.57*	*5.56*
pt	1.12	1.10	*1.02*	*1.07*	*1.13*	*1.11*	*1.71*	1.32	*1.14*	*1.58*
sf	1.30	1.17	*1.01*	*1.17*	*1.27*	*1.15*	*1.38*	2.73	*2.33*	*3.11*
sv	1.17	1.09	*1.02*	*1.11*	*1.20*	*1.06*	*1.70*	1.90	*1.43*	*2.24*
uk	1.08	1.06	*1.03*	*1.05*	*1.12*	*1.05*	*1.15*	1.12	*1.11*	*1.42*
Total	1.23	1.15	*1.03*	*1.15*	*1.21*	*1.17*	*1.19*	1.58	*1.42*	*2.23*

Note: Non-weighted median per category.

Table 4:

Ranking of the 33 most rigid indices (i.e. indices with a duration exceeding 12 months)

Rank	country	indexlabel	sector	duration
1	lu	Insurance linked to trans.	non-regulated services	56.0
2	at	Other purchased trans. services	non-regulated services	50.0
3	sf	Hospital services	regulated services	40.0
4	fr	Heat energy	energy	33.3
5	gr	Insurance linked to dwelling	non-regulated services	30.5
6	lu	Combined passenger trans.	non-regulated services	28.0
7	lu	Postal services	regulated services	22.4
8	be	Postal services	regulated services	22.4
9	gr	Passenger trans. by railway	regulated services	22.4
10	ie	Postal services	regulated services	22.4
11	lu	Maint. of other durables for recr.	non-regulated services	22.4
12	lu	Passenger trans. by road	regulated services	18.7
13	lu	Other purchased trans. services	non-regulated services	16.7
14	es	Postal services	regulated services	16.0
15	at	Postal services	regulated services	16.0
16	nl	Combined passenger trans.	non-regulated services	15.7
17	be	Sewerage collection	regulated services	14.0
18	sv	Gas	energy	14.0
19	sv	Hospital services	regulated services	13.3
20	es	Other insurance	non-regulated services	13.3
21	sf	Social protection	regulated services	13.0
22	be	Education	regulated services	13.0
23	ie	Sewerage collection	regulated services	13.0
24	ie	Refuse collection	regulated services	13.0
25	at	Dental services	regulated services	13.0
26	ie	Water supply	non-durables	13.0
27	nl	Sewerage collection	regulated services	12.8
28	nl	Actual rentals for housing	non-regulated services	12.4
29	es	Electricity	energy	12.4
30	at	Insurance linked to dwelling	non-regulated services	12.4
31	it	Postal services	regulated services	12.4
32	de	Insurance linked to dwelling	non-regulated services	12.4
33	dk	Postal services	regulated services	12.4

Table 5:

The 100 most rigid indices: Ranking of countries, sectors and indices

Country	Count
lu	18
be	10
at	10
dk	8
nl	8
sf	8
sv	7
gr	6
de	5
it	5
es	4
ie	4
fr	3
pt	2
uk	2
EU	0
EA	0
Total	**100**

Sectors	Count
regulated services	50
non-regulated services	37
energy	5
non-durables	4
processed food	4
Total	**100**

Duration statistics top 100	
Average	12.0
Median	12.4
Minimum	5.9
Maximum	56.0

Indices	Count
Postal services	13
Sewerage collection	7
Passenger trans. by railway	6
Refuse collection	6
Hospital services	4
Insurance linked to dwelling	4
Combined passenger trans.	4
Other insurance	4
Social protection	4
Dental services	4
Water supply	4
Tobacco	4
Other purchased trans. services	3
Education	3
Electricity	3
Canteens	3
Repair of av., photo & info. process.	3
Repair of household appl.	3
Insurance linked to trans.	2
(Para-)medical services	2
Passenger trans. by air	2
Heat energy	1
Maint. of other durables for recr.	1
Passenger trans. by road	1
Gas	1
Actual rentals for housing	1
Financial services n.e.c.	1
Dom. & househ. services	1
Telephone & telefax equip.	1
Other services n.e.c.	1
Insurance linked to health	1
Other services linked to dwelling	1
Repair of furniture, etc.	1
Total	**100**

Table 6:

Distribution of the size of average absolute price changes across countries and sectors

Country	# Indices	Average	Std.dev	5%ile	25%ile	Median	75%ile	95%ile
European Union 15	94	0.58	0.62	0.20	0.26	0.35	0.52	2.18
Euro Area	94	0.58	0.73	0.17	0.23	0.32	0.53	2.29
Belgium	88	1.45	2.13	0.19	0.29	0.59	1.49	6.25
Denmark	92	1.35	1.25	0.27	0.45	0.86	1.82	4.23
Germany	93	0.85	1.36	0.14	0.19	0.30	0.71	4.71
Greece	88	2.20	2.22	0.43	0.60	1.28	3.04	6.93
Spain	83	0.96	1.44	0.25	0.31	0.42	1.02	2.82
France	92	0.86	0.98	0.20	0.25	0.41	1.01	3.52
Ireland	92	1.98	4.37	0.37	0.51	0.80	1.45	4.84
Italy	88	0.79	0.67	0.22	0.36	0.57	0.95	2.44
Luxembourg	91	1.75	2.29	0.31	0.57	1.14	1.96	5.69
Netherlands	89	1.66	2.52	0.30	0.45	0.71	1.78	6.59
Austria	91	1.48	2.53	0.28	0.49	0.80	1.70	4.96
Portugal	88	0.99	1.55	0.26	0.42	0.60	1.03	2.52
Finland	92	1.36	1.16	0.33	0.59	0.94	1.73	3.96
Sweden	88	1.36	1.17	0.41	0.58	0.98	1.67	3.66
United Kingdom	83	1.13	1.30	0.33	0.48	0.64	1.07	3.62
Sector								
non-services	902	1.03	1.43	0.20	0.33	0.56	1.13	3.49
non-processed food	*68*	*1.79*	*1.61*	*0.30*	*0.67*	*1.16*	*2.56*	*4.96*
processed food	*187*	*0.55*	*0.48*	*0.19*	*0.29*	*0.43*	*0.60*	*1.43*
non-durables	*170*	*0.82*	*1.97*	*0.19*	*0.31*	*0.46*	*0.75*	*2.57*
durables	*389*	*1.06*	*1.29*	*0.18*	*0.32*	*0.60*	*1.24*	*3.68*
energy	*88*	*1.73*	*1.44*	*0.40*	*0.66*	*1.34*	*2.12*	*5.10*
services	624	1.57	2.48	0.24	0.45	0.80	1.73	5.10
non-regulated services	*440*	*1.35*	*1.81*	*0.23*	*0.42*	*0.77*	*1.61*	*4.62*
regulated services	*184*	*2.12*	*3.56*	*0.32*	*0.49*	*0.94*	*2.08*	*8.07*
Total	1526	1.25	1.95	0.21	0.37	0.62	1.36	4.21

Table 7:

Average absolute size of price changes across categories and countries

Country	Total	non-services	non-processed food	processed food	non-durables	durables	energy	services	non-regulated services	regulated services
EU	0.58	0.57	*1.16*	*0.30*	*0.35*	*0.56*	*1.07*	0.60	*0.66*	*0.43*
EA	0.58	0.55	*1.26*	*0.28*	*0.36*	*0.48*	*1.12*	0.63	*0.71*	*0.43*
be	1.45	1.22	*2.87*	*0.41*	*0.66*	*1.44*	*1.81*	1.80	*1.35*	*2.79*
dk	1.35	1.06	*1.46*	*0.67*	*1.32*	*0.90*	*1.65*	1.78	*1.51*	*2.43*
de	0.85	0.58	*1.83*	*0.49*	*0.38*	*0.25*	*1.50*	1.22	*1.42*	*0.73*
gr	2.20	2.09	*4.11*	*0.84*	*1.12*	*2.61*	*2.74*	2.38	*1.99*	*3.22*
es	0.96	0.73	*1.09*	*0.54*	*0.43*	*0.62*	*2.27*	1.33	*1.19*	*1.69*
fr	0.86	0.90	*2.22*	*0.48*	*0.51*	*0.77*	*1.93*	0.81	*0.80*	*0.82*
ie	1.98	1.34	*1.15*	*0.47*	*2.98*	*1.08*	*1.33*	2.90	*1.56*	*6.18*
it	0.79	0.63	*0.72*	*0.52*	*0.40*	*0.68*	*1.17*	1.02	*1.09*	*0.84*
lu	1.75	1.32	*0.77*	*0.49*	*0.94*	*1.71*	*2.55*	2.34	*1.58*	*4.20*
nl	1.66	1.23	*2.06*	*0.57*	*0.92*	*1.39*	*2.34*	2.24	*1.48*	*4.11*
at	1.48	1.11	*2.49*	*0.72*	*0.74*	*1.14*	*1.38*	2.03	*2.21*	*1.60*
pt	0.99	0.74	*1.45*	*0.60*	*0.54*	*0.69*	*1.17*	1.34	*1.54*	*0.89*
sf	1.36	1.10	*2.18*	*0.72*	*0.66*	*1.02*	*2.11*	1.72	*1.50*	*2.27*
sv	1.36	1.29	*1.93*	*0.61*	*0.83*	*1.54*	*2.10*	1.45	*1.20*	*1.99*
uk	1.13	1.07	*1.66*	*0.61*	*0.86*	*1.13*	*1.72*	1.22	*1.24*	*1.19*
Total	1.25	1.03	*1.79*	*0.55*	*0.82*	*1.06*	*1.73*	1.57	*1.35*	*2.12*

Table 8:

Panel estimates on nominal price rigidities: comparison of sectors

Sector	Frequency of price change	Duration without price change	Average price change (abs. terms)	Size of upward price change	Size of downward price change	Frequency of upward price change	Frequency of downward price change
non-processed food	0.249 ***	-1.211 ***	0.534 ***	0.584 ***	0.576 ***	-0.131 ***	0.131 ***
	0.012	0.092	0.189	0.190	0.192	0.009	0.009
processed food	0.112 ***	-0.849 ***	-0.705 ***	-0.678 ***	-0.687 ***	-0.023	0.023
	0.018	0.130	0.194	0.196	0.203	0.014	0.014
non-durables	0.052 ***	-0.636 ***	-0.431 *	-0.405 *	-0.536 ***	0.026 *	-0.026 *
	0.020	0.153	0.240	0.245	0.202	0.014	0.014
durables	0.096 ***	-0.932 ***	-0.196	-0.310	0.130	-0.133 ***	0.133 ***
	0.014	0.100	0.198	0.198	0.215	0.014	0.014
non-regulated services	-0.087 ***	0.567 **	0.101	0.136	0.041	0.091 ***	-0.091 ***
	0.017	0.229	0.207	0.218	0.214	0.013	0.013
regulated services	-0.247 ***	2.433 ***	0.857 ***	0.885 ***	0.516	0.163 ***	-0.163 ***
	0.023	0.391	0.315	0.318	0.588	0.012	0.012
energy	0.002	0.164	0.490 **	0.620 **	0.428 *	-0.103 ***	0.103 ***
	0.034	0.444	0.242	0.248	0.250	0.016	0.016
# obs	1526	1526	1526	1525	1406	1526	1526
F-Stat	112.2	24.7	29.0	26.0	20.7	146.5	146.5
F-prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.34	0.15	0.11	0.11	0.06	0.30	0.30
R-squared adj.	0.33	0.14	0.09	0.09	0.04	0.29	0.29

Note: Coefficients and significance relative to overall mean in sample. ***, **, * denote significance at the 1%, 5 % and 10% level of confidence, respectively. Estimated with robust standard errors and country fixed effects (absorbed).

Table 9:

Panel estimates on nominal price rigidities: non-services versus (non)-regulated services

Sector	Frequency of price change	Duration without price change	Average price change (abs. terms)	Size of upward price change	Size of downward price change	Frequency of upward price change	Frequency of downward price change
non-services	0.093 ***	-0.773 ***	-0.224 ***	-0.246 ***	-0.098 *	-0.077 ***	0.077 ***
	0.006	0.056	0.046	0.047	0.052	0.006	0.006
non-regulated services	-0.087 ***	0.567 ***	0.101	0.136	0.041	0.091 ***	-0.091 ***
	0.014	0.217	0.098	0.117	0.108	0.012	0.012
regulated services	-0.247 ***	2.434 ***	0.857 ***	0.885 ***	0.516	0.163 ***	-0.163 ***
	0.020	0.384	0.256	0.258	0.558	0.011	0.011
# obs	1526	1526	1526	1525	1406	1526	1526
F-Stat	197.4	52.2	13.4	14.0	1.3	283.0	283.0
F-prob	0.000	0.000	0.000	0.000	0.280	0.000	0.000
R-squared	0.32	0.14	0.09	0.08	0.04	0.25	0.25
R-squared adj.	0.31	0.13	0.08	0.07	0.03	0.24	0.24

Note: Coefficients and significance relative to overall mean in sample. ***, **, * denote significance at the 1%, 5 % and 10% level of confidence, respectively. Estimated with robust standard errors and country fixed effects (absorbed).

Table 10:

Summary statistics for q-o-q inflation rates of services and non-services

	EU15	EA	be	dk	de	gr	es	fr	ie	it	lu	nl	at	pt	fi	se	uk
Average																	
HICP	0.46	0.47	0.40	0.49	0.30	1.04	0.69	0.40	0.76	0.64	0.48	0.59	0.36	0.69	0.38	0.37	0.34
Services	0.65	0.59	0.53	0.74	0.40	1.34	0.91	0.46	1.11	0.78	0.60	0.78	0.58	1.07	0.60	0.55	0.90
HICP ex services	0.34	0.40	0.34	0.34	0.24	0.90	0.58	0.36	0.53	0.57	0.42	0.48	0.21	0.51	0.26	0.27	-0.07
Standard deviation																	
HICP	0.20	0.21	0.35	0.22	0.25	0.52	0.34	0.29	0.45	0.33	0.43	0.40	0.25	0.32	0.32	0.37	0.20
Services	0.15	0.18	0.29	0.22	0.29	0.75	0.24	0.24	0.56	0.26	0.25	0.40	0.28	0.30	0.32	0.32	0.18
HICP ex services	0.29	0.30	0.50	0.34	0.39	0.56	0.47	0.42	0.49	0.41	0.63	0.54	0.31	0.40	0.45	0.55	0.31
P25																	
HICP	0.33	0.33	0.13	0.30	0.19	0.73	0.43	0.16	0.48	0.39	0.16	0.26	0.22	0.48	0.19	0.10	0.24
Services	0.56	0.47	0.36	0.62	0.22	0.91	0.79	0.32	0.72	0.61	0.45	0.61	0.38	0.85	0.36	0.30	0.80
HICP ex services	0.14	0.16	0.02	0.06	-0.02	0.59	0.23	0.05	0.24	0.29	-0.04	0.11	0.01	0.24	-0.04	0.03	-0.30
Median																	
HICP	0.45	0.46	0.40	0.52	0.29	0.95	0.65	0.43	0.67	0.61	0.41	0.55	0.34	0.73	0.36	0.37	0.37
Services	0.66	0.61	0.60	0.76	0.39	1.10	0.88	0.42	1.15	0.77	0.67	0.73	0.59	1.06	0.65	0.56	0.91
HICP ex services	0.33	0.41	0.28	0.38	0.21	0.87	0.53	0.39	0.42	0.51	0.40	0.46	0.21	0.54	0.18	0.25	-0.04
P75																	
HICP	0.58	0.61	0.65	0.64	0.41	1.41	0.87	0.63	1.14	0.83	0.84	0.80	0.47	0.84	0.64	0.54	0.49
Services	0.78	0.69	0.70	0.90	0.52	1.52	1.02	0.60	1.48	0.86	0.75	0.98	0.68	1.24	0.84	0.75	0.98
HICP ex services	0.52	0.54	0.68	0.57	0.45	1.17	0.80	0.66	0.92	0.87	0.87	0.73	0.43	0.76	0.61	0.40	0.13
Correlation																	
HICP vs. HICP ex services	0.93	0.94	0.95	0.91	0.90	0.93	0.98	0.94	0.86	0.96	0.98	0.90	0.84	0.94	0.93	0.95	0.86
HICP vs. services	0.46	0.34	0.15	0.38	0.35	0.73	0.49	0.35	0.80	0.71	0.29	0.54	0.69	0.48	0.45	0.32	0.45
HICP ex services vs. Services	0.19	0.03	-0.12	-0.01	-0.03	0.47	0.32	0.04	0.40	0.52	0.12	0.16	0.22	0.18	0.12	0.02	0.04

Table 11:

Summary statistics for q-o-q inflation rates of regulated and non-regulated indices

	EU15	EA	be	dk	de	gr	es	fr	ie	it	lu	nl	at	pt	fi	se	uk
Average																	
HICP official	0.46	0.47	0.40	0.49	0.30	1.04	0.69	0.38	0.76	0.64	0.48	0.59	0.36	0.69	0.38	0.37	0.34
HICP chained	0.46	0.47	0.39	0.47	0.30	1.04	0.69	0.38	0.80	0.63	0.48	0.60	0.36	0.68	0.38	0.39	0.35
HICP ex regulated	0.44	0.45	0.42	0.44	0.26	1.04	0.67	0.38	0.75	0.62	0.47	0.59	0.34	0.65	0.36	0.38	0.30
Regulated	0.76	0.70	0.15	0.92	0.77	1.29	0.88	0.42	1.32	0.72	0.69	0.75	0.69	1.22	0.78	0.63	0.95
Standard deviation																	
HICP official	0.20	0.21	0.35	0.22	0.25	0.52	0.34	0.30	0.45	0.33	0.43	0.40	0.25	0.32	0.32	0.37	0.20
HICP chained	0.20	0.21	0.34	0.23	0.25	0.50	0.36	0.29	0.44	0.31	0.42	0.41	0.25	0.31	0.33	0.39	0.20
HICP ex regulated	0.21	0.22	0.34	0.25	0.27	0.56	0.36	0.31	0.44	0.30	0.44	0.43	0.26	0.33	0.32	0.41	0.21
Regulated	0.32	0.39	0.96	0.52	0.76	1.78	0.26	0.28	0.81	0.23	0.72	1.39	0.65	0.43	0.59	1.07	0.47
P25																	
HICP official	0.33	0.33	0.13	0.30	0.19	0.73	0.43	0.14	0.48	0.39	0.16	0.26	0.22	0.48	0.19	0.10	0.22
HICP chained	0.32	0.30	0.15	0.29	0.19	0.71	0.43	0.13	0.47	0.40	0.15	0.26	0.23	0.48	0.19	0.15	0.23
HICP ex regulated	0.29	0.27	0.17	0.25	0.10	0.67	0.41	0.13	0.40	0.38	0.14	0.27	0.21	0.47	0.14	0.15	0.21
Regulated	0.66	0.57	0.13	0.70	0.41	0.80	0.73	0.24	0.76	0.57	0.33	0.48	0.34	0.98	0.49	0.43	0.83
Median																	
HICP official	0.45	0.46	0.40	0.52	0.29	0.95	0.65	0.40	0.67	0.61	0.41	0.55	0.34	0.73	0.36	0.37	0.36
HICP chained	0.45	0.48	0.40	0.51	0.28	0.99	0.64	0.40	0.71	0.58	0.40	0.51	0.33	0.71	0.33	0.38	0.35
HICP ex regulated	0.44	0.47	0.43	0.50	0.22	0.94	0.59	0.39	0.69	0.58	0.43	0.56	0.31	0.70	0.29	0.37	0.31
Regulated	0.75	0.67	0.31	0.94	0.60	1.12	0.89	0.34	1.15	0.67	0.63	0.66	0.53	1.16	0.90	0.65	0.96
P75																	
HICP official	0.58	0.61	0.65	0.64	0.41	1.41	0.87	0.59	1.14	0.83	0.84	0.80	0.47	0.84	0.64	0.54	0.48
HICP chained	0.58	0.60	0.56	0.64	0.42	1.23	0.86	0.57	1.19	0.80	0.84	0.82	0.46	0.86	0.67	0.54	0.50
HICP ex regulated	0.58	0.59	0.59	0.61	0.41	1.40	0.80	0.57	1.12	0.79	0.83	0.78	0.46	0.87	0.63	0.53	0.43
Regulated	0.81	0.76	0.54	1.13	0.91	1.50	1.08	0.58	1.80	0.83	0.96	1.11	0.80	1.45	1.00	1.14	1.13
Correlation																	
HIPC offical vs. chained	0.99	0.99	0.99	0.98	0.99	0.96	0.99	1.00	0.99	0.99	1.00	0.99	0.99	0.99	0.99	0.98	0.97
HICP constr. vs. HICP ex regulate	0.99	0.99	0.96	0.99	0.97	0.95	0.96	1.00	0.99	0.99	1.00	0.95	0.98	0.99	0.96	0.98	0.98
HICP constr. vs. regulated	-0.01	-0.09	0.09	0.08	0.20	0.18	0.32	0.15	0.59	0.09	0.18	0.18	0.06	0.00	-0.01	0.11	0.26
HICP ex regulated vs. regulated	-0.11	-0.20	-0.02	-0.02	-0.04	0.05	0.26	0.09	0.49	0.05	0.12	-0.09	-0.11	-0.06	-0.08	-0.05	0.06

Table 12:

Sum of AR coefficients

Country	HICP	HICP	HICP ex services	services	HICP ex regulated	regulated
	constr.	offical	offical	offical	constr.	constr.
EU15	0.45	0.44	0.28	0.71	0.42	0.45
EA	0.61	0.59	0.50	0.70	0.59	0.41
be	0.39	0.36	0.30	-1.08	0.41	0.12
dk	0.32	0.30	0.37	0.39	0.27	-0.02
de	0.06	0.07	0.20	0.31	0.16	0.25
gr	0.50	0.54	0.29	0.65	0.51	-1.21
es	0.27	0.23	0.14	-0.02	0.20	0.36
fr	0.83	0.81	0.45	0.84	0.79	0.73
ie	0.58	0.59	0.30	0.67	0.58	0.70
it	0.29	0.29	0.20	0.62	0.27	-0.65
lu	0.34	0.33	0.18	0.52	0.31	-0.56
nl	0.65	0.66	0.72	0.61	0.72	0.24
at	0.44	0.41	0.35	0.35	0.34	0.11
pt	0.44	0.39	0.19	0.45	0.38	0.27
sf	0.70	0.71	0.43	0.66	0.69	0.20
sv	0.02	-0.02	-0.07	-0.16	0.16	0.10
uk	-0.16	0.01	0.47	-0.08	-0.01	0.19
Share of countries with						
HICP official > HICP ex services			0.76			
HICP official < services				0.65		
HICP ex services < services				0.71		
HICP constr. > HICP ex regulated					0.65	
HICP constr. < regulated					0.35	
HICP constr. ex regulated < regulated						0.29

Note: Estimates for France and the UK refer to 1996Q2 onwards; the others refer to 1995Q2 onwards.

Figure 1:

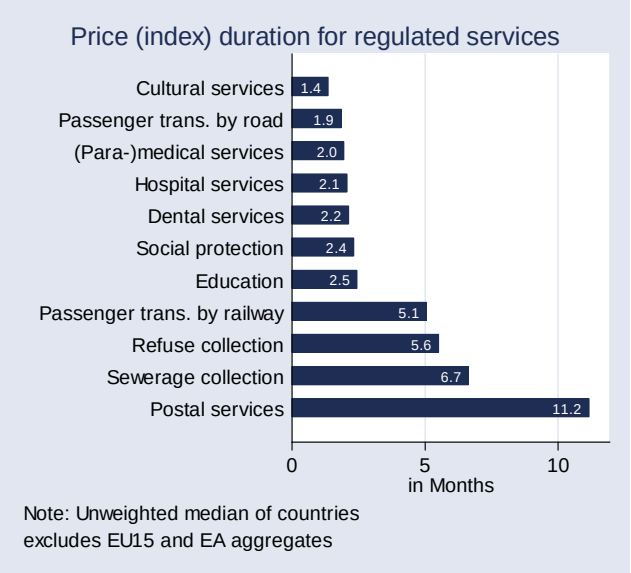


Figure 2:

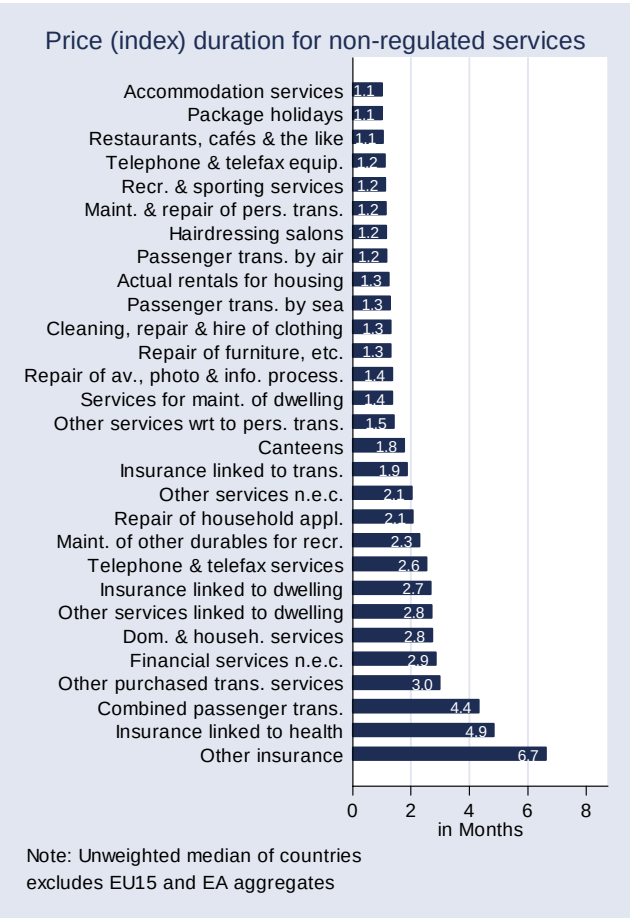


Figure 3:

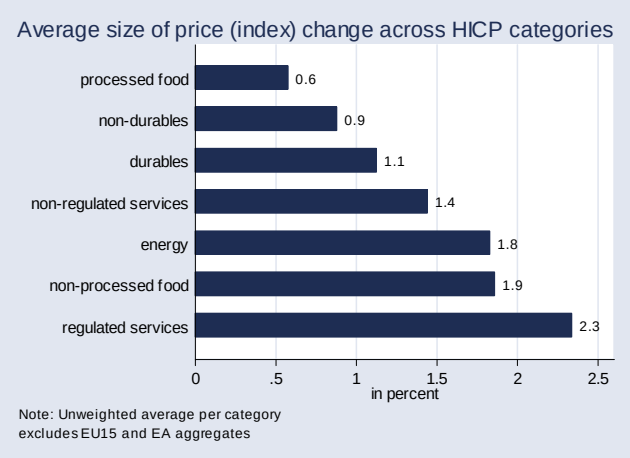


Figure 4:

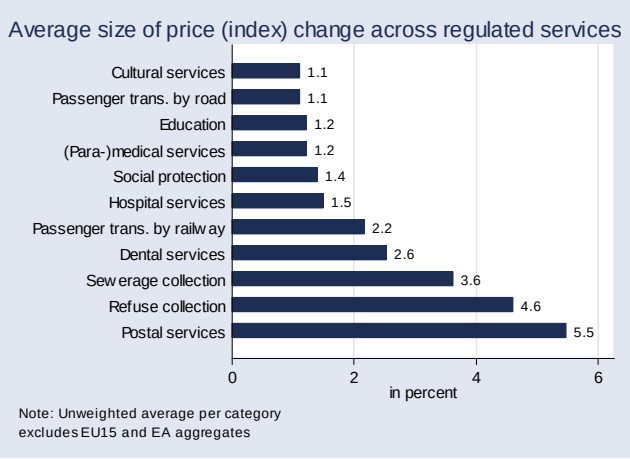


Figure 5:

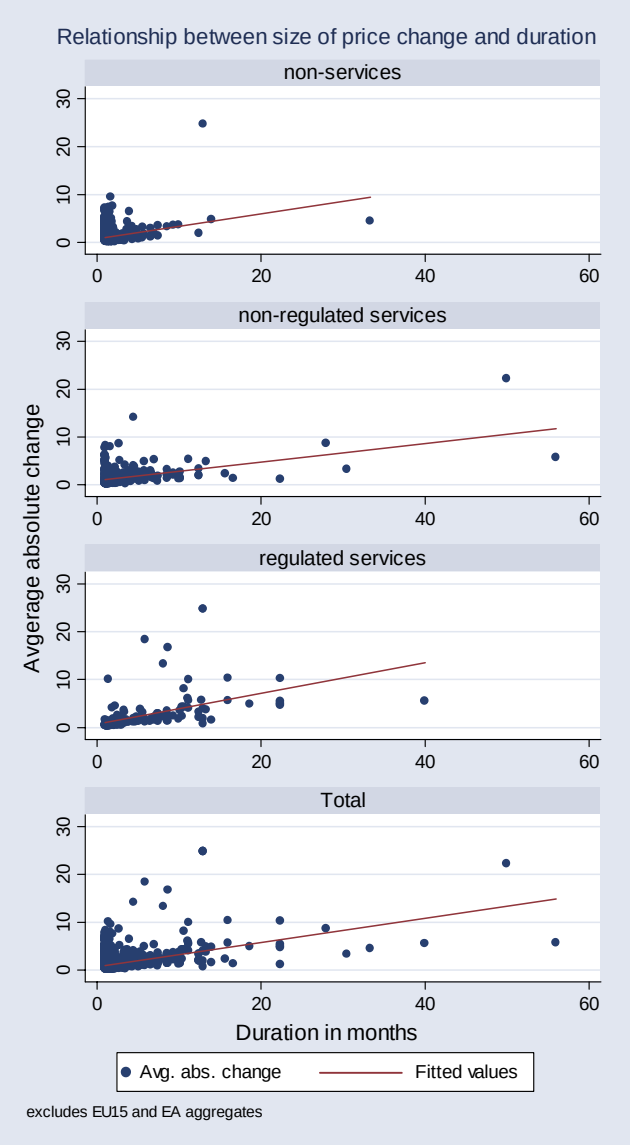

Relationship between size of price change and duration
non-services
non-regulated services
regulated services
Total
Avgerage absolute change
0
10
20
30
0
20
40
60
Duration in months
Avg. abs. change
Fitted values
excludes EU15 and EA aggregates

Figure 6:

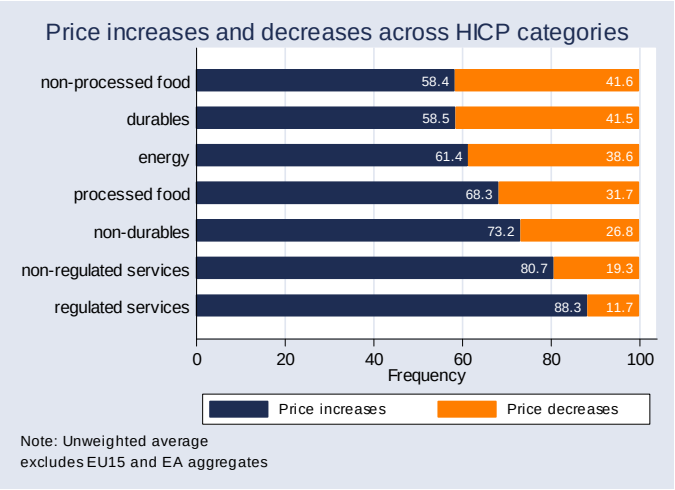


Figure 7:

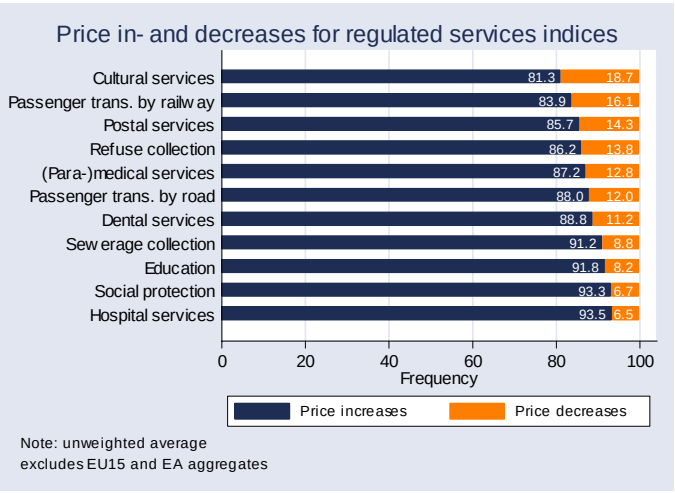
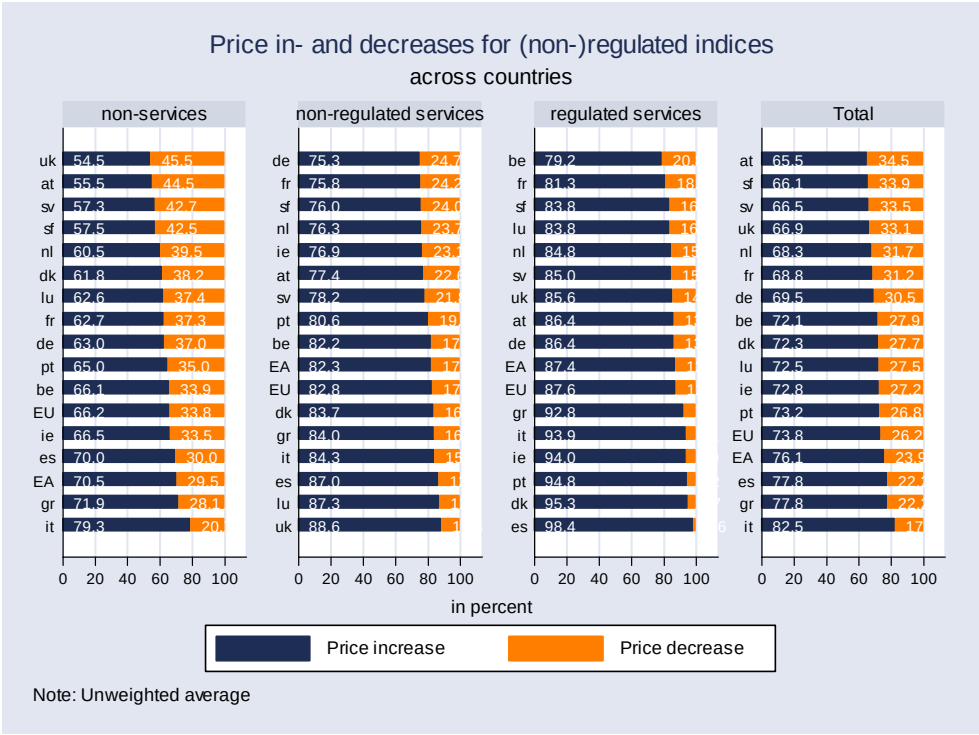
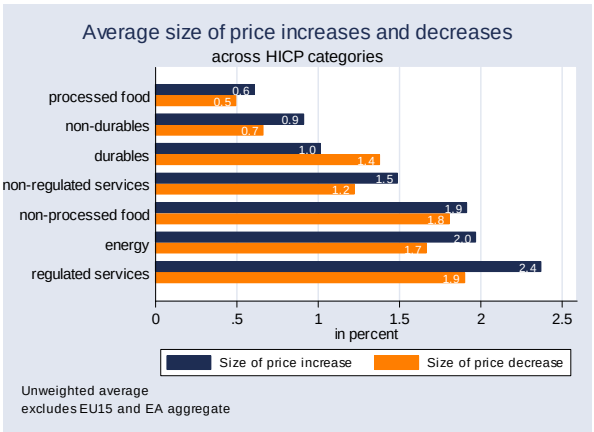


Figure 8:



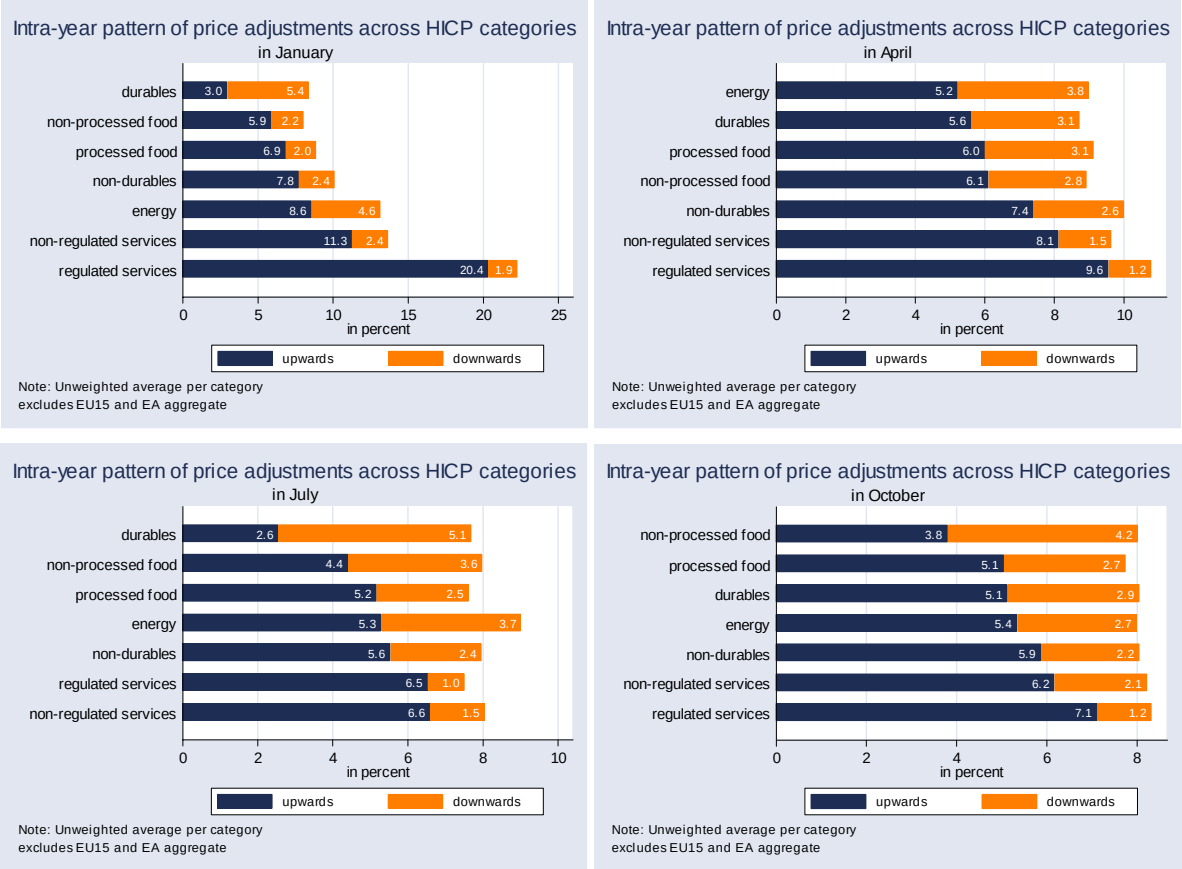
Note: Unweighted average

Figure 9:



Unweighted average
excludes EU15 and EA aggregate

Figure 10:


Intra-year pattern of price adjustments across HICP categories
in January
durables 3.0 5.4
non-processed food 5.9 2.2
processed food 6.9 2.0
non-durables 7.8 2.4
energy 8.6 4.6
non-regulated services 11.3 2.4
regulated services 20.4 1.9
0 5 10 15 20 25
in percent
upwards
downwards
Note: Unweighted average per category excludes EU15 and EA aggregate
Intra-year pattern of price adjustments across HICP categories
in April
energy 5.2 3.8
durables 5.6 3.1
processed food 6.0 3.1
non-processed food 6.1 2.8
non-durables 7.4 2.6
non-regulated services 8.1 1.5
regulated services 9.6 1.2
0 2 4 6 8 10
in percent
upwards
downwards
Note: Unweighted average per category excludes EU15 and EA aggregate
Intra-year pattern of price adjustments across HICP categories
in July
durables 2.6 5.1
non-processed food 4.4 3.6
processed food 5.2 2.5
energy 5.3 3.7
non-durables 5.6 2.4
regulated services 6.5 1.0
non-regulated services 6.6 1.5
0 2 4 6 8 10
in percent
upwards
downwards
Note: Unweighted average per category excludes EU15 and EA aggregate
Intra-year pattern of price adjustments across HICP categories
in October
non-processed food 3.8 4.2
processed food 5.1 2.7
durables 5.1 2.9
energy 5.4 2.7
non-durables 5.9 2.2
non-regulated services 6.2 2.1
regulated services 7.1 1.2
0 2 4 6 8
in percent
upwards
downwards
Note: Unweighted average per category excludes EU15 and EA aggregate

VII. Appendix

Table A1: Categorisation of HICP sub-indices

HICP Description	Weight 2002	non-processed food	processed food	services	durables	non-durables	energy	regulated
cp0111 Bread & cereals	25.28		1					
cp0112 Meat	39.92	1						
cp0113 Fish & seafood	11.25	1						
cp0114 Milk, cheese & eggs	22.69		1					
cp0115 Oils & fats	5.5		1					
cp0116 Fruit	11.49	1						
cp0117 Vegetables	15.57	1						
cp0118 Sugar, jam, honey, chocolate & confectionery	9.7		1					
cp0119 Food products n.e.c.	3.75		1					
cp0121 Coffee, tea & cocoa	4.18		1					
cp0122 Mineral waters, soft drinks, fruit & vegetable juices	8.77		1					
cp0211 Spirits	3.29		1					
cp0212 Wine	6.95		1					
cp0213 Beer	5.68		1					
cp022 Tobacco	22.41		1					
cp0311 Clothing materials	0.33				1			
cp0312 Garments	56.4				1			
cp0313 Other articles of clothing & clothing accessories	2.29				1			
cp0314 Cleaning, repair & hire of clothing	1.88			1				
cp032 Footwear incl. repair	16.21				1			
cp041 Actual rentals for housing	64.98			1				
cp0431 Materials for the maintenance & repair of the dwell	6.19					1		
cp0432 Services for the maintenance & repair of the dwelli	9.32			1				
cp0441 Water supply	8.01					1		
cp0442 Refuse collection	5.45			1				1
cp0443 Sewerage collection	4.71			1				1
cp0444 Other services relating to the dwelling n.e.c.	7.11			1				
cp0451 Electricity	20.12						1	
cp0452 Gas	14.24						1	
cp0453 Liquid fuels	6.12						1	
cp0454 Solid fuels	0.78						1	
cp0455 Heat energy	4.83						1	
cp0511 Furniture & furnishings	28.36				1			
cp0512 Carpets & other floor coverings	2.83				1			
cp0513 Repair of furniture, furnishings & floor coverings	1.13			1				
cp052 Household textiles	6.45				1			
cp0531 532 Major household appl. whether electric or not	10.73				1			
cp0533 Repair of household appl.	1.48			1				
cp054 Glassware, tableware & household utensils	6.14				1			
cp055 Tools & equip. for house & garden	4.57				1			
cp0561 Non-durable household goods	10.19					1		
cp0562 Domestic services & household services	8.43			1				
cp0611 Pharmaceutical products	11.84					1		
cp0612 613 Other medical products; therapeutic appl. & e	5.19					1		
cp0621 623 Medical services; paramedical services	9.22			1				1
cp0622 Dental services	6.4			1				1
cp063 Hospital services	6.7			1				1
cp071 not 711 Motor cycles, bicycles & animal drawn veh	3.91				1			
cp0711 Motor cars	45.28				1			
cp0721 Spares parts & accessories for personal trans. equ	10.11				1			
cp0722 Fuels & lubricants for personal trans. equip.	35.13						1	
cp0723 Maintenance & repair of personal trans. equip.	24.72			1				
cp0724 Other services in respect of personal trans. equip.	10.03			1				
cp0731 Passenger trans. by railway	4.15			1				1
cp0732 Passenger trans. by road	5.12			1				1
cp0733 Passenger trans. by air	5.3			1				
cp0734 Passenger trans. by sea & inl& waterway	0.96			1				
cp0735 Combined passenger trans.	5.43			1				
cp0736 Other purchased trans. services	0.68			1				
cp081 Postal services	1.98			1				1
cp082 Telephone & telefax equip.	2.97			1				
cp083 Telephone & telefax services	21.24			1				
cp0911 Equip. for the reception, recording & reproduction	6.17				1			
cp0912 Photographic & cinematographic equip. & optical i	1.75				1			
cp0913 Information process. equip.	4.18				1			
cp0914 Recording media	4.28				1			
cp0915 Repair of audio-visual, photographic & information	1.01			1				
cp0921 922 Major durables for indoor & outdoor recreatio	2.62				1			
cp0923 Maintenance & repair of other major durables for r	0.04			1				
cp0931 Games, toys & hobbies	4.31				1			
cp0932 equip. for sport, camping & open-air recreation	2.8				1			
cp0933 Gardens, plants & flowers	6.24					1		
cp0934 935 Pets & related products; veterinary & other se	4.8					1		
cp0941 Recreational & sporting services	10.11			1				
cp0942 Cultural services	14.62			1				1
cp0951 Books	6.71				1			
cp0952 Newspapers & periodicals	10.03					1		
cp0953 954 Miscellaneous printed matter; stationery & dra	3.22					1		
cp096 Package holidays	15.52			1				
cp10 Education	9.61			1				1
cp1111 Restaurants, cafés & the like	66.6			1				
cp1112 Canteens	7.89			1				
cp112 Accommodation services	17.32			1				
cp1211 Hairdressing salons & personal grooming establis	10.81			1				
cp1212 1213 Electrical appl. for personal care; other appl.	15.1					1		
cp1231 Jewellery, clocks & watches	5.5				1			
cp1232 Other personal effects	6.12				1			
cp124 Social protection	8.31			1				1
cp1252 Insurance connected with the dwelling	2.28			1				
cp1253 Insurance connected with health	5.58			1				
cp1254 Insurance connected with trans.	7.04			1				
cp1255 Other insurance	2.56			1				
cp126 Financial services n.e.c.	5.03			1				
cp127 Other services n.e.c.	8.67			1				
Sum	**998.9**	**4**	**11**	**40**	**23**	**10**	**6**	**11**

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