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Output sensitivity of inflation in the euro area: indirect evidence from disaggregated consumer prices

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Abstract:

We investigate output sensitivity of inflation in the euro area through a disaggregated analysis using price indices at the COICOP 4-digit level and compare cyclical sensitivity of a newly created index of cyclically sensitive items (ICSP) with that of headline HICP and core price indices. We also relate the ICSP to the first common factor extracted from the disaggregated prices, which best reflects the common dynamics of the underlying price indices. Our results indicate that two thirds of the items in the euro area HICP are cyclically sensitive. Categories most robustly related to the business cycle are food items (processed and unprocessed), non-durable industrial goods and services related to recreation. Output sensitivity of the ICSP is significantly higher than that of headline inflation. The difference in output sensitivity is most striking between the ICSP and core inflation because of the rather strong cyclical sensitivity of processed and unprocessed food prices (both in prevalence and the estimated parameter of output sensitivity). The index of cyclically sensitive prices is highly correlated with the first common factor. Given the weak factor structure of disaggregated prices, however, we conclude that the domestic business cycle is an important determinant of inflation but it is only one among a number of nearly equally important factors.

Keywords: output sensitivity, inflation, disaggregated price indices, heterogeneity, euro area, factor analysis.

JEL-Classification: E31.

Non technical summary

Output sensitivity of inflation has been rather weak in the euro area, including in the past recession. This has raised the question whether the business cycle still has a role in the inflation process. Recently, it was suggested for the US that the cyclical sensitivity of individual prices might differ and that the output-inflation relationship may hold true in particular for a specific part of the consumer basket (Bryan and Meyer, 2010). The idea of the present investigation is to determine the role of the business cycle for aggregate inflation dynamics in the euro area through a test of the output sensitivity of the euro area's aggregate and individual member states' HICP COICOP 4-digit level price indices. Specifically, does low output sensitivity hold true for all underlying HICP components in general or does cyclical sensitivity diverge. Should it differ, can a disaggregated analysis yield new insights about the inflation process?

Our research strategy consists, first, in the econometric determination of cyclical sensitivity of disaggregated consumer price indices (4-digit COICOP level of the HICP) in the euro area as a whole and in its member states. The weight of the cyclically sensitive items and the weight of these items in the broad product categories (food, industrial goods, services) are identified. Second, we create an index of cyclically sensitive prices (ICSP). Its output sensitivity can be quantified and compared with that of headline inflation and several core rates. Third, the ICSP is related to the first factor extracted from the disaggregated price indices, which is assumed to best reflect their common trend. The importance of the business cycle for aggregate inflation is thus established indirectly: if the newly created index is stronger correlated with the first factor than other price measures, this might prove that the business cycle still has an important role in the overall inflation process, not only for the prices assessed as cyclically responsive.

Our results indicate that cyclical sensitivity indeed differs among the individual disaggregated price indices. In the euro area as a whole (direct estimation), a rather substantial part of the HICP (two thirds) is cyclically sensitive. However, results are heterogeneous across the member states, with the larger countries tending to show a higher share of cyclically sensitive items than the smaller member states. Output sensitivity of the ICSP is significantly higher than that of headline inflation or the index of flexible prices. However, all indices are clearly more sensitive to the business cycle than core rates excluding food and energy prices. This stems from the fact that many food prices appear to be strongly cyclically sensitive, are regards prevalence and the estimated parameter. In the euro area, the correlation of the sub-index of cyclically sensitive prices with the first common factor of the HICP components is higher than for any of the other investigated price aggregates or special indices. We take these results as evidence that the business cycle still plays an important role for inflation dynamics, in particular through specific product classes. However, the weak factor structure indicates that the business cycle is not the single decisive factor driving inflation; other factors may have nearly equal relevance. All in all, our investigation shows that the business cycle does play a role in price dynamics, although probably more so in some categories than in others.

Nichttechnische Zusammenfassung

Die Reagibilität der Inflation bezüglich der Output-Lücke im Euro-Raum ist relativ gering, wie empirische Untersuchungen zeigen. Dies wirft die Frage auf, welche Rolle die Konjunktur noch im Inflationsprozess spielt. Bryan und Meyer (2010) zeigten kürzlich anhand von US-amerikanischen Daten, dass sich die zyklische Reagibilität disaggregierter Preise unterscheiden kann. Die Konjunktur spiele unverändert eine bedeutende Rolle für die Preisentwicklung, jedoch vor allem für spezifische Güterkategorien. Der vorliegende Aufsatz untersucht die Bedeutung der Konjunktur für den Inflationsprozess im Euroraum (insgesamt und für einzelne Mitgliedsländer) im Rahmen einer disaggregierten Analyse (COICOP-4-Steller des Harmonisierten Verbraucherpreisindizes, HVPI). Im Zentrum steht die Frage, ob die für den Gesamtindex beobachtete schwache Konjunkturreagibilität für alle Komponenten des Preisindex gleichermaßen gilt, oder ob sich die Konjunkturreagibilität der Preise auf disaggregierter Ebene unterscheidet. Sollte dies der Fall sein, können durch die gesonderte Betrachtung der konjunkturreagiblen Komponenten möglicherweise neue Erkenntnisse über die Dynamik der Preise gewonnen werden können.

In einem ersten Schritt wird die Konjunkturreagibilität aller Teilindizes des HVPI geschätzt. Aus den reagiblen Komponenten wird in einem zweiten Schritt ein neuer Index konjunkturreagibler Preise (ICSP) berechnet. Die Output-Reagibilität dieses Index wird dann verglichen mit den entsprechenden Werten für die Gesamtinflation und für unterschiedliche Kernraten. In einem dritten Schritt wird der ICSP mit dem ersten Faktor in Verbindung gesetzt, der aus den disaggregierten Teilindizes gezogen wurde und der annahmegemäß den gemeinsamen Inflationstrend am besten abbildet. Die Bedeutung der Konjunktur für den Inflationsprozess wird somit indirekt bestimmt: wenn der neu gebildete Index reagibler Preise stärker mit dem ersten Faktor korreliert ist als andere Indizes, kann dies ein Hinweis darauf sein, dass eine Betrachtung der disaggregierten Reagibilität wichtige Informationen über den Inflationstrend liefert, die beim Blick auf den Gesamtindex oder gängige Kernraten verstellt bleiben.

Unsere Untersuchungen ergeben, dass im Euro-Raum ein recht großer Teil des HVPI (zwei Drittel) konjunkturreagibel ist. Reagible und nicht-reagible Komponenten finden sich in allen großen Produktgruppen. Allerdings ist die Streuung der Ergebnisse für die Mitgliedsländer recht hoch. Die Anteile der reagiblen Teilindizes sind in den großen Mitgliedsländern in der Tendenz höher. Die Reagibilität des Index konjunkturreagibler Preise ist im Euroraum höher als die des Gesamtindex oder des Index flexibler Preise. Die Werte für alle genannten Indizes liegen aber deutlich oberhalb der Ergebnisse beispielsweise für die Kernrate ohne Nahrung und Energie. Ein Grund dafür dürfte die offensichtlich stark ausgeprägte Konjunkturreagibilität vieler Nahrungsmittel sein. Zudem ist im Euroraum insgesamt die Korrelation des ICSP mit dem ersten Faktor der Komponenten des HVPI höher als der entsprechende Wert für jeden anderen hier untersuchten Teilindex. Unsere Untersuchung bestätigt somit, dass die Preisdynamik nach wie vor auch von der Konjunktur abhängt, allerdings in einigen Kategorien stärker als in anderen. Es zeigt sich aber auch, dass weitere Faktoren für die Preisdynamik nahezu ähnlich wichtig sind.

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1 Introduction

In the early years of the euro area, inflation appeared only weakly sensitive to the business cycle. Inflation varied only marginally and often remained slightly above the value defined as price stability by the ECB of close to but below two per cent, even in phases of weak economic performance (Altissimo et al., 2006; see Figure A.1 in the Appendix). Some authors have attributed this weak co-movement of inflation and the business cycle ("the flattening of the Phillips curve") to the strong credibility of central banks (Ball, 2006; Roberts, 2006; Laxton and N'Diaye, 2002). Another strand of the literature has emphasised that increasing globalisation may have raised the importance of international factors for inflation dynamics (Borio and Filardo, 2007; Razin and Binyamini, 2007; White, 2008; IMF, 2006). A third explanation for the inflation inertia was that prices may not be flexible enough ("sticky"), e.g. due to adjustment costs, longer-term contracts or "sticky wages". This nominal rigidity creates inflation persistence and prevents prices from reacting timely to changes in business conditions (Altissimo et al., 2006).

In sharp contrast to the earlier part of the 2000s, inflation has fluctuated rather strongly since 2007 (see Figure A.1). In 2007 and 2008, after world-wide shocks to food and energy prices and with buoyant global growth, headline inflation in the euro area soared. During the 2008/09 recession, with marked negative output gaps, inflation fell sharply, reaching negative territory for a few months in 2009. Some authors suggested that this provides evidence of inflation dynamics still being affected by the Phillips curve relationship (Liu and Rudebusch, 2010). The link between the business cycle and inflation may still be relevant, although potentially only during periods with strongly negative output gaps (Meier, 2010; Stock and

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Watson, 2010; Peach et al., 2011). However, earlier doubts about the strength of the Phillips curve relation in the euro area quickly re-emerged when inflation rates rose significantly in 2010 despite large and only slowly declining negative output gaps (European Commission, 2011). As a result, the usefulness of the output gap as an indicator of underlying price trends has remained doubtful recently.

Econometric evidence of output sensitivity of inflation has also been inconclusive. Rumler and Valderrama (2008) tested the traditional and the New Keynesian Phillips curves and could establish only very modest, if any, output sensitivity of inflation in the euro area as a whole and in its member states. Mody and Ohnsorge (2007) found that inflation rates still do react to domestic influences such as the domestic output gap and labour costs if a common inflation component among the EU member states is controlled for. Also Musso et al. (2009) find evidence for the Phillips curve in the euro area even if it may have substantially flattened during the investigated time period that starts in 1970. The most recent investigations have concentrated on the link between the output gap and core inflation (excluding volatile components like food and energy), to better capture the underlying trends. Although not stated explicitly, this choice may be due to the fact that changes in the relative prices of food and energy are considered "the most common measures" of supply shocks (Ball and Mazumder, 2011:10; Gordon, 1982). European Commission staff found that "the output gap remains a significant driver of core inflation in the euro area" but "its impact is not very large" (European Commission, 2011:17). Similar research conducted at the OECD (Moccero et al., 2011) fails to establish a link between core inflation and the output gap in the euro area.

The weakness of the aggregate Phillips curve relationship notwithstanding, Bryan and Meyer (2010) suggested that the cyclical sensitivity of individual prices might differ and that the output-inflation relationship may still hold true for a part of the consumer price index. At least for some prices, the output gap could still be an important determinant and a suitable indicator of price trends. With reference to the New Keynesian Phillips curve, the authors de-composed the US CPI into "flexible" and "sticky" prices based on the investigation of Bils and Klenow (2004) and showed that a price index containing the more flexible prices indeed reacts more strongly to the output gap than the price index composed of the sticky prices.

We start from this suggestion and investigate output sensitivity of the euro area price indices at the COICOP 4-digit level for the time period 1997-2009. It is tested whether output sensitivity is generally weak also on a disaggregated level or whether it differs between the price indices that make up the HICP. Should it differ, how widespread and how pronounced is cyclical sensitivity at the disaggregated level? Furthermore, if cyclical responsiveness differs at

the disaggregated level, how does that relate to the low sensitivity observed for the aggregate? The chosen approach to aggregate output sensitivity is therefore *indirect*. After determining the cyclically sensitive items, the magnitude (parameter) of their combined cyclical sensitivity is estimated through a newly created index of cyclically sensitive items (ICSP) and compared with that of headline inflation and other frequently used inflation measures. While that gives an idea of the still prevailing link to the business cycle of some components of the HICP, it cannot show how important the business cycle is for aggregate inflation dynamics. We extract the cyclically sensitive items, not the cyclical component as such. The items that co-move with the business cycle can also be affected by a number of other inflation determinants. Again, to determine the importance of the business cycle for aggregate inflation dynamics, we choose an indirect approach and relate this newly created index to the first common factor extracted from the disaggregated prices. Like the ICSP, the factor is determined through extracting specific information from the underlying price indices. The first factor, however, is a purely statistical concept and reflects the strongest common dynamics in the disaggregated items. Hence, should the newly created index be strongly related to the first factor, this (indirectly) testifies to an important role of the business cycle in aggregate inflation dynamics.

Before starting this investigation, two main issues have to be addressed. The first concerns the theoretical basis. It is not obvious why disaggregated prices should diverge in their cyclical sensitivity and how divergent responsiveness of disaggregated prices to the business cycle could be motivated theoretically. Admittedly, the standard NKPC establishes a clear link between individual price flexibility and marginal costs, which can be approximated by the economy-wide output gap. It is the flexible components that co-move with the business cycle. However, the NKPC assumes a common probability for price changes at the disaggregated level. It is this *general* probability that determines aggregate output sensitivity, not differences in flexibility among the underlying price indices. In addition, according to the hybrid NKPC, prices can be adjusted also in a backward looking manner. This weakens the clear-cut link between flexibility and cyclical responsiveness of the standard NKPC while it does not change the assumption of a common probability for prices changing. Empirically, however, it was established that price flexibility varies systematically, e.g. along product types. That observation, in turn, precludes the approximation of marginal costs for an individual firm by the aggregate output gap as in the NKPC. As a result, the relation between disaggregated prices and the output gap appears best supported by models that relate price changes to idiosyncratic and common determinants, the output gap being one of the common factors (Bryan and Cecchetti, 1993). Its importance for the individual price can then be studied empirically.

A second major issue arises from the fact that the definition of "domestic" influences is not devoid of ambiguities in the euro area. What is "domestic" at the euro area level need not be "domestic" for the individual country, in particular in the small member states. We therefore investigated not only the euro area aggregate but also the individual member states for robustness, while in all cases disaggregated inflation rates were related to the respective domestic output gap. However, because the importance of purely domestic cost components may depend also on the size of the country, and the euro area output gap is not a simple average of the member states' domestic activity (in particular for the small countries it also reflects the activity in main trading partners), the relation between the average of the member states and the aggregate euro area results is not always straightforward and requires careful consideration.

The article is structured as follows. In the next section, we establish the theoretical and empirical background of our investigation. Section 3 presents the data set and Section 4 the price categories and items assessed as cyclically sensitive and non-sensitive. Section 5 contains the estimates of output sensitivity for the newly created time series, ICSP, compared with other inflation rates including headline, typical core rates and an index of "flexible" prices. Subsequently, we comment on the relation of the newly created series to the first common factor extracted from the HICP sub-components and its implications for the role of the business cycle in inflation dynamics.

2 Theoretical and empirical background

2.1 New Keynesian Phillips Curve

The New Keynesian Phillips Curve (NKPC) links disaggregated prices to the output gap. The model is derived from the price setting of a representative firm, which operates in an environment of monopolistic competition. The optimal price p_t^* is then a fix mark-up μ over marginal costs mc_t. It is assumed that all firms use identical technology and face an identical isoelastic demand curve (Gali, 2008). If all firms could reset prices every period, they would choose an identical price. However, only a fraction of the firms $(1-\theta)$, $0<\theta<1$, can reset prices optimally in every period (Calvo, 1983). As a result, there is heterogeneity in price adjustment. The firms resetting prices do not only take into account current marginal costs but also their expected future development. The optimal reset price z is[2]

$$z_t = \mu + (1-\theta\beta)\sum_{k=0}^{\infty}(\theta\beta)^k E_t mc_{t+k} \ . \qquad (1)$$

[2] The derivation follows Rudd and Whelan (2005).

The parameter β ($\beta<1$) stands for the discount rate applied to the future periods. The aggregate price level is composed of prices that are adjusted and those that remain unchanged:

$$p_t = \theta p_{t-1} + (1-\theta) z_t \,. \tag{2}$$

Combined with the optimal reset price (1) and after rearrangements this leads to the NKPC (cf. also Gali and Gertler, 1999):

$$\pi_t = \beta E_t \pi_{t+1} + \frac{(1-\theta)(1-\theta\beta)}{\theta}(\mu + mc_t - p_t) \,. \tag{3}$$

Current inflation depends on inflation in the following period and current real marginal costs. Inflation in the next period reflects the expectations of the development of marginal costs in all considered (and discounted) future periods. In highly stylised models of the NKPC, current real marginal costs and the output gap are linearly related (cf. e.g. Gali 2008)[3], which yields the link between individual price adjustment, aggregate inflation and the output gap. For our investigation it is essential to note that aggregate output sensitivity depends on "price flexibility"; the higher the share of firms that reset their prices, the higher the sensitivity of aggregate inflation towards contemporaneous real marginal costs. Inflation is purely forward-looking in the sense that past outcomes of inflation do not systematically affect current inflation.

The proposition that inflation could be purely forward-looking has been contested empirically (Fuhrer and Moore, 1995; Fuhrer, 1997; Rudd and Whelan, 2007). Therefore, macroeconomic models often work with a "hybrid" NKPC, which also includes lagged inflation (Gali and Gertler, 1999). Theoretically this can be motivated by the assumption that a fraction α of the firms resetting prices will be using a "rule of thumb" and reset the price in line with the recently observed inflation rate. The hybrid NKPC introduced by Gali and Gertler (1999) looks as follows:

$$\pi_t = \alpha\phi^{-1}\pi_{t-1} + \beta\theta\phi^{-1} E_t \pi_{t+1} + \frac{(1-\alpha)(1-\theta)(1-\theta\beta)}{\phi}(\mu + mc_t - p_t) \,, \text{ with} \tag{4}$$

$$\phi = \theta + \alpha\left[1 - \theta(1-\beta)\right] \,. \tag{5}$$

Inflation hence depends on past and expected future inflation rates and the current real marginal costs. The reaction of current inflation to current real marginal costs now depends on the fraction of firms that change prices (as above) but also on the fraction of firms that adjust prices in line with the inflation outcome in the previous period. The clear link between the (general)

[3] "Because inputs are scarce, marginal cost should be an increasing function of output." (Rotemberg/Woodford, 1999)

price flexibility and (aggregate) output sensitivity is not present anymore. Output sensitivity now depends (negatively) on the number of firms that keep their prices unchanged (as before) but also on the share of backward-looking price setters. Within this framework, inflation can be "persistent" in the sense of a systematic influence on current inflation rates from earlier inflation outcomes. Inflation is highly persistent if the coefficient in front of the lagged inflation term is close to 1 (cf. e.g. Fuhrer, 2009), and it depends in large part on the share of backward-looking firms (α); the higher this share, the higher *c.p.* inflation persistence.

It is important to remember that in this model all firms face an identical optimisation problem, the only difference being whether and how prices are adjusted (not at all, in a backward-looking manner, in an optimal manner, i.e. linked to the current and expected future development of marginal costs). All disaggregated prices are subject to the *same* probability of the duration of nominal rigidity. Output sensitivity is defined in relation to an *aggregate* price index, not to the individual firm's price. In this model, a weak reaction of aggregate inflation to the output gap follows from the small share of prices that are adjusted in a forward-looking manner.

2.2 Heterogeneity in price flexibility and inflation persistence and its implications for output sensitivity

Based on the (standard) NKPC, the extent of price flexibility has been inferred from the estimated slope of the Phillips curve (cf. Schorfheide, 2008). This approach yields an estimate of the homogenous probability of price changes. However, more reliable estimates of the extent of price flexibility and/or inflation persistence[4] stem from direct investigations of disaggregated data, which can be individual (store) price quotations but also aggregate price indices at levels below headline CPI[5] (e.g. Bils and Klenow, 2004, Dhyne et al., 2005, Nakamura and Steinson, 2008, Dhyne et al., 2009). This literature has established that the duration of nominal rigidity can be quite heterogeneous across the products and product groups. Many prices change more often than what the single estimated durations of nominal rigidities derived from reduced-form estimations of the NKPC suggest.[6] Flexibility is heterogeneous and moreover appears to be

[4] Price flexibility is most usefully defined in relation to the individual price, while persistence is defined for price indices at some level of aggregation. An individual price will be – in line with the theory presented above – adjusted either in a backward- or in a forward-looking manner.

[5] Disaggregated consumer price indices are composed of individual price quotes referring to one product class (such as "bread") but consist of price quotes of a number of firms in many places. A number of such aggregation levels exist, e.g. from "bread" to "processed food" or "goods". It will be dealt with in greater detail in Section 3.2.

[6] For the euro area it was established that the most flexible prices are energy prices and unprocessed food prices, whereas prices of services and industrial goods prices change less frequently (Dhyne et al., 2005).

subject to an aggregation bias (Bils and Klenow, 2004). Similar results are reported for inflation persistence at various levels of disaggregation: considerable heterogeneity prevails at a disaggregated level, and persistence is often lower for disaggregated price indices than for headline inflation (Altissimo et al., 2006; Clark, 2006). Altissimo et al. (2009) suggest that the higher persistence in the aggregate stems from the fact that the more persistent price indices dominate in the aggregation process (a point stressed also by Cagliarini et al., 2011).

Given heterogeneity and an aggregation bias in price flexibility and inflation persistence and bearing in mind the theoretical link between price stickiness, inflation persistence and output sensitivity, it is straightforward to infer the same heterogeneity for the sensitivity towards marginal costs and/or the output gap. Low responsiveness to the output gap of the aggregate might conceal that cyclical sensitivity is not low universally. However, with heterogeneity in the price setting and economic conditions, the marginal costs faced by the individual firms cannot be approximated by the economy-wide output gap anymore. As a result, heterogeneity in price flexibility and inflation persistence need not imply an equivalent heterogeneity in output sensitivity**.** The implications of an approximation of the average individual marginal costs through the economy-wide output gap were studied by Imbs et al. (2007). Using French sectoral data on prices and marginal costs the authors showed that the assumption of homogeneity between sectors when heterogeneity is "true" leads to an underestimation of the role of marginal costs and an overestimation of the "apparent" backward-looking component in price setting; the slope of the Phillips curve is too low. A similar point is made by Cagliarini et al. (2011). With heterogeneity in price setting and 'roundabout production',[7] an economy-wide estimate of real marginal costs (through the labour share or the output gap) is a biased indicator of marginal costs faced by the firms on average.

Notwithstanding the above, Bryan and Meyer (2010) showed that there might be an empirical link between flexibility and output sensitivity in the sense that the more flexible prices also react more strongly to the output gap. Heterogeneity in flexibility could be related to heterogeneity in output sensitivity. Using the classification of Bils and Klenow (2004) of flexible and sticky prices in the US CPI, they found that the slope of the "Phillips curve" is steeper for an index that contained the more flexible prices. Furthermore, despite the general unsuitability of the aggregate output gap as an indicator of disaggregated marginal costs, a test of the relation between disaggregated prices and the aggregate output gap can be motivated assuming that, in addition to idiosyncratic factors pertaining to the conditions in the individual market, prices are also determined through common macroeconomic factors (Altissimo et al.,

[7] "Roundabout production" tries to account for the fact that intermediate goods are used by firms that produce intermediate goods themselves and firms that produce final goods.

2009). Bryan and Cecchetti (1993) expressed aggregate inflation as a weighted average of changes in the disaggregated prices such as in

$$\pi_t = \sum_i \omega_i \pi_t^i \,, \tag{6}$$

and assumed that the change in the individual price stems from a common inflation component *m* and an idiosyncratic relative price movement *x*. Inflation can then be expressed as:

$$\pi_t^i = \dot{m}_t + \dot{x}_{it} \,, \tag{7}$$

with dots denoting growth rates. The common component can include e.g. all common determinants of costs, such as the domestic cost pressures reflected in the output gap but also imported inputs, whereas the idiosyncratic component contains all other influences. A test of output sensitivity of disaggregated consumer prices might hence still yield additional information if it is acknowledged that the output gap stands only for *a specific part* of the marginal costs that firms face.[8] The importance of the business cycle for the disaggregate price indices (product classes) can be established empirically. Such interpretation could be all the more acceptable on the grounds that the CPI, even on a rather disaggregated level, is created through weighting and cumulating inflation rates of similar consumer goods collected in a number of places throughout a country. While these prices also reflect the suppliers' specific cost and market structures, most indices are aggregates that show the average change in the price of a number of suppliers of a similar product in different places. These suppliers may or may not operate in the same cost and market conditions, and may or may not be affected by the general economic conditions reflected in the business cycle. We do assume that each product or product group follows its own idiosyncratic movements or developments, but our main interest is to determine empirically whether the output gap is *one* determinant of the specific product price (among potentially many). This approach also alleviates the problem stemming from the fact that the consumer price index does not contain only domestically produced goods, the prices of which are the most likely to be affected by the domestic cost components.

Also Boivin et al. (2009) tested the relative importance of common (macroeconomic) and idiosyncratic components for the changes of disaggregated prices, albeit with a rather different approach. The common (macroeconomic) shocks are approximated by the first five common factors extracted from a data set containing prices and consumption expenditure variables. The authors found that disaggregated prices are rather flexible but this flexibility is exercised mainly in reaction to sector-specific and idiosyncratic shocks. Nevertheless, prices do

[8] Alternatively it could be assumed that the correlation between the sector specific output gap and the economy-wide output gap is higher for some sectors or producers than for other sectors.

also react to macroeconomic shocks, although with some lag and to a minor extent. The authors conclude that in spite of price flexibility at the disaggregated level, inflation can appear persistent or rigid in the aggregate because of the more sluggish and weak response to macroeconomic shocks.

As a result, the empirical literature on disaggregated prices shows that prices need not be as rigid as suggested by the low output sensitivity established in estimations of the NKPC. Instead, prices can be rather flexible, while price flexibility can vary widely between the several products and product types. Flexibility need not be exercised primarily in reaction to macroeconomic factors such as the business cycle. The determination of the sensitivity of disaggregated price indices to the aggregate output gap is hence an empirical matter; price (index) flexibility alone need not be sufficient for cyclical responsiveness.

3 Applied Strategy and Data

3.1 Method

The idea is to test output sensitivity of HICP COICOP 4-digit level price indices for the euro area and infer indirectly, through the concentration on cyclically sensitive items, what role the business cycle plays for aggregate inflation dynamics. Our benchmark is the disaggregated consumer price indices for the euro area aggregate. These are related to the euro area output gap. This is a purely "product-related" (direct) approach. For robustness we also related the disaggregated price indices of each member state to the domestic (member state's) output gap. The results are then aggregated to form the "euro area average". This is, therefore, a product and country based aggregation (indirect approach).

To determine the cyclically sensitive price indices, we first ran simple regressions of disaggregated inflation rates (for all products *j*) on their own lagged observations and the output gap:

$$\pi_{j,t} = c + \alpha\pi_{j,t-1} + \sum_{i=0}^{4} \beta_i gap_{t-i} + \varepsilon_t \qquad (8)$$

for year-on-year inflation rates π_t of disaggregated price series at quarterly frequency. The output gap ($gap_{t\text{-}i}$) was tested at lags 0 to 4, the insignificant lags were subsequently removed. The estimations were carried out with OLS and Newey-West corrections of the t-values (Newey and West, 1987). Because we worked with COICOP 4-digit level price indices, endogeneity problems that would have suggested the use of GMM seemed unlikely. Since the regressions were run for 16 member states and the euro area, and for up to four output gap measures, our results are based on approximately 4,000 regressions. For most series, the sample covers the

period of 1997-2009, but it is shorter for some series.[9] Through these regressions we identified "cyclically sensitive" and "cyclically insensitive" disaggregated price indices. HICP components with at least one significant output gap coefficient (90%-level) and a positive sum of all output gap coefficients were defined as "cyclically sensitive".[10] This implies a rather broad definition of cyclical sensitivity.

In a second step we analysed these results and determined

- the weight of the cyclically sensitive items in the HICP,
- the weight of cyclically sensitive items in several HICP subgroups (e.g. durable and non-durable industrial goods, services etc.),
- whether cyclical sensitivity is subject to an aggregation bias in the sense that the results for the euro area member states might differ from those found for the euro area aggregate directly,
- whether the cyclically sensitive items are also more "flexible" than the cyclically insensitive items.

In a third step, we calculated indices of cyclically sensitive prices (ICSP). These indices are composed of the items assessed as cyclically responsive in Step 1; their weights are based on the weights in the HICP. For comparison, output sensitivity was also tested for the HICP, core inflation measures, some special indices and indices of 'flexible' and 'sticky' prices (altogether six series, for the definitions see next sections). When quantifying output sensitivity, we ran regressions of the following type:

$$\pi_t = c + \alpha_j \sum_{j=1}^{5} \pi_{t-j} + \sum_{i=0}^{4} \beta_i gap_{t-i} + \phi_k \sum_{k=0}^{4} control_{t-k} + \varepsilon_t . \qquad (9)$$

The regression considers a number of lagged own inflation rates but also control variables ($control_{t\text{-}k}$) such as the oil price, prices of raw materials and world food prices, the nominal effective exchange rate and import prices. The model was estimated with OLS and with GMM to check for possible endogeneity. In the GMM estimation, the instruments were lagged inflation and lagged output gap (both with 4 lags).

[9] The shorter series often start at around 2000. In most countries, these series include the items of health care. For Slovenia, all disaggregated time series start in 2000.

[10] In all countries and the euro area, there were items that seem to be negatively linked to the output gap. The combined weight of these items can be around 5 % of the HICP. However, we excluded these series from further analysis. Examples for items with a negative link in the euro area (direct approach, HP output gap based), are 'water supply', 'other medical products', 'postal services', 'transport by road'. It is tempting to consider many of these items administered prices, which are adjusted anti-cyclically, but no such statement can be made based on this simple analysis.

Finally, because the cyclically sensitive price indices do not reflect the cyclical component in inflation *only*, but the aggregate dynamics of the prices that are driven *also* by the business cycle, the relative importance of output fluctuations for aggregate inflation is gauged from the regression of the newly created index of sensitive prices (ICSP) on the first principal component (factor) of the disaggregated price measures. The framework of factor analysis has been used in a number of investigations of disaggregated prices such as in Altissimo et al. (2009), Boivin et al. (2009) or Clark (2006).[11] From a data set containing many potentially correlated series, a smaller set of uncorrelated estimated factors is extracted, which nevertheless captures a large part of the general or shared dynamics (the common components) contained in the original larger set of variables. The first factor contains the highest share of common information. When applying factor analysis to the disaggregated prices, it is hence assumed that the dynamics of (or variation in) disaggregated prices can be characterised by a vector of the common component C and series-specific components e:

$$\pi_{it} = \lambda_i' C_t + e_{it}. \tag{10}$$

This approach follows a similar reasoning as the decomposition of Bryan and Cecchetti (1993) shown in Equation (7). The applied method for factor determination is as in Stock and Watson (2002). Factors were calculated from the indices in monthly frequency. The relation between the first factor and the ICSP and other inflation measures was learned from the correlation coefficients.

3.2 HICP and components

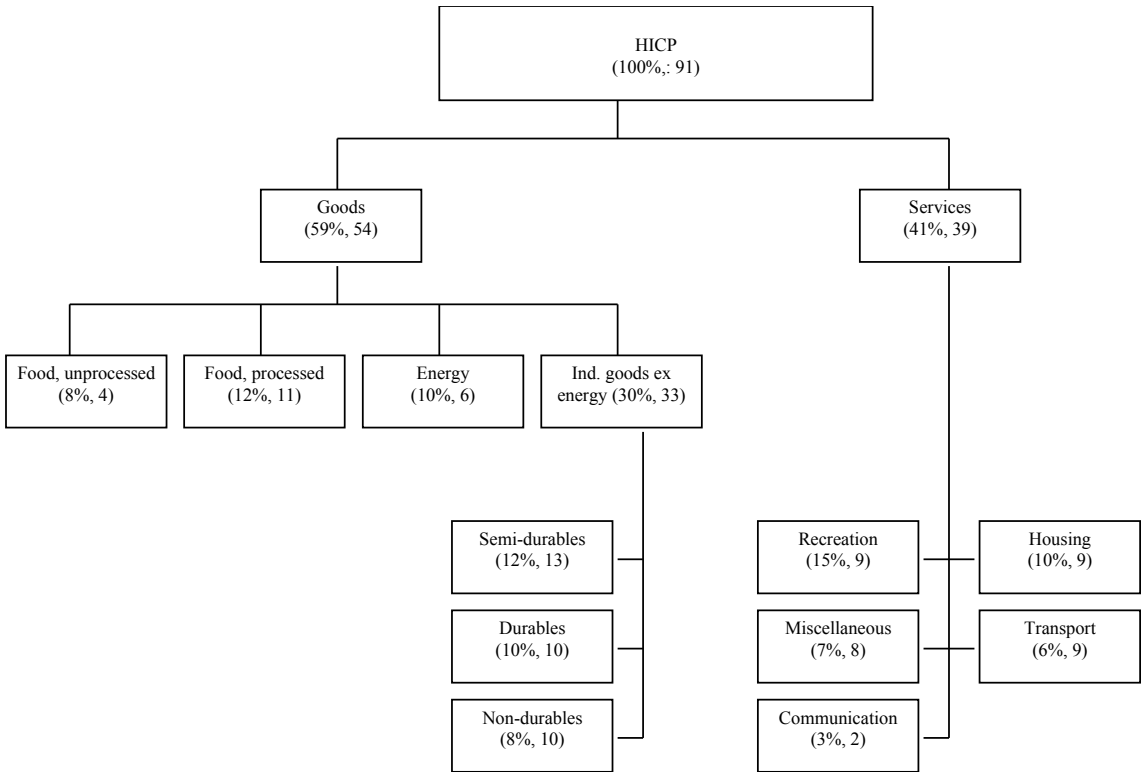
Our data set includes disaggregated consumer price indices (HICP, COICOP four-digit-level) for the euro area as a whole and for the 16 countries that formed the euro area in 2009. The price indices are published by Eurostat. Figure 3.1 presents the main components (broad categories) of the euro area HICP as typically used by the ECB, the number of included product groups and their weights in 2009. Food prices (including alcohol and tobacco) account for close to 20 %, industrial goods for 30 %, energy prices for 10 % and services 40 % of the HICP. All of these categories can comprise administered prices (partly or fully), which are supposed to be relatively little affected by the business cycle. In the euro area, these make up about 10 % of the consumer basket.[12]

[11] It is also used in forecasting models for inflation such as in e.g. Lenza and Warmedinger (2011). These data sets can include a broader set of time series in addition to the price data to take the dynamics of inflation determinants into account.

[12] Most of these prices belong to services, but they can also include industrial goods (e.g. water supply) and some energy categories in some of the member states. For the euro area as a whole, Eurostat does

As regards the number of 4-digit COICOP subcomponents – our main focus –, for the member states this can be as much as 93 product groups. However, this number need not apply to all countries as it depends on the spending patterns (for the euro area as a whole only 91 broad categories are compiled currently). A straightforward example for an excluded item is transport by rail for Malta, but many other such cases exist. Furthermore, for some items the series start later – e.g. for nearly all countries items such as health care related services. Table A.1 in the Appendix lists all 4-digit COICOP series, their weight in the euro area aggregate in 2009, the average inflation rate between 1997 and 2009 and its variation (standard deviation).

Figure 3.1: Composition of the euro area HICP, 2009



Source: Eurostat. In parentheses share in the euro area HICP and number of items belonging to this class.

Figure A.2 in the Appendix shows the countries' weights in the euro area in 2009 and the share of the main components in the member states' HICP. The two largest countries (Germany and France) accounted for 46 %, the five largest countries accounted for 83 %, and the seven largest countries (44 % of the 16 member states) for 90 % of the euro area's HICP. The weights of the components can differ markedly between the euro area member states. The weight of food prices (in 2009) ranged between 16 % (Austria) and 24 % (Slovakia); that of

not publish the data on administered prices (only for the member states). The weight indicated above is calculated by the authors.

energy between 6.5 % (Malta) and 16 % (Slovakia); industrial goods prices excluding energy 24 % (Ireland) and 32 % (Luxembourg); and that of services between 32 % (Slovakia) and 47 % (Austria). The core rate excluding energy prices, food prices and administered prices incorporates between 51 % (Slovakia) and 81 % (Finland) of the index.

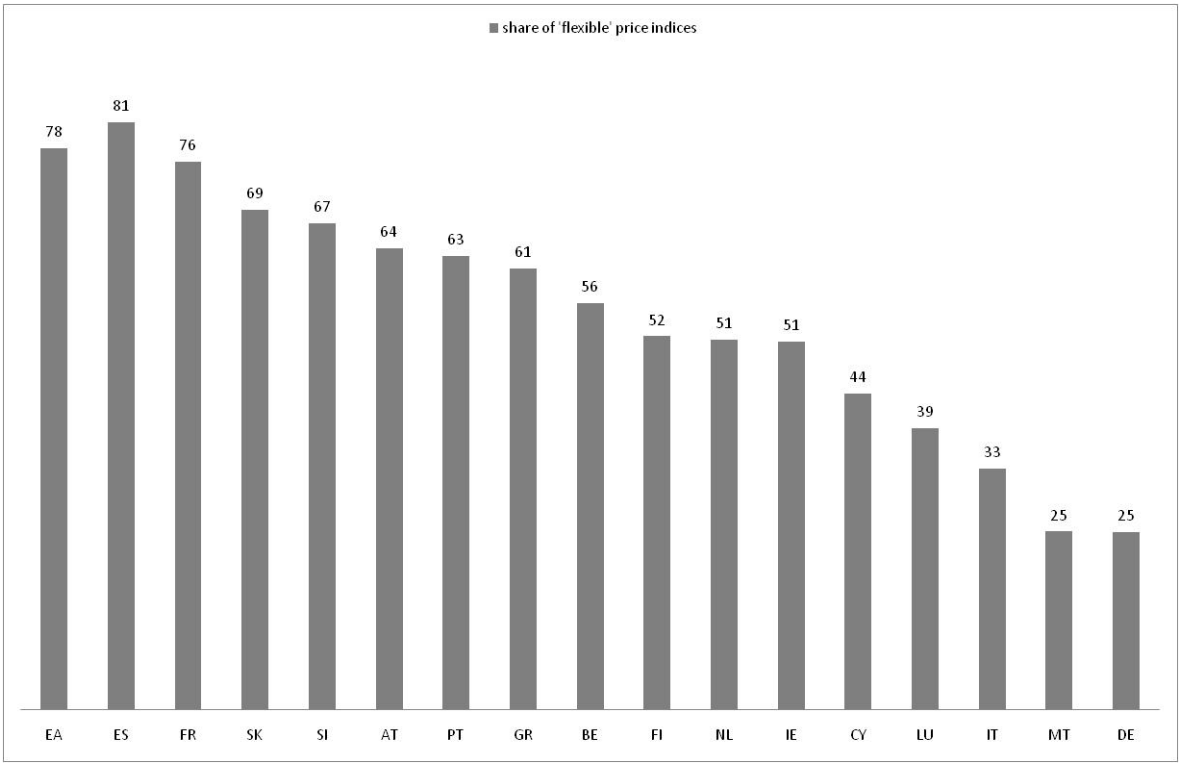
3.3 Flexibility of the disaggregated price indices

As it was suggested in the literature (Bryan and Mayer, 2010) that it is the more flexible prices that react to the output gap, we examined the "flexibility" of the indices included in our data set. Admittedly, flexibility or stickiness of prices is most meaningfully defined with reference to the individual store level price. Only in very rare cases an aggregate price index at whatever level of aggregation can convey information about the flexibility or stickiness of the underlying prices. Nevertheless, a co-movement between the disaggregated price indices with the business cycle still requires that the indices change; the frequency of a change in the index might therefore be of some interest. We defined flexibility as an index changing in more than 84 % of months, on a seasonally unadjusted basis, admittedly an arbitrary choice. It is a rather narrow definition of flexibility; the average duration of a flexible price index spell is 1.2 month. As a result, because the sensitivity towards the output gap is checked for lags 0 to 4, i.e. a whole year, flexibility and cyclical sensitivity need not overlap by definition.[13]

'Flexibility' defined as above differs markedly between the euro area member states (Figure 3.2). For the euro area aggregate, 67 of the 91 four-digit COICOP series change in at least 85 % of the months (78 %). The share of flexible items is higher than for the euro area aggregate in only one member state (Spain), while in eleven member states, this share is above 50 %. However, in a few member states, including Germany, Italy and the small member states of Malta, Cyprus and Luxembourg, the shares of flexible items are strikingly low. The origin of such differences is difficult to establish. According to these simple calculations, aggregation matters as the share of 'flexible' price indices in the euro area aggregate is higher than both the weighted and simple averages of the member states. It might be worthy of mention that as regards the four-digit COICOP series, some can be 'flexible' at the member states level and 'sticky' on the euro area level and vice versa.

[13] Also according to the theoretical and empirical literature presented in Section 2, the link is not unequivocal. In the framework of the hybrid NKPC, prices can also be changed in a backward-looking manner. The empirical literature pointed to prices being adjusted also in reaction to idiosyncratic shocks.

Figure 3.2: Share of 'flexible' 4-digit COICOP price indices



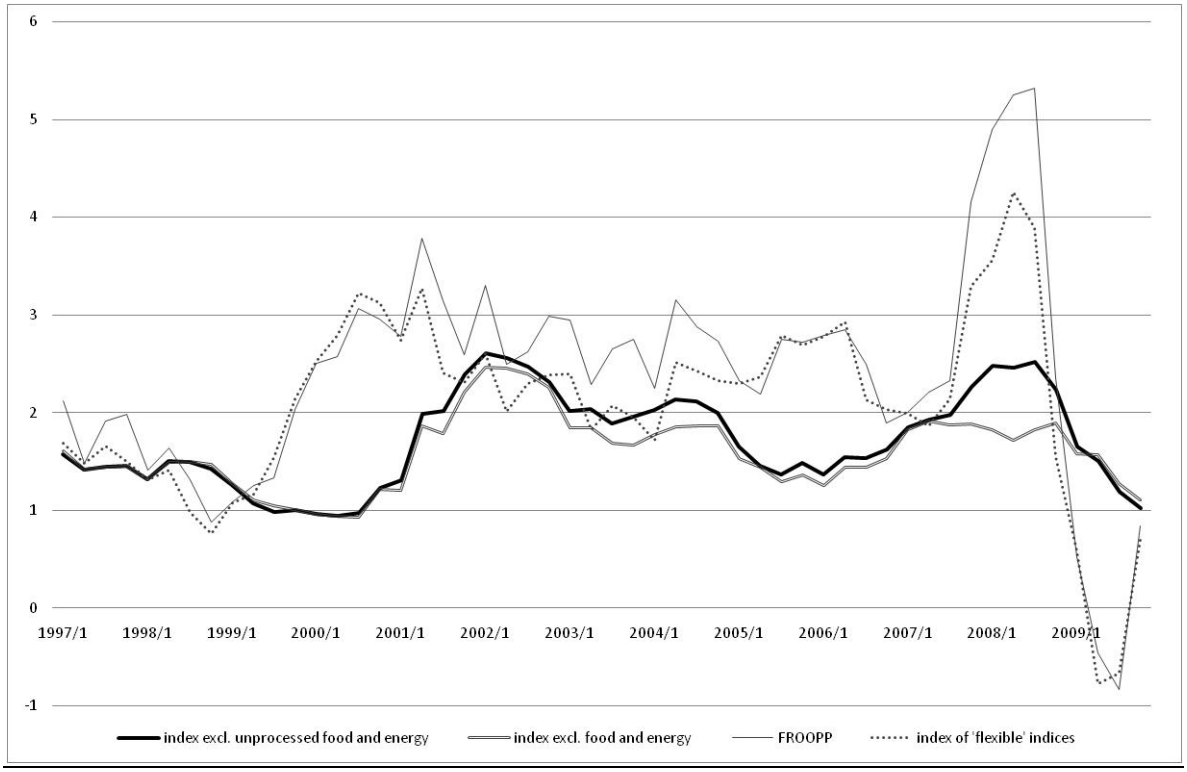
Source: Calculation of the authors based on Eurostat data. 'Flexible items' is defined as price indices that change in more than 84 % of months. For a discussion of 'flexible price indices' see text.

3.4 For comparison: Core inflation and special aggregates

To gauge the relative performance of the newly created index of cyclically sensitive prices (ICSP), we selected a number of core and special indices useful for comparison. Core inflation is a natural choice as it was used in recent estimations of output sensitivity in the euro area (OECD, 2011; European Commission, 2011). It is expected to abstract from the volatile and "noisy" components of inflation and reflect the underlying trend (e.g. Silver, 2007). Some authors suggest that it should reflect the business cycle and thus help predict inflation (e.g. Stock and Watson 2008). Core inflation rates typically used by central banks exclude from the CPI the most volatile components, i.e. energy prices and the prices of unprocessed food items. In some cases all food items and alcohol and tobacco (particularly affected by taxation) are excluded.[14] We considered both core indices in our investigation.

[14] The most appropriate derivation is an open issue (Silver, 2007; Roger, 1998). In addition to the exclusion of some items core rates can also be determined through the application of several filters, calculation of trimmed means or the persistent component. Also the first factor (principal component) extracted from disaggregated data is used to represent core inflation (Machado et al., 2001; Cristadoro et al., 2001).

Figure 3.3: Inflation rates of selected core indices and special aggregates in the euro area



Source: Eurostat, ECB, own calculations. Note: FROOPP stands for the special aggregate of 'frequent out-of-pocket-purchases'. See text for further explanations.

We further added the special aggregate of frequent out-of-pocket-purchases (FROOPP, Eurostat 2009). It was designed to measure inflation of those relatively inexpensive items that are most often purchased and, therefore, perhaps most easily adjusted when domestic market conditions change. The FROOPP includes all food prices and hence the most volatile components. Its weight in the euro area HICP in 2009 was 46 %. The FROOPP series for the member states were calculated by the authors based on its composition specified by Eurostat (2009).

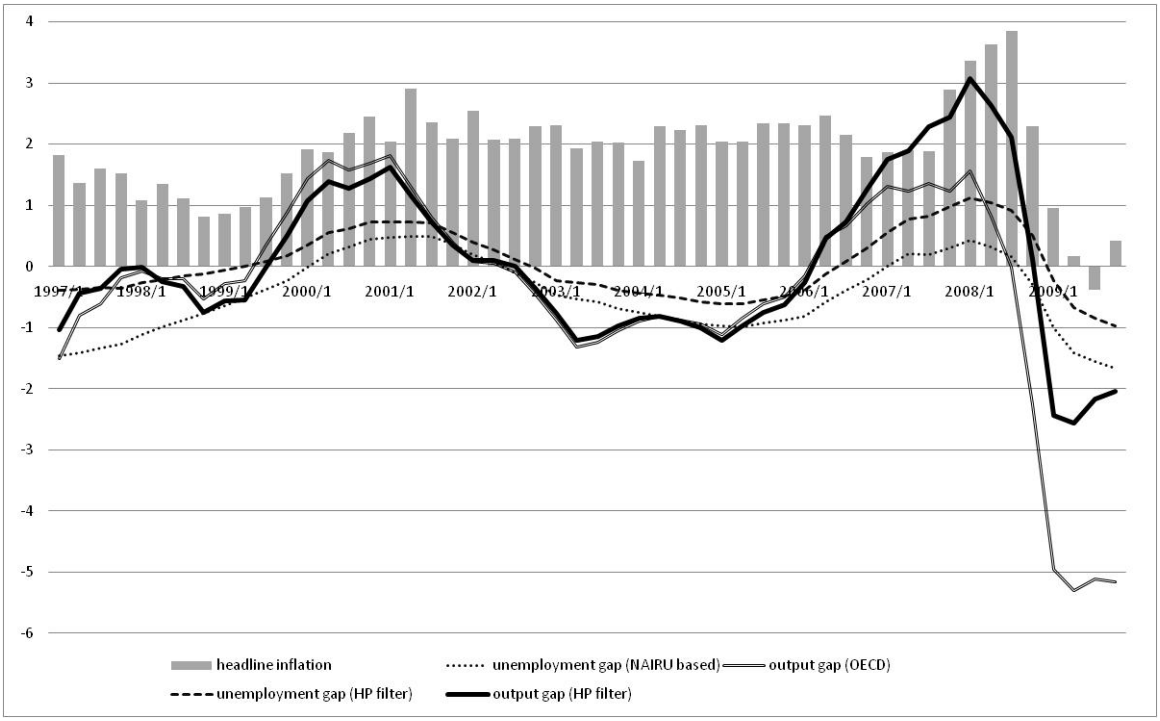
Finally, our newly created ISCP-series is compared to an index of flexible prices calculated along the lines described in Section 3.3 and an index of sticky prices, which includes all items not classified as flexible. The inflation rates of the two core series, the FROOPP and the flexible items' index are presented in Figure 3.3.

3.5 Output gap and control variables

The euro area inflation rates are related to the euro area output gap, and the inflation rates of the member states to their respective domestic output gap on a quarterly basis. For all

countries we considered two output gap measures, one reflecting deviations of the GDP from a corresponding HP–filtered series, the other deviations of the unemployment rate from the HP filter applied to the unemployment rate. Where available, we also used the output gap and the NAIRU gap calculated by the OECD on a quarterly basis.[15]

Figure 3.4: Euro area inflation (HICP) and output and unemployment gap measures



Source: Eurostat, OECD, own calculations.

The trend output based on the HP filter was calculated with GDP time series that go beyond the investigated period for all countries where this was possible to ease the endpoint problem. However, quarterly GDP series according to the (currently applied) harmonised chain-linked compilation system start only in 1995 for Spain, Portugal, Greece, Luxembourg, Cyprus, Slovenia, in 1997 for Ireland, and in 2000 for Malta. Where possible, the series were extended with the volume series compiled within the previous system of fixed prices of 1995 (Spain, Portugal, Greece) or other volume reference series (Ireland).[16] For Luxembourg, Cyprus and Slovenia, trend output (using the HP filter) was calculated starting in 1995. For Malta the GDP series was extended with an interpolated annual GDP series.

[15] These countries are: Germany, France, Italy, the Netherlands, Finland, Ireland, Slovakia.

[16] In some cases (e.g. Spain, Portugal and Greece) we extended the current chain-linked GDP series with the real GDP series with fixed prices of 1995 from the OECD Quarterly National Accounts database. For Ireland we used the volume reference series from the OECD Quarterly National Accounts.

According to Figure 3.4, which contains the four gap measures and headline inflation for the euro area for the time period studied in the empirical tests, the unemployment gaps are generally less volatile; the HP based series and the OECD series (NAIRU gap) are quite similar. The output gap appears to be subject to more pronounced swings than the unemployment gap. Furthermore, the two output gap measures diverge markedly during the most recent boom and recession phase. The HP filter based output gap indicates a stronger boom in 2008 and a milder recession in 2009, while the OECD production function based output gap points to an exceptionally deep recession in 2009.

The control variables used in the econometric estimations of output sensitivity are nominal effective exchange rates (from Eurostat), import prices (from the national accounts published by Eurostat), oil prices, world commodities, food commodities and agricultural raw materials price indicators (all converted to euro, from the IMF IFS Commodities Prices database).

4 Cyclical sensitivity of disaggregated price indices

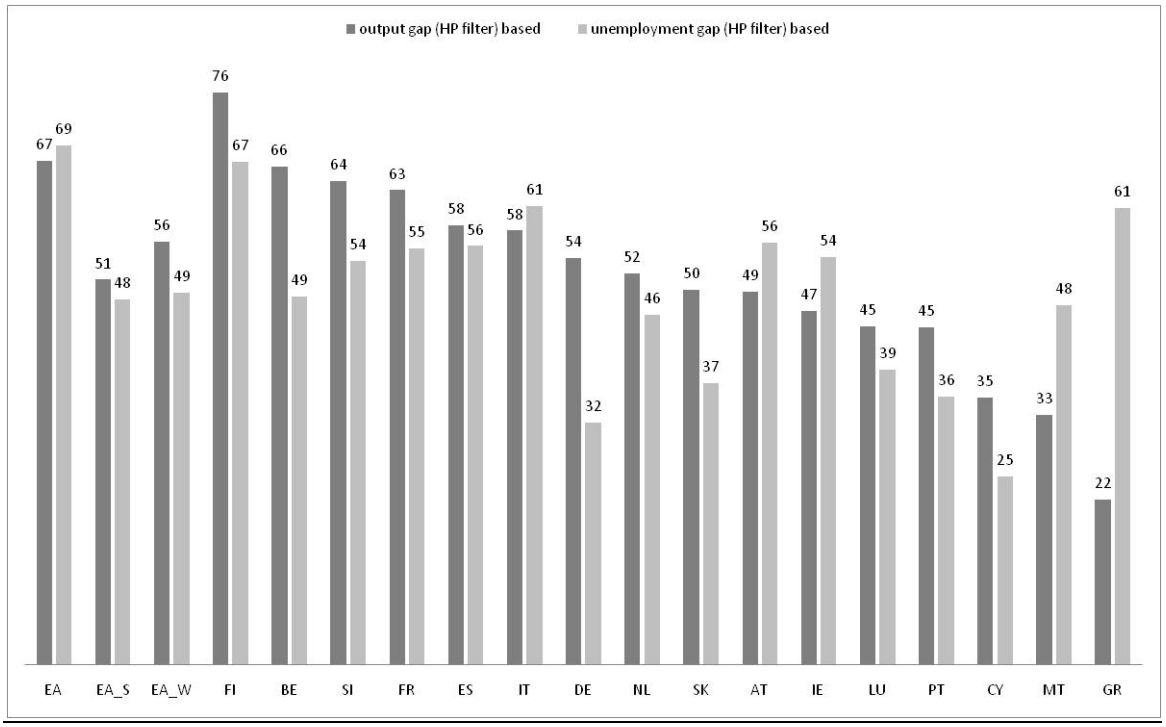
4.1 Weight of the cyclically sensitive components in the HICP

According to our estimations for the euro area (direct approach), 57 of the 91 items in the HICP react to the output gap (HP based), their combined weight in the HICP in 2009 was 67 %. The result is rather similar for the unemployment gap (HP based), as 60 items are found to be cyclically sensitive, with a combined weight of 69 % (Figure 4.1).

The indirect calculation of the weight of sensitive components in the euro area HICP via aggregation of member state results leads to a slightly different picture: As regards the output gap (HP) based sensitivity, the (weighted) share of cyclically sensitive items in sixteen member states is 56 %, more than ten percentage points below that determined in the direct (euro area aggregate) estimation. It is even lower for the simple average (51 %). On the face of it, the differences in the weights determined through the direct estimation and the indirect estimation point to an aggregation bias related to the fact that on a higher level of aggregation, the idiosyncratic components "wash out" and the common components get accentuated (OECD, 2000:109). However, the euro area output gap need not be an unbiased estimate of the average of the member states' output gaps. Furthermore, factors considered non-domestic for (in particular) some smaller euro area member states need not be non-domestic at the euro area level. Therefore, it may be even unlikely that the member states' results as regards the sensitivity towards fluctuations in their respective national economy could be mapped in a

straightforward manner into the euro area aggregate. It raises, however, the question how to define most suitably "domestic" economic activity in the euro area.[17]

Figure 4.1: Weight of the cyclically sensitive components in the HICP for the euro area and 16 member states (ranked by output gap results)



Source: Calculations of the authors. 'EA_S' stands for 'simple average of the member states' results', and 'EA_W' for 'weighted average of the member states' results'.

In the member states, the weight of the cyclically sensitive price series for the output gap (HP filter based) is rather heterogeneous: It ranges between 76 % (Finland) and 22 % (Greece).[18] With the exception of Finland, in all member states the weight of the cyclically sensitive components is smaller than for the euro area aggregate. However, in ten member states the weight of the sensitive components is at least 50 % (in Austria close to 50 %). The five largest member states can be found in the upper midrange and many small and medium-sized countries are found to have a rather low weight of cyclically sensitive items (although the three countries with the highest weight of cyclically sensitive prices - Finland, Belgium and Slovenia - are smaller sized). This could be in line with the proposition that prices in the smaller (and

[17] This point should be investigated further in future work.
[18] Table A.2 in the Appendix contains results based on the number of sensitive items. These are very similar to the weighted shares.

supposedly more open) economies are to a bigger extent determined through the international price movements (which can include those in the larger euro area countries).

The results for the unemployment gap are similar to those found for the output gap (HP based) in that the range among the euro area member states of the weights of cyclically sensitive components is rather wide. The weights range between 67 % (Finland) and 25 % (Cyprus). In eleven countries, the weight of the components that are sensitive to the unemployment gap is lower than the weight of the components that move with the output gap. These deviations are in most cases within a range of 10 percentage points. Only for Greece and Germany, the differences are substantial.

Figure A.3 in the Appendix presents the weights of the sensitive components in the estimations using the OECD gap measures for the countries where such gap measures are available. The results are rather similar to those found for the gap measures based on the HP filter, the only exception being Ireland where the OECD measures both point to substantially more pronounced cyclical sensitivity than the HP based measures of activity.

4.2. Cyclical sensitivity of broad categories and individual items in the euro area (direct approach)

Next we identified the share of cyclically sensitive items in the euro area broad categories. To determine the weight of cyclically sensitive items in a subgroup, we related the weight of all sensitive 4-digit COICOP items in the respective subgroup to the HICP-share of the respective subgroup.[19] Table 4.1 presents the weights of the cyclically sensitive items in the main categories for all four gap measures, the number of items belonging to a subgroup, the weight in the HICP and the share of the "flexible" items.

Only in rare cases all of the prices of a particular sub-component (sub-aggregate) are found to move with the business cycle. At the same time, in all cases at least some of the prices included in a particular sub-aggregate move with the business cycle. To start with the broad decomposition into goods and services, the weight of the cyclically sensitive components is – broadly speaking – rather similar for goods and services (the average of the four results being 71% and 69 %, respectively). However, the results do differ for the four gaps, with the range being higher for services.

[19] Table A.3 in the Appendix contains the same analysis for the number of items found to be cyclically sensitive. Again, the results do not differ much from the weighted results.

Table 4.1: Weight of the cyclically sensitive items in the euro area HICP and selected subgroups (direct estimation)

	Weight in HICP in 2009	No of items	weight of cyclically sensitive or flexible items				
			GAP GDP (HP)	GAP UNEMPL (HP)	GAP GDP (OECD)	GAP NAIRU (OECD)	*Memo item: Flexible indices*
HICP overall	**100**	**91**	**67**	**69**	**75**	**68**	***78***
CORE-XEUP	83	81	62	63	71	66	*80*
CORE-XEF	71	70	60	58	72	61	*84*
SERVICES	**41**	**37**	**67**	**64**	**80**	**63**	***76***
HOUSING	10	9	19	19	82	22	*88*
TRANSPORT	6	9	76	53	78	61	*93*
COMMUNIC.	3	2	95	95	95	95	*0*
RECREATION	15	9	100	93	91	84	*91*
MISCEL.	7	8	45	63	45	63	*50*
GOODS	**59**	**54**	**67**	**72**	**72**	**71**	***84***
UNPROC. FOOD	7	4	100	100	100	85	*100*
PROC. FOOD	12	11	73	97	71	95	*48*
ENERGY	10	6	85	93	85	69	*76*
IND. GOODS (excl. EN)	**30**	**33**	**50**	**49**	**60**	**59**	***87***
DURABLES	10	10	39	50	85	87	*84*
SEMI-DURABLES	11	13	51	39	39	32	*94*
NON-DURABLES	8	10	61	61	61	61	*81*

Source: Eurostat, own estimations.
Note: 'CORE-XEUP' stands for the index excluding unprocessed food and energy, 'CORE-XEF' stands for the index excluding all food and energy items.

Within goods, unprocessed food appears to be the category with the highest weight of cyclically sensitive components (100 % for three of four gap measures). That category is typically not included in the calculation of core inflation owing to its strong volatility. It is neither assumed to be the prime candidate for cyclically sensitive prices. It is, however, also the category with the highest share of flexible prices. In goods, the category with the second highest weight (based on the average of the four gap measures) of cyclically sensitive prices is processed food (84 %).[20] Seven[21] out of the eleven categories included here are found co-moving with all four gap measures; while for 'coffee, tea and cocoa' responsiveness could not be established to any gap measure. A nearly equal weight as for processed food is determined for energy prices, also too volatile to be included in core inflation measures.

Industrial goods excluding energy have a rather low weight of cyclically sensitive prices (54 % on average). Of that, semi-durables appear to be least sensitive (40 %). That is, however,

[20] Here, in contrast, the share of flexible items is rather low (48 %), also when compared with all other categories.
[21] These are: 'bread and cereals', 'milk, cheese, eggs', 'sugar, jam, honey and chocolate', 'mineral waters, soft drinks', 'wine', 'beer' and 'food products n.e.c'.

due to the fact that the two categories with the highest weight ('garments' and 'shoes', combined weight in semi-durables of 56 %) do not co-move with any measure of the business cycle. The result for durables (65 %) differs strongly among the different gap measures because 'motor cars' (weight in the HICP of 4.3 % and 43 % in durables) are found cyclically sensitive only to two output gaps. For non-durables the results are the same for all gap measures used. Six categories are found to be robustly related to the business cycle (significant with all gaps).[22]

Among services, the category with the highest sensitivity in terms of the average weight found for the four gap measures is communications services. This group however contains only two items and makes up only 3% of the consumer basket. The item that reacts to all investigated business cycle measures (and has a weight of 95 % in that category) is 'telephone and telefax equipment and telephone and telefax services', which actually appears to contain a mixture of goods and services. Next comes 'recreation and personal services' with an average weight of cyclically sensitive components of 92 %. It contains nine items and makes up 15 % of the consumer basket. The share of sensitive items is nearly as high as that of unprocessed food and higher than that of processed food. Seven out of the ten items included here respond to all four gap measures. Of these, the most important item is 'restaurants and cafes' (weight of 6.9 % in the HICP), followed by 'accommodation services' (1.7 %), 'package holidays' (1.6 %) and 'hairdressing' (1.2 %). In transport services, 67 % of the category reacts to the business cycle. For two of the nine items the co-movement is rather robustly established as they were found reacting to all four gaps, one further item is co-moving with three gap measures. However, items related to railway, road transport, air transport were sensitive only to one or two gap measures. From miscellaneous services, which include many different items from medical services to financial services and education, only half of the weighted basket reacts to the business cycle. In the case of housing services, the average of the results of the four gaps is 36 % (lowest of all categories).

To summarise these results, the categories that appear most robustly related to the business cycle are the rather volatile (and flexible) groups of unprocessed food and energy prices, processed food and two services categories. Judged by the average weight of cyclically sensitive components, industrial goods excluding energy and services are less strongly affected by output or unemployment gaps than food and energy products, although both categories include highly cyclically sensitive items. Furthermore, we cannot confirm that "tradables"

[22] These are: 'Materials for the maintenance and repair of the dwelling', 'non-durable household goods', 'pets and related products', 'newspapers and periodicals', 'misc. printed matters and stationary products', 'electric appliances'. The categories that are not sensitive to any gap measure are: 'water supply', 'pharmaceutical products', 'other medical products' (all items often regulated) and 'gardens, plants and flowers'.

approximated by goods or industrial goods would be less cyclically sensitive than services (considered "non-tradables"; the reasons for cyclical insensitivity may nevertheless differ). If anything, cyclical sensitivity seems stronger for items distributed through the retail sector and/or related to leisure (i.e. superior goods).

4.3 Cyclical sensitivity of broad categories and individual items in the euro area based on member states' results (indirect approach)

To obtain the results for the euro area indirectly via the member states we first classified the results for each of the 16 member states as in Table 4.1 above for the euro area as a whole. We then calculated simple averages and weighted averages of the respective shares to determine which categories are the most cyclically sensitive on average in the member states. The weight of country *k*'s component *i* in the euro area component is given by:

$$weight_k^{EA,i} = \frac{\alpha_k^{EA}\beta_i^k}{\beta_i^{EA}}$$

with α = country weight and β = component *i*'s weight in country *k* or in euro area. Table 4.2 shows the simple average of the weights in the member states, the weighted averages, the minimum and maximum values and the (already presented) results for the direct calculation. Because we wish to include comparable results for all member states, these calculations were made for the two HP based gaps.

For all main subgroups, the range of weights determined for the member states is rather wide (between 60 and 100 percentage points). For many categories, in at least one member state, no subcomponent reacts to the business cycle. At the same time, the highest share of cyclically sensitive prices determined in a member state is often close to 90 %, in some cases even 100 %. In line with the overall weights of cyclically sensitive items presented in Section 4.1, in the subgroups also the weight of the cyclically sensitive items is often lower in the smaller countries (which is why the weighted average often exceeds the simple average). Most strongly this applies to the categories of energy and unprocessed food, where the difference between the weighted and simple average is twenty percentage points for the output gap and the variation measured through the standard deviation is very high.

Table 4.2: Weight of the cyclically sensitive items in the euro area HICP and in selected subgroups (indirect approach via member states' results)

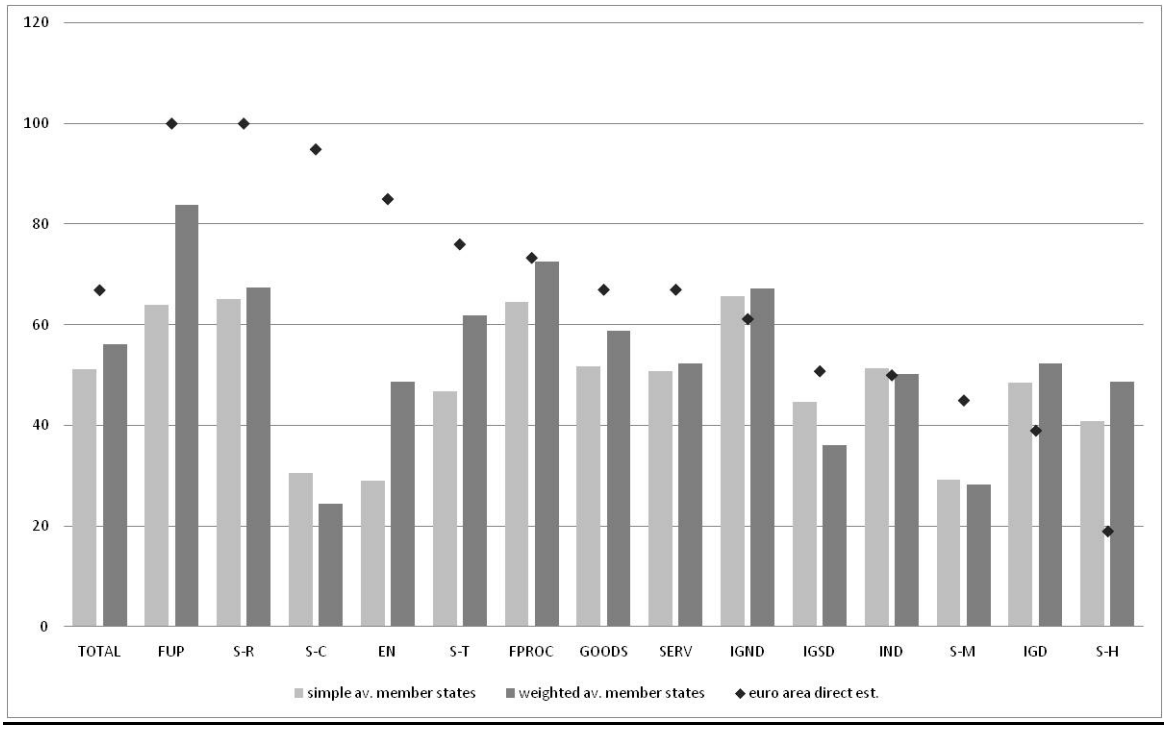
OUTPUT GAP (HP based)						
		euro area member states				
	Euro area (direct est.)	simple average	weighted average	minimum weight	maximum weight	standard dev. of weights
TOTAL	**67**	**51**	**56**	**22**	**76**	**13**
CORE-XEUP	62	53	54	18	78	13
CORE-XEF	60	51	51	13	73	14
GOODS	**67**	**52**	**59**	**22**	**81**	**17**
PROC. FOOD	100	65	73	33	97	17
UNPROC. FOOD	73	64	83	0	100	33
ENERGY	85	29	50	0	100	32
IND. GOODS excl. EN	**50**	**51**	**50**	**17**	**86**	**20**
DURABLES	39	49	51	0	91	30
NON-DURABLES	51	66	68	22	100	20
SEMI-DURABLES	61	45	37	8	92	30
SERVICES	**67**	**51**	**52**	**9**	**73**	**15**
HOUSING	19	41	47	0	98	31
TRANSPORT	76	47	59	0	88	27
COMMUNICATION	95	30	24	0	100	45
RECREATION	100	65	67	0	88	19
MISCELLANEOUS	45	29	29	0	73	18
UNEMPLOYMENT GAP (HP based)						
		euro area member states				
	Euro area (direct est.)	simple average	weighted average	minimum weight	maximum weight	standard dev. of weights
TOTAL	**69**	**48**	**49**	**25**	**67**	**11**
CORE-XEUP	63	51	52	27	67	10
CORE-XEF	58	49	49	18	66	12
GOODS	**72**	**46**	**49**	**22**	**63**	**12**
PROC. FOOD	100	58	65	27	93	20
UNPROC. FOOD	97	58	52	0	100	32
ENERGY	93	24	24	0	95	27
IND. GOODS excl. EN	**49**	**46**	**48**	**20**	**76**	**14**
DURABLES	50	44	48	0	86	28
NON-DURABLES	39	50	60	21	81	16
SEMI-DURABLES	61	48	42	11	83	24
SERVICES	**64**	**51**	**50**	**17**	**78**	**17**
HOUSING	19	38	29	1	92	33
TRANSPORT	53	38	49	0	87	25
COMMUNICATION	95	43	34	0	100	48
RECREATION	93	68	74	10	91	23
MISCELLANEOUS	63	41	40	0	85	23

Source: Estimations of the authors. Note: 'CORE-XEUP' stands for the index including unprocessed food and energy; 'CORE-XEF' stands for the index including all food and energy items. Standard deviation of the weights is calculated relative to the simple average of the member states. Second column repeats results shown already in Table 4.2, Column 2.

The average shares in the member states, weighted or simple, are in some cases markedly lower than the directly determined weight for the euro area. Figure 4.2 visualises this for the output gap results (included in Table 4.2). The biggest differences are found for the categories 'unprocessed food', 'services related to recreation', 'services related to

communication' and 'energy'. By contrast, rather similar weights are determined for processed food and non-durable industrial goods. The weights determined for durable goods and housing services are higher when the member states' results are aggregated. The bias appears to be even larger for the unemployment gap. The highest deviation (70 percentage points) is found for energy products but it is substantial in all categories except industrial goods excluding energy and miscellaneous services.

Figure 4.2: Comparison of weights determined for output sensitivity in the member states and the euro area



Note: 'FUP' stands for unprocessed food, 'S-R': services related to recreation, 'S-C': services related to communication, 'EN': energy, 'S-T': services related to transport, 'FPROC': processed food, 'goods': all goods (industrial goods, food, energy), 'SERV': all services combined, 'IGND': non-durable industrial goods, 'IGSD': semi-durable industrial goods, 'IND': all industrial goods excluding energy, 'S-M': miscellaneous services, 'IGD': durable industrial goods, 'S-H': services related to housing.

That notwithstanding, the ranking of the categories that appear most robustly sensitive towards the output gap stays broadly the same in the indirect approach compared with the direct estimation for the euro area: processed and unprocessed food prices are followed by those of services (especially related to recreation) and of industrial goods (especially non-durable industrial goods). Energy and services related to communication, however, which appear highly cyclically responsive for the euro area as a whole, are not as strongly cyclically sensitive when judged from the member states' results.

A brief look at the most disaggregated results of our estimations lends further credence to the ranking established above. Table 4.3 contains the twenty items assessed as the most cyclically sensitive towards the output gap[23] in the highest number of member states. The third column indicates the number of countries where this item is found cyclically responsive and the fourth column presents the joint weight of these countries in the respective euro area component. It may not come as a surprise that the three individual items assessed as the most cyclically responsive in the member states belong to processed food, services related to recreation and non-durable goods. Overall, for no item responsiveness could be established in all member states, the highest number of member states is therefore 15.

Table 4.3: Items with the most robust cyclical sensitivity in the member states (HP output gap based)

4-digit COICOP item	Sub-category	No. of countries with cycl. sensitive item	Joint weight in euro area component	Weight of item in euro area HICP
Bread and cereals	processed food	15	99.6	2.6
Electric appliances and other appliances etc. for pers. care	non-durable goods	15	99.9	1.7
Restaurants, cafes and the like	services /recr./	15	93.2	6.9
food products n.e.c.	processed food	14	98.7	0.4
Glassware, tableware and household utensils	semi-durable goods	14	99.1	0.6
Milk, cheese and eggs	processed food	13	98.6	2.3
Sugar, jam, honey, chocolate and confectionary	processed food	13	95.5	1.0
Beer	processed food	13	95.9	0.5
Furniture and furnishings	durable goods	13	97.9	2.3
Materials for the maintenance and repair of the dwellings	non-durable goods	13	96.7	0.6
Pets and related prod. incl. veterinary & other serv. for pets	non-durable goods	13	93.6	0.5
Oils and fats	processed food	12	46.0	0.5
Wine	processed food	12	62.4	0.7
Meat	unprocessed food	12	96.2	3.6
Non-durable household goods, n.e.c.	non-durable goods	12	78.1	1.1
Mineral waters, soft drinks, fruit and vegetable drinks	processed food	11	95.1	1.0
Fruit	unprocessed food	11	90.9	1.2
Newspapers and periodicals	non-durable goods	11	95.9	0.9
Misc. printed matter and stationery and drawing materials	non-durable goods	11	93.4	0.3
Games, toys and hobbies	semi-durable goods	11	79.3	0.5

Source: Calculations of the authors.

For the first ten items, the weight of the reacting countries in the euro area component is always above 90 per cent; however, if responsiveness is reported for only 12 countries, the weight in the euro area component can decline to 46 %. In such a case, the component was not found responsive in more than one of the four large countries. Among the first twenty components, there are eight processed food items (of 11 subcomponents in that group), two items of unprocessed food, nine industrial goods (six non-durables, two semi-durables, one

[23] The results for the unemployment gap are in the Appendix, Table A.4.

durable good; most of them appear to be connected to the "dwelling" in a wide sense), and one item from services (one with a rather large weight in the HICP – 'restaurants, cafes and the like'). If the twenty most responsive categories are determined from their weight in the euro area component, these are made up by six items from processed food, two items of unprocessed food, eight industrial goods (five non-durables, one semi-durable, two durable goods), three items from services, and one energy product (electricity).

Table 4.4: Items with the least robust cyclical sensitivity in the member states (HP output gap based)

4-digit COICOP item	Sub-category	No. of countries with cycl. sensitive item	Joint weight in euro area component	Weight of item in euro area HICP
Heat energy	energy	4	8.4	0.6
Other services relating to the dwelling	services /housing/	4	10.8	0.9
Passenger transport by railway	services /transport/	4	21.4	0.5
Insurance connected with transport	services /transport/	4	21.5	0.9
Recreational and sporting services	services /recr./	4	24.5	1.0
Education	services /misc./	4	38.0	1.0
Hospital services	services /misc./	4	21.8	0.6
Pharmaceutical products	non-durable goods	3	4.0	1.2
Postal services	services /comm./	3	1.7	0.2
Insurance connected with health	services /misc./	3	52.5	0.6
Tobacco	processed food	2	2.2	2.3
Fuels and lubricants for personal transport	energy	2	38.5	4.0
Refuse collection	services /housing/	2	3.7	0.5
Sewerage collection	services /housing/	2	1.7	0.4
Combined passenger transport	services /transport/	2	55.6	0.5
Cultural services	services /recr./	2	10.3	1.4
Other insurance	services /misc./	2	7.3	0.2
Information processing equipment	durable goods	1	0.2	0.5
Mainten. & repair of other major durab. for recreat. & culture	services /recr./	1	0.0	0.0
Financial services n.e.c.	services /misc./	1	2.4	0.6

Source: Calculations of the authors.

As regards the least sensitive components, there is always at least one country where a given product group is assessed as cyclically responsive (Table 4.4). The weight in the euro area item can nevertheless be rather high. For instance, the high weight of 56 % (in the euro area aggregate) in 'combined passenger transport' is due to the fact that only in two countries (Germany, Austria) this item is of some importance in the consumer basket, and in both countries this item is also cyclically responsive. Of the categories that are found to be the least cyclically sensitive, fifteen belong to services (of which five are miscellaneous services, three related to housing, three to transport, three to recreation and one to communication), two items are industrial goods, two energy items and one item from processed food (tobacco).

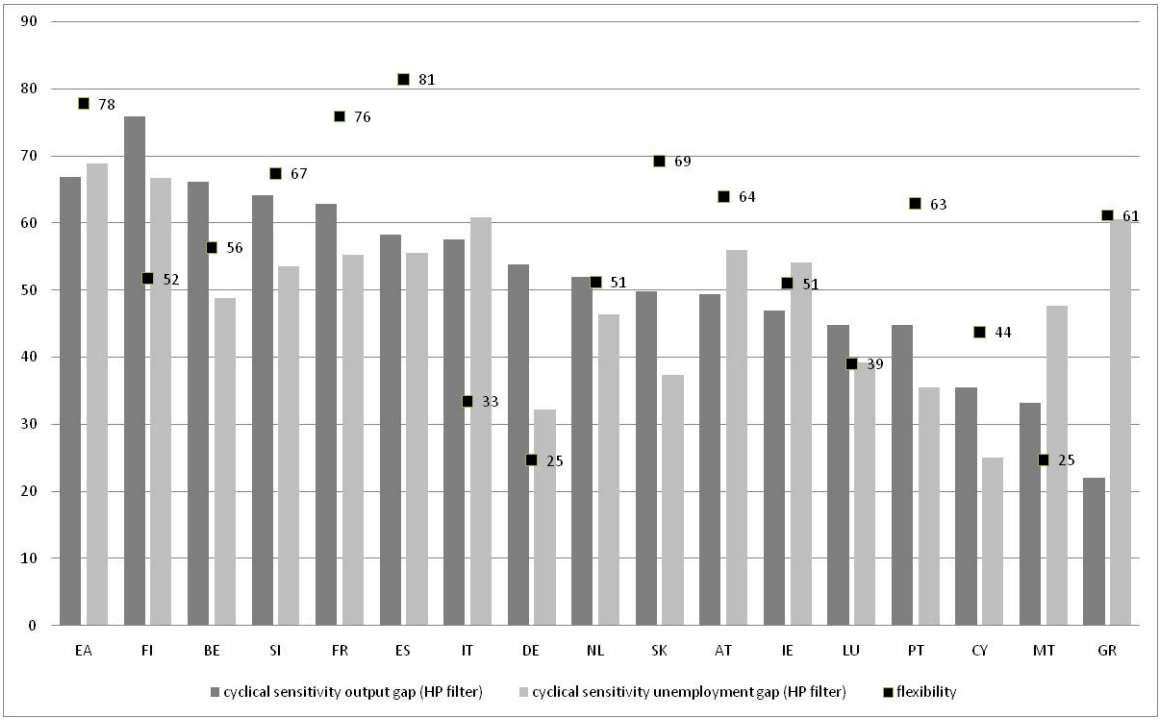
4.4 Cyclical sensitivity and flexibility

We already indicated that out of several considerations flexibility and output sensitivity need not overlap. Categories can be cyclically sensitive but not flexible if the reaction to the output gap is lagged. Likewise, items can be flexible but not cyclically sensitive if their flexibility is exercised in reaction to other (macroeconomic or item-specific) influences. But irrespective of that, given the general problem that the flexibility of the aggregate cannot be easily linked to the behaviour of the underlying prices, and the practical problem of the sharp (and unexplained) divergence in the flexibility of the disaggregated indices in the euro area member states, it might be doubtful whether a meaningful relation between cyclical sensitivity and flexibility of these disaggregated price indices can be obtained. We therefore did not attempt a detailed investigation of the link here. Instead, we first calculated the correlation coefficient between the weight of the cyclically sensitive items and that of the flexible items for the euro area member states plus the aggregate (see Figure 4.3). It turns out that a (modest) link could exist as the correlation coefficient is 0.32 for the output gap and 0.38 for the unemployment gap. Hence, flexibility cannot be discarded as a determinant of cyclical responsiveness and might be worth being investigated further.[24]

Second, for the euro area (direct approach), where 78 % of the 4-digit indices are flexible and about 70 % of the indices are cyclically responsive, we determined the overlap between flexible and sensitive items, i.e. the share of items that are flexible and cyclically sensitive, only flexible, only cyclically sensitive, or neither flexible nor cyclically sensitive (HP based output gap, Table 4.5). The biggest overlap is found in unprocessed food (all components are both flexible and cyclically sensitive), followed by services related to recreation and transport services. In industrial goods, where the majority of items are flexible, only half of these are also cyclically sensitive. In nearly all broad categories there are items that are cyclically sensitive without being 'flexible' and vice versa.

[24] First, because of the unexplained differences in the flexibility of the 4-digit price series and, second, because variation in flexibility among the member states is higher than that in cyclical sensitivity.

Figure 4.3: Relation between cyclically sensitive and flexible items in the euro area and the member states



Source: Calculations of the authors.

Table 4.5: Overlap between flexible and cyclically sensitive items in the euro area

	Flexible and cyclically sensitive	Flexible only	Cyclically sensitive only	Neither flexible nor cyclically sensitive
PROCESSED FOOD incl. alcohol and tobacco	**40**	8	**33**	19
UNPROCESSED FOOD	**100**	0	**0**	0
INDUSTRIAL GOODS EX ENERGY	**39**	48	**11**	2
INDUSTRIAL GOODS EX ENERGY, durables only	29	55	9	7
INDUSTRIAL GOODS EX ENERGY, non-durables	42	39	19	0
INDUSTRIAL GOODS EX ENERGY, semi-durables	44	49	6	0
ENERGY	**61**	15	**24**	0
SERVICES	**51**	25	**16**	7
Housing Services	19	69	0	12
Transport Services	76	17	0	7
Communication Services	0	0	95	5
Recreation and personal Services	91	0	9	0
Miscellaneous services	15	34	30	18

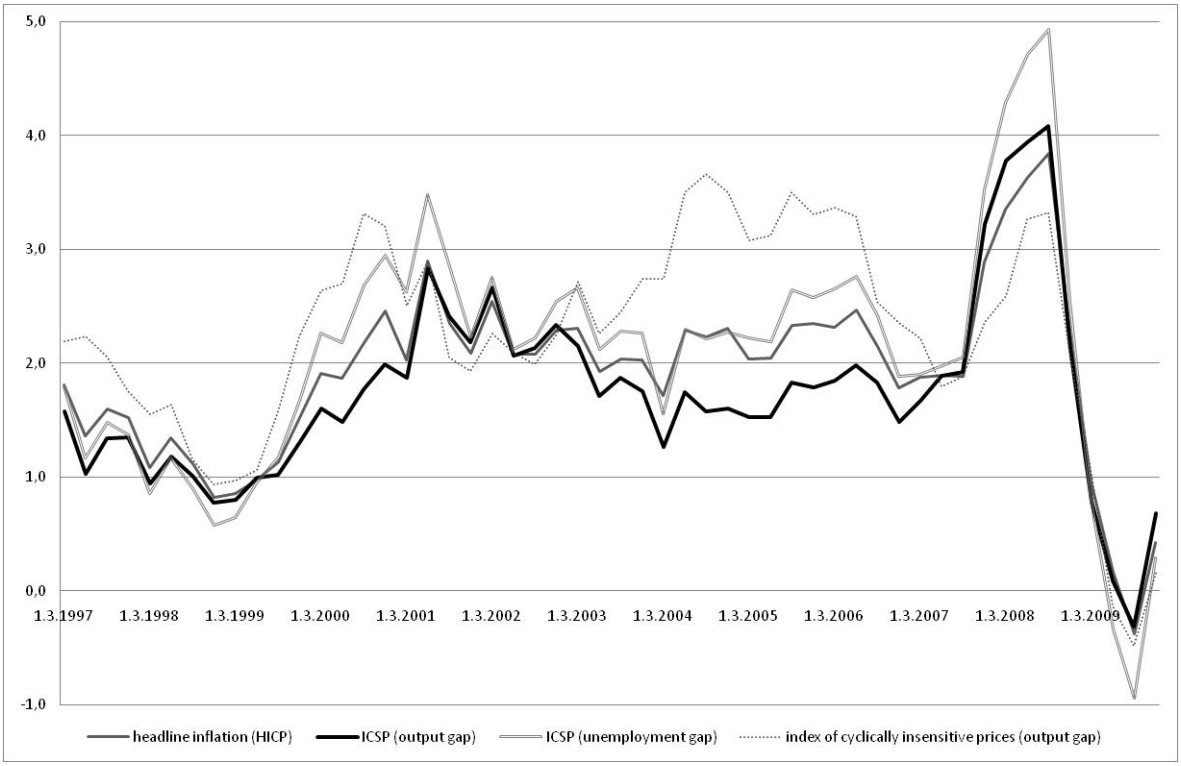
Source: Calculations of the authors.

5. Index of cyclically sensitive prices

5.1 Composition of the index

Having established the cyclically responsive items, we created for all countries and all gap measures "indices of cyclically sensitive prices" (ICSP). The annual rates of change of the indices for the euro area aggregate (direct estimation) based on the output gap (HP) and the unemployment gap (HP) along with headline inflation are shown in Figure 5.1. The dynamics of the newly created series (containing two-thirds of the consumer basket) resemble that of headline inflation, only the swings seem a bit more marked. However, when comparing the ICSP with its counterpart, the one-third of the HICP that was found cyclically non-responsive, the difference between the indices becomes more visible. In particular between 2004 and 2006, inflation rates of these two indices differed strongly.

Figure 5.1: Inflation rates of the indices of cyclically sensitive items compared with headline inflation in the euro area



Note: ICSP stands for "index of cyclically sensitive prices".

As regards the composition of the ICSP (HP-output gap) in the euro area (direct estimation), the weight of non-core components (unprocessed food and energy) is markedly higher than in the HICP (24 % in the ICSP versus 17 % in the HICP, most of the difference is

due to *unprocessed* food). Of the core components, the weight of services is on par with the weight in the HICP; the weight of industrial goods is by 8 pp lower (Table A.5 in the Appendix). However, within services, the weight of housing and miscellaneous services is much lower in the ICSP (by 7 and 2 pp, respectively), while that of services related to recreation is by 7 pp higher. Among industrial goods, the ICSP contains a lower share of durables and semi-durables. The weight of non-durables is the same in the HICP and the ICSP.

In the member states, the composition of the indirectly estimated ICSP for the euro area is replicated by only a few countries – in line with the outcome of heterogeneous sensitivity in the member states (see Section 4). The simple average of the weights in the ICSP of the member states indicates that the weight of services and industrial goods is equal to the weight in the HICP, the weight of energy goods is substantially lower while both processed and unprocessed food prices have higher shares in the ICSP (primarily due to *processed* food). The services component of the ICSP appears dominated by services related to recreation. In industrial goods, on average in the member states, the weight of non-durable goods is higher than in the HICP, while both durable and semi-durable goods have a lower weight in the ICSP than in the HICP.

These results hold true broadly also for the unemployment gap related ICSP, which in the euro area aggregate includes an even larger share of food prices and in the average over the member states an even higher share of the service component related to recreation. Turning to the volatility measured by the standard deviation it turns out that in the euro area aggregate, in spite of the higher share of food and energy prices in the ICSP-output gap, its standard deviation is not higher than that of the HICP (Table A.6 in the Appendix). It is, however, higher in the ICSP-unemployment rate, in which processed food is even more important. Second, higher volatility than for the HICP obtains for the FROOPP, which contains all food and some energy components, and in the index of flexible prices. In contrast, volatility of the core rates is markedly lower, in particular for the index that excludes all food and energy.

5.2 Output sensitivity

Table 5.1 presents the estimated output sensitivity (HP based) of the newly created indices (ICSP), the HICP, flexible and sticky price indices as defined above (Section 3.3), the two commonly used core indices (index excluding unprocessed food and energy, index excluding all food and energy) and the special index of frequently-out-of-pocket index (FROOPP) and its adversary (cf. Section 3.4) for the euro area and the member states. The respective coefficients refer to the average of the following estimated relations (altogether eight, cf. Section 3.1 and 3.5): OLS estimation containing only the lagged inflation series and the

output gap (benchmark), OLS estimations with six different control variables and GMM estimation. More detailed information, including the number of significant estimates, is contained in Table A.7 in the Appendix.

Table 5.1: Output sensitivity of the ICSP (HP-output gap) and several other price indices in the euro area and the member states

	ICSP	FROOPP	FLEX	HICP	XFROOPP	XEUP	XEF	STICKY
euro area	**0.19**	**0.21**	**0.14**	**0.12**	**0.07**	**0.06**	**0.04**	**0.08**
DE	0.11	0.15	0.13	0.09	0.08	0.04	0.05	0.07
FR	0.30	0.27	0.21	0.16	0.08	0.11	0.04	n.s.
IT	0.17	0.19	n.s.	0.13	0.12	0.13	0.08	0.10
ES	0.22	0.19	0.12	0.14	n.s.	0.09	n.s.	n.s.
NL	0.14	0.26	0.28	0.12	0.13	0.08	n.s.	0.15
GR	0.26	n.s.	0.20	n.s.	n.s.	n.s.	n.s.	n.s.
BE	0.28	0.31	0.45	0.26	0.23	0.13	0.11	0.07
AT	0.17	0.24	0.19	0.12	0.07	0.08	0.06	0.06
PT	0.25	0.25	0.18	0.18	0.15	0.20	0.17	n.s.
FI	0.16	0.19	0.24	0.13	0.08	0.17	0.08	0.09
IE	0.09	0.12	n.s.	0.06	n.s.	0.05	n.s.	0.09
SK	0.18	0.13	0.09	0.10	0.45	0.08	0.12	n.s.
SI	0.25	0.17	n.s.	0.07	0.19	0.14	0.12	n.s.
LU	0.11	0.12	0.23	0.10	0.06	0.05	0.03	0.04
CY	0.37	0.22	0.33	0.18	0.28	0.17	0.23	0.16
MT	0.48	0.23	0.41	0.11	n.s.	0.13	0.14	n.s.

Note: The table shows averages of the estimated relations presented in Table A.7 in Appendix. The significance level is 10 %; 'n.s.' denotes 'not significant'. The estimated equations are described in Section 3.1. Time period is 1997/1-2009/4 except for Slovenia where it starts in 2001/1. 'ICSP' stands for the 'index of cyclically sensitive products', 'XEUP' is the HICP excluding unprocessed food and energy (core inflation), 'SERV': 'all services items', 'FROOPP': 'index of frequent-out-of-pocket-purchases' as described in Section 3.4, 'XEF' stands for the HICP excluding all food and energy prices, 'XFROOPP': adversary of FROOPP, 'FLEX': index of flexible price indices as defined in Section 3.3, 'STICKY' is the adversary of the index of flexible items.

For the euro area aggregate, all investigated price series were found to be cyclically sensitive. (For the core inflation rates the estimates were not significant for all estimated relations, though.) The highest coefficient was determined for the FROOPP (0.21), followed by the ICSP with 0.19.[25] Output sensitivity of flexible prices is higher than for the overall HICP, but lower than for the ICSP. For the HICP, the sensitivity was assessed at 0.12 (average of all estimations). As we already established, the higher output sensitivity of the ICSP in the euro area is not due to a generally higher variation (measured through the standard deviation of the HICP and ICSP, Table A.6 in the Appendix) but reflects stronger co-movement with the cycle. Output sensitivity of the core series is markedly below that of the ICSP or the FROOPP. In that regard, our results confirm the investigation of the European Commission (European

[25] Note however that the ICSP comprises a higher share of the overall index (67 %) than the FROOPP (46 %).

Commission, 2011), which found a rather weak relationship between core inflation and the output gap.

Our results indicate that estimated output sensitivity might depend on the composition of the analysed aggregates. The tested aggregates differ in two important dimensions: Only the ICSP was designed to include solely cyclically sensitive items. All other aggregate indices most probably contain a mix of cyclically sensitive and cyclically insensitive price indices. Second, the FROOPP and the ICSP comprise a higher share of food prices than the HICP or core inflation rates. As a result, the higher parameter of cyclical sensitivity found for the ICSP and the FROOPP relative to core inflation might stem from a higher share of cyclically sensitive items in the former indices or a substantive impact on estimated output sensitivity from food prices.

In order to ascertain whether there are differences in the cyclical sensitivity of the components of the ICSP, for the euro area as a whole, we calculated cyclically sensitive indices for the broad categories of unprocessed food, processed food, industrial goods (and all three subcomponents), energy and services and estimated their output sensitivity in the same fashion as for the ICSP as a whole.

Table 5.2: Output sensitivity of the cyclically sensitive subgroups in the euro area (direct approach)

	share of cyclically sensitive items in	share of component in ICSP	coefficients		
			baseline	**average of estimation with controls**	**GMM**
Industrial goods	**50**	22	**0.09**	**0.09**	**0.08**
Industrial goods, durables	39	6	0.04	0.05	0.06
Industrial goods, semi-durables	51	9	0.08	0.08	0.07
Industrial goods, non-durables	61	8	0.10	0.10	0.09
Energy	85	12	**0.18**	**0.16**	**0.34**
Unprocessed food	**100**	13	**0.35**	**0.29**	**0.36**
Processed food	**73**	11	**0.33**	**0.43**	**0.45**
Services	**67**	41	**0.04**	**0.03**	**0.09**
of which: services related to recreation	100	22	0.15	0.13	0.12
Index of cyclically sensitive prices	**100**		**0.19**	**0.18**	**0.18**
memo items:					
HICP	*67*		*0.13*	*0.12*	*0.11*
Index ex unprocessed food and energy	*62*		*0.05*	*0.06*	*0.08*

Source: Own calculations. Share of cyclically sensitive items as in Table 4.1. Coefficients of ICSP, HICP and core inflation as in Tables 5.1 and A.7.

It turns out that output sensitivity of the cyclically sensitive industrial goods including its three sub-groups and the cyclically sensitive services is lower than estimated cyclical

sensitivity of the ICSP as a whole (see Table 5.2). By contrast, cyclical sensitivity of both processed and unprocessed food is higher than that of the ICSP. Hence not only is a higher share of food and energy prices sensitive to the business cycle, but their estimated coefficient of output sensitivity is higher than in other categories also.[26] Turning to the cyclically sensitive industrial goods excluding energy, the responsiveness to output fluctuations is higher for non-durable goods than durable goods in particular. For services cyclical sensitivity is found to be particularly low, although GMM suggests that it could be equally high as for the cyclically sensitive non-durable industrial items. However, for 'services related to recreation', which were found to be highly cyclically sensitive already as regards the share of cyclically sensitive items, the estimated coefficient is 0.13, which is considerably higher than for services as a whole. All in all, cyclical sensitivity of industrial goods' prices (typically assumed to be most strongly affected by international factors) and of services' prices (typically assumed to be "non-tradables") may not differ too much. The reasons for their relatively low cyclical sensitivity, however, may be different. Within industrial goods, it could depend on the importance of domestic cost components, while for services cyclical sensitivity might depend on whether or not the prices are market prices (not administered prices) and on the extent of competition in some market segments.

As a result, from our estimations it emerges that useful information may be ignored if cyclical sensitivity of consumer prices in the euro area is gauged from core indices only. Our research shows that cyclical sensitivity in the core components is not more widespread than in non-core components. If anything, cyclical sensitivity (measured through share and parameter) is higher in the non-core components (in particular unprocessed food) and the core component of processed food. Core inflation generally assumed to best reflect underlying trends such as the business cycle may thus erroneously signal too low overall cyclical responsiveness. The elimination of volatile components (unprocessed food and some energy components) may reduce overall "noise" but specific "signal" related to the cyclical component appears to get lost in the process also.[27]

Applied to the recent experience in the euro area, the rather mild reaction of headline inflation to the recession might on the one hand be owing to weak output sensitivity of core inflation components. On the other hand it probably arises from the fact that in particular those

[26] According to these estimations, cyclical sensitivity of processed food might be higher than that of unprocessed food despite a clearly higher volatility and variance of the latter. It is therefore not volatility as such that explains higher estimated output sensitivity.

[27] In a way this argument is similar to that of Cecchetti (2007) who claims that because of the trend rise in the relative price of food and energy items, i.e. a systematically higher inflation rate of these components, the exclusion of food and energy prices signals too low inflation. Core inflation is then a (downward) biased measure of overall inflation.

items that have a relatively higher cyclical responsiveness have been hit by adverse influences from the world market. Our investigation does not indicate which component - the world market prices or the business cycle - plays a bigger role for the price dynamics in food and energy.[28] But what can be said is that were it not for the dominant influences from the world food price dynamics, the effect of the domestic business cycle on food prices and consequently headline inflation would have probably been more visible. Therefore, the rather mild reaction of headline inflation to the recent recession is in part due to the adverse shocks from the world economy. Concentration on the output sensitivity of core inflation thus might be useful when inflation dynamics of the volatile components are dominated by strong supply shocks from the world economy. However, in the absence of strong supply shocks, an inflation forecast based on the estimated cyclical sensitivity of core inflation may underestimate the cyclical fluctuations in overall inflation as it ignores the rather strong output sensitivity of non-core-inflation.

Quickly turning to the member states, the determined output sensitivity of the ICSP has a rather wide range (0.09 – 0.48). The estimated sensitivity of the ICSP is lowest in Ireland, Germany and Luxembourg, and highest in Malta and Cyprus (where it includes a rather low share of the HICP) but also France, Belgium, Portugal and Slovenia. The fact that output sensitivity (measured through the estimated parameter of the ICSP) is low in both Germany and Ireland contradicts the proposition that a higher inflation rate or higher volatility alone could imply higher cyclical sensitivity.[29] The relatively high coefficient in France, Belgium and Greece could be linked to the bigger share of non-core components in the ICSP, similar as in the euro area aggregate.

Despite the wide variation in output sensitivity, the ranking of the indices (as regards the estimated parameter of output sensitivity) determined for the euro area holds broadly true also in the member states. In particular, the estimated parameter of output sensitivity of the ICSP is in most cases significantly above that of the HICP (for which we determined significant estimates for all member states except Greece, the range being 0.06 – 0.26). Furthermore, output sensitivity of the FROOPP and of the index of flexible items is rather strong, even if the latter was not found significantly related to the output gap in three member states including Italy. Output sensitivity of core inflation rates is moderate. The range of the index excluding unprocessed food is 0.04 – 0.20, that of the index excluding all food and energy 0.03 – 0.23. (For the latter index, there are no significant estimates for four countries.) The higher parameters are found for a number of smaller member states (among them Portugal, Slovenia,

[28] We cannot establish either to what extent the domestic business cycle is affected by world-wide developments.
[29] For mean and standard deviation see Table A.6 in the Appendix.

Cyprus and Malta), which tend to have a low share of food prices in the ICSP. As a result, the core rates seem to be more cyclically sensitive (measured through the coefficient) than in the larger member states. Because in the smaller countries the ICSP includes a relatively small number of product categories, we suspect that the higher coefficient of core inflation's cyclical sensitivity is owing to a relatively higher importance of the services prices related to recreation.

6. Relation of the ICSP to the first common factor

So far, we determined that cyclical sensitivity of some components is higher than what the estimates for headline or core inflation suggest. The rather moderate responsiveness of headline inflation to the output gap arises because only a part of the underlying price indices co-move with the business cycle. Because in the euro area aggregate two-thirds of the underlying indices appear cyclically sensitive, this might already prove that the output gap still has an important role in the inflation dynamics. However, prices of the cyclically sensitive items can, even to a substantial extent, be driven also by other influences, which might be even more relevant than the business cycle. To gauge the importance of the output gap for overall inflation, we again chose an indirect approach and related the newly created index to the first factor determined from the disaggregated price indices. This first factor contains the highest share of common variation among the price indices, while the ICSP contains the indices that move with the business cycle. If the link between these series is high, we conclude that the business cycle does have an important role for overall inflation dynamics.

The first common factor, the output gap and several price indices including the ICSP are presented in Figures A.4 and A.5 in the Appendix. Table 6.1 shows the correlation between the several sub-indices and the first factor (as described in Section 3.1) for the euro area and selected member states. [30]

Of the several investigated price indices for the euro area as a whole, the highest correlation with the first factor is found for the HP-output gap based ICSP.[31] However, a rather strong link also seems to exist between the first factor and the core rate that excludes unprocessed food and energy. By contrast, the relation to the index of flexible prices is the lowest among the investigated indices. Among the five main product types (all items, not only the cyclically sensitive ones), however, it is unprocessed followed by processed food, which are most significantly related to the first factor. Hence, while the high correlation of the ICSP and

[30] The results for the member states not included here are shown in Table A.8 in the Appendix. For Slovenia, factor analysis was not performed because the disaggregated time series start only in 2000.
[31] The correlation coefficient between the first factor and the HP-based output gap is 0.69.

core inflation excluding unprocessed food and energy with the first factor indicates that it is core components that may be decisive, the equally strong link of unprocessed food to the first factor clearly qualifies this proposition. We therefore computed the correlations also for the already presented sub-components of the ICSP (Table 6.2).

Table 6.1: Correlation of selected price indices with the first factor in the euro area and member states

	EA	DE	FR	IT	ES	NL	GR	BE
ICSP	**0.66**	**0.85**	**0.50**	**0.85**	0.86	**0.88**	0.46	0.71
ICSP-UNEMP	0.51	0.68	0.52	0.77	0.86	0.86	0.53	0.72
ICSP-OECD	0.65	0.68	0.74	0.74		0.85		
XEF	0.43	0.45	0.18	0.29	0.70	0.58	0.48	0.30
XEUP	0.61	0.42	0.32	0.58	0.83	0.73	0.60	**0.74**
HICP	0.46	0.21	0.38	0.71	**0.88**	0.71	**0.77**	0.52
FLEX	0.34	-0.09	0.46	0.48	0.85	0.80	0.63	0.40
STICKY	0.55	0.53	0.08	0.65	0.20	0.01	0.70	0.51
FROOPP	0.45	0.03	0.40	0.83	0.85	0.78	0.63	0.47
XFROOPP	0.42	0.42	0.28	0.31	0.78	0.40	0.61	0.49
FUP	**0.65**	**0.58**	**0.62**	0.67	**0.83**	0.61	0.15	0.34
FPROC	0.60	0.09	0.37	**0.77**	0.75	**0.78**	**0.54**	**0.77**
IND	0.49	0.53	0.60	0.28	0.53	0.69	0.42	0.37
EN	0.09	-0.15	0.13	0.33	0.66	-0.24	0.45	0.28
SERV	0.32	0.22	-0.35	0.23	0.79	0.34	0.47	0.14
weights	**EA**	**DE**	**FR**	**IT**	**ES**	**NL**	**GR**	**BE**
ICSP	67	54	63	58	58	52	22	66
ICSP-UNEMP	69	32	55	61	56	46	61	49
FLEX	78	25	76	33	81	51	61	56
FROOPP	45	37	44	47	54	40	52	45

Note: For results of the other member states cf. Table A.8 in the Appendix. All correlation coefficients are shown as positive numbers, so that for some countries the first factor had to be inverted. 'ICSP' stands for the 'index of cyclically sensitive products' based on the HP output gap, 'ICSP-UNEMP' for 'index of cyclically sensitive products' based on the unemployment gap (HP), 'ICSP-OECD' for the 'index of cyclically sensitive products' based on the OECD output gap, 'FPROC' for 'processed food', 'FUP' for 'unprocessed food', 'IGND' for 'non-durable industrial goods', 'IND': 'industrial goods excluding energy', 'IGSD': 'semi-durable industrial goods', 'FUP': 'unprocessed food', 'SERVR': 'services related to recreation', 'XEUP' is the HICP excluding unprocessed food and energy (core inflation), 'SERV': 'all services items', 'FLEX': index of flexible price indices as defined in Section 3.3, , 'STICKY' is its adversary, 'IGD': 'durable industrial goods', 'FROOPP': 'index of frequent-out-of-pocket-purchases' as described in Section 3.4, 'XEF' stands for the HICP excluding all food and energy prices, 'XFROOPP': adversary of FROOPP, 'EN' energy prices. The factors were extracted from the most disaggregated series, i.e. 4-digit COICOP items.

For three cyclically sensitive subcomponents the correlation with the first factor is even higher than for the ICSP together. Interestingly, processed food leads and it is two industrial goods groups that come next. Unprocessed food is only in the fourth place, followed by the ICSP for services related to recreation. These are the same product categories that were assessed as the most robustly cyclically sensitive in the euro area according to the aggregated results of

the member states' estimations (indirect approach, Section 4.3). As a result, although by definition the factors do not have economic meaning, the structure of links between the first factor and the several sub-indices indicates that it is some of the cyclically sensitive components that appear to be linked most strongly to the shared common inflation dynamics. Of these products, those related to the domestic distribution sector and therefore probably containing a substantial domestic (non-tradable) cost component (processed food, non-durable industrial goods, services related to recreation) seem to be affected by this common macroeconomic factor most strongly. This also explains why the correlation of core inflation with the first common factor is rather strong. As a result, while the dynamics of the business cycle (the oscillations) could be most precisely tracked by some core items, notably non-durable industrial goods and services related to recreation, the amplitude might be higher for processed and unprocessed food. The relatively low correlation between the cyclically sensitive energy prices and the first factor proves that influences other than the business cycle can dominate inflation dynamics even for the cyclically sensitive items.

Table 6.2: Correlation of selected sub-indices of the ICSP with the first factor in the euro area

	correlation coefficient		correlation coefficient
ICSP processed food	0.81	HICP semi-durable industrial goods	0.52
ICSP non-durable ind. goods	0.78	HICPdurable industrial goods	0.47
ICSP semi-durable industrial goods	0.71	HICP	0.46
ICSP	0.66	FROOPP	0.45
ICSP unprocessed food	0.65	Core inflation excl. all food and energy	0.43
HICP unprocessed food	0.65	Index of flexible prices	0.34
ICSP services related to recreation	0.62	HICP services	0.32
Core inflation excl. unproc. food and energy	0.61	ICSP energy	0.28
HICP processed food	0.60	HICP non-durable ind. goods	0.26
ICSP services	0.59	HICP durable ind. goods	0.22
Index of sticky prices	0.55	HICP energy	0.09

Source: Own calculations. 'ICSP' stands for the index of cyclically sensitive prices measured through the HP filtered output gap. The indices of flexible and of sticky prices are defined in Section 3.3. The factors were extracted from the most disaggregated series, i.e. 4-digit COICOP items.

In this indirect way, we arrive at the conclusion that the business cycle still has an important role in price dynamics. However, this result should not be overrated. This follows first from the fact mentioned above that the first factor is strongly related only to a part of the items identified as cyclically sensitive. Second, it cannot be disregarded that the factor structure of the disaggregated prices indices is rather weak, i.e. the dynamics of the price indices cannot

be captured by a few dimensions.[32] For the euro area aggregate, the first factor captures just 18 % of total variance, the five most powerful factors 46 % (Figure A.6 in the Appendix). As a result, there is not one dominant driver of inflation but a number of nearly equally important common influences, which still do not explain more than half of the variance prevailing in the disaggregated price indices. Hence, even if the business cycle could be regarded as the most powerful influence based on this indirect evidence through the relation of cyclically sensitive product groups to the first factor, it can hardly be said that it would "drive inflation". It is an important determinant - but apparently one among many.

In the member states, the aggregate result of a particularly strong relation of the ICSP to the first factor holds true for the five largest economies and Austria (Table 6.1 and A.8 in the Appendix). It is above 0.7 also in Belgium, Portugal (ICSP-unemployment), Finland and Ireland. For the largest member states also, the first factor seems strongly related to the food components (except for Germany and France in the case of processed food) and to industrial goods; the results are therefore to some extent similar to those found for the euro area aggregate. In the smaller countries, the first factor is often linked most strongly to the industrial goods components. In not a single case, the highest correlation is found for services' prices, typically assumed to be most strongly affected by the domestic business conditions. However, except for Ireland and Slovakia, the factor structure in the member states is even weaker than for the euro area aggregate (see Figure A.6 in the Appendix). Therefore, even in those cases where the ICSP is correlated most strongly with the first factor, the domestic output gap need not have an overriding role in aggregate inflation dynamics.[33]

7. Conclusion

The main objective of our investigation was to determine what role the business cycle still has in inflation dynamics of the euro area, given the weak responsiveness of aggregate inflation to the cyclical stance in recent years. We started from the suggestion that cyclical sensitivity might differ between the items that underlie the HICP, and that the weak aggregate response may conceal that a part of the prices still co-move with activity. While Bryan and Meyer (2010) suggested that it is the flexibility of the items that decides about their cyclical responsiveness, the theoretical relation between disaggregated prices and the output gap might

[32] This point was made already by Pollan (1978). In his investigation of Austrian consumer prices, however, he finds that the first three components account for 74 % of the total variance.

[33] However, we stressed already that the definition of domestic business conditions may get blurred in the euro area; it is not *a priori* clear, in particular for the small economies, how the "domestic" business cycle relates to the euro area cycle.

be motivated best by the assumption that disaggregated prices are affected by idiosyncratic and common factors, the business cycle being one of the common determinants.

As a result, we tested output sensitivity of inflation in the euro area and its member states through an indirect, disaggregated analysis, i.e. through the cyclical responsiveness of the price indices at COICOP 4-digit level that underlie the HICP. Our aim was to assess whether the commonly found moderate output sensitivity of inflation in the euro area holds true for all underlying price components in general or whether cyclical sensitivity of prices diverges on a disaggregated level. Should it differ, how widespread and how pronounced is cyclical sensitivity at the components' level? Furthermore, if responsiveness to the business cycle might vary but nevertheless exist for the disaggregated indices, how does that relate to the low output sensitivity observed for headline inflation? To check for robustness, our data set of disaggregated prices does not include only the euro area indices but also the corresponding indices of the member states as a benchmark.

We first econometrically determined those 4-digit COICOP items of the HICP that co-move with the business cycle and the composition of the cyclically sensitive prices. Second, we created an index of cyclically sensitive prices and quantified its output sensitivity. That was related to the estimated parameter for headline inflation, several "core rates" and special indices. Third, we related the index of cyclically sensitive prices to the first factor extracted from the disaggregated price indices, which is assumed to best reflect their common trend.

Our results indicate that cyclical sensitivity indeed differs among the individual disaggregated price indices. In the euro area as a whole (direct estimation), a rather substantial part of the HICP (two thirds) is cyclically sensitive. The share of cyclically sensitive items is smaller in most member states. The indirectly calculated euro area average weight of cyclically sensitive items is thus below the weight obtained from the direct estimation. However, results are heterogeneous across the member states, with the larger countries tending to show a higher share of cyclically sensitive items than the smaller member states. These deviations between member states' results and the euro area aggregate may have several reasons: On a higher level of aggregation, the idiosyncratic factors can "wash out" and the common component may get accentuated. Moreover the euro area output gap need not be an unbiased estimate of the average of the member states' out-put gaps. Furthermore, factors considered non-domestic (in particular) for some smaller euro area member states may become domestic at the euro area level. Therefore, it might be even unlikely that the member states' results as regards the sensitivity towards fluctuations in their respective national economy could be easily carried over into the euro area aggregate. However, this should be addressed in more detail in future analysis.

Cyclically sensitive and insensitive prices can be found in all main categories (processed and unprocessed food, industrial goods excluding energy, services and energy). On the euro area aggregate level, the categories that appear most robustly related to the business cycle are the rather volatile (and flexible) groups of food and energy prices. Judged by the weight of cyclically sensitive components in the euro area as a whole, industrial goods excluding energy and services are less strongly affected by output or unemployment gaps, although both categories include highly cyclically sensitive items such as in particular non-durable industrial goods and services related to recreation. Furthermore, we cannot confirm that "tradables" approximated by goods or industrial goods are less cyclically sensitive than services (considered "non-tradables"). If anything, goods – through the impact of food prices – appear more sensitive to the cycle than services, which include also the bulk of administered prices. On the member states' level, the most cyclically sensitive product groups are food items (processed and unprocessed), non-durable industrial goods and services related to recreation. In marked contrast to the outcome on the euro area aggregate level, energy prices (and also some food prices) do not seem strongly related to the business cycle.

Output sensitivity of the index of cyclically sensitive prices is significantly higher than that of headline inflation, while both indices are clearly more sensitive to the business cycle than e.g. core rates excluding food and energy prices. This arises from the fact that both core inflation and the HICP contain a large number of cyclically insensitive items. However, a second reason appears to be the fact that many food prices are found to be strongly cyclically sensitive – not only as regards the share of cyclically sensitive indices but also as regards the estimated parameter of output sensitivity. That coefficient is higher for the index of cyclically sensitive food prices (both processed and unprocessed) than for any of the investigated cyclically sensitive industrial goods' or services' price indices. Moreover, the share of food prices in the index of cyclically sensitive prices (ICSP) is larger than their share in the HICP and in the core inflation rate that excludes unprocessed food.

From our estimations it thus emerges that useful information is ignored if cyclical sensitivity of consumer prices in the euro area is gauged from core indices only. Core inflation generally assumed to best reflect underlying trends such as the business cycle may erroneously signal too low cyclical sensitivity because the elimination of volatile components reduces not only general "noise" but also "signal" related to the cyclical component. Therefore, an inflation forecast based on the estimated cyclical sensitivity of core inflation may underestimate the cyclical fluctuations in overall inflation since it ignores the rather strong output sensitivity of non-core-inflation. With this in mind the index of frequent-out-of-pocket purchases (FROOPP) may be a better indicator of the output sensitivity of the components that are responsive to the

business cycle than core inflation. Applied to the recent experience in the euro area, the rather mild reaction of headline inflation to the recession might be owing to the weak output sensitivity of core inflation components but also to the fact that components with a relatively higher cyclical responsiveness have been hit by adverse influences from the world market.

Finally, the correlation of the ICSP with the first common factor of the disaggregated components in the HICP is higher than for any of the other investigated price aggregates or special indices. However, the co-movement with the core rate that excludes unprocessed food and energy is close to that of the ICSP. A disaggregated analysis shows that the components that are related strongest to the first factor are processed food, and non-durable and semi-durable industrial goods. The first common factor hence cannot stand only or primarily e.g. for global influences such as food price dynamics of shocks stemming from the world economy. Instead, this result suggests that the dynamics of the business cycle (the oscillations) might be rather precisely tracked by some core items (industrial goods, services), while the amplitude is higher for processed and unprocessed food items.

We take these results as evidence that the business cycle still plays an important role for inflation dynamics, in particular through the product classes mentioned above. However, the weak factor structure indicates that the business cycle is not the *single* decisive factor driving inflation. The price indices that we determined as the most cyclically sensitive both in terms of the coefficient and the share of cyclically sensitive items (food prices) are too obviously affected also by other determinants, which can – as observed in recent years – impact inflation dynamics adversely to domestic economic activity. All in all, our investigation shows – more clearly than investigations at the aggregate level – that the business cycle does play a role in price dynamics, although perhaps in some categories more than in others.

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Appendix

1. Tables

Table A.1: Four-digit COICOP items and broad categories in the HICP, their weights in 2009, average inflation rate and variation in 1997-2009, and indicators of their cyclical sensitivity to output gap

HICP broad categories (grey) and 4-digit COICOP items	weight in 2009	average inflation rate, 1997-2009	standard deviation of inflation rate, 1997-2009	sensitivity towards output gap (HP based) in euro area direct estimation	number of EA member states with output sensitivity (HP based)	weight of EA member states with output sensitivity (HP based)
OVERALL	**100.0**	1.9	0.8	x	12	96
Goods	**58.6**	1.7	1.2	x	10	68
PROCESSED FOOD incl. alcohol and tabacco	**11.9**	2.4	1.5	x	13	95
Bread and cereals	2.6	2.3	2.2	x	15	100
Milk, cheese and eggs	2.3	1.8	3.6	x	13	99
Oils and fats	0.5	1.3	4.7		12	46
Sugar, jam, honey, chocolate and confectionary	1.0	1.7	1.3	x	13	95
Food products n.e.c.	0.4	1.5	1.2	x	14	99
Coffee, tea and cocoa	0.4	0.9	4.1		6	26
Mineral waters, soft drinks, fruit and vegetables	1.0	1.3	1.2	x	11	95
Spirits	0.3	1.1	1.2	x	8	78
Wine	0.7	1.8	1.1	x	12	62
Beer	0.5	1.5	1.1	x	13	96
Tobacco	2.3	5.4	2.8		2	2
UNPROCESSED FOOD	**7.5**	2.2	2.2	x	12	92
Meat	3.6	2.0	2.2	x	12	96
Fish	1.1	2.9	1.8	x	8	79
Fruit	1.2	2.4	3.7	x	11	91
Vegetables	1.5	2.2	4.6	x	6	52
INDUSTRIAL GOODS EX ENERGY	**29.7**	0.8	0.3	x	10	59
INDUSTRIAL GOODS EX ENERGY, durables	***10.0***	-0.1	0.4		8	51
Furniture and furnishings	2.3	1.5	0.5	x	13	98
Carpets and other floor coverings	0.2	1.0	0.8	x	8	76
Major household appliances, small electric hous. appl.	0.9	-0.7	0.5	x	10	94
Motor cars	4.3	0.9	0.8		6	30
Motor cycles, bicycles and animal drawn vehicles	0.4	0.8	0.9		4	17
Equip. for reception, recording and reprod. of	0.5	-6.4	3.3	x	7	65
Photographic and cinematographic equip. & optic.	0.2	-7.1	4.6		4	35
Information processing equipment	0.5	-13.8	4.3		1	0
Major durables for in/outdoor recreation incl. musical in	0.3	1.6	0.7		6	60
Jewellery, clocks and watches	0.5	3.1	3.6		5	20

Table A.1 – continued (1)

HICP broad categories (grey) and 4-digit COICOP items	weight in 2009	average inflation rate, 1997-2009	standard deviation of inflation rate, 1997-2009	sensitivity towards output gap (HP based) in euro area direct estimation	number of EA member states with output sensitivity (HP based)	weight of EA member states with output sensitivity (HP based)
INDUSTRIAL GOODS EX ENERGY, non-durables only	***8.3***	1.8	0.4	x	13	94
Materials for the maintenance and repair of the dwellling	0.6	2.3	0.8	x	13	97
Water supply	0.7	2.7	0.7		6	31
Non-durable household goods	1.1	1.1	1.0	x	12	78
Pharmaceutical products	1.2	1.2	1.8		3	4
Other medical products, therapeutic appliances and equipm	0.6	2.4	2.8		9	55
Gardens, plants and flowers	0.6	1.5	1.1		7	36
Pets and related prod. incl. veterinary & other serv. for pets	0.5	1.6	1.3	x	13	94
Newspapers and periodicals	0.9	2.6	0.8	x	11	96
Misc. printed matter and stationery and drawing materials	0.3	1.5	1.0	x	11	93
Electric appliances and other appliances etc. for pers. Care	1.7	1.4	0.9	x	15	100
INDUSTRIAL GOODS EX ENERGY, semi-durables onl	***11.5***	0.8	0.5		10	59
Clothing materials	0.0	0.9	1.5		4	11
Garments	5.0	0.6	0.8		6	22
Other articles of clothing and clothing accessoirs	0.2	0.9	0.7	x	7	26
Shoes and other footwear including repair and hire of footw	1.4	1.3	0.9	x	10	49
Household textiles	0.5	0.9	0.5	x	8	54
Glassware, tableware and household utensils	0.6	1.7	0.7	x	14	99
Major tools and equip. and small tools and misc. accessorie	0.4	0.9	0.5	x	9	53
Spare parts and accessories for personal transport eq.	1.1	1.6	1.5	x	5	5
Recording media	0.3	-1.6	1.3	x	7	18
Games, toys and hobbies	0.5	-0.3	1.1	x	11	79
Equipment for sport, camping and open-air recreation	0.3	-0.3	0.8	x	10	82
Books	0.6	1.7	1.0		4	31
Other personal effects	0.5	1.1	0.6	x	10	56
ENERGY	**9.6**	3.7	6.6		4	36
Electricity	2.3	2.2	2.2	x	9	90
Gas	1.8	5.2	7.7	x	5	30
Liquid fuels	0.7	7.2	22.0		7	52
Solid fuels	0.1	2.6	1.3		4	59
Heat energy	0.6	5.9	7.8		4	8
Fuels and lubricants for personal transport equipment	4.0	3.5	9.3	x	2	38

Table A.1 – continued (2)

HICP broad categories (grey) and 4-digit COICOP items	weight in 2009	average inflation rate, 1997-2009	standard deviation of inflation rate, 1997-2009	sensitivity towards output gap (HP based) in euro area direct estimation	number of EA member states with output sensitivity (HP based)	weight of EA member states with output sensitivity (HP based)
SERVICES	**41.4**	2.3	0.5	x	13	75
Housing Services	***10.1***	2.3	0.4		5	7
Actual rentals paid by tenants including other actual rentals	6.0	1.9	0.4		8	65
Services for the maintenance and repair of the dwelling	0.9	2.7	1.2	x	6	26
Refuse collection	0.5	3.5	1.3		2	4
Sewerage collection	0.4	2.7	1.0		2	2
Other services relating to the dwelling	0.9	2.9	0.8		4	11
Repair of furniture, furnishings and floor coverings	0.1	2.4	0.5	x	6	73
Repair of household appliances	0.1	2.6	0.5		8	32
Domestic services and household services	0.9	3.2	0.6	x	8	48
Insurance connected with the dwelling	0.3	1.8	1.2		7	65
Transport Services	***6.3***	2.8	0.6	x	10	93
Maintenance and repair of personal transport equipment	2.4	3.2	0.8	x	10	84
Other services in respect of personal transport	0.8	2.0	0.5	x	7	85
Passenger transport by railway	0.5	2.7	1.1		4	21
Passenger transport by road	0.5	2.8	0.6		7	53
Passenger transport by air	0.6	2.8	4.0		7	48
Passenger transport by sea and inland waterway	0.1	3.1	2.9	x	5	63
Combined passenger transport	0.5	3.2	0.7	x	2	56
Other purchased transport services	0.1	2.0	1.0	x	6	51
Insurance connected with transport	0.9	2.1	2.9	x	4	21
Communication Services	***3.2***	-2.4	2.1	x	5	25
Postal services	0.2	1.9	1.6		3	2
Telephone and telefax equipment and tel. and telefax service	3.1	-2.8	2.2	x	5	25
Recreation and personal Services	***14.9***	2.7	0.7	x	14	93
Cleaning, repair and hire of clothing	0.2	2.0	0.7	x	8	67
Package holidays	1.6	2.7	2.9	x	7	80
Accommodation services	1.7	2.9	1.3	x	7	50
Repair of audio-visual, photographic and information proc. eq	0.1	2.2	0.6	x	10	57
Mainten. & repair of other major durab. for recreat. & culture	0.0				1	0
Recreational and sporting services	1.0	2.9	0.8	x	4	24
Cultural services	1.4	2.0	1.2	x	2	10
Restarants, cafes and the like	6.9	2.9	0.8	x	15	93
Canteens	0.8	2.3	0.5	x	11	38
Hairdressing salons and personal grooming establishments	1.2	2.4	0.5	x	7	49
Miscellaneous services	***6.8***	2.8	0.9		5	17
Education	1.0	3.3	1.9	x	4	38
Medical and paramedical services (01-09)	1.0	3.4	2.3		7	14
Dental services (01-09)	0.7	2.4	1.3		7	38
Hospital services (02-09)	0.6	3.7	2.3		4	22
Social protection (01-09)	1.0	2.7	1.1	x	6	36
Insurance connected with health (01-09)	0.6	3.3	0.9		3	53
Other insurance	0.2				2	7
Financial services n.e.c.	0.6	2.8	1.9		1	2
Other services n.e.c.	1.0	2.4	0.8	x	5	32
HICP ex Energy and unprocessed Food	83.0	1.7	0.5	x	14	96
HICP ex Energy and Food	71.1	1.6	0.4	x	12	77
Administered prices (02-09)	11.0	2.3	0.6		6	32

Source: Eurostat, own calculations. Note: Time period indicated in parentheses, if shorter than 1997-2009.

Table A.2: Cyclical sensitivity in the euro area and member states, weighted and simple shares in the HICP

	Number of items	Number of cyclically sensitive items		Share of cyclically sensitive items (not weighted)		Weight of cyclically sensitive items	
		output gap (HP based)	unempl. gap (HP based)	output gap (HP based)	unempl. gap (HP based)	output gap (HP based)	unempl. gap (HP based)
EA	**91**	**57**	**60**	**63**	**66**	**67**	**69**
FI	87	62	46	71	53	76	67
BE	88	48	39	55	44	66	49
SI	86	53	43	62	50	64	54
FR	91	58	42	64	46	63	55
ES	89	41	43	46	48	58	56
IT	86	44	46	51	53	58	61
DE	92	47	32	51	35	54	32
NL	87	50	44	57	51	52	46
SK	86	44	35	51	41	50	37
AT	91	35	37	38	41	49	56
IE	93	45	47	48	51	47	54
LU	91	38	33	42	36	45	39
PT	92	38	24	41	26	45	36
CY	87	29	25	33	29	35	25
MT	78	24	29	31	37	33	48
GR	89	22	43	25	48	22	61

Source: Eurostat, own calculation. The weight of cyclically sensitive items corresponds to the weights presented in Figure 4.1 in the main text.

Table A.3: Cyclical sensitivity in the euro area (direct approach) according to main categories: number of responsive items

	Weight in HICP in 2009	No of items	number of cyclically sensitive or flexible items				
			GAP GDP (HP)	GAP UNEMPL (HP)	GAP GDP (OECD)	GAP NAIRU (OECD)	*Memo item: Flexible indices*
HICP overall	**100**	**93**	**57**	**60**	**60**	**54**	***67***
CORE-XEUP	83	83	53	56	56	51	*63*
CORE-XEF	71	72	45	46	49	42	*57*
SERVICES	**41**	**39**	**22**	**20**	**24**	**20**	***26***
HOUSING	10	9	3	3	5	4	*6*
TRANSPORT	6	9	6	3	7	3	*8*
COMMUNIC.	3	2	1	1	1	1	*0*
RECREATION	15	10	9	8	8	7	*8*
MISCEL.	7	9	3	5	3	5	*4*
GOODS	**59**	**54**	**35**	**40**	**36**	**34**	***41***
UNPROC. FOOD	7	4	4	4	4	3	*4*
PROC. FOOD	12	11	8	10	7	9	*6*
ENERGY	10	6	3	4	3	3	*5*
IND. GOODS (excl. EN)	**30**	**33**	**20**	**22**	**22**	**19**	***26***
DURABLES	10	10	4	7	6	6	*7*
SEMI-DURABLES	11	13	10	9	10	7	*11*
NON-DURABLES	8	10	6	6	6	6	*8*

Source: Eurostat, own calculations. Note: 'CORE-XEUP' is the HICP excluding unprocessed food and energy (core inflation), 'CORE-XEF' stands for the HICP excluding all food and energy prices.

Table A.4: The most and the least cyclically sensitive items (HP-unemployment gap based)

most responsive items		least responsive items	
4-digit COICOP item	No. of countries with cycl. sensitive item	4-digit COICOP item	No. of countries with cycl. sensitive item
Bread and cereals	15	Financial services n.e.c.	4
Restaurants, cafes and the like	14	Photographic and cinematographic eqip.	3
Shoes and other footwear including repair and hire o	13	Jewellery, clocks and watches	3
Sugar, jam, honey, chocolate and confectionary	12	Books	3
Food products, n.e.c.	12	Solid fuels	3
Furniture and furnishings	12	Fuels and lubricants for personal transport	3
Newspapers and periodicals	12	Repair of furniture, furnishings and floor coverings	3
Major tools and equip. and small tools and misc. acce	12	Passenger transport by sea and inland waterway	3
Fruit	11	Postal services	3
Electric appliances and other appliances etc. for pers.	11	Education	3
Canteens	11	Insurance connected with health	3
Milk, cheese and eggs	10	Other insurance	3
Wine	10	Equip. for recepotion, recording and reprod.	2
Meat	10	Heat energy	2
Materials for the maintenance and repair of the dwel	10	Combined passenger transport	2
Misc. printed matter and stationery and drawing mat	10	Mainten. & repair of other major durab. for recreat.	2
Beer	9	Information processing equipment	1
Non-durable household goods, n.e.c.	9	Liquid fuels	1
Equipment for sport, camping and open-air recreatio	9	Refuse collection	1
Other personal effects	9	Sewerage collection	1

Source: Eurostat, own calculations.

Table A.5: Composition of the ICSP based on output gap (HP) and unemployment gap (HP)

	TOTAL	Processed Food	Unproc. Food	Energy	Industrial Goods ex Energy	Services	Of which: Serv. rel. to recreation	Unproc. Food and Energy	All Food and Energy
Index of cyclically sensitive prices ICSP (OUTPUT GAP)									
EA	67	13	11	12	22	41	22	24	36
DE	54	16	7	6	23	49	16	12	29
FR	63	13	13	13	37	24	10	26	39
IT	58	16	15	3	20	46	19	18	34
ES	58	14	15	18	16	38	30	32	47
NL	52	17	10	0	35	38	16	10	27
BE	66	15	11	11	31	33	17	21	37
AT	49	17	6	1	43	33	27	7	24
FI	76	20	9	3	27	41	13	12	32
PT	45	19	0	8	27	47	33	7	27
IE	47	22	8	0	22	48	37	8	30
GR	22	27	24	7	25	17	0	31	58
LU	45	16	7	4	36	36	16	12	27
SI	64	12	9	6	42	31	17	15	27
SK	50	17	0	0	39	44	21	0	17
MT	33	21	3	0	16	60	54	3	24
CY	35	12	11	0	27	51	29	10	23
Index of cyclically sensitive prices ICSP (UNEMPLOYMENT GAP)									
EA	69	17	11	13	21	39	20	24	40
DE	32	13	0	0	41	46	27	0	13
FR	55	18	12	4	34	32	14	16	34
IT	61	19	11	2	28	40	19	13	32
ES	56	14	11	18	15	42	32	29	43
NL	46	19	5	0	25	50	22	5	24
BE	49	13	12	6	18	52	29	18	31
AT	56	8	8	1	29	54	37	9	17
FI	67	17	10	3	20	49	15	14	30
PT	36	14	0	0	23	63	42	0	14
IE	54	18	6	11	21	43	28	17	35
GR	61	6	14	3	23	55	28	17	23
LU	39	18	8	3	49	22	19	11	30
SI	54	11	3	4	44	37	23	8	18
SK	37	17	4	0	41	39	25	4	20
MT	48	23	18	8	26	25	5	27	49
CY	25	37	15	0	23	25	11	15	52
HICP									
EA	100	12	7	10	30	41	15	17	29
DE	100	12	5	12	28	44	13	17	28
FR	100	12	8	8	32	40	12	16	28
IT	100	12	8	8	32	40	16	16	29
ES	100	11	10	10	30	39	20	21	31
NL	100	12	5	10	31	42	12	16	27
BE	100	13	8	11	31	37	17	19	32
AT	100	11	5	8	29	47	22	13	24
FI	100	16	7	7	28	42	14	14	30
PT	100	12	10	11	26	42	18	21	32
IE	100	15	6	9	24	47	25	15	30
GR	100	14	9	7	28	42	19	16	29
LU	100	18	5	11	32	34	13	16	34
SI	100	15	7	12	31	35	15	19	34
SK	100	16	7	16	28	32	13	24	40
MT	100	15	9	6	31	39	23	15	30
CY	100	13	8	12	29	38	18	20	33

Source: Eurostat, own calculations. Weights refer to 2009. 'ICSP' stands for the index of cyclically sensitive prices.

Table A.6: Mean value and standard deviation of headline inflation, the ICSP and several core and special indices

	HICP	ICSP (output gap)	ICSP (unemployment gap)	Index ex. Unproc. Food and Energy	Index ex. all Food and Energy	Index of 'flexible' price indices	Index of 'sticky' price indices	FROOPP	Index ex FROOPP
					MEAN				
EA	1.9	1.7	2.1	1.7	1.6	2.1	1.3	2.4	1.5
DE	1.5	1.3	1.3	1.2	1.0	1.2	1.6	1.9	1.2
FR	1.6	1.5	1.6	1.5	1.3	1.5	1.9	2.2	1.2
IT	2.2	2.1	2.2	2.2	2.1	2.5	2.0	2.4	2.1
ES	2.7	3.2	3.1	2.6	2.5	2.8	2.7	3.2	2.1
NL	2.2	1.7	1.9	1.9	1.8	1.6	2.8	2.5	2.0
BE	1.9	2.2	2.4	1.7	1.5	2.3	1.5	2.3	1.6
GR	3.4	3.3	3.3	3.5	3.4	3.6	3.2	4.0	2.8
AT	1.6	1.4	1.6	1.5	1.4	1.7	1.5	2.1	1.3
PT	2.5	2.1	2.1	2.4	2.5	2.2	3.0	2.8	2.2
FI	1.7	2.1	2.0	1.6	1.5	1.0	2.7	2.2	1.3
IE	2.7	3.1	2.6	2.6	2.4	2.2	2.9	3.6	1.3
SK	5.8	4.8	4.4	5.0	5.1	3.6	11.1	4.7	7.2
SI	4.5	3.9	4.1	4.3	4.0	4.0	5.5	5.2	4.1
LU	2.4	2.1	2.0	2.2	1.8	2.5	2.3	3.0	1.7
CY	2.6	2.3	3.5	2.0	1.4	3.2	2.2	4.1	0.7
MT	2.7	3.3	2.9	2.5	2.2	3.2	2.5	3.3	2.0
					STANDARD DEVIATION				
EA	0.8	0.8	1.1	0.5	0.4	1.0	0.8	1.1	0.5
DE	0.8	0.8	0.7	0.6	0.5	3.0	0.6	1.2	0.6
FR	0.9	1.2	0.9	0.6	0.5	0.8	1.2	1.3	0.7
IT	0.7	0.8	0.9	0.4	0.4	1.3	0.6	1.0	0.6
ES	1.2	1.8	1.8	0.7	0.7	1.5	0.8	1.7	0.9
NL	1.1	1.8	1.7	1.1	1.1	1.7	1.2	1.4	1.2
BE	1.2	1.4	1.3	0.5	0.5	2.1	0.5	1.3	1.2
GR	1.1	1.7	1.7	1.2	1.4	1.3	1.3	1.1	1.5
AT	0.8	1.0	0.9	0.6	0.5	1.3	0.8	1.5	0.6
PT	1.3	1.3	1.2	1.1	1.1	1.5	2.1	1.7	1.2
FI	1.0	1.3	1.3	1.0	0.8	1.2	1.2	1.5	0.8
IE	1.7	1.7	2.0	1.6	1.7	2.4	1.6	1.8	2.1
SK	3.6	2.6	2.1	2.6	2.7	2.5	8.5	2.6	5.3
SI	3.2	2.9	3.0	3.2	3.0	3.2	3.8	3.7	3.2
LU	1.4	1.1	0.9	0.7	0.5	2.9	0.8	2.0	0.9
CY	1.4	2.2	3.1	1.0	1.0	3.3	1.3	2.0	1.6
MT	1.2	2.2	1.6	1.1	1.1	2.8	1.1	1.6	1.6

Note: 'ICSP' stands for the index of cyclically sensitive prices determined with reference to the output gap (HP based), 'ICSP-UN' the index determined with reference to the unemployment gap (HP based), 'Index of 'sticky' price indices is defined in Section 3.2.4, 'FROOPP': 'index of frequent-out-of-pocket-purchases' as described in Section 3.2.2, 'XFROOPP': adversary of FROOPP.

Table A.7: Output sensitivity of headline inflation, the ICSP (output gap) and several core and special indices

		ICSP	FROOPP	FLEX	HICP	XFROOPP	XEUP	XEF	STICKY
EA	**benchmark**	0.19	0.20	0.15	0.13	0.09	0.05	0.03	*n.s.*
	GMM	0.18	0.21	0.15	0.11	0.07	0.08	0.06	0.08
	ALL	**0.19**	**0.21**	**0.14**	**0.12**	**0.07**	**0.06**	**0.04**	**0.08**
	Sign. Est.	8	8	8	8	8	7	6	5
DE	**benchmark**	0.11	0.14	0.07	0.05	0.09	*n.s.*	0.06	0.08
	GMM	0.12	*n.s.*	*n.s.*	0.12	0.10	0.06	*n.s.*	0.09
	ALL	**0.11**	**0.15**	**0.13**	**0.09**	**0.08**	**0.04**	**0.05**	**0.07**
	Sign. Est.	8	7	5	8	8	4	7	8
FR	**benchmark**	0.30	*n.s.*	0.20	0.16	0.06	*n.s.*	0.04	*n.s.*
	GMM	0.43	0.43	0.19	0.17	0.08	0.10	0.06	0.17
	ALL	**0.30**	**0.27**	**0.21**	**0.16**	**0.08**	**0.11**	**0.04**	***n.s.***
	Sign. Est.	8	5	8	7	8	4	6	1
IT	**benchmark**	0.16	0.18	*n.s.*	0.10	*n.s.*	0.12	0.08	0.08
	GMM	0.13	0.14	*n.s.*	0.13	0.11	0.07	0.04	0.18
	ALL	**0.17**	**0.19**	***n.s.***	**0.13**	**0.12**	**0.13**	**0.08**	**0.10**
	Sign. Est.	8	7	1	6	2	8	8	7
ES	**benchmark**	0.24	0.19	0.10	0.14	*n.s.*	0.08	*n.s.*	0.06
	GMM	0.20	0.26	0.18	0.13	*n.s.*	0.08	*n.s.*	*n.s.*
	ALL	**0.22**	**0.19**	**0.12**	**0.14**	***n.s.***	**0.09**	***n.s.***	***n.s.***
	Sign. Est.	8	8	5	6	0	6	0	1
NL	**benchmark**	0.14	0.24	0.26	0.12	0.15	0.07	*n.s.*	0.17
	GMM	0.20	0.21	0.24	0.12	0.10	0.10	*n.s.*	0.13
	ALL	**0.14**	**0.26**	**0.28**	**0.12**	**0.13**	**0.08**	**n.s.**	**0.15**
	Sign. Est.	8	8	8	8	7	8	1	8
GR	**benchmark**	0.20	*n.s.*	0.17	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
	GMM	0.36	*n.s.*	*n.s.*	*n.s.*	*n.s.*	0.07	*n.s.*	*n.s.*
	ALL	**0.26**	***n.s.***	**0.20**	***n.s.***	***n.s.***	***n.s.***	***n.s.***	***n.s.***
	Sign. Est.	8	0	7	0	0	1	0	0
BE	**benchmark**	0.28	0.30	0.46	0.26	0.20	0.13	0.13	0.08
	GMM	0.45	0.28	0.66	0.33	0.42	0.08	*n.s.*	*n.s.*
	ALL	**0.28**	**0.31**	**0.45**	**0.26**	**0.23**	**0.13**	**0.11**	**0.07**
	Sign. Est.	8	7	7	7	7	8	7	7
AT	**benchmark**	0.16	*n.s.*	*n.s.*	0.11	0.06	0.08	0.07	0.05
	GMM	0.16	*n.s.*	*n.s.*	0.16	0.10	0.09	0.06	*n.s.*
	ALL	**0.17**	**0.24**	**0.19**	**0.12**	**0.07**	**0.08**	**0.06**	**0.06**
	Sign. Est.	8	2	2	5	5	8	7	2

Note: 'benchmark': OLS estimation containing only the lagged inflation series and the output gap (benchmark), 'ALL': average of 'benchmark', 'GMM' and further OLS estimation with six different control variables: oil prices, nominal exchange rate, import prices, international food prices, agricultural raw materials prices and commodity prices, as described in Section 3.5; 'Sign. Est.': number of significant estimates 'ICSP' stands for the 'index of cyclically sensitive products', 'XEUP' is the HICP excluding unprocessed food and energy (core inflation), 'FROOPP': 'index of frequent-out-of-pocket-purchases' as described in Section 3.4, 'XEF' stands for the HICP excluding all food and energy prices, 'XFROOPP': adversary of FROOPP, 'FLEX': index of flexible price indices as defined in Section 3.3, 'STICKY' is the adversary of the index of flexible price indices.

Table A.7: Output sensitivity of headline inflation, the ICSP (output gap) and several core and special indices (Cont.)

		ICSP	FROOPP	FLEX	HICP	XFROOPP	XEUP	XEF	STICKY
PT	**benchmark**	0.24	0.24	0.20	0.21	0.17	0.21	0.17	*n.s.*
	GMM	0.31	0.30	0.20	0.18	0.16	0.22	0.19	*n.s.*
	ALL	**0.25**	**0.25**	**0.18**	**0.18**	**0.15**	**0.20**	**0.17**	**n.s.**
	Sign. Est.	8	7	8	8	8	8	8	0
FI	**benchmark**	0.15	0.17	0.23	0.13	0.08	0.16	0.08	0.09
	GMM	0.19	0.23	0.19	0.12	0.05	0.10	0.05	0.10
	ALL	**0.16**	**0.19**	**0.24**	**0.13**	**0.08**	**0.17**	**0.08**	**0.09**
	Sign. Est.	8	8	8	8	8	8	8	8
IE	**benchmark**	0.08	0.12	*n.s.*	0.06	*n.s.*	0.04	*n.s.*	0.09
	GMM	0.21	0.16	*n.s.*	0.09	*n.s.*	0.08	*n.s.*	0.10
	ALL	**0.09**	**0.12**	***n.s.***	**0.06**	***n.s.***	**0.05**	***n.s.***	**0.09**
	Sign. Est.	8	8	0	8	0	5	0	8
SK	**benchmark**	0.18	*n.s.*	*n.s.*	0.06	*n.s.*	0.08	0.11	*n.s.*
	GMM	0.18	0.18	0.13	0.14	*n.s.*	0.13	0.12	*n.s.*
	ALL	**0.18**	**0.13**	**0.09**	**0.10**	**0.45**	**0.08**	**0.12**	***n.s.***
	Sign. Est.	8	4	3	4	2	8	8	0
SI	**benchmark**	0.26	*n.s.*	*n.s.*	0.03	0.22	0.12	0.11	*n.s.*
	GMM	0.20	0.22	0.21	0.12	0.16	0.14	0.12	*n.s.*
	ALL	**0.25**	**0.17**	***n.s.***	**0.07**	**0.19**	**0.14**	**0.12**	*n.s.*
	Sign. Est.	8	2	1	8	8	7	8	0
LU	**benchmark**	0.09	0.11	0.19	0.09	0.06	0.05	0.02	0.04
	GMM	0.20	0.17	0.30	0.14	0.11	0.04	0.02	*n.s.*
	ALL	**0.11**	**0.12**	**0.23**	**0.10**	**0.06**	**0.05**	**0.03**	**0.04**
	Sign. Est.	8	7	5	8	7	8	6	5
CY	**benchmark**	0.37	n.s.	0.34	n.s.	0.29	0.16	0.22	n.s.
	GMM	0.34	0.19	0.29	0.21	0.26	0.17	0.22	n.s.
	ALL	**0.37**	**0.22**	**0.33**	**0.18**	**0.28**	**0.17**	**0.23**	**0.16**
	Sign. Est.	8	3	7	4	8	8	8	3
MT	**benchmark**	0.42	0.20	0.35	0.10	n.s.	0.12	0.13	n.s.
	GMM	0.36	n.s.	0.45	n.s.	n.s.	n.s.	n.s.	n.s.
	ALL	**0.48**	**0.23**	**0.41**	**0.11**	**n.s.**	**0.13**	**0.14**	**n.s.**
	Sign. Est.	8	7	8	6	0	6	6	0

Note: 'benchmark': OLS estimation containing only the lagged inflation series and the output gap (benchmark), 'ALL': average of 'benchmark', 'GMM' and further OLS estimation with six different control variables: oil prices, nominal exchange rate, import prices, international food prices, agricultural raw materials prices and commodity prices, as described in Section 3.5; 'Sign. Est.': number of significant estimates 'ICSP' stands for the 'index of cyclically sensitive products', 'XEUP' is the HICP excluding unprocessed food and energy (core inflation), 'FROOPP': 'index of frequent-out-of-pocket-purchases' as described in Section 3.4, 'XEF' stands for the HICP excluding all food and energy prices, 'XFROOPP': adversary of FROOPP, 'FLEX': index of flexible price indices as defined in Section 3.3, 'STICKY' is the adversary of the index of flexible price indices.

Table A.8: Correlation of the price indices with the first factor extracted from the disaggregated consumer indices (Cont. of Table 6.1 in main text)

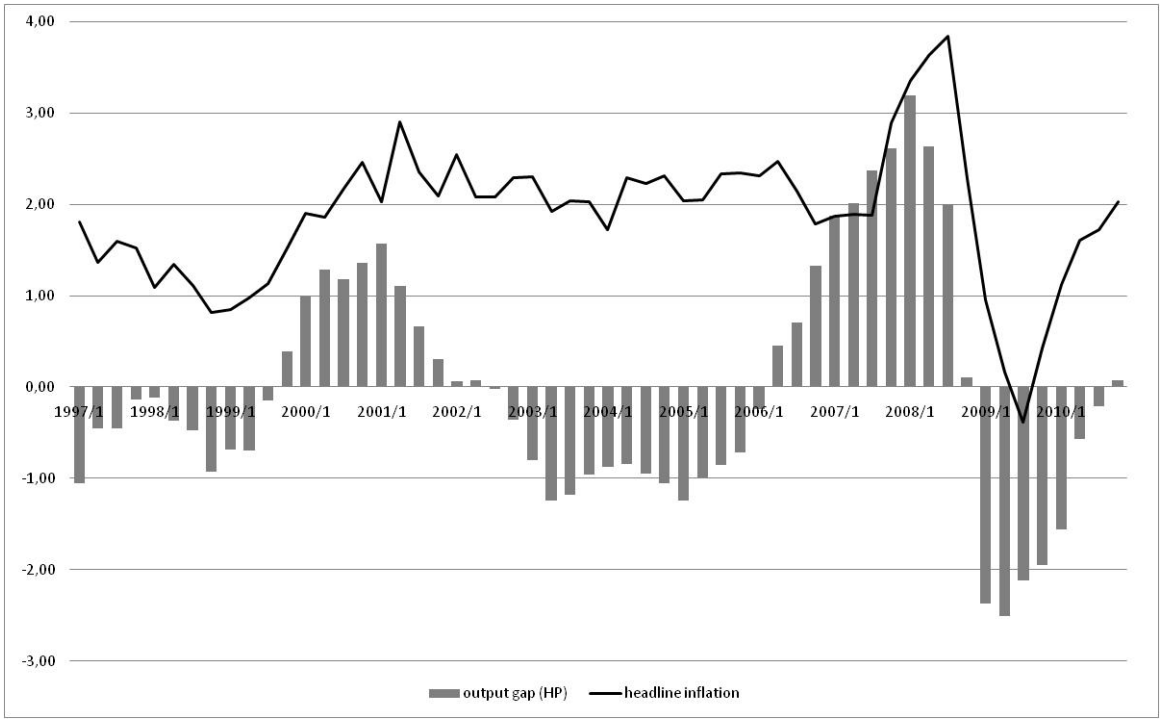
	AT	PT	FI	IE	SK	LU	CY	MT
ICSP	**0.72**	0.62	0.80	0.82	0.72	0.46	0.25	0.42
ICSP-UNEMP	0.57	0.71	0.77	0.88	0.58	**0.62**	0.50	**0.68**
ICSP-OECD			0.82	0.84	**0.85**			
XEF	0.24	**0.89**	0.42	0.90	0.66	0.42	0.18	0.26
XEUP	0.55	0.87	0.71	0.90	0.74	0.51	0.53	0.36
HICP	0.46	0.75	0.84	**0.95**	0.65	0.11	0.37	0.52
FLEX	0.31	0.82	0.61	0.92	0.66	0.04	0.11	0.42
STICKY	0.51	0.41	0.69	0.93	0.56	0.15	0.45	0.39
FROOPP	0.50	0.55	**0.86**	0.86	0.55	0.05	**0.55**	0.65
XFROOPP	0.05	0.88	0.45	0.89	0.61	0.30	0.06	0.30
FUP	0.57	0.29	0.50	0.73	-0.07	**0.50**	-0.24	0.48
FPROC	**0.66**	0.30	**0.84**	0.48	0.68	0.21	**0.82**	0.52
IND	0.58	**0.81**	-0.30	**0.94**	**0.81**	0.25	0.04	**0.55**
EN	0.18	0.28	0.21	0.55	0.41	-0.04	0.24	0.35
SERV	-0.22	0.85	0.61	0.82	0.56	0.44	0.41	-0.06

weights	AT	PT	FI	IE	SK	LU	CY	MT
ICSP	49	45	76	47	50	45	35	33
ICSP-UNEMP	56	36	67	54	37	39	25	48
FLEX	64	63	52	51	69	67	39	44
FROOPP	44	55	49	54	50	50	53	47

Note: 'ICSP' stands for the 'index of cyclically sensitive products' based on the HP output gap, 'ICSP-UNEMP' for 'index of cyclically sensitive products' based on the unemployment gap (HP), 'ICSP-OECD' for the 'index of cyclically sensitive products' based on the OECD output gap, 'FPROC' for 'processed food', 'FUP' for 'unprocessed food', 'IGND' for 'non-durable industrial goods', 'IND': 'industrial goods excluding energy', 'IGSD': 'semi-durable industrial goods', 'FUP': 'unprocessed food', 'SERVR': 'services related to recreation', 'XEUP' is the HICP excluding unprocessed food and energy (core inflation), 'SERV': 'all services items', 'FLEX': index of flexible price indices as defined in Section 3.3, 'STICKY' is the adversary of the index of flexible prices, 'IGD': 'durable industrial goods', 'FROOPP': 'index of frequent-out-of-pocket-purchases' as described in Section 3.4, 'XEF' stands for the HICP excluding all food and energy prices, 'XFROOPP': adversary of FROOPP, 'EN' energy prices.

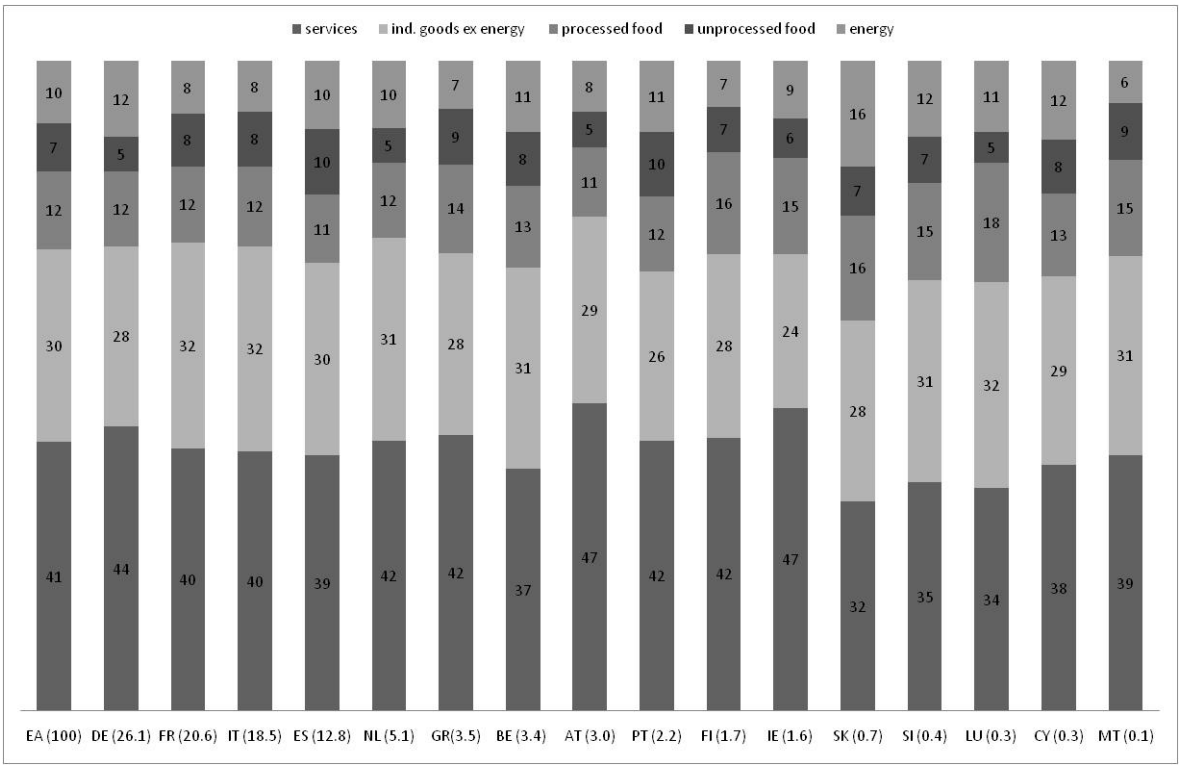
2. Figures

Figure A.1: Output gap and headline inflation rate in the euro area 1997-2010.



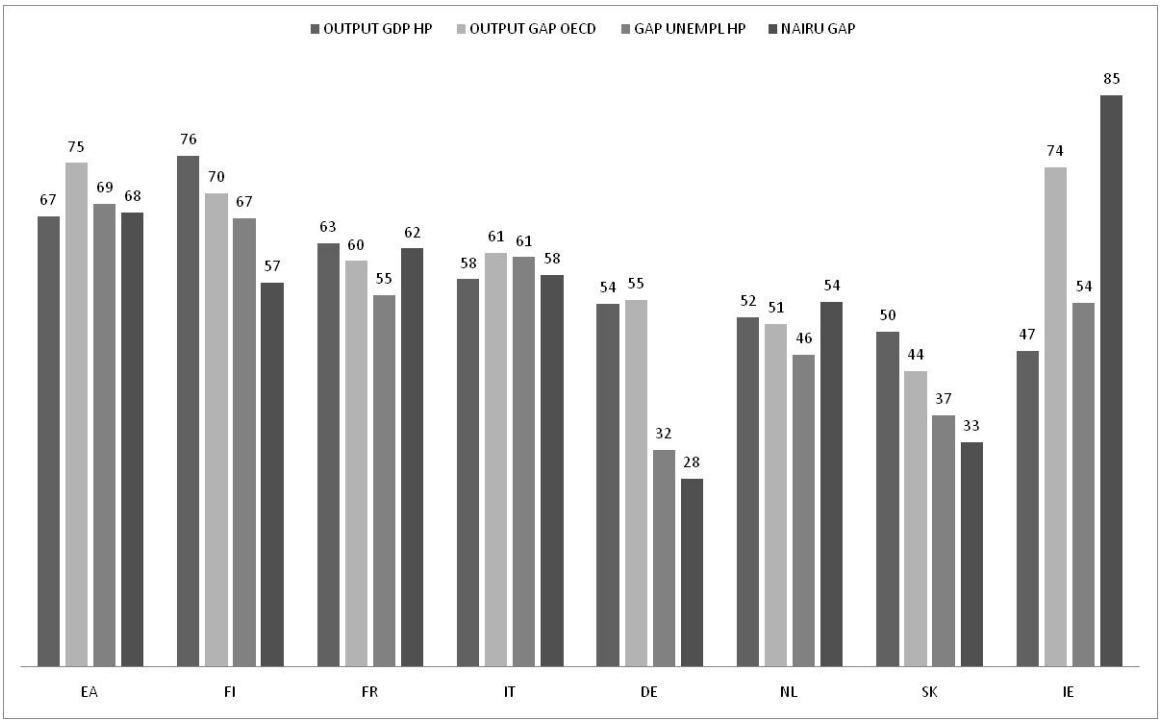
Source: Eurostat. Inflation rate year-on-year in per cent. Output gap in per cent of trend GDP.

Figure A.2: Composition of the HICP in euro area and its member states and weight of the member states in the euro area aggregate HICP in 2009.



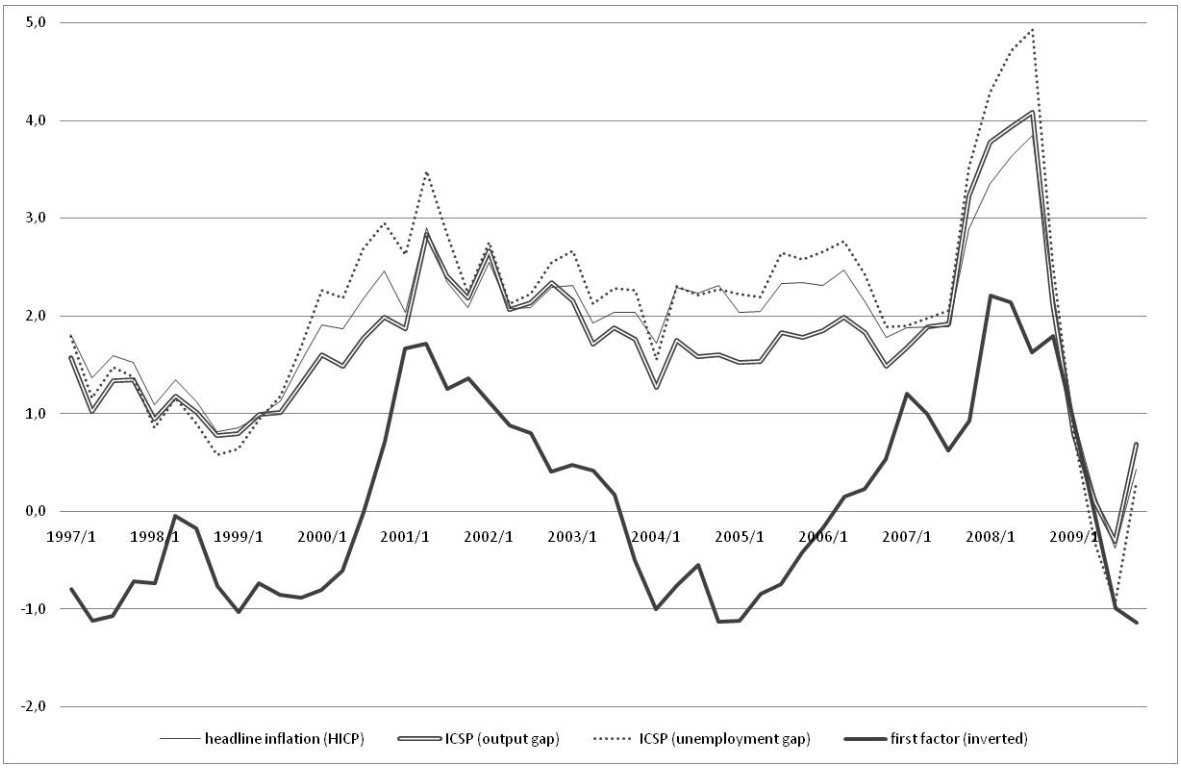
Source: Eurostat. In parentheses weight of the country in euro area HICP in %.

Graph A.3: Weight of the cyclically sensitive items including OECD measures of the business cycle



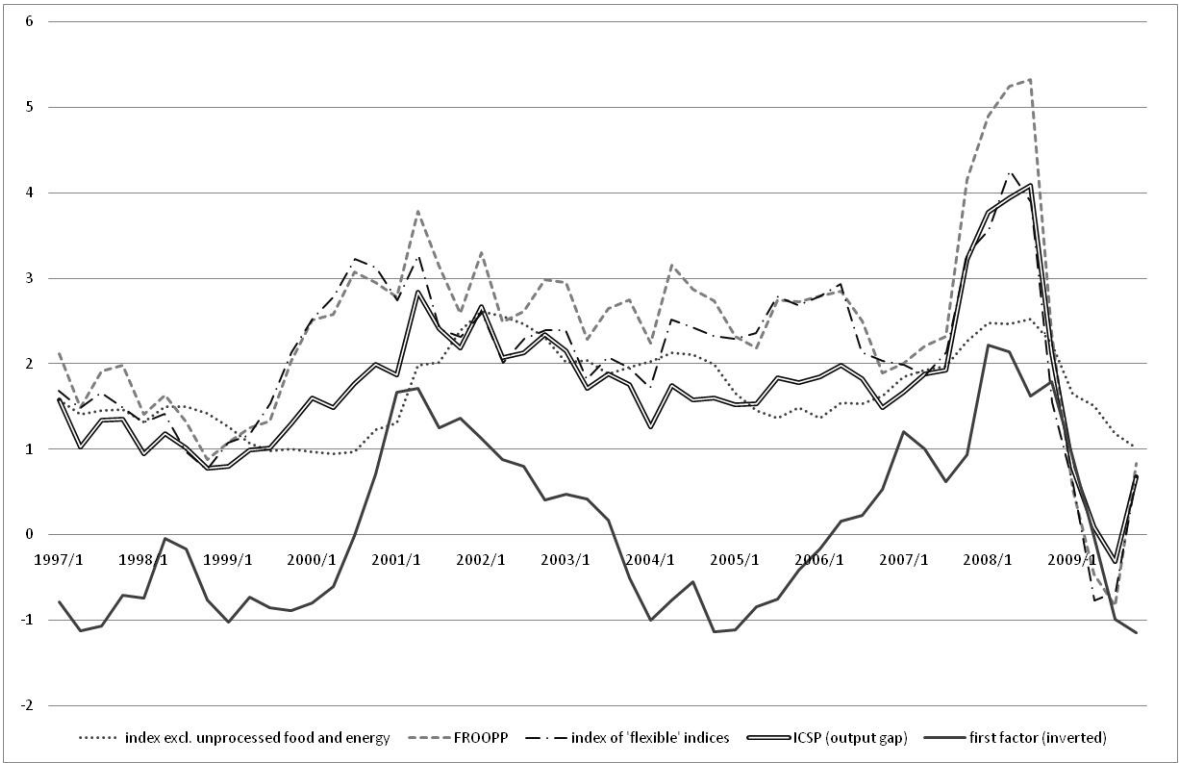
Source: Calculations of the authors.

Graph A.4: First factor and inflation rates of the ICSP (output gap), ICSP (unemployment gap) and headline HICP in the euro area (direct approach)



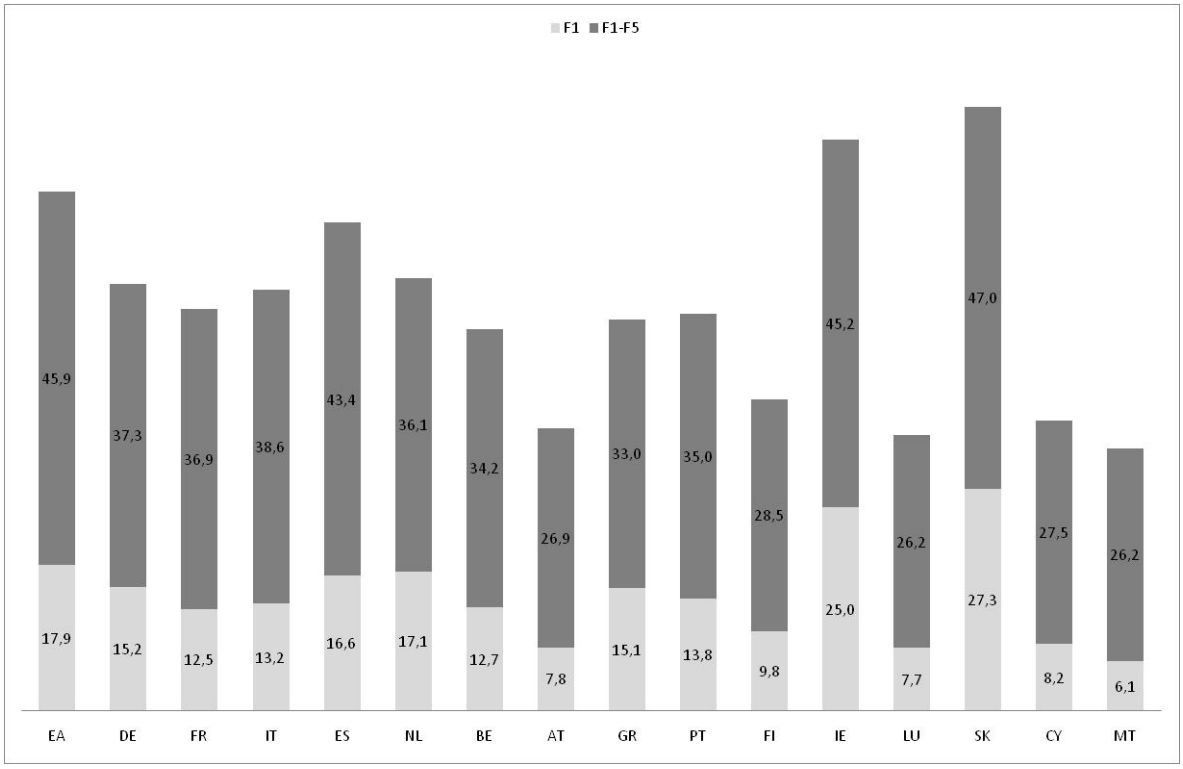
Source: Eurostat, calculations of the authors. The factors were extracted from the 4-digit COICOP items.

Graph A.5: First factor and inflation rates of several core and special indices, euro area (direct approach)



Source: Eurostat, calculations of the authors. The factors were extracted from the 4-digit COICOP items.

Graph A.6: Share in total variance explained by the first and the first five factors in the euro area and member states



Source: Eurostat, calculations of the authors. The factors were extracted from the 4-digit COICOP items.

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