

# Inflation in Austria since the introduction of the euro

Friedrich Fritzer, Fabio Rumler<sup>1</sup>

Refereed by: Josef Baumgartner, Austrian Institute of Economic Research

Given that Austria had already pursued a fixed exchange rate regime with Germany prior to the establishment of European Economic and Monetary Union (EMU), it is unlikely that the inflation process in Austria has changed fundamentally due to the introduction of the euro. Nevertheless, according to the theory of monetary union, inflation rates and price levels should converge in a monetary union in the long run due to greater transparency and the abolition of (formal and informal) trade barriers. In this article, we investigate the inflation process in Austria in the last 20 years by analyzing the inflation-output trade-off, the degree of price flexibility as well as the development of inflation differences and price level convergence in the euro area since 1999. We find that comparatively higher inflation rates of services, in particular of catering services, have been the main reason for the above-average inflation rate in Austria since 2011. Furthermore, we find that the convergence of price levels within the euro area, as measured by the coefficient of variation between national price levels, primarily decreased in the years prior to EMU, but increased after 2007. The latter can be explained by the accession of a number of low price level countries to EMU in the years after its establishment. At the micro level, the degree of flexibility of consumer prices appears to have increased in Austria in the last 20 years, indicating that the macroeconomic frictions induced by price rigidity may have decreased in recent years.

JEL classification: E31, E52, F45

Keywords: inflation, inflation differences, price level convergence, Phillips curve, price rigidities, Austria

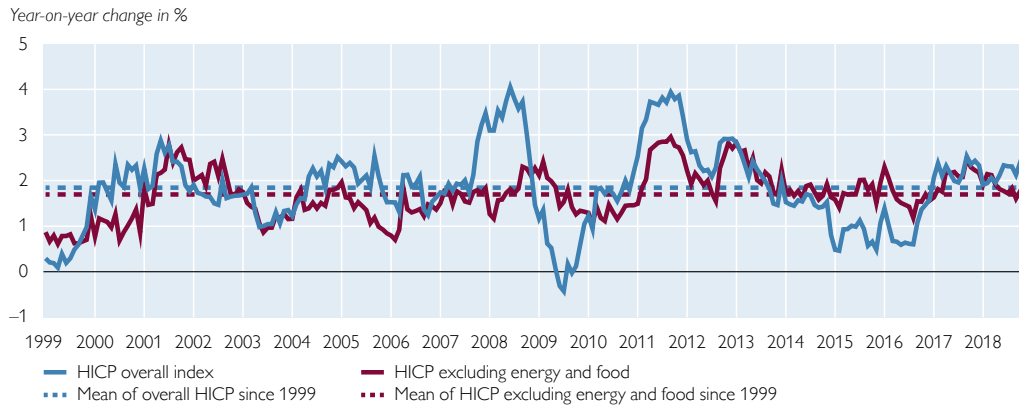
With the establishment of Economic and Monetary Union (EMU) in Europe, the exchange rate was given up as a policy instrument and as an adjustment mechanism in case of asymmetric shocks. A common monetary policy requires a common price stability target, implying, in turn, that equilibrium inflation rates should be equalized across member countries in the long run (see chapter 20 in Blanchard, 2017). In the short run, inflation rates can still differ substantially due to various reasons, including differences in taxation or asymmetric shocks. According to the theory of optimum currency areas (OCA), however, changes in the real exchange rate induced by differing inflation rates create a tendency for real economic and inflation developments to converge toward the long-run equilibrium (see De Grauwe, 2016). The elimination of imbalances occurs more rapidly and smoothly if prices and wages are more flexible and/or labor is more mobile within the union.

From a long-run perspective, average annual inflation, as measured by the Harmonized Index of Consumer Prices (HICP), has amounted to 1.8% in Austria since the establishment of EMU in 1999, which is indeed quite close to the average inflation rate of 1.7% in the whole euro area over the same period (see chart 1.1). Both values are also very much in line with the Eurosystem's definition of price stability of "below, but close to, 2%."

<sup>1</sup> Oesterreichische Nationalbank, Economic Analysis Division, [friedrich.fritzer@oenb.at](mailto:friedrich.fritzer@oenb.at) and [fabio.rumler@oenb.at](mailto:fabio.rumler@oenb.at). Opinions expressed by the authors of studies do not necessarily reflect the official viewpoint of the OeNB or the Eurosystem. The authors would like to thank the participants of an OeNB workshop, in particular Claudia Kwapil and Clemens Jobst, for their helpful comments and valuable suggestions.

Chart 1.1

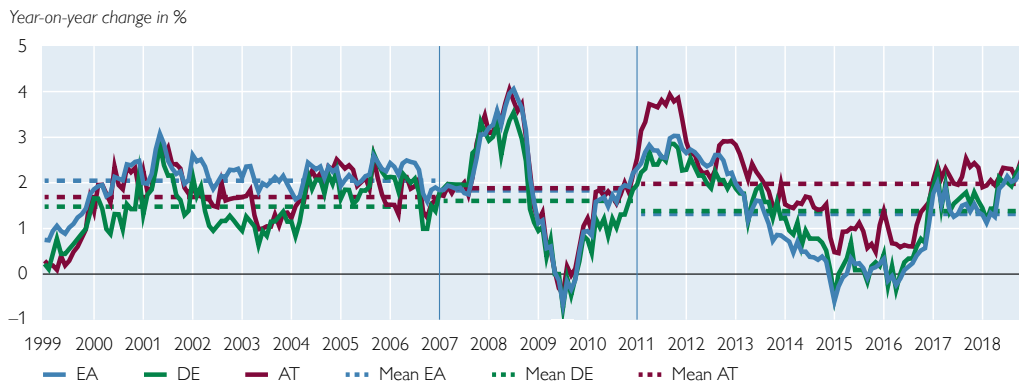
### HICP inflation and core inflation in Austria



Source: Statistics Austria.

Chart 1.2

### Inflation in Austria, Germany and the euro area



Source: Eurostat.

In order to identify the medium- to long-run movements of inflation, central banks usually calculate a measure that excludes the most volatile components of the HICP: energy, food, alcohol and tobacco. This measure, which is commonly called core inflation, amounted to 1.7% on average in Austria from January 1999 to December 2018 (chart 1.1). Large deviations of overall or headline inflation from core inflation reflect the fact that either food price inflation was particularly high, as in 2008 (or low), or energy price inflation was particularly high, as in 2011 (or low, as in 2009 and 2015/2016). In the long run, when transitory movements of the volatile components washed out, core inflation was very close to headline inflation, as can be seen in chart 1.1.

Even though inflation rates in Austria, the euro area and Austria's main trading partner, Germany<sup>2</sup>, were very close to each other in the long run, there were also

<sup>2</sup> After the cut-off date of this article, DESTATIS, the Federal Statistical Office of Germany, revised German inflation data as of 2015 due to a methodological change in the treatment of package holiday data in Germany. As a result, annual German HICP inflation for 2015 was revised upward from 0.1% to 0.7%. The revisions for the years after 2015 are negligible. For more information on this revision, see Deutsche Bundesbank (2019).

periods of more substantial deviations. In the early years of EMU, i.e. the period from 1999 to 2006, Austrian inflation was slightly below euro area inflation by an average 0.4 percentage points (yet by 0.2 percentage points higher than in Germany). In the period from 2007 to 2010, inflation in Austria was almost identical on average with euro area inflation, while in the latest period, i.e. from 2011 to 2018, it exceeded both euro area and German inflation considerably, namely by an average 0.6 percentage points and 0.5 percentage points, respectively (see chart 1.2).

Following this brief introduction, section 1 digs deeper into inflation differences and discusses the main reasons for the sustained above-average inflation rate in Austria since 2011. Section 2 analyzes the convergence of price levels both within and outside the euro area, which was to be expected as a result of the abolition of trade barriers after the introduction of the common currency. Based on estimations of the price Phillips curve, section 3 then addresses the trade-off between inflation and economic slack in Austria in the last 20 years. In section 4, we examine whether the degree of price rigidity present in HICP micro data has changed over time and, finally, section 5 concludes.

## 1 Inflation differences compared to other euro area countries

The persistent inflation differential between Austria and the euro area as well as between Austria and Germany since 2011 has almost exclusively been the result of considerably higher inflation in the Austrian service sector, while inflation rates in the goods sector have been almost identical in Austria, the euro area and Germany (see chart 2).<sup>3</sup>

Chart 2

### Inflation of goods and services

#### Goods



Source: Eurostat.

#### Services



<sup>3</sup> Even though the revision of German inflation data for 2015 was considerable, it is limited to package holidays and affects the inflation difference between Austria and Germany in 2015 only, so that the findings for the period from 2011 to 2018 discussed in this section should not be affected qualitatively by this revision.

Looking particularly at the differential between Austria and its main trading partner, Germany, we find that within the service sector, catering services<sup>4</sup> have accounted for almost half of the total inflation differential between the two countries since 2011 (see chart 3). Medical services and paramedical services, telephone and telefax services, recreational and sporting services as well as accommodation services follow as further important contributors to the inflation differential. However, their contribution is an order of magnitude smaller than that of catering services. Other service items, such as air tickets and social protection (more specifically, childcare services and nursing homes) have even had a small negative contribution to the inflation differential between Austria and Germany since 2011.<sup>5</sup>

The contribution of a particular service item to overall inflation is the product of its weight and its inflation rate. In chart 3, total differences between Austria and Germany in the inflation contributions of selected services (depicted by black frames) are decomposed into the contribution of differences in weights (blue bars) and the contribution of differences in inflation rates (dark red bars).<sup>6</sup> In the case of catering services, we find that the large contribution of catering services to the inflation differential rather results from a large difference in weights than from a difference in inflation rates. In fact, the weight of catering services in the Austrian HICP was 7 percentage points larger than that in the German HICP from 2011 to 2018, while its inflation rate was only about 1 percentage point larger. This implies that about 0.19 percentage points (or 70%) of the total 0.27 percentage points difference in the contribution of catering services to the Austrian-German inflation differential are due to differences in weights; the rest is due to differences in inflation rates.

Generally speaking, differences in weights of certain service items reflect the fact that households in one country spend a larger share of their income on these items than households in another country.<sup>7</sup> The larger weight of catering services in Austria is often explained by the importance of the tourism industry in Austria, which generates a lot of spending on catering and accommodation services and may also have exerted upward price pressures on these service items in recent years. However, this explanation can only be part of the story because prices of catering services are primarily collected in large cities rather than in rural touristic areas in Austria. Additionally, the weight difference between Austria and Germany for catering services is also substantial in the national Consumer Price Indices (CPIs), which do not include expenses of tourists.<sup>8</sup> Thus, the larger weight of catering

<sup>4</sup> Catering services include restaurants, cafés, bars, discotheques, fast food outlets and canteens.

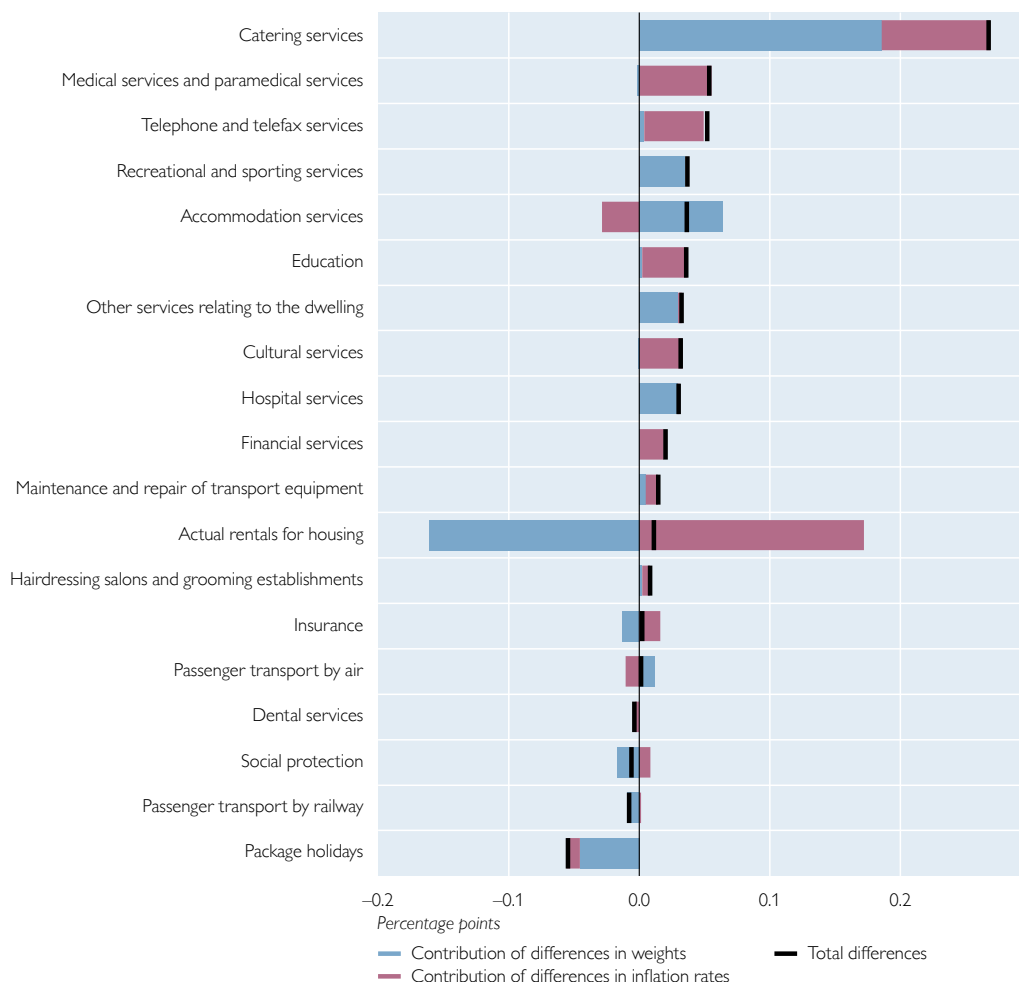
<sup>5</sup> For a more detailed analysis of inflation differences between Austria, Germany and the euro area, see Roitner and Rumler (2017).

<sup>6</sup> The calculations are based on the so-called Shapley decomposition, which was first employed for the decomposition of income inequality. Shorrocks (2013) showed that it can be applied to any – not necessarily linear – function. Since, in our case, the decomposition is based on time-averaged weight and inflation data, the sum of the contributions of differences in weights and differences in inflation rates does not always exactly equal total differences, which are also time-averaged.

<sup>7</sup> Assuming that the underlying household consumption surveys are conducted in a similar way in both countries.

<sup>8</sup> Over the period from 2011 to 2018, the average weight of catering services in the Austrian HICP was roughly 11%, while it amounted to 4% in Germany. Within the euro area, the weight of catering services is lowest in Germany and highest in Ireland (16%), with Austria ranking fifth. In the national CPI, the weight of catering services was 9.5% in Austria in 2018, compared to 3.4% in Germany.

### Differences between Austria and Germany in inflation contributions of selected services from 2011 to 2018



Source: Eurostat.

Note: Contribution of differences in weights and inflation rates are approximated using the Shapley decomposition.

services in Austria indeed reflects a stronger preference of Austrian households for dining and drinking out relative to German households.<sup>9</sup>

The weight of accommodation services (hotels, pensions, holiday homes, camping) in the Austrian HICP was also larger (by about 2 percentage points) than that in the German HICP, which is also partly due to the important role the tourism industry plays in Austria. However, inflation rates of accommodation services were slightly lower in Austria than in Germany from 2011 to 2018, which dampens the contribution of these services to the total inflation differential between the two countries. In contrast, in the cases of medical services and paramedical services as well as telephone and telefax services, the contribution to the inflation differential was mainly determined by higher inflation rates in Austria compared to Germany in the period from 2011 to 2018 (see chart 3). Moreover, interesting results can be

<sup>9</sup> For more details, see Roitner and Rumler (2017).

observed for actual rentals for housing in chart 3. Even though inflation of housing rents was 2.4 percentage points higher in Austria than in Germany over the period from 2011 to 2018, higher inflation developments were almost completely compensated by the substantially lower weight of rents in Austria (–6 percentage points), resulting in a negligible contribution of rents to the overall inflation differential. Comparing the weight of rents among euro area countries, we find that it is largest in the German HICP (10%) and lowest in Lithuania (0.6%), with Austria (4%) ranking somewhere in the middle.<sup>10</sup>

Apart from the service items shown in chart 3, the contribution of the public sector to overall inflation (through indirect taxes, public fees and administered prices) has been 0.2 percentage points higher in Austria than in Germany since 2011, which implies that the government also contributed a small amount to the inflation differential between the two countries.<sup>11</sup>

## 2 Price level convergence in the euro area and other country groups

During the past decades, policymakers have made continuous efforts to foster the economic and monetary integration of European markets, with one of the most important milestones being the introduction of a common currency in 1999. All of these efforts are likely to promote the convergence of price levels across euro area countries for the following reasons: (1) European economic integration goes hand in hand with the erosion of trade barriers (tariffs, non-tariff barriers, regulatory restrictions) and hence fosters price convergence for traded goods, in particular, simply by way of goods market arbitrage; (2) prices in less advanced countries (with usually lower price levels) increase faster simply because their productivity growth surpasses that of advanced economies (with higher price levels), which also leads to a catch-up in terms of price levels. The latter is due to the link between wages and productivity growth.

Section 2.1 explores the convergence in consumer prices for groups of countries within the EU, using price level data drawn from the comparative price level indices developed jointly by Eurostat and the Organisation for Economic Co-operation and Development (OECD) together with national central statistical offices. Based on these price level indices, convergence is measured using the standard deviation and variation coefficient<sup>12</sup> calculated for several groups of countries. The 28 EU countries are grouped into nine clusters for the purpose of comparing euro area with non-euro area price level convergence. The clusters are as follows:

- The euro area in a “fixed composition:” The founding members of the euro area, that is Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain as of 1995.
- The euro area in a “flexible composition:” All countries listed under (1) as of 1995 as well as Greece as of 2001, Slovenia as of 2007, Malta and Cyprus as of 2008, Slovakia as of 2009, Estonia as of 2011, Latvia as of 2014 and Lithuania as of 2015.

<sup>10</sup> For a detailed analysis of the coverage of housing costs in the Austrian HICP, see Roitner et al. (2018).

<sup>11</sup> For a more detailed analysis of the contribution of the public sector and other factors to the inflation differential between Austria and Germany, see Roitner and Rumler (2017).

<sup>12</sup> For the variation coefficient, the standard deviation is divided by the mean of the variable. Countries are not weighted as the analysis of price convergence requires the measurement of actual price differences, and not weighted price differences.

- The current 19 euro area countries as of 1995. In addition, the 19 euro area countries were split (3a) into a high-income group (Austria, Belgium, Cyprus, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Spain) and (3b) into a low-income group (Estonia, Greece, Latvia, Lithuania, Malta, Portugal, Slovakia, Slovenia).<sup>13</sup>
- The current 28 EU countries excluding the euro area countries: Bulgaria, Croatia, the Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, and the United Kingdom. Furthermore, this group was split (4a) into high-income countries (Denmark, Sweden, the United Kingdom) and (4b) into low-income countries (Bulgaria, Croatia, the Czech Republic, Hungary, Poland and Romania).
- All 28 EU countries.

## 2.1 General consumer price level and prices for goods and services: Country groups

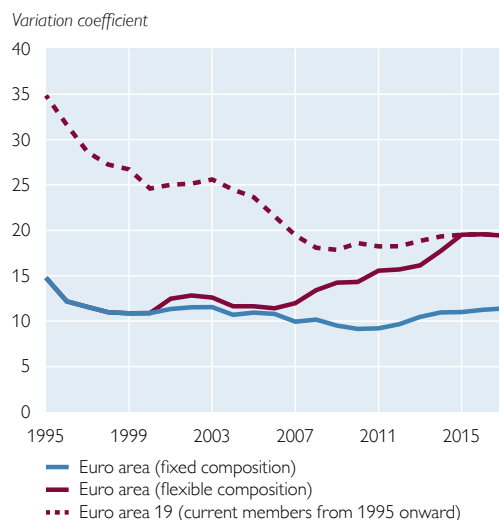
Chart 4 provides an overview of the changes in the variation coefficient for the aggregate consumer price level (household consumption expenditure) over time.

The variation coefficient<sup>14</sup> in chart 4 shows that price variation has been considerably lower in the euro area countries since 1995 than in other EU countries

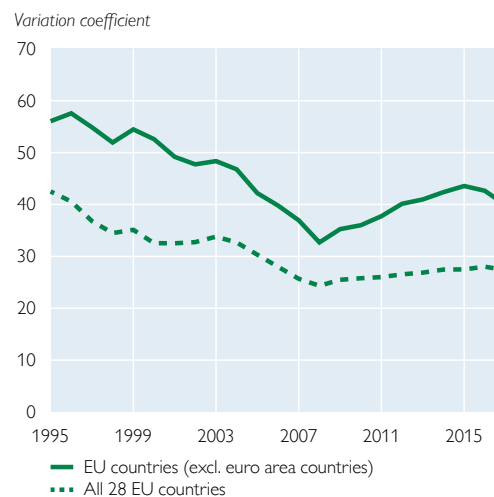
Chart 4

### General consumer price level: variation coefficient developments

#### Euro area



#### EU countries (excl. euro area countries) and EU countries



Source: Eurostat (price level indices from the European Comparison Programme), author's calculations.

Note: Euro area (fixed composition): founding members of Monetary Union as of 1995; euro area (flexible composition): founding members of Monetary Union as of 1995 as well as other euro area members as of their entry into the euro area; euro area 19: current members of Monetary Union lumped together as of 1995.

<sup>13</sup> The income groups are based on real per capita GDP. All 28 EU countries were ranked according to their income level and split into two groups comprising 14 countries each.

<sup>14</sup> The qualitative conclusions remain unchanged when the standard deviation is used as the measure of convergence. In the following pages, we will therefore only refer to the variation coefficient in our assessment of the level of price convergence.



excluding the euro area countries as well as the group of all 28 EU countries. In 2017 (the most recent year for which data are available), price level variation in the “fixed composition” euro area group, i.e. within the 11 founding members of the euro area, stood at 11.4% of the mean price level, while price level convergence within the “flexible composition” euro area group stood at 19.4%. However, in the group of the EU countries excluding the euro area countries, price level convergence reached almost four times the level of the “fixed composition” euro area group. In addition, we find an improvement in price level convergence for the “fixed composition” euro area countries until 2011, as opposed to a significant deterioration in price level convergence within the “flexible composition” euro area countries as of 2006. This can be attributed to the euro area accession of a number of countries with relatively low price levels during this period – i.e. of Greece (2001), Slovenia (2007), Cyprus and Malta (2008), Slovakia (2009), Estonia (2011), Latvia (2014) and Lithuania (2015). Lumping together all current euro area countries from 1995 onward shows a slightly different picture: Price convergence strongly improved from 1995 until 2008, and broadly stagnated from then onward. A closer look at the consumer price level reveals that, irrespective of the country group, services prices showed a higher variation compared to goods prices.

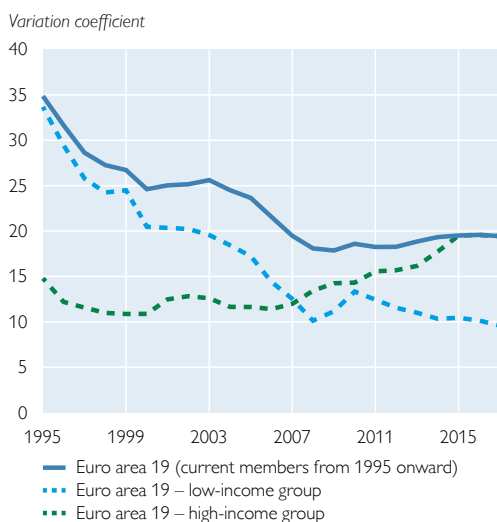
A further analysis of high-income as opposed to low-income countries indicates that price convergence progressed exclusively within the low-income country group. This is valid for both the group comprising the 19 euro area countries (see left panel of chart 5) and the group comprising the EU countries that are not members of the euro area (see right panel of chart 5). In addition, chart 5 shows that within the high-income euro area countries prices even diverged after 2007.

Even though – as described above – price convergence in the euro area countries is at a more advanced stage than in other EU countries, the question remains as to why convergence is not complete or why prices for some products even diverged.

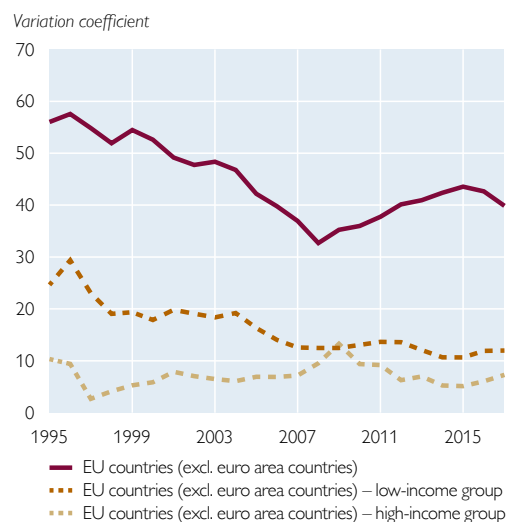
Chart 5

### General consumer price level in the EU according to income groups

#### Euro area countries according to income levels



#### EU countries (excl. euro area countries) according to income levels



Source: Eurostat (price level indices from the European Comparison Programme), author's calculations.



The effect of taxation on the price level may be one source of price divergence. Within the euro area, some countries have augmented their value-added tax (VAT) rates since 1995, including larger countries like Germany (from 16% to currently 19%), Spain (from 16% to currently 21%) and Italy (from 19% to currently 22%), but also smaller countries like Greece (from 18% to currently 24%) and Ireland (from 21% to currently 23%). Furthermore, economies with a relatively high level of prosperity (as measured by real per capita GDP) have been found to have higher price levels compared to countries with a lower level of real per capita GDP. The positive correlation between real GDP and price levels operates through both demand (e.g. higher consumer demand) and supply factors (higher productivity and thus higher wages). Therefore, the new Member States of the euro area – which are also countries with a considerably lower real per capita GDP level – may drive a long-lasting wedge between the price level of the euro area countries in “flexible composition” and that of the euro area founding members. However, also among the 11 founding members of the euro area, some divergence of the prosperity level could be observed after the financial and economic crisis in 2007/2008. The real per capita GDP level of Italy and Greece declined, while Spain’s level broadly stagnated. Other countries of the core euro area have recorded moderate increases in their real per capita GDP level since 2007/2008. Alongside these macroeconomic conditions, several structural factors may also have a causal effect on existing price differences. As a case in point, both retail profit margins and barriers to market entry for newly established firms may cause price level differences.

After having explored consumer price convergence for different country groups within the EU, section 2.2 examines price level convergence in Austria with respect to two of its most important trading partners – Germany and Italy.<sup>15</sup>

## **2.2 General consumer price level and prices for goods and services: Austria in comparison**

Based on the relative price level indices,<sup>16</sup> convergence in general consumer price levels has been recorded for Austria and its main trading partners over sub-periods since 1995. Against Germany, the period of convergence spans from 1995 to 2009, while it ranges from 1995 to 2002 against Italy (see left panel of chart 6).

In 1995, the price level in Austria was considerably above Italy’s, and slightly below Germany’s price level. One important factor contributing to consumer price convergence between Austria and Italy before 1999 was the appreciation of the Italian lira against the Austrian schilling. One interesting observation is that goods prices in Austria converged toward those of its main trading partners, while services prices did not. In fact, there have been no marked sustained differences in goods prices compared to Germany and Italy since about 2002. This is likely to be due to the higher tradability of goods compared to services. For services prices, however, Austrian prices have surpassed the German and Italian level since about 2007 (see right panel of chart 6). This might be the result of unit labor cost developments

<sup>15</sup> A previous analysis of price level convergence similar to the one in section 2 can be found in Fritzer (2012).

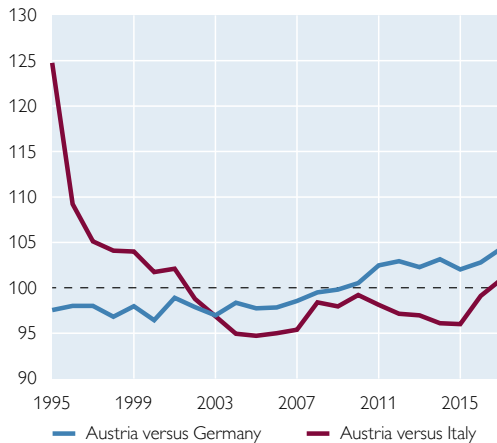
<sup>16</sup> The price level indices compiled under the Eurostat/OECD Purchasing Power Parities Programme are normalized to an EU average (here EU-15=100). In order to compare Austrian price levels directly with those in Germany, Italy and the euro area, the price level indices for Austria are divided by those of the other countries or regions, respectively, and then multiplied by 100. If the resulting relation is over (under) 100, Austria’s price level is above (below) that of the other countries or regions.

Chart 6

## Differences in price levels: Austria versus Germany and Italy

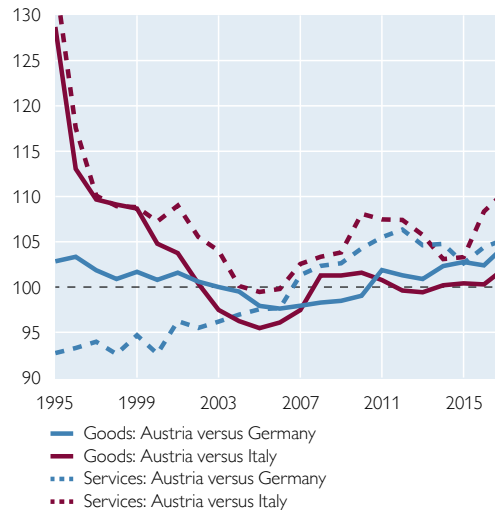
### Consumer price level

Relative price level for AT vis-à-vis DE, IT<sup>1</sup>



### Consumer goods and services

Relative price level for AT vis-à-vis DE, IT<sup>1</sup>



Source: Eurostat (price level indices from the European Comparison Programme), authors' calculations.

<sup>1</sup> Austria versus Germany (Italy) is defined as the price level index for Austria divided by that of Germany (Italy) and multiplied by 100. The Eurostat price level indices are normalized to EU-15=100.

for market services, which have developed more vigorously in Austria compared to Germany, in particular. Austrian unit labor costs (normalized to 1999=100) surpassed the German level in 2006, and remained above the latter until 2017.

### 3 The Austrian Phillips curve: inflation persistence and trade-off between inflation and economic slack

The Phillips curve is a long-standing framework to investigate the relation between inflation, inflation expectations, economic slack and imported inflation. We use empirically estimated Austrian Phillips curves to investigate two questions: First, has the trade-off between inflation and economic slack – the slope of the Phillips curve – changed during the last 20 years? Second, has inflation persistence, i.e. the dependence of inflation on its recent past, changed during the past two decades? Both questions are of high importance for policymakers: The trade-off between inflation and economic slack determines the output loss necessary to bring down inflation (the so-called sacrifice ratio) or, vice versa, the output growth necessary to lift inflation in case it is below levels deemed appropriate. Inflation persistence decreases the effectiveness of monetary policy as the impact of monetary policy measures passes through to inflation at a slower pace. For the euro area, there is evidence that both inflation persistence as well as the responsiveness of inflation to economic slack has increased during recent years (see Ciccarelli and Osbat, 2017). In our analysis, we deliver a full and updated account on these issues for Austria.

Our benchmark specification is

$$\pi_t = \mu + \rho\pi_{t-1} + \theta\pi_t^e + \beta x_t + \gamma imp_{t-1} + \varepsilon_t,$$

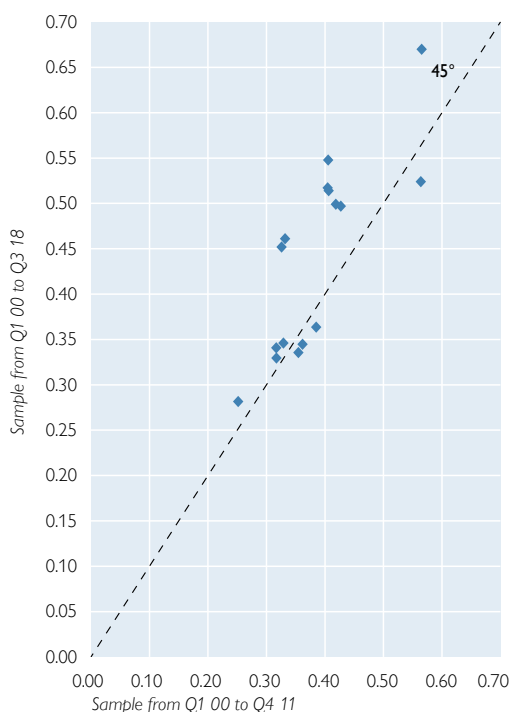
where  $\pi$  is the annual HICP inflation rate (seasonally adjusted),  $\pi^e$  are inflation expectations,  $x$  is the measure of economic slack and  $imp$  is the annual growth rate of oil prices in euro. In this specification,  $\rho$  is our indicator of inflation persistence, and  $\beta$  represents the trade-off between inflation and economic slack.

One of the critical issues in Phillips curve specifications of this kind is that neither economic slack nor inflation expectations are directly observable. Therefore, results may be sensitive to the measurement (errors) of these variables. We try to robustify the results by estimating the Phillips curve for a bundle of slack and inflation expectations measures. The following indicators of economic slack are incorporated into the estimation one at a time: GDP growth, the unemployment rate, the unemployment gap (unemployment rate minus an estimate of the non-accelerating inflation rate of unemployment), the unemployment recession gap<sup>17</sup> as well as estimates of the output gap from the OeNB, the OECD, the International Monetary Fund (IMF) and the European Commission. Furthermore, two estimates of inflation

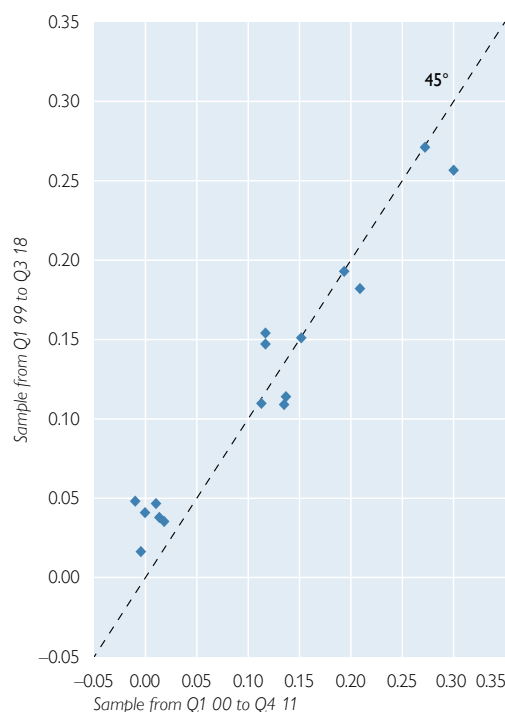
Chart 7

### Austrian Phillips curve

Inflation persistence in two samples



Slope in two samples



Source: Authors' calculations.

<sup>17</sup> The unemployment recession gap is the difference between the current unemployment rate and the minimum unemployment rate over the current and previous 11 quarters. Hence, the slack indicator is the unemployment rate recorded during downturns and zero otherwise. For more information, see Stock and Watson (2010).

expectations are incorporated one at a time: inflation forecasts for the current year and inflation forecasts for the next year, as provided by Consensus Economics<sup>18</sup>. Hence, in total there are 16 Phillips curve specifications, which we estimate over two different periods: from Q1 2000 to Q3 2018 and from Q1 2000 to Q4 2011. The second sample was restricted to end in Q4 2011 as inflation followed a markedly different path after this point in time. During the period up to Q4 2011, the stable development of inflation was interrupted by volatile developments during the economic and financial crisis in 2007/2008. As of Q1 2012, a long disinflation period was followed by a dynamic acceleration of inflation after 2016.<sup>19</sup>

The empirical estimates of inflation persistence and the slope of the Phillips curve are depicted in chart 7 where the vertical axis measures the estimates over the full sample (until Q3 2018) and the horizontal axis measures the estimates over the shorter sample (ending in Q4 2011). In case the estimates coincide with the 45-degree line, they are identical in the two samples. Estimates above (below) the 45-degree line signal higher (lower) parameter estimates over the full sample as compared to the sample restricted to the period up to Q4 2011.

The left panel of chart 7 represents inflation persistence (the estimate of  $\rho$  in the Phillips curve), i.e. the dependence of inflation on its past. Increases in inflation persistence indicate that monetary policy was working less efficiently as central bank actions took longer to pass through to inflation. Chart 7 shows that the majority of inflation persistence estimates are above the 45-degree line, with some of these

Table 1

### Chow test of parameter stability

Specification	Inflation persistence		Slope of the Phillips curve	
	Chow test statistic	P-value	Chow test statistic	P-value
HICP, GDP, OIL, Consensus_CY	0.94	0.34	0.87	0.35
HICP, GDP, OIL, Consensus_NY	0.49	0.49	0.85	0.36
HICP, UR, OIL, Consensus_CY	0.08	0.78	0.00	0.95
HICP, UR, OIL, Consensus_NY	0.00	0.97	0.04	0.84
HICP, Output Gap, OIL, Consensus_CY	0.29	0.59	0.29	0.59
HICP, Output Gap, OIL, Consensus_NY	0.22	0.64	0.41	0.52
HICP, Unemployment Gap, OIL, Consensus_CY	0.00	0.97	0.30	0.58
HICP, Unemployment Gap, OIL, Consensus_NY	0.01	0.92	0.24	0.62
HICP, Unemp. Recession Gap, OIL, Consensus_CY	0.19	0.66	0.00	1.00
HICP, Unemp. Recession Gap, OIL, Consensus_NY	0.02	0.88	0.00	0.97
HICP, OECD OG, OIL, Consensus_CY	0.62	0.44	2.00	0.16
HICP, OECD OG, OIL, Consensus_NY	0.33	0.57	2.02	0.16
HICP, WEO OG, OIL, Consensus_CY	0.49	0.49	1.14	0.29
HICP, WEO OG, OIL, Consensus_NY	0.61	0.44	1.87	0.18
HICP, EC OG, OIL, Consensus_CY	0.37	0.54	1.81	0.18
HICP, EC OG, OIL, Consensus_NY	0.12	0.73	1.76	0.19

Source: Authors' calculations.

Notes: The null hypothesis of the Chow test is that parameters are equal in the sub-samples. In the current application, the samples cover the periods from Q1 2000 to Q4 2011 and from Q1 2012 to Q3 2018.

<sup>18</sup> Consensus Economics collects forecasts of several professional forecasters and publishes an average thereof; available at <https://www.consensuseconomics.com/>.

<sup>19</sup> The separate estimation of the Phillips curves over the sample starting in Q1 2012 was not implemented as it contains only 27 quarterly observations. The lack of sufficient observations deteriorates the precision of the parameter estimates considerably.

estimates being pretty close to and fewer estimates being below the 45-degree line. Over the whole sample, all but one estimate of inflation persistence are significantly different from zero, while over the shorter sample (up to Q4 2011) only 9 out of the 16 estimates are statistically significant. Altogether, there seems to be more evidence for an increase in inflation persistence after Q4 2011.

Considering the link between inflation and real activity (see right panel of chart 7), the majority of estimates lies above the 45-degree line, with four estimates coinciding with the 45-degree line. It turns out that the significant parameter estimates are all close to or coincide with the 45-degree line. The results provide (very weak) evidence that the slope of the Phillips curve has not changed since 2000. No change in the Phillips curve slope suggests, in turn, that dampened economic growth occurring from 2012 to 2016 has not fundamentally changed wage bargaining or firms' price-setting behavior.

To shed more light on the statistical significance of the results, a structural break test according to Chow (see Chow, 1960) was conducted. Table 1 provides the results of the test examining the equality of the parameter estimates for inflation persistence and the Phillips curve slope during the two periods from Q1 2000 to Q4 2011 and from Q1 2012 to Q3 2018.<sup>20</sup>

In all of the specifications, the hypothesis of stable parameters in the two samples is rejected for both inflation persistence and the slope of the Phillips curve (the trade-off between inflation and economic activity). This is at odds, in particular, with the previous tentative assessments of a stable slope of the Phillips curve and, to a lesser extent, with an increase in inflation persistence during the last two decades. The test, however, assumes that the parameters are estimated separately during the two periods, which is likely to have affected the precision of the estimates. Furthermore, the Phillips curve estimates seem to be rather sensitive to sample changes. Overall, however, the previous assessment could not be confirmed by statistical evidence.

#### 4 Price rigidity over the last 20 years as derived from micro price data

Micro price data, i.e. individual data collected by Statistics Austria for HICP calculation, allow us to analyze how often and by how much retailers and service providers change their prices. From this, we can derive the degree of price rigidity present in the Austrian retail industry and further analyze whether it has changed over time.

To compute the inflation rate, Statistics Austria collects the prices of more than 700 goods and services in different outlets in 20 cities in Austria and (for some products) on the internet at monthly frequency. Based on this data, we calculate a number of descriptive statistics that characterize the price-setting behavior of Austrian retail firms, i.e. the average frequency of price changes, the average duration of constant prices (length of price spells) and the average size of price changes.<sup>21</sup>

<sup>20</sup> The acronyms HICP (HICP inflation), GDP (GDP growth), OIL (growth of oil prices in euro), Consensus\_CY and Consensus\_NY (inflation forecasts for the current year and the next year as provided by Consensus Economics), UR (unemployment rate), Output Gap (OeNB estimate of the output gap), OECD OG (OECD estimate of the output gap), WEO OG (IMF estimate of the output gap), EC OG (European Commission estimate of the output gap), Unemployment Gap (unemployment rate minus the non-accelerating rate of unemployment), and Unemployment Recession Gap (as defined in section 3) comprise the variables included in the Phillips curve specification.

<sup>21</sup> Our analysis is based on an updated version of the dataset used in Baumgartner et al. (2005). In the new dataset, the sample period spans from January 1996 to December 2017. For a more detailed description of the features of the data used and a detailed explanation of how the descriptive statistics were calculated and interpreted, see Baumgartner et al. (2005).

#### 4.1 Prices of energy and unprocessed food items are more flexible than prices of other products

Over the whole basket of goods and services and over the entire sample period from January 1996 to December 2017, 18.1% of all prices were changed each month. This implies that, on average, prices remained constant for about 12 months (median of 10 months).<sup>22</sup> Furthermore, more prices were changed upward (10.2%) than downward (7.3%),<sup>23</sup> but the average price increase (+10.5%) was smaller than the average price decrease (−14%). These average numbers for the whole basket hide a considerable degree of heterogeneity across products. Broken down by product type, we find that prices were changed much more frequently for energy and unprocessed food items than for processed food items, non-energy industrial goods and services.

#### 4.2 Price flexibility has increased over time, no inflationary effect of the euro cash changeover

The large number of monthly observations in our dataset allows us to calculate the descriptive statistics for every single month. Chart 8.1 plots the average frequency of price changes of all products over time. From the chart, we can clearly detect a seasonal pattern of price changes, with most price adjustments taking place in January of each year. This is particularly the case for many service items whose prices are typically changed in January. Apart from the seasonal pattern, we can also detect a clear upward movement of the frequency of price changes over time: Between the beginning and the end of our observation period, the average frequency of price changes has almost doubled. This indicates that the price-setting process has become more flexible in Austria over time and, consequently, macro-economic frictions induced by nominal rigidities are likely to have decreased in the recent past compared to before.

At first sight, the finding of higher price flexibility over time may seem to be at odds with the weak evidence of increased inflation persistence in the previous section. However, when consulting the most widely recognized theory of inflation determination, the hybrid New Keynesian Phillips Curve (NKPC), we realize that the frequency of price adjustments and inflation persistence are actually positively correlated. This is due to the fact that the NKPC assumes Calvo price setting<sup>24</sup> with partial indexation: Each firm is allowed to reset its prices in a given period with a constant probability (Calvo probability) and within this group, a fraction of firms does not set prices optimally but chooses to index its prices to past inflation. Thus, the more firms change their prices in any period, the larger the number (in absolute terms) of firms that set their prices in a backward-looking way and, as a result, the higher the persistence of the inflation process.

To examine whether the introduction of euro cash in January 2002 has had an effect on the price-setting behavior of Austrian retailers, we draw separate trend

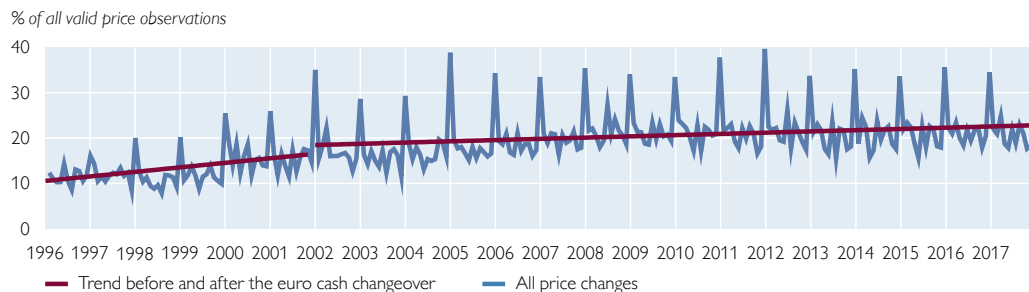
<sup>22</sup> The frequency of price changes  $F$  is converted to the price duration  $T$  by using the formula  $T = -1/\ln(1-F)$ . The calculations are done at the product level and then aggregated over the whole basket (using the HICP weights) to arrive at the mean and median price duration cited in the text.

<sup>23</sup> The frequencies of price increases and decreases do not exactly sum to the frequency of all price changes because of the weighting employed in the aggregation.

<sup>24</sup> For more information, see Calvo (1983).

Chart 8.1

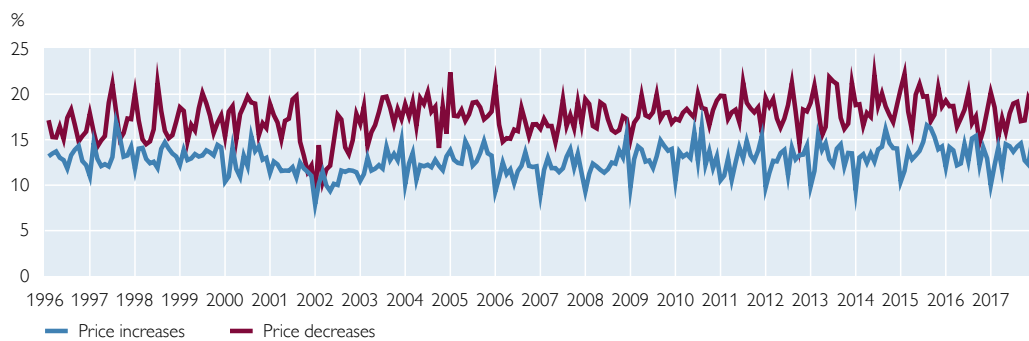
### Frequency of price changes



Source: Statistics Austria, authors' calculations.

Chart 8.2

### Size of price changes



Source: Statistics Austria, authors' calculations.

lines for the periods before and after the cash changeover and indeed find that a mean shift in the frequency of price changes occurred around the date of the cash changeover. This observation is supported by a Chow breakpoint test, which detects a significant break in both the mean and the trend of the frequency of price changes.

Turning to the time series of the average size of price increases and decreases shown in chart 8.2, we cannot detect any clear trend over time. Average price decreases are always larger than price increases, and they also appear to follow a seasonal pattern: Price decreases are largest in the summer months of July and August, while price increases are lowest in January. The former observation most likely results from summer sales in the clothing retail sector. However, since there are no fixed dates for sales periods throughout the year as they vary with demand conditions in retail markets, the seasonal pattern is not entirely stable over time.

Another striking feature in chart 8.2 is the sharp drop in the average size of both price increases and decreases in January 2002, the month of the cash changeover. Obviously, in this month (and, to a smaller extent, also in the three months preceding and following the cash changeover), more prices were adjusted than normally (as can be seen in chart 8.1); yet, they were adjusted by a smaller amount. Given that the upward and downward adjustments at the time of the cash changeover were about symmetrical both in terms of size and frequency, we cannot detect any inflationary effect of the cash changeover in our data.



## 5 Conclusions

In the period after the introduction of the euro 20 years ago, Austrian inflation was relatively low and stable. Since 2011, however, inflation rates in Austria have been above the euro area average, which is the result of relatively higher price increases of services, in particular of catering and accommodation services. The strong and prosperous tourism industry in Austria, which may have driven up prices of these services, is only part of the answer. There also seems to be a stronger preference of Austrian consumers to dine and drink out than in other countries, which is reflected by the considerably higher weight of catering services in the Austrian HICP.

Price level convergence among today's euro area countries improved, in particular, in the years prior to EMU and, to some extent, in the first years after the introduction of the common currency. Afterwards, this process stagnated or even worsened. The latter can be attributed to the accession of several low price level countries to EMU during the past 17 years. Austria's general consumer price level has surpassed the German price level from 2010 onward, while being broadly in line with Italy's consumer price level during the two most recent years. While services prices in Austria appear to have stayed above German and Italian services prices, Austrian goods prices have witnessed less (compared to Germany) or no (compared to Italy) divergence from the goods price level of its main trading partners. The development of Austria's unit labor costs with respect to Germany, in particular, may be one reason for the divergent services price development in Austria compared to Germany and Italy.

Concerning the persistence of the inflation process, we find that inflation persistence, as measured by Phillips curve estimations, may have increased during the past 20 years; however, no firm empirical evidence has been found to support this conclusion. Furthermore, estimates of the relation between inflation and economic slack do not provide clear evidence whether this link has remained unchanged or not.

In macroeconomic theory, the degree of price rigidity in an economy – together with other nominal and real frictions – is relevant for the size and timing of the real effects of monetary policy. We find that the degree of price rigidity, as measured by micro consumer prices, has gradually decreased in Austria over the last 20 years, which implies that the transmission of monetary policy may have changed over that period.

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