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Is the Phillips curve concept still useful for Slovakia?

Empirical evidence says yes. *

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We address the issue of the receding impact of domestic demand factors on inflation in Slovakia. Moreover, we demonstrate the relevance of the phenomenon commonly known as the flattening of the Phillips curve for policy analysis. The results show that the flattening of the Phillips curve should be seen as a feature of globalization and anchored inflation expectations, rather than a bug. Our estimations, which include global variables (including oil prices, non-oil commodity prices, global slack, REER, and PPI dispersion) in addition to measures of domestic slack, show that the essential determinants of the inflation process are global and supply-side factors, while inflation remains well anchored. Our global model can explain the structural effects of recent economic shocks (such as the COVID-19 pandemic and the 2021-2022 inflation shock) and help address structural issues in inflation forecasting (especially in 2014-2016 and 2021-2023).

- The flattening of the Phillips curve is a feature, not a bug - factors beyond domestic slack are equally or more significant.
- Inflation is well-anchored at the long-run level, with global factors dominating the inflation process.
- Inflation in Slovakia is explained by both supply and demand factors.
- The global Phillips curve model helps to explain structural issues (COVID-19 shock in 2020-2021, inflation shock in 2021-2023).

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The Phillips curve flattening - it's a feature, not a bug.

The Phillips curve is a cornerstone of contemporary macroeconomic models, serving as a critical link in the transmission mechanism of monetary policy by connecting the real economy to price developments. In applied monetary policy, the central bank uses its tools to influence various financial variables, such as long-term interest rates, spreads, credit standards, lending volumes, and exchange rates, to shape general financial conditions that impact the real economy. When financial conditions ease, aggregate demand rises, the labour market tightens, and overall slack in the economy decreases. This dynamic exerts upward pressure on wages and, more broadly, on prices. Consequently, the Phillips curve represents an inverse relationship between economic slack and inflation.

One of the key challenges in contemporary applied policy work on the Phillips curve is its observed flattening. Flattening indicates that changes in economic slack within an economy have a diminishing effect on consumer prices, which can undermine the stabilizing properties of monetary policy. In other words, reducing economic slack would be less inflationary, but the cost of reducing inflation would rise. Empirical evidence supports this. Turner et al. (2019) found that the disinflation following the twin recessions of the Global Financial Crisis and the European Debt Crisis was significantly less than that of the 1990s recessions in OECD countries. Similarly, there was a notable lack of inflation during the last period of economic growth, which culminated in 2019. Furthermore, the COVID-19 shock has further complicated this relationship.

The flattening of the Phillips curve is a feature, not a bug, of the current macroeconomic environment. Transparent policy conduct and other factors beyond domestic slack may have played a larger role in the inflation process. Ha et al. (2019) identified two broad sources of this flattening. The first group relates to structural factors, such as the effects of globalization (including the global inflation cycle, the global financial cycle, international trade, and financial market integration) or technological advances that impact production processes and price setting. The second group pertains to macroeconomic stabilization policies that lead to a more transparent inflation process and help anchor inflation, such as increased transparency in monetary, exchange rate, and fiscal policies, as well as the implementation of various structural reforms.

In this policy brief, we address the flattening of the Phillips curve in the context of Slovakia and demonstrate how it enhances its utility for policy analysis. We utilize the OECD's versions of the Phillips curve by Turner et al. (2019) and Forbes (2019a, 2019b), which account for the structural changes mentioned earlier. The model assumes that inflation expectations are anchored around the long-run level of inflation. We employ a set of explanatory variables that control for the effects of globalization. These modelling approaches and their country-specific modifications are discussed in detail below.

An updated Phillips curve is useful for modelling inflation …

The Phillips curve formulation, with inflation expectations anchored around the central bank's inflation target, systematically outperforms other models in most OECD countries. Coibion and Gorodnichenko (2015) explain that a credible inflation target can anchor long-term inflation expectations, reducing inflation persistence and thereby diminishing the current inflation rate's effectiveness in predicting future inflation. In this functional form, Rusticelli et al. (2015) and Turner et al. (2019) achieve this by including an additional term that accounts for the deviation of lagged inflation from expected long-term inflation expectations anchored at the inflation target.[1]

There is no consistent inflation target for Slovakia in the analyzed sample, so we estimate it from the data and refer to it as the long-run level of inflation. Firstly, there is the issue of establishing a credible central bank target for individual euro area countries.[2] Secondly, data and consistency issues arise when determining specific values or variables to which inflation in Slovakia should converge. Therefore, we treat this parameter as unknown, estimate it from the data, and refer to it as the inflation attractor or long-run level of inflation (π^*).[3] Recent evidence from Slovakia (Modhurima, 2024) supports this stable version of the Phillips curve.

To control for the effect of globalization, we include several global variables alongside the measure of economic slack, which act as inflation factors. These global variables are significant drivers of CPI inflation[4] across various countries, and their influence has increased over the decades (Forbes, 2019a, 2019b). We use the following set of explanatory variables to model CPI inflation over the period from the first quarter of 1996 to the fourth quarter of 2023 (see Table 2 in the appendix for more details).[5]

- **Home slack:** This includes the principal component of the output gap, unemployment gap, labour force participation (LFPR) gap, and hours worked gap, emphasizing the importance of measuring slack more broadly[6]. Expected sign (+): As the economy heats up, aggregate demand outstrips total production capacity, putting upward pressure on prices and leading to higher inflation.
- **Supply shocks:** These are captured by import prices, oil prices, commodity prices (fuel and non-fuel price indices), and commodity prices excluding oil (including food, beverages, agricultural raw materials, base metals, and precious metals price indices). Expected sign (+): Rising production costs constrain aggregate supply, putting upward pressure on prices.
- **Global slack:** This includes measures of slack in advanced and non-advanced economies (proxied by slack in China). Expected sign (+): Improving global growth boosts the small open economy and, through the demand channel, increases inflation.
- **Real effective exchange rate (REER) gap:** Expected sign (-): An increase in the REER makes exports more expensive and imports cheaper, leading to a loss of trade competitiveness. This negatively impacts growth and inflation in a small open economy. However, this understanding of the rise in the REER differs from the increase due to the convergence process typical of a transition economy, which we have previously accounted for in this analysis (see Footnote 5).

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[1] A standard Phillips curve has the form: $\pi_t = \pi_t^e + \beta(inflation\ factors_t) + \epsilon_t$,
where long-term inflation expectations are defined as the combination of the inflation target and the lag polynomial $\pi_t^e = [1 - b(1)]\pi^{IT} + b(L)\pi_{t-1}$, which can be rewritten as $\pi_t^e = [1 - b(1)]\pi^{IT} + b(1)\pi_{t-1} + \tilde{b}(L)\Delta\pi_{t-1}$.
Inserting the reformulated equation for inflation expectations back into the standard Philips curve and rearranging the terms, we obtain the following empirical version of the Phillips curve:
$\Delta\pi_t = \beta^*(\pi^{IT} - \pi_{t-1}) + \beta(inflation\ factors_t) + \tilde{b}(L)\Delta\pi_{t-1} + \epsilon_t$.

[2] Turner et al. (2019): *„... while there is a commitment to keep area-wide inflation close to (and just) below 2% per annum, there is no such commitment for any individual member country. "*

[3] Assuming a constant inflation attractor starting from the second half of the 1990s is unrealistic. Therefore, we conducted several structural break tests (Quandt-Andrews breakpoint test, Bai-Perron multiple breakpoints tests, and breakpoints test based on information criteria) using the equation $\Delta\pi_t = \beta^*(\pi^* - \pi_{t-1}) + \tilde{b}(L)\Delta\pi_{t-1} + \epsilon_t$ to determine if and when there was a breakpoint in the constant $\theta = \beta^*\pi^*$. Most tests indicate a breakpoint in the inflation attractor, with the likely date estimated to be the second quarter of 2004. This date splits the sample into high (θ_{High}) and low (θ_{Low}) inflation periods. This date also coincides with Slovakia's accession to the EU and its strategy to eventually join the monetary union, which likely helped anchor inflation expectations at a lower rate.

[4] We have done the same exercise for core inflation, but as pointed out in Forbes (2019a,b), this approach is more appropriate for CPI inflation.

[5] 112 observations

[6] The results were broadly similar when we used the slack measures separately.

- **Effect of EU supply chains approximated by dispersion in PPI gap:** Expected sign (+): If dispersion increases, this means that PPI inflation is rising in some EU countries. As GVCs in the EU are highly integrated, this increase will soon follow in other countries and (also) affect headline inflation in Slovakia. The interconnectedness of EU supply chains amplifies the impact of price fluctuations.[7]

The Philips curve is estimated in the following form:

$$\Delta\pi_t = \beta^*[(\pi^{Low} + \pi^{High} D^{<2004Q2}) - \pi_{t-1}] + \beta(inflation\ factors_t) + b\Delta\pi_{t-1} + \beta^Q D^Q + \epsilon_t$$

where we assume a structural break in the long-run level of inflation occurred in the second quarter of 2004 (with the dummy variable $D^{<2004Q2}$ taking the value 1 before 2004Q2 and 0 afterward), splitting the sample into the high and low inflation periods. We also adopt three groupings of inflation factors. The first is a domestic version of the Phillips curve, containing only the measure of domestic slack (Table 1, column (1)), while the second grouping also contains a measure of supply shocks and forms a triangle model (Table 1, column (2))[8]. The third grouping is a global version of the Phillips curve, which includes a full set of global variables (Table 1, column (3) and (4)). The dummy variables D^Q take the value 1 in selected quarters[9].

Table 1
Phillips curves explaining headline (CPI) inflation.[10]

Phillips curves	Domestic Model (1)	Triangular Model (2)	Global Model (3)	(4)
$\hat{\theta}_{Low}$	0.912**	0.814**	0.810***	0.986***
	(0.38)	(0.32)	(0.30)	(0.27)
$\hat{\theta}_{High}$	1.684**	1.732**	2.663***	1.758*
	(0.82)	(0.83)	(0.79)	(0.93)
$-\hat{\beta}^*$	0.384***	0.361***	0.373***	0.323***
	(0.13)	(0.13)	(0.09)	(0.09)
$\hat{\pi}^*_{Low}$	2.38	2.25	2.17	3.05
$\hat{\pi}^*_{High}$	6.77	7.04	9.31	8.50
Home slack (Lag: 0Q, 0Q, 1Q)	0.293***	0.252***	0.180***	
	(0.09)	(0.09)	(0.07)	
Oil prices (Lag: 0Q)			0.051***	0.033**
			(0.02)	(0.02)
Commodity prices (Lag: 1Q)		0.082***		
		(0.03)		
Commodity prices ex. oil (Lag: 1Q)			0.119**	0.125**
			(0.05)	(0.05)
Global slack (Lag: 4Q)				0.275
				(0.17)
REER gap (Lag: 1Q, 0Q)			-0.214**	-0.233***
			(0.08)	(0.08)
Dispersion in PPI gap (Lag: 1Q)			0.347**	0.370*
			(0.16)	(0.15)
Dependent variable (Lag: 1Q)	-0.132	-0.202*	-0.211**	-0.187*
	(0.12)	(0.12)	(0.10)	(0.11)
Dummy Q variables	1999Q3, 2000Q1, 2003Q1, 1999Q4			
Adj. R^2	0.7799	0.7926	0.8174	0.8040
Obs.	109	109	107	107

Notes: Robust (HAC) heteroskedasticity and autocorrelation adjusted standard errors (Prewhitening with lags = 0, Quadratic-Spectral kernel, Andrews automatic bandwidth with offset=1) are in round brackets. ***/**/* indicates statistical significance the 1%/5%/10% significance level. Lag Q indicates the quarterly lag with which a variable enters the model. It follows from the model that $\hat{\pi}^*_{Low} = \hat{\theta}_{Low}/(-\hat{\beta}^*)$ and $\hat{\pi}^*_{High} = (\hat{\theta}_{Low} + \hat{\theta}_{High})/(-\hat{\beta}^*)$.
Source: Author's own computations.

[7] To construct business cycle gap variables, we use different approaches based on their statistical properties. For the output gap, unemployment gap, output gap in AE, and cyclical activity in China, we use available model estimates. For the hours worked gap and the dispersion in the PPI gap, we use one-year and two-year changes, respectively. For the REER gap, we also use one- and two-year changes, but first we have detrended the REER until 2008Q4 to take into account the trend appreciation in transition and post-transition countries, as was the case in Slovakia. Finally, we compute the LFPR gap as deviations from its long-run mean.
[8] The triangle or triangular model of inflation stems from research carried out in the late 1970s and early 1980s, in which the two traditional determinants of inflation - inflation expectations and demand factors - were supplemented by a third factor - a supply shock. Hence the name triangle.
[9] These dummy variables are chosen to ensure the normality of the residuals and are consistent with the dummy quarterly variables used in Turner et al. (2015) for Slovakia.
[10] The residuals in these estimated equations show only mild autocorrelation up to 3-4 quarters. Hence, a properly set heteroskedasticity and autocorrelation adjusted (HAC) estimator captures the effect of autocorrelation on the size of standard errors. See the notes in Table 1 for more details.

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From a historical perspective, inflation in Slovakia can be divided into two regimes: a high inflation period before 2004 and a low inflation period thereafter. During the high inflation regime of the 1990s until 2004, inflation rates were elevated, hovering around 7-8%, which is not unusual for a transition economy. After 2004, the low inflation regime prevailed, with long-term inflation remaining remarkably low and stable at around 2.5%, despite current and past shocks typically being short-lived. The official inflation target of the NBS evolved prior to the adoption of the euro to meet entry criteria. In 2004, the target was 3.5% (+/-0.5%) for 2005, below 2.5% for 2006, and below 2.0% for 2007-2008. After joining the monetary union, Slovakia adopted the euro area-wide inflation target of 2% in the medium term. Nevertheless, the estimated value of 2.5% is consistent with the level of long-term or "normal" inflation implicitly assumed for Slovakia. It also coincides with the estimated equilibrium appreciation of the REER over this period, which is 0.5 pp above the ECB's inflation target.

The flattening of the Phillips curve is evident in Slovakia, indicating that the inflationary impact of domestic slack is diminishing as other variables (such as commodity prices, REER, and PPI) become more dominant. As shown in Table 1, the coefficient on domestic slack decreases by over 10% in the triangular model and by nearly 40% in the global model. Importantly, while the coefficient decreases, the fit and precision of this estimation (as indicated by standard errors) continue to improve.

In addition to the flattening process described above (reduction in the value of the coefficient), the flattening can also be observed over time (a downward trend in the time-varying coefficient) in all three specifications, including the domestic model. The addition of supply (triangular model) or global variables to the Phillips curve reduces the effect of domestic inflationary pressures, which is the main theme of this paper. Nevertheless, for the sake of completeness, time-varying estimates of this coefficient from Table 1 (not reported here) show a downward trend in all three specifications. Explaining this phenomenon is beyond the scope of this paper. However, it may be related to firms' wage and price-setting behaviour or, more generally, to the time-varying transmission mechanisms from economic slack to prices.

From a policy perspective in the context of the Phillips curve, it is important to understand that the main determinants of the inflation process in Slovakia as a small and open economy are global in nature. In the triangular version of the Phillips curve, we approximate the (global) supply shocks with the index of commodity prices. In the global version of the model, in addition to the full set of global variables, we distinguish between two versions: one with domestic slack and one with global slack[11]. The explained variability of inflation is higher in the triangular model than in the domestic model, and even more so in the global model[12]. Even when we use the global model with global slack instead of home slack, the fit is better than in the domestic or triangular model. This evidence supports the hypothesis that factors such as commodity prices, the REER, or input prices play a larger role in determining inflation in Slovakia and should, therefore, be included in the Phillips curve.

Slovakia is a country integrated into global supply chains, with a dominant manufacturing and industrial sector, so the effects of (global) supply-side factors are more important for the inflation process than their (domestic) demand-side counterparts. Looking at the individual effects of inflation factors, we can assess the relative importance of supply-side or demand-side macroeconomic factors in explaining inflation (Table 3 in the appendix). The most important factor in explaining inflation is the commodity price index excluding oil prices, which is a global supply-side factor. A less important variable is a typical demand-side factor, home slack, followed by the index of commodity prices and the

[11] A slight difference compared to the literature is that we do not include a measure of domestic and global slack in the same model. These variables are, of course, correlated. Slovakia is highly integrated into the EA (EU), which is integrated into the world economy. Therefore, shocks are transmitted through this system.

[12] Unsurprisingly, in absolute terms, the largest contribution to the model fit comes from the quarterly dummy variables.

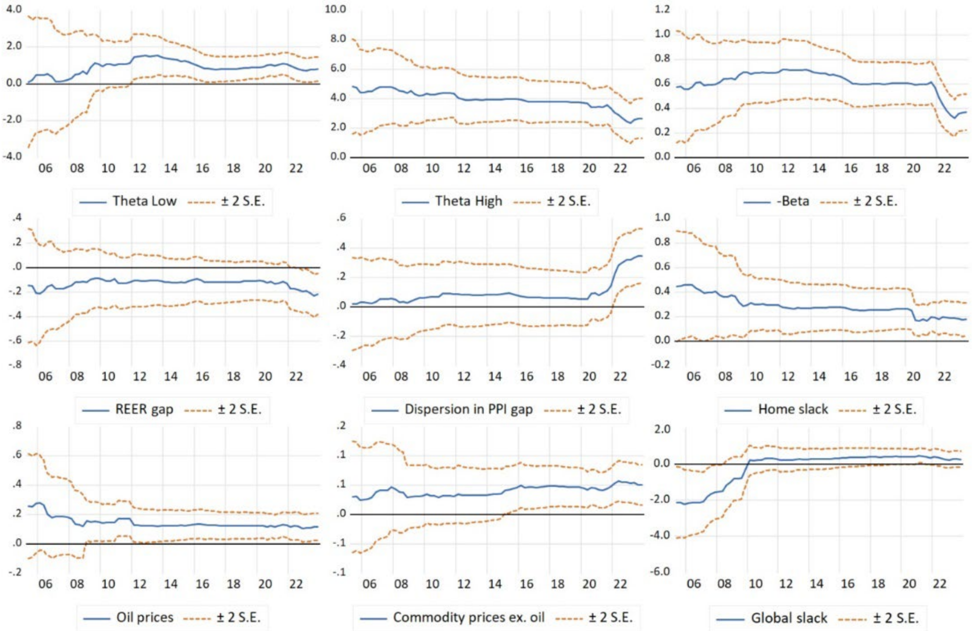
dispersion of producer prices, again representing supply-side variables. Inflation in Slovakia is thus explained by supply rather than demand factors.

… even for structural analysis.

Independently of the flattening process, the COVID-19 shock in 2020-2021 obscures the effect of domestic and global slack on inflation due to measurement errors and policy interventions. This specification of the Phillips curve is useful not only in terms of the statistical significance of the explanatory variables and the econometric fit but also from a structural point of view. Chart 1 shows the evolution of the estimated coefficients (Table 1 eq. (3)) as more and more sample data become available. The episode of the COVID-19 pandemic has reduced the impact of economic slack (either domestic or global) on inflation by more than 30%. This episode must be understood independently of the flattening process described above. We can attribute this to the problem of measuring economic activity during the pandemic and lockdowns, increased volatility, and government intervention to mitigate the adverse health and economic effects.

Chart 1

The evolution of the estimated coefficients (Table 1 eq. (3)) as more and more data become available.

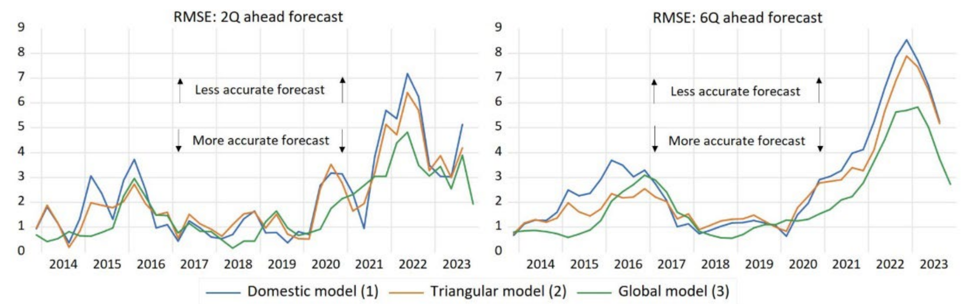


Source: Authors' own computation.

During the inflation shock of 2021-2023, the impact of competitiveness (REER gap) and EU supply chains (dispersion in the PPI gap) increased significantly due to the nature of the Slovak economy. Under normal inflation conditions, the negative effect of the REER gap and the positive effect of the PPI dispersion were muted and statistically insignificant. However, following the inflation shock that began in 2021, the impact of these variables became significant. The pass-through from the REER to inflation varies across countries and over time, depending on the nature of the shocks affecting the economy. In this instance, a strong negative global supply (energy) shock increased the pass-through from the REER to inflation. Similarly, this shock impacted Slovakia through its supply chains. Slovakia is highly integrated into the EU manufacturing sector, and the significant increase in input or producer price dispersion among trading partners amplified its effect on domestic inflation. Finally, prior to the fourth quarter of 2021, the attractor in the low-inflation period was 1.8%, but it later increased to 2.2%, remaining within the range of expected long-run inflation.

The addition of global variables helped to reduce the overshooting of inflation during the low inflation period (2014-2015) and partially reduced the undershooting of inflation during the high inflation period (2021-2023). Chart 2 shows the accuracy of the inflation forecasts two and six quarters ahead of the models in Table 1 (eq. (1), eq. (2), and eq. (3)) in terms of root mean squared errors (RMSEs). The global model helps to mitigate the problem of inflation overshooting in economic forecasts in 2014-2015, when economies were hit by the collapse in oil prices in mid-2014. Second, the model refines forecasts from 2018 to mid-2019, when negative economic slack closes and positive slack opens in Slovakia and other economies. Finally, the global model contributes significantly to mitigating the problem of undershooting inflation forecasts in 2021-2023. In this period, the economies recover from the GVC disruptions caused by the COVID-19 pandemic and are exposed to a series of energy shocks. The accuracy of the forecasts improves, especially over the longer horizon.

Chart 2
Forecast comparisons 2Q and 6Q ahead from equations (1), (2), and (3) in Table 1.



Notes: The interpretation of the values is as follows: the value of the RMSE in 2022Q4 for the domestic model (8.5) refers to the forecast sample starting in 2021Q3 (included) and ending in 2022Q4 (included). The lower the RMSE, the more accurate the forecast.
Source: Authors' own computation.

Conclusion

Empirical evidence shows that the Phillips curve remains a valid concept for understanding inflation in Slovakia if its known drawbacks are addressed. The main issue was the flattening of the Phillips curve, which weakened the impact of economic changes on headline inflation. However, the literature offers two explanations and potential solutions for this phenomenon. First, more transparent economic policies have helped anchor inflation at stable levels, which must be considered. Second, globalization and technological progress have influenced the price formation process, necessitating the selection of appropriate explanatory variables.

The updated Phillips curve is relevant for Slovakia in explaining the variability of headline inflation and provides insights into some structural issues. The global model of the Phillips curve, which includes domestic slack and global variables (oil prices, non-oil commodity prices, global slack, REER, PPI dispersion), outperforms other versions and offers valuable insights into the determinants of inflation. Additionally, this version of the Phillips curve can explain the structural effects of recent economic shocks (such as the inflation shock of 2021-2022 and the COVID-19 shock) and help address structural problems in inflation forecasting.

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Appendix

Table 2
Data definitions.

Variable	Definition	Details	Source
CPI	Consumer prices, all items	Quaterly percent changes, annualised, seasonally adjusted	SOSR
Output gap	Difference between real GDP and potential product	Percentage points	NBS, SOSR
Unemploy-ment gap	The difference between the unemployment rate and NAIRU	Percentage points, enters the model with a negative sign. From 1996 to 1997 is used OECD unemployment gap	LFS, SOSR, NBS, OECD
LFPR gap	Difference between actual par-ticipation rate and normal rate	Percentage points, normal rate is computed as the sample average	LFS, SOSR
Hours gap	Hours worked	The gap is approximated as an annual change. Quaterly percent changes	SOSR
Home slack	The principal component of the previous four measures of domestic slack	A positive value indicates less slack	
Import prices	Import prices, all items	Quarterly percent changes, in regressions measured as difference relative to CPI inflation	Eurostat
Oil prices	World oil price index	Index of crude oil, Brent, spot prices. Quarterly percent changes, in regressions measured as difference relative to CPI inflation	ICE
Commodity prices	World commodity price index, including fuel	All commodities index. Quarterly percent changes, in regressions measured as difference relative to CPI inflation	IMF
Commodity prices ex. oil	World commodity price index, excluding fuel	All commodities excluding fuel index. Quarterly percent changes, in regressions measured as difference relative to CPI inflation	IMF
Output gap in AE	Output gap in advanced economies	Percentage points	IMF
China's activity tracker	The China cyclical activity tracker	An alternative measure of China's economic growth which combines eight non-GDP indicators (consumer sentiment, electricity production, exports, fixed asset investment, new floor space constructed, industrial production, rail freight shipments, and retail sales)	Macrobond
Global slack	The weighted average of the output gap in AE and China's activity tracker	Weights vary over time based on the IMF calculation of the advanced economies' share of global GDP	IMF
REER gap	Real effective exchange rate based on consumer prices	The gap measure is approximated as an annual change in the detrended index	IMF
Dispersion in PPI gap	Dispersion of producer prices	Cross-section standard deviation in producer price inflation (annual change) for EU countries in each quarter. The gap for this measure is approximated as a two-year change	SOSR, IMF

Source: See data sources in the table.

Table 3
Separate effects of explanatory variables – inflation factors - on headline (CPI) inflation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\hat{\theta}_{Low}$	0.912***	0.912**	0.924***	0.771**	0.781**	0.715**	1.246***	0.751**	1.177***
	(0.32)	(0.38)	(0.33)	(0.33)	(0.30)	(0.29)	(0.40)	(0.32)	(0.36)
$\hat{\theta}_{High}$	0.686	1.684**	0.857	0.720	0.885	0.871	0.639	0.381	1.840**
	(0.72)	(0.82)	(0.87)	(0.93)	(0.89)	(0.94)	(0.98)	(0.77)	(0.73)
$-\hat{\beta}^*$	0.310***	0.384***	0.329**	0.288*	0.293**	0.270*	0.335**	0.239**	0.425***
	(0.10)	(0.13)	(0.13)	(0.15)	(0.14)	(0.15)	(0.15)	(0.10)	(0.09)
$\hat{\pi}^*_{Low}$	2.94	2.38	2.82	2.68	2.66	2.24	3.72	3.14	2.77
$\hat{\pi}^*_{High}$	5.15	6.77	5.42	5.17	5.68	8.22	5.62	4.73	7.10
Home slack (Lag: 0Q)		0.293***							
		(0.09)							
Import prices (Lag: 3Q)			0.162**						
			(0.08)						
Oil prices (Lag: 0Q)				0.045**					
				(0.02)					
Commodity prices (Lag: 4Q)					0.109***				
					(0.03)				
Commodity prices ex. oil (Lag: 1Q)						0.147***			
						(0.04)			
Global slack (Lag: 2Q)							0.409**		
							(0.17)		
REER gap (Lag: 0Q)								-0.190*	
								(0.10)	
Dispersion in PPI gap (Lag: 1Q)									0.333*
									(0.18)
Dependent variable (Lag: 1Q)	-0.168	-0.132	-0.136	-0.169	-0.252**	-0.212*	-0.162	-0.222*	-0.104
	(0.11)	(0.12)	(0.11)	(0.11)	(0.12)	(0.11)	(0.11)	(0.11)	(0.13)
Dummy Q variables	1999Q3, 2000Q1, 2003Q1, 1999Q4								
Adj. R^2	0.7377	0.7799	0.7434	0.7503	0.7625	0.8070	0.7422	0.7458	0.7622
Increase in Adj. $\bar{R}^2$		0.0422	0.0057	0.0126	0.0248	0.0693	0.0045	0.0081	0.0245
Obs.	112	109	112	112	112	107	112	112	107

Notes: Robust (HAC) heteroskedasticity and autocorrelation adjusted standard errors (Prewhitening with lags = 0, Quadratic-Spectral kernel, Andrews automatic bandwidth with offset=1) are in round brackets. ***/**/* indicates statistical significance the 1%/5%/10% significance level. Lag Q indicates the quarterly lag with which a variable enters the model. It follows from the model (see Footnote 2 and Footnote 4) that $\hat{\pi}^*_{Low} = \hat{\theta}_{Low}/(-\hat{\beta}^*)$ and $\hat{\pi}^*_{High} = (\hat{\theta}_{Low} + \hat{\theta}_{High})/(-\hat{\beta}^*)$.
Source: Author's own computations.