A Time-Varying Phillips Curve with Global Factors: Are Global Factors Important?*

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Abstract

This paper empirically investigates whether global or domestic factors play an important role in driving a countrys inflation dynamics. In addition, we also examine a countrys Phillips curve relationship over time. We utilize state-of-the-art bivariate unobserved components with time-varying parameters and stochastic volatility on a panel dataset comprising 34 countries of 23 advanced economies and 11 emerging economies. We found that global factors predominantly drive a countrys inflation dynamics and that the slope of the Phillips curve across countries, especially for the advanced economies, is flat over time. Our results appear to support the theoretical view that increased globalization and trade were the underlying cause of the flattening of the Phillips curve slope, and global factors primarily determine a country's inflation.

JEL classification: C11, C32, E31, F62
Kerwords: trend inflation, global factors, non-linear state space model, multi-country

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1 Introduction

Recent development in inflation dynamics has raised questions about the validity of the Phillips curve relationship across countries. In the aftermath of the Global Financial Crisis (GFC), many countries experienced a sharp decline in output with mild effects on inflation (see, Simon et al., 2013). The fear of deflation shared by many policymakers and central banks did not materialize. Surprisingly, many advanced economies (AEs) experienced record-low unemployment and low inflationary pressures during the post-crisis recovery. Consequently, there is a general consensus in the empirical literature that the slope of the Phillips curve has flattened since the early 1990s. A possible explanation for this flattening is due to both improved conduct of monetary policy with a better anchoring of inflation expectations (see, Simon et al., 2013; Kiley et al., 2015; Coibion and Gorodnichenko, 2015; Jordà et al., 2019), and a decline in inflation volatility[1].

Theoretically, Wynne and Martínez-García (2010) argues that the flattening of the Phillips curve across countries is largely attributed to globalization and international trade. Furthermore, they also find the important role of global factors in driving a country's inflation dynamics as a country's trade openness increases. Similarly, Gilchrist and Zakrajsek (2019) also demonstrate how increased trade exposure significantly reduces the response of the US inflation to fluctuations in economic activity over time since the 1990s. Additionally, the expansion of emerging economies (EMEs), particularly in China, can also contribute in various ways to rcountries'elopment in many countries inflation. For example Eickmeier and Kühnlenz (2018) show that China's demand and supply shock can significantly affect inflation in other countries. These theoretical findings appear to be supported by the empirical studies by Ciccarelli and Mojon (2010) and Kabukçuoğlu and Martínez-García (2018), where they find that a global inflation factor accounts for about 70 percent of the variance of inflation across 22 OCED countries and the addition of a global inflation factor predictor significantly improves the forecasting accuracy of US inflation, respectively.

There is, however, another strand of the literature that views the underlying cause of the flattening of the Phillips curve as the result of the central banks' anchoring of inflation expectations around their set target. For instance, King and Wolman (1996) illustrates how credible monetary policy authority is capable of stabilizing inflation by anchoring the expectations of agents around its objective. As agents form their expectations through learning, a gradual disinflation process results in slow learning, leading to adaptive inflation expectations. However, if the central bank conveys a strong commitment to disinflation, agents will react accordingly as they believe the central bank will achieve its objective. Hence expectations become anchored. Consequently, this leads to

[1]See for example Carlstrom and Fuerst (2008); Ball and Mazumder (2011); Simon et al. (2013); Blanchard et al. (2015); Gillitzer and Simon (2018); Blanchard (2016); Chan et al. (2016); Kabundi et al. (2019) on flattening the Phillips curve.

a mild reaction of inflation to demand pressures, implying a flat Phillips curve. Furthermore, there is increasing empirical evidence linking the flattening of the Phillips curve to credible monetary policy, especially for AEs, but also for some EMEs with inflation targeting (IT) policy framework.[2]

Subsequently, all the studies mentioned above have reignited the debate in the empirical literature on whether a country's inflation dynamics are primarily driven by either a domestic or global phenomenon. In this paper, we attempt to provide a unified study that empirically investigates this debate of whether global or domestic factors are important for a country's inflation dynamics over time. Furthermore, we also investigate the persistence of the long-term inflation trend and inflation volatility dynamics over time across countries. As a result, we can directly infer whether a country's Phillips curve relationship has indeed flattened. To investigate these questions, we estimate a flexible state-of-the-art bivariate unobserved components model with time-varying parameters and stochastic volatility on a panel dataset comprising 34 countries spanning 23 AEs and 11 EMEs from 1995Q1 to 2018Q1.

Our study is closely related to Forbes (2019) and Borio and Filardo (2007), where both studies demonstrate empirically, using an Open Economy New Keynesian Phillips curve framework, that global factors play an increasingly more important role in explaining inflation dynamics. However, they note that domestic forces are still relevant in driving inflation, but these factors have become less important over time.

Empirically, our paper contributes to the existing literature on the role of global factors affecting inflation dynamics in three folds. First, we investigate the role of global factors on a large panel set of countries' inflation dynamics. In contrast, many previous studies have only examined the role of global factors on US inflation and a narrow set of countries' inflation. The key advantage of our study is that we can elicit insight into whether global factors are important for explaining AEs and EMEs inflation dynamics. Second, it is well established in Cogley et al. (2010) that the inflation gap persistence has changed over time. Therefore, within our proposed framework, we allow for time variation in the parameters, which enables us to directly assess a country's key driver of inflation dynamics over time. On the contrary, the studies by Forbes (2019) and Borio and Filardo (2007) both implements a time-invariant framework. Forbes (2019) does investigate the role of global factors on a country's inflation dynamics over time, but it is only through a sub-sample analysis. Finally, we explicitly model a country's inflation gap and output gap endogenously, whereas, in Forbes (2019) and Borio and Filardo (2007), they treat a country's output gap as an exogenous variable in their New Keynesian Phillips curve model.

Our empirical results support the view that global factors play an important role in

[2]See for example Ball (2006), Williams et al. (2006), Simon et al. (2013), Kiley et al. (2015), Jordà et al. (2019), Gagnon and Collins (2019) and Hooper et al. (2020).

explaining a country's inflation dynamics. In particular, we find that global demand (output) plays a more significant role in explaining inflation across all countries, especially in EMEs, than AEs. Furthermore, we also find that oil prices play a dominant role in inflation dynamics across countries and over time. For instance, on average, the parameter on the oil price gap is about 6 and 4 times more than the domestic and global output gap parameters.

We also find evidence that the slope of the Phillips curve is flat and time-invariant across most countries. This is likely due to the decline in inflation volatility and the low inflation persistence experienced across all countries. Finally, we find that AEs than EMEs are more likely to experience low inflation persistence. This is because most AEs central banks have adopted an IT policy since the early 1990s. Unsurprisingly, these countries have low inflation persistence, given that a credible monetary policy anchors the agent's inflation expectations. In sum, our results appear to provide empirical support for the theoretical view of Wynne and Martínez-García (2010) that global factors dominate a countrys inflation dynamics and that its flattened Phillips curve slope is due to an increase in trade and globalization in the world.

The rest of the paper is organised as follows. Section 2 discusses the empirical model. Section 3 presents and discusses the empirical results. Finally, section 4 concludes.

2 Model Specification

We start from the model of Chan et al. (2016); this is given by equations (1) to (4) below.

$$\pi_{i,t} - \tau^{\pi}_{i,t} = \rho_{i,t}(\pi_{i,t-1} - \tau^{\pi}_{i,t-1}) + \alpha_{i,t}(y_{i,t} - \tau^{y}_{i,t}) + \varepsilon^{\pi}_{i,t}, \quad \varepsilon^{\pi}_{i,t} \sim \mathcal{N}(0,\ e^{h_t}) \tag{1}$$

$$y_{i,t} - \tau^{y}_{i,t} = \varphi_{i,1}(y_{i,t-1} - \tau^{y}_{i,t-1}) + \varphi_{i,2}(y_{i,t-2} - \tau^{y}_{i,t-2}) + \varepsilon^{y}_{i,t}, \quad \varepsilon^{y}_{i,t} \sim \mathcal{N}(0,\ \sigma^2_{y}) \tag{2}$$

$$\tau^{\pi}_{i,t} = \tau^{\pi}_{i,t-1} + \varepsilon^{\tau\pi}_{i,t}, \quad \varepsilon^{\tau\pi}_{i,t} \sim \mathcal{N}(0,\ \sigma^2_{\tau\pi}) \tag{3}$$

$$\tau^{y}_{i,t} = \tau^{y}_{i,t-1} + \varepsilon^{\tau y}_{i,t}, \quad \varepsilon^{\tau y}_{i,t} \sim \mathcal{N}(0,\ \sigma^2_{\tau y}) \tag{4}$$

where i denotes country i, $i = 1, \ldots, N$. At time t, $\pi_{i,t}$ is the inflation of country i and $y_{i,t}$ is the output growth of country i, $\tau^{\pi}_{i,t}$ and $\tau^{y}_{i,t}$ are their trends. These trends are unobserved latent states which can be interpreted as long-run equilibrium level of inflation and output, also known as trend inflation and trend output. $\pi_{i,t} - \tau^{\pi}_{i,t}$ is the inflation gap, $y_{i,t} - \tau^{y}_{i,t}$ is the domestic output gap. $\varepsilon^{\pi}_{i,t}$ is the error term with a stochastic volatility defined as:

$$h_{i,t} = h_{i,t-1} + \varepsilon^{h}_{i,t}, \quad \varepsilon^{h}_{t} \sim \mathcal{N}(0,\ \sigma^2_{i,h}) \tag{5}$$

$\rho_{i,t}$ is the inflation persistence. When expectations are well anchored, inflation is less persistent. Conversely, when expectations are adaptive, inflation tends to exhibit high persistence. $\alpha_{i,t}$ is the slope of the Phillips curve. $\rho_{i,t}$ and $\alpha_{i,t}$ are allowed to vary over time expressed by:

$$\rho_{i,t} = \rho_{i,t-1} + \varepsilon^{\rho}_{i,t}, \quad \varepsilon^{\rho}_{i,t} \sim \mathcal{N}(0,\ \sigma^2_{i,\rho}) \tag{6}$$
$$\alpha_{i,t} = \alpha_{i,t-1} + \varepsilon^{\alpha}_{i,t}, \quad \varepsilon^{\alpha}_{i,t} \sim \mathcal{N}(0,\ \sigma^2_{i,\alpha}) \tag{7}$$

In order to provide additional information regarding inflation, global output gap and oil price are also included in our model. With these two additional variables, the Equation (1) becomes:

$$\pi_{i,t} - \tau^{\pi}_{i,t} = \rho_{i,t}(\pi_{i,t} - \tau^{\pi}_{i,t}) + \alpha_{i,t}(y_{i,t} - \tau^{y}_{i,t}) + \beta_{i,t}\widetilde{g}_t + \gamma_{i,t}\widetilde{d}_t + \varepsilon^{\pi}_{i,t} \tag{8}$$

where $\widetilde{g}_t$ is the global output gap, $\widetilde{d}_t$ is the oil price gap, $\beta_{i,t}$ and $\gamma_{i,t}$ are time-varying parameters:

$$\beta_{i,t} = \beta_{i,t-1} + \varepsilon^{\beta}_{i,t}, \quad \varepsilon^{\beta}_{i,t} \sim \mathcal{N}(0,\ \sigma^2_{i,\beta}) \tag{9}$$
$$\gamma_{i,t} = \gamma_{i,t-1} + \varepsilon^{\gamma}_{i,t}, \quad \varepsilon^{\gamma}_{i,t} \sim \mathcal{N}(0,\ \sigma^2_{i,\gamma}) \tag{10}$$

Note that each country faces the same global demand and oil price shock. It therefore makes sense to estimate them outside of the model, otherwise these shocks will be specific to each country, which is counter-intuitive. Thus, $\widetilde{g}_t$ and $\widetilde{d}_t$ are estimated using different filtering techniques. The baseline model uses the filtering approach developed by Grant and Chan (2017).

To assess a country's monetary policy credibility and the slope of the Phillips curve, we constrained specific parameters in our proposed model specification to be between an interval according to economic theory. Specifically, we restrict the inflation persistence parameter (the coefficient on lagged inflation) to be positive and less than one. This restriction allows us to assess the degree of central bank credibility. For instance, a value of 0 implies the central bank is fully credible and agents are forward-looking. In contrast, a value of 1 suggests a complete lack of credibility and agents are backwards-looking. Furthermore, we also restrict the parameters on the domestic, global, and oil price gaps to be positive and less than one. This ensures that a positive domestic or global output gap shock leads to higher inflation, which is consistent with economic theory. These restrictions are imposed following Chan et al. (2016), who employ a bounded random walk process. More specifically, the error terms ε^{ρ}_t, ε^{α}_t, ε^{β}_t, and ε^{γ}_t are assumed to follow a truncated normal distribution:

$$\varepsilon^{\rho}_{i,t} \sim \mathcal{TN}(-\rho_{i,t}, 1-\rho_{i,t}, 0,\ \sigma^2_{i,\rho}) \tag{11}$$
$$\varepsilon^{\alpha}_{i,t} \sim \mathcal{TN}(-\alpha_{i,t}, 1-\alpha_{i,t}, 0,\ \sigma^2_{\alpha}) \tag{12}$$
$$\varepsilon^{\beta}_{i,t} \sim \mathcal{TN}(-\beta_{i,t}, 1-\beta_{i,t}, 0,\ \sigma^2_{i,\beta}) \tag{13}$$
$$\varepsilon^{\gamma}_{i,t} \sim \mathcal{TN}(-\gamma_{i,t}, 1-\gamma_{i,t}, 0,\ \sigma^2_{i,\gamma}) \tag{14}$$

where $\mathcal{TN}$ denotes the truncated normal distribution. All coefficients, bounded and unbounded, are estimated by Bayesian method using Markov chain Monte Carlo (MCMC) algorithm. The priors are in Appendix A and for further details of estimation, we refer our readers to Chan et al. (2016).

3 Empirical Results

3.1 Overview and Data Description

In this section, we present empirical results from the bivariate unobserved components model with two global factors. In particular, we group the results for AEs and EMEs. First, we begin from a global view, discussing the role of global factors in driving a countrys inflation dynamics. Second, we focus on the domestic factors.

We use a dataset that consists of quarterly series from 34 countries, 23 advanced economies (AEs)[3] and 11 emerging market economies (EMEs)[4], observed from 1995Q1 to 2018Q1. The choice of countries and the sample size are based on data availability. The series included are the consumer price index (CPI) representing domestic inflation, the real gross domestic product (GDP) which reflects domestic demand, oil price is used as proxy of supply shock, and global GDP as a proxy of global demand.[5] Oil price is taken from the World Bank Commodity Price Data, domestic GDPs are obtained from Haver Analytics, and the global GDP is from the St. Louis Federal Reserve Banks database, FRED. The series are transformed into quarter-on-quarter difference of natural logarithms times 400. Note that the global output gap, obtained using the global GDP, and the detrended oil price inflation are constructed outside of the model using the filtering technique developed by Grant and Chan (2017).[6] As mentioned above, it is appropriate to estimate the global output trend and oil price trend outside the model, given that each country faces the same global demand and supply shock. Conversely, deriving them from the

[3]Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Israel, Italy, Latvia, Lithuania, Netherlands, Portugal, Slovakia, South Korea, Spain, Sweden, Switzerland, UK, USA.

[4]Bolivia, Brazil, China, Hungary, Indonesia, Mexico, Philippines, Russia, South Africa, Thailand, Turkey.

[5]Alternatively, import prices could be used to represent supply shocks, unfortunately this series is not available for many countries. Importantly, substituting oil price with import price yields similar results.

[6]Importantly, the results remain unchanged when using other filtering techniques such as the unobserved component with stochastic volatility (UCSV) of Watson(1986); the Hodrick and Prescott(1997) (henceforth HP filter), and the AR(4) filter of Hamilton (2018). Note that the Grant and Chan (2017) is flexible enough that it does not impose a constant smoothing parameter of 1600 like the HP filter and it does not suffer from end-point issue which is common in many filters. See Grant and Chan(2017), Hamilton(2018) for more details on the weaknesses of the HP filter. For interested readers, we provide the estimate of global factors using HP filter in Appendix D.

model will yield different global output trend and oil price trend for each country, which is counter-intuitive.

3.2 The role of global factors

We first show the estimates of global factors, then report their roles in explaining inflation.

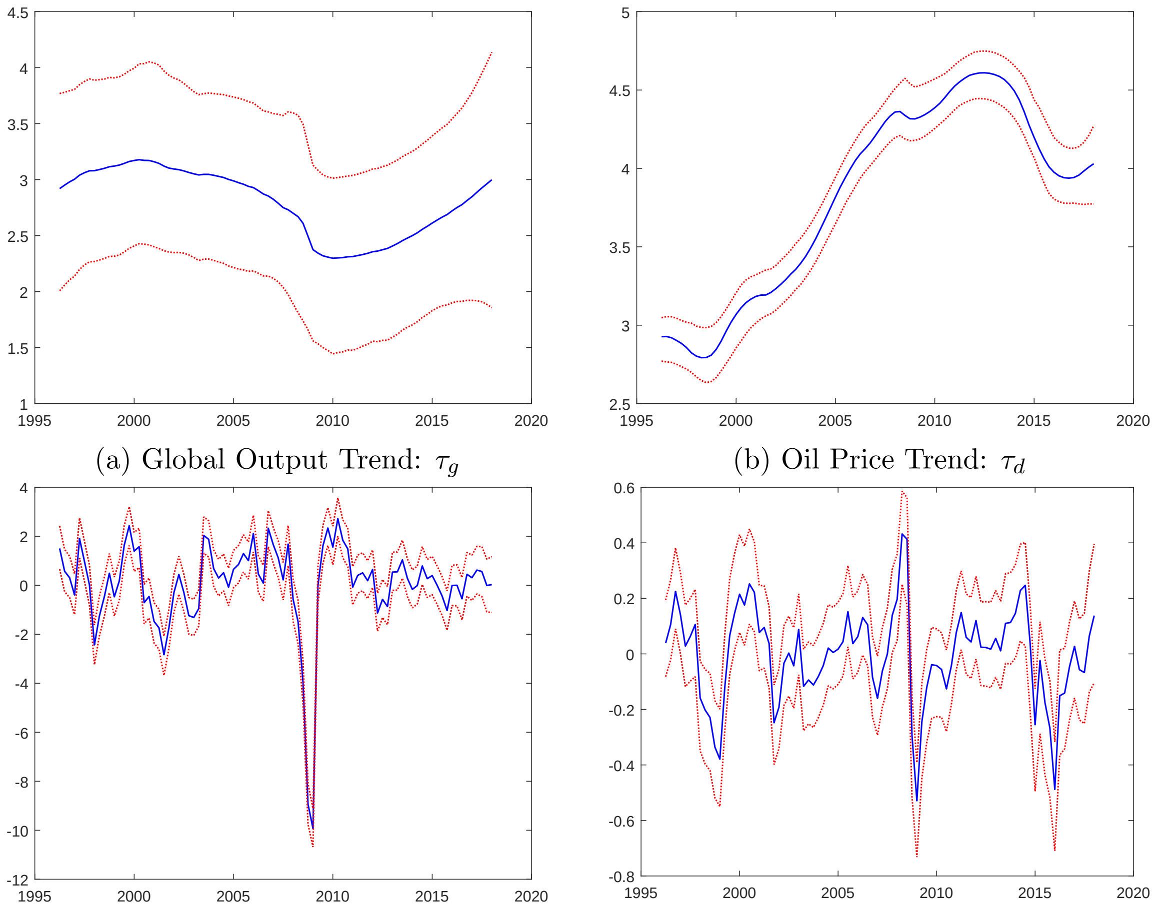
3.2.1 Estimates of global factors

Figure 1 presents the estimated global output trend and oil price trend, their gaps, and corresponding 84% credible intervals. The global output gap captures economic cycle in the global economy. In particular, it illustrates recessionary episodes, namely, the East Asian crisis of 1997-1998, the 2000-2001 dotcom crisis, the global financial crisis of 2007-2008, and the sovereign crisis in Europe in 2012. It then stabilizes around zero. The global output trend depicts a growth rate of 3 percent before the GFC, then drifted down to 2.3 percent before reverting back to its pre-crisis growth of 3 percent in 2018. The oil price gap captures relatively well instances where the oil price deviates from its long-term trend. Specifically, the upward movement in oil price before the GFC was driven by high global demand, particularly in emerging market economies. This demand pressure is exemplified by a steep rise in its trend starting in the late 1990s, then plateaus during and after the GFC. The cyclical component of oil price turned negative, then recovered gradually before dropping again in 2014, as a response to positive supply shock in oil market. This pushed down the trend in oil price.

3.2.2 Parameters on global factors

Global demand Figure 2 reports the parameter on the global output gap and the domestic output gap. The left panel is for the parameter on the global output gap, and the right panel is for the parameter on the domestic output gap.

In Figure 2, the upper panel is for all countries, the middle panel is AEs, and the lower panel is for EMEs. We find the parameter on the global output gap (left panel) is higher across all countries than the parameter on the domestic output gap (right panel). This result means that global demand (output) plays a more significant role in explaining inflation across all countries. It is consistent with Borio and Filardo (2007) and Forbes (2019), their results indicate that global demand matters more than domestic demand in explaining dynamics in inflation in both AEs and EMEs. This finding has important monetary policy implications. It suggests that monetary policy authority should monitor closely the global economy when they make decisions. Interestingly some central banks



(a) Global Output Trend: τ_g

(b) Oil Price Trend: τ_d

(c) Global Output Gap: $\widetilde{g}_t$

(d) Oil Price Gap: $\widetilde{d}_t$

Figure 1: **Estimates of global factors:** The solid blue line is the posterior median, while the dotted red lines are 16% and 84% quantiles. Y-axis is the percentage change. For global output, we use quarter-on-quarter difference of natural logarithms times 400. For oil price, we use quarter-on-quarter difference of natural logarithms times 100.

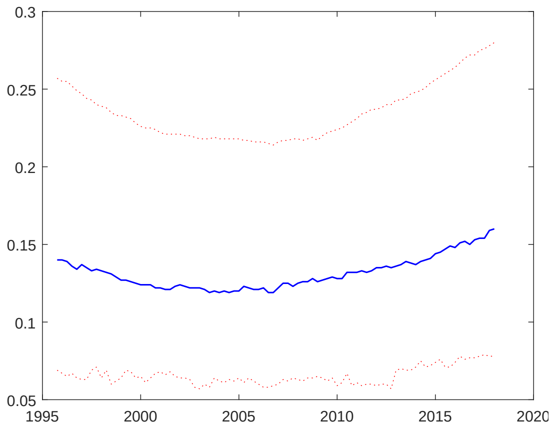
have already started incorporating the global economic outlook in their decision-making process. In its statement of October 30, 2019, the Federal Reserve Bank clearly stated that its decision to lower the federal funds rate was informed by the combination of weak global economic and muted inflationary pressure.

Examining the role of global demand in AEs and EMEs, we find that global demand plays a more significant role in determining inflation in EMEs than AEs. The inflation gap decomposition result in Table 5 (Appendix C) reinforces this finding. The contribution of global demand has increased in 9 countries. And out of 23 AEs, only in 2 countries, the contribution of domestic demand has increased after GFC. Compared with 7 countries out of 11 EMEs, this supports the finding that inflation tend to react more to global demand in EMEs than in AEs. This finding is not surprising, given that most multinational firms are likely to set up different intermediate input processing plants across various EMEs due to their low labor cost. Therefore, any shift in global demand for the production of goods, will likely increase trade and inflation in these EMEs. According to Hanson et al. (2005), they argue that much of the increase in global trade is due to the rapid growth in the intermediate input trade in these countries. Thus, our result appears to be consistent with the theoretical findings of Wynne and Martínez-García (2010) that increased globalization and trade lead to a country's inflation dynamics being dominated by global factors.

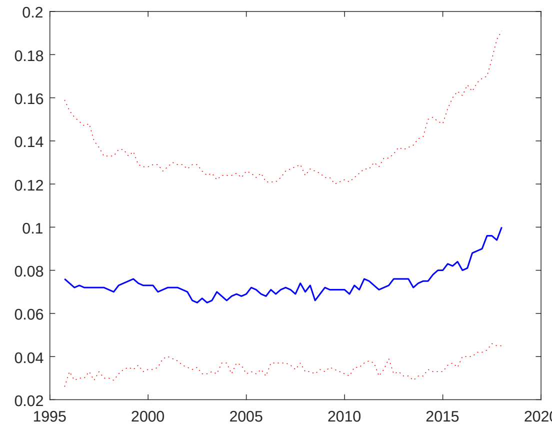
Oil price Figure 3 reports the parameter on the oil price gap, for all countries, for AEs, and for EMEs, respectively. We find it is flat over time (see Forbes, 2019). Another two stories can be added to.

The first story is by comparing Figure 2 and Figure 3, we find on average, the parameter on the oil price gap is about 6 and 4 times more than the domestic and global output gap parameters. This supports that oil prices play a dominant role in inflation dynamics across countries. Table 1 to Table 3 report the average value over time of the three parameters for each country. The parameters on the oil price gap vary between 0.393 (Brazil) and 0.739 (Germany), compared with the maximum of 0.212 and 0.337 for domestic and global demand, respectively. Simon et al. (2013) find similar magnitudes using import prices.

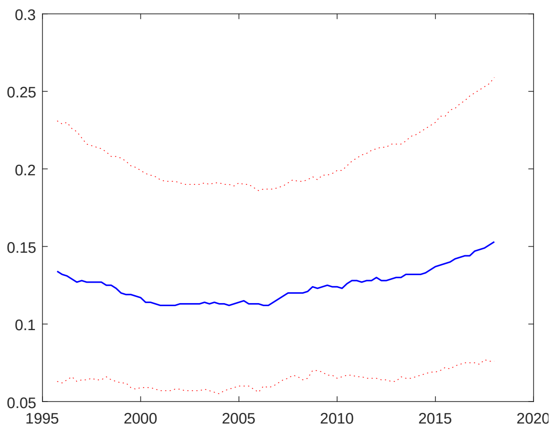
The second story is by comparing AEs and EMEs in Figure 3, the impact of oil price seems to prevail more in AEs than in EMEs. This is consistent with Jordà and Nechio (2018) and with the observation of downturn in inflation in 2014 in most AEs, which is in line with the oil price shock during the same period.



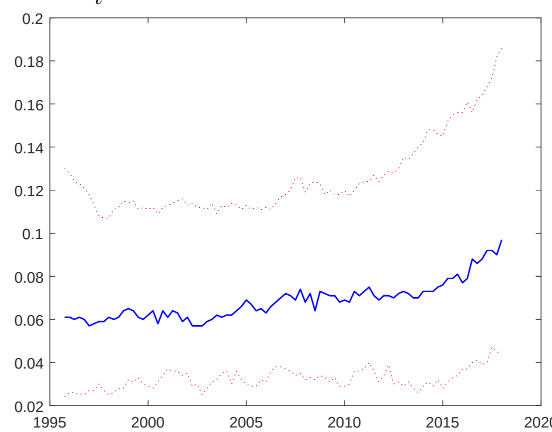
(a) All countries: Parameter on global demand: β_t



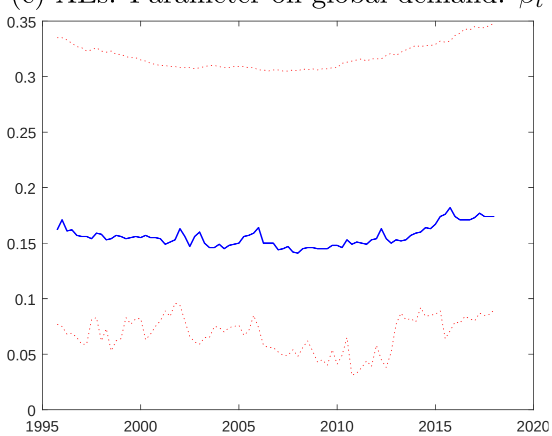
(b) All countries: Parameter on domestic demand: α_t



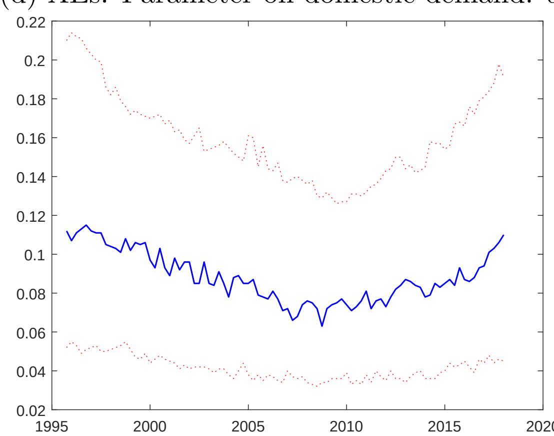
(c) AEs: Parameter on global demand: β_t



(d) AEs: Parameter on domestic demand: α_t

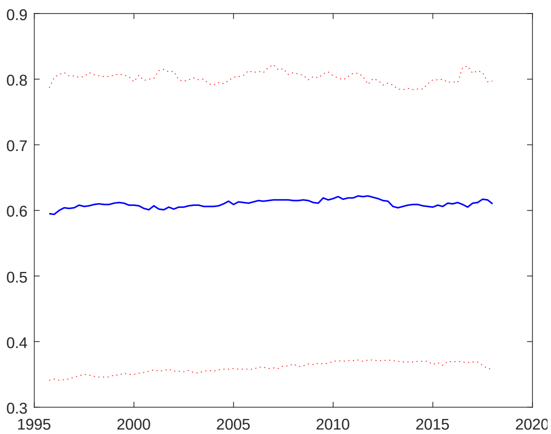


(e) EMEs: Parameter on global demand: β_t

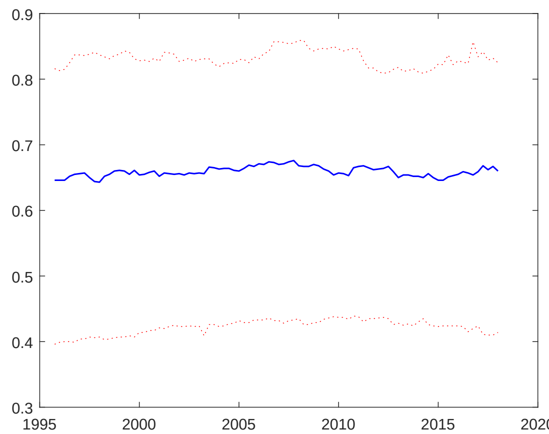


(f) EMEs: Parameter on domestic demand: α_t

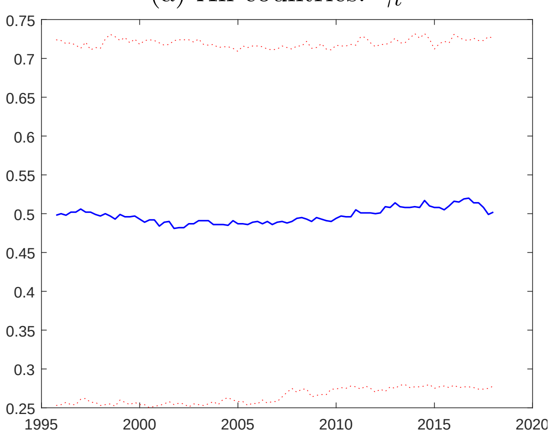
Figure 2: **Parameter on the global output gap β_t and the domestic output gap α_t:** The solid blue line is the posterior median, while the dotted red lines are 16% and 84% quantiles.



(a) All countries: γ_t



(b) AEs: γ_t



(c) EMEs: γ_t

Figure 3: **Parameter on the oil price gap γ_t:** The solid blue line is the posterior median, while the dotted red lines are 16% and 84% quantiles.

3.3 The role of Domestic factors

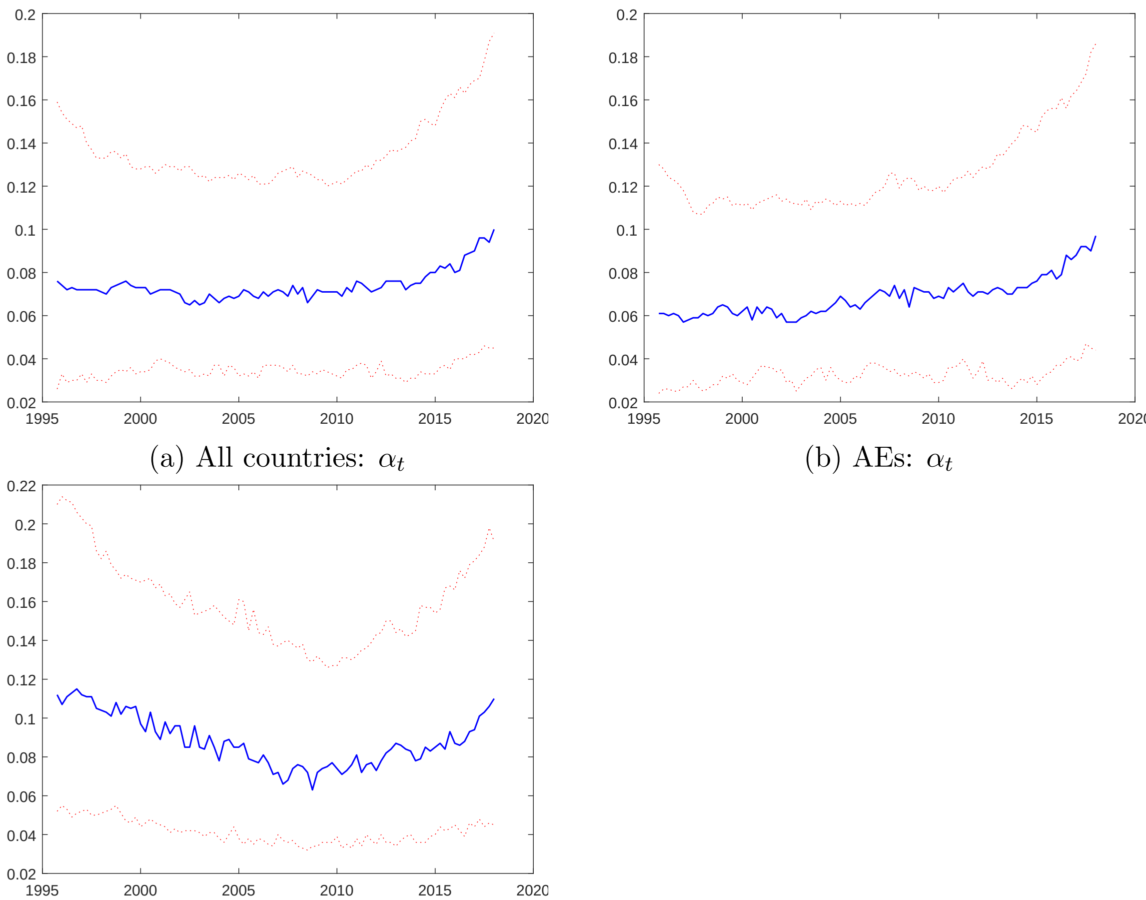
The slope of the Phillips curve α_t Figure 4 reports the parameter on the oil price gap, for all countries, for AEs, and for EMEs, respectively. We do not observe evident time variation in it. It is quite flat from 1995 to 2018. This is consistent with Blanchard et al. (2015) and Chan et al. (2016), Kabundi et al. (2019). They use longer sample and find evidence of changing slope of the Phillips curve in the 1970s and the 1980s. But the slope has remained unchanged since early 1990s. Actually, if there is any recent change, the results point to a marginal steepness of the slope recently. The recent marginal rise in the slope of the Phillips observed in the US is also documented by Gilchrist and Zakrajsek (2019). Another pattern which emerges from Figure 4 is that inflation tend to react more to domestic demand in EMEs than in AEs.

Recall that we find the parameters on global factors are flat, so we think the time-invariant of α is likely due to the domestic factors. For instance, we observe a decline in inflation volatility and the low inflation persistence experienced across all countries.

Decline in inflation volatility Figure 5 reports the inflation standard deviation. There is a substantial decline in inflation volatility across countries. This can be attributed to a good policy, reflecting stable inflation dynamics which in most cases coincide with the adoption of IT policy. Besides, the literature also explains this drop by a good luck induced by a global common shock affecting simultaneously inflation volatility in all countries. This global decline in inflation volatility also reflects the great moderation periods associated with a decrease in shock affecting the global economy. It is evident from Figure 5 that volatility has declined in both AEs and EMs albeit with different magnitudes. In general, volatility in AEs, which has recently been closer to one, is lower than the levels attained in EMEs.

Low inflation persistence Figure 6 reports the inflation persistence. A noticeable difference is observed in the inflation persistence between AEs and EMEs. AEs exhibit a small persistence which literature attributes to a better anchoring of inflation expectations, suggesting that agents in these countries have become more forward looking. In other words, inflation process is no longer adaptive (see Cogley and Sargent, 2005; Stock and Watson, 2007; Carlstrom and Fuerst, 2008; Ball and Mazumder, 2011; Matheson and Stavrev, 2013; Blanchard et al., 2015; Gillitzer and Simon, 2018; Chan et al., 2016; Kabundi et al., 2019). In Table 4, we report the average value over time of inflation persistence for each country. The lowest persistence is found in Canada, followed by Germany, Switzerland, USA, Australia, France, Denmark, the Netherlands, and South Korea. Note that these countries have implicitly or explicitly adopted the inflation targeting regime in the mid-1990s. Even though Switzerland has not explicitly adopted the IT policy, it does have a nominal anchor of maintaining inflation below 2 percent. AEs with high persistence include Italy, Ireland, Slovakia, Lithuania, and Latvia. Agents are somewhat backward looking in Sweden, Hong Kong, and Finland. It is not surprising that Hong Kong, which has a fixed exchange rate monetary policy, is the only AE with extremely high persistence.

In stark contrast, EMEs portray high persistence which suggests that expectation formation is more adaptive in these countries. Then EMEs experienced a marked drop in inflation persistence. This suggests a drastic change in agents beliefs from backward looking to forward looking in EMEs.



(a) All countries: α_t

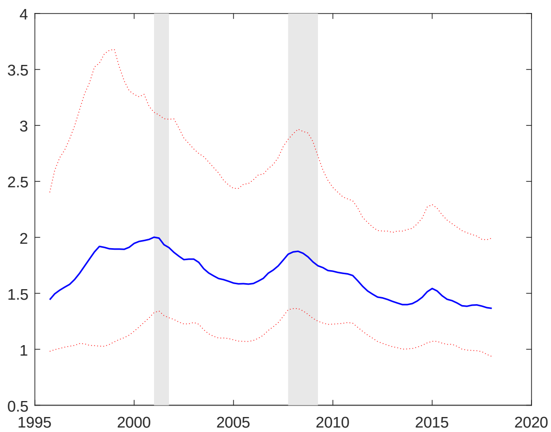
(b) AEs: α_t

(c) EMEs: α_t

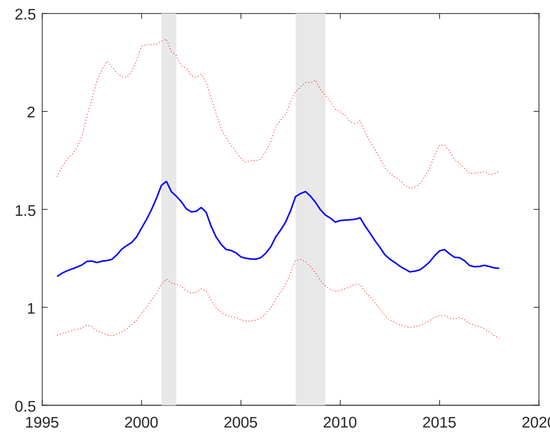
Figure 4: **The slope of the Phillips curve α_t:** The solid blue line is the posterior median, while the dotted red lines are 16% and 84% quantiles.

4 Conclusion

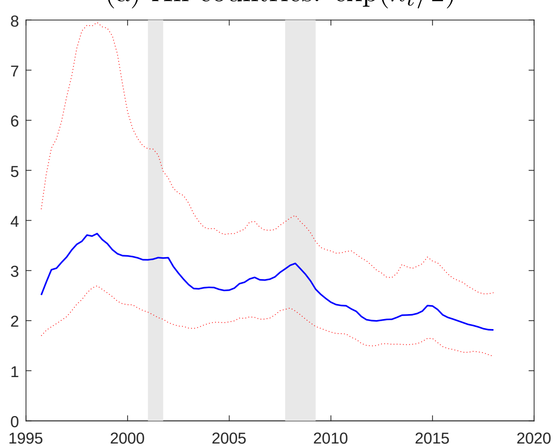
This paper utilizes state-of-the-art bivariate unobserved components on a panel dataset comprising 34 countries (23 AEs and 11 EMEs) to investigate whether global or domestic factors largely drive a country's inflation dynamics. Furthermore, we also examine



(a) All countries: $\exp(h_t/2)$

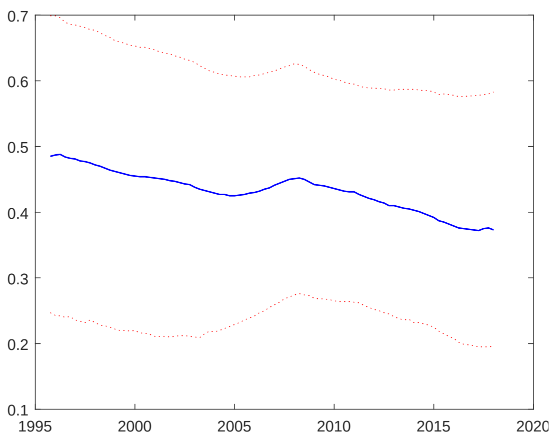


(b) AEs: $\exp(h_t/2)$

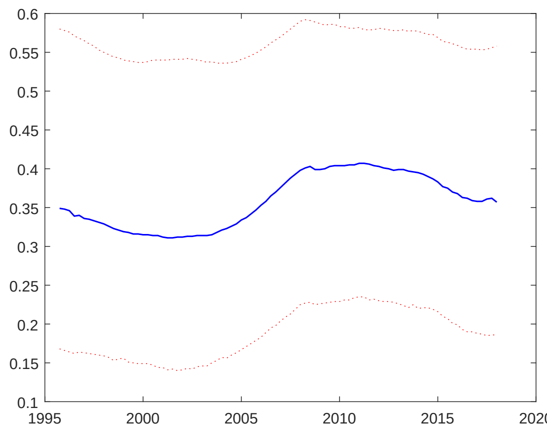


(c) EMEs: $\exp(h_t/2)$

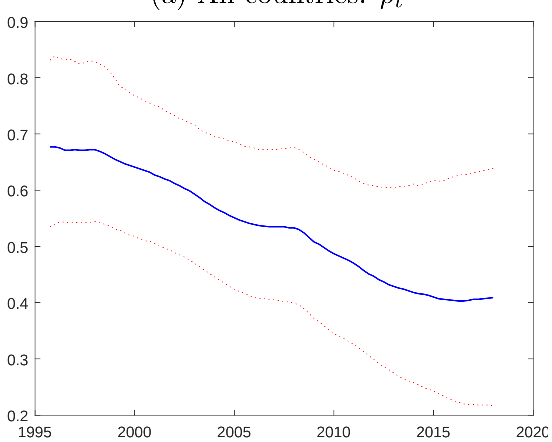
Figure 5: **Inflation standard deviation** $\exp(h_t/2)$**:** The solid blue line is the posterior median, while the dotted red lines are 16% and 84% quantiles. The shaded regions are the NBER recession dates.



(a) All countries: ρ_t



(b) AEs: ρ_t



(c) EMEs: ρ_t

Figure 6: **Inflation persistence ρ_t:** The solid blue line is the posterior median, while the dotted red lines are 16% and 84% quantiles.

whether a country's Phillips curve relationship has flattened over time. We find evidence that global factors, especially oil, drive a country's inflation. In addition, we find that the slope of the Phillips curve across our panel of countries is indeed flat most of the time, especially for AEs. Therefore, our empirical results support the theoretical findings of Wynne and Martínez-García (2010) that increased globalization and trade were the underlying cause of the flattening of the Phillips curve slope, and global factors primarily determine a country's inflation.

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A Priors

$$
\begin{aligned}
\varphi_1 &\sim \mathcal{N}(0,\ 10) \\
\varphi_2 &\sim \mathcal{N}(0,\ 10) \\
\tau_1^{\pi} &\sim \mathcal{N}(3,\ 10) \\
\tau_1^{y} &\sim \mathcal{N}(5,\ 10) \\
h_1 &\sim \mathcal{N}(0,\ 1) \\
\rho_1 &\sim \mathcal{N}(0,\ 10) \\
\alpha_1 &\sim \mathcal{N}(0,\ 10) \\
\beta_1 &\sim \mathcal{N}(0,\ 10) \\
\gamma_1 &\sim \mathcal{N}(0,\ 10) \\
\sigma_{\tau\pi}^2 &\sim \mathcal{IG}(10,\ 0.18) \\
\sigma_{\tau y}^2 &\sim \mathcal{IG}(10,\ 0.09) \\
\sigma_{y}^2 &\sim \mathcal{IG}(10,\ 4.5) \\
\sigma_{h}^2 &\sim \mathcal{IG}(10,\ 0.9) \\
\sigma_{\rho}^2 &\sim \mathcal{IG}(10,\ 0.018) \\
\sigma_{\alpha}^2 &\sim \mathcal{IG}(10,\ 0.009) \\
\sigma_{\beta}^2 &\sim \mathcal{IG}(10,\ 0.009) \\
\sigma_{\gamma}^2 &\sim \mathcal{IG}(10,\ 0.009)
\end{aligned}
$$

B Estimates of coefficients

Table 1: Coefficient on domestic output gap α

Countries	posterior mean over time	16% quantile	84% quantile
Belgium	0.150	0.046	0.250
Greece	0.042	0.016	0.069
Ireland	0.035	0.020	0.043
Netherlands	0.045	0.016	0.072
Portugal	0.078	0.030	0.124
Latvia	0.101	0.037	0.165
Lithuania	0.105	0.034	0.174
Slovakia	0.091	0.031	0.151
Israel	0.114	0.035	0.197
Hong Kong	0.096	0.032	0.163
South Korea	0.112	0.045	0.178
UK	0.098	0.036	0.162
USA	0.103	0.036	0.173
Sweden	0.108	0.038	0.178
Switzerland	0.125	0.048	0.201
Spain	0.119	0.039	0.201
Denmark	0.074	0.034	0.117
Italy	0.080	0.027	0.132
Finland	0.093	0.033	0.151
France	0.092	0.032	0.150
Germany	0.043	0.013	0.074
Australia	0.100	0.073	0.138
Canada	0.142	0.052	0.232
South Africa	0.133	0.048	0.210
Hungary	0.153	0.053	0.255
Russia	0.107	0.036	0.180
Turkey	0.110	0.042	0.177
Mexico	0.060	0.024	0.098
Bolivia	0.121	0.040	0.203
Brazil	0.107	0.042	0.174
China	0.167	0.061	0.274
Philippines	0.068	0.031	0.103
Indonesia	0.212	0.069	0.360
Thailand	0.031	0.013	0.044

Table 2: Coefficient on global output gap β

countries	posterior mean over time	16% quantile	84% quantile
Belgium	0.161	0.056	0.267
Greece	0.113	0.035	0.192
Ireland	0.162	0.075	0.245
Netherlands	0.066	0.020	0.112
Portugal	0.176	0.067	0.284
Latvia	0.169	0.046	0.298
Lithuania	0.151	0.043	0.266
Slovakia	0.171	0.056	0.286
Israel	0.169	0.051	0.290
Hong Kong	0.205	0.058	0.354
South Korea	0.120	0.033	0.208
UK	0.122	0.040	0.205
USA	0.210	0.077	0.343
Sweden	0.174	0.049	0.297
Switzerland	0.123	0.041	0.206
Spain	0.203	0.080	0.323
Denmark	0.125	0.043	0.210
Italy	0.094	0.030	0.156
Finland	0.152	0.052	0.254
France	0.117	0.040	0.195
Germany	0.136	0.044	0.230
Australia	0.138	0.055	0.219
Canada	0.179	0.061	0.298
South Africa	0.120	0.042	0.200
Hungary	0.221	0.063	0.385
Russia	0.160	0.052	0.259
Turkey	0.249	0.078	0.425
Mexico	0.068	0.025	0.112
Bolivia	0.337	0.126	0.542
Brazil	0.166	0.053	0.287
China	0.337	0.170	0.499
Philippines	0.187	0.060	0.319
Indonesia	0.254	0.088	0.421
Thailand	0.322	0.122	0.517

Table 3: Coefficient on oil price gap γ

countries	posterior mean over time	16% quantile	84% quantile
Belgium	0.613	0.314	0.871
Greece	0.556	0.251	0.849
Ireland	0.602	0.306	0.876
Netherlands	0.581	0.296	0.844
Portugal	0.502	0.164	0.835
Latvia	0.484	0.167	0.810
Lithuania	0.528	0.207	0.844
Slovakia	0.738	0.469	0.901
Israel	0.545	0.240	0.837
Hong Kong	0.560	0.252	0.860
South Korea	0.590	0.260	0.879
UK	0.570	0.261	0.861
USA	0.698	0.510	0.906
Sweden	0.476	0.168	0.787
Switzerland	0.718	0.502	0.924
Spain	0.589	0.293	0.866
Denmark	0.596	0.303	0.869
Italy	0.628	0.349	0.884
Finland	0.680	0.408	0.916
France	0.708	0.499	0.910
Germany	0.739	0.534	0.915
Australia	0.657	0.401	0.872
Canada	0.527	0.144	0.837
South Africa	0.477	0.154	0.795
Hungary	0.474	0.169	0.791
Russia	0.477	0.141	0.834
Turkey	0.534	0.310	0.702
Mexico	0.533	0.214	0.839
Bolivia	0.513	0.175	0.845
Brazil	0.393	0.109	0.699
China	0.490	0.164	0.836
Philippines	0.463	0.109	0.811
Indonesia	0.532	0.220	0.831
Thailand	0.598	0.189	0.880

Table 4: Inflation persistence ρ

countries	posterior mean over time	16% quantile	84% quantile
Belgium	0.303	0.156	0.447
Greece	0.399	0.217	0.577
Ireland	0.577	0.381	0.777
Netherlands	0.268	0.105	0.429
Portugal	0.441	0.257	0.623
Latvia	0.714	0.576	0.855
Lithuania	0.639	0.492	0.790
Slovakia	0.586	0.405	0.769
Israel	0.552	0.386	0.718
Hong Kong	0.487	0.321	0.649
South Korea	0.282	0.112	0.450
UK	0.372	0.218	0.528
USA	0.209	0.072	0.346
Sweden	0.486	0.316	0.656
Switzerland	0.207	0.072	0.342
Spain	0.300	0.135	0.462
Denmark	0.252	0.095	0.407
Italy	0.543	0.372	0.716
Finland	0.489	0.317	0.659
France	0.235	0.091	0.379
Germany	0.160	0.054	0.266
Australia	0.229	0.091	0.366
Canada	0.159	0.052	0.265
South Africa	0.559	0.388	0.732
Hungary	0.483	0.308	0.656
Russia	0.734	0.604	0.865
Turkey	0.518	0.390	0.644
Mexico	0.501	0.342	0.657
Bolivia	0.433	0.269	0.597
Brazil	0.650	0.508	0.796
China	0.479	0.335	0.622
Philippines	0.623	0.451	0.801
Indonesia	0.497	0.330	0.660
Thailand	0.479	0.311	0.646

C Inflation Gap Decomposition

Table 5: Inflation Gap Decomposition

	Country		lagged inflation	domestic output	global output	oil price	Other
North	USA	pre GFC	0.223	0.085	0.223	0.086	0.945
		post GFC	0.178	**0.098**	0.181	0.062	0.976
America	Canada	pre GFC	0.110	0.211	0.175	0.077	0.945
		post GFC	**0.136**	0.123	0.100	**0.094**	0.996
Latin	Bolivia	pre GFC	0.623	0.155	0.179	0.036	1.059
		post GFC	0.376	0.085	0.076	0.021	1.006
America	Mexico	pre GFC	0.890	0.044	0.018	0.020	0.812
		post GFC	0.374	**0.046**	**0.032**	**0.054**	1.070
	Brazil	pre GFC	0.569	0.160	0.049	0.020	1.107
		post GFC	**0.775**	0.098	0.033	**0.024**	1.151
Europe	UK	pre GFC	0.232	0.096	0.166	0.135	1.011
		post GFC	**0.572**	0.057	0.076	0.070	1.020
	Belgium	pre GFC	0.124	0.175	0.139	0.088	0.763
		post GFC	**0.464**	0.153	0.070	0.056	0.567
	Greece	pre GFC	0.426	0.099	0.124	0.063	1.114
		post GFC	**0.479**	0.066	0.031	0.035	0.730
	Italy	pre GFC	0.505	0.202	0.169	0.171	1.051
		post GFC	**0.691**	0.140	0.066	0.090	1.007
	Spain	pre GFC	0.252	0.282	0.161	0.065	0.883
		post GFC	**0.341**	0.132	0.088	0.049	1.114
	Sweden	pre GFC	0.480	0.177	0.159	0.070	1.298
		post GFC	**0.562**	0.122	0.080	0.053	0.995
	Switzerland	pre GFC	0.142	0.269	0.199	0.157	0.953
		post GFC	**0.222**	0.256	0.140	0.109	0.776
	Denmark	pre GFC	0.159	0.255	0.176	0.089	0.951
		post GFC	**0.276**	0.187	0.118	**0.144**	1.145
	Finland	pre GFC	0.363	0.328	0.199	0.080	1.202
		post GFC	**0.588**	0.238	0.106	**0.105**	0.968
	Germany	pre GFC	0.133	0.101	0.149	0.094	1.017
		post GFC	**0.167**	0.086	0.127	**0.124**	0.935

Table 6: *Continued* Inflation Gap Decomposition

	Country		lagged inflation	domestic output	global output	oil price	Other
	Slovakia	pre GFC	0.522	0.144	0.065	0.025	0.964
		post GFC	**0.662**	0.069	0.048	**0.047**	1.037
	France	pre GFC	0.189	0.156	0.121	0.164	0.945
		post GFC	**0.246**	**0.172**	0.098	0.126	0.972
	Ireland	pre GFC	0.522	0.060	0.103	0.048	0.937
		post GFC	**0.616**	**0.111**	0.095	**0.069**	1.309
	Portugal	pre GFC	0.511	0.121	0.141	0.070	1.158
		post GFC	0.412	**0.134**	**0.143**	0.049	1.106
	Lithuania	pre GFC	0.738	0.116	0.068	0.022	1.068
		post GFC	0.715	**0.129**	0.040	**0.035**	1.063
	Hungry	pre GFC	0.603	0.057	0.032	0.009	0.579
		post GFC	0.439	0.057	**0.057**	**0.018**	0.826
	Latvia	pre GFC	0.752	0.164	0.050	0.012	0.801
		post GFC	0.716	0.128	0.038	**0.021**	0.991
	Netherlands	pre GFC	0.308	0.077	0.067	0.083	0.988
		post GFC	0.184	0.042	0.032	0.063	0.960
Asia	Indonesia	pre GFC	0.640	0.097	0.044	0.014	0.870
		post GFC	0.369	**0.244**	**0.110**	**0.051**	0.968
	Philippines	pre GFC	0.585	0.079	0.054	0.032	0.939
		post GFC	0.552	**0.106**	**0.077**	**0.040**	0.947
	China	pre GFC	0.589	0.089	0.175	0.035	1.095
		post GFC	0.477	**0.234**	**0.180**	**0.046**	0.825
	Hong Kong	pre GFC	0.756	0.080	0.051	0.021	0.914
		post GFC	0.244	0.074	0.049	**0.039**	1.012
	Thailand	pre GFC	0.690	0.065	0.202	0.036	1.090
		post GFC	0.440	0.050	0.113	0.035	0.980
	South Korea	pre GFC	0.200	0.181	0.074	0.048	1.122
		post GFC	**0.263**	**0.214**	0.067	**0.120**	0.900

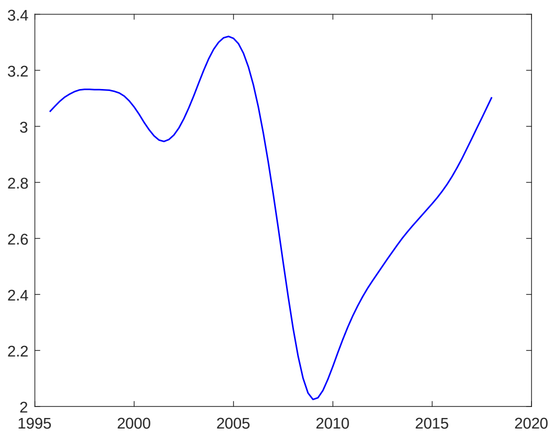
Table 7: *Continued* Inflation Gap Decomposition

	Country		lagged inflation	domestic output	global output	oil price	Other
Other	Australia	pre GFC	0.177	0.048	0.133	0.085	0.986
		post GFC	**0.191**	0.046	0.092	0.079	1.033
	Israel	pre GFC	0.548	0.117	0.055	0.028	1.247
		post GFC	0.449	0.112	**0.063**	**0.041**	1.029
	Russia	pre GFC	0.837	0.057	0.015	0.004	0.645
		post GFC	0.824	**0.068**	**0.031**	**0.016**	1.175
	Turkey	pre GFC	0.842	0.025	0.010	0.001	0.491
		post GFC	0.219	**0.148**	**0.063**	**0.020**	1.011
	South Africa	pre GFC	0.701	0.090	0.053	0.019	1.269
		post GFC	0.497	**0.112**	0.053	**0.037**	1.022

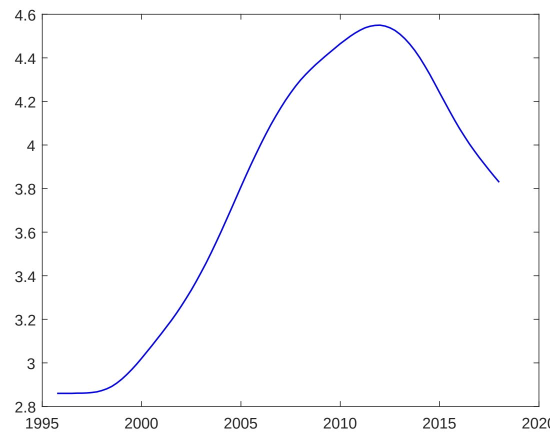
Note that the increasing contribution is indicated in Bold.

D Other filtering techniques

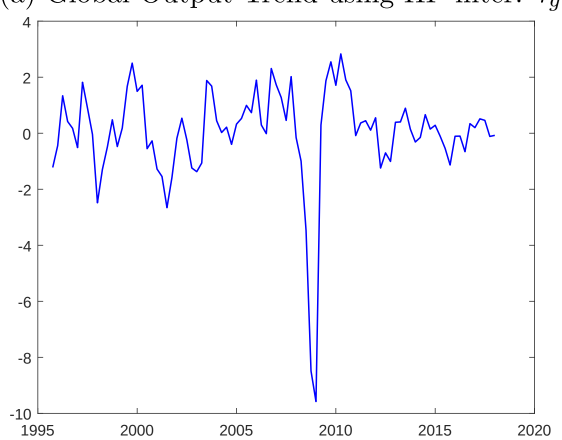
This section reports the estimate of global output trend and oil price trend using the HP filter of Hodrick and Prescott(1997).



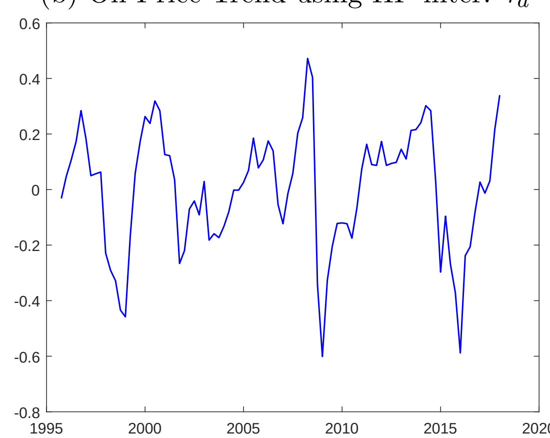
(a) Global Output Trend using HP filter: τ_g



(b) Oil Price Trend using HP filter: τ_d



(c) Global Output Gap using HP filter: τ_g



(d) Oil Price Gap using HP filter: τ_d

Figure 7: **Estimates of global output trend and oil price trend using the HP filter:** For global output, we use quarter-on-quarter difference of natural logarithms times 400. For oil price, we use quarter-on-quarter difference of natural logarithms times 100.