

HAS GLOBALIZATION CHANGED THE INFLATION PROCESS?

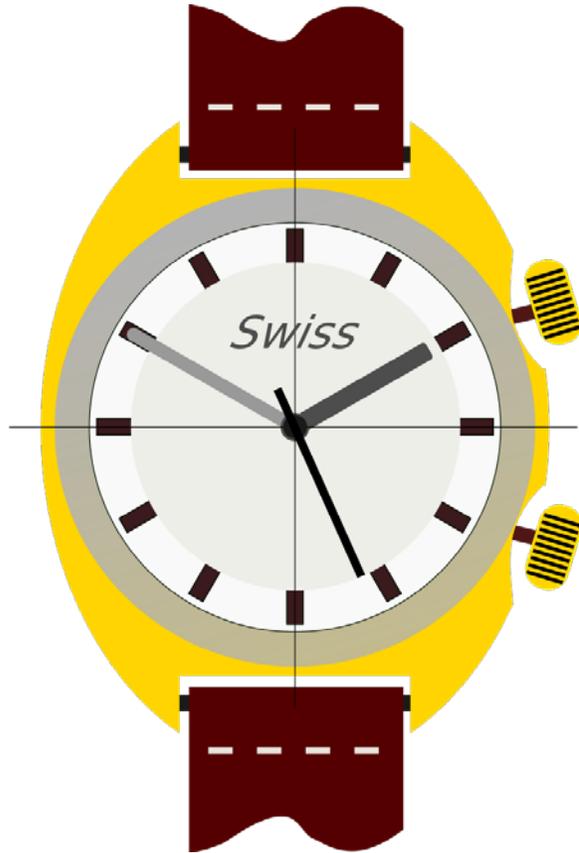
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17th BIS Annual Conference
10 Years after the Great Financial Crisis: What Has Changed?
Zurich, Switzerland

June 22, 2018

A Broken Watch?



Fixing the Watch?

- **Changing Role of Global Economy**
- **Three Pieces of Evidence**
 1. Principal Components
 2. Phillips Curve
 3. Trend-Cycle Analysis
- **Conclusions**
 - Global factors should be more explicitly included in inflation models
 - Role of global factors has changed over time for CPI/cyclical inflation
 - Less so for core/trend inflation



Globalization and Inflation

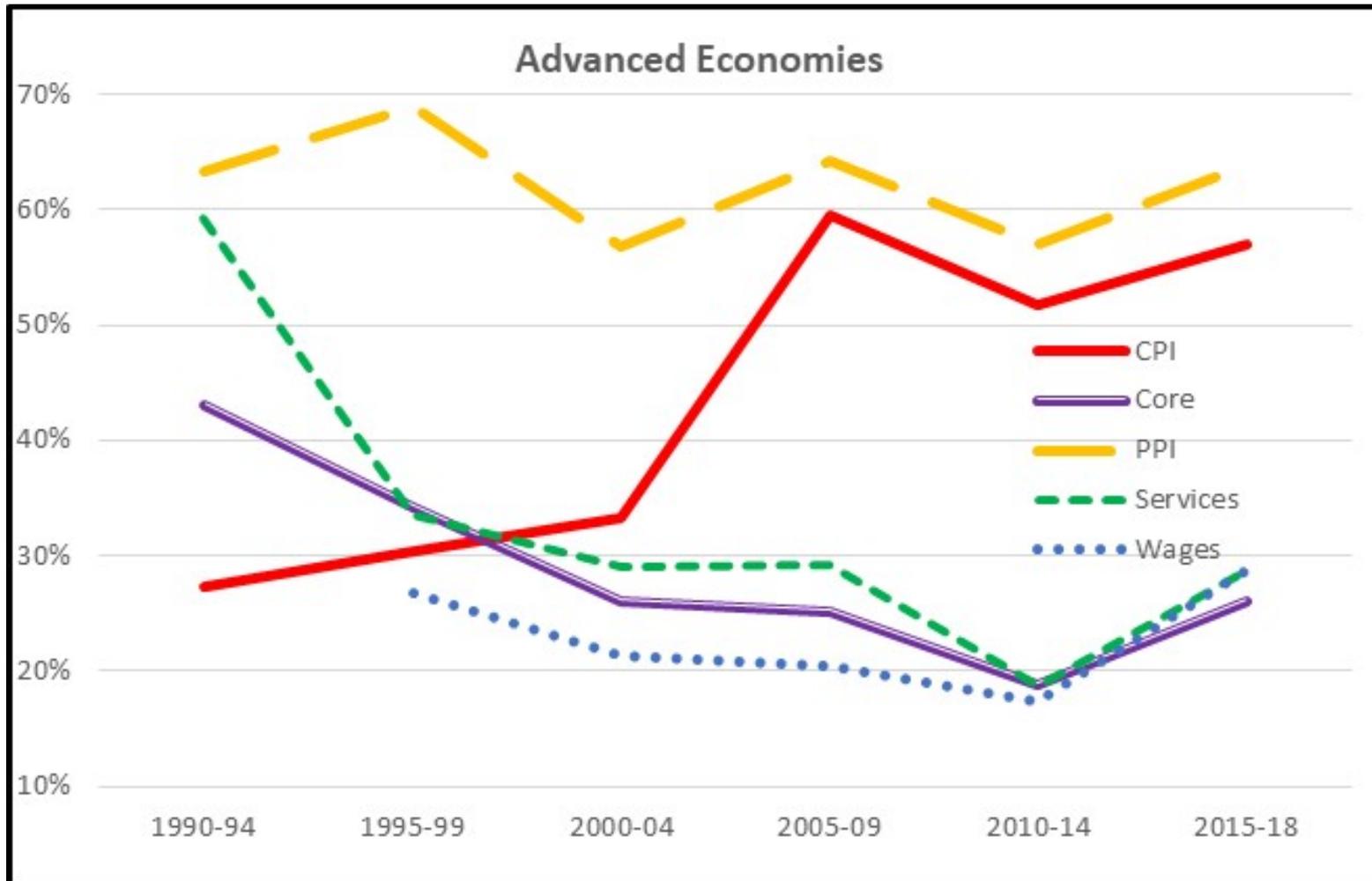
- **Several ways changes in global economy could be affecting inflation**
 - Increased trade → **greater role for “global slack” and exchange rates**
 - Greater heft of emerging markets → **volatility in commodity prices**
 - Pricing competition/supply chains → **less pricing power**
 - Reduced bargaining power of local workers → **weaker role for domestic slack**
- **Limited incorporation of globalization in inflation models**
 - Standard approach—maybe import prices/oil
 - Global principal component
 - Adding select variables
 - Global slack (Borio and Filardo, 2007)
 - Supply chains (Auer *et al.*, 2016, 2017)
 - Exchange rates (Forbes, 2015, Forbes *et al.*, 2017)
- **This paper: fuller inclusion of dynamic global variables in different frameworks**



GLOBAL PRINCIPAL COMPONENT



Global Principal Component in Inflation



Percent of variance for each measure of inflation explained by first principal component over 5-year windows. Wage is private sector, household hourly wages. All inflation measures are relative to the previous quarter, annualized and seasonally adjusted.



PHILLIPS CURVE APPROACH

Expanded Phillips Curve Framework

Standard domestic controls

$$\pi_{it} = \alpha_1 \pi_{it}^e + \alpha_1 \pi_{it}^L + \beta GAP_{it}^D + Constant_i + \epsilon_{it} \\ + \gamma_1 ER_{it} + \gamma_2 GAP_t^F + \gamma_3 Oil_t^W + \gamma_4 Comm_t^W + \gamma_5 PriceDisp_t^W$$

Additional global controls

- π_t : CPI inflation (quarterly, annualized & seasonally adjusted)
 π_t^e, π_t^L : inflation expectations and lagged inflation
 ER_t : Δ in trade-weighted exchange rate
 GAP_t^D, GAP_t^F : domestic output gap (principal component) and foreign output gap
 $Comm_t^W, Oil_t^W$: commodity (ex. energy) and oil price inflation (relative to CPI)
 $PriceDisp_t^W$: price dispersion in PPI in sample

About 40 advanced economies and emerging markets, 1990-2017



Regressions
of quarterly,
annualized
inflation from
1990-2017
for 43
countries.

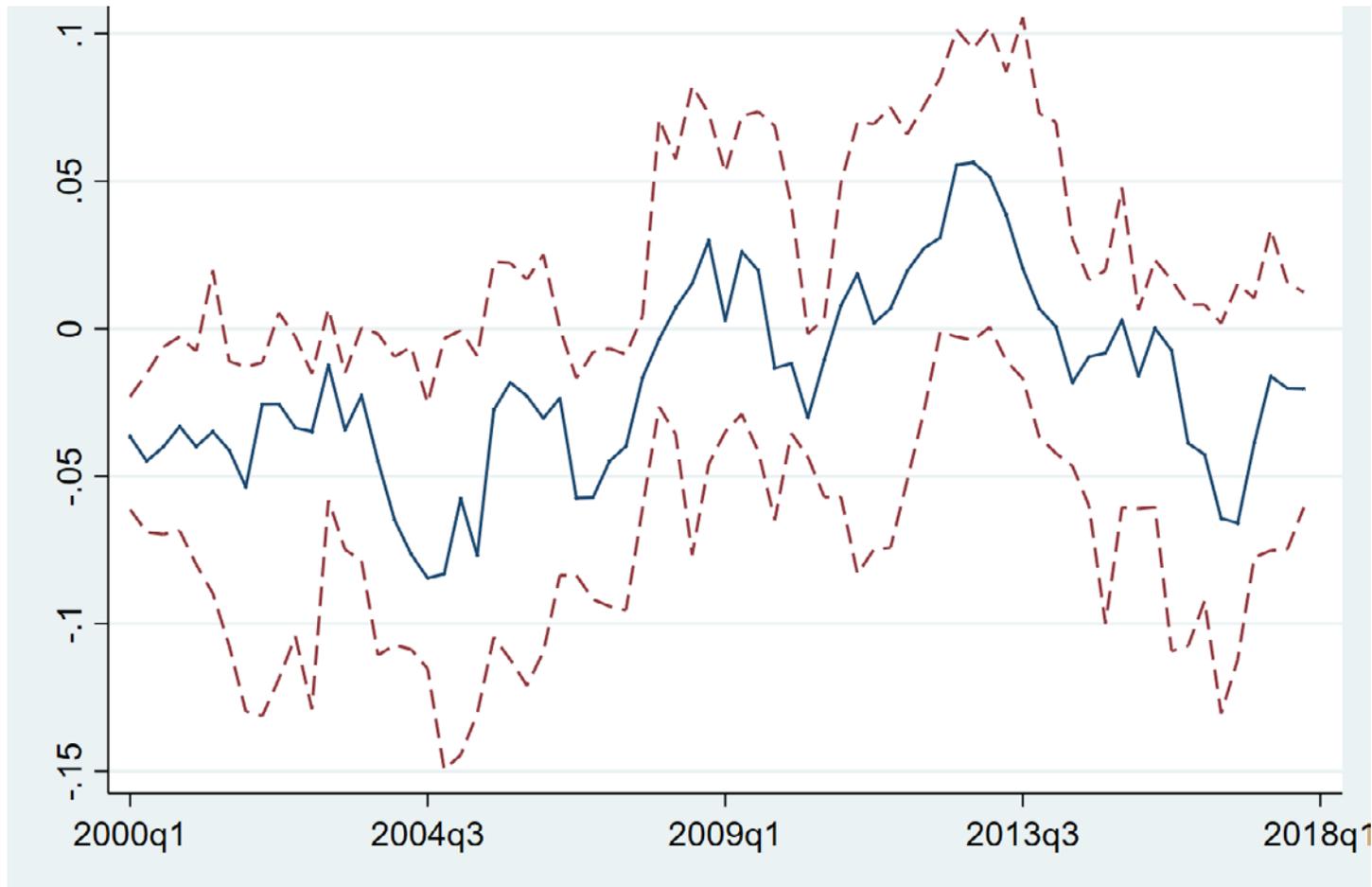
See Forbes (2018)
for details.

	CPI Inflation	Core Inflation
<i>Inflation</i>	0.670***	0.462***
<i>Expectations</i>	(0.073)	(0.052)
<i>Lagged</i>	0.646***	0.704***
<i>Inflation</i>	(0.034)	(0.024)
<i>Domestic</i>	0.094***	0.084***
<i>Output Gap</i>	(0.017)	(0.012)
<i>Real Exchange</i>	-0.020***	-0.013***
<i>Rate</i>	(0.006)	(0.004)
<i>World Output</i>	0.072***	0.043***
<i>Gap</i>	(0.023)	(0.012)
<i>World Oil</i>	0.002***	0.001**
<i>Prices</i>	(0.001)	(0.000)
<i>World Commodity</i>	0.010***	0.003**
<i>Prices</i>	(0.002)	(0.001)
<i>World PPI</i>	0.114***	0.019
<i>Dispersion</i>	(0.034)	(0.028)
<i>Adj. R2</i>	<i>0.55</i>	<i>0.63</i>
<i># observations</i>	<i>3002</i>	<i>3038</i>

**But
important
differences
across
individual
countries**



Changes across Time: Rolling Coefficient on Exchange Rate

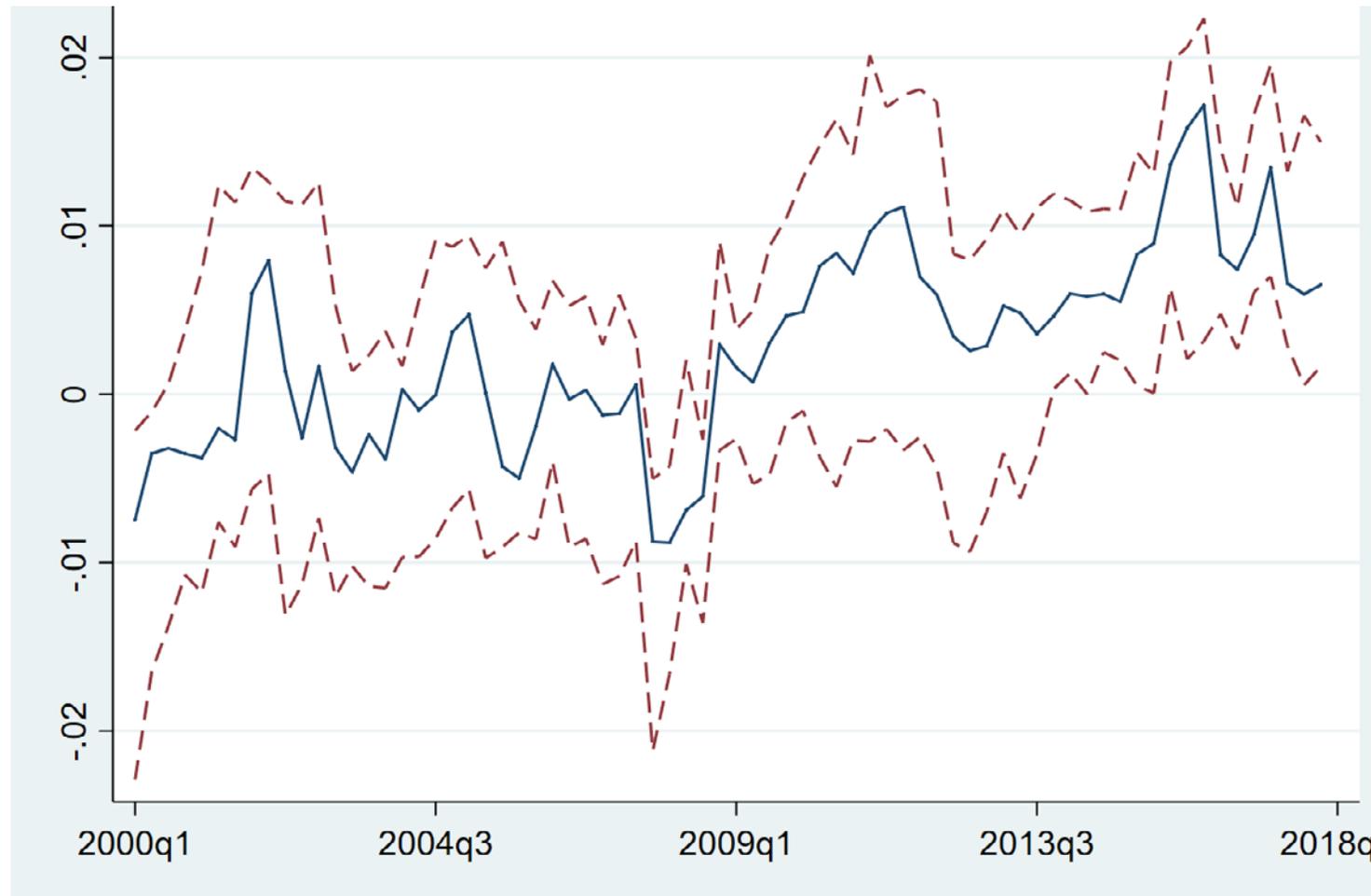


Median coefficient from rolling regressions using 8-year windows for quarterly, annualized CPI inflation from 1990-2017, estimated separately for each country. Dashed lines are the 33% and 66% of the distribution. See Forbes (2018) for more details.



Changes across Time: Rolling Coefficient on Commodity Prices

Commodity price inflation measured relative to CPI inflation

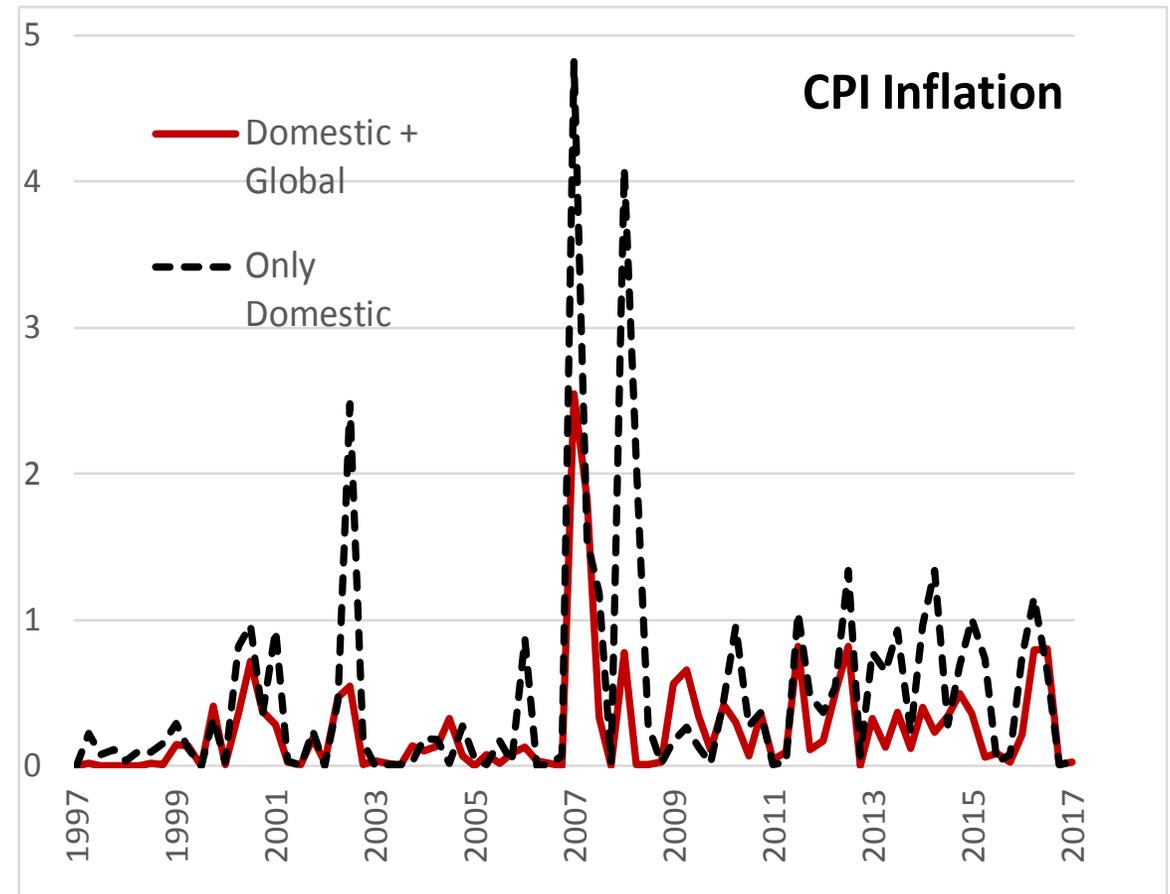


Median coefficient from rolling regressions using 8-year windows for quarterly, annualized CPI inflation from 1990-2017, estimated separately for each country. Dashed lines are the 33% and 66% of the distribution. See Forbes (2018) for more details.



Meaningful Improvement?

- **Adding global variables to Phillips curve regressions**
 - Reduces “errors” in predicted versus actual inflation by over half
 - Much less reduction if only include oil prices or import prices
 - Biggest reductions in errors in last decade



CPI Phillips Curve: *Changes over Time?*

	Fixed: 1990-'17		With dummies: 2007-17	
	CPI		CPI	Significant Changes in 2007-17?
Inflation expectations	++			
Lagged inflation	++			
Domestic output gap	++			
Exchange rate	--			
World output gap	++			
World oil prices	++			
World commodity prices	++			
PPI price dispersion	++			
<i>Global Variables Significant?</i>	<i>Y</i>			

Results for 1990-2017 in pooled sample with fixed effects and robust errors clustered by country. ++/-- sign indicates sign of coefficient that is significant at 5% level.



CPI Phillips Curve: *Changes over Time?*

	Fixed: 1990-'17		With dummies: 2007-17	
	CPI		CPI	Significant Changes in 2007-17?
Inflation expectations	++		++	++
Lagged inflation	++		++	
Domestic output gap	++		++	
Exchange rate	--		--	
World output gap	++			++
World oil prices	++		++	
World commodity prices	++			++
PPI price dispersion	++		++	--
Global Variables Significant?	Y		Y	Significant change

Results for 1990-2017 in pooled sample with fixed effects and robust errors clustered by country. ++/-- sign indicates sign of coefficient that is significant at 5% level.



Repeat for Core Inflation

- **Lots of tables....**
- **The bottom line**
- **Global variables jointly significantly (mainly exchange rate)**
 - But no significant change in global variables over last decade



Phillips Curve Results: Bottom Line

- **Are global variables important to understand inflation dynamics?**
 - YES
 - Global variables significant in cross-section (for CPI and core)
 - Different global (and domestic) variables significant for individual countries
 - Meaningfully improve ability to explain inflation
- **Has role of global variables changed over time?**
 - YES for CPI, No for core
 - Increased role for global slack & commodity price movements



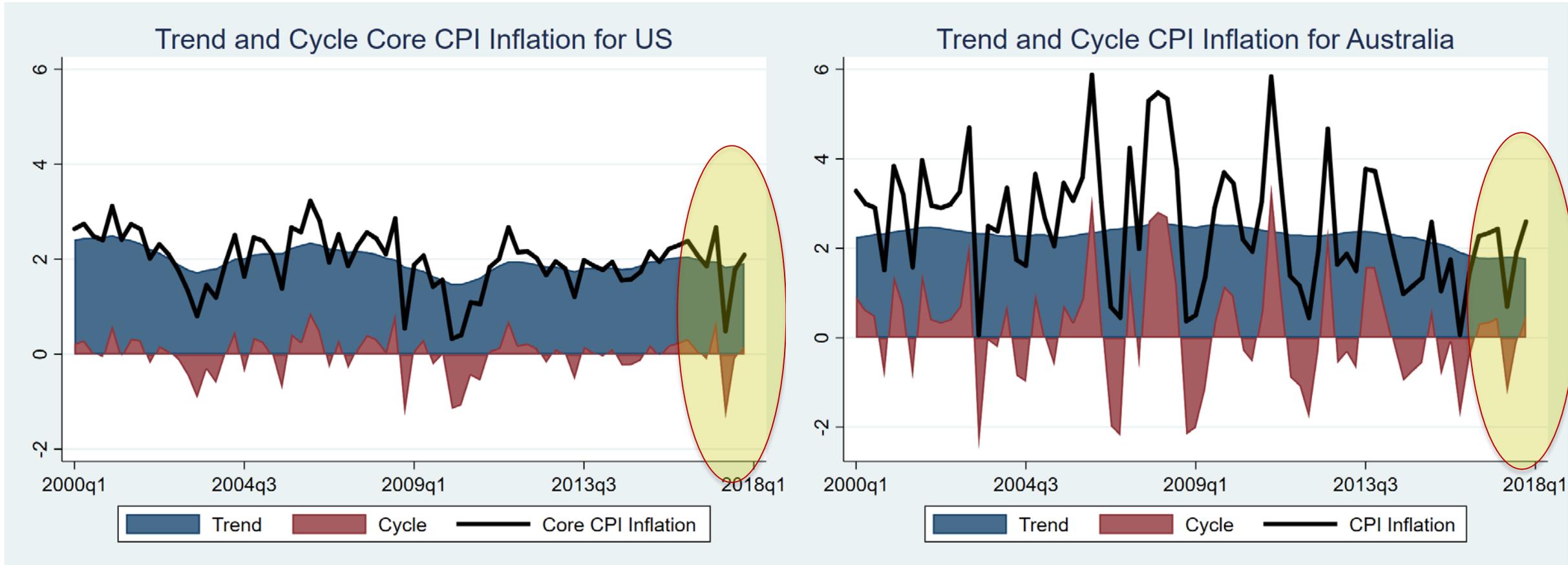
TREND-CYCLE APPROACH

Trend-Cycle Analysis

- **Uses time-series to separate inflation into 2 components**
 1. slow-moving and persistent “trend”
 2. temporary, cyclical movements around the trend
- **Minimal assumptions & parameterization**
- **Flexibility over time**
- **The Model:** $\pi_t - \tau_t = \varphi(\pi_{t-1} - \tau_{t-1}) + \eta_t$, **where** $\eta_t = \sigma_{\eta t} \zeta_{\eta t}$
 - “ARSV” model developed in Forbes *et al.* (2017)
 - Combination of UCSV model in Stock and Watson (2007) & auto-regressive (ARUC) model in Chan, Coop and Potter (2013) and Cecchetti *et al.* (2017)
 - Allows trend to follow unit root ($\tau_t = \tau_{t-1} + \varepsilon_t$) and captures the autoregressive process in deviations around trend as well as the stochastic volatility observed in the inflation data



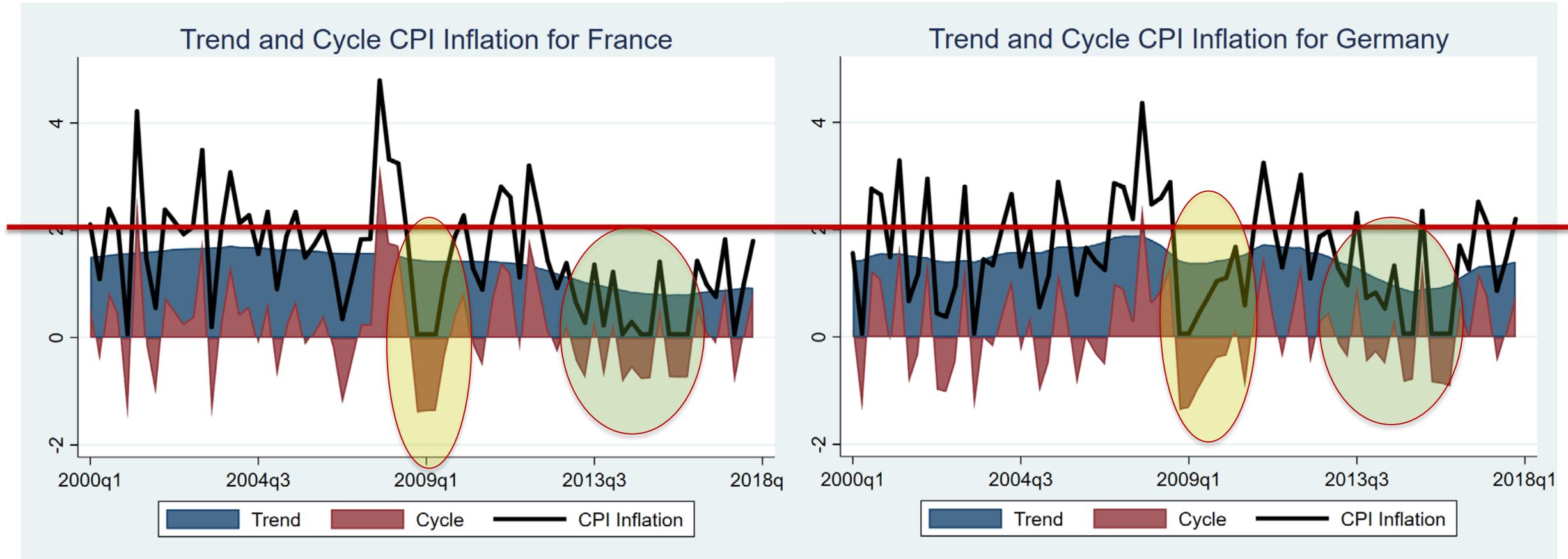
Trend-Cycle Decomposition: US & Australia



See Forbes, Kirkham and Theodoridis (2017) or Forbes (2018) for more details.



Trend-Cycle Decomposition: France & Germany

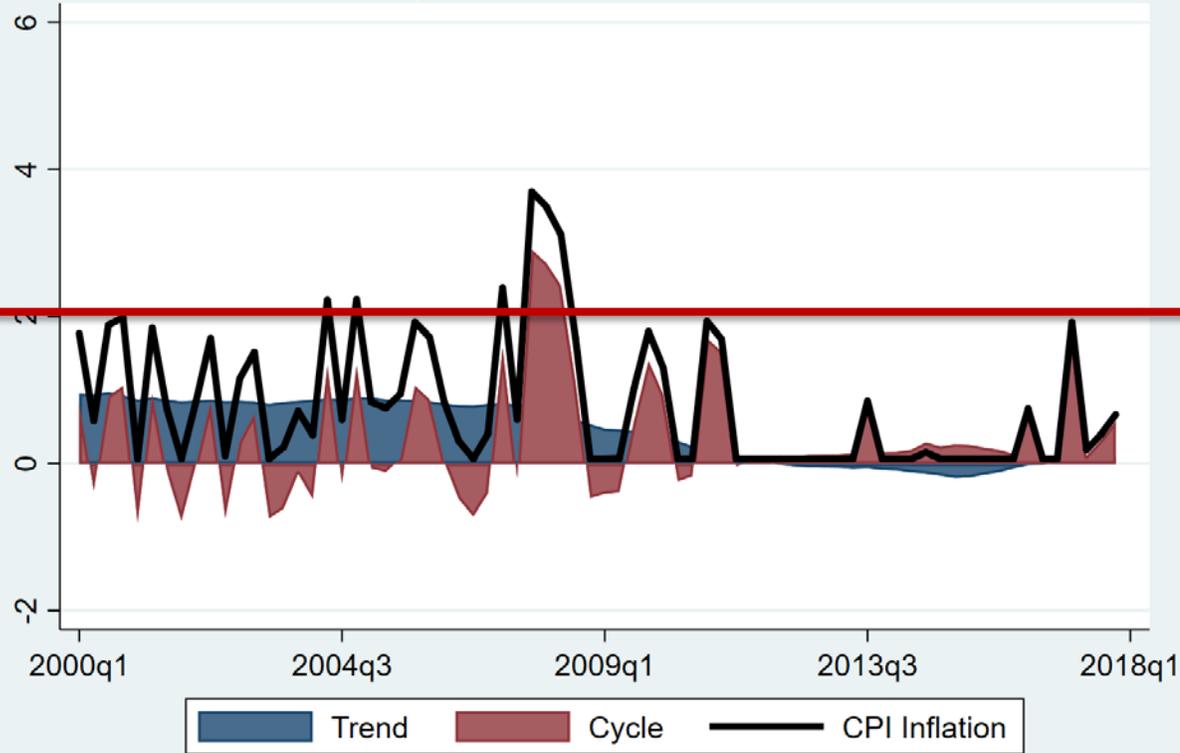


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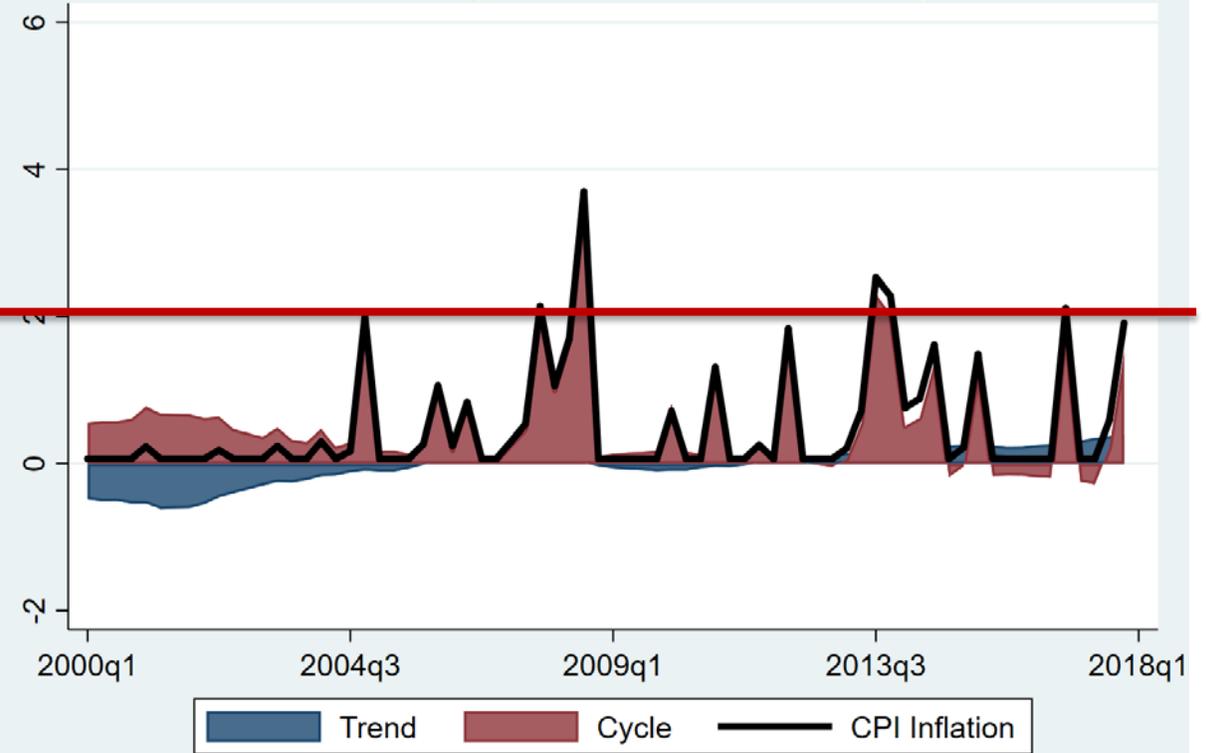


Trend-Cycle Decomposition: Switzerland & Japan

Trend and Cycle CPI Inflation for Switzerland



Trend and Cycle CPI Inflation for Japan



See Forbes, Kirkham and Theodoridis (2017) or Forbes (2018) for more details.



What Drives Headline CPI & the Cycle

	Fixed: 1990-'17		With dummies: 2007-17	
	CPI		CPI	Significant Changes in 2007-17?
Trend inflation	++			
Inflation expectations	++			
Domestic output gap	++			
Exchange rate				
World output gap	++			
World oil prices	++			
World commodity prices	++			
PPI price dispersion	++			
Global Variables Significant?	Y			

Results for 1990-2017 in pooled sample with fixed effects and robust errors clustered by country. ++/-- sign indicates sign of coefficient that is significant at 5% level.

* Is significant in some specifications, such a when EMs are dropped, crisis periods are dropped, or just 2013-2017 is the post period.



What Drives Headline CPI & the Cycle Changes over Time?

	Fixed: 1990-'17		With dummies: 2007-17	
	CPI		CPI	Significant Changes in 2007-17?
Trend inflation	++		++	
Inflation expectations	++		++	
Domestic output gap	++		++	
Exchange rate				
World output gap	++			+*
World oil prices	++		++	
World commodity prices	++			++
PPI price dispersion	++		++	--
Global Variables Significant?	Y		Y	Significant change

Results for 1990-2017 in pooled sample with fixed effects and robust errors clustered by country. ++/-- sign indicates sign of coefficient that is significant at 5% level.

* Is significant in some specifications, such a when EMs are dropped, crisis periods are dropped, or just 2013-2017 is the post period.



What Drives the Trend (Core) Changes over Time?

	Fixed: 1990-'17		With dummies: 2007-17	
	Core		Core	Significant Changes in 2007-17?
Inflation expectations	++		++	
Domestic output gap	++		++	
Exchange rate	--		--	++
World output gap				
World oil prices				
World commodity prices				
PPI price dispersion				
Global Variables Significant?	Y		Y	no significant change

Results for 1990-2017 in pooled sample with fixed effects and robust errors clustered by country. ++/-- sign indicates sign of coefficient that is significant at 5% level.



Phillips Curve Results: Bottom Line

Trend-Cycle

- **Are global variables important to understand inflation dynamics?**

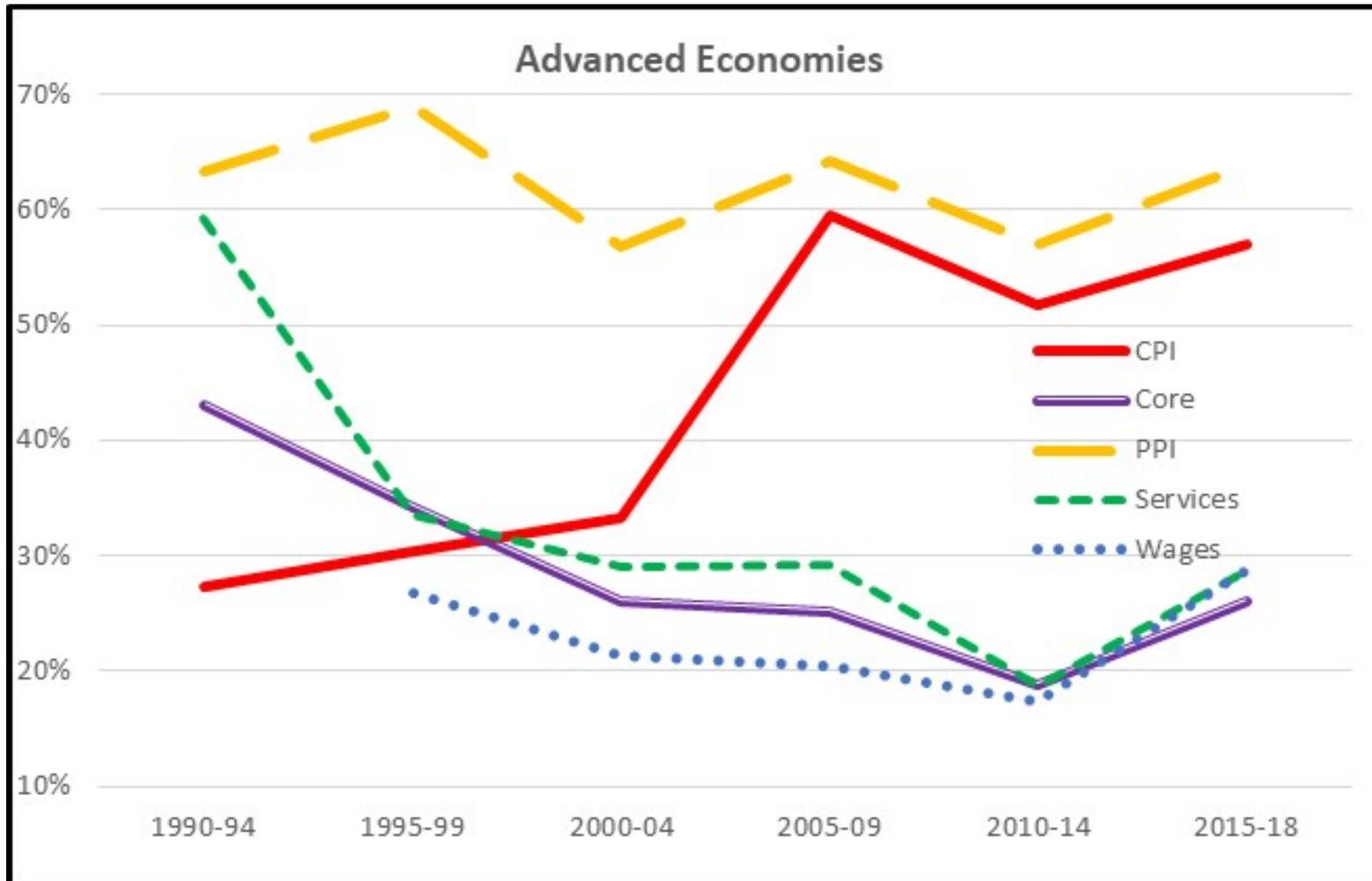
- YES
- Global variables significant in cross-section (for CPI and core) **Cycle and trend**
 - Different global (and domestic) variables significant for individual countries
- Meaningfully improve ability to explain inflation

- **Has role of global variables changes over time?**

- YES for CPI, No for core **YES for Cycle, No for trend**
- Increased role for global slack & commodity price movements



Global Principal Component in Inflation

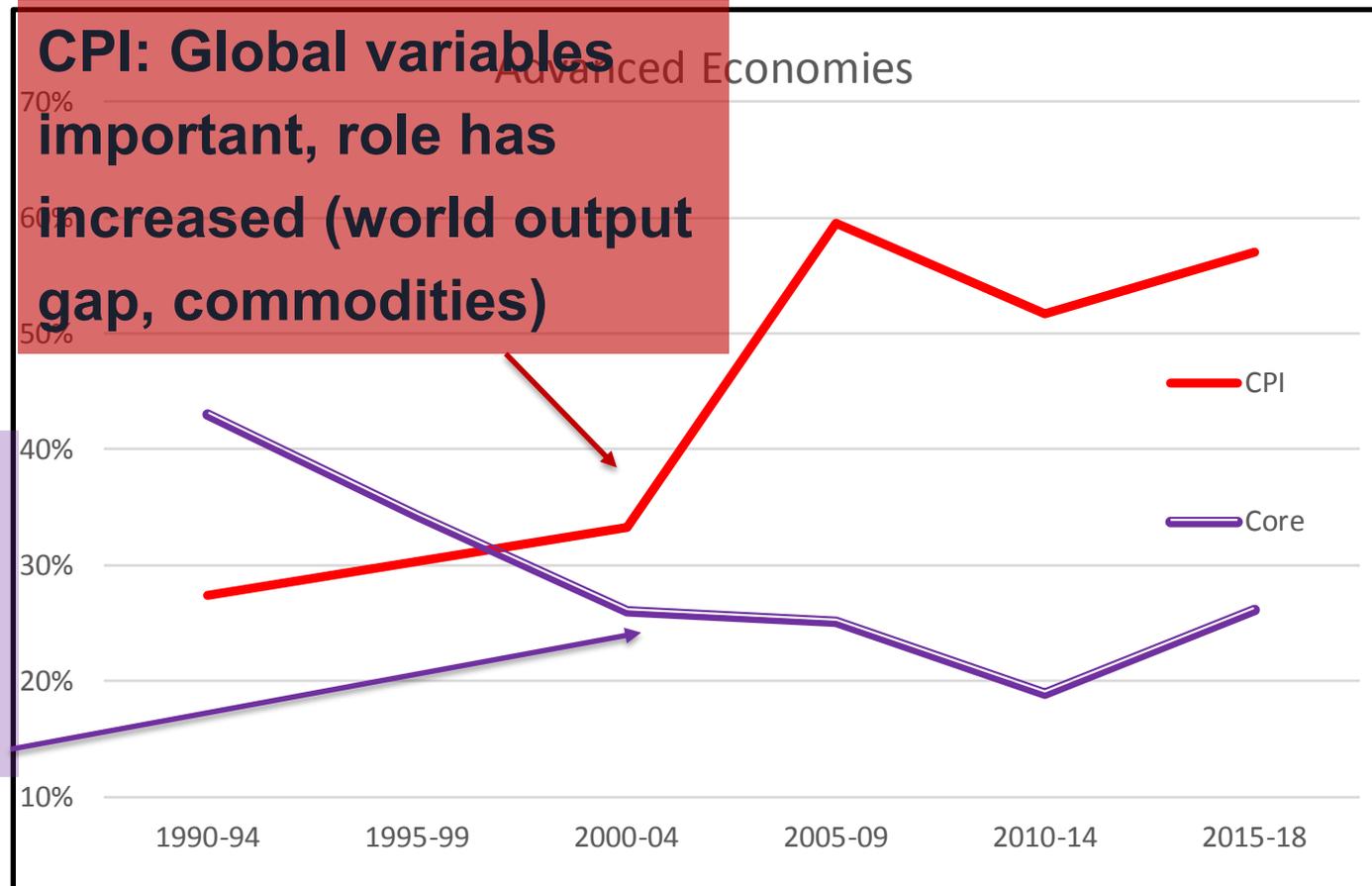


Percent of variance for each measure of inflation explained by first principal component over 5-year windows. Wage is private sector, household hourly wages. All inflation measures are relative to the previous quarter, annualized and seasonally adjusted.



Global Principal Component in Inflation

ER important, but less change in role for global variables



Percent of variance for each measure of inflation explained by first principal component over 5-year windows. Wage is private sector, household hourly wages. All inflation measures are relative to the previous quarter, annualized and seasonally adjusted.



Conclusions

- **Global factors should be included more comprehensively in inflation models**
 - Allow parameters to evolve over time
 - Global economy has evolved, needs to be explicitly included
- **Which global factors are most important?**
 - Increased role for commodity prices & global slack for CPI/cyclical inflation
 - In some countries: decreased role of domestic slack
 - **Open question: will the changes persist?**
- **Don't throw out the Swiss watch**

