APPENDIX A: Data Definitions and Statistics

Variable	Definition	Details	Source
Inflation and Price Data			
Commodity prices	World commodity price index, including fuel	Calculated as quarterly percent changes, in regressions measured as difference relative to quarterly CPI inflation	Index data from IMF
Commodity prices, exc. fuel	World commodity price index, excluding fuel	Calculated as quarterly percent changes, in regressions measured as difference relative to quarterly CPI inflation	Index from Datastream, code: WDXWPCN.F
Core CPI inflation	Consumer prices, all items except food and energy	Calculated as quarterly percent changes, annualized, seasonally adjusted[1]	Index data from OECD
CPI inflation	Consumer prices, all items	Calculated as quarterly percent changes, annualized, seasonally adjusted[1]	Index data from IMF
Import prices	Import prices, all items	Calculated as quarterly percent changes, in regressions measured as difference relative to quarterly CPI inflation	Index data from IMF
Inflation expectations	5-year ahead forecast for CPI inflation	Forecasts released in spring WEO are treated as Q1, and in fall WEO as Q3; Q2 and Q4 are interpolated between the nearest spring and fall forecasts	IMF, from historical WEO forecasts, at: https://www.imf.org/external/pubs/ft/weo/faq.htm
Oil prices	World oil price index	Index of crude oil, Brent, spot prices in US$. Calculated as quarterly percent changes, in regressions measured as difference relative to quarterly CPI inflation	Index from Datastream, code: WDXWPOI.F
Producer price inflation	Producer prices, all commodities	Calculated as quarterly percent changes, annualized, seasonally adjusted[1]	Index data from IMF
Wage inflation	Hourly earnings in the private sector	Calculated as quarterly percent changes, annualized, seasonally adjusted	Index data from OECD
Labor Market and Slack Data			
Domestic slack	Principal component of 7 measures of domestic slack, with a positive value indicating more slack	Negative of principal component of as many of following variables as available: OECD domestic output gap, unemployment gap, participation gap, hours gap, involuntary workers gap, self-employment gap and temporary workers gap, all defined below	Calculated
Domestic slack * Import Share	Interaction of domestic slack and import share	Domestic slack defined above. Import share is the ratio of the country's imports to GDP (both in nominal domestic currency), over the last four quarters	Calculated. Import share data from the IMF, IFS.
Hours gap	Difference between hours worked and "normal" hours	Calculated as % of "normal" hours worked (the sample average for each country)	Calculated based on OECD data
Involuntary part-time workers gap	Difference between "normal" involuntary workers and current involuntary workers	Calculated as % of "normal" involuntary workers (the sample average for each country); available annually and interpolated to quarterly	Calculated based on Hong *et al*. (2017) data
OECD domestic output gap	Output gap as % of GDP	Available annually and interpolated to quarterly	OECD

| Participation gap	Gap between actual participation rate and "normal" participation rate	Calculated as % of "normal" participation rate (the sample average for each country); available annually and interpolated to quarterly	Calculated based on OECD data
Self-employment gap	Difference between "normal" self-employment and current rate of self-employment	Calculated as % of "normal" self-employment (sample average for each country)	Calculated based on OECD data
Temporary workers gap	Difference between "normal" temporary workers and current temporary workers	Calculated as % of "normal" temporary workers (sample average for each country); available annually and interpolated to quarterly	Calculated based on Hong *et al.* (2017) data
Unemployment gap	Difference of NAIRU and unemployment rate	Available annually and interpolated to quarterly	OECD
World slack	Weighted average of slack in advanced economies and China	Slack in advanced economies reported by the IMF; slack in China calculated as the deviation in growth over the previous two years relevant to the current quarter. Weights vary over time based on IMF calculation of advanced economy share of global GDP.	Calculated based on IMF data
World slack-IMF Measure	Negative of output gap for advanced economies	Calculated as a % of GDP for relevant economies; available annually and interpolated to quarterly	IMF
World slack-OECD Measure	Negative of output gap for OECD economies	Calculated as a % of GDP for relevant economies; available annually and interpolated to quarterly	OECD
Other Control Variables			
Global value chains	Principal component of four measures	Components are: (1) relative growth of merchandise trade volumes relative to global GDP; (2) traded intermediate goods as a share of global GDP; (3) share of these traded intermediate goods that are "complex" in the sense that they cross country borders at least twice; and (4) PPI dispersion (defined below). Available annually and interpolated to quarterly.	First three components from Li, Meng and Wang (2019).
PPI dispersion	Dispersion of producer prices	Standard deviation in producer price inflation for all countries in sample in each quarter, PPI inflation measured relative to 4 quarters earlier	Calculated based on IMF PPI
Real exchange rate index	Real effective exchange rate based on consumer prices	% change in real exchange rate, relative to 8 quarters earlier	IMF, IFS

Note: (1) Adjustments for VAT increases: Australia in 2000q3, Japan in 1997q2 and 2014q2, New Zealand in 2010q4, and United Kingdom in 2010q1 and 2011q1.

Appendix B: Country Sample

Advanced Economies[1]		Emerging Economies[1]
Australia	Korea	Brazil
Austria	Latvia	Chile
Belgium	Lithuania	China
Canada	Luxembourg	Colombia
Czech Republic	Netherlands	Hungary
Denmark	New Zealand	India
Estonia	Norway	Indonesia
Finland	Portugal	Mexico
France	Slovak Republic	Poland
Germany	Slovenia	Russia
Greece	Spain	South Africa
Iceland	Sweden	Turkey
Ireland	Switzerland	
Israel	United Kingdom	
Italy	United States	
Japan		

Note: Division between advanced economies and emerging markets based on definitions in IMF, *World Economic Outlook,* 2017Q4.

Appendix Figure 1

Global Control Variables: World Slack and Global Value Chains

Alternate Measures of Global Slack
(as % of global GDP)

Global Value Chains: Principal Component
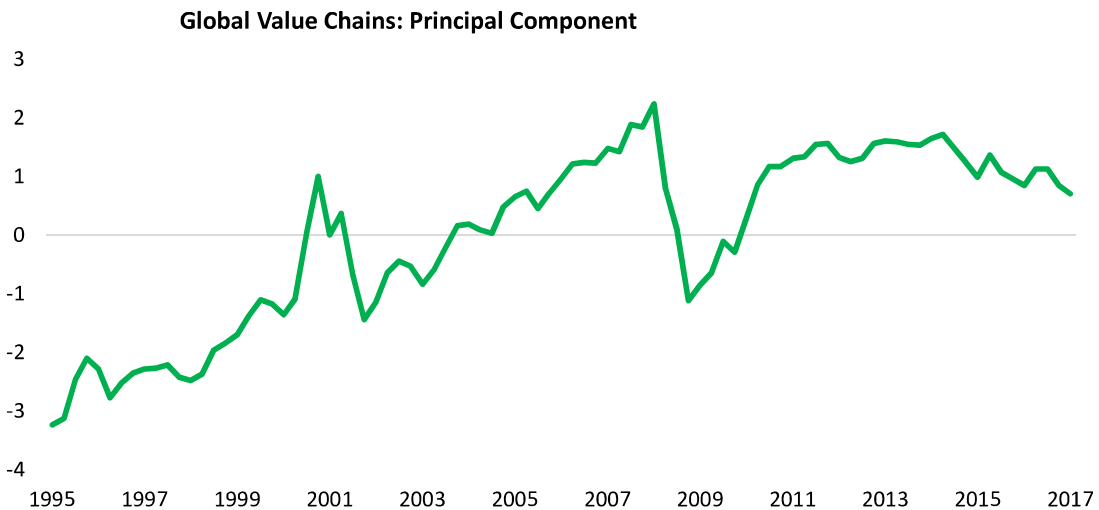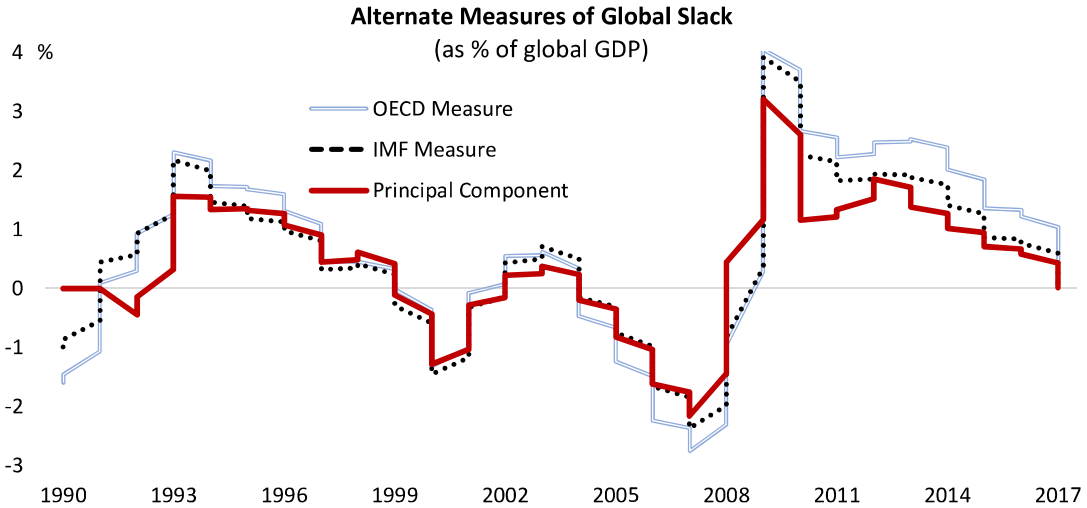
Notes: "World slack" is a weighted average of slack in advanced economies (from the IMF) and slack in China. Slack in China calculated as the deviation in GDP growth from recent averages. The weight of the advanced economies for this calculation varies over time, based on the share of advanced economy GDP in world GDP according to IMF statistics. The IMF measure of slack only includes advanced economies, and the OECD measure only includes OECD economies. See text and Appendix A for more details.

Global value chains are measured as a principal component of: relative growth of merchandise trade, share of traded intermediate goods, complex share of traded intermediate goods, and dispersion in PPI inflation. See text and Appendix A for more details.

Appendix Table 1

Sensitivity Tests for Phillips Curve Analysis: CPI Inflation

PRE-CRISIS (1996-2007)

	Different Definitions			Diff. Period/Sample		Diff. Specifications	
	Domestic Slack: Unemploy Gap	World Slack: OECD Measure	GVC: China Exp Growth	Exclude 2008	Only AEs	Drop Inf. Expect.	Random Effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inflation Expect.	0.794***	0.708***	0.800***	0.741***	0.640***		0.693***
	0.146	0.158	0.166	0.163	0.207		0.084
Lagged Inflation	0.583***	0.595***	0.594***	0.589***	0.453***	0.697***	0.709***
	0.068	0.066	0.075	0.067	0.055	0.058	0.041
Domestic Slack	-0.141*	-0.198***	-0.191***	-0.188***	-0.210***	-0.182**	-0.103***
	0.080	0.059	0.059	0.061	0.068	0.066	0.036
World Oil Prices	0.030***	0.030***	0.031***	0.030***	0.029***	0.030***	0.032***
	0.004	0.004	0.004	0.004	0.003	0.004	0.004
World Comm. Prices	-0.006	0.006	-0.004	0.004	-0.003	0.004	0.005
	0.010	0.013	0.012	0.013	0.013	0.013	0.014
Real Exch. Rate	-0.021*	-0.029***	-0.034***	-0.027**	-0.022**	-0.023**	-0.020**
	0.012	0.010	0.011	0.011	0.010	0.010	0.009
World Slack	-0.481***	-0.272***	-0.174	-0.410***	-0.404***	-0.358***	-0.469***
	0.106	0.059	0.116	0.092	0.091	0.092	0.083
Global Value Chains	-0.282***	-0.229***	0.000	-0.258***	-0.197**	-0.295***	-0.239***
	0.067	0.064	0.000	0.068	0.072	0.069	0.059
Constant	-1.025***	-0.842**	-0.721**	-0.938***	-0.425	0.430**	-1.178***
	0.300	0.319	0.317	0.321	0.372	0.180	0.146
R2	0.416	0.411	0.406	0.414	0.275	0.397	0.642
# obs	1360	1404	1404	1404	1263	1404	1404
F-Test: Global	50.9***	32.0***	30.0***	32.4***	30.6***	22.8***	154.7***

LAST DECADE (2008-2017)

	Different Definitions			Diff. Period/Sample		Diff. Specifications	
	Domestic Slack: Unemploy Gap	World Slack: OECD Measure	GVC: China Exp Growth	Exclude 2008	Only AEs	Drop Inf. Expect.	Random Effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inflation Expect.	0.446	0.382	0.435	0.139	0.298		0.596***
	0.335	0.289	0.320	0.449	0.270		0.105
Lagged Inflation	0.575***	0.518***	0.452***	0.466***	0.561***	0.562***	0.623***
	0.039	0.034	0.034	0.030	0.045	0.039	0.043
Domestic Slack	-0.016	-0.103**	-0.059	-0.070	-0.084*	-0.110**	-0.045*
	0.040	0.042	0.055	0.047	0.042	0.041	0.027
World Oil Prices	0.027***	0.027***	0.026***	0.023***	0.025***	0.026***	0.026***
	0.003	0.003	0.003	0.004	0.003	0.003	0.003
World Comm. Prices	0.030***	0.039***	0.042***	0.023***	0.038***	0.031***	0.029***
	0.009	0.009	0.008	0.008	0.008	0.009	0.009
Real Exch. Rate	-0.036***	-0.037***	-0.039***	-0.038***	-0.038**	-0.039***	-0.035***
	0.013	0.013	0.014	0.011	0.014	0.012	0.010
World Slack	-0.443***	-0.203***	-0.442***	-0.186**	-0.443***	-0.439***	-0.455***
	0.062	0.047	0.081	0.079	0.080	0.071	0.072
Global Value Chains	-0.354***	-0.247***	0.000***	-0.340***	-0.346***	-0.362***	-0.371***
	0.083	0.069	0.000	0.072	0.084	0.077	0.078
Constant	0.690	0.769	2.266***	1.216	1.043*	1.735***	0.338
	0.715	0.632	0.791	1.030	0.569	0.132	0.273
R2	0.391	0.405	0.444	0.295	0.447	0.418	0.513
# obs	1191	1231	1107	1111	1080	1231	1231
F-Test: Global	66.2***	68.7***	70.5***	59.0***	79.7***	72.7***	361.1***

Notes: *Phillips curve regressions of equation (3) for quarterly CPI inflation from 1996-2017. See Appendix A for data definitions and text for details. Estimated using fixed effects with robust standard errors clustered by country, except column (7) is estimated with random effects. Column (1) measures domestic slack with the unemployment gap and column (2) measures world slack using the OECD measure. Column (3) measures GVCs using growth in China's exports. Column (4) drops 2008 and column (5) only includes advanced economies, according to IMF definitions. Column (6) drops inflation expectations. F-Test: Global is an F-test for the joint significance of the five global variables. *** is significant at the 1% level, ** at the 5% level and * at the 10% level.*

Appendix Table 2

Median Values for Key Statistics for Trend-Cycle Estimates

	15%-85% Trend Range		Variance in "Trend"		Variance in "Cycle"		% of Variation Explained by Trend	
	CPI (1)	Core (2)	CPI (3)	Core (4)	CPI (5)	Core (6)	CPI (7)	Core (8)
Full Period 1990-2017	0.954	0.708	0.382	0.311	1.504	0.710	31%	55%
Pre-crisis 1997-2007	0.914	0.768	0.262	0.305	1.329	0.841	19%	40%
Last Decade 2008-2017	1.039	0.648	0.170	0.097	1.504	0.642	40%	68%

Notes: Table reports median statistics for estimates of the trend and cycle for CPI and core inflation for advanced economies using the ARSV model developed in Forbes et al. (2019) and discussed in Section V.A. The column "15% to 85% Trend Range" reports the range between the 15th and 85th percentile estimates of the corresponding measure of the trend.

Appendix Table 3

Sensitivity Tests for Phillips Curve Analysis: <u>Core Inflation</u>

PRE-CRISIS (1996-2007)

	Different Definitions			Diff. Period/Sample		Diff. Specifications	
	Domestic Slack: Unemploy Gap	World Slack: OECD Measure	GVC: China Exp Growth	Exclude 2008	Only AEs	Drop Inf. Expect.	Random Effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inflation Expect.	0.440***	0.474***	0.512***	0.483***	0.471***		0.421***
	0.097	0.095	0.087	0.092	0.126		0.058
Lagged Inflation	0.674***	0.654***	0.643***	0.653***	0.590***	0.737***	0.788***
	0.060	0.060	0.059	0.059	0.060	0.042	0.034
Domestic Slack	-0.118*	-0.176***	-0.167***	-0.170***	-0.173***	-0.164***	-0.097***
	0.062	0.040	0.043	0.042	0.046	0.044	0.031
World Comm. + Oil Prices	-0.002	0.000	-0.001	-0.001	-0.001	-0.003	0.000
	0.005	0.006	0.006	0.006	0.006	0.006	0.005
Real Exch. Rate	-0.020***	-0.027***	-0.024***	-0.026***	-0.026***	-0.024***	-0.023***
	0.006	0.006	0.007	0.006	0.007	0.006	0.006
World Slack	-0.208***	-0.062	-0.167**	-0.124**	-0.089	-0.101	-0.184***
	0.060	0.044	0.076	0.059	0.066	0.066	0.054
Global Value Chains	-0.096**	-0.047	0.000*	-0.069	-0.023	-0.092**	-0.051
	0.042	0.043	0.000	0.043	0.042	0.042	0.040
Constant	-0.321**	-0.315**	-0.157	-0.360***	-0.199	0.525***	-0.558***
	0.130	0.120	0.149	0.111	0.172	0.135	0.082
R2	**0.475**	**0.487**	**0.490**	**0.488**	**0.395**	**0.473**	**0.714**
# obs	**1358**	**1402**	**1402**	**1402**	**1262**	**1402**	**1402**
F-Test: Global	**6.2*****	**6.0*****	**10.6*****	**6.6*****	**5.8*****	**5.6*****	**30.7*****

LAST DECADE (2008-2017)

	Different Definitions			Diff. Period/Sample		Diff. Specifications	
	Domestic Slack: Unemploy Gap	World Slack: OECD Measure	GVC: China Exp Growth	Exclude 2008	Only AEs	Drop Inf. Expect.	Random Effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inflation Expect.	0.345*	0.529***	0.582***	0.360*	0.553***		0.527***
	0.179	0.159	0.188	0.200	0.170		0.097
Lagged Inflation	0.480***	0.469***	0.442***	0.407***	0.444***	0.497***	0.592***
	0.053	0.047	0.047	0.061	0.068	0.047	0.046
Domestic Slack	-0.074**	-0.111***	-0.102**	-0.104***	-0.120***	-0.125***	-0.061***
	0.029	0.031	0.038	0.028	0.035	0.029	0.019
World Comm. + Oil Prices	0.016***	0.015***	0.010***	0.011***	0.015***	0.015***	0.014***
	0.004	0.003	0.003	0.003	0.004	0.004	0.004
Real Exch. Rate	-0.015	-0.013	-0.011	-0.018**	-0.010	-0.013	-0.012*
	0.009	0.009	0.008	0.007	0.010	0.008	0.007
World Slack	-0.045	-0.028	-0.119**	0.042	-0.032	-0.047	-0.074
	0.050	0.035	0.055	0.089	0.054	0.054	0.048
Global Value Chains	0.084	0.074	0.000*	0.067	0.062	0.068	0.068
	0.061	0.054	0.000	0.068	0.065	0.062	0.062
Constant	0.152	-0.166	0.337	0.162	-0.164	0.913***	-0.383*
	0.382	0.315	0.490	0.441	0.281	0.134	0.200
R2	**0.199**	**0.243**	**0.253**	**0.140**	**0.245**	**0.239**	**0.424**
# obs	**1194**	**1234**	**1110**	**1114**	**1080**	**1234**	**1234**
F-Test: Global	**6.2*****	**5.3*****	**6.6*****	**5.8*****	**6.1*****	**6.1*****	**26.6*****

Notes: *Phillips curve regressions of equation (3) for quarterly core CPI inflation from 1996-2017. See Appendix A for data definitions and text for details. Estimated using fixed effects with robust standard errors clustered by country, except column (7) is estimated with random effects. Column (1) measures domestic slack with the unemployment gap and column (2) measures world slack using the OECD measure. Column (3) measures GVCs using growth in China's exports. Column (4) drops 2008 and column (5) only includes advanced economies, according to IMF definitions. Column (6) drops inflation expectations. F-Test: Global is an F-test for the joint significance of the four global variables. *** is significant at the 1% level, ** at the 5% level and * at the 10% level.*

Appendix Table 4

Sensitivity Tests for Phillips Curve Analysis: <u>Wage Inflation</u>

PRE-CRISIS (1996-2007)

	Different Definitions			Diff. Period/Sample		Diff. Specifications	
	Domestic Slack: Unemploy Gap	World Slack: OECD Measure	GVC: China Exp Growth	Exclude 2008	Only AEs	Drop Inf. Expect.	Random Effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inflation Expect.	-0.086	0.039	0.088	0.052	-0.152		0.528***
	0.209	0.204	0.198	0.202	0.381		0.182
Lagged Inflation	0.239***	0.241***	0.231***	0.237***	0.120	0.244***	0.330***
	0.044	0.059	0.063	0.058	0.089	0.052	0.039
Domestic Slack	-0.211*	-0.200***	-0.195**	-0.197***	-0.193***	-0.196***	-0.135**
	0.121	0.064	0.068	0.066	0.076	0.068	0.055
World Comm. + Oil Prices	0.006	0.006	0.004	0.005	0.010	0.005	0.008
	0.013	0.013	0.014	0.013	0.014	0.013	0.013
World Slack	-0.222	-0.159	-0.192	-0.230	-0.152	-0.228	-0.246
	0.162	0.148	0.134	0.178	0.184	0.178	0.188
Global Value Chains	-0.125	-0.114	0.000	-0.126	-0.073	-0.128	-0.060
	0.105	0.110	0.000	0.107	0.109	0.105	0.116
Constant	3.487***	3.132***	3.313***	3.100***	3.543***	3.195***	1.823***
	0.411	0.445	0.466	0.438	0.856	0.257	0.496
R2	0.067	0.064	0.063	0.065	0.028	0.064	0.365
# obs	878	878	878	878	784	878	878
F-Test: Global	1.0	0.9	1.7	1.2	1.2	1.0	9.4**

LAST DECADE (2008-2017)

	Different Definitions			Diff. Period/Sample		Diff. Specifications	
	Domestic Slack: Unemploy Gap	World Slack: OECD Measure	GVC: China Exp Growth	Exclude 2008	Only AEs	Drop Inf. Expect.	Random Effects
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inflation Expect.	-0.148	0.341	0.278	0.077	0.238		1.939***
	0.686	0.647	0.651	0.526	0.639		0.508
Lagged Inflation	0.050	-0.059	-0.139	-0.074	0.000	-0.024	0.113
	0.114	0.110	0.127	0.104	0.143	0.103	0.083
Domestic Slack	-0.294***	-0.261***	-0.207**	-0.278***	-0.304***	-0.311***	-0.137
	0.054	0.108	0.093	0.099	0.096	0.088	0.094
World Comm. + Oil Prices	0.007	0.007	0.000	0.001	0.003	0.006	0.001
	0.008	0.007	0.007	0.009	0.008	0.008	0.008
World Slack	-0.233	-0.202*	-0.368**	0.020	-0.147	-0.233	-0.345**
	0.160	0.109	0.164	0.174	0.141	0.169	0.168
Global Value Chains	-0.050	-0.102	0.000**	-0.017	-0.045	-0.071	-0.105
	0.087	0.112	0.000	0.085	0.079	0.097	0.112
Constant	3.560***	2.973***	5.232***	3.012**	2.666**	3.542***	-0.748
	1.440	1.280	1.490	1.182	1.277	0.304	0.914
R2	0.067	0.061	0.074	0.021	0.051	0.059	0.197
# obs	782	782	720	702	703	782	782
F-Test: Global	1.3	1.3	2.7*	0.0	0.8	1.2	5.2

Notes: *Phillips curve regressions of equation (3) for private sector wage inflation from 1996-2017. See Appendix A for data definitions and text for details. Estimated using fixed effects with robust standard errors clustered by country, except column (7) is estimated with random effects. Column (1) measures domestic slack with the unemployment gap and column (2) measures world slack using the OECD measure. Column (3) measures GVCs using growth in China's exports. Column (4) drops 2008 and column (5) only includes advanced economies, according to IMF definitions. Column (6) drops inflation expectations. F-Test: Global is an F-test for the joint significance of the three global variables. *** is significant at the 1% level, ** at the 5% level and * at the 10% level.*