The "Supply-Side Origins" of Inflation

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Three main things I do in this presentation

Think beyond demand-driven business cycle fluctuations

- Correlated demand and supply shocks erase output-inflation tradeoff
- Does not mean that there is no monetary transmission mechanism

Account for the supply-side factors that drive inflation

- U.S. PCE value chain barely changed in last 20 years
- Imports and mining/utilities account for three quarters of variance of inflation
- Simple real-time rule-of-thumb approximates supply-side origins of inflation

Propose to extend supply-side analysis of inflation

- Beyond neoclassical growth-accounting assumptions and beyond U.S.

Think beyond demand-driven business cycle fluctuations
No clear evidence of positive output-inflation
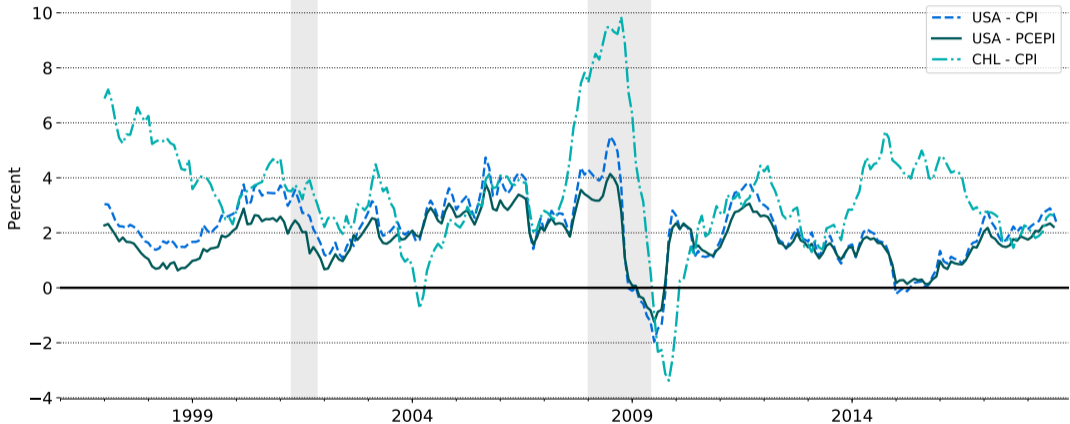tradeoff in recent data for many countries.

Correlated demand and supply shocks

Blinder (2018)

Country Inflation Rates
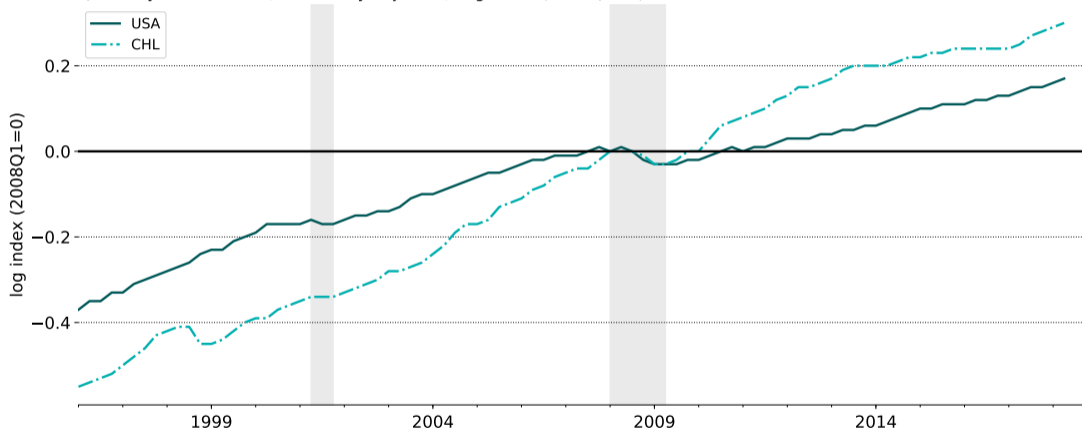Monthly observations; seasonally adjusted; 12-month inflation rates

Source: Bureau of Labor Statistics, Bureau of Economic Analysis, and OECD

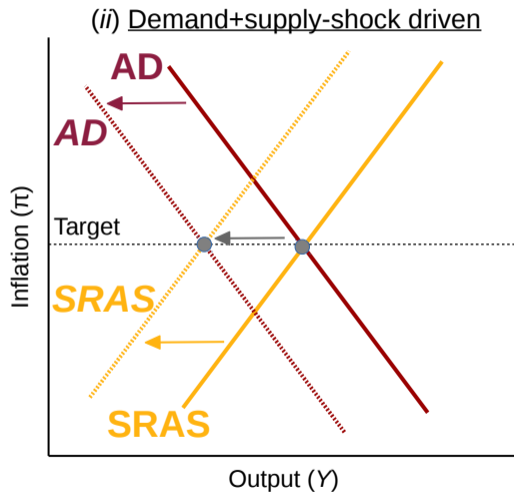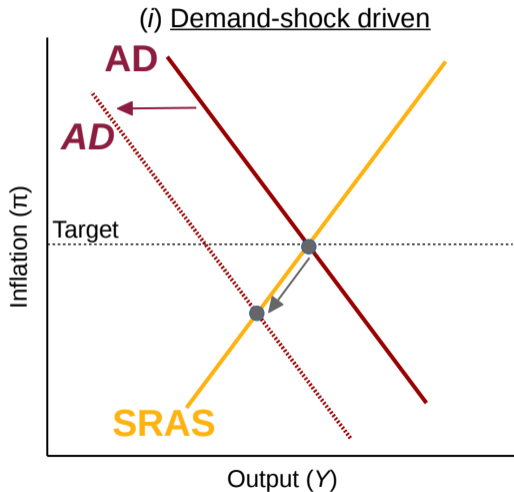# Level shifts in GDP trends hint at supply shocks

Log Real GDP in U.S. and Chile
Quarterly observations; seasonally adjusted; Log index (2008Q1=0)

Source: Bureau of Economic Analysis and OECD

Joint shifts in AD and SRAS curves flatten Phillips curve

(i) Demand-shock driven

Inflation (π)

AD

AD

Target

SRAS

Output (Y)

(ii) Demand+supply-shock driven

Inflation (π)

AD

AD

Target

SRAS

SRAS

Output (Y)

Insight translates to NK model

Correlation demand and supply shocks: 0

Correlation demand and supply shocks: 0.5
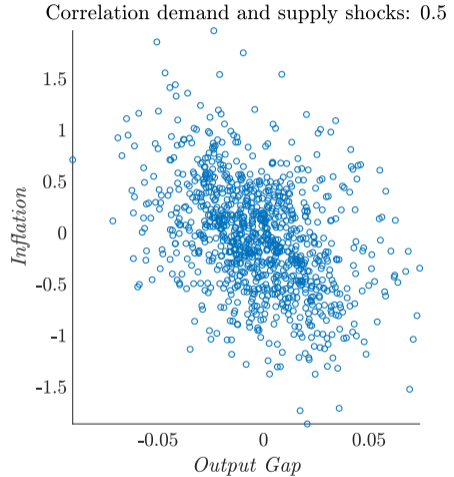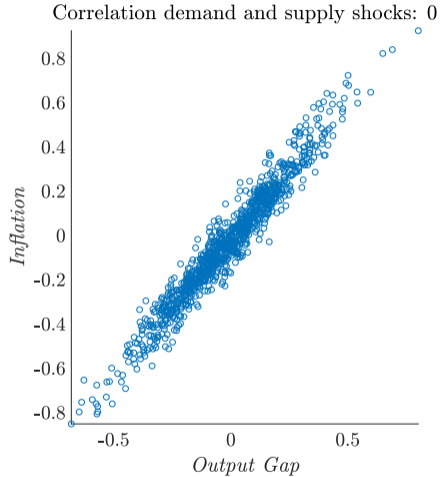
Special thanks to Dennis Bonam (DNB)

Challenges in the face of correlated demand and supply shocks

Theory: Model the common source that drives both shocks

- Many candidates already out there, but not discussed in this context

  Ravenna & Walsh (2006), Daly & Hobijn (2014), Gilchrist *et al.* (2017), Carlstrom *et al.* (2017)

Policy: Emphasize the supply-side effects of monetary policy decisions

- Communicate the supply-side transmission of monetary policy
- Price stability and maximum employment not necessarily a tradeoff

Measurement: Improve our understanding of 'supply-side origins' of inflation

- Account for cost factors that drive inflation from production (supply) side
- Apply dual growth accounting method to short-run PCE inflation fluctuations

  Complements long-run growth accounting for supply-side factors (Congressional Budget Office, 2018; Federal Reserve Board of Governors, 2012)
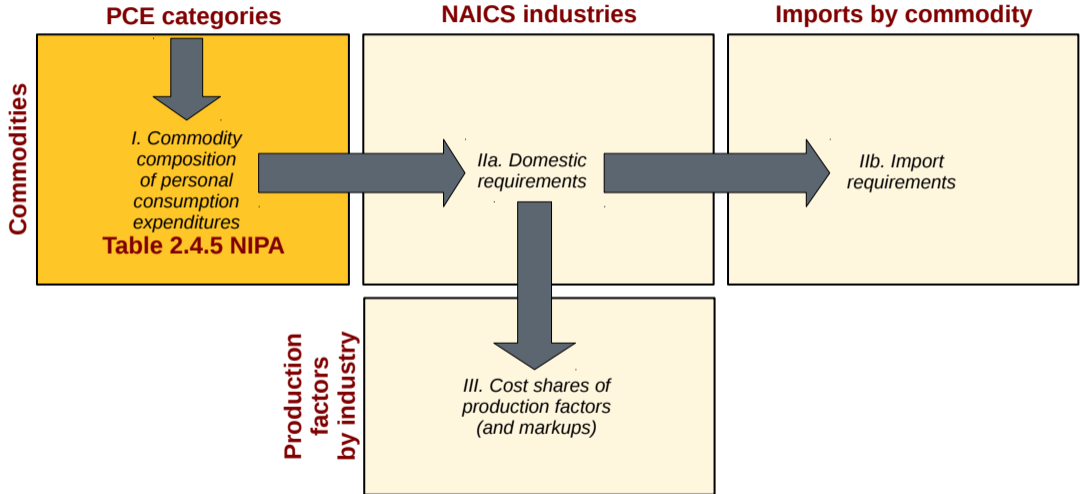
Supply-side origins of inflation in a nutshell
Best understood in context of a simple value-chain diagram

Trace value-added embodied in PCE back along value chain
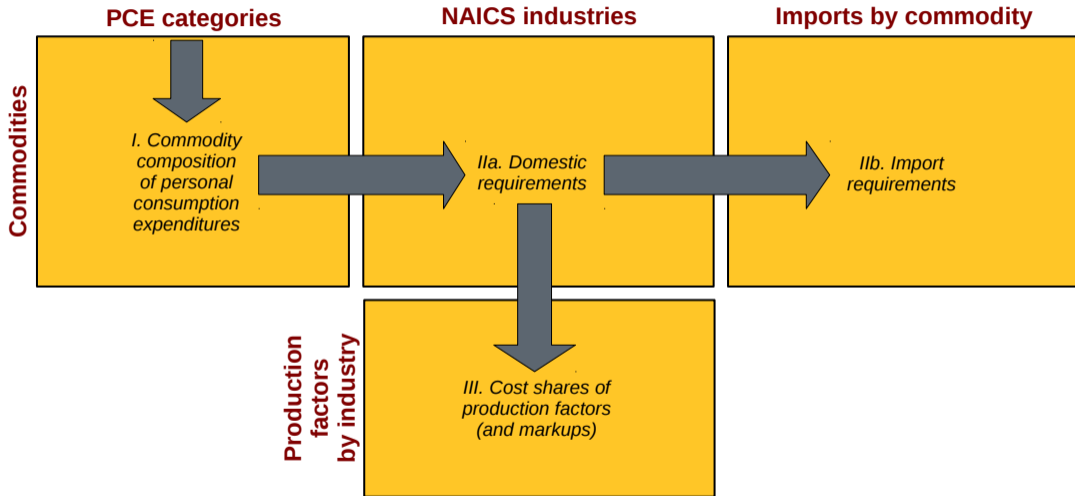
Demand/expenditure side reported in regular NIPA tables

Inflation contributions by expenditure category in NIPA

PCE categories

NAICS industries

Imports by commodity

Commodities

I. Commodity composition of personal consumption expenditures
Table 2.3.2 NIPA

IIa. Domestic requirements

IIb. Import requirements

Production factors by industry

III. Cost shares of production factors (and markups)
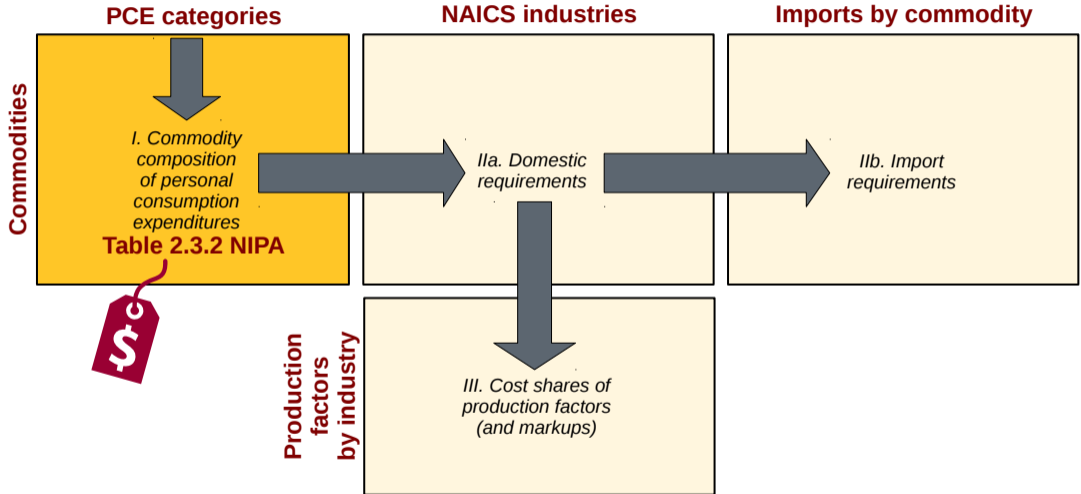
Ball (2018) will discuss some of this tomorrow (Median inflation)

Trace origins of PCE costs and inflation up value chain

PCE categories

NAICS industries

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Domestic and foreign requirements in U.S. PCE

PCE categories

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*III. Cost shares of production factors (and markups)*

No major shifts in U.S. PCE supply chain
Domestic requirements for a dollar of
PCE spending have not changed much.
Slight change in import requirements.

Domestic and foreign requirements per dollar of PCE by subperiod

	1998-2000	2001-2004	2005-2008	2009-2012	2013-2015	Average
	(a) Domestic requirements					
Agriculture, forestry, fishing, and hunting	1.2	1.1	1.1	1.2	1.3	1.2
Mining and utilities	2.7	2.7	3.1	3.3	3.2	3.0
Construction	0.5	0.7	0.8	0.9	0.9	0.8
Manufacturing	9.8	9.1	8.2	8.1	7.9	8.6
Trade and transportation	15.9	15.1	14.6	14.1	14.2	14.7
Information	4.1	4.1	4.0	3.9	3.9	4.0
Finance, insurance, and non-housing real estate	**11.8**	**12.0**	**11.4**	**10.9**	**11.6**	**11.5**
Housing	13.6	13.8	13.8	14.3	14.0	13.9
Professional and business services	8.7	8.8	9.0	9.1	9.3	9.0
Education and Health	9.7	10.2	10.5	11.6	11.4	10.7
Arts, entertainment, and food svcs	5.2	5.2	5.2	5.1	5.4	5.2
Other services	4.9	4.4	4.1	3.9	3.8	4.2
Government	3.4	3.3	3.1	3.2	3.1	3.2
Other	0.6	0.5	0.4	0.3	0.4	0.4
Total value added	91.5	90.6	88.9	89.5	89.9	90.0
	(b) Import requirements					
Materials	6.5	6.8	7.2	6.8	7.2	6.9
Energy	1.0	1.4	2.6	2.3	1.7	1.8
Services	0.5	0.7	0.9	1.1	1.1	0.9
Other	0.6	0.5	0.4	0.3	0.4	0.4
Total imports	8.6	9.4	11.0	10.5	10.3	10.0

Factor and foreign requirements in U.S. PCE
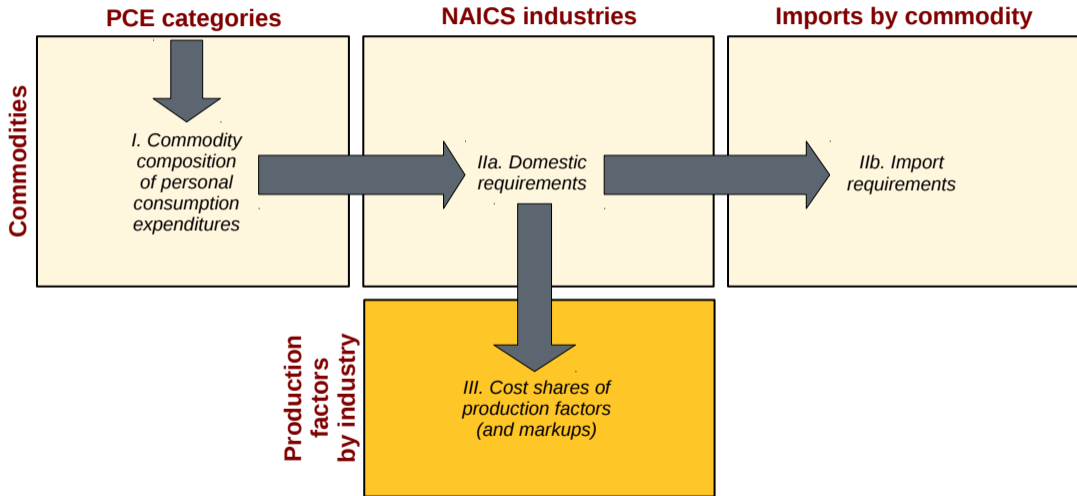
Factor requirement of labor declined
Shift away from non-college educated labor.

# Declining factor requirement of labor driven by low-skilled

Domestic requirements split up by production factor and subperiod

|	1998-2000	2001-2004	2005-2008	2009-2012	2013-2015	Average
(a) Labor						
Labor - college	22.8	23.8	23.7	24.3	25.2	24.0
Labor - no college	28.7	26.7	24.4	22.8	22.1	24.9
Labor - Total	51.5	50.5	48.1	47.1	47.3	48.9
(b) Capital						
Capital - Total	39.6	39.4	40.1	41.7	41.9	40.5
Total value added	91.5	90.6	88.9	89.5	89.9	90.0

Factor requirements in PCE

Requirement in cent per dollar of PCE by production factor and imports: 1998-2015
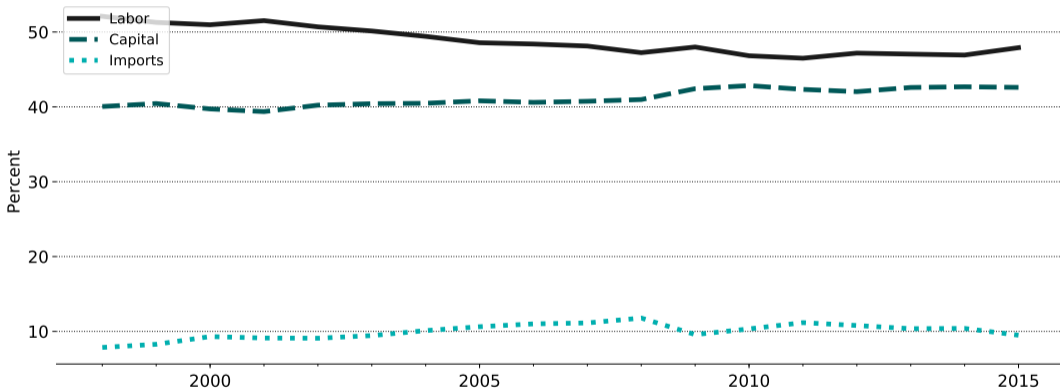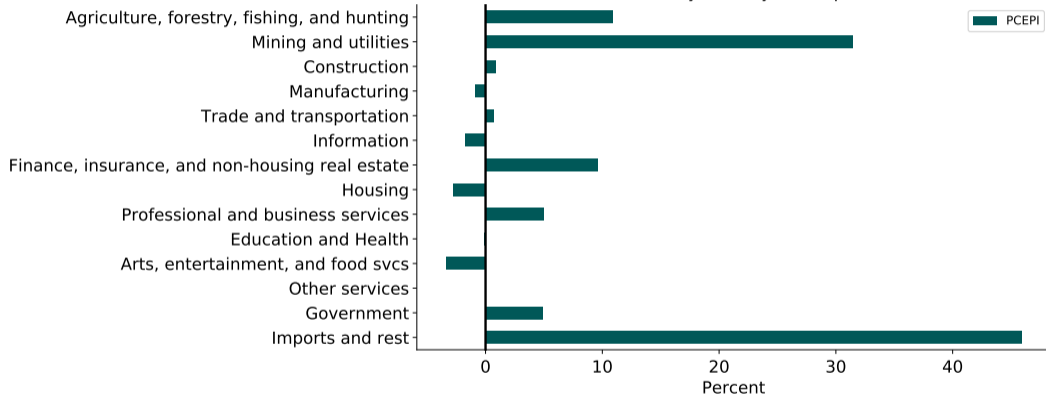

Source: BEA, BLS, and author's calculations

Trace inflation *fluctuations* to domestic and foreign origin
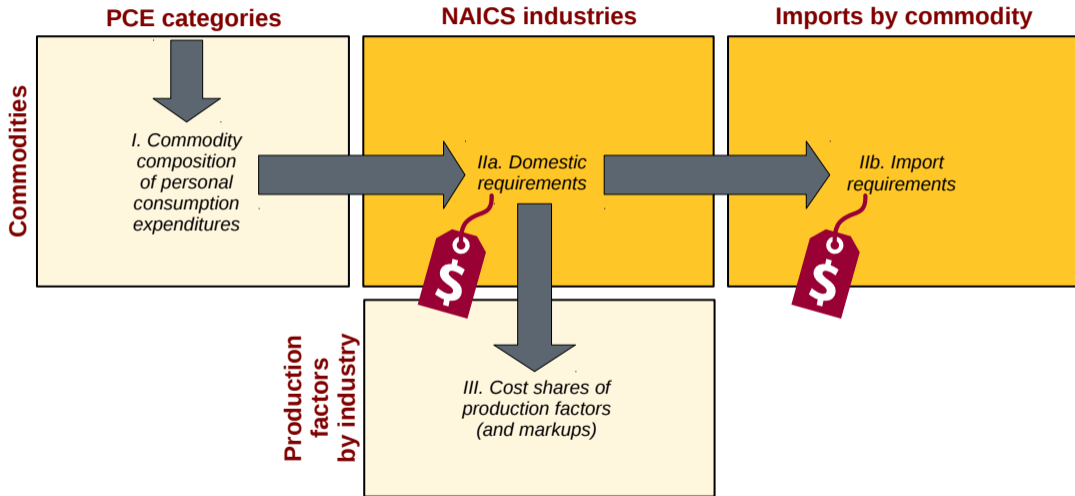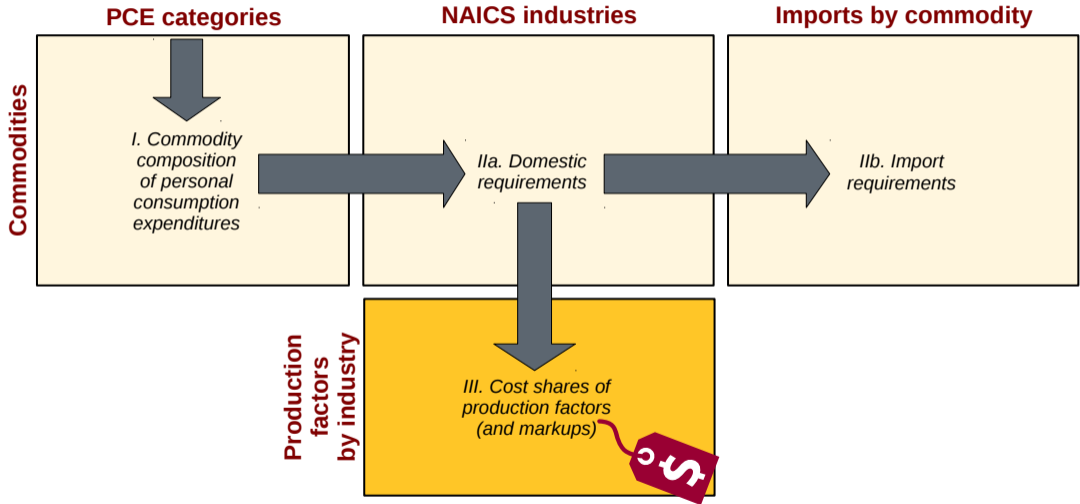
Variance decomposition of PCE inflation

Percent of variance of inflation by industry and imports: 1999-2015

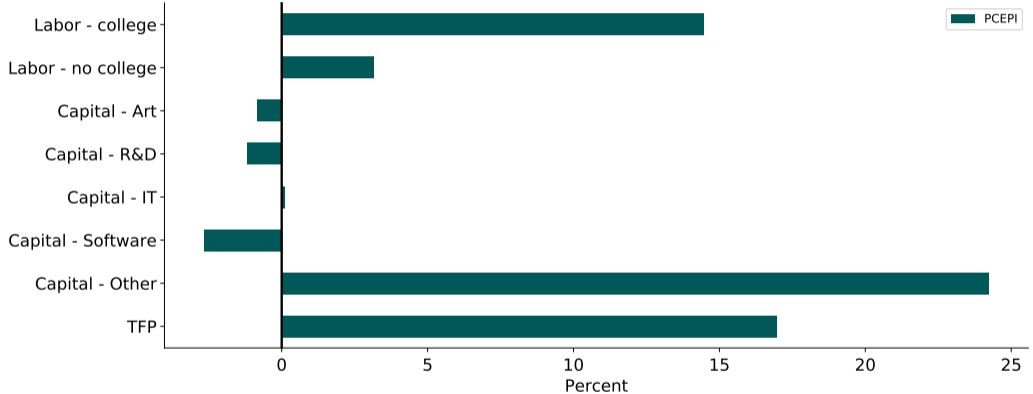Source: BEA, BLS, and author's calculations

Factor contributions to inflation *fluctuations*

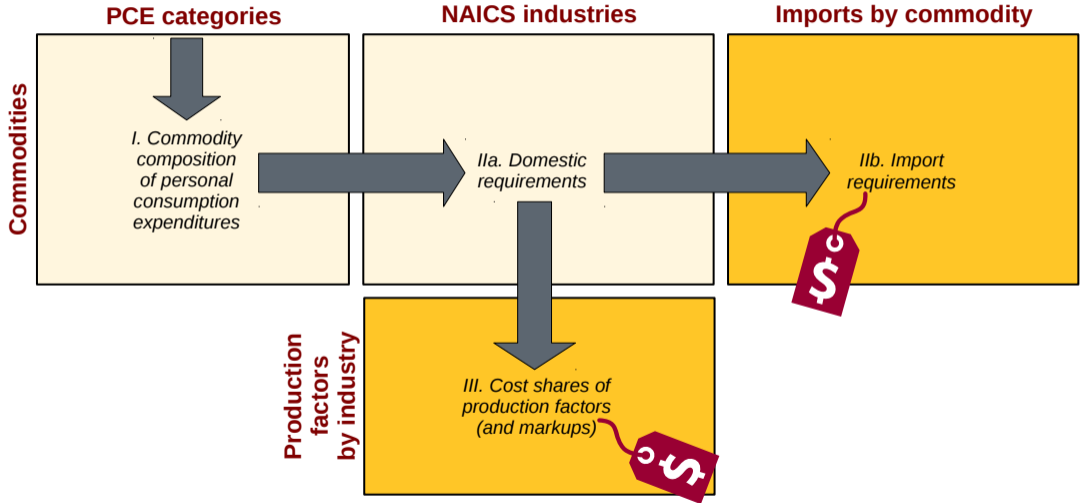## **Variance decomposition of PCE inflation**
Percent of variance of inflation by factor: 1999-2015

Source: BEA, BLS, and author's calculations

Total does not add to 100 because imports are omitted.

Factor contributions to *level of* inflation

PCE categories

NAICS industries

Imports by commodity

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Production factors by industry

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Factor contributions to PCE inflation

Contribution to annual PCE inflation by production factor, TFP, and imports: 1999-2015
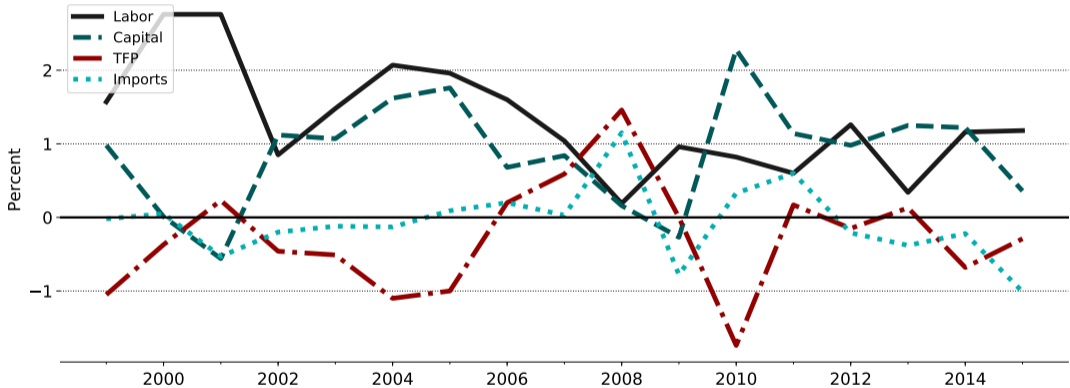
Source: BEA, BLS, and author's calculations
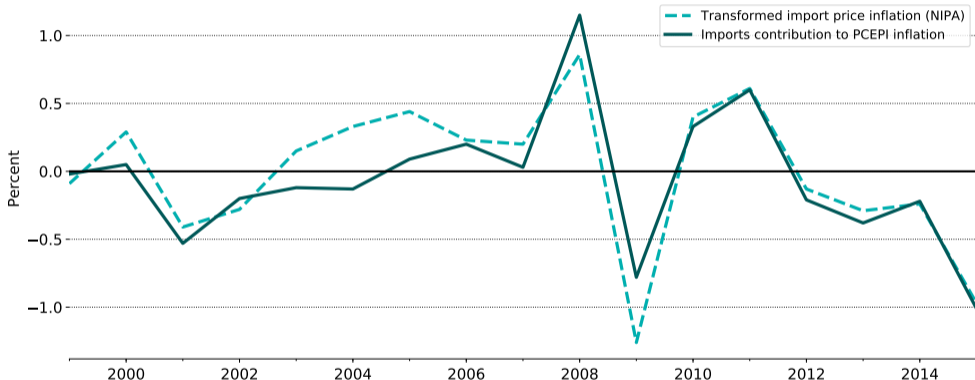
Real-time rule of thumb

Sources of inflation can be approximated
at higher frequency using real-time rule of thumb

Useful for analysis of inflation for policy purposes

Import contribution to PCE inflation and import price deflator

Annual observations; Contribution of imports to PCEPI inflation and transformed import price inflation (NIPA)

Source: Bureau of Economic Analysis and author's calculations

Transformed import price inflation is $0.1\pi_t^M - 0.15$, where π_t^M is annual inflation

in the implicit price deflator of imports of goods and services (NIPA, Table 4.2.4, line 26).

TFP contribution to PCE and TFP-C measure of Fernald

Annual growth rates of productivity contribution of TFP to PCEPI inflation and transformed TFP-C growth

Source: John Fernald (FRBSF, 2018) and author's calculations

Transformed TFP-C growth is $-0.5\Delta tfp_{c,t} - 0.25$, where $\Delta tfp_{c,t}$ is growth rate of TFP-C from Fernald (2012).

Labor contribution and quality adjusted compensation growth
Monthly and quarterly observations; 12-month and 4-quarter growth rates

Source: Bureau of Labor Statistics, Bureau of Economic Analysis, and author's calculations
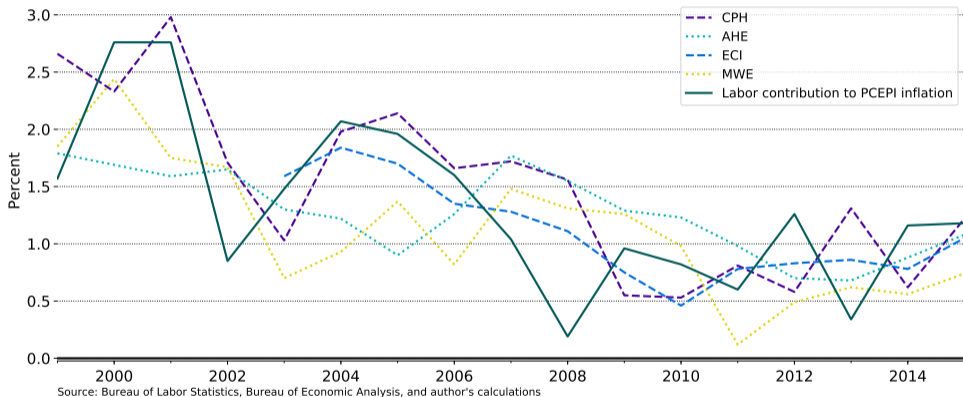
Quality adjusted compensation growth is $0.5\,(\Delta w_t - \Delta LQ_t)$, where Δw_t is annual growth rate of the respective compensation measure and ΔLQ_t is the growth rate of labor quality, based on Aaronson & Sullivan (2003), from Fernald (2012).

Extensions

Methodological:
Revisit growth accounting with
deviations from Neoclassical assumptions

Data:
Collect data for industry-accounts for broader set of countries

Room for improvement in supply-side accounting for inflation

Revisit growth accounting with deviations from Neoclassical assumptions

- Markup dynamics crucial for existence upward-sloping SRAS (NK Phillips curve)
- Markup fluctuations in mining/utilities important for inflation fluctuations
- Understanding nature of and reason for markups important

Collect data for industry-accounts for broader set of countries

- Recent vintage of World Input-Output Tables does not contain capital data

Stehrer *et al.* (2014)

- OECD STAN database, that contains Chile, is outdated

Conclusion

Think beyond demand-driven business cycle fluctuations
- Correlated demand and supply shocks erase output-inflation tradeoff
- Does not mean that there is no monetary transmission mechanism

Account for the supply-side factors that drive inflation
- U.S. PCE value chain barely changed in last 20 years
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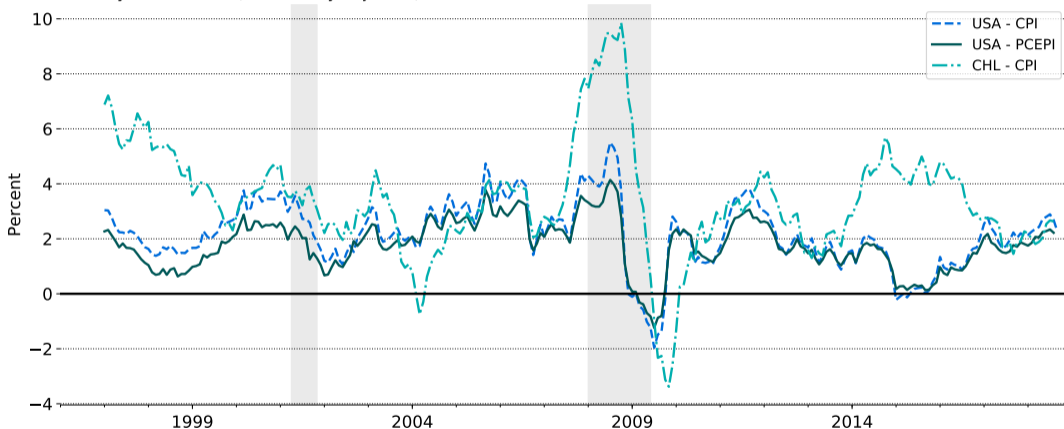
Extend supply-side analysis of inflation
- Beyond neoclassical growth-accounting assumptions and beyond U.S.

Country Inflation Rates
Monthly observations; seasonally adjusted; 12-month inflation rates

Source: Bureau of Labor Statistics, Bureau of Economic Analysis, and OECD

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