Lecture 3: Macroeconomic Aggregates
See Barro Ch. 2

Trevor Gallen

Question

▶ What are "macroeconomic aggregates" and why do we use them?

Motivation-I

- We want to know how *everyone* is doing

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  ► (With some loss!)

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  ▶ Maybe you put stock in happiness surveys (N.B.: A priori, this is a terrible idea from my perspective!)

---

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STEVENSON & WOLFERS, 2008

Figure 1
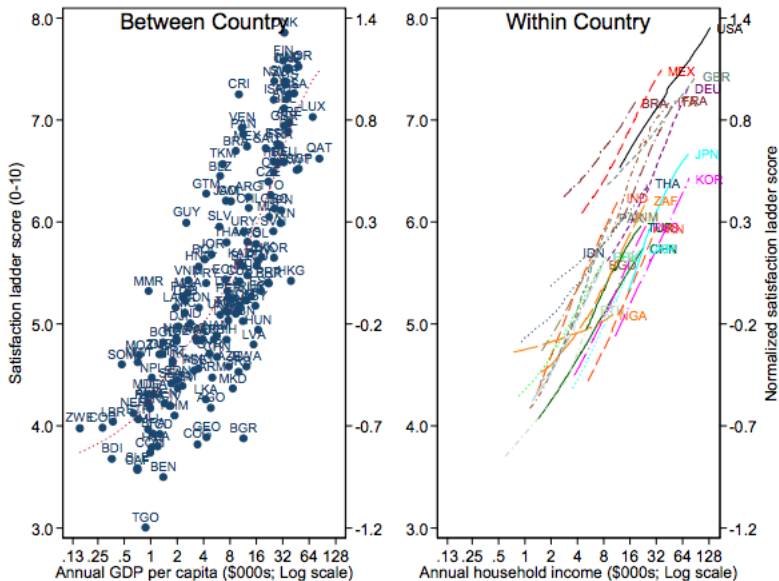
Nominal and Real GDP-I

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    ▶ Impute rental value of housing

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▶ If we're trying to add up everything produced, we need to use prices

▶ But prices change from year to year...aren't we comparing apples and oranges?

Example: Calculating Nominal GDP

▶ Take a set of N goods

$$\text{NomGDP}_t = \sum_{i=1}^{N} P_{i,t} Q_{i,t}$$

Year	$P_{a,t}$	$P_{b,t}$	$Q_{a,t}$	$Q_{b,t}$	$GDP_{a,t}$	$GDP_{b,t}$	GDP_t
2010	\$1	\$1	1	1	\$1	\$1	\$2
2011	\$1	\$2	1	0.4	\$1	\$0.8	\$1.8
2012	\$2	\$1	0.8	1	\$1.6	\$1	\$2.6
2013	\$2	\$2	1	1	\$2	\$2	\$4
2014	\$2	\$2	0.5	0.5	\$1	\$1	\$2
Eq.	·	·	·	·	$P_{a,t}Q_{a,t}$	$P_{b,t}Q_{b,t}$	$GDP_{a,t}$ $+GDP_{b,t}$

▶ Why is this troubling?
  ▶ Does 2010 $\rightarrow$ 2012 make sense?
  ▶ Does 2010 $\rightarrow$ 2013 make sense?
  ▶ Does 2010 $\rightarrow$ 2014 make sense?
▶ How do we fix it?

EXAMPLE: CALCULATING GDP IN CONSTANT DOLLARS-I

We'll use 2010 prices (denoted by a bar):

$$\text{RealGDP}_t = \sum_{i=1}^{N} \bar{P}_i Q_{i,t}$$

Year	$P_{a,t}$	$P_{b,t}$	$Q_{a,t}$	$Q_{b,t}$	$GDP_{a,t}$	$GDP_{b,t}$	GDP_t
2010	\$1	\$1	1	1	\$1	\$1	\$2
2011	·	·	1	0.4	\$1	\$0.4	\$1.4
2012	·	·	0.8	1	\$0.8	\$1	\$1.8
2013	·	·	1	1	\$1	\$1	\$2
2014	·	·	0.5	0.5	\$0.5	\$0.5	\$1
Eq.	·	·	·	·	$P_{a,2010}Q_{a,t}$	$P_{b,2010}Q_{b,t}$	$GDP_{a,t}$ $+GDP_{b,t}$

▶ Does 2010 → 2012 make sense now?
▶ Does 2010 → 2013 make sense now?
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EXAMPLE: CALCULATING GDP IN CONSTANT DOLLARS-II

Or use 2014 prices:

Year	$P_{a,t}$	$P_{b,t}$	$Q_{a,t}$	$Q_{b,t}$	$GDP_{a,t}$	$GDP_{b,t}$	GDP_t
2010	·	·	1	1	$2	$2	$4
2011	·	·	1	0.4	$2	$0.8	$2.4
2012	·	·	0.8	1	$1.6	$2	$3.6
2013	·	·	1	1	$2	$2	$4
2014	$2	$2	0.5	0.5	$1	$1	$2
Eq.	·	·	·	·	$P_{a,2014}Q_{a,t}$	$P_{b,2014}Q_{b,t}$	$GDP_{a,t}$ $+GDP_{b,t}$

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▶ We can improve on this with chain-weighted GDP

    1. Get average price between two years for each good:
$$\bar{P}_a = \frac{P_{a,t} + P_{a,t+1}}{2}, \ \bar{P}_b = \frac{P_{b,t} + P_{b,t+1}}{2}$$

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   2. Find the new GDP component for each good: $Q_{a,t}\bar{P}_a + Q_{b,t}\bar{P}_b$
      and $Q_{a,t+1}\bar{P}_a + Q_{b,t+1}\bar{P}_b$

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    3. Find the percentage difference between the two:
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CHAIN-WEIGHTED GDP

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▶ Note: this is slightly simpler than what we actually do. See online notes for details.

Example: Chain-Weighted GDP

Year	$P_{a,t}$	$P_{b,t}$	$Q_{a,t}$	$Q_{b,t}$	$\frac{GDP_t}{GDP_{t-1}}$	GDP_t
2010	\$1	\$1	1	1	·	100
2011	\$1	\$2	1	0.4	0.64	64
2012	\$2	\$1	0.8	1	1.29	82.6
2013	\$2	\$2	1	1	1.13	93.3
2014	\$2	\$2	0.5	0.5	0.5	46

▶ We now have the relative change in GDP between each period.

▶ Chain them together and choose an arbitrary starting point

Measuring GDP

▶ GDP is measured three different ways

▶ First, recall that every dollar spent is a dollar "earned"

    ▶ All goods purchased by households ("expenditure")

    ▶ All goods produced by firms ("value added")

    ▶ All income earned by entities ("income")

▶ All three should add up to the same thing

Measuring GDP: Expenditure

$$Y = C + I + G + X - Im$$

- ▶ Consumption-purchases for consumption by HH's
  - ▶ Nondurable goods
  - ▶ Durable goods
- ▶ Investment-purchases of new capital goods by businesses (not financial instruments!)
- ▶ Government expenditure and gross investment-government purchases and "investment"
  - ▶ Does include expenditures of all levels of government!
  - ▶ Does *not* include all government *spending*!
- ▶ Net Exports-Value of what we send out minus what we bring in
- ▶ Note that things fall apart, depreciate: net domestic product, $NDP = GDP - $depreciation.

Measuring GDP: Income Approach

▶ Rather than measuring final good consumption, could measure income

▶ For every dollar paid in for the final good, one is paid out

▶ In the end, all payments go to compensation of employees, proprietors, capital, or taxes: add it all up by recipient

Measuring GDP: Value-Added Approach

▶ Income approach measured income by group

▶ We could instead measure net income by sector/firm

▶ In the end, firm gets the difference between what you sold it for and the raw goods you purchased (the value added)

GDP, GDI, Value-Added

Table: Corn and Cornbread's Contribution to GDP

Step	Input Cost	Gross Revenue	Net Revenue
Farmer→Miller	$0	$0.10	$0.10
Miller→Baker	$0.10	$1	$0.90
Baker→Supermarket	$1	$10	$9
Supermarket→ Household	$10	*$11*	$1

$$\underbrace{C + I + G + X - M}_{\textit{Outflows}} = Y = \underbrace{wL + \pi + rK + T}_{\textit{Inflows}}$$

FAILURES OF GDP

▶ What are some failures of GDP?

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  - No measures of distribution

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- Nevertheless, it seems to be quite important and correlates with things we think are correlated with welfare (health, mental health, happiness, mortality)

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▶ Nevertheless, it seems to be quite important and correlates with things we think are correlated with welfare (health, mental health, happiness, mortality)

  ▶ Recall our previous discussion of causality!

ASIDE ON EXPONENTIAL GROWTH-I

▶ Let's say something is continuously exponentially growing:

$$Y_t = \bar{Y} \exp(\gamma t)$$

Then:

$$
\begin{aligned}
Y_t &= \bar{Y} \exp(\gamma t) \\
\log(Y_t) &= \log(\bar{Y} \exp(\gamma t)) \\
&= \log(\bar{Y}) + \log(\exp(\gamma t)) \\
&= \log(\bar{Y}) + \quad \gamma \quad \cdot \quad t
\end{aligned}
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▶ So logging an exponential object with growth rate ("frequency" γ) turns it into a linear function with slope γ.

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▶ So logging an exponential object with growth rate
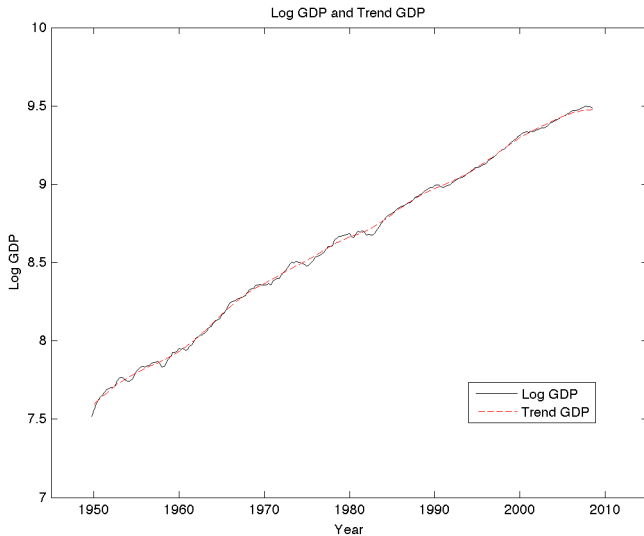("frequency" γ) turns it into a linear function with slope γ.

ASIDE ON EXPONENTIAL GROWTH-II

▶ Let's say something is discretely exponentially growing:

$$Y_t = Y_{t-1}(1 + \gamma)$$

Then:

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\begin{aligned}
Y_t &= Y_{t-1}(1 + \gamma) \\
&= Y_{t-2}(1 + \gamma)(1 + \gamma) \\
&= Y_{t-2}(1 + \gamma)^2 \\
&= Y_0(1 + \gamma)^t \\
\log(Y_t) &= \log(Y_0(1 + \gamma)^t) \\
&= \log(Y_0) + \log((1 + \gamma)^t) \\
&= \log(Y_0) + t\log((1 + \gamma)) \\
&\approx \log(Y_0) + \quad \gamma \quad \cdot \quad t
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ASIDE ON EXPONENTIAL GROWTH-III

▶ For those of you who are dubious, recall that when x is small, $1 + x$ is near 1.

▶ When log is evaluated near 1, it's nearly linear

▶ You can see the same thing from a first-order taylor expansion
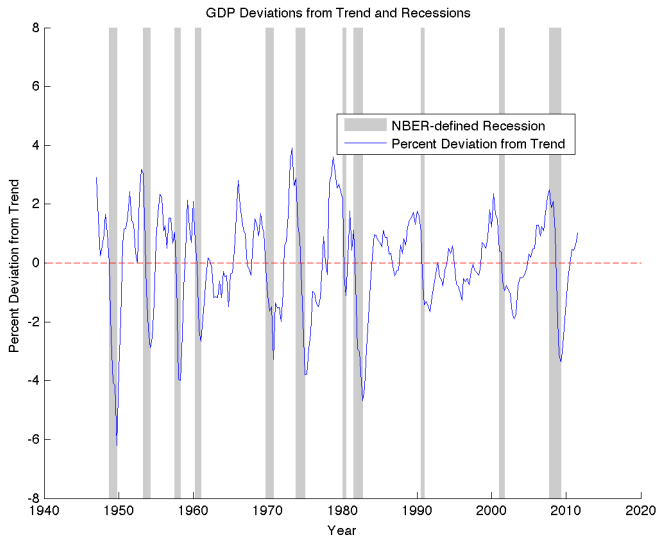
U.S. GDP over Time: Historical Yearly Series

U.S. Production over Time
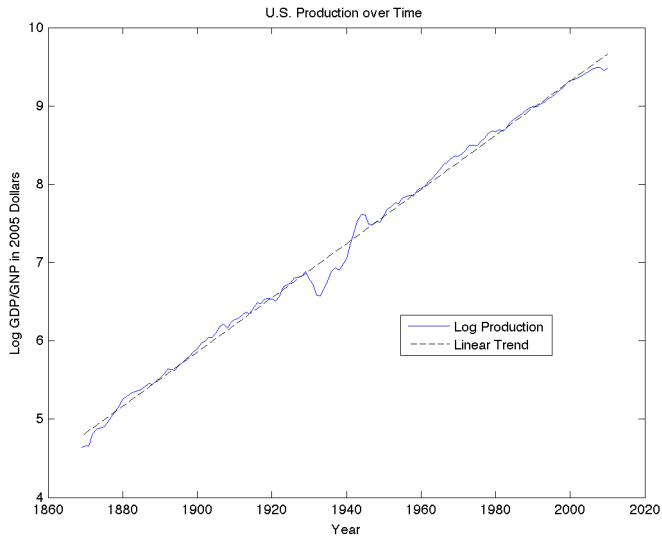
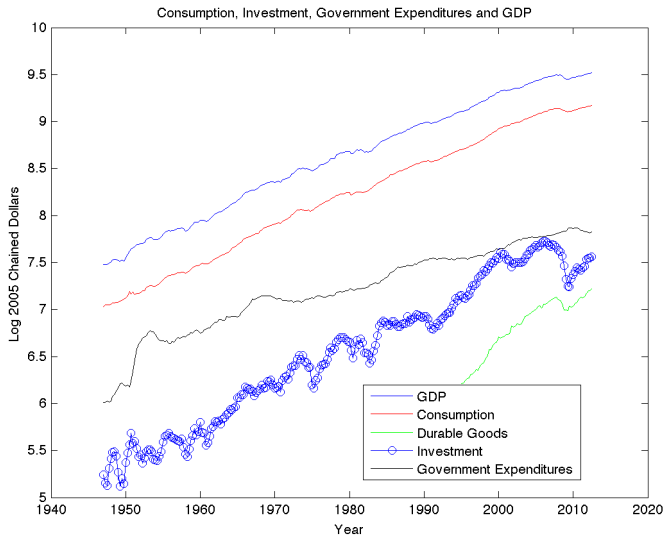# U.S. GDP over Time: NIPA Quarterly
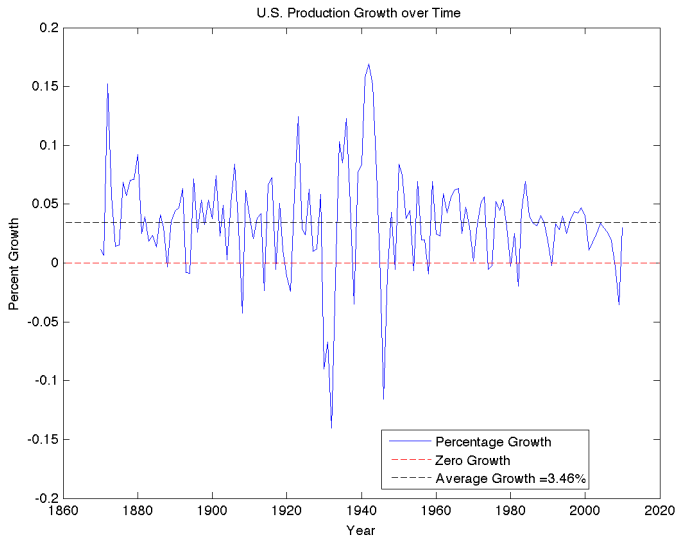
Log GDP and Trend GDP

U.S. GDP over Time: Growth Rate (Quarterly)

U.S. Production Growth over Time

U.S. GDP over Time: Growth Rate (Quarterly)

GDP Deviations from Trend and Recessions

COMPONENTS OF U.S. GDP OVER TIME

Consumption, Investment, Government Expenditures and GDP

COMPONENTS OF U.S. GDP OVER TIME

Fractions of GDP by Category
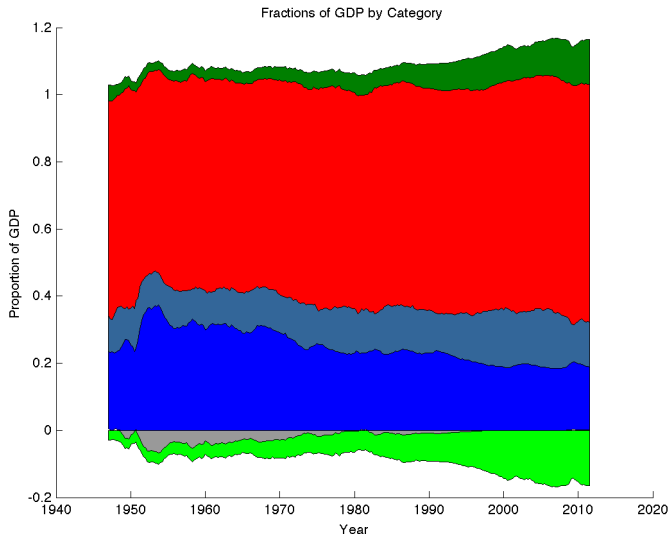
Can you figure out which color is what category?

Components of U.S. GDP over Time: Legend

▶ Red is consumption: it's the biggest and is quite smooth

▶ Gray-blue is investment, and is quite volatile for its size

▶ Light blue is government consumption and investment...note the trend

▶ Light green is imports, they weren't produced in U.S. but were consumed so we take them out

▶ Dark green is exports, they were produced in U.S. but weren't consumed, so we keep them in

▶ Dark gray is a statistical error

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- ▶ Light blue is government consumption and investment...note the trend (?)

- ▶ Light green is imports, they weren't produced in U.S. but were consumed so we take them out

- ▶ Dark green is exports, they were produced in U.S. but weren't consumed, so we keep them in

- ▶ Dark gray is a statistical error

INFLATION

- ▶ Inflation is measured by a basket of goods

- ▶ It's the flipside of the nominal vs. real GDP discussion above

- ▶ We have a few baskets to care about:

    - ▶ Basket of goods and services produced domestically: GDP Deflator

    - ▶ Basket of goods and services consumed by households: Consumer Price Index

    - ▶ Basket of goods consumed by "producers" (no services, primarily raw materials and intermediate goods): Producer Price Index

- ▶ Let's see what they look like

Misstated Inflation

▶ It is generally accepted by economists that inflation is misstated

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▶ Gallen's Theorem: Stated inflation *must* be too high, because Social Security is indexed to it.

▶ Proof by contradiction: I could find no photos of old people rioting in the streets

MISSTATED INFLATION

- ▶ The BLS makes its price data available to researchers, rougher data to public

Misstated Inflation

▶ The BLS makes its price data available to researchers, rougher data to public

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▶ General result: in U.S. it's all fairly similar, some say it overstates, some it understates

Misstated Inflation

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▶ General result: in U.S. it's all fairly similar, some say it overstates, some it understates

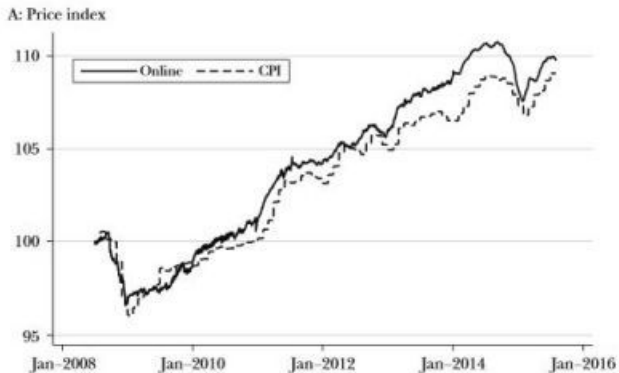▶ In some instances, inflation is misstated by about 15% per year (??)

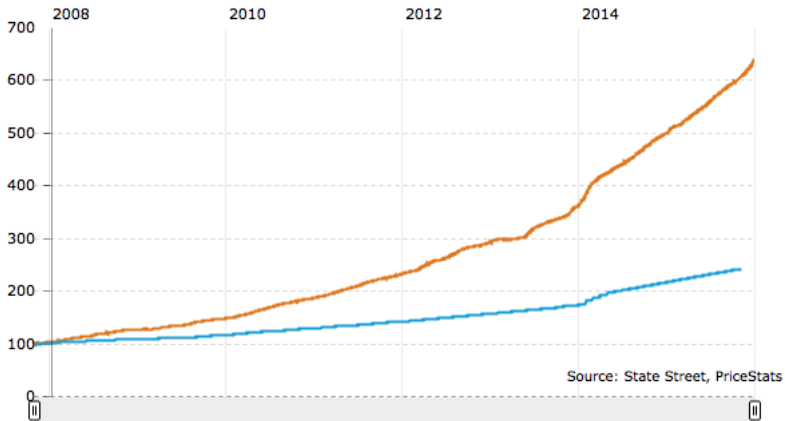# Misstated Inflation

DAILY ONLINE PRICE INDEX

Source: BPP - PriceStats - State Street
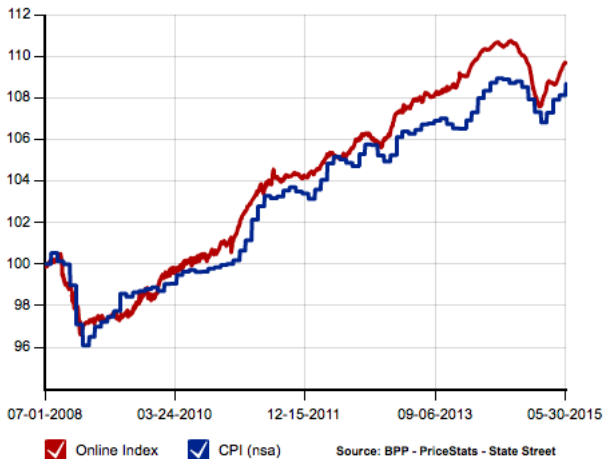
Misstated Inflation

Figure 2
United States

A: Price index

MISSTATED INFLATION

ARGENTINA AGGREGATE INFLATION SERIES
DAILY VALUE (DECEMBER '07 - PRESENT)

Source: State Street, PriceStats

MISSTATED INFLATION

ARGENTINA AGGREGATE INFLATION SERIES
ANNUAL RATE (DECEMBER '07 - PRESENT)

Source: State Street, PriceStats
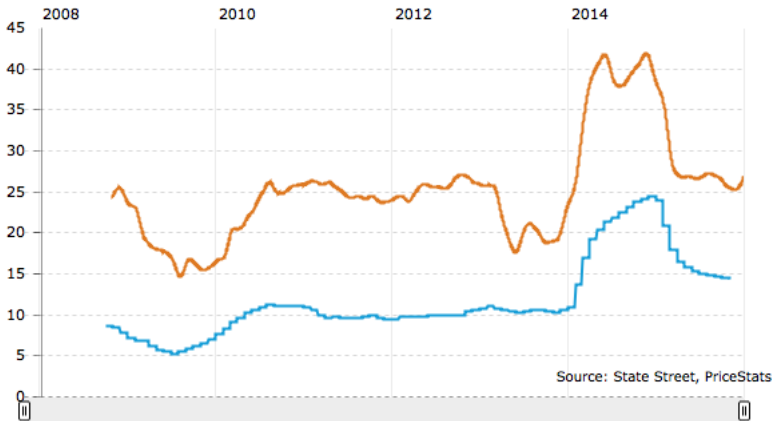
Unemployment

- ▶ U-1: persons unemployed 15 weeks or longer, as a percent of the civilian labor force
- ▶ U-2: job losers and persons who completed temporary jobs, as a percent of the civilian labor force
- ▶ U-3: total unemployed, as a percent of the civilian labor force
- ▶ U-4: total unemployed plus discouraged workers, as a percent of the civilian labor force plus discouraged workers
- ▶ U-5: total unemployed, plus discouraged workers, plus all other marginally attached workers, as a percent of the civilian labor force plus all marginally attached workers
- ▶ U-6: total unemployed, plus all marginally attached workers, plus total employed part time for economic reasons, as a percent of the civilian labor force plus all marginally attached workers

UNEMPLOYMENT RATES

Measures of Utilization
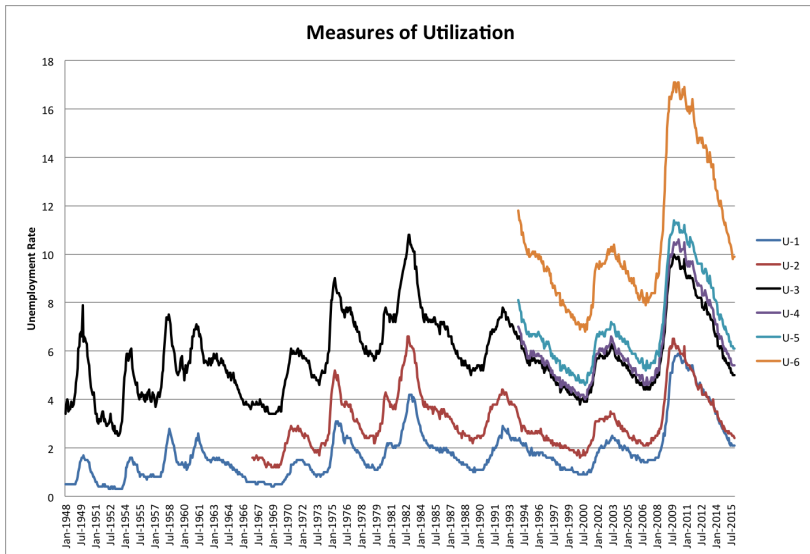
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