

Interpreting Data: How to Make Sense of the Numbers

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Apologies Upfront

- Please excuse me if what I am about to tell you is either obvious or of no use.
- I've made all sorts of mistakes in understanding my audience.
- I will try to provide a few lessons in how data can be used and misused.

Outline

- Data Revisions
- Data Transformations
 - Real and nominal variables
 - *Stationary* variables
 - Differencing, trends, scaling
- Consequences of *nonstationarity*
 - No useful information
 - Spurious correlations
- Correlation is not causality
 - The Fed does not cause Christmas
 - Remember the Lucas critique

Data Revisions

“If we could first know where we are and whither we are tending, we could better judge what to do and how to do it.”

-- President Abraham Lincoln.

“Where am I and what am I doing here?”

-- Vice Presidential Candidate James Stockdale, 1992

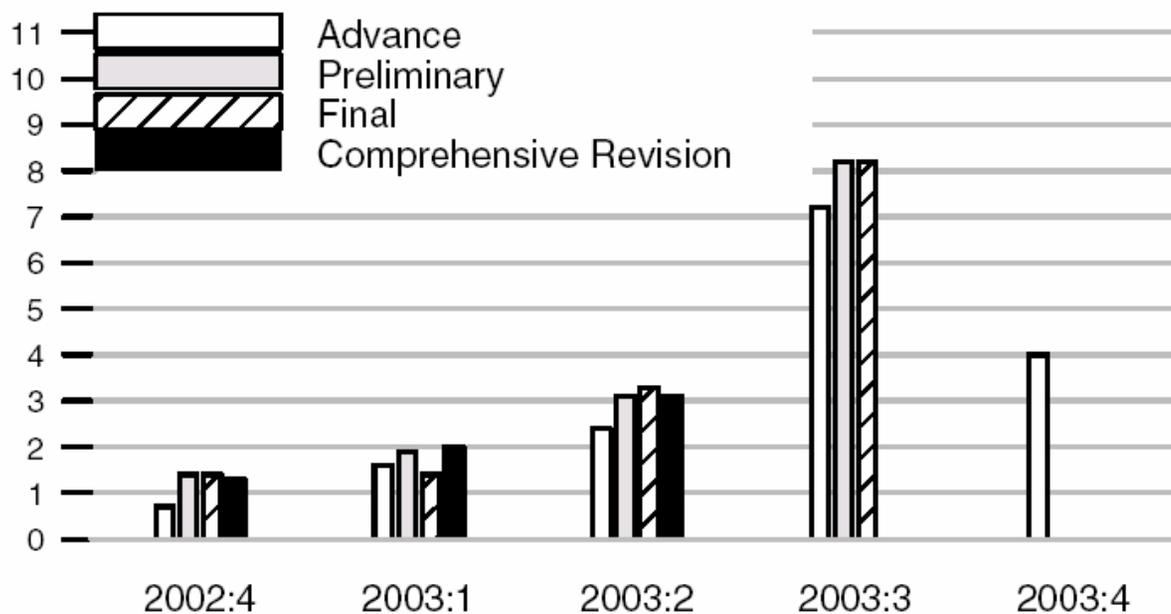
- Many macro data series (e.g., GDP) are revised several times.**
- This source of uncertainty was largely ignored until fairly recently.**

Data Revisions

How big are the revisions to GDP?

Real GDP Revisions

Compounded annual rates of change



Data Revisions

How big are the revisions to GDP?

- Advance numbers are within 1.5 % of the final estimates.
- Preliminary numbers are within 0.8 % of the final estimates.
- Advance, preliminary and final numbers are within about 3.6 % of the latest estimates.

		MEAN	STDDEV	MEANABS
FINAL-	ADVANCE	0.16	0.74	0.60
FINAL-	PRELIM	0.03	0.40	0.31
LATEST-	ADVANCE	0.56	1.84	1.41
LATEST-	PRELIM	0.43	1.72	1.33
LATEST-	FINAL	0.40	1.78	1.37

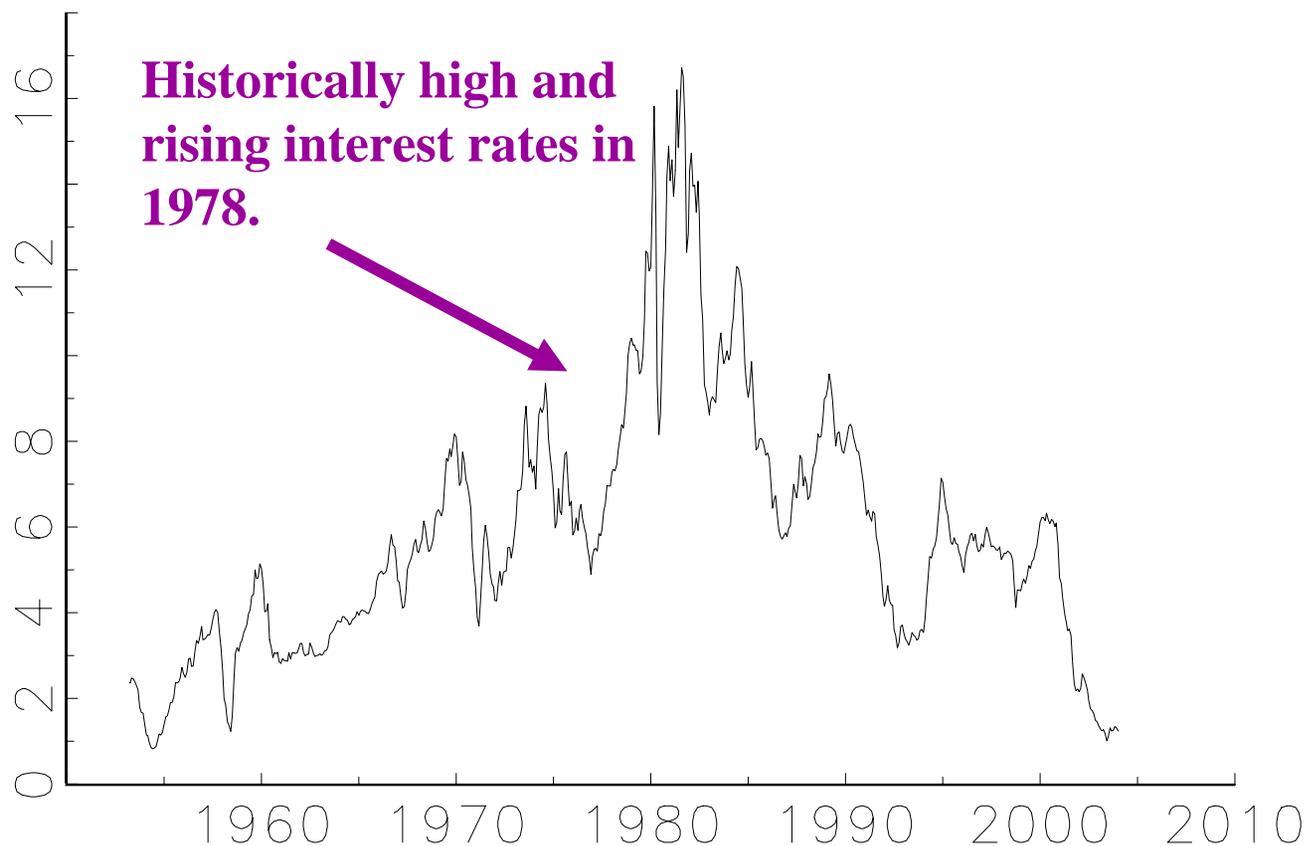
Data Transformations

- **Real versus nominal variables**
 - Decisions are based on real variables, not nominal variables.
 - We are usually more interested in real variables.
 - Do nominal interest rates measure the stance of monetary policy?
 - Was monetary policy tight or easy in 1978?

Real versus Nominal Data

- Was monetary policy tight or easy in 1978?

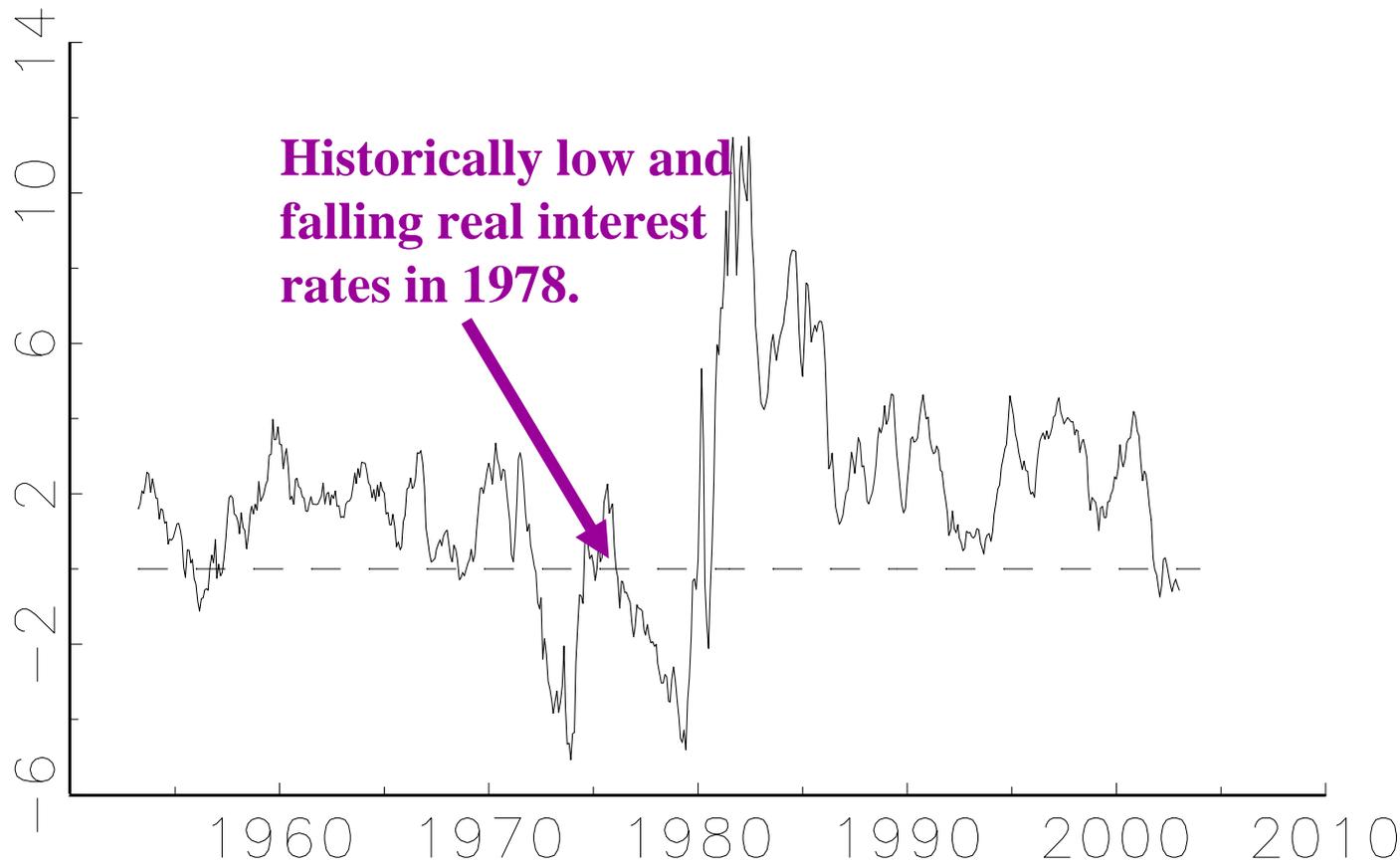
One-year Treasury Yield (Constant Maturity)



Real versus Nominal Data

- Was monetary policy tight or easy in 1978?

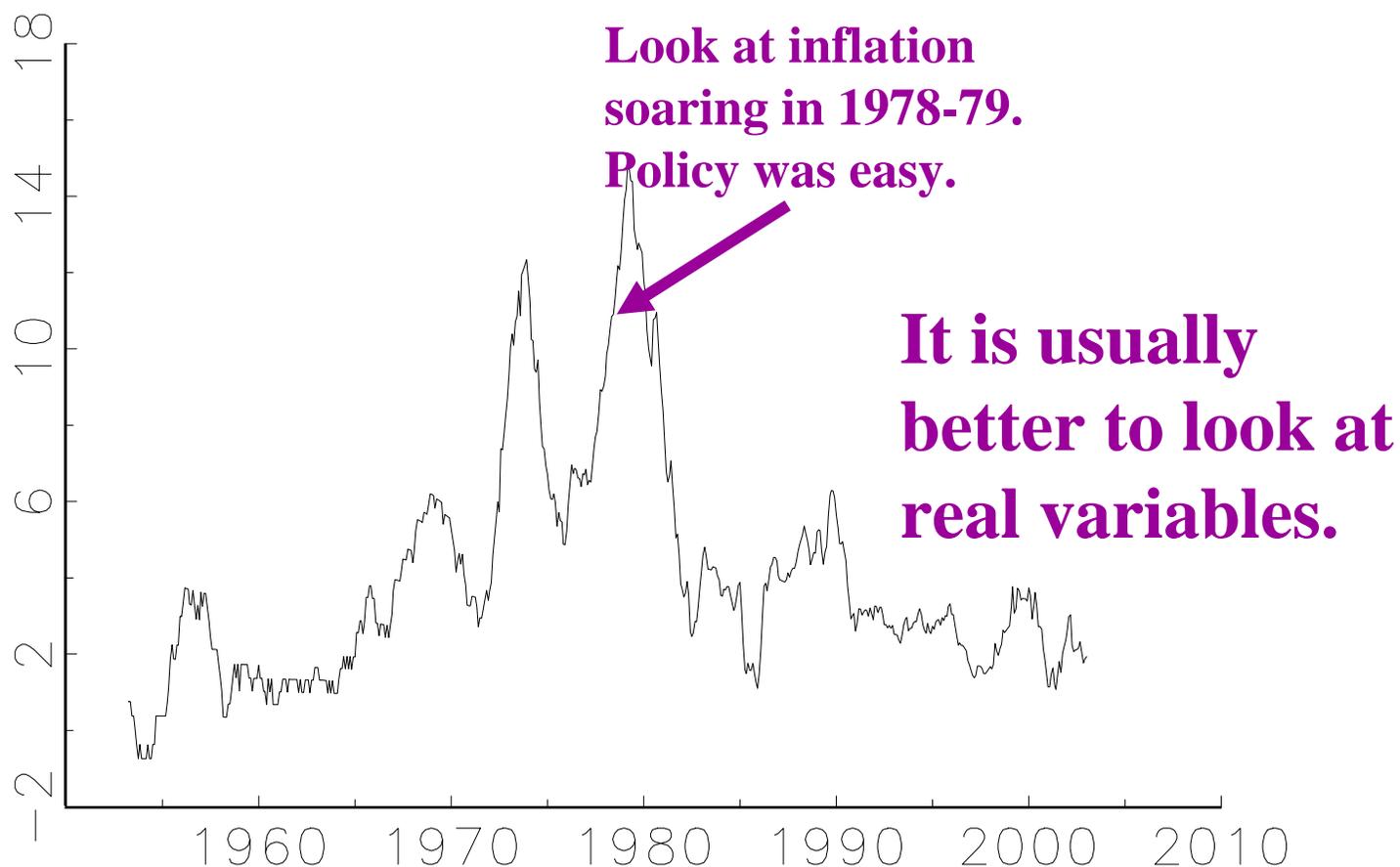
Ex Post One-year
Real Treasury Yield



Real versus Nominal Data

- Was monetary policy tight or easy in 1978?

Annual Forward-Looking Inflation



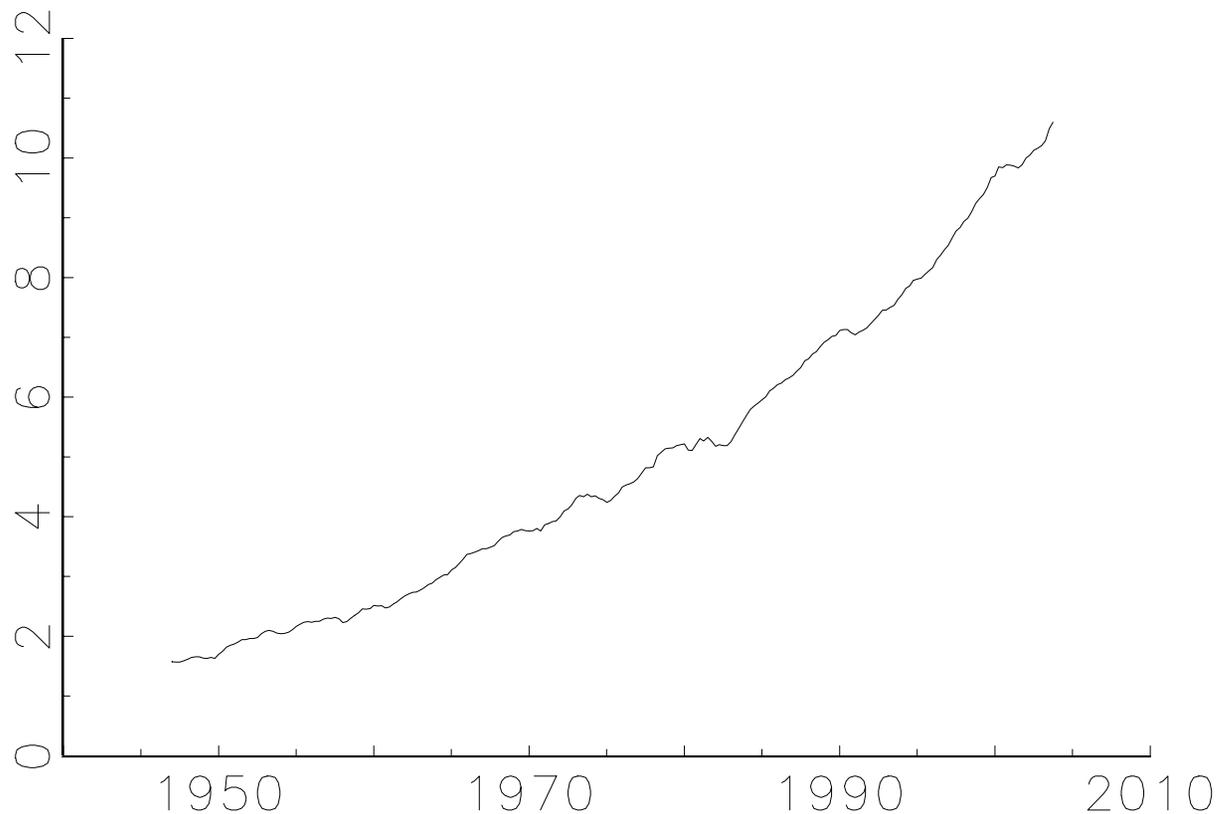
Data Transformations

- *Stationarity*
 - A variable has the same conditional behavior at different points in time.
 - For example it has a constant unconditional mean.
 - What rules out stationarity?
 - For example, a variable that tends to wander off to positive or negative infinity like the price level.
 - Why do we want stationarity?
 - We want to compare the present to the past or predict the future.

Data Transformations

- Real GDP is *nonstationary*.
 - It wanders around, rising over time; it does not have a constant mean.

Real U.S. GDP in Trillions of 2000 Dollars



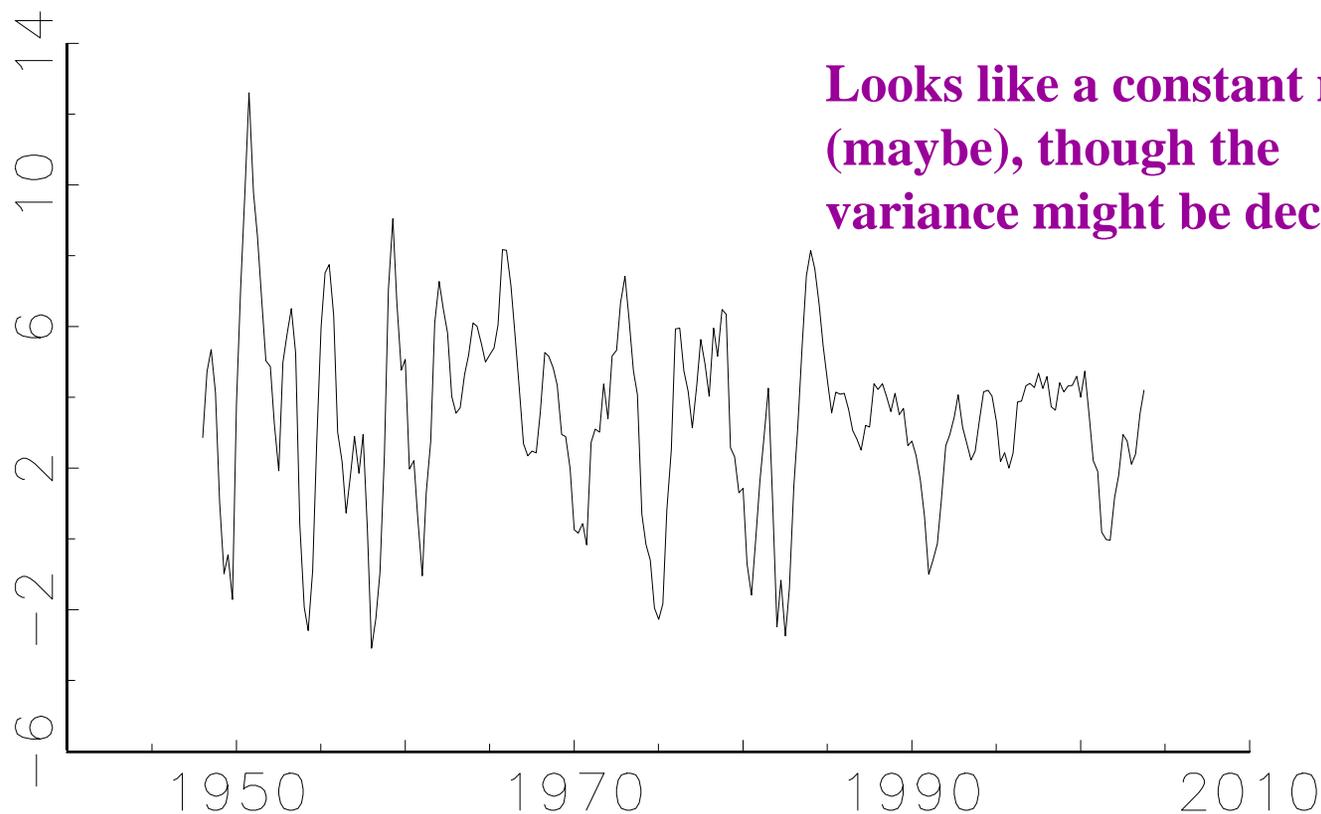
Data Transformations

- If we want to say something sensible about real GDP or to predict it, we need to transform it to be stationary.
 - I'll get back to this point later.
- How to achieve stationarity?
 - Are log differences stationary?
 - Does the variable revert to a trend?
 - Scale the variable by a related variable.

Data Transformations

- Are log real GDP differences stationary?

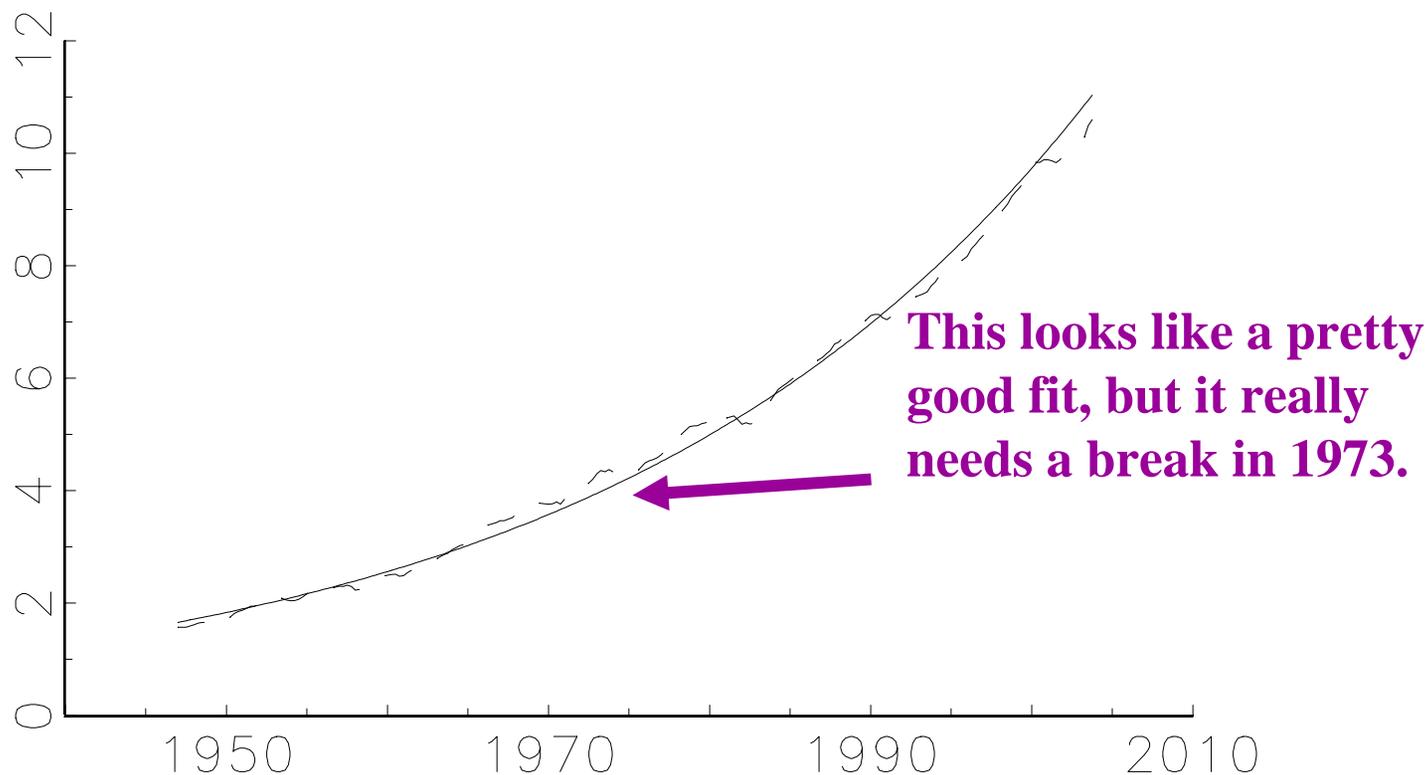
Percentage Annualized 4Q Changes in
Real U.S. GDP in Trillions of 2000 Dollars



Data Transformations

- Are deviations from an exponential trend stationary?

Real U.S. GDP in Trillions of 2000 Dollars
Around an Exponential Time Trend



Data Transformations

- Are deviations from an exponential trend stationary?

Percentage Deviations of Real U.S. GDP
Around an Exponential Time Trend



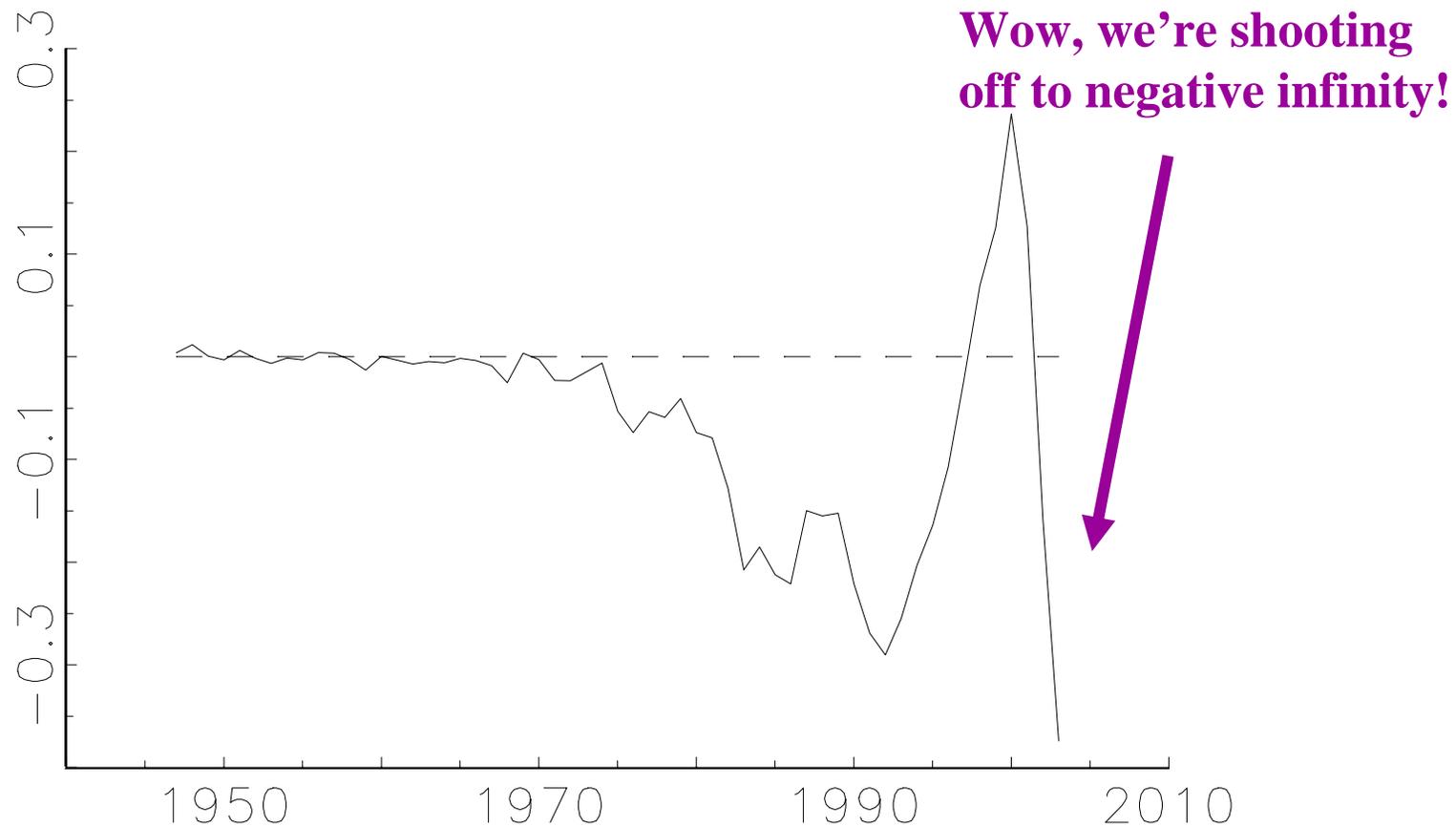
Consequences of Bad Data Transformations

- **Statements about the data aren't meaningful.**
 - “The largest budget deficit in history.”
 - “Record stock prices...”
- **Correlations could be spurious.**
 - Even “real” correlations can create misleading policy advice.

Consequences of Bad Data Transformations

“The largest budget deficit in history.”

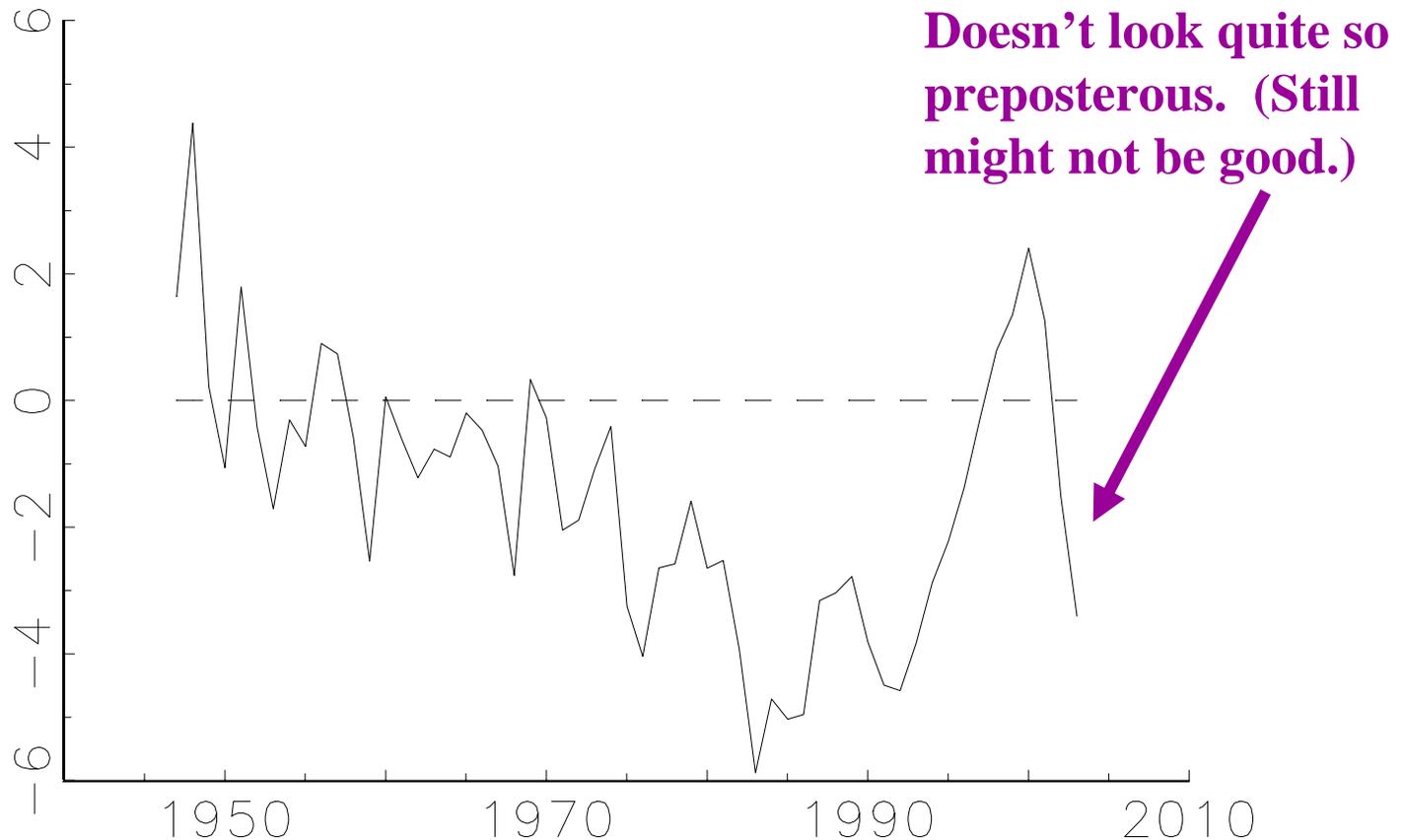
U.S. Federal Deficit in Trillions of Dollars



A Good Transformation: Scale by GDP

Why scale budget deficits by GDP instead of the price level or something else?

U.S. Federal Deficit as a percentage of GDP



Consequences of Bad Transformations

“Record stock prices!”

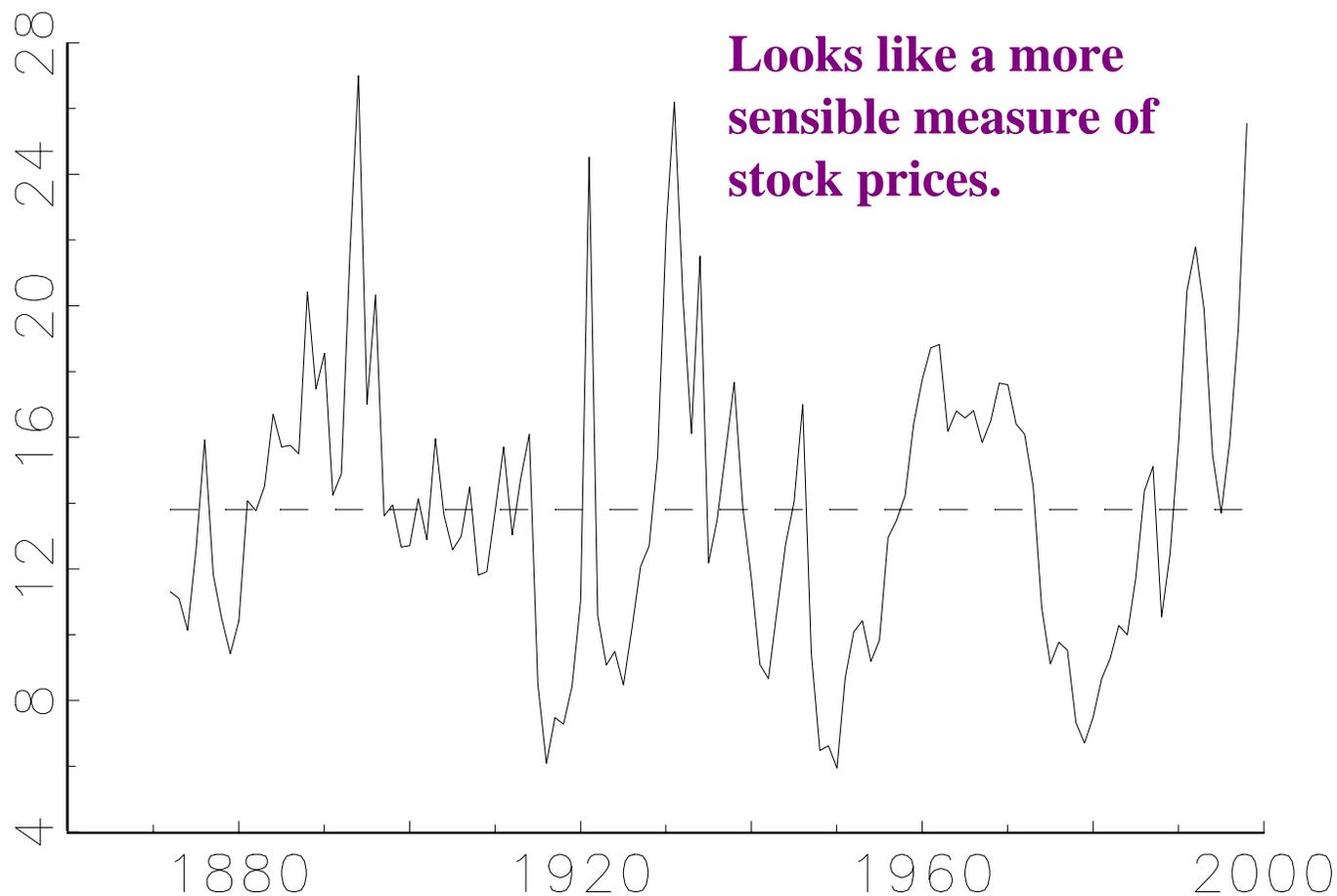
S&P 500 Index: January 1928–1995



A Better Transformation

- Why scale by earnings?

S&P 500 P/E ratio 1872–1998

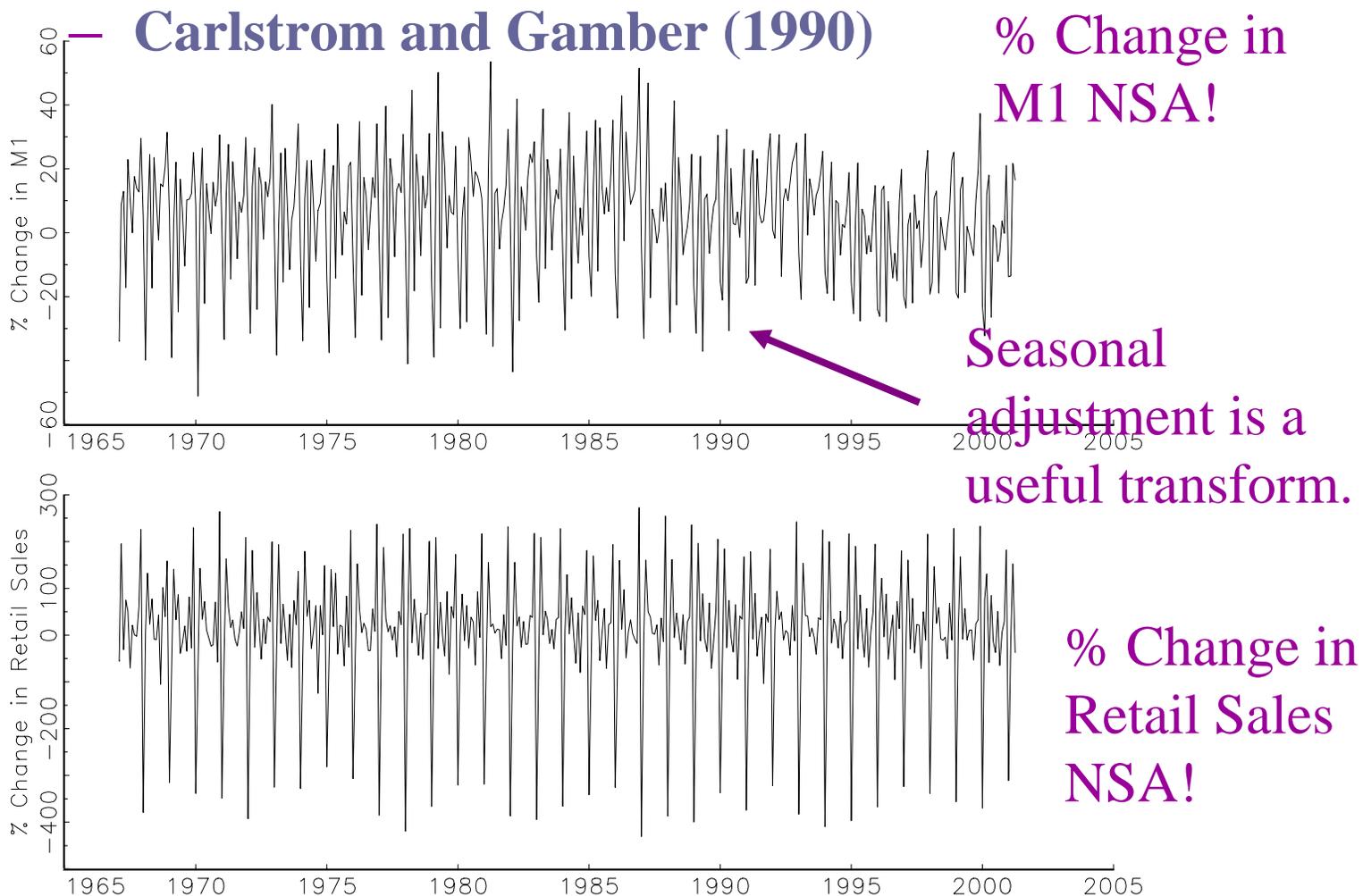


Correlation is not causality

- One can't figure out economic relations from correlations or regressions without assumptions about how the economy works.
 - The Fed does not cause Christmas.
 - Apologies to Charles T. Carlstrom and Edward N. Gamber (1990) from whom I stole this example.
- In general, all correlations will change when the structure of the economy changes.
 - What if the NFL eliminates 4rth down?
 - This is called the “Lucas Critique.”

Correlation is not causality

- The Fed does not cause Christmas.

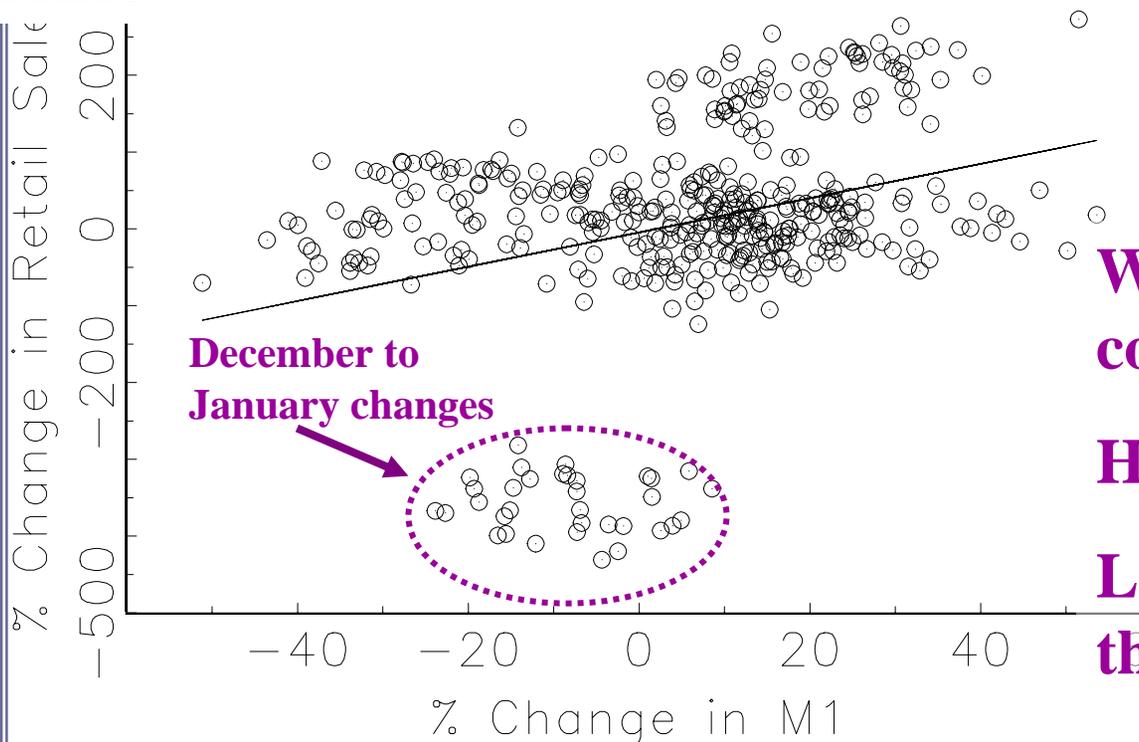


Correlation is not causality

- What if we regress monthly changes in retail sales on changes in M1? (Both NSA.)

This is obviously an example of bad inference.

Does the Fed Cause Xmas?



	Coeffs	t stats
b0	-4.7	-0.7
b1	2.2	6.7
R²	0.098	

We get significant coefficients!

Hooray!

Let's send it off to the AER.

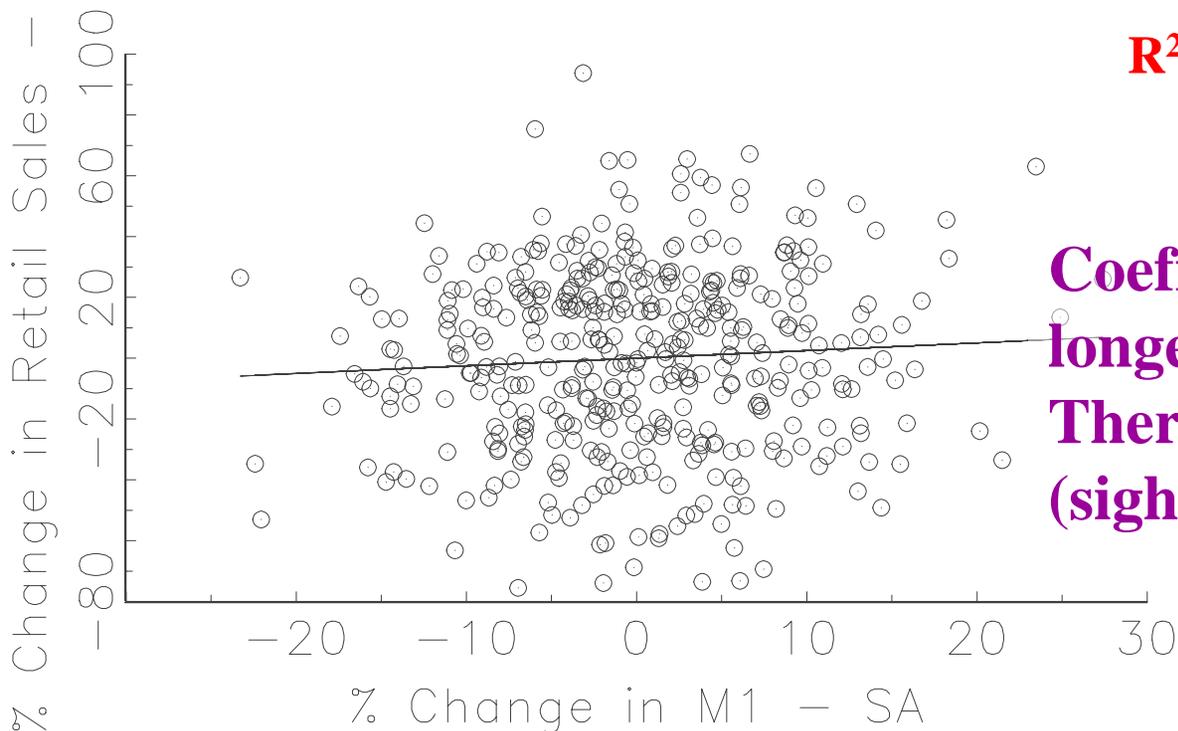
Correlation is not causality

- What if we used deseasonalized M1 and sales data?

This is still not good inference.

Does the Fed Cause Xmas?
Seasonally Adjusted Data

	Coeffs	t stats
b1	0.25	1.36
R²	0.005	



**Coefficients are no longer significant.
There goes tenure.
(sigh...)**

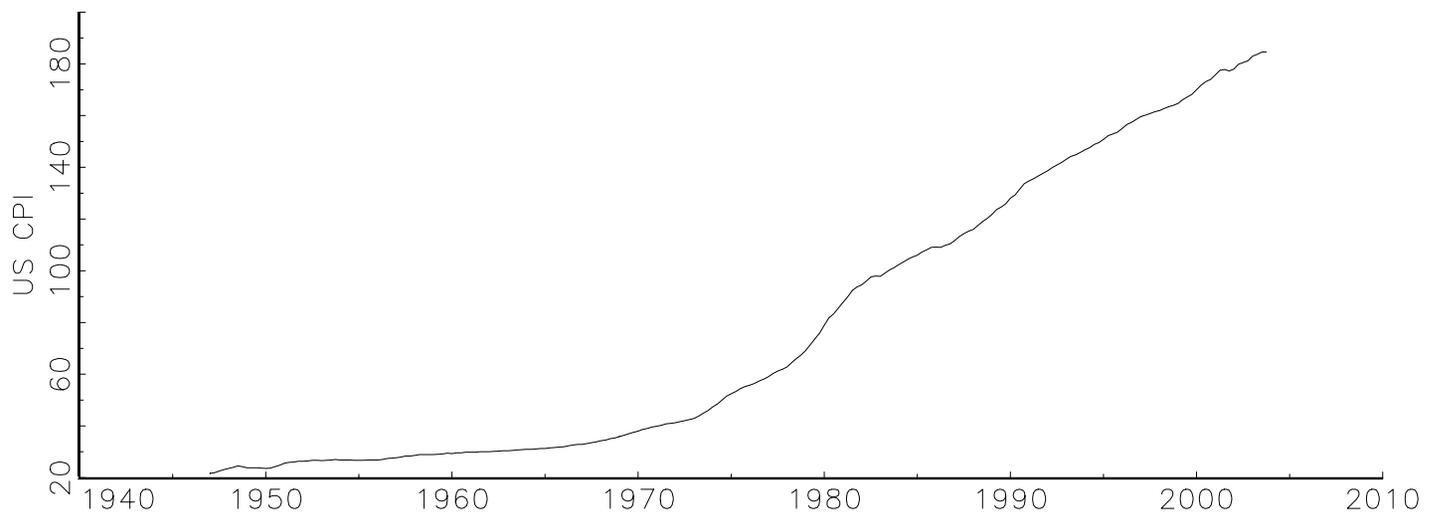
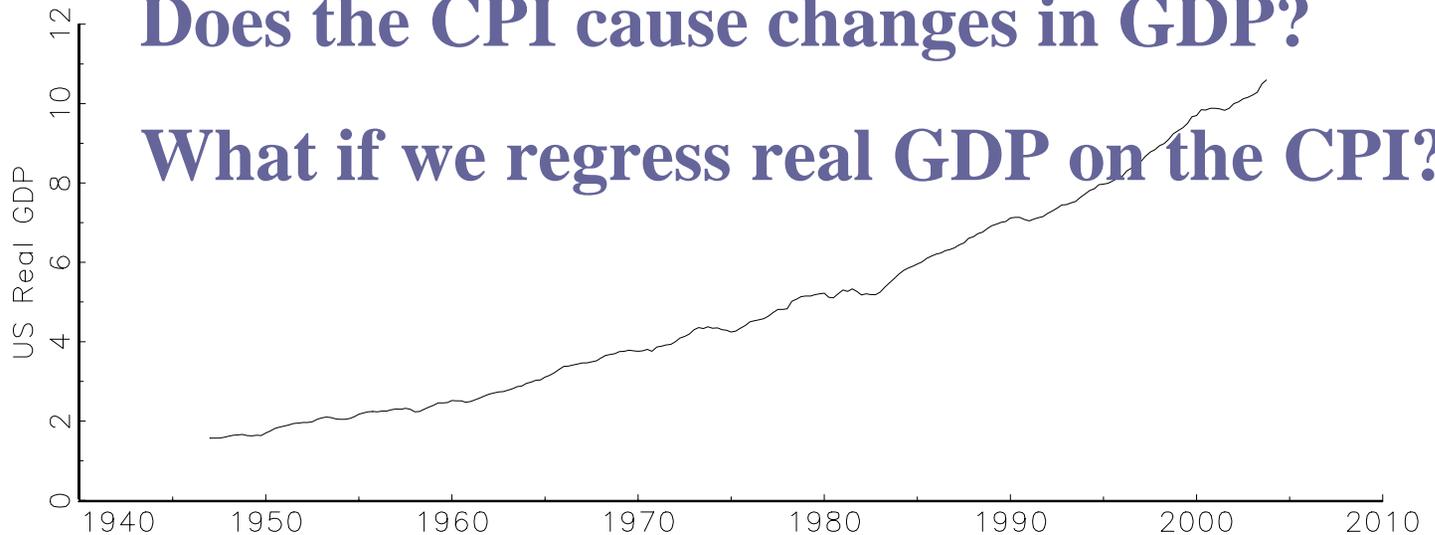
Consequences of Bad Data Transformations

- **Correlations could be spurious.**
- **Regressions assume that both variables have a constant unconditional mean.**
- **If you regress 2 independent variables that don't have means on each other, you can get spurious results.**
- **Does the price level increase GDP?**
 - **Let's run a regression to see!**

Consequences of Bad Data Transformations

Does the CPI cause changes in GDP?

What if we regress real GDP on the CPI?

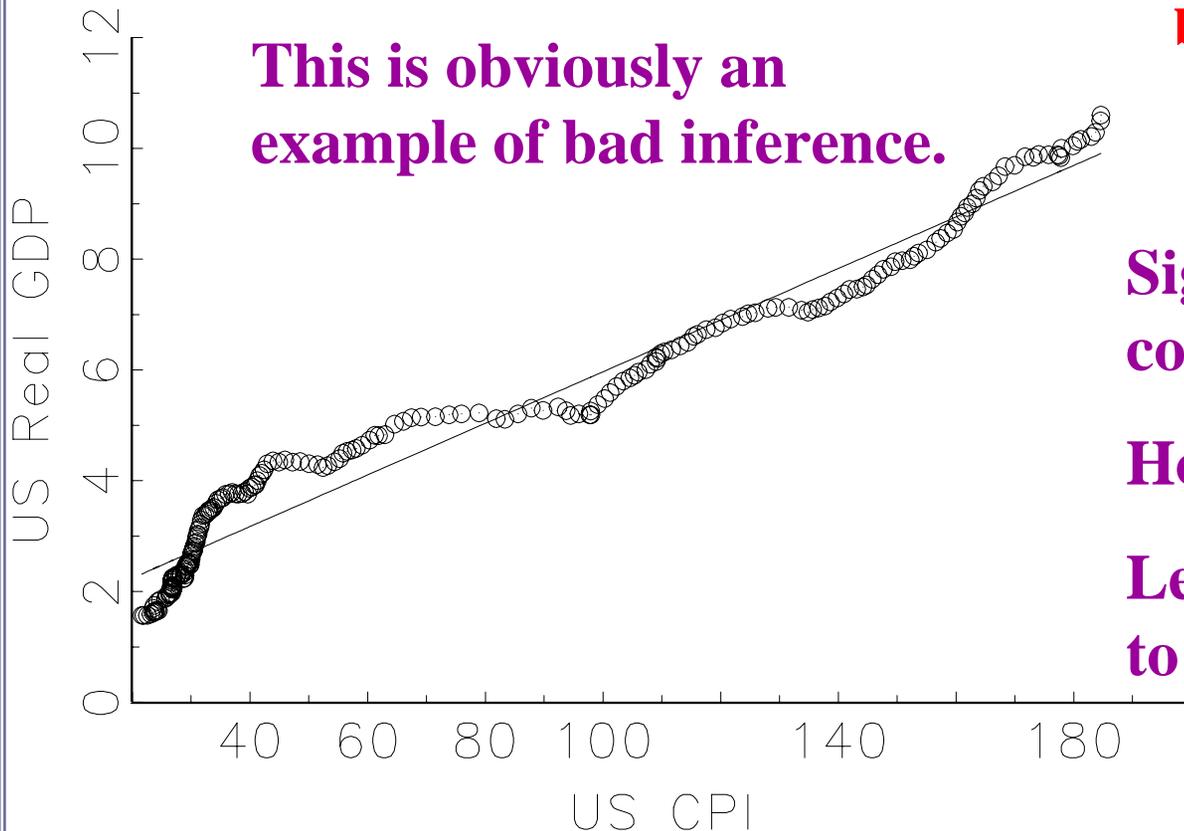


Consequences of Bad Data Transformations

Does the CPI cause changes in GDP?

What if we regress real GDP on the CPI?

A spurious regression



	Coeffs	t stats
b0	1.31	22.6
b1	0.05	76.0

R² 0.96

Significant coefficients!

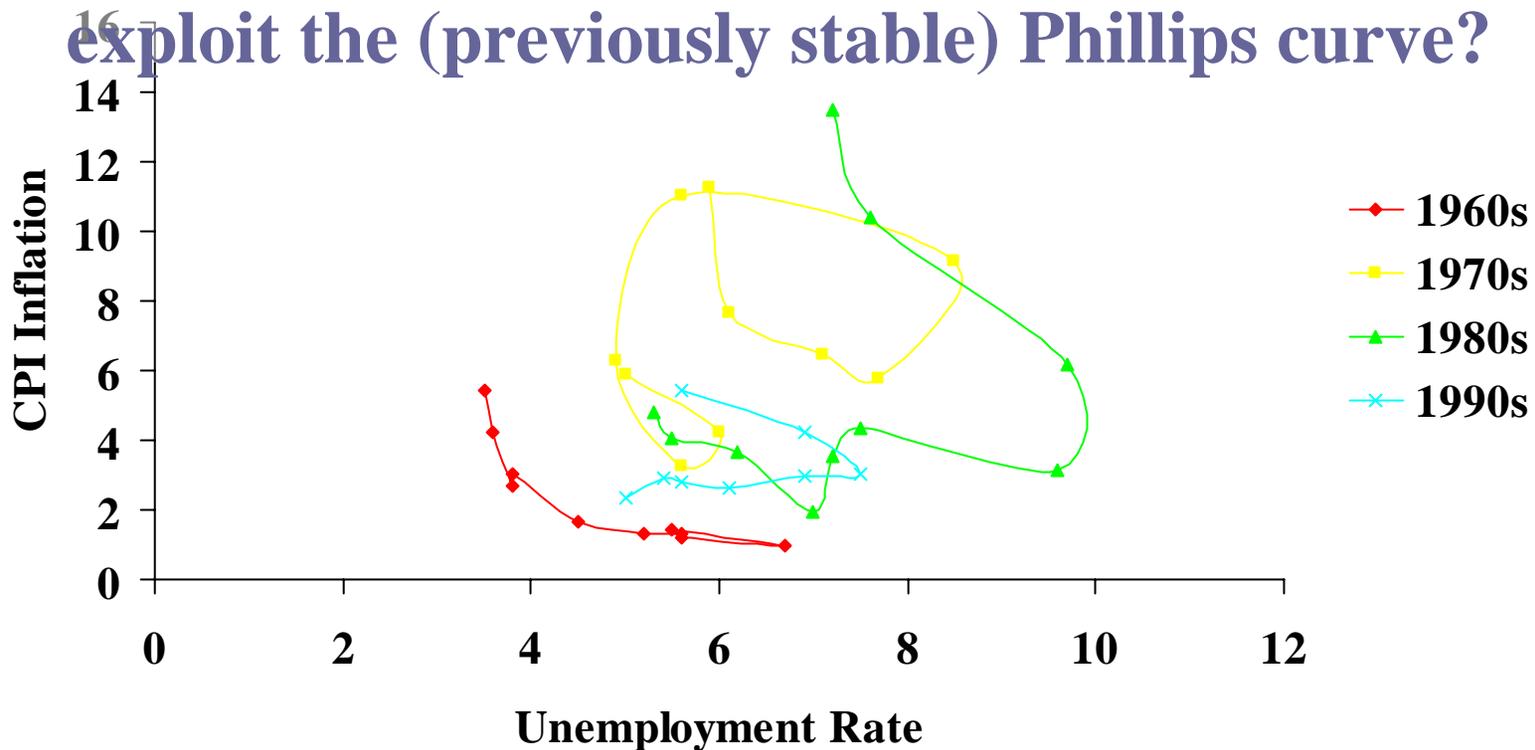
Hooray!

Let's send it off to the AER.

The Lucas Critique

- If the rules of the game change, people change their behavior and correlations change too.

- What happened when the Fed tried to exploit the (previously stable) Phillips curve?



The End