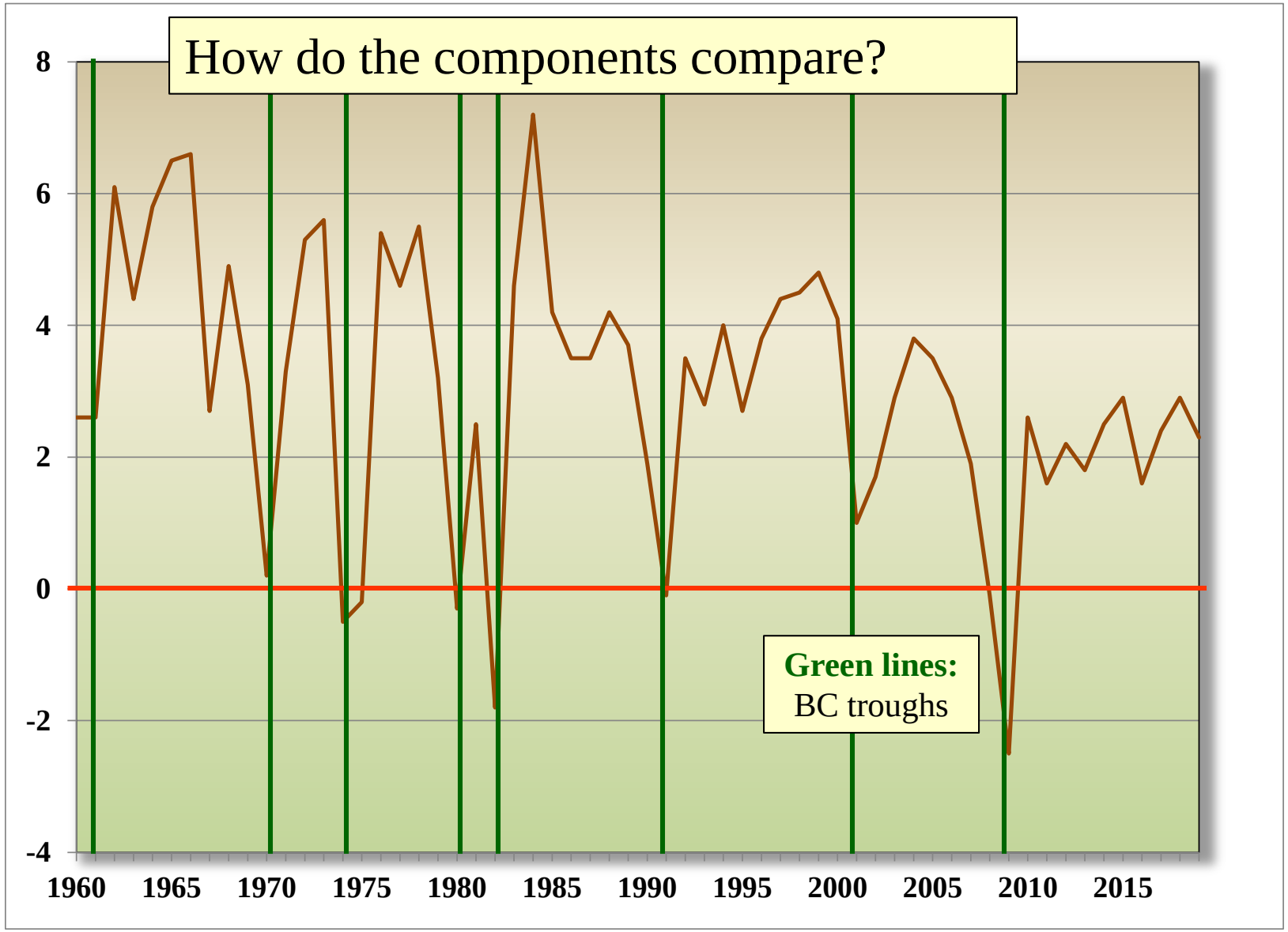
Business Cycles

.... in data

All data within are from the ***Bureau of Economic Analysis***, unless otherwise indicated.

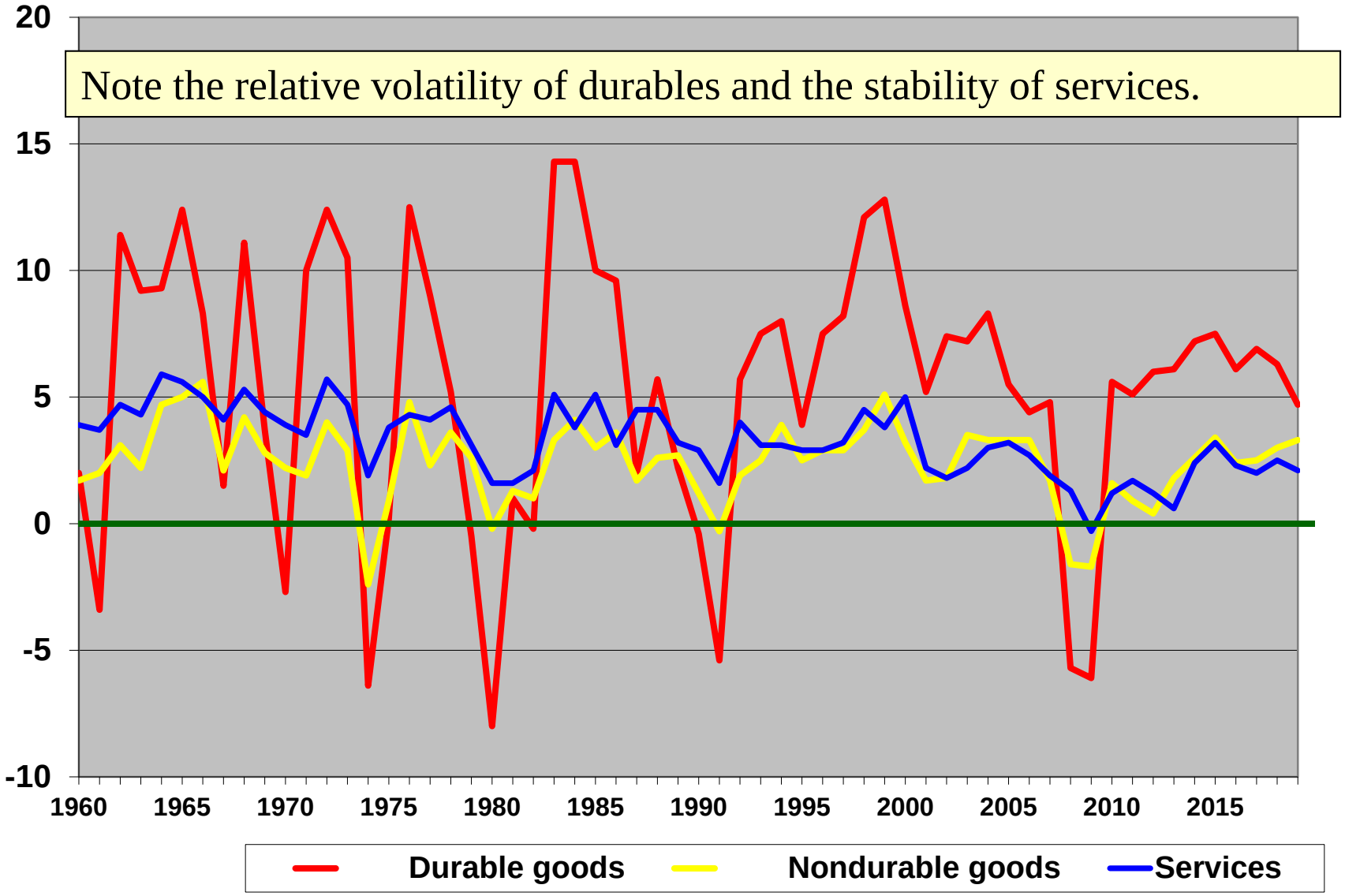
Real GDP Growth: 1960-2019 ann.



Average: 3.08%
1960-2000: 3.59%
2001-2019: 1.99%

Source: Bureau of Economic Analysis, National Income and Product Accounts, Table 1.1.1

Consumption 1960-2019



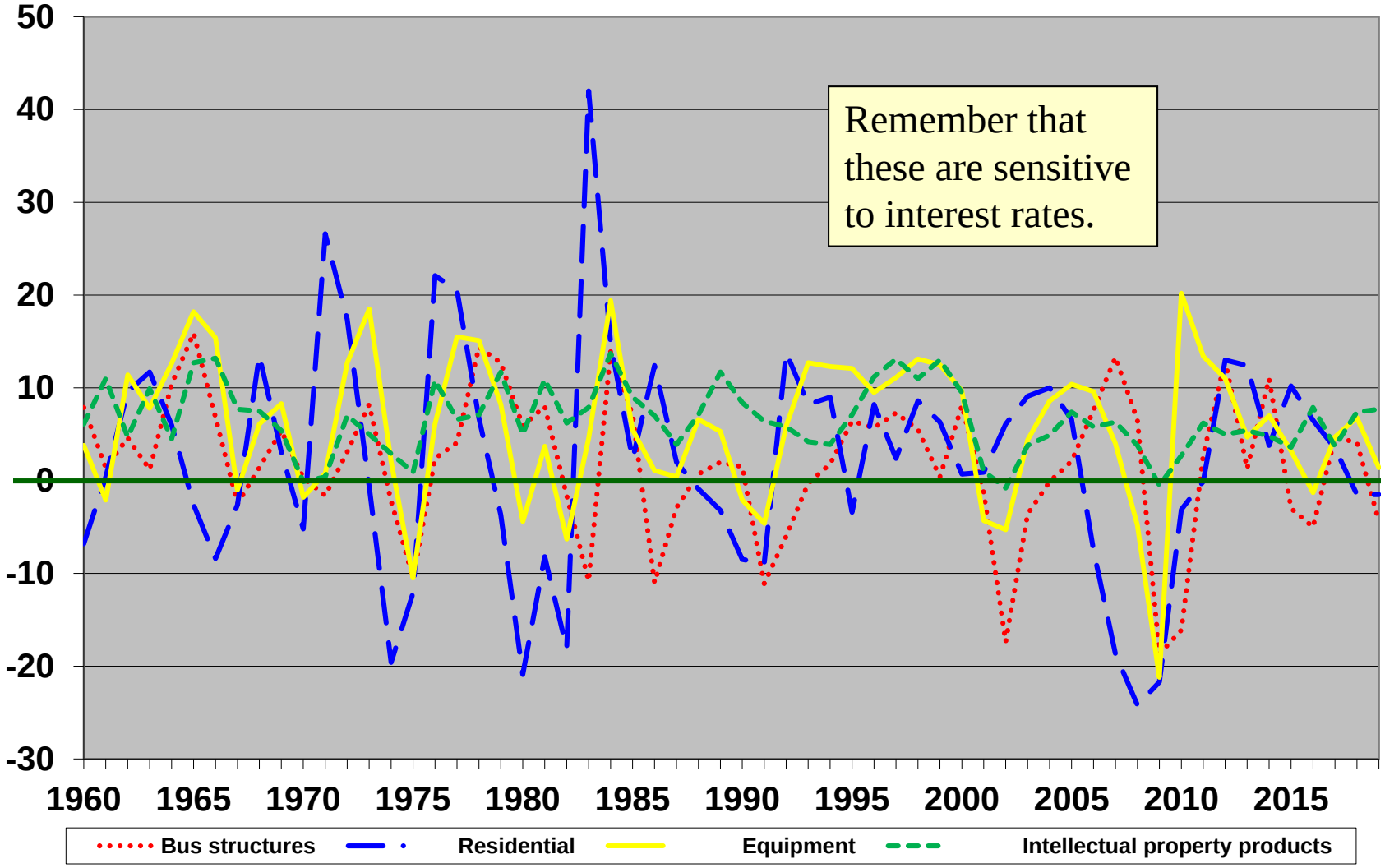
What drives consumption?

(to be covered in more detail in theory section)

- Personal income
- Access to credit
- Interest rates (real estate and durables)
- **Perceived wealth**
  - home equity
  - financial investments
- ***Expectations*** of the above

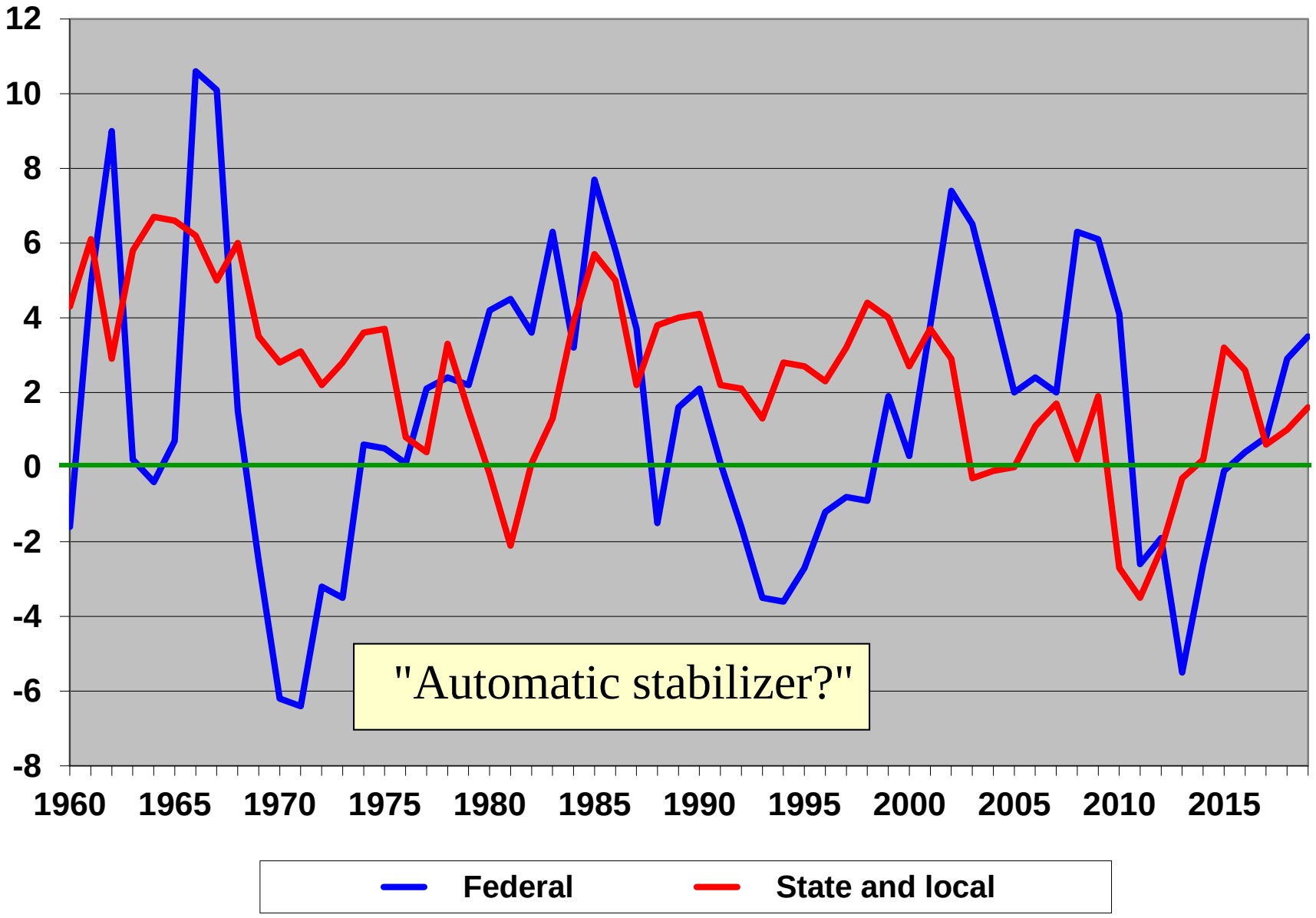
Compare this to consumption ranges!

Investment 1960-2019



Note the peaks and troughs (magnitude) of residential construction.

Government Purchases, 1960-2019



Elementary Macroeconomic Analysis

We want to compare average growth rates and especially standard deviations for the components of GDP to GDP.

- We use continuous (LN) growth rates: Shows the growing or declining importance of the component over time.
- Standard deviations normalized to GDP or compared to GDP: Shows the relative volatility of the component, which may add insight into risk, cyclical activity, etc.

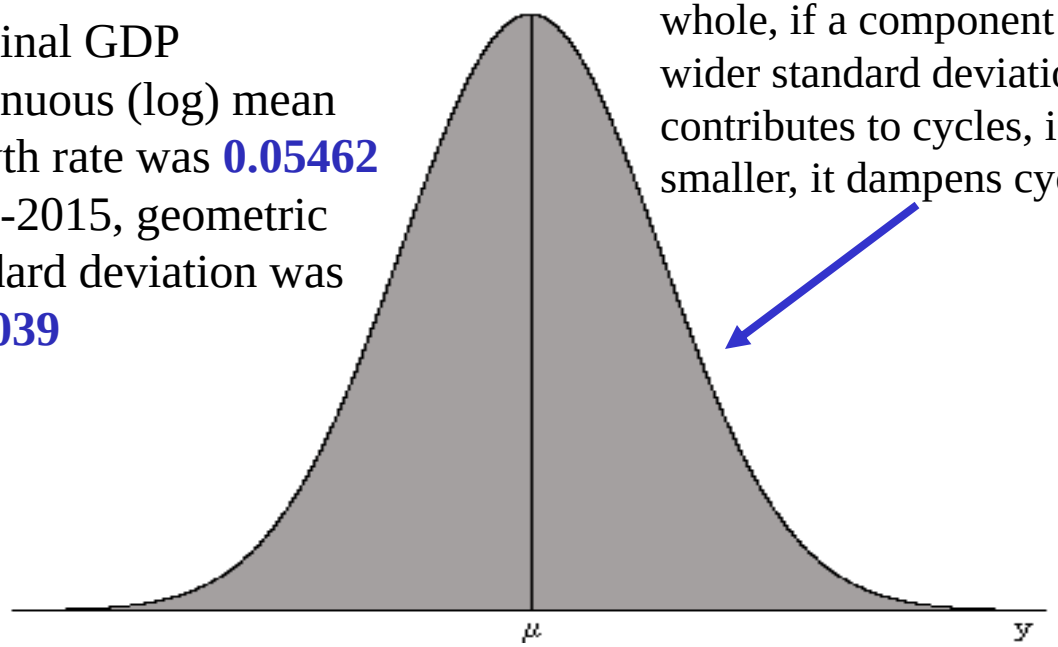
This is not required and is not an assignment, but if you want to know why we are using continuous natural log growth rates, see my video for Econ 136:

https://youtu.be/S1fZngkp7yY

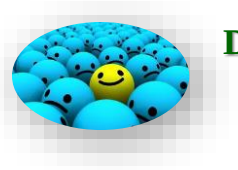
A good proxy for cycle candidates

Nominal GDP continuous (log) mean growth rate was **0.05462** 1960-2015, geometric standard deviation was **0.03039**

When compared to GDP as a whole, if a component has a wider standard deviation it contributes to cycles, if smaller, it dampens cycles.



5.462%



DWBH: I am not going to ask you this!

Three alternative growth rates

(point by point estimation from time-series data)

t	x
X_0	100
X_1	115
etc.	

Working with raw time-series data, we have to transform it to growth rates, but which?

Example from 1st 2 observations on left

Discrete:	$\frac{X_{t+1}-X_t}{X_t}=\frac{X_{t+1}}{X_t}-1$	**0.15**
Geometric Discrete:	$\frac{X_{t+1}}{X_t}$	**1.15**
Continuous (log):	$\ln\left(\frac{X_{t+1}}{X_t}\right)=\ln\left(X_{t+1}\right)-\ln\left(X_t\right)$	**0.13976**

DWBH: I am not going to ask you this!

... calculating mean, standard deviation and variance from the log-converted data

Mean value of growth rate:

$$\overline{R_p} = \frac{\sum_{i=1}^{n} R_i}{n} = \mu_p$$

Variance of the growth rate:

$$\overline{V_p} = \frac{\sum_{i=1}^{n} \left(R_i - \overline{R}\right)^2}{n} = \sigma_p^2$$

Note: these estimators assume that you are using a Gaussian (normal) distribution. **Equally important** – these classical estimators ***cannot be used*** on data transformed into discrete growth rates!

Standard deviation of growth rate:

$$\overline{SD_p} = \sqrt{\overline{V_p}} = \sigma_p$$

Note: A good source for reviewing statistical applications is the National Institute of Standards and Technology *Engineering Statistics Handbook*, available online at http://www.itl.nist.gov/div898/handbook/

Nominal GDP component continuous growth rates and standard deviations, 1960 - 2019 annual

	% GDP	Mean NCGR	CGR StdDev	Norm CGRSDV	Price Deflator
Gross domestic product	100.0%	0.062	0.00935	**1.000**	100.0
Durable goods	7.1%	0.059	0.02816	**3.011**	77.0
Nondurable goods	13.9%	0.053	0.01182	**1.264**	88.3
Services	46.9%	0.071	0.00734	**0.785**	104.5
Residential construction	3.7%	0.056	0.04468	**4.777**	119.5
Nonresidential construction	2.9%	0.058	0.03528	**3.772**	93.2
Equipment and software	5.8%	0.062	0.02732	**2.921**	86.8
Intellectual property products	4.7%	0.084	0.01347	**1.440**	92.7
Federal purchases	6.6%	0.051	0.01731	**1.851**	99.3
State and local purchases	10.9%	0.066	0.01025	**1.096**	102.6
Key: Contributes to cycle	**Neutral**	**Dampens**	**Adds**	**Adds++**	

Mean NCGR: Mean nominal (not adjusted for inflation) continuous (log) growth rate, annualized.

CGR StdDev: Standard deviation of the log continuous growth rate quarterly, not annualized.

Norm CGRSDV: Normalized standard deviation - each category SD divided by GDP SD.

Price deflator: 2012 price deflator normalized by GDP price deflator (112.4)

Note: Very important slide to understand for exam.

How to interpret the previous slide ...

GDP is an aggregate and all of the other categories are components of the aggregate. Their weights vary from **Services**, which constitute 46.9% of GDP, to **Non-residential Construction**, which constitutes only 2.9%. The volatility of GDP, which we here represent by standard deviation of its quarterly continuous growth rate, will obviously be impacted by the volatility of its components, which we represent by the individual standard deviations of their growth rates.

Two rules: (1) the higher the volatility of the component relative to the volatility of GDP, the more that component is raising the volatility of GDP. (2) The higher the weight of the component, the more the impact. Maybe you can see it in the math.

(You are not accountable for the material below):

The sum of variances formula is below. In this context, the variance of GDP can be thought of as the extreme left term, and the individual Xs are the components. If the components are independent, the covariance term disappears. SD is the square root of Variance. Clearly the higher the weight, the higher the effect.

$$V\left(\sum_i \alpha_i X_i\right) = \sum_i \alpha_i^2 V(X_i) + 2\sum_i \sum_j \alpha_i \alpha_j Cov(X_i, X_j)$$

Certain conclusions ...

- This economy is relatively stable compared to other economies and compared to our own history because the GDP components with the highest weights have the least volatility, led by services.
- All classes of investment, although relatively small in weight, are high in volatility, therefore contribute greatly to the cycle
- To watch for business cycles, your teacher monitors
  - Durables (consumer)
  - Structures (residential and business)

Memo items ..

- Productivity gains are robust in services and durables
  - which combats inflation
- Importing manufactured goods also combats inflation unless the $$ is weakening
- The volatile categories are “interest sensitive”
- Federal government purchases are not the same as expenditures
  - transfer payments are the difference
- Federal and state and local government purchases, especially the latter, do not necessarily counter-balance a recession. They are not really “automatic stabilizers.”