ECON 6356
International Finance and Macroeconomics

Lecture 1: Introduction to International Business-cycle Facts

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About me

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Outline

This lecture is the introduction of a course on international macroeconomics and finance at the graduate level. I hope you find it useful.

Texbook: A significant part of this lectures are based on the book by Martin Uribe and Stephanie Schmitt-Grohé (2017): Open Economy Macroeconomics (they have a book's website with resources we'll use, including slides)

Other books and materials: We'll also borrow from the Maurice Obstfeld, and Kenneth Rogoff's (1996) seminal book: Foundations of International Macroeconomics, as well as from papers and articles directly.

Princeton University Press, 2017

slides

business-cycle facts around the world

These slides are an adjusted version of the materials for Chapter 2 of the OEM book provided by the authors

To characterize business cycle facts we decompose a time series, y_t, into a

- cyclical component, y_t^c, and a
- secular (or trend) component, y_t^s

$$y_t = y_t^c + y_t^s$$

There are various methods to extract the cyclical component:

- log-linear detrending
- log-quadratic detrending
- HP filtering
- Band pass filtering

Log-linear detrending

Let

$$y_t \equiv \ln Y_t$$

denote the natural logarithm of a time series Y_t, where t denotes time. Then write

$$y_t = a + bt + \epsilon_t$$

where

cycle

$$\text{cycle:} \quad y_t^c = \epsilon_t$$

$$\text{secular trend:} \quad y_t^s = a + bt$$

The parameters a and b can be estimated via ordinary least squares (OLS).

This is, how King, Plosser, and Rebelo (JME, 1988) define the cyclical component of U.S. time series in their seminal real-business-cycle paper. They further impose constant spending shares in the long run–they impose that b is the same for output, consumption, and investment.

Log-quadratic detrending

$$y_t = a + bt + ct^2 + \epsilon_t$$

cycle: $y_t^c = \epsilon_t$

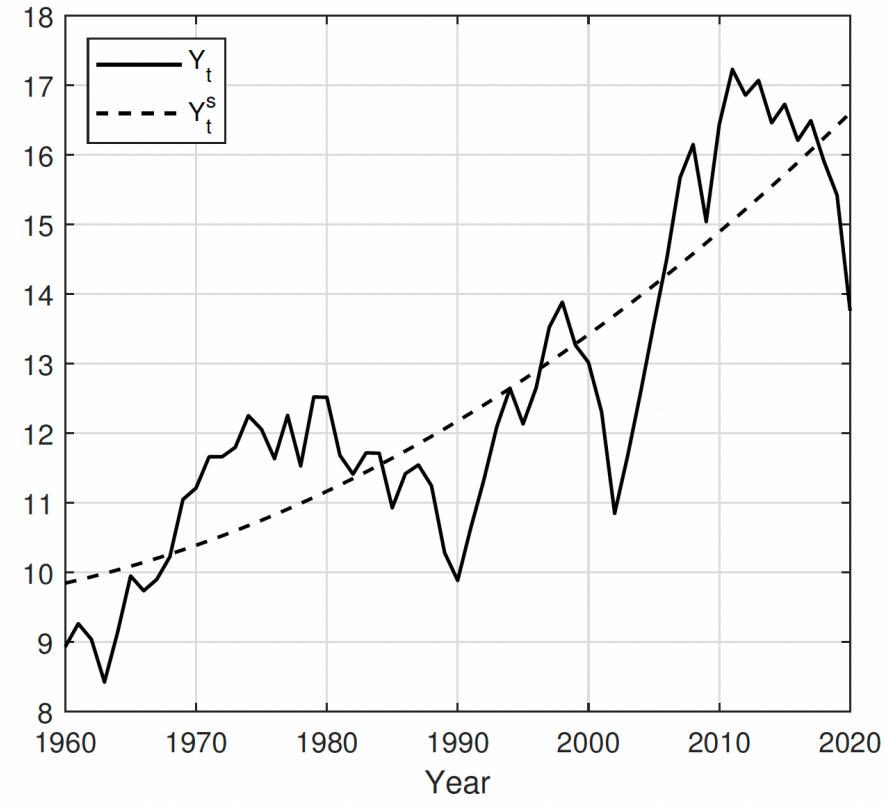
secular trend: $y_t^s = a + bt + ct^2$

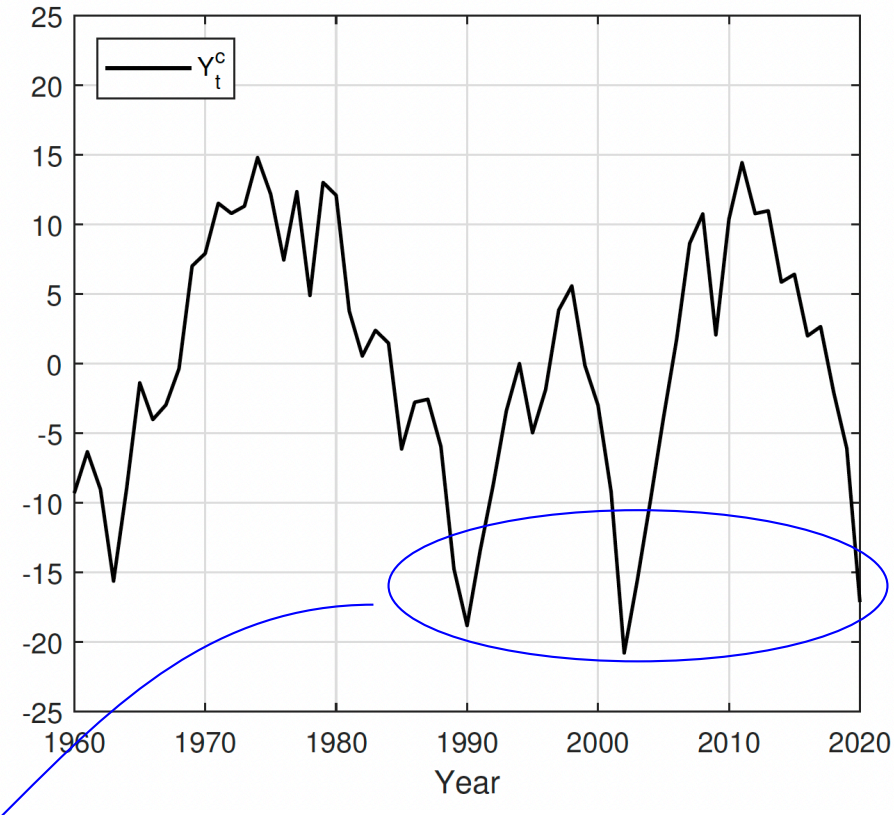
with this the trend does not look like a straight line

Again, the parameters a, b, and c can be estimated via OLS.

This is, for example, how Mendoza (AER, 1991) defines the cyclical component of Canadian time series in his small-open-economy real-business-cycle model.

Log-quadratic detrending: Application to Argentine real GDP per capita, annual data, 1960-2020





Filter Identifies
main contractions

Result of quadratically detrending the Argentine output:

• 3 large cycles: (1) 1960-1990; (2) 1990-2002; (3) 2002-2020;

• In 1960-1990 cycle output fell from 15 percent above trend at the peak in 1980 to 25 percent below trend at the trough in 1990 $\rightarrow$ "lost decade"

• Log-quadratic filter **successfully identifies contractions** associated with:

– the hyperinflation of the late 1980s
– the demise of the Convertivility Plan and default in 2001
– the COVID 2020 recession

• std(y_t^c) $=$ 10.7 percent per year, implying a highly volatile business cycle

• corr(y_t^c, y_{t-1}^c) $= 0.85$, implying persistent cyclical fluctuations

What are the **characteristics of a typical business cycle**?

To answer $\longrightarrow$ compute business cycle facts for a large number of countries.

Annual data set from the World Development Indicators (WDI), 1960-2011. To be included: a country must have at least 30 consecutive observations of:

- y_t (log of) real GDP per capita
- c_t (log of) real private consumption per capita
- g_t (log of) real government consumption per capita
- i_t (log of) real investment per capita
- x_t (log of) real exports per capita
- m_t (log of) real imports per capita

120 countries satisfying this requirement in the data set. Of those 120 countries, 94 have 30 consecutive years of data on the current account –statistics regarding the current account are based on a sample of 94 countries.

A Comment on the Consumption Data

The WDI private consumption series includes expenditures on durables, services, and nondurables. Typically, business-cycle studies remove expenditures on durables from the definition of consumption. The reason is that from an economic point of view, expenditures on durable consumption goods, such as cars and washing machines, represent an investment in household physical capital. And this makes expenditures on durables far more volatile than expenditures on nondurables and services.

The next slides shows how much **more volatile total consumption is relative to that of nondurables** and services for the U.S. economy.

Unfortunately, most countries do not publish disaggregated consumption data. So, the volatility of consumption reported in the cross-country comparisons below is higher than what it would be were expenditures on durables excluded.

Relative Volatilty of Disaggregated Consumption, σ_c/σ_y

(annual U.S. data, 1965-2011, data source, bls.gov)

Measure of C_t	Avg. Share	log-linear detrending	log-quadratic detrending	HP filter
Total Consumption	1	1.02	1.01	0.88
Nondurables and Services	0.87	0.87	0.84	0.64
Durables	0.13	2.47	2.53	2.95

- all standard deviations are scaled by σ_y

- nondurable and services consumption is less volatile than output.

- whereas durable consumption is much more volatile than output.

- the standard deviation of total consumption is nearly 20 percent higher than that of nondurables and services (even though durable consumption represents only 13 percent of total consumption expenditure).

We first present **business-cycle facts based on quadratically detrended** versions of y_t, c_t, g_t, i_t, x_t, and m_t.

Trade Balance, $TB_t \equiv X_t - M_t$ can be negative so its log doesn't exist.

Instead, we detrend it by first scaling it by the trend component of output to obtain $tb_t \equiv \frac{X_t - M_t}{\exp(y_t^s)}$ and then removing a quadratic trend. In this way, the deviations from trend are measured in percent of trend output.

Same with the Current Account, denoted CA_t; thus, $ca_t \equiv \frac{CA_t}{\exp(y_t^s)}$.

For each country: compute standard deviations, contemporaneous correlations with output, and serial correlations of all variables.

After: population-weighted average of each statistic.

Business Cycles Around the World:

Ten Facts

Spoiler Alert:

10 Business-Cyle Facts Around the World

Fact 1: [High Global Volatility] The cross-country average standard deviation of output is about twice as large as its U.S. counterpart.

Fact 2: [Excess Consumption Volatility] On average across countries, private consumption including durables is more volatile than output.

Fact 3: [Global Ranking of Volatilities] The ranking of cross-country average standard deviations from top to bottom is imports, investment, exports, government spending, consumption, and output.

Fact 4: [Procyclicality of the Components of Aggregate Demand] On average across countries, consumption, investment, exports, and imports are positively correlated with output.

Fact 5: [Countercyclicality of the Trade Balance and the Current Account] On average across countries, the trade balance, trade-balance-to-output ratio, current account, and current-account-to-output ratio are negatively correlated with output.

Fact 6: [Acyclicality of the Share of Government Consumption in GDP] On average across countries, the share of government consumption in output is roughly uncorrelated with output.

Fact 7: [Persistence] The components of aggregate supply (output and imports) and aggregate demand (consumption, government spending, investment, and exports) are all positively serially correlated.

Fact 8: [Excess Volatility of Poor and Emerging Countries] Business cycles in emerging or poor countries are about twice as volatile as business cycles in rich countries.

Fact 9: [Excess Consumption Volatility in Poor and Emerging Countries] The relative consumption volatility is higher in poor and emerging countries than in rich countries.

Fact 10: [The Countercyclicality of Government Spending Increases with Income] The share of government consumption is countercyclical in rich countries, but acyclical in emerging and poor countries.

High Global Volatility

Business-Cycle Statistic	World	U.S.
σ_y	6.2%	2.9%

RoW is more volatile than the US

Fact 1: The cross-country average standard deviation of output is **twice as large** as its U.S. counterpart.

Excess Consumption Volatility

Business-Cycle Statistic	World Average
$\frac{\sigma_c}{\sigma_y}$	1.05

Fact 2: On average, across countries, private **consumption (including durables) is more volatile than output**.

Global Ranking of Volatilities

Business-Cycle Statistic	World Average
$\frac{\sigma_m}{\sigma_y}$	3.23
$\frac{\sigma_i}{\sigma_y}$	3.14
$\frac{\sigma_x}{\sigma_y}$	3.07
$\frac{\sigma_g}{\sigma_y}$	2.26
$\frac{\sigma_c}{\sigma_y}$	1.05

Vol. of: M $>$ I $>$ X $>$ G $>$ C $>$ Output

Fact 3: The ranking of cross-country average standard deviations from top to bottom is imports, investment, exports, government spending, consumption, and output.

Cyclicality

Business-Cycle Statistic	World Average
corr(c, y)	0.69
corr(i, y)	0.66
corr(x, y)	0.19
corr(m, y)	0.24
corr(tb, y)	-0.18
corr(ca, y)	-0.28
corr$(g/y, y)$	-0.02

Fact 4: Consumption, investment, exports, and imports are **procyclical**.

Fact 5: The trade balance and the current account are **countercyclical**.

Fact 6: The share of government consumption in output is acyclical.

Open Economy Fact

Persistence

Business-Cycle Statistic	World Average
corr(y_t, y_{t-1})	0.71
corr(c_t, c_{t-1})	0.66
corr(g_t, g_{t-1})	0.76
corr(i_t, i_{t-1})	0.56
corr(x_t, x_{t-1})	0.68
corr(m_t, m_{t-1})	0.61

Fact 7: All components of demand (c, g, i, x) and supply (y, m) are positively serially (*auto*) correlated.

The U.S. Business Cycle as

A Point of Comparison

Comparing Business Cycles around the World to the U.S. Business Cycle

Statistic	United States	All Countries
Standard Deviations		
σ_y	2.94	6.22
σ_c/σ_y	1.02	1.05
σ_g/σ_y	1.93	2.26
σ_i/σ_y	3.52	3.14
σ_x/σ_y	3.49	3.07
σ_m/σ_y	3.24	3.23
$\sigma_{tb/y}$	0.94	2.34
$\sigma_{ca/y}$	1.11	2.16
Correlations with y		
y	1.00	1.00
c	0.90	0.69
g/y	-0.32	-0.02
i	0.80	0.66
x	-0.11	0.19
m	0.31	0.24
tb/y	-0.51	-0.15
tb	-0.54	-0.18
ca/y	-0.62	-0.28
ca	-0.64	-0.28
Serial Correlations		
y	0.75	0.71
c	0.82	0.66
g	0.91	0.76
i	0.67	0.56
x	0.75	0.68
m	0.63	0.65
tb/y	0.79	0.61
ca/y	0.79	0.57
Means		
tb/y	-1.5	-1.3
$(x+m)/y$	18.9	36.5

Gov. exp. share in the US is countercyclical

Trade is more important in RoW (US operates as if closed)

Some Observations

US1: The **world is a much more volatile place than the U.S.**: The cross-country average volatility of output is twice as large as its U.S. counterpart. Important question in Macro: Why? Is the U.S. lucky, that is, is it hit by smaller shocks?; or does the U.S. have better policy?

US2: Besides that, business cycle facts for the United States are not that different from what is observed around the world.

US3: Consumption is **as volatile as output both in the U.S. and The world** ($\sigma_c/\sigma_y \approx 1$). You might find this surprising in the case of the U.S., as you might be used to the result that consumption is less volatile than output. Reason: WDI's consumption series used here includes expenditures on durables.

US4: The share of government spending is more countercyclical in the United States than around the world (-0.32 versus -0.02), that is, the U.S. appears to employ more strongly countercyclical fiscal policy than the rest of the world.

US5: One other difference: the **U.S. is less open**, $(x+m)/y = 18.9\%$ compared to 36.5%.

To sum up, the two most striking differences between U.S. business cycles and business cycles around the world are:

- Business **cycles are half as volatile in the U.S.**

- Fiscal policy is more strongly countercyclical in the U.S.

Business Cycles in

Rich, Emerging, and Poor Countries

Question: Are business cycles different in rich, poor, and middle-income (or emerging) countries?

To answer this question, the first thing to do is to determine **which countries are rich, poor, or middle income**. This, in turn, requires coming up with a measure of income per capita that is comparable across countries.

We use the geometric average of PPP-converted GDP per capita in U.S. dollars of 2005 over the period 1990-2009.

Loosely speaking, PPP-converted GDP in a given country is the value of all goods and services produced in that country evaluated at U.S. prices. By evaluating production of goods and services in different countries at the same prices, PPP conversion makes cross-country comparisons more sensible.

A good source for PPP-converted GDP numbers is the World Bank's *International Comparison Program (ICP)*.

PPP-Converted GDP — An example

Suppose that in a given year country X produces: 3 hair cuts and 1 ton of grain.

Suppose the unit prices of these items in country X are, 1 and 200 dollars, respectively.

Hence the nonconverted measure of GDP in country X is 203 dollars.

Suppose that in the United States a hair cut costs 20 dollars and 1 ton of grain 200 dollars.

Then, the PPP-converted measure of GDP in country X is 260 dollars.

Country X is 28% (260/203-1) richer when GDP is measured at PPP prices than when it is measured at domestic prices. The reason is that nontradable services are more expensive in the U.S. than in country X.

This hypothetical result is indeed typical for poor and emerging countries, where labor-intensive services are far cheaper than in the U.S.

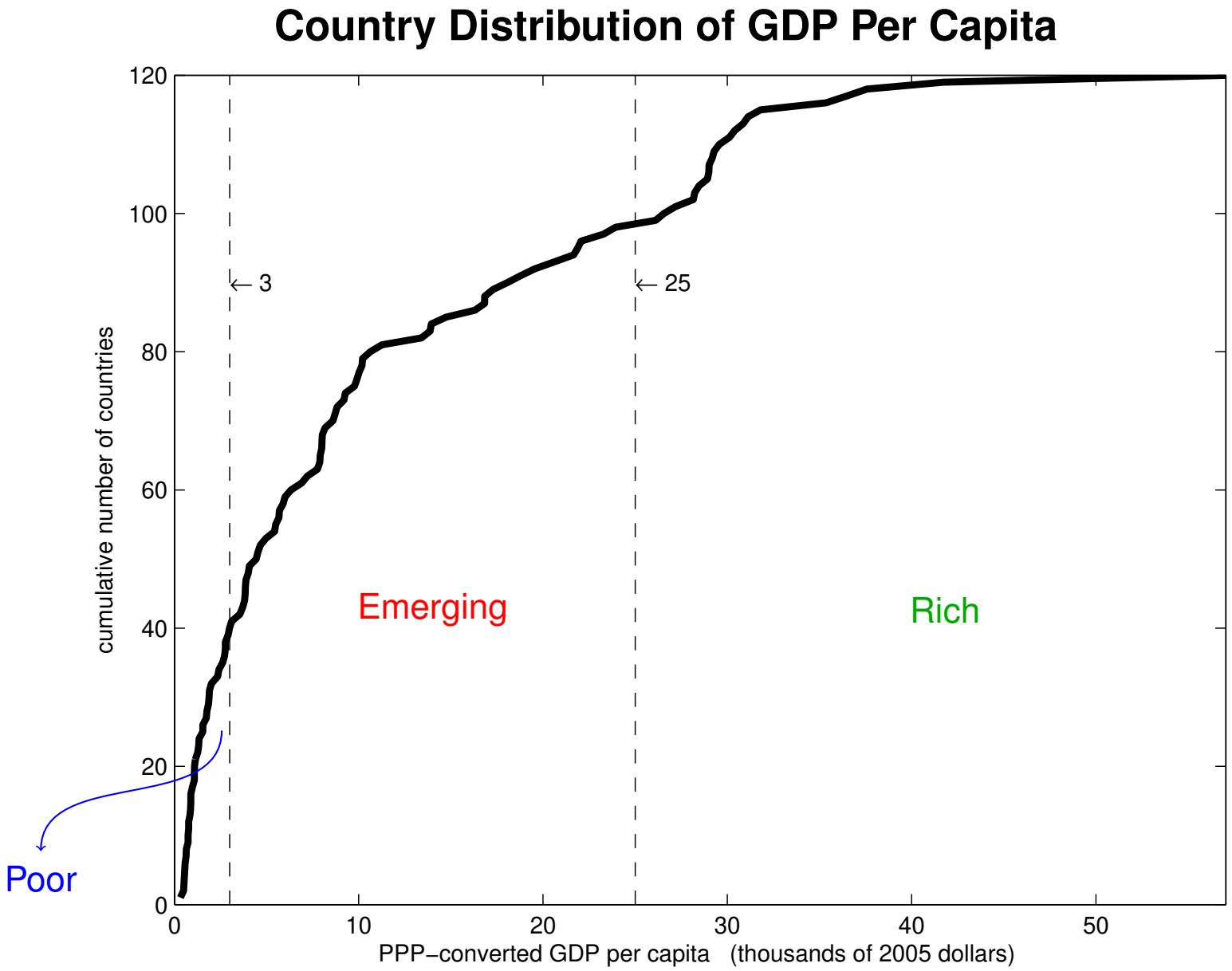
Country Distribution of GDP Per Capita

The next figure displays the distribution of PPP-converted GDP per capita across countries. The horizontal axis measures the average PPP-converted GDP per capita in U.S. dollars of 2005 over the period 1990 to 2009. The vertical axis measures the number of countries with GDP less than or equal to the associated level on the horizontal axis.

The median GDP per capita is $6,615, and the mean GDP per capita is $11,254. Eighty countries (or 2/3) have per capita incomes below the mean.

Income is unevenly distributed across countries: The plotted line is so steep at low levels of output.

Q: How would the figure look if income was evenly distributed across countries?


Country Distribution of GDP Per Capita
cumulative number of countries
PPP−converted GDP per capita (thousands of 2005 dollars)
← 3
← 25
Emerging
Rich
Poor
0
20
40
60
80
100
120
0
10
20
30
40
50

Defining the Three Income Groups

Divide our sample of 120 countries into three groups: Poor, emerging, and rich countries. These groups are defined as all countries with average PPP converted GDP per capita within the ranges:

Poor: less than $3,000,
Emerging: $3,000 to $25,000,
Rich: more than $25,000,

This results in 40 poor (1/3), 58 emerging (1/2), and 22 (1/6) rich countries.

Poor Countries

–Benin, Bhutan, Burkina Faso, Burundi, Central African Republic, Comoros, Gambia, Guyana, Honduras, Lesotho, Malawi, Mali, Mauritania, Mongolia, Niger, Papua New Guinea, Rwanda, Senegal, Sierra Leone, Togo, Zambia, Zimbabwe.
–Cameroon, Congo, Côte d'Ivoire, Ghana, Kenya, Madagascar, Mozambique, Nepal, Sri Lanka, Sudan, Uganda.
–Bangladesh, China, Ethiopia, India, Indonesia, Pakistan, Philippines.

Emerging Countries

–Albania, Antigua and Barbuda, Bahrain, Barbados, Bolivia, Botswana, Bulgaria, Chile, Costa Rica, Cuba, Cyprus, Dominica, Dominican Republic, Ecuador, El Salvador, Fiji, Gabon, Greece, Grenada, Guatemala, Hungary, Israel, Jordan, Malta, Mauritius, Namibia, New Zealand, Panama, Paraguay, Portugal, Puerto Rico, Seychelles, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Swaziland, Tonga, Trinidad and Tobago, Tunisia, Uruguay.
–Algeria, Argentina, Colombia, Iran, Malaysia, Morocco, Peru, South Africa, South Korea, Spain, Syria, Thailand, Turkey, Venezuela.
–Brazil, Egypt, Mexico.

Rich Countries

–Austria, Belgium, Denmark, Finland, Hong Kong, Iceland, Ireland, Luxembourg, Macao, Netherlands, Norway, Singapore, Sweden, Switzerland.

–Australia, Canada, France, Italy, United Kingdom.

–Germany, Japan, United States.

Subgroups by size are marked by dashes.

Choice of classification thresholds is somewhat arbitrary.

World Bank uses GNI per capita with thresholds set ad hoc in 1989 and adjusted for inflation since then to classify countries as low-, middle-, or high income.

Standard and Poor's (S&P) classifies countries into groups with developed, emerging, and frontier markets. Its classification system is not rule based, instead it considers a country's market and regulatory structure, the trading environment, and the operational efficiency.

All countries that have developed markets according to S&P as of 2011 fall into the group of rich countries in this sample, with the exception of Israel, Portugal, Spain, and Greece, which by the classification used here are emerging economies. Overall there is a high degree of overlap between the S&P classification of countries with emerging and frontier markets the emerging and poor country classification above. A limitation of the S&P classification system is that it covers only 77 countries.

Three important differences emerge in business cycles acrosss rich, poor, and emerging countries:

Excess Volatility of Poor and Emerging Countries

Business-Cycle Statistic	Poor	Emerging	Rich
σ_y	6.1%	8.7%	3.3%

Fact 8: Business Cycles in poor and emerging countries are about **twice as volatile** as business cycles in rich countries.

and ...

Less Consumption Smoothing in Poor and Emerging than in Rich Countries

Business-Cycle Statistic	Poor	Emerging	Rich
σ_c/σ_y	1.12	0.98	0.87

Fact 9: The relative consumption volatility is higher in poor and emerging countries than in rich countries.

and ...

The Countercyclicality of Government Spending Increases With Income

Business-Cycle Statistic	Poor	Emerging	Rich
corr$(g/y, y)$	0.08	-0.08	-0.39

Fact 10: The share of government consumption is **countercyclical** in rich countries, but acyclical in emerging and poor countries.

To recap: Three important differences between poor and emerging and rich country business cycles:

• Poor and emerging countries are **twice as volative** as rich countries (Fact 8).

• Poor and emerging countries have a **higher relative consumption volatility** than rich countries (Fact 9).

• Only in **rich countries** the share of government consumption is **counter-cyclical** (Fact 10).

Country Size and Business Cycles

Sorting by population size:

Countries are sorted into three size categories: small, medium, and large. These three categories are defined, respectively, as all countries with population in 2009 of less than 20 million, between 20 and 80 million, and more than 80 million.

Small: 77 countries; Medium: 30 countries; Large: 13 countries.

Volatility of Output
Controlling for Country Size and Income

	σ_y		
	Poor	Emerging	Rich
All	6.1%	8.7%	3.3%
Small	8.2%	9.5%	4.3%
Medium	9.5%	9.0%	3.1%
Large	5.6%	7.9%	3.3%

Fact 8 is robust to controlling for country size: poor and emerging economies are at least twice as volatile as rich economies.

Relative Volatility of Consumption, σ_c/σ_y, Controlling for Country Size and Income

	σ_c/σ_y		
	Poor	Emerging	Rich
All	1.1	0.98	0.87
Small	1.4	0.97	0.92
Medium	1.1	0.93	0.93
Large	1.1	1.1	0.84

Fact 9 is robust to controlling for country size: in poor and emerging countries consumption is excessively volatile.

Are the business cycle facts we document robust to alternative detrending methods?

Consider next:

(a) Hodrick-Prescott (HP) filtered data

(b) First-differenced data

HP-Filtered Business Cycles

(a) The Hodrick and Prescott (1997) Filter

Given a time series y_t , for $t = 1, 2, \ldots T$, pick y_t^c and y_t^s to

$$\min_{\{y_t^c, y_t^s\}_{t=1}^T} \left\{ \sum_{t=1}^{T} (y_t^c)^2 + \lambda \sum_{t=2}^{T-1} \left[(y_{t+1}^s - y_t^s) - (y_t^s - y_{t-1}^s) \right]^2 \right\}$$

$$\text{subject to} \quad y_t^s + y_t^c = y_t$$

penalizes fluctuations in y (time series)

where λ is a parameter.

When $\lambda \to \infty$, changes in the growth rate of y_t^s become infinitely costly, and the HP trend component converges to a log-linear trend.

When $\lambda \to 0$, the cycle disappears ($y^c = 0$), and the secular trend is the time series itself ($y_t^s = y_t$).

After setting this problem in Matrix Form, we have that the optimality conditions to this minimization problem can be written as

$$Y = (I + \lambda A)Y^s$$

where Y is the vector of observations of y_t , Y^s is the vector of the secular components y_t^s, and the matrix A is a matrix of integers.

Solve for Y^s:

$$Y^s = (I + \lambda A)^{-1} Y$$

coefficient of
a linear expression

With Y^s in hand, Y^c, is

$$Y^c = Y - Y^s$$

$\Rightarrow$ HP filter is a **linear filter**.

The Size of λ Matters

Annual data: $\lambda = 100$. But Ravn and Uhlig (2001) suggest $\lambda = 6.25$

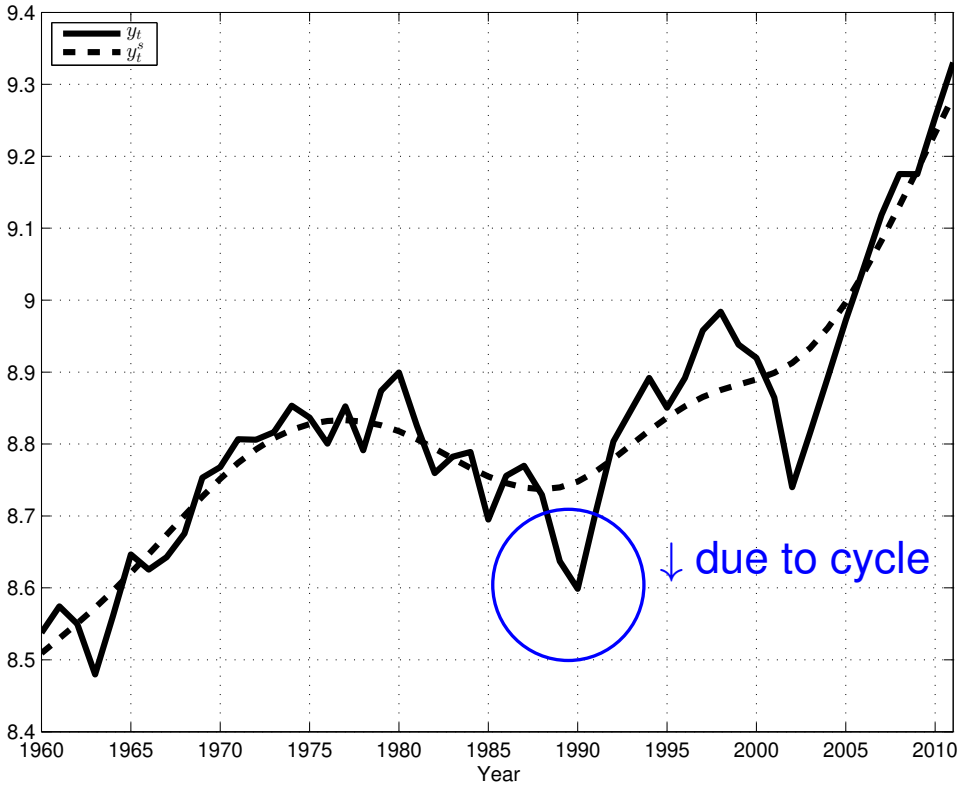
Example: Argentina

	λ	
	100	6.25
σ_y	5.7%	3.6%

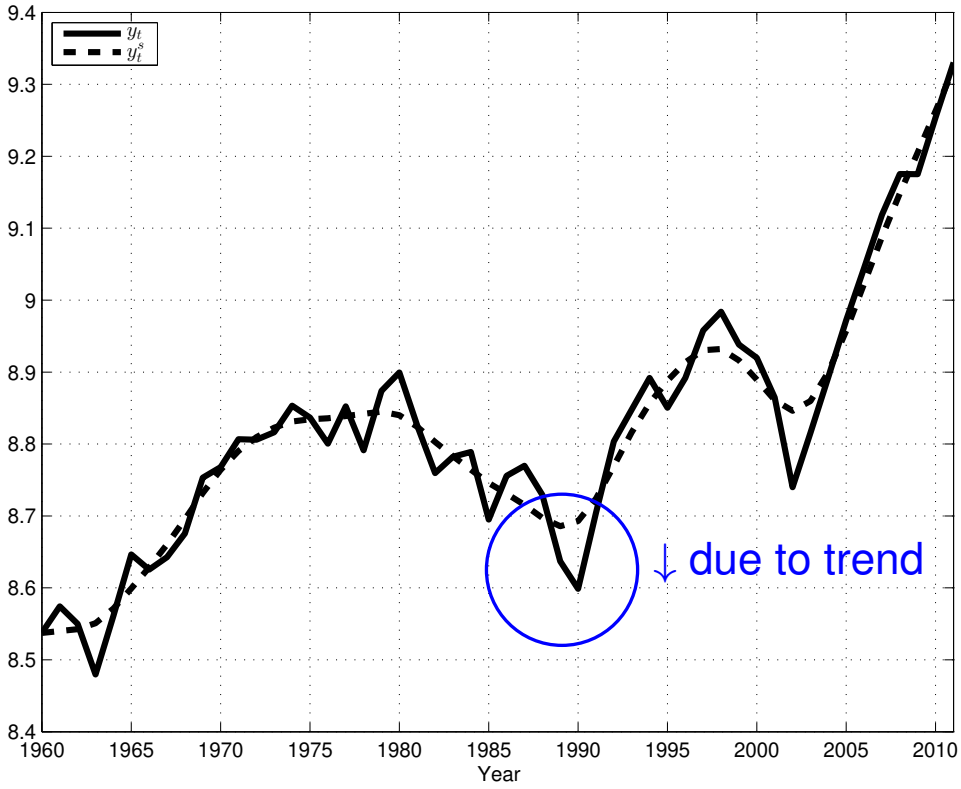
$\uparrow$ penalization $\Rightarrow$ more stable trend

HP Filtered Trend of Argentine Output

($\lambda = 100$)

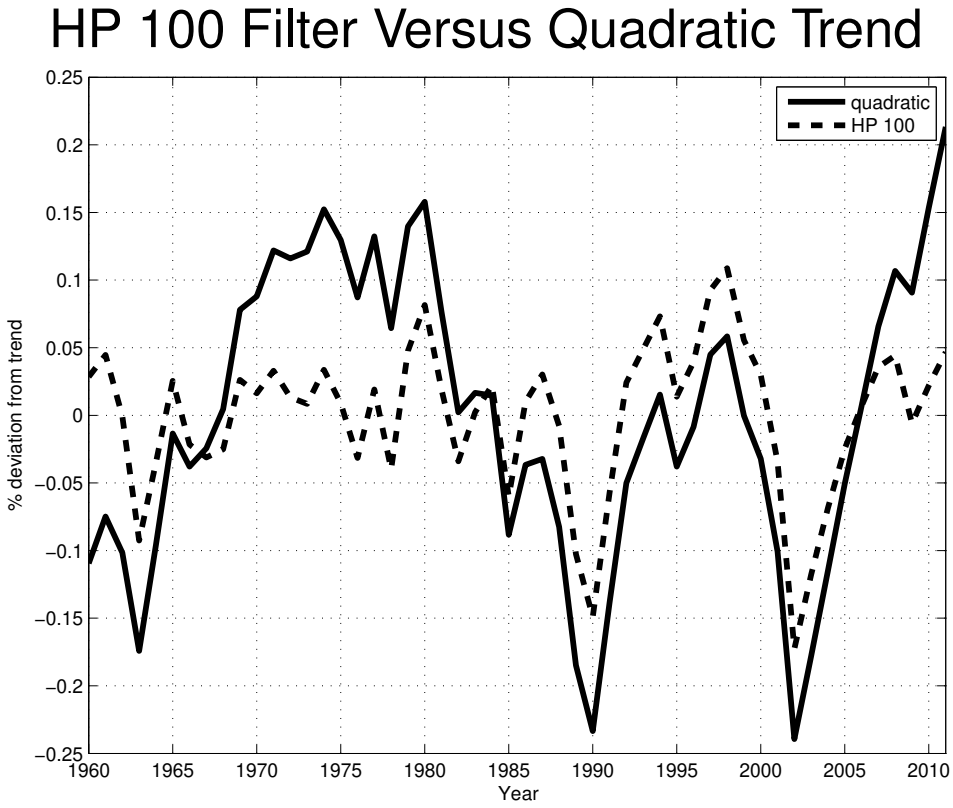


($\lambda = 6.25$)



HP-6.25 attributes bulk of the 1989 crisis and of the 2001 crisis to trend. But both were cyclical rather than secular for both were followed by rapid recovery. Thus, we will use $\lambda = 100$ for remainder of section.

Cyclical Component of Argentine Output:



High Global Volatility

Detrending Method	σ_y	
	World Average	USA
QT	6.2%	2.9%
HP	3.8%	2.0%

Fact 1: The cross-country average volatility of output is twice as large as its U.S. counterpart.

- Fact 1 **continues to hold**.
- Under HP filtering volatility falls by about 2/3.

Countercyclicality of the Trade-Balance-to-Output Ratio

corr(tby, y)	QT	HP
All	-0.15	-0.18
Poor	-0.11	-0.08
Emerging	-0.21	-0.34
Rich	-0.26	-0.37

Fact 5: On average across countries the share of the trade balance in output is negatively correlated with output.

- Fact 5 **continues to hold** under HP filtering

Excess Volatility of Poor and Emerging Countries

Detrending Method	σ_y		
	Poor	Emerging	Rich
QT	6.1%	8.7%	3.3%
HP	4.1%	4.0%	2.0%

Fact 8: Business Cycles in rich countries are about half as volatile as business cycles in emerging or poor countries.

- Fact 8 **continues to hold** under HP filtering

Less Consumption Smoothing In Poor and Emerging Countries

Detrending Method	σ_c/σ_y		
	Poor	Emerging	Rich
QT	1.12	0.98	0.87
HP	1.09	1.23	0.87

Fact 9: The relative consumption volatility is higher in poor and emerging countries than in rich countries.

- Fact 9 **continues to hold** under HP Filtering

The countercyclicality of Government Spending Increases With Income

Detrending Method	corr$(g/y, y)$		
	Poor	Emerging	Rich
QT	0.08	-0.08	-0.39
HP	0.02	-0.06	-0.56

Fact 10: The share of government consumption is countercyclical in rich countries, but acyclical in emerging and poor countries.

- Fact 10 **continues to hold** under HP filtering

Summary of Comparison

- QT and HP result in **largely the same business cycle facts**!
- The main difference is that HP filtering implies that the volatility of output and aggregate demand is 2/3 that implied by log-quadratic detrending.

(b) First-differenced data

$$\Delta y_t \equiv \ln Y_t - \ln Y_{t-1}$$

Statistic	All Countries	Poor Countries	Emerging Countries	Rich Countries
Standard Deviations				
$\sigma_{\Delta y}$	4.39	4.94	4.08	2.38
$\sigma_{\Delta c}/\sigma_{\Delta y}$	1.14	1.14	1.34	0.85
$\sigma_{\Delta g}/\sigma_{\Delta y}$	2.14	2.28	2.39	1.17
$\sigma_{\Delta i}/\sigma_{\Delta y}$	3.81	3.80	4.06	3.49
$\sigma_{\Delta x}/\sigma_{\Delta y}$	3.37	3.22	3.98	3.22
$\sigma_{\Delta m}/\sigma_{\Delta y}$	3.60	3.50	3.84	3.76
$\sigma_{tb/y}$	2.34	2.12	3.80	1.25
$\sigma_{ca/y}$	2.16	2.06	3.08	1.39
Correlations with Δy				
Δy	1.00	1.00	1.00	1.00
Δc	0.60	0.54	0.64	0.79
g/y	-0.10	-0.02	-0.18	-0.32
Δi	0.64	0.59	0.66	0.83
Δx	0.21	0.18	0.15	0.42
Δm	0.33	0.26	0.40	0.57
tb/y	-0.10	-0.08	-0.20	-0.07
ca/y	-0.07	-0.06	-0.12	-0.07
Serial Correlations				
Δy	0.29	0.28	0.29	0.32
Δc	0.02	-0.03	0.02	0.27
Δg	0.18	0.14	0.11	0.48
Δi	0.01	-0.01	0.03	0.08
Δx	0.07	0.08	-0.00	0.10
Δm	0.04	0.08	-0.02	-0.04
tb/y	0.61	0.59	0.62	0.69
ca/y	0.57	0.55	0.52	0.71

First-differenced Business Cycles

Note. The variables Δy, Δc, Δg, Δi, Δx, and Δm denote, respectively the log differences of output, consumption, government consumption, investment, exports, and imports. The variables g/y, tb/y, and ca/y are quadratically detrended in levels. All variables are expressed in percent.

Summary of Comparison

- QT, HP, and first-differencing result in **largely the same business cycle facts**!

- In particular, Facts 8 and 9 continue to hold: Emerging countries are about twice as volatile as rich countries, and emerging countries have a larger relative consumption volatility.

Business Cycle Facts with Quarterly Data

Main problem of quarterly data: not many long time series.

Include countries that have quarterly data on y, c, g i, x, and m for at least 30 years. This requirement reduces the number of countries from 120 to **28**!

poor countries: 0 (out of 40)
emerging countries: 11 (out of 58)
rich countries: 17 (out of 22)

The sample period is 1980Q1 to 2012Q4.
The data is online in file `usg_data_quarterly.xls` on the Open Economy Macroeconomics (2017) book's Web site. This data was collected from national statistical agencies, the OECD, IFS, and Eurostat.

Business Cycles in Emerging and Rich Countries, Quarterly Data, 1980Q1-2012Q4

	Log-Quadratic Time Trend			HP Filter			First Differences		
Statistic	All	Emerging	Rich	All	Emerging	Rich	All	Emerging	Rich
Standard Deviations									
σ_y	3.26	4.27	2.74	1.80	2.60	1.38	1.12	1.70	0.81
σ_c/σ_y	0.99	1.23	0.87	1.01	1.32	0.85	1.18	1.48	1.03
σ_g/σ_y	1.46	2.07	1.15	1.30	2.02	0.93	2.07	3.33	1.41
σ_i/σ_y	3.44	3.67	3.31	3.73	3.88	3.65	4.32	4.95	3.99
σ_x/σ_y	3.77	3.97	3.67	4.01	3.80	4.11	4.38	4.65	4.25
σ_m/σ_y	3.52	3.55	3.51	4.44	3.65	4.84	4.60	4.26	4.77
$\sigma_{tb/y}$	1.80	2.93	1.21	1.09	1.95	0.64	1.80	2.93	1.21
Correlations with y									
y	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
c	0.83	0.72	0.88	0.78	0.78	0.78	0.61	0.62	0.61
g/y	-0.43	-0.11	-0.59	-0.58	-0.22	-0.78	-0.16	-0.17	-0.15
i	0.86	0.82	0.88	0.84	0.77	0.87	0.65	0.57	0.70
x	0.17	-0.00	0.26	0.43	-0.05	0.67	0.33	0.04	0.48
m	0.60	0.48	0.66	0.68	0.52	0.76	0.44	0.37	0.47
tb/y	-0.44	-0.52	-0.41	-0.39	-0.56	-0.31	-0.02	-0.11	0.02
tb	-0.44	-0.51	-0.40	-0.39	-0.56	-0.31			

Notes: Moments are averaged across countries using population weights. Rich Countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, United Kingdom, United States. Emerging Countries: Argentina, Israel, South Korea, Mexico, New Zealand, Peru, Portugal, South Africa, Spain, Turkey, and Uruguay.

Observations on the table:

In quarterly data, as in annual data,

• Business cycles in emerging countries are about twice as volatile as business cycles in rich countries. (Fact 8)

• There is less consumption smoothing in emerging countries than in rich countries. (Fact 9)

• Countercyclicality of government spending increases with income. (Fact 10)

• The trade balance is negatively correlated with output. (Fact 5)

Summary of Chapter 1:

10 Business-Cyle Facts Around the World

Fact 1: [High Global Volatility] The cross-country average standard deviation of output is about twice as large as its U.S. counterpart.

Fact 2: [Excess Consumption Volatility] On average across countries, private consumption including durables is more volatile than output.

Fact 3: [Global Ranking of Volatilities] The ranking of cross-country average standard deviations from top to bottom is imports, investment, exports, government spending, consumption, and output.

Fact 4: [Procyclicality of the Components of Aggregate Demand] On average across countries, consumption, investment, exports, and imports are positively correlated with output.

Fact 5: [Countercyclicality of the Trade Balance and the Current Account] On average across countries, the trade balance, trade-balance-to-output ratio, current account, and current-account-to-output ratio are negatively correlated with output.

Fact 6: [Acyclicality of the Share of Government Consumption in GDP] On average across countries, the share of government consumption in output is roughly uncorrelated with output.

Fact 7: [Persistence] The components of aggregate supply (output and imports) and aggregate demand (consumption, government spending, investment, and exports) are all positively serially correlated.

Fact 8: [Excess Volatility of Poor and Emerging Countries] Business cycles in emerging or poor countries are about twice as volatile as business cycles in rich countries.

Fact 9: [Excess Consumption Volatility in Poor and Emerging Countries] The relative consumption volatility is higher in poor and emerging countries than in rich countries.

Fact 10: [The Countercyclicality of Government Spending Increases with Income] The share of government consumption is countercyclical in rich countries, but acyclical in emerging and poor countries.