Business Cycles

.... in data

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Topical issue: the rapid devaluation of emerging market currencies in 2014

Emerging market currencies

$ per currency, related

| 100 |
| 50 |
| 80 |
| 70 |
| 50 |

Indonesian rupiah
Russian rouble
South African rand
Turkish lira
Brazilian real
Argentine peso

Sources: Schroders, MTS Broker, Westpac, January update, Bloomberg, Thomson Reuters Datastream

Emerging markets: Fear of contagion

By James Kyung

Policy makers from Argentina to Turkey are scrambling to defend their currencies
What is a business cycle?

The business cycle is an economic phenomenon measured by, in terms of the real GDP growth rate, the movement from a peak to a trough (recession) back to a peak (expansion). A recession is loosely defined to be two or more consecutive quarters when the real GDP growth rate is negative.

Business cycles are investigated by a private research organization called The National Bureau of Economic Research (see http://www.nber.org). The NBER has a more subtle definition of recessions:

"A recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales. A recession begins just after the economy reaches a peak of activity and ends as the economy reaches its trough. Between trough and peak, the economy is in an expansion."

For a detailed explanation of how the NBER determines the turning points of cycles, see http://www.nber.org/cycles/recessions.html

Post WWII business cycles

<table>
<thead>
<tr>
<th>Peak Trough</th>
<th>Duration in Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contraction: Peak to Trough</td>
</tr>
<tr>
<td>April 1960-2</td>
<td>February 1961-1</td>
</tr>
<tr>
<td>December 1969-4</td>
<td>November 1970-4</td>
</tr>
<tr>
<td>November 1973-4</td>
<td>March 1975-1</td>
</tr>
<tr>
<td>January 1980-1</td>
<td>July 1980-3</td>
</tr>
<tr>
<td>July 1981-3</td>
<td>November 1982-4</td>
</tr>
<tr>
<td>July 1990-3</td>
<td>March 1991-1</td>
</tr>
<tr>
<td>March 2001-1</td>
<td>November 2001-4</td>
</tr>
<tr>
<td>December 2007-4</td>
<td>June 2009-2</td>
</tr>
</tbody>
</table>

Note the relative duration of contractions relative to expansions.

*Source*: National Bureau of Economic Research, current to February 1, 2014
Historical average of all cycles

<table>
<thead>
<tr>
<th>Average, all cycles:</th>
<th>Duration in Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contraction:</td>
</tr>
<tr>
<td></td>
<td>Peak to Trough</td>
</tr>
<tr>
<td>1854-1919 (16 cycles)</td>
<td>22</td>
</tr>
<tr>
<td>1919-1945 (6 cycles)</td>
<td>18</td>
</tr>
<tr>
<td>1945-2009 (11 cycles)</td>
<td>11</td>
</tr>
</tbody>
</table>

Note how much milder business cycles have become in the modern (post WWII) era.

Source: Same as previous slide. Data are current to February 1, 2014.

Real GDP Growth: 1960-2013

How do the components compare?

Average: 3.13%

Green lines: BC troughs

Simpler definition: Below 0.0% for 2 consecutive quarters is a recession.

Source: Bureau of Economic Analysis, National Income and Product Accounts, Table 1.1.
Consumption 1960-2013

Note the relative volatility of durables and the stability of services.

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
Investment 1960-2013

Compare this to consumption ranges!

Remember that these are sensitive to interest rates.

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

Government Purchases, 1960-2013

"Automatic stabilizer?"
Elementary Macroeconomic Analysis

We want to compare average growth rates and especially standard deviations (or other measures of dispersion) for the components of GDP to GDP.

- Geometric Mean or LN growth rates: Shows the growing or declining importance of the component over time. (Geometric mean or natural logs should be used because the growth rate is a geometric series).

- 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.

A good proxy for cycle candidates

Real GDP geometric mean growth rate was 0.0304 1960-2010, geometric standard deviation is 0.0211

When compared to GDP as a whole, if a component has a wider standard deviation it contributes to cycles, if smaller, it dampens cycles.
### Three alternative growth rates
(point by point estimation from time-series data)

<table>
<thead>
<tr>
<th>t</th>
<th>x</th>
<th>Discrete: ( \frac{X_{t+1} - X_t}{X_t} = \frac{X_{t+1}}{X_t} - 1 )</th>
<th>Geometric Discrete: ( \frac{X_{t+1}}{X_t} )</th>
<th>Continuous (log): ( \ln \left( \frac{X_{t+1}}{X_t} \right) = \ln(X_{t+1}) - \ln(X_t) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
<td>0.15</td>
<td>1.15</td>
<td>0.13976</td>
</tr>
<tr>
<td>1</td>
<td>115</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

---

### ... calculating geometric mean and geometric standard deviation (from discrete-converted data)

Geometric Mean value of growth rate:

\[
\mu_{gx} = \left( \prod_{i=1}^{n} X_i \right)^{1/n}
\]

or

\[
\mu_{gx} = e^{\frac{1}{n} \sum_{i=1}^{n} \ln(X_i)}
\]

Geometric standard deviation of the growth rate:

\[
\sigma_{gx} = \sqrt{\frac{1}{t} \sum_{t=1}^{t} \left[ \ln(X_t) - \ln(\mu_{gx}) \right]^2}
\]

Typically used to calculate the mean and dispersion of a log-normal distribution, here we are stating that this must be used to the same for time-series data transformed to discrete rather than continuous growth rates.

Remember – the growth rate will be expressed as 1.15 rather than 0.15.
Real GDP component growth and standard deviation, 1960-2010

<table>
<thead>
<tr>
<th>Gross domestic product</th>
<th>% GDP</th>
<th>Geom Mean</th>
<th>Geom StdDev</th>
<th>2010-4 IPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durable goods</td>
<td>7.6</td>
<td>5.07</td>
<td>5.52</td>
<td>91.7</td>
</tr>
<tr>
<td>Nondurable goods</td>
<td>15.6</td>
<td>2.47</td>
<td>1.58</td>
<td>114.1</td>
</tr>
<tr>
<td>Services</td>
<td>47.2</td>
<td>3.35</td>
<td>1.38</td>
<td>114.6</td>
</tr>
<tr>
<td>Nonresidential construction</td>
<td>2.9</td>
<td>4.49</td>
<td>6.87</td>
<td>103.9</td>
</tr>
<tr>
<td>Equipment and software</td>
<td>7.6</td>
<td>5.88</td>
<td>7.32</td>
<td>97.6</td>
</tr>
<tr>
<td>Residential construction</td>
<td>2.3</td>
<td>0.83</td>
<td>12.97</td>
<td>102.5</td>
</tr>
<tr>
<td>Federal purchases</td>
<td>8.4</td>
<td>1.58</td>
<td>4.13</td>
<td>113.2</td>
</tr>
<tr>
<td>State and local purchases</td>
<td>12.1</td>
<td>2.72</td>
<td>3.16</td>
<td>120.3</td>
</tr>
</tbody>
</table>

Key: Contributes to cycles

IPD is implicit price deflator base 2005=100, the higher the number, the higher the rate of inflation in that category.

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 47% of GDP, to Residential Construction, which constitutes only 2.3%. The volatility of GDP, which we here represent by standard deviation of its growth rate, will obviously be impacted by the volatility of its components, which we represent by the individual standard deviations of their growth rates, derived from their variances.

Generally, the higher the volatility of the component relative to the volatility of GDP, the more that component is raising the volatility of GDP. The net impact is also determined by the weight of the component. The higher the weight, the more the impact. Maybe you can see it in the math.

\[ \text{(You are not accountable for the material below):} \]

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.

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

Clearly the higher the weight, the higher the effect.
This slide, from the last lecture, shows that services have grown in relative importance compared to other categories of consumption. But the volatility slide showed that durables have grown faster than services and even GDP. How do we reconcile this apparent contradiction?

Look at the IPD numbers, which measures inflation. What does this imply? (Price effect).

Certain conclusions ...

- This has become a “service” economy
  - and that has stabilized the cycle because the volatility of services, as measured by relative standard deviation, is very low
- All classes of investment contribute to the cycle
- The two largest business cycle contributors are typically
  - Durables (consumer)
  - Residential structures
- This is especially apparent when comparing component standard deviations to GDP (the aggregate)
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.

Inflation and interest rates

... and the business cycle

Source: All CPI numbers are from The Bureau of Labor Statistics
Inflation: why a problem?

• Reallocates income and wealth unfairly
  – from lender to borrower
  – from salaried
  – from elderly (unless prepared)
  – to speculators
• Injects tremendous uncertainty
  – curbs investment

Inflation: (continued)

• Seriously threatens financial markets
  – especially stocks
• Invites a policy response
  – the modern FRS crunch
• As goes inflation, so go interest rates
CPI Inflation Rate: 1960-2013

Average: 4%

Green lines: BC troughs

Acceptable level (about 2.5%)

Double-digit hyperinflation

CPI for urban consumers, U.S. city average, all items, NSA. Source: Bureau of Labor Statistics

CPI and Mortgage and 10-year Treasury Bond Rates: 1972-2013

What story is found here?
As goes inflation, so will go mortgage rates and other key rates.

Source for interest rates: Federal Reserve Board data download program, H-15 series
Domestic Non-financial Debt / National Income
1962-2012

This is the total net indebtedness of all parties in the U.S. economy (non-financial eliminates double counting) divided by National Income. This is a national proxy for our debt divided by our capacity to pay it.

This is at the root of why we are in trouble.

Source (debt): Federal Reserve Flow of Funds Accounts, Z1 statistical release

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Business Cycle Mechanics
... the pathology of the business cycle

Sammy the Seagull, consultant
The point here is to examine some general features of all business cycles.

... at the trough

- Low interest rates
  - ... and a monetary stimulus
- Pent up consumer demand
  - ... average auto age an example
- Businesses lean and mean

... the expansion

- Consumer-led (durables)
- Sometimes 5+% growth very early
- Real estate often lags
- Productivity gains can substantially increase the time period and the rate of gain
... near the peak

✓ Bottlenecks in supply arise
✓ Inflation/interest rates rising
  • ... produces an FRS policy reaction
✓ Rates of profit are squeezed
  • ... which sometimes impacts the stock market
  • ... which can engender a negative “wealth effect”
✓ Sometimes speculative excess

Unemployment

✓ ... rises sharply during the recession
✓ ... sometimes continues to rise into the recovery

.. this is sometimes a long lag variable
Unemployment Rate
1960-2012, annual, % of civilian workforce

Specifically, all wage earners above age 16, seasonally adjusted.
Mean: 6.09%

Red represents the trough of business cycles. In recent cycles, unemployment lags the cycle by a few months.

How this expansion, though, is not typical

Private employment is very slow to respond ...

Why no bad recession in the early 2000s?

- 1995-2000: **Wealth effect** of rising stock market
- 2000-2004: **Wealth effect** of rising home equity
- Easy monetary policy … record low interest rates
- Generous fiscal policy … heavy tax cuts

Why a slow recovery now?

- Bad mortgages/credit crisis still hammering housing.
- Credit crisis spread past financial sector
- Negative *wealth effects* of declining home equity values
- Negative *wealth effects* of declining stock and corporate bond markets
- Unemployment remains stubbornly high

This graph is now old, but the effect is still current ...
Policy Stimulators

• Huge budget deficits from tax cuts and spending increases
  ➢ ... more than $1.4 trillion deficit in 2009 and above $1 trillion since until this year.
  ➢ … but these can create problems for the future
• Federal Reserve monetary and interest rate stimulus (QE3)
  ➢ ... purchasing $85 billion per month of U.S. Treasury securities and mortgages
  ➢ … but this can lead to excessive debt formation
• Now, in 2014, as this class is taught
  ➢ QE3 is being rolled back to $75 billion per month, which so far has had a disturbing effect upon the worlds financial markets, although that may abate.