Great moderation or “Will o’ the Wisp”? The Great Moderation that Never Was

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Cyclical Movements in US GDP components....

Fig. 1. US GDP and components: log annual change.
.....and in UK GDP components

Fig. 2. UK GDP and components: log annual change.
Cycle lengths studied

<table>
<thead>
<tr>
<th>Scale</th>
<th>Quarterly frequency resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>d1</td>
<td>2–4 = 6 m-1 yr</td>
</tr>
<tr>
<td>d2</td>
<td>4–8 = 1–2 yrs</td>
</tr>
<tr>
<td>d3</td>
<td>8–16 = 2–4 yrs</td>
</tr>
<tr>
<td>d4</td>
<td>16–32 = 4–8 yrs</td>
</tr>
<tr>
<td>d5</td>
<td>32–64 = 8–16 yrs</td>
</tr>
<tr>
<td>d6</td>
<td>64–128 = 16–3 2yrs</td>
</tr>
<tr>
<td>d7</td>
<td>etc.</td>
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The Main Cycles in US GDP
(s=cycles longer than 32 years)

Fig. 3. MODWT decomposition of log change in US GDP.
Variance decomposition (weight of each cycle): US

Fig. 4. Variance decomposition by scale for US GDP.
Cyclical Decomposition of UK GDP

Fig. 5. MODWT decomposition of log change in UK GDP.
Variance decomposition: UK GDP

Fig. 6. Variance decomposition by scale for UK GDP.
Cyclical Variances/Strengths over Time: US GDP

Fig. 7. Rolling variance for US GDP growth.
Cycle strengths: US Consumption

Fig. 8. Rolling variance for US real consumption growth.
Cycle strengths: US Investment
Cycle Strengths in the US: government spending

Fig. 10. Rolling variance for US real government expenditure growth.
Cycle strengths in the US: exports

Fig. 11. Rolling variances for real US export growth.
Cycle strengths in the UK: GDP

Fig. 12. Rolling variances for real UK economic growth.
Modelling of volatility transfers:

Specifically, for aggregate demand we have

$$y_t = a_1 E_t y_{t+1} + (1 - a_1) y_{t-1} + a_2 (r_t - E_t \pi_{t+1}) + \varepsilon_t$$  \hspace{1cm} (1)

Aggregate supply is given by:

$$\pi_t = b_1 E_t \pi_{t+1} + (1 - b_1) \pi_{t-1} + b_2 y_t + \eta_t$$  \hspace{1cm} (2)

The Taylor rule for monetary policy with an additional term for interest rate smoothing is given by:

$$r_t = c_1 (\pi_t - \pi^*) + c_2 y_t + c_3 r_{t-1} + d E_t r_{t+1} + u_t$$  \hspace{1cm} (3)

where the variables have their usual interpretations: $y_t$ is the output gap (a value > 0 means above trend), $\pi$ = the rate of inflation, $\pi^*$ = the inflation target, $r_t$ = nominal interest rate (policy rate), $E_t$ denotes an expectation conditioned on the information set available at time $t$, and $\varepsilon_t$, $\eta_t$ and $u_t$ are random shocks. The policy parameters are $c_1$ and $c_2$, although the policymakers could in principle also choose $c_3$ and $d$ to control the degree of smoothing.
Parameter restrictions

We expect all parameters to be positive except $a_2$. Also $a_1 > 1$ and $b_1 > 1$, and $c_1 > 1$ (the Taylor principle holds). We further suppose that $a_2 < 0$ and that it is likely to be small in numerical terms (the proportional impact effect of higher real interest rates on the output gap is likely to be quite a lot less than one-for-one); and likewise that $b_2 > 1$ (the impact effect of the output gap on inflation is likely to be greater than one-to-one); and that $c_2 > 0$ is small (by convention, the output gap has a limited influence on central bank monetary policy, except in cases of severe recession). Finally interest smoothing implies $c_3 > 0$, $d > 0$, but small relative to the influence of policy failures $\pi_t - \pi^*$ and $y_t \neq 0$. 
Roots and stability

\[
\lambda_{1,2} = \frac{1 - a_2 b_2 c_1 - a_2 c_2 \pm \sqrt{(a_2 b_2 c_1 - 1)^2 - 4a_1(1 - a_1)}}{2a_1}
\]

\[
\lambda_{3,4} = \frac{a_2(b_2 c_1 + c_2) - 1 \pm \sqrt{[1 - a_2(b_2 c_1 + c_2)]^2 - 4b_1(a_2 c_2 - 1)^2(b_2 - 1)}}{2b_1(a_2 c_2 - 1)}
\]

and

\[
\lambda_{5,6} = \frac{1 - a_2 b_2 c_1 - a_2 c_2 \pm \sqrt{[a_2(b_2 c_1 + c_2) - 1]^2 + 4c_2d}}{2d}
\]

There are therefore 3 pairs of roots, of which \(\lambda_{1,2}\) and \(\lambda_{3,4}\) maybe complex, but \(\lambda_{5,6}\) cannot be because the terms under the square root in (6) are always non-negative under our parameter restrictions. Note that we expect \(c_2 > 0\) to be small in the great moderation period, and likewise \(c_3 > 0\) and \(d > 0\) to create the observed stability of monetary policy.

\(\lambda_{1,2}\) are complex if \(4a_1^2 - 4a_1 > [a_2 b_2 c_1^2 + 1 - 2a_2 b_2 c_1]\). That is, when:

\[
a_1 > 0.5 + 0.5\sqrt{1 + (a_2 b_2 c_1 - 1)^2}
\]
Volatility transfers from business cycles is achieved by increasing ..... 

\[
\frac{\partial |\lambda_{1,2}|}{\partial c_1} = \frac{a_2b_2(2 + a_2c_2)}{2a_1\sqrt{4(a_1 - 1)a_1 + (a_2c_2)^2 - 2a_2c_2(1 - a_2b_2c_1)}} < 0
\]

\[
\frac{\partial |\lambda_{1,2}|}{\partial c_2} = \frac{-a_2[1 - a_2(b_2c_1 + c_2)]}{2a_1\sqrt{-(a_2b_2c_1 - 1)^2 + 4(a_1 - 1)a_1 + [1 - a_2(b_2c_1 + c_2)]^2}} > 0
\]

since the square root term is again positive as in (10) and \(a_2\) is small. Thus increasing inflation aversion, and therefore higher \(c_1\), as was evident during the "great moderation" will decrease the size of the \(\lambda_{1,2}\) cycles. Similarly, a decrease in the attention paid to output stabilization and growth, and therefore a lower \(c_2\), again evident in the "great moderation", will also decrease the size of the \(\lambda_{1,2}\) cycles.
.... inflation aversion and lower attention to output stability (conservative policies)

\[ |\lambda_{3,4}| = \left[ \frac{-\left(1 - a_2 (b_2 c_1 + c_2)\right)^2 + 4b_1 (b_2 - 1) (a_2 c_2 - 1)^2 a_1 + \left[1 - a_2 (b_2 c_1 + c_2)\right]^2}{4b_1^2 (a_2 c_2 - 1)^2} \right]^{0.5} \]  

(12)

\[ = \left[ \frac{b_2 - 1}{b_1} \right]^{0.5} \]  

(13)

So the partial derivatives of \( |\lambda_{3,4}| \) with respect to \( c_1 \) and \( c_2 \) are both zero, as can be checked directly.

In other words, there will always be a shift in relative power to/from \( \lambda_{1,2} \), relative to \( \lambda_{3,4} \), when \( c_1 \) and/or \( c_2 \) change. In fact relative power will pass from \( \lambda_{1,2} \) to \( \lambda_{3,4} \) when either \( c_1 \) increases or \( c_2 \) falls, as happened in the great moderation episode. The implication is that the great moderation may not have been a "moderation" in a cyclical sense at all; but a situation in which cyclical power shifted from the business cycle lengths (the sole focus of attention in previous studies) to longer cycles which lie outside the business cycle frequency
Transfers of power between business and longer cycles

To see which root dominates to start with, suppose \( \lambda_{1,2} \) represents the business cycle. This cycle will dominate the economy before the moderation or change in policy parameters if \( |\lambda_{1,2}| > |\lambda_{3,4}| \); that is, if:

\[
\frac{4(a_1 - 1)a_1 - (a_2 b_2 c_1 - 1)^2 + [1 - a_2(b_2 c_1 + c_2)]^2}{4a_1^2} = \frac{4a_1(a_1 - 1) + a_2 c_2[a_2 c_2 - 2b_2 c_2 + 1]}{4a_1^2}
\]

\[
> \frac{b_2 - 1}{b_1}
\]

This inequality is easily satisfied; for example, when \( a_2 < 0 \) is relatively small (as we expect), \( a_1 > 1 \), and \( b_1 \) relatively large (meaning that the main issue is inflation persistence); and/or when \( b_2 \to 1 \), as in the Rogoff and Barro-Gordon applications\(^3\). Then when \( c_1 \) increases or \( c_2 \) falls, the power of the business and longer cycles swap around and the mirage of a great moderation follows.