The Slowdown in GDP Growth: Decomposition and Some Implications

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The Slow Recovery

Real GDP (log) and NBER peak-to-peak trend
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1960q1 1970q1 1980q1 1990q1 2000q1 2010q1 2020q1
The Slow Recovery

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The Slow Recovery

Real Gross Domestic Product and Trends, 1960–2012

Trillions of chained 2005 dollars, log scale

Note: Shading denotes recession. Trend lines represent the average growth rate between successive business-cycle peaks.
Real GDP: 4Q growth rates and trends

<table>
<thead>
<tr>
<th>Year</th>
<th>Trend GDP growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>3.8%</td>
</tr>
<tr>
<td>1975</td>
<td>3.5%</td>
</tr>
<tr>
<td>1985</td>
<td>3.1%</td>
</tr>
<tr>
<td>1995</td>
<td>3.0%</td>
</tr>
<tr>
<td>2005</td>
<td>2.5%</td>
</tr>
<tr>
<td>2010</td>
<td>2.1%</td>
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</tbody>
</table>
Outline

1. Accounting framework: supply-side decomposition

2. Econometric approach to estimating trends; cyclical adjustment

3. Discussion of decomposition components (growth rates):
   a) Decomposition
   b) Additional discussion of components:
      i. Productivity
      ii. Weekly hours
      iii. Labor force participation

4. Selected implications
   a) [Fiscal: deficit, debt, Social Security, etc.]
   b) [The slow recovery]
   c) Equilibrium real rate, r-g, and monetary policy
Selected References

Selected references on aspects of the GDP slowdown

Aaronson, S. et. al., *BPEA* (2014) (on LFPR)
Hall, *NBER Macro Annual* (2014)
Hall (ms, 2014)
ASSA session on secular stagnation (2015) (Gordon, Summers, Eichengreen; Hall, Nordhaus, Mankiw)
1. Accounting Framework: Supply-Side Decomposition

Supply side decomposition:

\[ GDP_t = \frac{GDP_t}{\text{Hours}_t} \times \frac{\text{Hours}_t}{\text{Worker}_t} \times \frac{\text{Workers}_t}{\text{LaborForce}_t} \times \frac{\text{LF}_t}{\text{Population}_t} \times \text{Population}_t \]

Data note:
- Hours, workers, labor force, LFPR are all economy-wide, measured from the household survey. (Hours data: Gordon (2014); Hall)
- Population: Census, adjusted and unadjusted

In growth rates:

\[ \Delta \ln GDP_t = \Delta \ln Productivity_t + \Delta \ln WklyHrs_t + \Delta \ln EmpRate_t + \Delta \ln LFPR_t + \Delta \ln Pop_t \]

Note: EmpRate = the employment rate = 1 – unemployment rate, which is almost entirely cyclical – so ignore for this long-run analysis (makes negligible contribution)
2. Econometrics: The End-Point Problem of Trend Estimation

Total LFPR and 1970-2007 time series trend
2. Econometrics: Models for Cyclically-Adjusted Trend

**Econometric task:** Estimate low-frequency movements in $\Delta y_t = \Delta \ln(LFPR_t)$

**Option 1: UC model**

\[
\Delta y_t = \mu_t + \beta(L)u_t^{gap} + v_t,
\]

\[
\mu_t = \mu_{t-1} + \eta_t,
\]

\[
(v_t, \eta_t) \text{ i.i.d. } N(0, diag)
\]

- Estimation by MLE/Kalman filter
- K Smoother provides estimates of $\text{var}(\mu_t)$
- $\beta(L)$ $T^{1/2}$-consistently estimated
- Optimal filter implied by time series model
- End points handled (in effect) by model-based projection of $(\mu_t, v_t)$
- Estimated trends aggregate over series in the decomposition if the model parameters are the same for each series

**Option 2: Partially linear regression**

\[
\Delta y_t = \mu_t + \beta(L)u_t^{gap} + v_t,
\]

\[
\mu_t = \mu(t / T),
\]

$\mu''(.)$ is bdd and cts.

- Estimation by kernel methods (or extensions – local linear trend)
- Asymptotics provides $\text{SE}(\mu)$
- $\beta(L)$ $T^{1/2}$-consistently estimated
- Optimal filter implied by $\mu''$
- End points handled by truncation of filter and reweighting (so asymmetric filter)
- Estimated trends aggregate over series in the decomposition if the kernel is the same for each series

**References:** Harvey (1989); Gordon (2014)

Comparison of implied filters

Filter weights for MA(60), Bandpass ($\omega_0 = 200$), Biweight ($m = 100$), and UC model (local level) – no UGAP term
2. Econometrics: Partially Linear Regression Model – odds & ends

\[ \Delta y_t = \mu_t + \beta(L)u_{t}^{\text{gap}} + \nu_t \]

Estimation

• Options for trend:
  o Kernel smoother (the choice here)
  o Local polynomial (local linear trend)
  o Global polynomial (many drawbacks, especially end-points)

• 2-step kernel estimation of \( \beta(L) \):
  i. Deviate LFPR, u-gap from low-frequency trend (biweight kernel, BW = 40)
  ii. Regress deviated LFPR on deviated u-gap (\( t+2, t+1, \ldots, t-8 \))
     ➢ Smoothed residual (biweight kernel, BW = 72) is cyclically-adjusted estimate of \( \mu_t \)
     ➢ Trend in \( y_t \) is cumulated trend in \( \Delta y_t \)

• Estimate on 1959q1-2007q4 – so cyclical coeffs estimated through 2007q4
• Have done many robust checks, alternative estimators (local linear trend), etc.
3. Supply-side growth rate decomposition

\[ \Delta \ln GDP_t = \Delta \ln Productivity_t + \Delta \ln WklyHrs_t + \Delta \ln EmpRate_t + \Delta \ln LFPR_t + \Delta \ln Pop_t \]

Economy-wide productivity: 4Q growth rates and trends
\[ \Delta \ln GDP_t = \Delta \ln Productivity_t + \Delta \ln WklyHrs_t + \Delta \ln EmpRate_t + \Delta \ln LFPR_t + \Delta \ln Pop_t \]

**Hours per employee (HH): 4Q growth rates and trends**

- **d4lwklyhrshh**: Seasonal differences
- **wklyhrshh: cycl. adj. trend**: Cyclical adjusted trend
- **wklyhrshh: MA(40) trend**: Moving average of order 40
\[ \Delta \ln GDP_t = \Delta \ln Productivity_t + \Delta \ln WklyHrs_t + \Delta \ln EmpRate_t + \Delta \ln LFPR_t + \Delta \ln Pop_t \]

**LFPR: 4Q growth rates and trends**

![Graph showing LFPR growth rates and trends](chart.png)
\( \Delta \ln GDP_t = \Delta \ln \text{Productivity}_t + \Delta \ln WklyHrs_t + \Delta \ln \text{EmpRate}_t + \Delta \ln LFPR_t + \Delta \ln \text{Pop}_t \)
\[
\Delta \ln GDP_t = \Delta \ln Productivity_t + \Delta \ln WklyHrs_t + \Delta \ln EmpRate_t + \Delta \ln LFPR_t + \Delta \ln Pop_t
\]
\[ \Delta \ln GDP_t = \Delta \ln Productivity_t + \Delta \ln WklyHrs_t + \Delta \ln EmpRate_t + \Delta \ln LFPR_t + \Delta \ln Pop_t \]

**Real GDP: 4Q growth rates and trends**

![Graph showing Real GDP: 4Q growth rates and trends with time from 1960q1 to 2010q1.](image-url)
3b(i) Productivity

Economy-wide productivity: 4Q growth rates and trends

-2 0 2 4 6

1960q1 1970q1 1980q1 1990q1 2000q1 2010q1

d4lrgdpperhh
rgdpperhh: cycl. adj. trend
rgdpperhh: MA(40) trend
The past ~10 years have seen very slow productivity growth: Are we reverting to a slow-growth period (Gordon)?

Four observations
1. Data remark: Economy-wide v. NFB productivity growth
2. Is the slow productivity growth a normal cyclical movement, or unusual?
3. Regime shifts in productivity growth?
4. A stray piece of evidence from agriculture
1. Data remark: Economy-wide v. NFB productivity growth

Labor productivity: 4-quarter growth:
Non-farm business (blue) and economy-wide (green)
2. Is the slow productivity growth a normal cyclical movement, or unusual?

NFB Labor Productivity, 4-quarter growth, and cyclical component
- Cyclical component estimated **1960q1-2007q4**
- 95% confidence interval for predicted cyclical component is shown in orange
- No time-varying parameters
2. Is the slow productivity growth a normal cyclical movement, or unusual?

NFB Labor Productivity, 4-quarter growth, and cyclical component
• Cyclical component estimated 1984q1-2007q4
• 95% confidence interval for predicted cyclical component is shown in orange
• No time-varying parameters
Productivity

3. Regime shifts in productivity growth?

HAR break tests (2-regime), breaks in 1974 and 1998:

<table>
<thead>
<tr>
<th></th>
<th>$F$-stat</th>
<th>$p$ (given break)</th>
<th>$p$ (break estimated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor productivity:</td>
<td>4.21</td>
<td>.020</td>
<td>&gt;0.9</td>
</tr>
<tr>
<td>MFP</td>
<td>6.34</td>
<td>.003</td>
<td>0.8</td>
</tr>
<tr>
<td>Joint (SUR, same dates)</td>
<td>3.01</td>
<td>.017</td>
<td>&gt;0.9</td>
</tr>
</tbody>
</table>
4. A stray piece of evidence from agriculture

Agricultural Productivity
- Labor productivity growth (7r MA)
- TFP growth (7r MA)
- Labor productivity growth, 1868-2011 (3.2%)

- Outputs and inputs are relatively well-measured
- Little evidence of a labor productivity or TFP slowdown
- In fact, ag. labor productivity growth 1975-present fluctuates around its post-1868 average [Iowa corn, Parker and Klein (1966), 1870 Census of Mfgrs, BLS, USDA; CEA ERP (2014)]
Employee-hours

Hours per employee (HH): 4Q growth rates and trends

- d4lwklyhrshh
- wklyhrshh: cycl. adj. trend
- wklyhrshh: MA(40) trend
• Overall weekly hours fell during the 1970s, have fallen less since then
• Shift-share decomposition suggests that the decline in hours is largely compositional
• Women work part-time more than men – both shares are fairly stable – and entered the workforce strongly in the 1970s, with a plateau around 2000
• Full-time and part-time hours have remained remarkably steady
• There has also been a shift from goods-producing industries (with hours around 40) to services (with lower hours, around 32.5 since the mid-80s.)
Labor Force Participation Rate (LFPR)

LFPR: 4Q growth rates and trends

1960q1 1970q1 1980q1 1990q1 2000q1 2010q1

d4lfpr  Ifpr: cycl. adj. trend  Ifpr: MA(40) trend
Labor Force Participation Rate (LFPR)
Currently, the dominant trend is the retirement of the Baby Boom.

The pure aging effect is calculated by holding the 2007 age profile constant and letting the population age (i.e. retire at historically normal rates).

The pure aging trend and the time series trends are virtually identical.
LFPR, Women 16+

Women 16+

- Women 16+ (green line)
- Cyclically adjusted trend (red line)
- Cyclically adjusted trend + cycle (blue line)
LFPR, men 16+

Men, 16+

Time:
- 1970q1
- 1975q1
- 1980q1
- 1985q1
- 1990q1
- 1995q1
- 2000q1
- 2005q1
- 2010q1
- 2015q1

Graph:
- Men, 16+
- Cyclically adj. trend
- Cyclically adj. trend + cycle
For men, the downward decline in the LFPR has been ongoing for decades – that isn’t an aging effect.

Cyclical LFPR movements for men 25-54 are small.

A key question is whether this preexisting non-aging trend decline will continue, on top of the aging effect?
Long-term unemployment (>26 weeks)

Trends in GDP growth and long-term unemployment rate (inverted)

- LT-U trend, not cyclically adjusted
- GDP trend, not cyclically adjusted
- GDP trend, cyclically adjusted
Since 1985, the 10-year Treasury rate has followed the decline in real GDP growth.

Both series are noisy and cyclical...
During the late 60’s and 70’s, inflation forecasts were too low.
During the late 80’s and 90’s, inflation forecasts were too high.
During 2000-2007, inflation forecasts were right on average and r-g averaged ~0.
This points to r-g close to zero; the post-1960 average is 0.06.
A decline in g of 0.9pp since 1995 corresponds to a comparable decline in r.