Sectoral Productivity and Economic Growth in Japan, 1970-98: An Empirical Analysis Based on the JIP Database

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1. Macro Growth Accounting 1

We assume that a macro production function at time $t$ can be expressed as the following function of capital input $K_t$, labor input $L_t$, and an index of the technology level $T_t$.

$$Y_{j,t} = F(K_t, L_t, T_t)$$  \hspace{1cm} (1)

where $Y_t$ denotes real GDP at time $t$. We assume constant returns to scale. The capital input $K_t$ is derived by an aggregation of several types of assets, structures and equipment. The labor input $L_t$ is an aggregate of the number of workers cross-classified by sex, age, and educational attainment.
1. Macro Growth Accounting 2

By differentiating the production function (1) over time, we get

\[ d\ln Y_t = s_{k,t}^{av} \ d\ln K_t + s_{l,t}^{av} \ d\ln L_t + d\ln A_t \]

where \( d\ln Y_t \), \( d\ln K_t \), and \( d\ln L_t \) denote \( \ln Y_t - \ln Y_{t-1}, \ln K_t - \ln K_{t-1}, \) and \( \ln L_t - \ln L_{t-1} \) respectively. \( s_{k,t}^{av} \) (\( s_{l,t}^{av} \)) denote the average of cost share of capital (labor) at time \( t-1 \) and time \( t \). \( s_{k,t}^{av} \) is defined by

\[ s_{k,t}^{av} = (w_{k,t} K_t/p_t Y_t + w_{k,t-1} K_{t-1}/p_{t-1} Y_{t-1})/2 \]

where \( w_{k,t} \) denotes service price of capital at time \( t \).
1. Macro Growth Accounting 3

• $d\ln A_t$ denotes $(\partial \ln F/ \partial \ln T)d\ln T_t$, the contribution of technology improvement $\ln T_t - \ln T_{t-1}$ to the increase in production at the macro-level.
Factors contributing to the fall in Japan’s growth rate: 1) decline in capital accumulation ratio, 2) decrease in labor input (numbers & hours), 3) decline in labor quality growth

Sources of Economic Growth: US–Japan Comparison


<table>
<thead>
<tr>
<th></th>
<th>Real GDP Growth</th>
<th>Man-hour growth</th>
<th>Labor productivity (GDP/man-hour) growth</th>
<th>TFP growth</th>
<th>Contribution of labor quality growth</th>
<th>Contribution of capital services/man-hour growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973–1995</td>
<td>2.78%</td>
<td>1.44%</td>
<td>1.33%</td>
<td>0.26%</td>
<td>0.27%</td>
<td>0.80%</td>
</tr>
<tr>
<td>1995–2000</td>
<td>4.07%</td>
<td>1.99%</td>
<td>2.07%</td>
<td>0.62%</td>
<td>0.21%</td>
<td>1.24%</td>
</tr>
</tbody>
</table>


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</thead>
<tbody>
<tr>
<td>1973–83</td>
<td>3.56%</td>
<td>1.53%</td>
<td>2.03%</td>
<td>-0.30%</td>
<td>0.65%</td>
<td>1.88%</td>
</tr>
<tr>
<td>1983–91</td>
<td>3.94%</td>
<td>1.79%</td>
<td>2.15%</td>
<td>0.40%</td>
<td>0.46%</td>
<td>1.29%</td>
</tr>
<tr>
<td>1991–98</td>
<td>1.25%</td>
<td>-0.08%</td>
<td>1.34%</td>
<td>0.03%</td>
<td>0.21%</td>
<td>1.10%</td>
</tr>
</tbody>
</table>

Calculated from JIP database.
4. TFP Growth at the 3-Digit Industry Level

For the growth accounting of 84 sectors we use the following equation.

\[ d\ln A_{j,t} = d\ln Q_{j,t} - (s^{av}_{A_k,j,t} d\ln Z_{j,t} K_{j,t} + s^{av}_{A_L,j,t} d\ln L_{j,t} + s^{av}_{A_M,j,t} d\ln M_{j,t}) \]

Where \( d\ln A_{j,t} \) denotes the TFP growth rate from time \( t-1 \) to \( t \) in sector \( j \), while \( d\ln Q_{j,t} \) denotes the growth rate of real gross output. \( K_{j,t}, L_{j,t}, \) and \( M_{j,t} \) denote the capital, labor, and real intermediate input in sector \( j \) at time \( t \). \( M_{j,t} \) is a composite index of 84 commodities and services, which is based on the annual real IO tables of the JIP Database. \( Z_{j,t} \) denotes the capacity utilization rate. \( s^{av}_{A_f,j,t} \) denote the average of cost share of factor \( f \) in sector \( j \) at time \( t-1 \) and time \( t \).
TFP growth accelerated in industries – retail, wholesale, broadcasting, communications, banking, insurance, real estate and other services to individuals – where restrictions were relaxed.