TECHNOLOGICAL CATCH UP AND DIVERGING INCOMES PATTERNS OF ECONOMIC GROWTH 1960-88

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Introduction and Summary

The pattern of worldwide economic growth over the last three decades displays diverging growth paths. Most economies shared the experience of high growth rates in the 1950s and 1960s, reverting in the 1970s and 1980s to rates which are more normal by historical standards. At the same time, however, income disparities across the national economies of the world have been widening. The richer economies have, in per capita terms, been growing faster than the middle-income economies, which in turn have outpaced the poorest economies. Moreover, within each of these broadly defined groups, income levels have been diverging.

The divergence of growth paths of GDP per capita is perhaps surprising. The post war period has witnessed an explosion in world trade, communications and the dissemination of information - all factors which might be supposed to both encourage and enable the technologically backward economies to learn from and adopt the production techniques of the more advanced. At the same time, the integration of capital markets, the emerging dominance of trans-national corporations and the development of both transport and communications technology might be supposed to lead to growth-enhancing investment in the poorer, low wage economies.

The first of these conjectures is supported by an analysis of the sources of economic growth. There is indeed evidence to support the technological spillover hypothesis: the less advanced economies have tended to experience faster growth in multi-factor productivity (although not necessarily with respect to manufacturing technology in the poorest economies). It appears, therefore, that income divergence has occurred in spite of technological catching up. The proximate causes are lower rates of investment in the poorer countries allied to declining rates of labour force participation in the poorer countries and rising participation in the richer countries.
There are several explanations for the divergence of the growth paths of capital and labour inputs. Employment growth, relative to total population, is strongly enhanced in the medium term by the demographic transition from high to low rates of population growth. The poorest group of countries have tended to experience, however, either stable or even increasing rates of population growth over the last three decades. Population has tended to decelerate only in those countries which already had higher income levels by 1960.

There is some weak statistical evidence that aggregate rates of return on capital investment across poorer countries may be higher than in richer countries, in which case their low investment rates might be attributable to capital barriers and an inability to generate substantial domestic savings out of near-subsistence incomes. Moreover, it seems likely that complementarities between private capital investment on the one hand and human capital and public infrastructure on the other, lower the private returns to investment in the poorer economies.

1. The Pattern of Growth 1960-64 to 1984-88 for 113 countries

Alan Summers and Robert Heston (1991) continue to feed the on-going analysis of worldwide economic growth with improved estimates of real GDP and its principal components for an ever increasing number of countries. The sample of countries used here consists of 113 out of their total of 138. The 25 exclusions were made either because of lack of data on key variables before 1965, or because a country belongs to OPEC. The sample breaks down into 42 African countries, 25 American, 20 Asian, 22 European and 4 Southern Pacific.

I take as the base for measurement of economic growth the annual average value of real GDP (1985 US$) over the period 1960-64. The end-point is the average for the period 1984-88. The purpose of taking these five year averages is to remove cyclical variation from the cross-country comparisons. Real output is deflated either by population or by the workforce to give approximate indicators of per capita incomes and labour productivity. Examination of the ranked productivity measure reveals natural breaks which divide the sample into three (in a similar way to Baumol's, 1986, divisions). The high productivity group, with 1960-64 output per worker above $6,500 contains most of the European economies and the richer American and Asian economies. The low productivity group, with output per worker below $2,800 contains most of the African economies and the poorer Asian economies. The middle group contains mostly Asian and Latin American countries. Since output per head of population and output per worker are highly correlated (r=0.98), I also refer to these groups as the rich, poor and middle-income economies - although such descriptions ignore variations in average incomes which may be due to foreign ownership and the terms of trade.

Table 1 displays some of the key statistics for the entire sample and for each of the three groups. Rows 4 and 5 reveal that while the average growth rates of GDP per worker are very similar for the three groups (ranging from 1.90 to 2.06 percent per annum for the rich and middle respectively), growth of GDP per capita is substantially lower in the poor group (1.36 percent per annum) than in the middle group (2.16%) and the rich group (2.49%). In other words, although average labour productivity across the three groups displays only a weak tendency towards divergence, this tendency is amplified strongly when output is measured per head of population. The proximate reason is given in rows 11 and 12 of the Table: the workforce has, on average, grown slower than population in the poorer countries, and vice versa in the rich countries.

The dispersion of income and productivity levels within each group can be read from rows 6-9 of Table 1. In each case within group dispersion increased between 1960-64 and 1984-88. Divergence appears to be somewhat stronger in output per capita than in output per worker. The overall picture is one of increasing dispersion in
Table 1
Average values of principal variables

<table>
<thead>
<tr>
<th></th>
<th>entire sample</th>
<th>poor</th>
<th>middle</th>
<th>rich</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. sample size</td>
<td>113</td>
<td>42</td>
<td>32</td>
<td>39</td>
</tr>
<tr>
<td>2. RGDP per capita (pc) 1962</td>
<td>2330</td>
<td>736</td>
<td>1481</td>
<td>4744</td>
</tr>
<tr>
<td>3. RGDP per worker (pw) 1962</td>
<td>6019</td>
<td>1658</td>
<td>4231</td>
<td>12183</td>
</tr>
<tr>
<td>4. growth of RGDP pc (%pa)$^2$</td>
<td>1.98</td>
<td>1.36</td>
<td>2.16</td>
<td>2.49</td>
</tr>
<tr>
<td>5. growth of RGDP pw (%pa)</td>
<td>2.00</td>
<td>1.90</td>
<td>2.03</td>
<td>2.06</td>
</tr>
<tr>
<td>6. dispersion of RGDP pc 1962$^3$</td>
<td>0.88</td>
<td>0.44</td>
<td>0.24</td>
<td>0.48</td>
</tr>
<tr>
<td>7. dispersion of RGDP pc 1986$^4$</td>
<td>1.07</td>
<td>0.59</td>
<td>0.62</td>
<td>0.57</td>
</tr>
<tr>
<td>8. dispersion of RGDP pw 1962</td>
<td>0.96</td>
<td>0.48</td>
<td>0.26</td>
<td>0.37</td>
</tr>
<tr>
<td>9. dispersion of RGDP pw 1986</td>
<td>1.06</td>
<td>0.62</td>
<td>0.62</td>
<td>0.42</td>
</tr>
<tr>
<td>10. investment 1960-88 (% GDP)</td>
<td>18.1</td>
<td>12.4</td>
<td>20.1</td>
<td>22.6</td>
</tr>
<tr>
<td>11. population growth (% pa)</td>
<td>2.05</td>
<td>2.60</td>
<td>2.22</td>
<td>1.32</td>
</tr>
<tr>
<td>12. workforce growth (% pa)</td>
<td>2.03</td>
<td>2.06</td>
<td>2.34</td>
<td>1.75</td>
</tr>
</tbody>
</table>

1. 1962 is the average for the period 1960-64 and 1986 is the average for 1984-88.
2. Growth rates are annual averages of logarithmic growth rates 1962 to 1986.
3. Dispersion is the standard deviation of the logarithm.

Incomes and productivity both within and between the three income groups. Over the last three decades it appears that the world’s economies have been on divergent growth paths, leading to increasing inequality, especially in per capita output.

This divergence in world income levels can be seen in Figure 1 which plots the growth of per capita GDP against the logarithm of 1960-64 real GDP for the 113 countries. First it is evident that growth rates have varied tremendously, within a range of -2 to +7 percent per annum) for all but the richest 20 countries (where the range has been between 1 and 4 percent). Second, a weak upward drift in the scatter points is just about discernible, at least with the aid of a least squares regression line as displayed. Average incomes in the richer countries are tending to pull away from the levels in the poorer countries. Closer examination also reveals a tendency for income convergence amongst the very richest group of countries - at the extreme right of the Figure - roughly speaking the OECD group.

Evidence such as this has been taken by some commentators, for example Bradford de Long (1988) to refute arguments that there has been a tendency for poorer economies to catch up on the richer. Nevertheless, Dowrick and Nguyen (1989) have shown that at least within the OECD group of countries there has been a strong and consist tendency since 1950 for technological catch up to occur, even though income levels have not been converging since 1973. In other words, after taking account of the rate of growth of labour and capital, the poorer OECD countries have tended to experience faster growth in the residual (multi factor productivity).

If we repeat this growth accounting exercise on the 113 economies in our sample, we reach a similar conclusion. There is a strong tendency, at least within the upper and lower ends of the world income distribution, for multi factor productivity growth to be inversely related to the starting level of productivity. Simple regression of GDP growth ($\hat{Y}$) on initial labour productivity ($\ln Y/L_0$), the growth of the workforce ($\hat{W}$) and average investment rates (INV) gives estimates of the growth accounting
Growth of real GDP per capita 1960-64 to 1984-88 for 113 countries

\[ y = -1.212 + 0.433x \quad r^2 = 0.040 \]

**FIGURE 1**

Growth of multi factor productivity 1960-88

\[ y = 0.72 - 0.57x \quad r^2 = 0.10 \]

**FIGURE 2**

parameters within each of the three income groupings. The first parameter captures the extent of technological catch up (if negative); the second parameter measures the elasticity of output with respect to employment; the third is an estimate of the marginal productivity of gross capital investment. The regression results are summarised below, omitting the constant terms, with heteroscedasticity-consistent t-statistics in brackets.

**Poor economies**

\[
\hat{Y} = -0.013 \ln Y/L_0 + 0.89 \hat{W} + 0.15 \text{INV}
\]

\[
\begin{array}{ccc}
(2.2) & (2.3) & (4.0) \\
\end{array}
\]

n=42 \quad R^2 = 0.33 \quad s.e. = 1.87

**Middle income economies**

\[
\hat{Y} = 0.019 \ln Y/L_0 + 0.48 \hat{W} + 0.05 \text{INV}
\]

\[
\begin{array}{ccc}
(1.4) & (0.9) & (0.9) \\
\end{array}
\]

n=32 \quad R^2 = 0.13 \quad s.e. = 1.88

**Rich economies**

\[
\hat{Y} = -0.014 \ln Y/L_0 + 0.95 \hat{W} + 0.13 \text{INV}
\]

\[
\begin{array}{ccc}
(-3.1) & (5.9) & (5.6) \\
\end{array}
\]

n=39 \quad R^2 = 0.63 \quad s.e. = 0.94

It is only within the middle income group that we fail to find evidence of technological catch up. Within this group, however, the standard errors are large, due to collinearity amongst the explanatory variables. The coefficients estimated on the other two groups are well defined and remarkably similar. The hypothesis that the parameters are in fact the same across all three samples is not rejected at even the 20% level (F_{8,101} = 1.38) - so it is legitimate on statistical criteria to pool the samples.

Pooling the three samples gives weight to the inter-group variation in the data, as well as the intra-group variation, so these are the preferred estimates.

**All economies**

\[
\hat{Y} = -0.006 \ln Y_0 + 0.88 \hat{W} + 0.11 \text{INV}
\]

\[
\begin{array}{ccc}
(-3.1) & (4.6) & (4.2) \\
\end{array}
\]

n=113 \quad R^2 = 0.28 \quad s.e. = 1.63
Technological catch up is strongly significant across the whole sample. So too are the growth of the workforce and the rate of gross investment although nearly three quarters of the variance in growth rates remains unexplained. Figure 2 illustrates the technological catch up tendency by plotting growth in multi factor productivity against productivity levels. We can discern the tendency for a negative correlation, with dispersion around the regression line most pronounced for the middle-income countries.

Using these parameter estimates it is possible to decompose observed rates of growth of per capita GDP into four elements: the amount attributable to technological catch up; the amount due to the growth of the workforce relative to the total population; the amount due to investment; and the unexplained residual. The decomposition method is explained in Dowrick and Nguyen (1989, p. 1025). Results for each of 113 countries are listed in the Appendix. Table 2 gives the average values for each of the three income groups. The decomposition is also given for a group of 5 rapidly growing Asia-Pacific economies consisting of Japan, Korea, Taiwan, Singapore and Hong Kong. Their exceptional growth record makes study of this group of Newly Industrialising Countries (NICs) of particular interest.

Output per capita in the poorest group of countries grew at 0.6 percentage points per annum below the sample average. This performance occurred despite the "advantage of backwardness", or catching up effect, which afforded them 0.6 points in above average productivity growth. Overall, then, these economies underperformed, relative to the world average, by 1.2 points. This underperformance is, on average, attributable to two factors: the decline in employment relative to population and the poor rate of growth of the capital stock, which contributed -0.5 and -0.7 points respectively. The employment shallowing effect reflects the fact that the workforce failed to grow at the same rate as population. The capital shallowing effect reflects the fact that investment rates were only just over one half of average investment rates in the rich economies, despite much higher population growth in the poor countries.

<table>
<thead>
<tr>
<th>Country Group</th>
<th>relative growth of RGDP per capita</th>
<th>catching up</th>
<th>employment deepening</th>
<th>capital deepening</th>
<th>residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>poorest</td>
<td>average</td>
<td>-0.6</td>
<td>0.6</td>
<td>-0.5</td>
<td>-0.7</td>
</tr>
<tr>
<td></td>
<td>st.dev.</td>
<td>2.1</td>
<td>0.3</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>middle income</td>
<td>average</td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>st.dev.</td>
<td>2.2</td>
<td>0.2</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>richest</td>
<td>average</td>
<td>0.5</td>
<td>-0.6</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>st.dev.</td>
<td>1.3</td>
<td>0.2</td>
<td>0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>5 NICs</td>
<td>average</td>
<td>4.0</td>
<td>-0.1</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>st.dev.</td>
<td>0.5</td>
<td>0.3</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>
When this growth accounting exercise is repeated for the rich group of countries it presents an almost exact mirror image. Above average per capita growth of 0.5 points, on top of the slower productivity growth due to less opportunity for technological catch up, implies that the richer countries' growth performance was some 1.1 percentage points per annum above what might have been expected. This performance is partly due to employment deepening, which contributed 0.4 points, but is mainly due to capital deepening which contributed 0.6 points.

The five rapidly growing Asian economies have each outperformed the world economy by over four percentage points per annum, with the exception of Japan whose growth rate has been only 3.1 points above average. These exceptional growth rates imply that per capita output in each of these countries is now more than double what it would have been if they had grown at the world average rate of two percent per annum. The growth decomposition in Table 2 suggests that nearly half of this exceptional performance can be attributed to faster than average growth in factor inputs relative to population. It is particularly interesting to note that employment deepening, i.e. raising the ratio of the workforce to the population, has been relatively more important than capital deepening in three of these five countries. It is only in Japan that capital deepening has substantially outweighed the employment deepening effect.

Increasing the ratio of workers to population has also made significant contributions to the growth record of a number of other countries, notably the USA and Portugal (in each case contributing an average of 0.7 percentage points per annum) and Iceland and Malta (1.1 points). Capital deepening has been particularly important in contributing to above average annual growth rates in Norway (1.9 points), West Germany, Denmark, France, Israel, Italy, Spain, Cyprus, Malaysia, Malta and Yugoslavia (above 1 point in each case).

The relationship between divergence of world incomes on the one hand and both employment deepening and capital deepening on the other hand is illustrated in Figures 3 and 4. Figure 3 plots the growth in the workforce to population ratio against the logarithm of real GDP per capita. The simple regression line highlights the moderately strong positive correlation in the data ($r=0.53$). Over the last three decades, the richer countries have tended to experience a rise in the ratio of workers to population, whilst in the poorer countries the ratio has tended to decline. Note also that some of the middle-income countries (including Singapore, Hong Kong and South Korea) have experienced particularly large rises in this aggregate participation ratio.

Figure 4 presents a corresponding plot of investment rates against 1960-64 levels of per capita GDP. There is again a clear positive correlation ($r=0.58$). Richer countries tend to devote a greater proportion of their output to physical investment than do the poorer countries. Allied with employment deepening, it is this relative capital deepening in the more advanced economies which provides a proximate explanation for the divergence of world per capita GDP despite technological catch up.

2. Explanations and policies

The growth accounting exercises of the previous section are important in isolating the immediate features and patterns of world economic growth. They do not necessarily provide much depth of explanation, nor much guide for constructive policies by either national governments or development agencies, except to add weight to 'motherhood' prescriptions such as that more investment and employment will promote economic growth! I will discuss in turn some of the mechanisms that may underlie the three sources of growth that have been identified: catch up, employment deepening and capital deepening.

The most obvious explanation of observed productivity catch up is technological spillover, or the ability of less advanced economies to imitate and copy the techniques of production used by more advanced economies. Abramovitz (1986) warns, however, that such spillovers may not be effective if a country lacks the technical and social capability to absorb and implement new ideas. This hypothesis is
supported by several studies which suggest reasons why catch up may be limited in the poorest economies of the world. Dowrick and Gemmell (1991) report evidence that although the poorest countries of sub-Saharan Africa have managed some catch up in agricultural productivity, they have tended to fall behind in industrial productivity, where complementarities with human capital and infrastructural development are likely to be particularly strong. Barro (1991) finds that low levels of educational enrolment are a substantial impediment to growth.3

We have seen in the previous section that the contribution of employment deepening to the faster economic growth of the richer economies is substantial. This does not reflect, however, any systematic increase in the rate of participation by adults in the workforce. Although rising participation is important in a number of individual countries, on average it is offset by increasing aged dependency. The average ratio of workers to adults (over 15 years of age) in the richer economies has barely increased at all over the last three decades. The major demographic change affecting the aggregate participation ratio in the richer countries has been the decline in youth dependency. This in turn reflects declining birth rates in most advanced economies. Brander and Dowrick (1990) argue that even though economic growth is independent of steady-state birth rates, declining birth rates provide a temporary but substantial stimulus through this labour supply effect.

There is evidence to support this view in Figure 5 where the growth of the worker to population ratio is plotted against the change in rates of population growth between the beginning and end of the sample period. A strong negative correlation (r=−0.69) supports the idea that declining fertility raises, albeit temporarily, the ratio of adults to total population which in turn raises the ratio of workers to population for a given adult participation rate. Moreover, to the extent that female participation in the labour force is a substitute for child-rearing, declining fertility may have an additional positive participation effect.
The importance of demographic change for the five fastest growing Asian economies is illustrated in Table 3. With the exception of Japan, all countries experienced a sharp rise in the ratio of workers to population. In each of these four cases the main impetus was a rise in the ratio of adults to population, i.e. a decline in youth dependency rates. In the case of Japan, the fall in youth dependency more than offset a fall in the adult participation rate. In all five cases, the rising ratio of adults to population was associated with a sharp fall in the rate of growth of population.

We can infer from these figures that the halving of population growth over three decades, and the consequent maturing of the population age structure, has increased substantially the supply of labour relative to total population. The labour supply effect of demographic change has contributed substantially to the rapid increase in per capita output in these countries, and it is probable that the rapid increase in per capita incomes has also contributed to the demographic change.

Turning to investment, and referring back to Figure 4, the pattern to be explained here is the strong tendency for rates of investment to rise with income levels. In the absence of international capital movements, where investment has to be funded entirely out of domestic savings, this pattern might simply reflect sharply diminishing marginal utility of consumption, i.e. if the cost of foregoing present consumption is higher, the nearer a person is to a subsistence income. This would imply, however, that real rates of return to investment should be substantially higher in the poorer countries and that internationally mobile capital should flow to these economies. The simple regression estimates (1) to (3) of gross returns to investment are difficult to interpret because of the large standard error on the estimate for the middle-income countries. There is some weak evidence that rates of return are slightly higher in the low income countries, although the differences are not statistically significant. It is possible then that it is barriers to capital mobility which are holding back investment rates in the poorer countries.
Table 3
Demographic change in 5 NICs

<table>
<thead>
<tr>
<th>Country</th>
<th>Population growth rate</th>
<th>Adult/worker population ratio</th>
<th>Adult worker ratio</th>
<th>Worker population ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>av. 1960-65 3.2</td>
<td>60.4</td>
<td>64.1</td>
<td>36.7</td>
</tr>
<tr>
<td></td>
<td>av. 1964-88 1.4</td>
<td>76.4</td>
<td>68.9</td>
<td>52.6</td>
</tr>
<tr>
<td></td>
<td>growth % p.a. 1.0</td>
<td>1.0</td>
<td>0.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Japan</td>
<td>av. 1960-65 1.0</td>
<td>71.6</td>
<td>67.7</td>
<td>48.7</td>
</tr>
<tr>
<td></td>
<td>av. 1964-88 0.5</td>
<td>78.8</td>
<td>63.0</td>
<td>49.6</td>
</tr>
<tr>
<td></td>
<td>growth % p.a. 0.4</td>
<td>0.4</td>
<td>-0.3</td>
<td>0.1</td>
</tr>
<tr>
<td>South Korea</td>
<td>av. 1960-65 2.8</td>
<td>58.2</td>
<td>58.9</td>
<td>34.2</td>
</tr>
<tr>
<td></td>
<td>av. 1964-88 1.3</td>
<td>69.0</td>
<td>59.8</td>
<td>41.2</td>
</tr>
<tr>
<td></td>
<td>growth % p.a. 0.7</td>
<td>0.7</td>
<td>0.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Singapore</td>
<td>av. 1960-65 2.7</td>
<td>56.4</td>
<td>56.4</td>
<td>32.9</td>
</tr>
<tr>
<td></td>
<td>av. 1960-85 1.2</td>
<td>74.5</td>
<td>63.4</td>
<td>47.2</td>
</tr>
<tr>
<td></td>
<td>growth % p.a. 1.0</td>
<td>1.0</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Taiwan</td>
<td>av. 1960-65 3.1</td>
<td>56.5</td>
<td>58.1</td>
<td>32.9</td>
</tr>
<tr>
<td></td>
<td>av. 1964-88 1.2</td>
<td>71.0</td>
<td>57.1</td>
<td>40.6</td>
</tr>
<tr>
<td></td>
<td>growth % p.a. 1.0</td>
<td>1.0</td>
<td>-0.1</td>
<td>0.9</td>
</tr>
</tbody>
</table>

A more likely general explanation of the pattern of investment rates would seem to be concerned with complementarities between physical investment and human and social capital. Simple neo-classical growth models based on diminishing returns to capital imply that real rates of return should be highest in those countries with the lowest capital stock. It seems to be the case, however, that backward infrastructure and low levels of education and training substantially reduce rates of return to physical investment. Whilst investment in the physical and social infrastructure might generate a higher return, these returns would not generally be captured by private investors. The problem then becomes one of directing international investment and aid into infrastructural development and education and training.

Footnotes

1 The magnitude of the factor input parameters might be taken to imply that there are increasing returns to scale since the output-labour elasticity is almost 0.9 and the output-capital elasticity is approximated by multiplying the coefficient 0.11 by the capital-output ratio which is typically between two and three. Some of the unexplained variance in the regression is due to differences in openness to world trade, as in Romer (1990), and variance in industrial structure, as in Dowrick and Gemmell (1991) as well as a multiplicity of country-specific policies and natural events. Government consumption is not a significant explanatory variable; however there is evidence that government consumption crowds out investment, which would explain Barro's (1991) result. The addition of dummy variables for Asia, Africa, Europe and Latin America raises the $R^2$ to 0.35, statistically significant at the 5% level but not at the 1% level. The parameter estimates are not affected significantly by these additions, except that the coefficient on investment falls from 0.11 to 0.09. A further test of the regression model has been carried out by dividing the observations for each country into two periods, 1960-75 and 1975-88. The hypothesis that the regression coefficients are stable over
the two periods is accepted (F_{3,218}=0.4) and the coefficient estimates for the pooled
samples are very similar to those reported here.

2 Multi factor productivity is defined here as the growth in GDP minus the contribution
of the growth of the workforce and of investment (relative to the sample averages)
calculated using the coefficients of equation (4).

3 Note however that measurement of technological catch-up in these broad cross-
section studies is fraught with difficulties. First, we have to rely on gross investment
rates to capture changes in capital stocks and gross employment to capture aggregate
labour input. Second, there are substantial gaps in standard national accounting
techniques which may lead to systematic mismeasurement of GDP growth due to the
omission of domestic production and the omission of production externalities such as
pollution and the maintenance of environmental standards.

4 This is the immediate consequence of lowering birth rates. There will in future,
however, be a rebound effect due to increases in the aged dependency rate.

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