Green Asia country report: Pakistan

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1 Policy summary

Development planning in Pakistan would benefit from a strong focus on the principles of sustainable consumption and production to guide investments into institutions, policies and strategies to manage the country’s transition to a middle income economy in a way commensurate with the SDGs.

1) Pakistan still has very low material and energy inputs on a per capita basis, especially after adjusting to take account of where final consumption actually takes place. Pakistan’s current level of material footprint per capita, at around 2.8 tonnes, is only around one fifth the level generally required to achieve a high level of human development. Given this, it is important that any general "messages" regarding the path to more sustainable development be tempered by the reality that Pakistan, in common with a number of Developing Asian countries, is currently consuming much less than it will ultimately need to. While making efforts to improve the efficiency with which materials are used is always a central and appropriate recommendation to any government, in the case of countries like Pakistan this message should not be extended to suggest that it is also possible, or even desirable, for them to consider reducing or even stabilizing their absolute levels of consumption at this point or in the near future. Such absolute reduction goals probably only make sense for nations above a level of 15 tonnes of material footprint per capita, at least given current technologies. Some level of convergence between current low-income and high-income countries in terms of their resource availability, at a level much lower than current high-income countries rely upon, will probably be required.

2) Notwithstanding point 1) above, while Pakistan’s growth in material and energy inputs on a per capita basis has been slow, its rate of population growth has been very rapid, the highest in the Developing Asia group. Consequently, Pakistan’s absolute requirements for materials and energy, and emissions of GHGs, escalated rapidly. As issues such as resource depletion and environmental degradation depend on total demand placed on the environment, not per capita demands, any positive effects on sustainability that Pakistan’s restraint in per capita terms had was largely offset by its lack of restraint in population growth.

3) The current level of urbanization in Pakistan is still relatively low, and urban housing and transport infrastructure is lacking. Future growth of Pakistan’s cities can be expected and it will be important for the country to invest in built and transport infrastructure that, as far as possible, implements design principles and technologies that will create sustainable and liveable cities. There is a window of opportunity, if policies and standards are set appropriately, to achieve good urban outcomes that will have a lasting legacy for the attractiveness and competitive strength of Pakistan’s cities. Cities are also the places where changes in incomes, lifestyles and consumption occur first and embarking on policies, examples and practices that facilitate environmentally-sustainable consumption behaviours early in the transition process would be beneficial for the country.
4) The earlier options for moving up value adding chains are considered, the better. This is because the physical and social infrastructure appropriate for continued expansion of primary industries for export will, in many cases, be different to that required for using those resources as inputs to local secondary industry. In addition to the possibility of being "locked in" to infrastructure inappropriate for further value adding, elements of institutional and contractual lock in will also occur. Land tenure arrangements most suitable to encourage expansion in forestry may disadvantage other primary industries, and *vice versa*.

5) The question of which higher value adding industries have most potential in Pakistan should take into account the country's relatively constrained water supplies, and the fact that it already exports a considerable quantity of its limited water supplies in "virtual" form, embodied in its current export mix.

6) Pakistan's transition from agrarian to industrial society is underway, but has been proceeding slowly relative to many other countries in the region. This slow transition has been reflected by a stagnation in the country's human development index in recent years, signalling that the current development path is failing to consistently deliver improved living standards to the average Pakistani. Another trend of relevance here was a re-orientation of economic final demand away from investment and towards consumption in recent decades, in a country which already had low relative investment. This reduction in investment for the future is likely to further delay improvements in development levels.
2 Introduction

Pakistan's GDP growth was below average among the Developing Asia group\(^1\) between 1970 and 2015, while its population growth was the fastest. This combination led to affluence (GDP per capita) increasing relatively slowly, by a factor of 2.5 between 1970 and 2015, a performance which saw its ranking on this measure decline from eighth to twelfth out of the 17 countries which make up the Developing Asia group.

Pakistan was in the low human development category (as measured by UNDP) in 2014, with an HDI of 0.54, a life expectancy of 66.2 years and a mean of 4.7 years of schooling (UNDP 2016). GDP per capita in 2014 was $888 (US$ constant 2005 exchange rate basis).

The growth of three key economic indicators for Pakistan since 1970 is shown in Figure 1. GDP growth, while below the Developing Asia average, still averaged 4.7% p.a. compounding between 1970 and 2015. This rapid growth in GDP did not translate into rapid gains in affluence, which grew at 2.1% p.a., due to Pakistan's simultaneous rapid population growth, which averaged 2.6% p.a. over the same period. This rapid growth in population strongly influences a number of other key indicators throughout this report, with Pakistan often displaying major escalation in total environmental demands and loadings between 1970 and 2015, but relatively limited increases in resource availability on a per capita basis.

Pakistan's growth from 1970 to 1990 was accompanied by major changes in the underlying structure of the economy, however from 1990 to 2013 these changes were less pronounced. From data in UNSD (2015) it can be ascertained that the importance of the value added in the combined agriculture, hunting, forestry, and fishing sectors decreased greatly, from 39% of GDP in 1970 to 25% in 1990, but by 2013 that share was still 22%. The mining, manufacturing, and utilities sector increased its share from 11%\(^2\) in 1970 to 15% in 1990, increasing further to 17% by 2013. Wholesale, retail trade, restaurants and hotels saw an increase in share from 16% to 18% between 1970 and 1990, but had reverted to a 16% share of GDP by 2013. The one area where share changed more rapidly in the later period was for the miscellaneous "Other Activities" category where shares were 15%, 19% and 25% for 1970, 1990 and 2013 respectively.

\(^{1}\) The Developing Asia group referred to throughout this document is a group of 17 countries in the region: Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Viet Nam.

\(^{2}\) Note that there are no individual data in UNSD (2015) for manufacturing in 1990, so it had to be reported here grouped with mining and utilities. Similarly, mining and utilities could not be separated out from the combined figure.
Data in UNSD (2015) also show a significant change in balance between final consumption and capital investment (as reflected in gross capital formation) over time, with final consumption increasing from 78% of final demand in 1970 to 86% in 2013, while gross capital formation declined from 22% to 14% over the same period. The growth in final consumption was led by growth in government final consumption, which increased from 6% of final demand to 11%, while household consumption increased from 72% to 75%. This increase in consumption at the expense of investment seems likely to have negative implications for a nation which was already characterized by poor infrastructure and productive capacity.

The decrease in relative terms of investment may also in part explain the decreasing importance of trade in Pakistan’s economy over the same period. While total trade grew greatly in absolute terms, with exports increasing by a factor of eight and imports by a factor of four between 1970 and 2013, total trade (Exports plus Imports) decreased from 34% of GDP in 1970 to 26% by 2013. Interestingly, the greater part of this decline happened in the earlier 1970 to 1990 period, as did the greatest proportional shift towards government final consumption. An important and positive aspect of the decrease in the share of total trade is that it has come about entirely due to a major decrease in imports. In 1970, the value of Pakistan’s imports greatly outweighed exports, at 22% and 12% of GDP respectively. By 2013, imports and exports were each at 13% of GDP, which indicates that Pakistan’s balance of trade situation improved markedly.

Exchange rate based GDP per capita values tend to greatly understate local purchasing ability for low-income countries, so a purchasing power parity (PPP) basis has been provided as well in Figure 2. Here we see that Pakistan’s exchange rate based GDP per capita of US$888 in 2014 actually had a local purchasing power more than five times that, equivalent to $4621 spent in the US. This helps establish a more realistic idea of the real material living standards achievable locally.

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Figure 1 GDP, population and affluence (GDP per capita) for Pakistan, indexed (1970=100)

\(^3\) An important qualification here is that, for poorer countries, using exchange rate currency units will tend to exaggerate the real economic activity associated with exports/imports compared to that for the domestic consumption. While an exchange rate basis is appropriate for quantifying international trade, the level of economic activity which underpins the domestic economic activity would perhaps better reflected by purchasing power parity (PPP) measures.
Figure 2: Affluence compared on constant 2005 exchange rate versus purchasing power parity basis for Pakistan.
3 Material use, waste, material efficiency, trade dependency and extractive pressure

Pakistan's material inputs grew rapidly over the full period studied, i.e. between 1970 and 2015. This growth occurred across all materials categories, and reflected a moderate degree of socio-metabolic transition, away from the biomass-based domestic materials and energy systems of an agrarian society, towards the minerals-based systems of an industrial society. The rate of change was considerably faster in the earlier part of the period examined, perhaps reflecting the relative decline of investment over the period.

Figure 3 illustrates Pakistan's relatively steady and sustained growth in direct material input (DMI) in all major materials categories over the period 1970 to 2015, with only three years in which DMI appears to have actually contracted, one of which was during the first year of the Global Financial Crisis (GFC). Despite having grown the least in percentage terms, biomass tripled in total tonnage and its continued paramount importance in Pakistan's economy is obvious, still accounting for over 62% of total DMI in 2013. Fossil fuels and non-metallic minerals increased by factors of 8.8 and 9.0 respectively between 1970 and 2013. The greatest growth in relative terms was for metal ores, but this was off an extremely low base, so that by 2013 it still accounted for less than 3% of total DMI. The apparent steady cumulative growth of DMI in Pakistan in Figure 3 masks to some extent the slowdown in DMI growth rate over the period. Between 1970 and 1990, total DMI increased at over 4.1% p.a. compounding, compared to 3.1% p.a. from 1990 to 2013. In volumetric terms, imports are much more important as a source of material inputs to Pakistan's economy, increasing from 2.1% to 7.4% of DMI between 1970 and 2013, and increasing by a factor of 32 in total tonnage terms. Pakistan's economy grew massively over the period, however in aggregate terms, domestic extraction still dominated DMI. While physical imports increased by a factor of 144 between 1970 and 2013, they still only accounted for less than 7% of total DMI in 2013. This still leaves Pakistan apparently largely self-reliant for materials in aggregate terms, but masks important differences with regard to the key material categories. While Pakistan's self-reliance is strong for biomass and non-metallic minerals, it relied on imports for 47% of its fossil fuels, and 75% of metal ores. Reference to the detailed information in IEA (2015) further shows that Pakistan's dependence on imports in the key fossil fuel sub-category of petroleum was over 66% in 2013. With regard to metal ores, it is important to note that a tonne of imports typically contains many times the metal that a tonne of domestic extraction contains, thus the 47% will greatly understate Pakistan's true reliance on imports in this category.

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4 This is because trade statistics typically do not sufficiently disaggregate metals, metal concentrates, and metal ores. Internationally traded metal concentrates are likely to be counted in tonnage terms the same as un-beneficiated ores, even though they typically contain an order of magnitude more metal per tonne. This phenomenon of the concentration of commodities prior to trade, and the effect it has on the different material flow account categories, is discussed at length in Schandl and West (2012).
Comparing Figure 4 to Figure 3 shows Pakistan’s material footprint (MF) following a similar trajectory to DMI for the period 1990 to 2015, in terms of overall growth and relative shares between different materials categories. Growth in MF over the period was 2.6% p.a. compounding, compared to 3.1% p.a. for DMI. MF growing faster than DMI implies that Pakistan increased the amount of primary commodities which were effectively "embodied" in those goods and services it exported, relative to those embodied in imports. This is consistent with what was noted previously regarding the reduction in Pakistan’s (monetary) trade deficit over time. The ratio of Pakistan’s MF to DMI decreased over time, from 0.77 in 1990 to 0.69 by 2013.

Figure 5 shows the relative importance of different economic sectors in generating MF in tonnage terms. The very large joint share of manufacturing (44%) and services (25%), compared to agriculture (19% in 2013) is somewhat surprising, given the dominance of biomass seen previously in Figure 4. This may suggest that much of the value of biomass production is only being formally recorded when it enters the manufacturing (e.g. food processing) or service sectors, and there
may be a very large component used in the subsistence or informal economy which is either underestimated, or evades accounting entirely, in Pakistan's economic accounts.

Per capita, Pakistan's economy has low material inputs, around one third the Developing Asia average on both territorial and trade adjusted bases. By 2015, both DMI per capita and MF per capita remained at only a fraction of the minimum levels required to support a high level of human development.

Figure 6 shows that DMI to Pakistan's economy was just over four tonnes per capita by 2013, with MF per capita below three tonnes per capita in the same year. Since 1990, the DMI per capita grew at 0.9% p.a. compounding, roughly the same rate as from 1970 to 1990, while MF per capita grew even more slowly, at nearly 0.4% p.a. from 1990 to 2013. This is very slow growth relative to the Developing Asia group average, so Pakistan's DMI per capita decreased rapidly in relative terms, from 118% of the group average in 1970 to 36% by 2013. Pakistan's MF per capita also decreased rapidly relative to the Developing Asia average, from 90% in 1990 to 31% in 2013. While this is, on the face of it, a good trend for environmental sustainability, maintaining material flows at such low per capita levels is unlikely to be socially sustainable, as it appears incompatible with the average Pakistani attaining a high (or even moderate) material standard of living. It is likely that any major improvements in Pakistan's HDI will be accompanied by large increases in per capita DMI and MF.
Pakistan's economy was more efficient at converting materials to GDP than the Developing Asia group average for the entire period 1970 to 2015, using either the DMI or MF metrics. Using a DMI basis, Pakistan's material intensity (MI) decreased by 40% between 1970 and 2013, while adjusted MI (using MF basis) decreased by 28% from 1990 to 2013. In 1970 Pakistan had required 21% less DMI per US$ of GDP earned than the regional average, by 2013 this advantage had decreased to only 8%. For adjusted MI, Pakistan actually increased its efficiency advantage relative to the region. In 1990 Pakistan's adjusted MI was 20% lower than the regional average, and by 2013 this gap had widened to 23%. Pakistan's MI decreased at a rate of −1.3% p.a. compounding between 1970 and 1990. From 1990 to 2013 the corresponding rate was −1.1% p.a., while for adjusted MI it was −1.4% p.a.

In Figure 8, the domestic material consumption (DMC) indicator is used to illustrate the long-term waste potential of Pakistan. DMC measures territorial consumption of materials. Some DMC passes through the economy, going from input to waste, rapidly (e.g. metal ores processed to produce saleable metal). Other DMC can reside as a part of the active economy for years (e.g. the construction materials invested in infrastructure). In all cases, materials consumed territorially will
generally need to be sunk back into the local environment as some form of waste at some point, thus the idea of using DMC as an indicator of long-term waste potential. Two measures have been used to illustrate different aspects of the long-term waste potential issue, one which uses a per capita basis, and a second that measures intensity per unit of land area, or spatial intensity. Figure 8 shows that by 2013, Pakistan's long-term waste potential on a per capita basis was 1.4 times that in 1970, which was very slow growth by regional standards. Growth in intensity per km² was much faster, although at a factor of 4.3, still moderate compared to the Developing Asia average. Pakistan's DMC per km² was almost exactly equal to the regional average for the two decades 1970 to 1990, at which point it began to diverge rapidly, so that by 2013 Pakistan's DMC per km² was less than half the regional average. Again, while this is good in terms of restraining the rate at which long-term waste potential is accumulating on Pakistan's territory, the low per capita levels of DMC also point to ongoing low material standards of living and a continued restraint on Pakistan's capacity to deliver higher levels of human development.

Figure 8 Long-term waste potential of Pakistan (DMC/ha and DMC/cap), 1985–2015, tonnes per ha and per capita
4 Energy use, energy security, renewable energy and energy efficiency

In Figure 9 we see that Pakistan began the period with low levels of energy availability relative to the Developing Asia average, and that this position deteriorated in relative terms, despite per capita availability improving in absolute terms. Using the primary energy supply (TPES) basis, per capita energy availability grew by 1.2% p.a. compounding from 1970 to 2013, with most of this growth concentrated before 1995, and a slight decline evident from 2007. Using an energy footprint (EF) basis, per capita energy use grew by 1.6% p.a. from 1990 to 2013, much slower than the 4.8% average for the Developing Asia group over the same time period.

![Figure 9 Per capita TPES and energy footprint of Pakistan and Developing Asia, 1970–2015, GJ per capita](image)

The data on the detailed composition of TPES in Figure 10 shows that Pakistan's energy systems have undergone a much greater transition away from a biomass basis, and towards a minerals basis, than seen earlier for materials. While non-hydro renewables (which are dominated by biomass) remained the largest single component of Pakistan's energy supply, they decreased from 62% of total TPES in 1970 to 35% in 2013. In contrast, fossil fuels combined increased from 36% to 60% over the same period.

Pakistan's dependence on natural gas in particular has grown rapidly. Unlike petroleum, according to the detailed information in IEA (2015) Pakistan is self-sufficient in natural gas, so this should indicate some measure of energy security in the medium term. Natural gas production was largely static from 2007 onward in tonnage terms, and decreasing in per capita terms. Given the country's ongoing rapid rate of population increase, it appears likely that Pakistan's ability to meet its energy from this domestic source will decline rapidly in the absence of significant new discoveries and production.
Figure 10 Total primary energy supply of Pakistan by energy sources, 1985–2015, in petajoules

Figure 11 shows that Pakistan's energy intensity, on a TPES basis, was around half that of the Developing Asia group at the beginning of the period, but improved at a very slow rate (−0.8% p.a.) compared to the regional average (−2.2% p.a.), so that they had effectively converged by the early 2000s. There was a similar but less complete convergence between Pakistan's energy intensity on an EF basis, and that of the region. In 1990 Pakistan's EF per $ of GDP generated was 59% of the regional average, by 2013 this had increased to 80%, even though Pakistan's EF per $ had decreased marginally in absolute terms, from 14.4 MJ per $ in 1990 to 13.4 MJ per $ by 2013.

Figure 11 also shows that between 1990 and 2013, Pakistan's ratio of TPES to EF decreased somewhat. In 1990 EF was just 50% of TPES, but by 2013 it was almost 58%. Even after this change, Pakistan apparently remained a net exporter of energy embodied in its exports of goods and services.

Figure 11 Energy intensity of production and consumption in Pakistan and Developing Asia, 1970–2015, MJ per US$
5 Emissions, air pollution and climate change

The statistics used for GHG emissions for Pakistan are sourced from the European Commission's EDGAR database. Aggregated GHG territorial emissions and GHG footprints are presented in Figure 13, from which it is evident that Pakistan's GHG emissions per capita began the period much lower than the Developing Asia average, and then decreased further in relative terms, while growing slowly in absolute terms (0.9% p.a. compounding for 1970 to 2013). By 2013 Pakistan's GHG emissions per capita were less than 40% of the regional average. In the detailed EDGAR data it is noteworthy that methane, rather than CO₂, was Pakistan's most important GHG until 2005. Pakistan's GHG emissions on a territorial basis are unusually closely matched to those on a GHG footprint (GHGF) basis for the period where both are available. This indicates that Pakistan does not have a significant net imbalance between the GHGs embodied in its exports versus those embodied in imports.

![Figure 12 Per capita GHG emissions and carbon footprint of Pakistan and Developing Asia, 1970–2015, tonnes](image)

In Figure 13 we see that Pakistan's GHG emission intensities on both territorial and footprint bases indicate that Pakistan began the period much more efficient at generating income per unit of GHG emissions than the regional average. In 1970 Pakistan's 4.0 kg of CO₂e per $ was only 41% of the regional average, while GHGF in 1990, at 3.0 kg of CO₂e per $ was 58% of the regional average. From these low bases, Pakistan's GHG intensities on both territorial and trade adjusted (footprint) bases only improved very slowly, and remained nearly static in the new millennium. Meanwhile,

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5 Reasonable data on both the breakdown of GHGs by gas type, and by economic sector, exist for most countries for the period up 2008. From 2008 on, a detailed sectoral breakout is missing, while data on actual GHG component gases ends in 2012. In assembling the database for the Developing Asia countries, a number of assumptions and scaling options were adopted to derive both the sectoral and component gas compositions of each country's emissions, while data from 2012 on used a simple technique of forecasting based on forecast future growth in GDP and population, and the elasticity of increasing energy use with regard to both population and affluence (GDP/capita). This method appears to provide reasonable results for larger and more stable economies with broad-based and steadily-growing economies. It does not work well for countries where annual GHG emissions can be profoundly affected by forest fires, which show up as major spikes.
the Developing Asia average on both metrics improved (decreased) rapidly, at –3.7% p.a. and 3.1% p.a. compounding, between 1990 and 2013, for the territorial and footprint based measures respectively. By the end of the period Pakistan's energy GHG intensities had converged close to the regional averages.

Figure 13 Carbon intensity of production and consumption in Pakistan, 1970–2015, kg per US$
6 Water and wastewater

It is important to note data on water extraction and use is the sparsest and least frequently updated basic data of all used for this report.\(^6\)

Before interpreting Figure 14, it is important to note that unlike materials and energy, the territorial measure of water withdrawals (Water) and water footprint (WF) have very different scopes and are not meant to add to similar totals even at the global scale. One major difference is that water footprint takes into account rain inputs to rain-fed agriculture, while territorial water withdrawals do not. This means that the global total for water footprint should be much larger than water withdrawals. Given this, we should expect that where a country has a net balance between water embodied in its exports and imports, then the WF should be markedly higher than water withdrawals. This is clearly not the case for Pakistan, so the logical interpretation of this is that Pakistan embodies a great deal of water in its exports. Furthermore, Pakistan's WF per capita is declining more rapidly than water withdrawals, at –2.6% p.a. compounding as compared to –1.4% p.a., for the period 1990 to 2013. This indicates that the tendency for Pakistan to support water consumption in other countries via water embodied in its exports is increasing over time. This has led to a situation where Pakistan's water withdrawals per capita were almost twice the regional average in 2013, but WF per capita was less than three quarters the regional average (and

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\(^6\) The FAO's Aquastat database has been selected as the standard here. An alternative source would be the World Bank's WDI statistics. The two have different categorizations, and can diverge quite widely from each other even after aggregation. For most countries there are three or fewer data points available for any full time series. Furthermore, unlike materials, energy and GHGs, it is not reasonable to assume a consistent growth trend over time, as withdrawal levels in any particular year can be much higher or lower according to whether the year the data were acquired was wet or dry. As a result, the values for water extraction recorded for most years have usually been obtained by simply filling with the nearest real data point. Also, water availability is to some extent naturally capped for a country, and not subject to arbitrary, large scale expansion by investing more in extraction infrastructure.
only 57% of its domestic withdrawals). Whether this trend remains viable in a country reckoned to be under significant water stress (Reig et al. 2013) is questionable.

Figure 14 Per capita water use and water footprint in Pakistan and Developing Asia, 1970–2015, kl per capita

Pakistan's water intensity (water extracted per US$ of GDP) decreased by 84% between 1970 and 2015, compared to the Developing Asia average of 92%. In Figure 15 we see that despite clear and rapid improvements in water efficiency, especially between 1970 and 1995, Pakistan's water intensity was almost five times the Developing Asia average in 2013 on a territorial basis, and almost twice the regional average on a footprint basis. Given that Pakistan is arguably the most water-constrained of any of the Developing Asia group, assessing the efficiency with which water is being used to generate income, and whether it is being allocated to the different economic sectors in a manner which most effectively promotes human development, would seem one logical area for Pakistan's policymakers to focus on.

Figure 15 Water intensity of production and consumption in Pakistan and Developing Asia, 1970–2015, litres per US$
7 Natural resource use, emissions and human development

Figure 16 shows that Pakistan’s growth and development since 1990 has been achieved with roughly proportional increases in GHG emissions per capita, somewhat higher inputs of energy per capita, and with very modest increases in materials per capita (all after adjusting for trade). Unfortunately, another salient feature of Figure 16 is that a period of stagnating HDI commenced around 2008, roughly coincident with a period of reduced MF and EF inputs, and GHGF output. This implies an ongoing and tight coupling between material and energy inputs, and continued human development. A point of interest is that an earlier period of reduced inputs, in the late 1990s, does not appear to have been associated with anywhere near as strong a stagnation in HDI. The reasons why this is so are unclear, but a possibility is that the trajectory of those institutions which generate increases in HDI was more resilient in the late 1990s\(^7\). It is possible that these institutions have been operating under stress for a prolonged period now, and their capacity to continue to deliver gains in HDI, without major additional inputs of materials and energy, was exhausted by the time of the GFC.

\[ \text{HDI, per capita material and energy use, per capita GHG footprints for Pakistan, 1990–2015, indexed (1990=100)} \]

\(^7\) An economy which has been making progress in improving the education and health of its citizens, via building up educational and health infrastructure and training the requisite workforce, should not suddenly cease making those improvements due to temporary financial hardships. The expanded stock of schools, hospitals etc. can continue to “produce” for years, until longer term underspending and the need for maintenance and re-equipment eventually begin to erode the stock of such infrastructure.
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