Urbanisation, Vietnam.
Image: Tran Veit Duc, World Bank.

Essay 4

Tropical underdevelopment – is it a thing of the past?

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Tropical underdevelopment – Is it a thing of the past?

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Introduction

In his 2000 paper on Tropical Underdevelopment, Jeffrey D. Sachs (Sachs 2000) concluded that there was a significant historical difference between temperate and tropical regions in terms of economic growth rates and per capita incomes. His hypotheses were based on a range of quantitative models and he suggested this historical divide would persist into the near and far future. 'The income gap has also been amplified because poor public health and weak agricultural technology in the tropics have combined to slow the demographic transition from high fertility and mortality rates to low fertility and mortality rates. The analysis suggests that economic development in tropical ecozones would benefit from a concerted international effort to develop health and agricultural technologies specific to the needs of the tropical economies' (Sachs 2000).
The time period used for much of his analysis ended at 1995 and correctly represented the situation at that time. He noted that tropical countries had grown more rapidly in the years leading immediately up to 1995 (per capita GDP both temperate and non-temperate regions had grown at 2.3%)[1]. He thought, however, that this growth should have been greater, given the natural tendency of per capita incomes to converge as a consequence of global trade, technology diffusion and capital flows from richer countries. You would expect the tropical countries to grow faster than the temperate zone but he believes 'this tendency towards convergence is muted, if not eliminated altogether' (Sachs 2000, pg. 9). He also highlighted the relatively poor performance of many African and Latin American countries.
I have used 1995 as the starting point for my analysis wherever possible. That period has not always been available in the data used for the State of the Tropics Report so I have used a similar period in these cases. Sometimes, I have also referred to data from more distant periods to emphasise the changes to tropical countries. It should be noted that I am a statistician not an economist and I have taken a statistician's perspective to this analytical essay.

The economic growth rates for the Tropics have greatly exceeded those for the Rest of the World since 1995, probably more so than expected by Sachs. Improvements have also occurred in a range of other progress indicators. The main purpose of this paper is to provide some explanation of the arguably surprising strength of this economic growth. I have primarily used the indicators in the State of the Tropics Report to illustrate my points.

[1] All references to GDP in the text and tables are to real GDP ie nominal GDP adjusted for the impact of price increases

Table E4.1 **Average annual change in real GDP (%)***

	1980-1985	1985-1990	1990-1995	1995-2000	2000-2005	2005-2010		*1980-2010*	*1995-2010*	*2000-2010*
Tropics	**2.1%**	**3.9%**	**4.6%**	**3.6%**	**4.8%**	**5.8%**		***4.1%***	***4.7%***	***5.3%***
Central & Southern Africa	0.9%	3.3%	1.1%	3.8%	5.5%	6.5%		*3.5%*	*5.3%*	*6.0%*
Northern Africa & Middle East	-3.2%	3.4%	2.6%	3.3%	4.3%	3.6%		*2.3%*	*3.7%*	*4.0%*
South Asia	4.9%	5.7%	5.9%	5.6%	7.1%	8.3%		*6.3%*	*7.0%*	*7.7%*
South East Asia	4.5%	7.5%	8.2%	3.4%	6.1%	6.5%		*6.0%*	*5.3%*	*6.3%*
Caribbean	0.3%	2.3%	3.7%	4.7%	4.0%	4.6%		*3.3%*	*4.4%*	*4.3%*
Central America	1.7%	1.4%	1.5%	4.9%	1.8%	2.6%		*2.3%*	*3.1%*	*2.2%*
South America	0.9%	2.1%	3.3%	1.7%	3.1%	4.5%		*2.6%*	*3.1%*	*3.8%*
Oceania	4.1%	3.7%	3.2%	3.9%	3.3%	2.1%		*3.4%*	*3.1%*	*2.7%*
Rest of the World	**3.4%**	**3.6%**	**2.7%**	**3.7%**	**3.1%**	**2.7%**		***3.2%***	***3.2%***	***2.9%***
World	**3.2%**	**3.6%**	**3.0%**	**3.7%**	**3.4%**	**3.3%**		***3.4%***	***3.5%***	***3.4%***

Source: World Bank (2013), State of the Tropics project
*Measured at purchasing prices parity in constant 2005 international dollars.

To be clear, the objective of the essay is not to criticise Sachs' significant paper; rather, it is to use Sachs' paper as a base and to provide some analysis of the main driving forces for the relatively strong improvements in the Tropics since the publication of that paper. In particular I will analyse Sachs' hypotheses to explain the lower growth rates in the Tropics to assess whether changes in the areas addressed by the hypotheses have led to better economic performance. I will also look at other indicators we think may be important to explain the extraordinary economic performance of the Tropics.

A review of Sachs' main findings

Sachs' quantitative analysis showed that the growth rates for the Tropics were much lower than the temperate region over the period 1820 to 1995. Per capita incomes in the Tropics were correspondingly lower than the Rest of the World and the ratio decreased over time.

Sachs provided five hypotheses as to why this might be the case. These five factors related to technology development, technology productivity, innovation, societal dynamics and geopolitical factors.

(1) Technologies in critical areas are ecologically specific, especially in the areas of health and agriculture, but also construction, energy use, and some manufacturing processes. Such technologies do not easily transfer across ecological zones.

(2) Temperate zone technologies were more productive than tropical zone technologies in crucial areas of health, agriculture, energy utilisation, and military technology. It is likely these differences could not be overcome by altering existing temperate zone technologies.

Table E4.2 **Annualised change in per capita GDP for selected period***

	1995 - 2010	2005 - 2010
Tropics	**3.0%**	**4.1%**
Central & Southern Africa	2.6%	3.8%
Northern Africa & Middle East	0.8%	0.3%
South Asia	5.6%	6.9%
South East Asia	3.9%	5.2%
Caribbean	3.2%	3.6%
Central America	1.6%	1.2%
South America	1.7%	3.3%
Oceania	0.6%	0.1%
Rest of the World	**2.2%**	**1.8%**

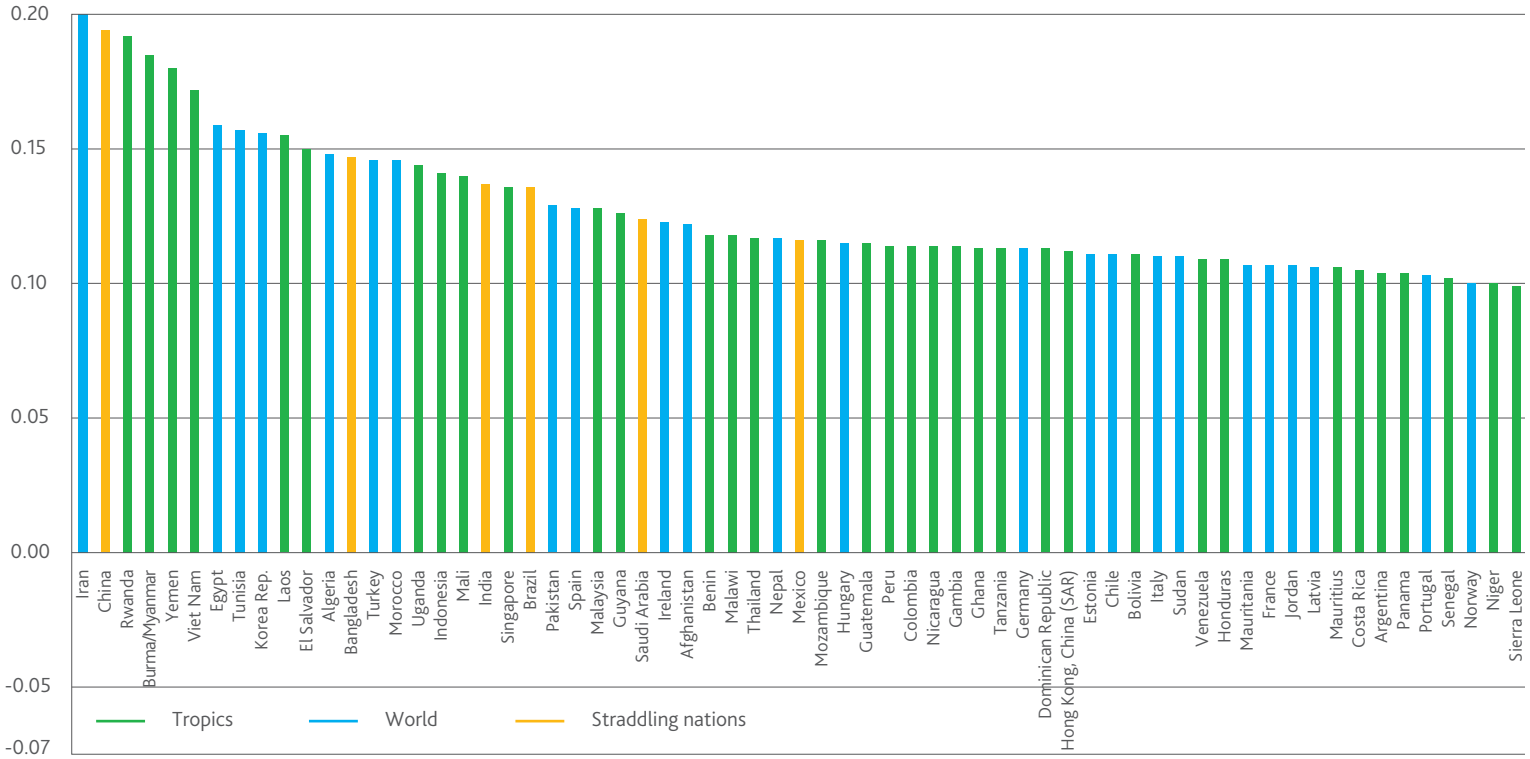
Source: World Bank (2013), State of the Tropics project
*Measured at purchasing prices parity in constant 2005 international dollars.

Table E4.3 **Change in Human Development Index between 1990 and 2010***

	Average of 1990 HDI	Average of 2010 HDI	Difference 1990-2010
Tropics (excluding straddling nations**)	**0.48**	**0.58**	**0.10**
Central & Southern Africa	0.38	0.45	0.07
Northern Africa & Middle East	0.37	0.50	0.13
South Asia	0.46	0.59	0.13
South East Asia	0.57	0.70	0.13
Caribbean	0.63	0.71	0.08
Central America	0.58	0.69	0.11
South America	0.60	0.71	0.11
Oceania	0.68	0.75	0.07
Oceania (Australia & USA omitted)	0.55	0.62	0.08
Rest of the World	**0.69**	**0.76**	**0.08**
Rest of World (including Australia and USA)	**0.69**	**0.77**	**0.07**
World	**0.59**	**0.68**	**0.09**
Straddling nations**	**0.62**	**0.74**	**0.12**

Source: UNDP (2014), State of the Tropics project
*Values are the average for nations with available data using State of the Tropics regions.
**Straddling nations include: Mexico, Brazil, Saudi Arabia, India, Bangladesh, China, Australia and United States (Hawaii).

Figure E4.1 **Magnitude of change in Human Development Index between 1990 – 2010**



Source: UNDP (2014), State of the Tropics project

(3) Temperate zone innovation has been favoured strongly by larger and richer populations. Technological innovation has an increasing return to scale. Therefore, the larger, richer population in the temperate zone, which has been integrated in a global market since 1800, has strongly favoured innovation. This has probably amplified the gap between the temperate and tropical zones over the past 200 years.

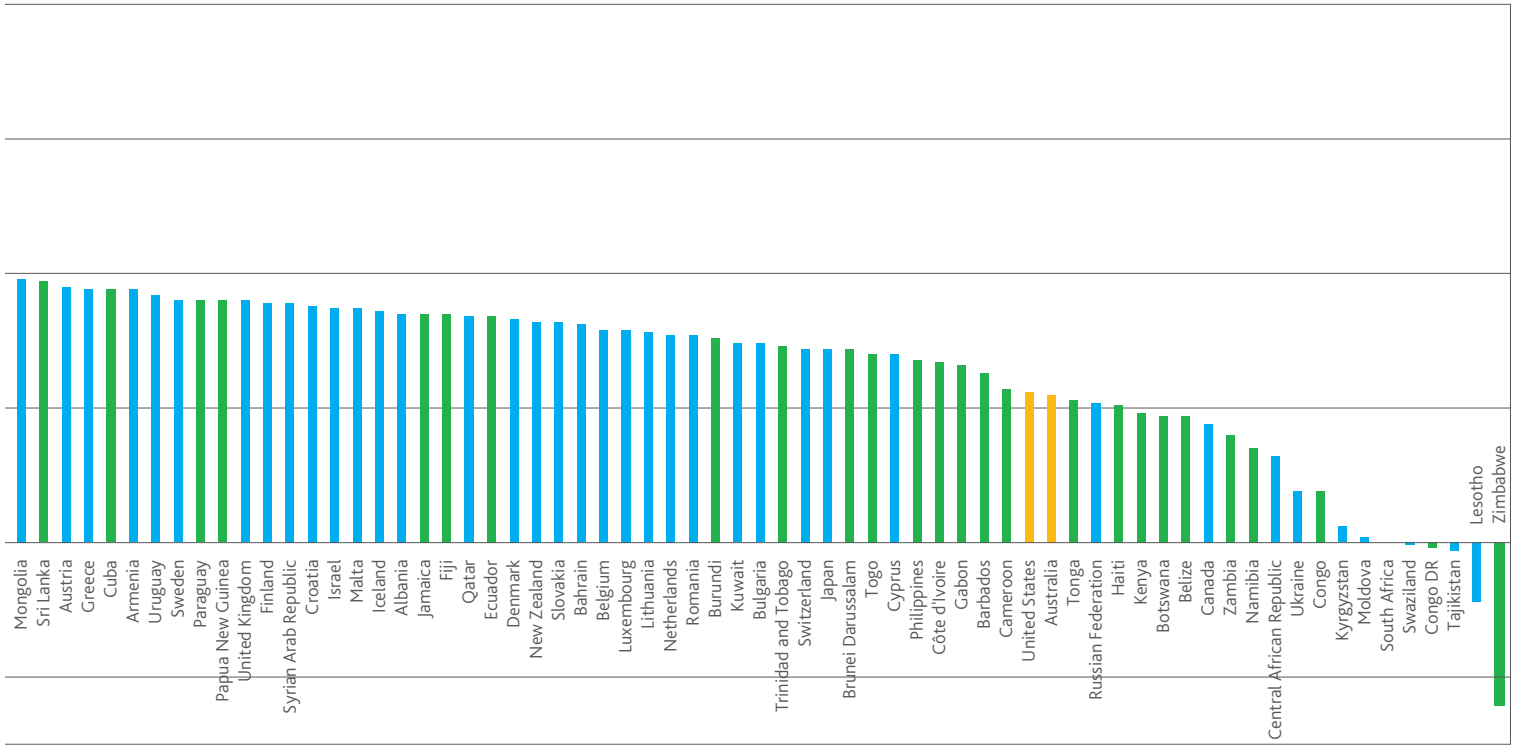
(4) Societal dynamics are different. The processes of urbanisation and demographic transition, among other societal dynamics, further amplify discrepancies in the development process. Tropical regions have long lagged behind fast growing temperature regions.

(5) Geopolitical factors. Temperate zone imperial domination of tropical regions on the basis of superior military technology, and rich-country control of the institutions of globalisation – are further amplifiers. However Sachs believed their role was often exaggerated when not considered alongside the underlying technological, demographic, and urbanisation processes.

According to Sachs, 'If these hypotheses are broadly correct, then policy solutions for tropical underdevelopment will require a much greater national and international focus on technological innovation directed at the problems of tropical ecology' (Sachs 2000 pg.4).

Overview of economic performance since 1995

How have the Tropics performed economically in more recent years? Over the period from 1995 to 2010, GDP in tropical nations grew at an annual rate of 4.7% compared with 3.2% for the Rest of the World (see Table E4.1). The fastest growing regions have been South Asia (7.0%), Central and Southern Africa (5.3%) and South East Asia (5.3%).



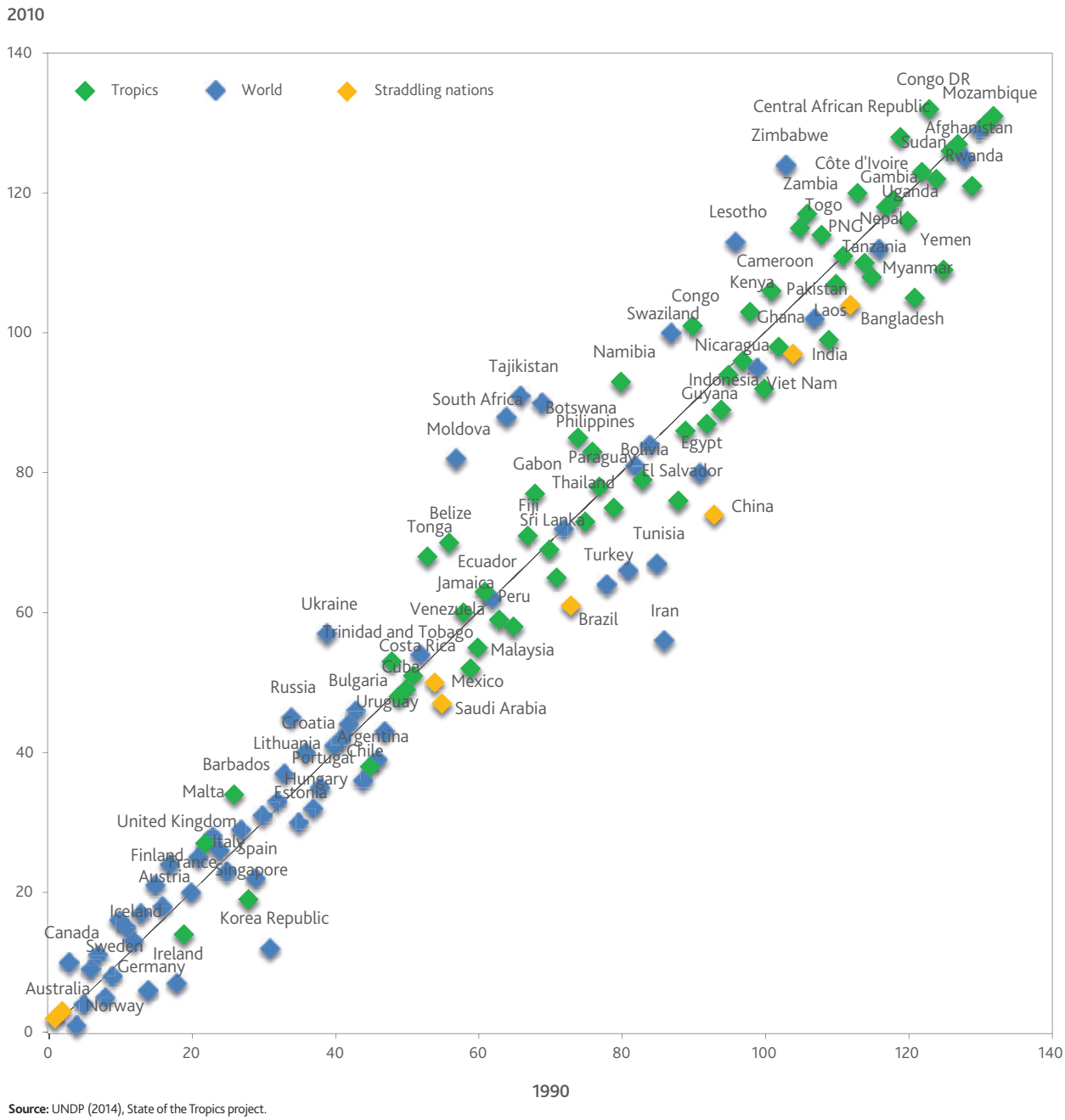
In fact, the rate of growth for these regions has accelerated in recent periods. This is also true for Latin America. Looking at the more recent 2005-10 period, it can be seen that the growth has been 5.8%, much higher than the 2.7% experienced by the Rest of the World (see Table E4.1). Of course, per capita incomes remain much lower – it will take many decades of higher growth to catch up.

How does this compare with Sachs' analysis of earlier periods? His definitions of regions are not identical but are close enough to make comparisons valid. During the long period from 1820 to 1992, the per capita GDP of the temperate region grew at an annual average rate of 1.4 percent per year, compared with 0.9 percent per year in the non-temperate region (dominated by tropical countries). Note that these are per capita measures so they will be lower than growth in GDP measures if there has been positive population growth. He also points out that the ratio of per capita GDP measures for temperate to non-temperate countries changed from 1.4 in 1820 to 4.5 in 1995.

Table E4.2 shows the comparisons for annualised growth rates for per capita GDP. On this measure, the Tropics are also growing much faster than the Rest of the World. Over the 1995 to 2010 period, the Tropics grew at 3.0% compared with 2.2% for the Rest of the World.

In more recent times, the growth in the Tropics has accelerated whereas it has gone in the opposite direction for the Rest of the World. Over the 2005 to 2010 period, the annualised growth in per capita GDP for the Tropics was 4.1% compared with 1.8% for the Rest of the World. This is much greater than the 0.9% annualised growth estimated by Sachs for the non-temperate region (which will be dominated by countries in the Tropics). Things have clearly changed although the performance by region is quite mixed. Differences between regions are explored later in the paper.

Figure E4.2 **Human Development Index, 1990 rankings versus 2010 rankings**



Source: UNDP (2014), State of the Tropics project.

This relative improvement for tropical countries is also true for a range of other progress indicators, some of which are summarised by the UNDP's Human Development Index (HDI) (UNDP 2014).[2] As can be seen from Table E4.3, the change in the HDI between 1990 and 2010 has been 0.10 (21%) for tropical countries (excluding those large countries straddling the tropical and temperate regions) compared with 0.07 (10%) for the Rest of the World.[3] If you include the straddling countries, such as China, India and Brazil, the improvement would be 0.11. The regions showing the greatest improvement are South East Asia, South Asia and Northern Africa and the Middle East. The regional estimates in Table E4.3 include the straddling countries.

These findings are reinforced by the following two figures. In Figure E4.1, the countries with the greatest improvement in HDI scores are shown on the left. The tropical countries are shown in green and countries which straddle the Tropics are shown in yellow. There is a definite preponderance of tropical countries on the left hand side of the graph especially if the straddling countries are included (which have performed better on average). There is also some clustering on the right hand side. This latter group is dominated by poor performing African countries. The performance has been quite mixed in African countries – some have shown significant improvements, others have not. Figure E4.2 shows rankings rather than HDI scores. Countries falling below or to the right of the diagonal line improved their ranking. It is not as easy to see but the tropical and straddling countries are more likely to have improved their ranking.

Then and now: a comparison, a viewpoint, a changing landscape?

I will look now at the economic growth and development in the Tropics with specific attention to each of Sachs' five hypotheses. A number of indicators have been used to illustrate the way the tropical landscape has changed economically, socially and environmentally. I will look first at hypotheses (1), (2) and (3); it is convenient to look at these hypotheses concurrently as they all relate to technology and transfer of technology. The relevant indicators are shown in italics and, for the first three hypotheses, they are as follows: foreign direct investment, research and development expenditure, mobile technology, internet, tertiary enrolments and scientific and technical journal articles.

The expectation is that *foreign direct investment (inflows)* should have increased as it is an effective way to transfer knowledge. Likewise, *research and development* activity should have increased in tropical countries. *Mobile technology* and the *Internet* have been powerful technologies for developing countries including those in the Tropics. The extent of the take-up of mobile technology is of interest. Likewise, an increase in tertiary education enrolments is a good proxy indicator to understand the development of knowledge in the Tropics. Within the tertiary sector, the number of scientific and technical journal articles also provides an indicator of research capability and output. I will look at each of these indicators in turn but the figures for each of these indicators suggest that there has been "a much greater national and international focus on technological innovation directed at the problems of tropical ecology" since the time period on which Sachs' paper was based. Perhaps his proposed policy solution has occurred, at least to some extent.

Foreign direct investment (inflows) increased substantially in all regions of the Tropics over the 30 years to 2010. Foreign direct investment to tropical nations increased more than tenfold between 1980 and 2010, from US$11 billion to US$157 billion. As a percentage of GDP, it has increased from 0.7% of GDP in 1980 to 2.2% in 1995 to 3.5% in 2010. This ratio was highest in the Northern Africa and Middle East (6.1%) and South East Asia (5.7%) regions. It also increased fastest in these two regions. However, the ratio declined in Central America between 1995 and 2010.

Research and development expenditure (as % of GDP) remained much lower than the Rest of the World (0.58% compared with 1.96%) in the late 1990s, but grew much faster at 18% between 2000 and 2008 compared with 9% for the Rest of the World. The fastest growing regions have been South East Asia and South America.

Mobile technology has emerged as one of the fastest growing consumer technologies ever introduced. In the Tropics mobile telephony has become the dominant means of communication and the principal gateway to increased ICT access and use, with penetration rates reaching 68% in 2010 up from 3.7% in 2000 and 0.1% in 1993 although somewhat less than the Rest of the World at 83%. The penetration is highest for South America, Central America and South East Asia all of which have higher penetrations than the Rest of the World on average.

Diffusion of the Internet in the Tropics has happened quickly in terms of both users and penetration, although access is considerably less widespread than mobile communications. Growth rates of 30% per annum between 2000 and 2010 (twice that of the Rest of the World) enabled the number of Internet users in the Tropics to reach 471 million in 2010 and achieve a penetration rate of 16.5%. All regions have grown rapidly, although Central and Southern Africa, Northern Africa and the Middle East, and South Asia lag behind the other regions.

With respect to *tertiary education enrolments per 100,000 population,* growth has been rapid from 1190 to 2031 over the 2000 to 2010 period. Although still considerably less than the ratio of 3423 students in the Rest of the World, there has been considerable catch-up. The proportional growth in Central and Southern Africa has been stronger than most other regions although the number of enrolments is still relatively low.

[2] The Human Development Index combines indicators of life-expectancy, educational attainment and income into a composite index. It is designed to serve as a frame of reference for both social and economic development.

[3] Data for 1990 are used as the base period as data for 1995 could not be sourced. This in unlikely to have a major impact on the analysis, noting that the improvement in the performance of the tropical countries has been accelerating.

The *number of scientific and technical journal articles per 100,000 population* originating from authors in the Tropics has more than doubled over the 1990 to 2009 period, but this figure remains very low at 1.8 when compared with for the Rest of the World at 18.9. Consistent with research and development expenditure, the regions with the most rapid growth were South East Asia and South America.

Sachs' policy solution to develop technology in the Tropics was to have a much greater national and international focus on technological innovation directed at the problems of tropical ecology. The indicators discussed above suggest there has been considerable progress in this direction, perhaps because newer technologies are not so ecology dependent (e.g. a lower reliance on agriculture). The impressive increase in foreign direct investment implies that there has been significant technology transfer. The advent of air conditioning and additional protections from tropical diseases has also made it easier for people from temperate climates to work in the Tropics and transfer their knowledge. Furthermore, the large increase in tertiary enrolments suggests that there is growing capacity within the tropical regions to adopt new technologies. The other indicators suggest important increases in home-grown technical capability even though still considerably less than the Rest of the World. All these factors are likely to have contributed to the higher economic growth in the tropical regions.

I turn now to hypothesis (4), which relates to societal dynamics such as urbanisation and demographic transition. Have there been many changes since 1995? The indicators I will look at are as follows: *urban population, life expectancy, maternal mortality, child (under 5) mortality and youth literacy.* Although not one of the indicators in the State of Tropics Report, I will also look at *fertility* because it is an important part of the demographic transition.

Urban population (as a percentage of the total population has increased considerably over the past 30 years, much greater than Sachs would have envisaged when writing his paper, I think. It has been growing steadily at an annual rate of 3.3% and was 45% of the population in 2010 compared with 38% in 1995 and 30.5% in 1980. This is still less than the 56.2% for the Rest of the World. In relative terms, the biggest growth has been in South East Asia. The process of urbanisation has supported economic development by providing the labour needed for industrial activity, but has also been a factor in the expansion of slums.

With respect to life expectancy, there have been significant improvements in the tropical countries. Over the past 50 years, life expectancy has improved from 41.3 years to 65.2 years. Although this represents a considerable catch-up to the Rest of the World, it remains 7.7 years lower. Over the past 15 years, the improvement for the tropical regions has been about five years, showing some acceleration. The relatively larger increase in life expectancy in the Tropics reflects greater access to vaccines and major improvements in many of the social determinants of health, including increased access to potable water and sanitation facilities, and enhanced public health infrastructure. There are two important exceptions. Whilst deaths from most of the so-called neglected tropical diseases (NTDs) have declined, this is not the case for dengue fever. Also obesity and non-communicable diseases such as diabetes are growing concerns. The rates have been growing steadily, although they are still well below those for the Rest of the World.

Sachs noted the significant improvements in public health in a number of tropical countries (mostly Asian) that preceded their economic take-offs. These improvements in public health have also now occurred in a number of other tropical countries and might have similar impacts. Reduction of maternal and child mortality has also been an important contributor to the improvement in life expectancy. All regions experienced significant decreases in both indicators with some regions now experiencing rates lower than the average for the Rest of the World.

Fertility has decreased significantly in the tropical regions and is continuing to fall. For the 1950-55 period, the fertility rate was 6.2 which had fallen to 3.2 by 2005-10. Much of the reduction occurred prior to 1990-95 when it had already dropped to 4.1. For the South America, Central America and South East Asia regions the fertility rate is now only slightly above that for the Rest of the World. It remains high for the Northern Africa & Middle East and Southern & Central Africa regions but, in Africa at least, it is expected to fall with reductions in child mortality and improvements in the education levels of girls.

Youth literacy has improved steadily over the period from 1989-93 to 2005-10, from 79.8% of youth to 86.2%. Whilst the rate is still lower than the Rest of the World, the South East Asia, South America and Central America regions have rates higher than the Rest of the World on average. Also, the South Asia region is experiencing the most significant increase in youth literacy. This is a consequence of a significant increase in mean years of schooling over this period.

It can be seen that the societal dynamics of the tropical regions have changed in that they now represent more closely the conditions that exist in non-tropical countries. Urbanisation has definitely increased and a demographic transition is occurring because of lower mortality and fertility rates, as discussed above. The tropical countries are experiencing the so called demographic dividend to their economic growth as relatively high proportions of their populations are of working age. The improvements in youth and adult literacy mean t there is a more skilled workforce and a greater range of job opportunities for this workforce.

Societal dynamics have changed more rapidly in some regions than others with South East Asia being the most notable example. However, there are other regions such as South Asia and Central and Southern Africa where the transition has started. If Sachs' hypothesis (4) is correct, then it could be concluded that changes in societal dynamics have contributed to the faster economic growth in the tropical regions.

Sachs' hypothesis (5) is about geopolitical factors but I will not comment on this aspect of Sachs' theory because the State of the Tropics Report does not contain any relevant indicators except to note improved governance in many countries. Furthermore, Sachs' assessment is that "their role is often exaggerated when not considered alongside the underlying technological, demographic, and urbanisation processes".

Other factors

Sachs also mentions the importance of agriculture productivity to growth in the tropical regions, and notes that productivity had been much lower than the Rest of the World for a number of reasons including the lack of technology specific to the tropical ecological regions. Significant improvement appears to have been made in agriculture productivity in more recent years. Although there has been little increase in the use of land in the Tropics, output has increased dramatically because of improved productivity. Two of the important contributions have been increased irrigation and use of inorganic fertilisers both of which have their own environmental problems.

Over the past 30 years, livestock productivity has increased by 89% for cattle/buffalo (South America being the main contributor) and 44% for sheep/goats (Central and Southern Africa being the main contributor) compared with much more modest growth for the Rest of the World (3% and 4% respectively). Total cereal production has more than doubled (South America and South East Asia being the main contributors) but still lags the Rest of the World in yield even though it has improved by 67% over the past 30 years. The increase in agriculture productivity has been important because it has corresponded with an increase in demand (and prices) for agriculture commodities. Africa has generally lagged the other regions in the use of technology and improved techniques to improve agriculture productivity. However, the analysis above suggests there is some catch-up.

On the other hand, there are some warning signs with respect to future agriculture productivity. Nearly one-third of land in the Tropics suffered degradation between 1981 and 2003. This is more than the global average of 20%. South East Asia had the greatest area of land degradation at 53% but it is now much less reliant on agriculture for economic activity. Deforestation followed by poor agricultural practices were the major causes of land degradation.

Water is also an issue. The Tropics have just over half the world's renewable resources (54%). Despite this, half the tropical population was considered vulnerable to water stress in 2010 and current water use patterns are still considered unsustainable in many parts of the Tropics. Agriculture accounts for 81% of water withdrawals so is especially vulnerable.

Despite these improvements in agriculture productivity and increase in agriculture production, agriculture has become a relatively less important part of the economy in the Tropics. It was 18% of GDP in 1980, down to 15% in 1995 and further down to 12% by 2010.[4]

Sachs also referred to the ability to mobilise energy resources and suggested that tropical countries were disadvantaged because they had relatively fewer coal resources. However, electricity generation has grown much faster in the Tropics than the Rest of the World. Tropical regions accounted for 7% of electricity generation in 1980 and grew to 15% by 2010. On a per capita basis, it is still much faster with energy production increasing by 4% per annum in the Tropics over the past 30 years compared with 1.7% per annum in the Rest of the World. Furthermore, electricity generation from renewable resources (mostly hydroelectricity) has also increased much faster in the Tropics from 15% of world usage in 1980 to 23% in 2010. Imports of energy sources such as coal would have been an important contributor but the tropical regions are also richer in oil and renewable resources.

To summarise, there appears to be considerable progress in the Tropics in all the factors that Sachs regarded as pre-conditions for improved growth, namely the "underlying technological, demographic, and urbanisation processes" as well as substantially improved agriculture productivity even though agriculture has become relatively less important as the economies have diversified. Furthermore, the "ability to mobilise energy resources" seems to have improved. Consistent with his hypotheses, these are likely to be significant factors in the greatly improved economic performance of the tropical regions. However, these may not be the only factors that matter. This issue is explored in the following section.

What other factors might be driving the improved performance of the tropical regions?

Apart from the South East Asia and South Asia regions, the tropical regions had relatively low growth compared with the Rest of the World up until the mid-1990s, i.e. the end point of Sachs' analysis. For the other regions, the improved growth started about then or shortly afterwards. Improved political stability has been one important factor that has influenced the sudden improvement in many circumstances in the Tropics. This does not hold for every tropical country and, where it does not exist, poor economic performance is one of the outcomes. Institutional strengthening and good governance are also important, which includes arrangements for collecting taxes and other revenues due to government. This applies particularly to the financial system and its supervision. Also, there needs to be a favourable policy environment that includes flexible capital and labour markets. The performance of tropical countries is mixed but generally there have been significant improvements in those countries where the economic performance is best.

One of the comparative advantages of most tropical countries is relatively low labour costs. This has facilitated a shift in manufacturing and

[4] Agriculture includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production

certain services from developed countries to a number of tropical countries. This has been an important factor in South Asia, for example.

There are other important factors which are covered by the State of the Tropics indicators such as (i) education (mean years of schooling of adults), (ii) openness through international trade and investment (exports of goods as %of GDP, foreign direct investment, net inflows), (iii) infrastructure development (gross capital formation) and (iv) corruption.

The mean years of schooling as an adult almost doubled in the Tropics between 1980 and 2010 from 2.9 years to 5.9 years. This is still less than the Rest of the World (8.5 years). The regions with the highest mean years of schooling are the Caribbean (8.2 years) and Central America (7.8 years). It is important that these improvements continue as it has been shown that there is a strong relationship between mean years of schooling and per capita incomes.

Growth in exports of goods as a % of GDP has been very strong from 26.4% in 1980 to 37.0% in 1995 to 47.1% in 2010. This is much faster than the growth in exports in the Rest of the World, where the ratio was 25.1% in 2010. GDP growth has also been slower in the Rest of the World. Exports of goods as a % of GDP for the Tropics were actually more than 50% prior to the Global Financial Crisis. The ratio for exports (47.1%) is higher than that for imports (45.8%) so the Tropics are a net exporter, and trade in goods contributes positively to economic growth. Unfortunately there is no similar data for trade in services.

South East Asia has the highest proportion of exports to goods as a % of GDP (90.2%) but this large number may be due in part to re-exports from places like Hong Kong and Singapore. South Asia has the strongest growth in exports driven by the trade liberalisation policies of India and Bangladesh. These regions in particular have more mixed economies and have significant exports from industries other than agriculture. Services are also becoming increasingly important.

Foreign direct investment, net inflows increased substantially in all regions of the Tropics in the 30 years to 2010 assisted in part by liberalisation policies in many countries. Foreign direct investment to tropical nations increased more than tenfold between 1980 and 2010, from US$11 billion to US$157 billion. As a percentage of GDP, it has increased from 0.7% of GDP in 1980 to 3.5% in 2010. The petroleum industry was an important contributor. When consideration is given to this increase in foreign investment together with the story on exports, tropical countries have clearly become more open. Developed countries have traditionally been the source of funds for foreign investment but in recent years, developing countries such as China have also become important investors.

With respect to gross capital formation, there has been sound performance in the Tropics which has contributed to both current and future economic growth. This indicator includes both private and public outlays. As a proportion of GDP, gross capital formation has been growing at about 0.5% per annum over the last 30 years and the ratio is now 25%. In the Rest of the World, the ratio has declined at a rate of 0.1% per annum to 22%, and is now lower than for the Tropics. The ratio is highest in South Asia (35%) and South East Asia (30%) with the highest growth in South Asia where there have been active policies in place in India to encourage investment. The growth in South East Asia was affected somewhat by the Asian Financial Crisis in 1997 but has since recovered.

Corruption, according to the World Bank's World Governance Indicators (World Bank 2013), is more prevalent in the Tropics than in the Rest of the World, and the gap has not changed significantly since 2000. Corruption tends to be more prevalent in resource rich developing countries, especially where there is weak rule of law and state ownership of resources.

It is difficult to assess the influence of corruption on economic growth. Studies have shown that it will have a negative impact and the World Bank is trying to address it for that reason. Certainly the most corrupt countries are among those that performed the worst economically. It would be interesting to look at whether there is correlation between those countries that have reduced corruption (unfortunately this number is small) and economic growth.

To summarise, apart from the pre-conditions implied by Sachs' hypotheses and the other factors mentioned in the opening paragraphs of this section, it appears that there is a relationship between economic growth and education, openness through international trade and investment, and infrastructure development. It could be argued that Sachs' pre-conditions are necessary but not sufficient, as other factors are also important.

What has been the industry breakdown of economic growth?

It is illuminating to look at how various sectors of the economy contribute to growth. As shown in Table E4.4, the trend for the Tropics has been the decline in the relative importance of agriculture4 (even though it has increased substantially in actual size), and the increased importance of both industry[5] and services[6]. Industry has increased from 29% of GDP to 32% between 1995 and 2010. The increase for services is slightly greater from 49% of GDP to 53%. This is not unexpected. As countries develop, there is generally relatively less reliance on agriculture.

The ability to adapt the industry structure of economies is important. To quote Sachs, 'these (more successful) economies were able to establish new productive sectors (e.g. textiles, electronic machinery, semiconductors and electronic components) where tropical production was not burdened by climatic or ecological factors' (Sachs 2000 pg. 31).

The story is quite mixed across the regions as is the relative importance each sector. For agriculture the biggest decreases between 1995 and 2010 were in Southern and Central Africa, Northern Africa and the Middle East and South Asia. For South East

Asia, the decrease in the relative importance of agriculture occurred earlier.

The relative increase in the importance of industry started from the mid-1990s. For this grouping, the biggest increases have been in Southern and Central Africa, and Northern Africa and the Middle East. There were actually decreases in the relative importance of industry in the Caribbean and Central America.

On the other hand, for services, the Caribbean and Central America were among the regions with the biggest increases along with South East Asia from 1995 to 2010. The trend towards services started even earlier in South East Asia. There was a significant fall in the relative importance of services over this period in Northern Africa and the Middle East.

Differences between regions

In this section I rely mostly on information in the State of the Tropics Report. The approach I have taken is to arrange the regions by their annualised growth over the 1995 – 2010 period and then look at where the regions are relatively strong or weak, mostly in terms of the indicators in the Report (see Table E4.5). The economic performance of the regions is quite mixed and will use Table E4.5 to see whether there are any patterns that help explain this mixed performance.

It is worth noting the following pen pictures of the nature of the growth for each of the regions.

- South Asia: Very strong growth well before 1995, accelerating through the 2000s
- South East Asia: Very strong growth started well before 1995 and has continued with a slight setback during the 1997 Asian Financial Crisis
- Central and Southern Africa: Very strong growth only started during the 2000s but has been accelerating
- Caribbean: Strong but steady growth since 1995

[5] Industry includes mining, manufacturing, construction, electricity, water, and gas.

[6] Services include wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services.

Table E4.4 **Contribution of different sectors to GDP (%)**

	1980			1995			2010		
	Agriculture	Industry	Services	Agriculture	Industry	Services	Agriculture	Industry	Services
Tropics	**18%**	**29%**	**48%**	**15%**	**29%**	**49%**	**12%**	**32%**	**53%**
Central & Southern Africa	32%	27%	42%	30%	27%	44%	24%	34%	43%
Northern Africa & Middle East	26%	25%	42%	32%	22%	36%	20%	37%	32%
South Asia	35%	21%	48%	26%	25%	49%	19%	28%	53%
South East Asia	24%	30%	43%	16%	32%	48%	12%	34%	54%
Caribbean	13%	23%	55%	8%	25%	60%	5%	18%	71%
Central America	9%	25%	53%	6%	30%	50%	4%	26%	62%
South America	11%	35%	48%	8%	32%	51%	6%	36%	53%
Oceania	10%	36%	53%	7%	29%	64%	6%	29%	64%
Rest of the World	**6%**	**38%**	**50%**	**5%**	**32%**	**55%**	**4%**	**30%**	**63%**
World (estimated)	**8%**	**36%**	**50%**	**7%**	**31%**	**54%**	**6%**	**31%**	**61%**

Source: World Bank (2013), State of the Tropics project.

- Northern Africa and the Middle East: Growth has been steady since 1995 but there has been significant population increases so per capita growth has been quite small

- South America: Strong growth only really started in the 2000s after many decades of weak growth

- Central America: Apart from the late 1990s relatively low growth during this period, with per capita GDP hardly growing at all

- Oceania: Relatively weak growth that has been declining in magnitude with virtually no growth in per capita GDP

It is difficult to see a clear pattern from Table E4.5. Exports are clearly important for the stronger growing regions but the nature of the exports vary quite a bit from one region to another. South Asia seems to be taking advantage of relatively low labour costs but with improvements in education and youth literacy. Their economy has had significant increase in both industry and services. This increase has been supported by capital formation although foreign investment remains surprisingly low.

The strong performance of South East Asia is not surprising. There has been an excellent performance on the full range of economic, scientific and social indicators. Exports have clearly been a big part of the story. In the past there would have been a comparative advantage through relatively low labour costs, however their costs would no longer be low compared with South Asia for example. They have needed to add value through improved labour productivity or a switch to less labour intensive industry. The indicators suggest this may be happening. Also, services are playing a much larger role in the economy than previously.

Although Southern & Central Africa remains low on a range of science, education and other social indicators, there has been an increase in foreign investment. This may be due to foreign investors taking advantage of low labour costs, even though most industry in the region is based around commodities such as oil. Also, there have been important improvements in agriculture productivity. Export performance has grown steadily as a percentage of GDP but nowhere near as strongly as South Asia which also has relatively low labour costs. The Southern & Central Africa region is large and diverse: culturally, historically and politically. It is therefore not surprising that there is a great deal of variation in the performance of nations within the region.

The Caribbean has high and improving education indicators, especially tertiary education. The labour costs for the region are relatively high. There has been a big switch from industry to services possibly as a consequence. Also, exports (and economic growth) have been limited because Cuba does not have as much access to open markets and investment as many other countries.

Oceania is the worst performing region especially when you look at growth in per capita GDP. Their tertiary education levels are high, mostly because of the contribution of tropical Australia and Hawaii, but other education levels are declining. The labour costs of the region are relatively high compared with the high performing regions so the comparative advantage of the smaller countries is not clear.

The influence of China and India is important both because of their own contribution to economic growth and the contagion effect on other economies in the region. Only parts of both countries are in the Tropics so this diminishes their impact, especially China. In India, we have estimated 57% of the population live in the Tropics and contribute to 68% of India's GDP. In China, only 12% of the population live in tropical regions producing 12% of national GDP. However, even after removing the direct contributions of China and India, the regions still show strong growth, although at a lower level. China and India, although important, are only part of the story.

The Future

The World Bank's Global Economic Prospect (World Bank 2014) provides a positive picture for economic growth for the Tropics driven primarily by strong global demand for their commodities and services. However, the predicted performance is mixed across the regions as it is at present. South Asia is seen as growing strongly and getting back to near previous levels of very high growth. South East Asia is seen as growing at high but slowly reducing levels. Central and Southern Africa is shown as having increasingly high economic growth at relatively high levels. The Caribbean is shown as having steady growth at reasonably high levels. Northern Africa and the Middle East is shown as having improving but relatively weak growth. Both South America and Central America are shown as having steadily improving economic growth prospects although growth will not be as high as most other regions. For Oceania, growth is shown as steady at relatively low levels but could do better depending on the performance of Papua New Guinea.

There will be a range of challenges if the Tropics are to continue their current and projected strong performance. One such challenge is climate change and the climate change essay suggests that global warming will be an ongoing issue for the Tropics despite acknowledged uncertainty about other climate outcomes. Although it is unclear how rising temperatures and changing weather conditions will affect highly variable weather patterns such as rainfall and tropical cyclones, small changes in a region with reasonably constant temperatures are likely to have a larger impact than in areas with a more variable temperature range.

Tropical countries will need to invest in infrastructure development through private and public capital formation, expenditure on research and development relevant to the needs of the Tropics, improved access to the Internet and other relevant technologies, and continue to strengthen institutions and governance to reduce corruption and similar constraints on business activity.

Table E4.5 **Analysis of the relative strengths and weaknesses of regions**

	Relative Strengths	Relative Weaknesses
South Asia (7.0%)	• Large increase in exports • Low labour costs • Large increase in capital formation • Switch from Agriculture to Industry & Services • Increases in life expectancy and youth literacy	• Low level of Internet usage • Low level and relatively smallincrease in foreign investment
South East Asia (5.3%)	• High level and growth in foreign investment • Increase in R&D and technology indicators • High level and growth in capital formation • Increase in a range of social indicators • Increased urbanization • High level of exports • Switch to Services	• High (and increasing) income inequality
Central & Southern Africa (5.3%)	• Increase in foreign investment • Switch from Agriculture to Industry • Low labour costs • Improvement in Agriculture productivity	• Technology still at low level • Tertiary education at low level but growing quickly • Fertility is high
Caribbean (4.4%)	• High level and growth in tertiary education • High level for mean years of schooling • Switch from Industry to Services	• Net importer of goods
Northern Africa & Middle East (3.7%)	• Large increase in foreign investment • Switch from Agriculture to Industry • Significant net exporter	• Technology indicators are relatively low • Fertility is high • Decline in exports as % of GDP
South America (3.1%)	• Increase in a range of technology indicators • Increase in youth literacy • Large increase in agriculture productivity • Relatively high commodity prices	• High income inequality
Central America (3.1%)	• Increase in a range of technology indicators • Increase in youth literacy • Increase in mean years of schooling • Switch from industry to services	• Decline in foreign investment as % of GDP
Oceania (3.1%)	• High level of tertiary education	• Poor performance on a range of economic indicators • Imports growing faster than exports

Source: State of the Tropics project

Conclusions

My conclusion is the pre-conditions for growth as outlined by Sachs paper are necessary, but not sufficient to guarantee that the Tropics will match or exceed growth in the Rest of the World. One of the most important conditions is having appropriate institutional and policy settings. This is seen not so much by the information in this report but the very different performance of countries within a region.

Returning to the Sachs pre-conditions, significant factors have been the improvement in agriculture productivity coupled with improvements in health and public stability. These have increased the workforce available for productive activities and enabled tropical countries to take advantage of available technologies.

Once these essential conditions have been met, economic growth will be improved further through education, openness to trade and investment, and infrastructure development, among other things. GDP depends on the factors of production (e.g. labour and capital) and how you use these factors (e.g. technology). As the essay shows, there have been improvements in all these areas in the tropical regions. In particular, trade and investment have facilitated the transfer of technology and knowledge and enabled countries to focus on activities where they have a comparative advantage. Furthermore, the transfer of technology and knowledge has reduced the need for countries to undertake these types of innovative activities themselves.

Is tropical underdevelopment a thing of the past? Clearly the answer is no. However, unprecedented growth and change in recent years has closed the gap between the Tropics and the Rest of the World, and within an appropriate policy framework can continue to do so into the future.

References

Sachs JD. (2000), "Tropical Underdevelopment", CID Working Paper No 57, Centre for International Development at Harvard University, Boston.

UNDP (2014), Human Development Index. United Nations Development Programme. http://hdr.undp.org/en/statistics/hdi (accessed 01 February 2014).

World Bank (2013) World Development Indicators. http://data.worldbank.org/data-catalog/world-development-indicators (accessed 11 January 2013).

World Bank (2014) Global Economic Prospects. http://www.worldbank.org/en/publication/global-economic-prospects (accessed 01 February 2014).

Stock exchange, Ghana.
Image: Jonathan Ernst, World Bank.