Reviewing Long Run Trends in Productivity: a Linear Growth Hypothesis

Discussion Paper

14 September 2015

Over the last few decades the long run real growth in GDP per hour worked has been approximately linear in most advanced economies. This calls into question the exponential increases in productivity assumed in many models of steady state economic growth. Amongst other implications, this may explain a large part of the UK's current productivity puzzle.

Introduction

Policy-makers in many advanced economies around the world are concerned about the lacklustre productivity growth of recent years.

In the UK, for example, there has been exceptionally weak growth in the value of output per hour worked since the onset of the 2007-2008 financial crisis, and this is a worry for policy-makers, as productivity growth is fundamental to our future prosperity. In its latest Economic and Fiscal Outlook (July 2015), the Office for Budget Responsibility noted that:

> *In March, we forecast a gradual strengthening of potential output growth over the forecast period and that remains our central judgement. But that outcome depends on the most important uncertainty in our (and most people's) economic forecast: the timing and strength of the long-awaited return to sustained productivity growth.*

Although various potential explanatory factors have been put forward, there remains a perplexing gap between the current levels of productivity versus those which we would be seeing if the pre-crisis trend in productivity growth had continued. See, for example, the Bank of England's paper from 2014.

But how sure are we about the shape of that pre-crisis trend?

Long run productivity trends from 1950 to 2014

Many formal models of economic growth assume that the economy will tend towards a steady state 'balanced growth path' over the long run, in which productivity (output per hour worked) increases at a constant percentage rate per annum (i.e. exponentially), due to continual technological progress. This assumption was strongly supported by the evidence from the first half of the twentieth century. In particular, Nicholas Kaldor set out a very influential set of empirically-based 'stylized facts' in the early 1960s as a starting point for the construction of theoretical models [Kaldor, N (1961) "Capital Accumulation and Economic Growth," in F.A. Lutz and D.C. Hague, eds., *The Theory of Capital*, St. Martins Press, pp. 177–222.]. The first of these was:

> *The continued growth in the aggregate volume of production and in the productivity of labour at a steady trend rate; no recorded tendency for a falling rate of growth of productivity.*

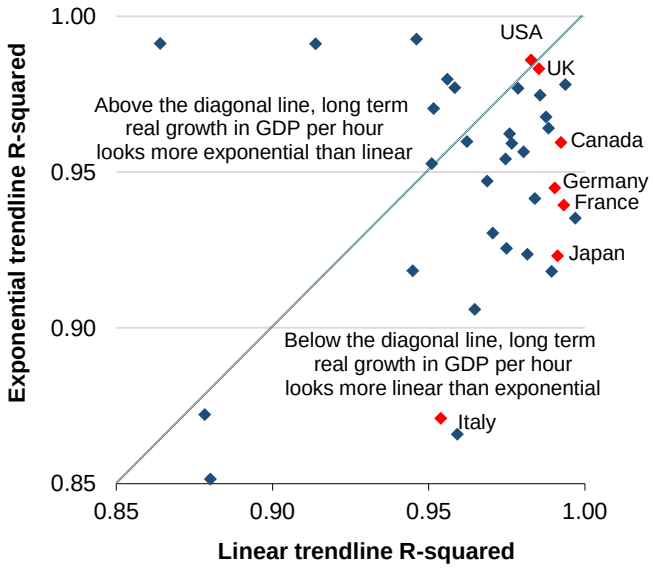
In this paper we examine the *shape* of the long run trends in productivity for the UK and several other countries over the period 1950 to 2014. In particular, we are interested to test how well the recent empirical data fits the assumption of exponential growth for the long run trend, as set out by Kaldor, and as commonly used in models of economic growth.

Using data for 66 countries sourced from the Conference Board's Total Economy Database, the charts in the Annex to this paper show a straightforward comparison of the goodness-of-fit of two different types of best-fit line for the real GDP per hour data over the period 1950 to 2014: exponential and linear. The values in the Conference Board dataset are given in US dollars at 2014 prices, using Purchasing Power Parity adjustments from 2011.

"R-squared" is used as a measure of fit for these lines (R-squared=0 meaning that there is no fit at all between the best-fit line and the actual data, and R-squared=1 meaning that the fit is perfect). For many countries, the dataset does not extend as far back as 1950, in which cases the charts show as many years of data as are available.

For the UK, the fit is very marginally better for the linear trendline than for the exponential trendline (although exponential growth appeared to be the better fit until 2008). But more importantly, it is striking that of the 36 countries classed as 'advanced economies' by the IMF and for which this data is available, **the linear best-fit line is the closer fit for 28 countries (78%) over the 1950 to 2014 period**, as summarised in the chart below. The eight advanced economies *above* the diagonal line (for which an exponential trend is a better fit than a linear trend over that period) are: USA, Ireland, Singapore, Hong Kong, Taiwan, Malta, Czech Republic and South Korea.

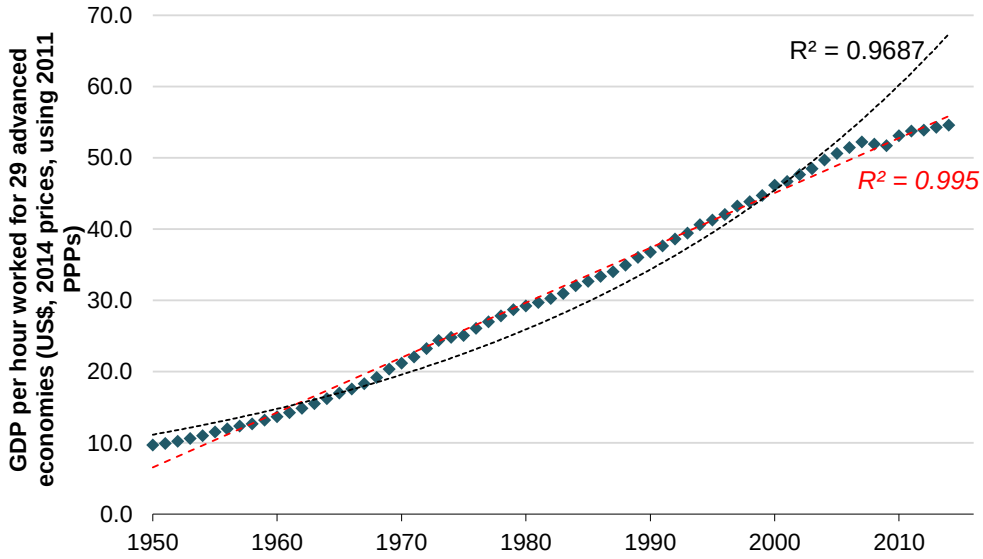
Figure 1: Relative goodness-of-fit for exponential and linear best-fit lines for real GDP per hour worked growth in 36 advanced economies since 1950 (G7 countries highlighted in red)



Source: SQW analysis of data from The Conference Board. 2015. The Conference Board Total Economy Database™, May 2015, http://www.conference-board.org/data/economydatabase/

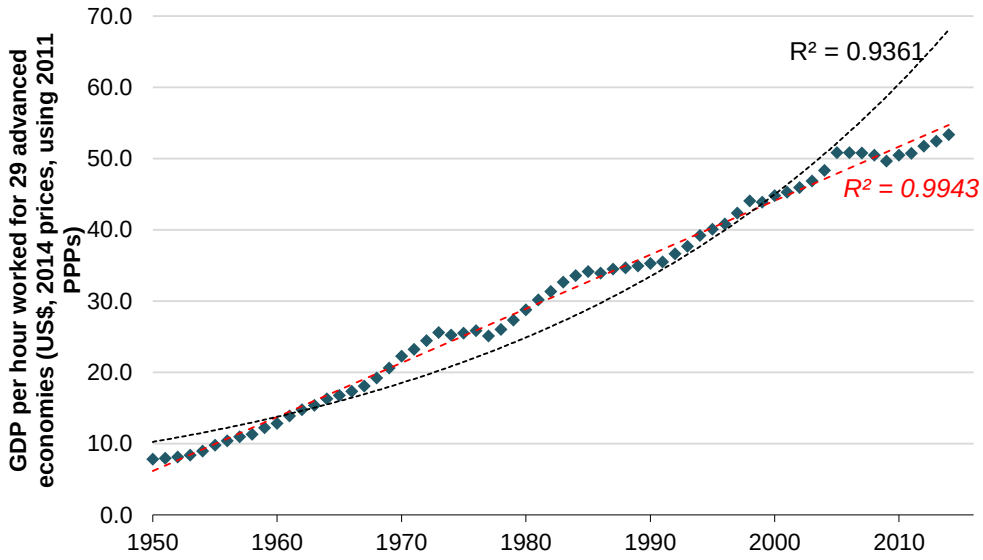
Looking at the productivity levels averaged across the advanced economies for which the GDP per hour worked data extends back to 1950, we see that the (red) linear best-fit line is a very close fit – and clearly a better fit since about 1970 than the (black) exponential best-fit line - for both the mean (Figure 2) and the median (Figure 3) values. From Figure 2, we can see that the shift from an exponential trend to a linear trend coincided with the start of the much-debated productivity slowdown of the 1970s [see, for example, Nordhaus, W. (2004), "A Retrospective on the 1970s Productivity Slowdown", NBER Working Paper 10950].

Figure 2: Mean GDP per hour worked across 29 advanced economies (those countries for which the dataset is complete back to 1950)



Source: SQW analysis of Conference Board data

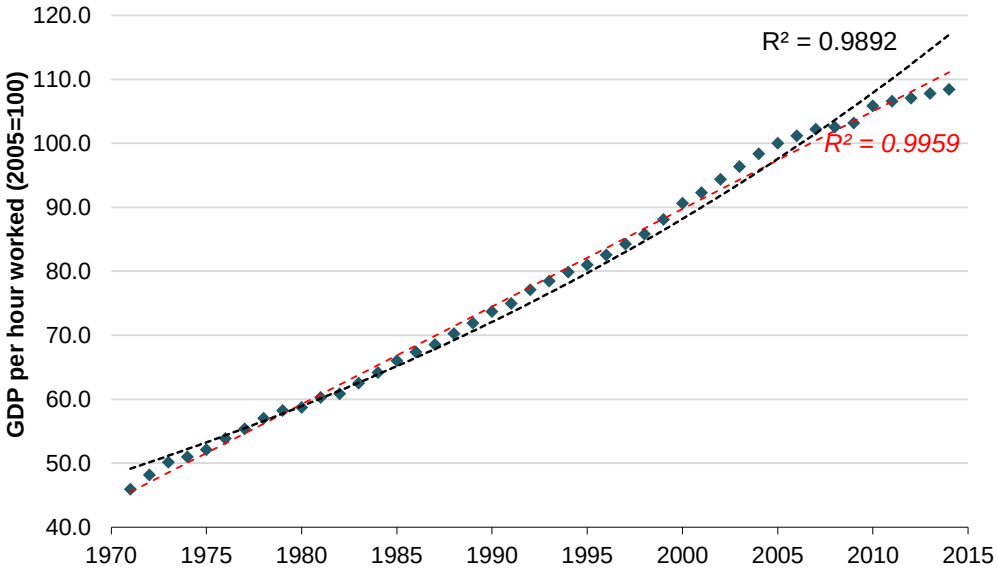
Figure 3: Median GDP per hour worked across 29 advanced economies



Source: SQW analysis of Conference Board data

Using an alternative productivity dataset from the OECD, which provides data over a shorter period (1971 to 2014), gives similar results: 21 (70%) of the 30 advanced economies in the OECD dataset experienced real productivity growth which appeared more linear than exponential over that period. The OECD data for the G7 countries are illustrated below.

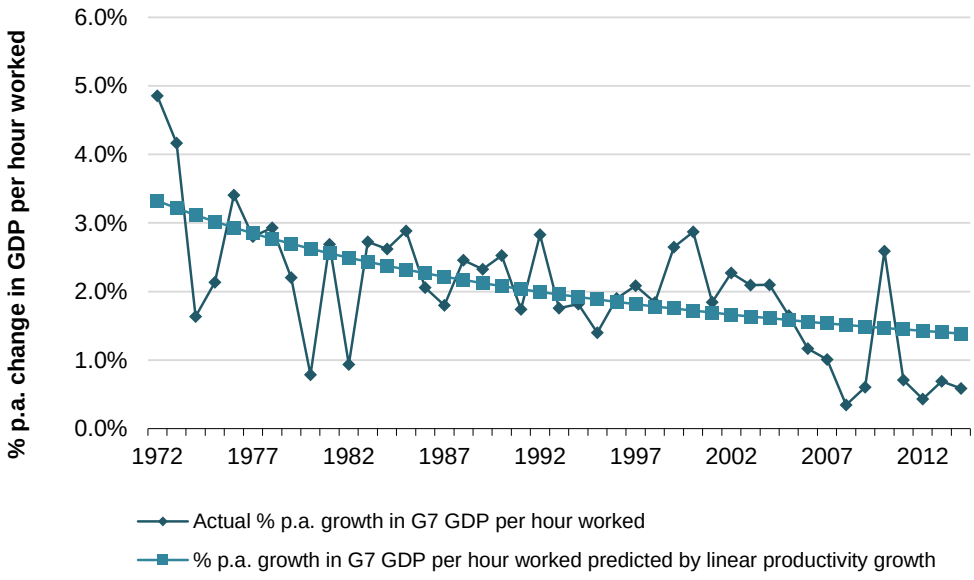
Figure 4: GDP per hour worked in the G7 group of countries (2005=100)



Source: SQW analysis of OECD productivity data

Looking at this from a different perspective, an assumption of linear productivity growth provides a plausible description of the long run trend in actual annual real growth (% p.a.) in the productivity of the G7 group of countries (see Figure 5).

Figure 5: Annual growth rates in real GDP per hour worked in the G7 (2005=100)



Source: SQW analysis of OECD productivity data

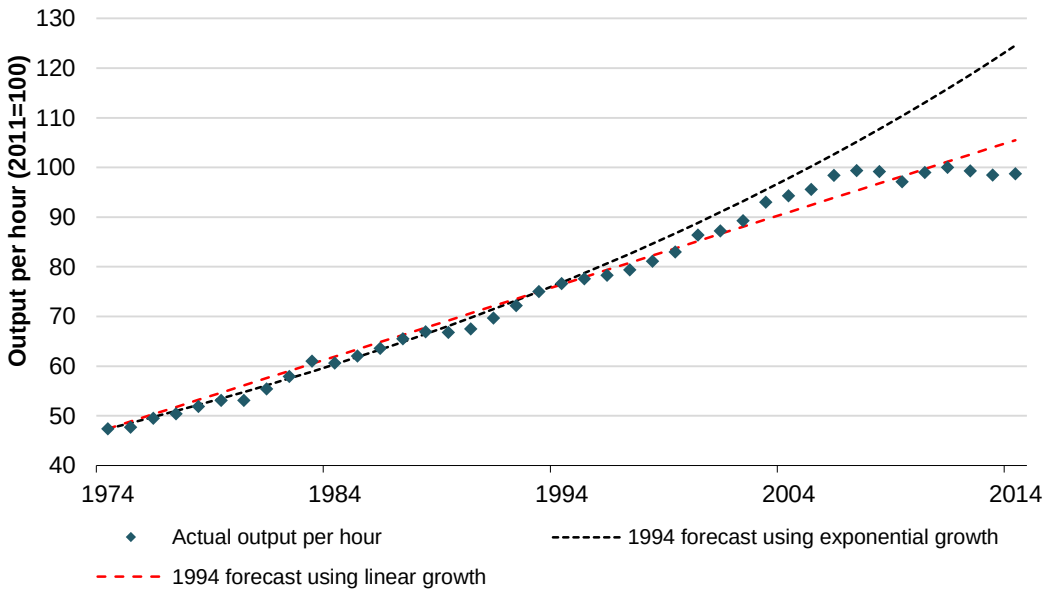
A hypothesis

The above observations suggest a hypothesis that **aggregate productivity has tended towards linear real growth, rather than exponential real growth, over the long run in advanced economies** since about 1970 – i.e. the start of the 'productivity slowdown' of the 1970s.

In the case of the UK, this may help explain a large part of the current productivity puzzle. If we believe this hypothesis, then the 2014 level of productivity would actually be quite close to the level indicated by the linear long run trend. The weak productivity growth over the last seven years would be a correction back towards the genuine long run trend, after unusually high growth in measured productivity in the period from 1997 leading up to the crash in 2008. The charts in the Annex to this paper illustrate that cycles around the long run trend of a decade or more are not unusual for productivity in advanced economies (see the charts for Sweden, Germany and Denmark for example).

Suppose you had made a forecast in 1994 as to what the UK's productivity would be 20 years hence, on the basis of the previous 20 years' data (1974 to 1993). According to ONS statistics, the whole economy output per hour index was 47.4 in 1974 and 75.0 in 1993 (the index is set to 100 for the 2011 level). Under the exponential growth assumption you would have taken 2.44% p.a. as the long run growth rate, giving a projected index of 124.5 in 2014. Under the linear growth hypothesis you would have assumed an improvement of 1.45 index units p.a., leading to a forecast of 105.5 in 2014. Given that the actual index turned out to be 98.7 in 2014, we can see that the exponential growth forecast overestimated by about 26%, whereas the linear growth forecast was significantly closer: overestimating by 7% (Figure 6).

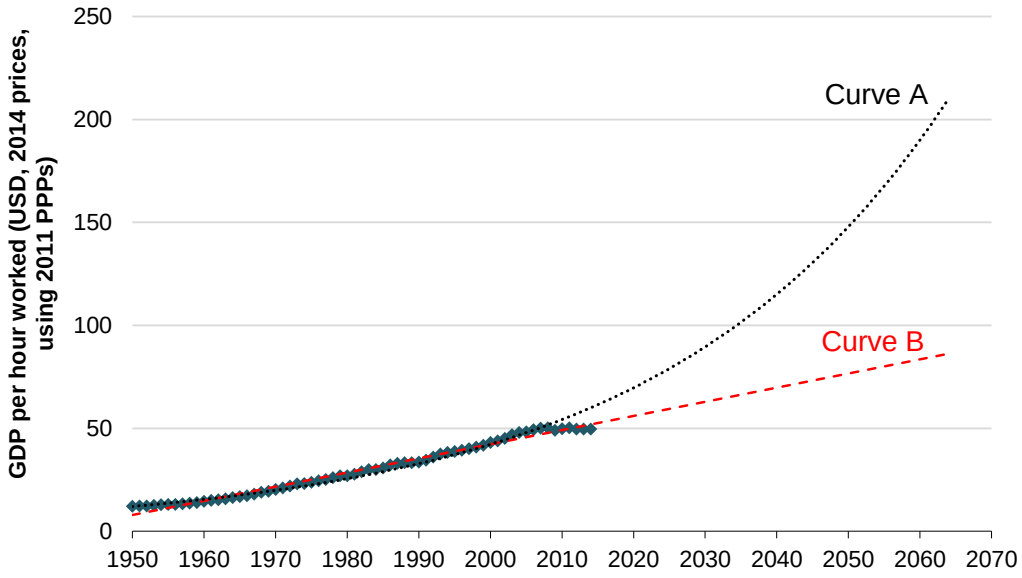
Figure 6: Whole economy output per hour worked in the UK (2011=100)



Source: SQW analysis of ONS data

Clearly, a shift towards linear long run growth in productivity would have important implications. Extrapolating the two different trendlines over a few further decades for the UK in Figure 7: we thought we were on Curve A, but we may actually now be on Curve B.

Figure 7: Extrapolation of two potential trends for GDP per hour worked in the UK



Source: SQW analysis of Conference Board data

If this linear trend continues, the *rate* of growth (in terms of % p.a.) would gradually reduce over time – tending towards 0% p.a. in the very long term – as a constant increment each year would be a decreasing proportion of the rising level of productivity.

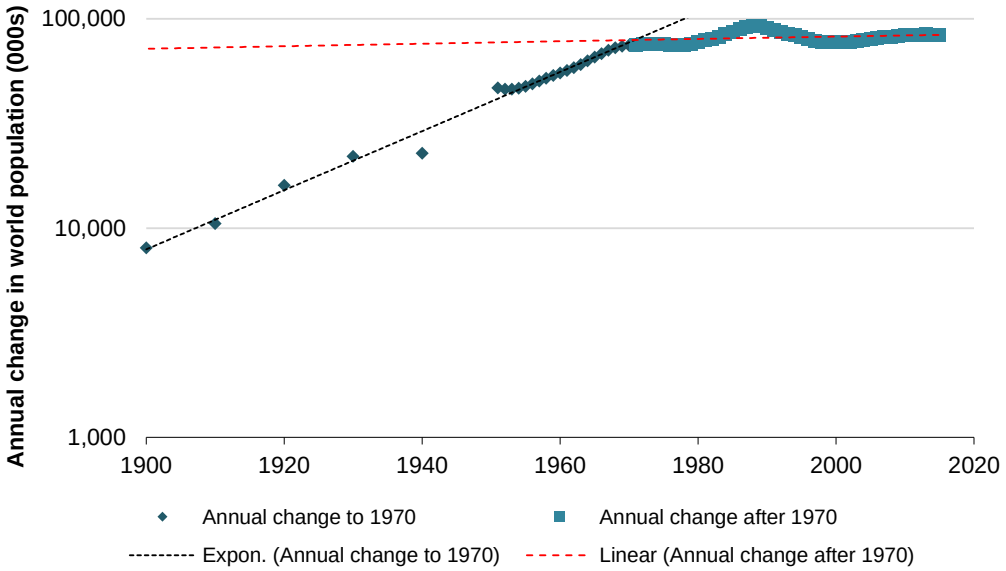
Why?

The obvious question arises: why should this be? What could possibly explain productivity shifting towards a linear long run growth path in advanced economies, when it had been so reliably exponential for many decades before the early 1970s?

We do not attempt to provide any theoretical explanation for this, but it would certainly be an interesting and important area of inquiry.

A tentative suggestion is that trends in world population growth might play a part, as the annual change in the world's total population has been broadly flat since about 1970, after many decades of exponential growth (Figure 8).

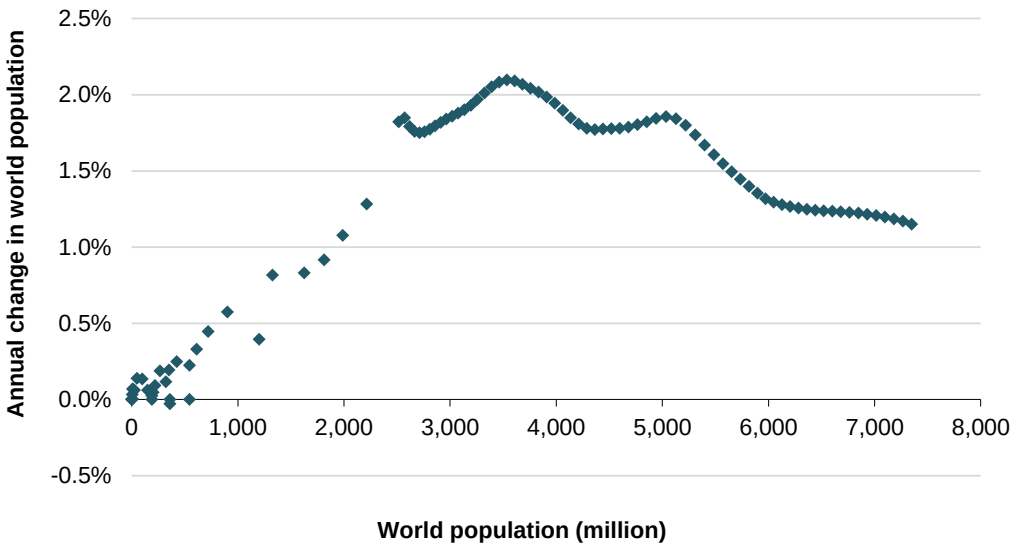
Figure 8: Annual change in world population (000s), 1900 to 2015. Note logarithmic y axis



Source: SQW analysis using total population data for 1950 to 2015 (for 1 July each year) from United Nations World Population Prospects 2015; SQW estimates for 1900 to 1940 are decade averages for annual growth derived from total populations in the UN's The World at Six Billion

Taking a (much) longer perspective, the inflection point in world population growth at about 1970 looks even more significant. In the chart below we have updated Kremer's world population growth estimates [Kremer, M. (1993), "Population Growth and Technological Change: One Million BC to 1990", *Quarterly Journal of Economics* 108: 681-716], using Kremer's data for 1 million BC to 1950, and the latest United Nations population estimates for 1950 to 2015.

Figure 9: Annual world population growth rate versus world population



Source: SQW analysis using data from Kremer (1993), and United Nations population estimates for 1950 to 2015

As pointed out by Kremer, the growth in world population has actually been faster than exponential for much of human history: with the growth *rate* being proportional to the total population. With the advantage of two more decades of data since that paper, we can see now that this ceased to be the case in 1968 when the percentage growth in total world population peaked at 2.1% p.a. (at a world population of 3.5 billion), and that the growth rate has been trending downwards since then.

Some link between this discontinuity in the trend of world population growth and the discontinuity in the trend of productivity growth in advanced economies would be reasonably plausible.

For example, 'semi-endogenous' growth theorists have previously suggested that the rate of productivity growth should be dependent on the rate of population growth (or the growth of the labour force engaged in research), as the greater the world population the more people there are to make new discoveries. [See Jones, C.I. (1995), "R&D-Based Models of Economic Growth", *Journal of Political Economy* 103: 759-784].

The almost simultaneous discontinuities in world population growth and productivity growth around 1970 might not support the semi-endogenous growth theory as a credible single explanation for a shift to linear long run productivity growth (given the lags between a person being born and them taking up research), but we suspect that alternative explanations involving population growth could yet be uncovered.

In conclusion

The hypothesis set out in this paper does *not* imply that policy-makers are powerless to change the path of productivity growth. Indeed, we are hopeful that this different way of looking at the development of productivity over time (putting aside implicit or explicit assumptions that the long run trend is exponential) may lead to new analytical approaches shedding further light on what does – and what doesn't – determine long run productivity growth, which would help to inform policy decisions.

Finally, we note that our analysis is readily replicated using the international productivity datasets referenced in this paper. There are no advanced methods or hidden assumptions involved. We have simply sought to understand the shape of the long run trend in observed real GDP per hour worked for as many countries as possible over as long a period as is available in consistent international productivity datasets.

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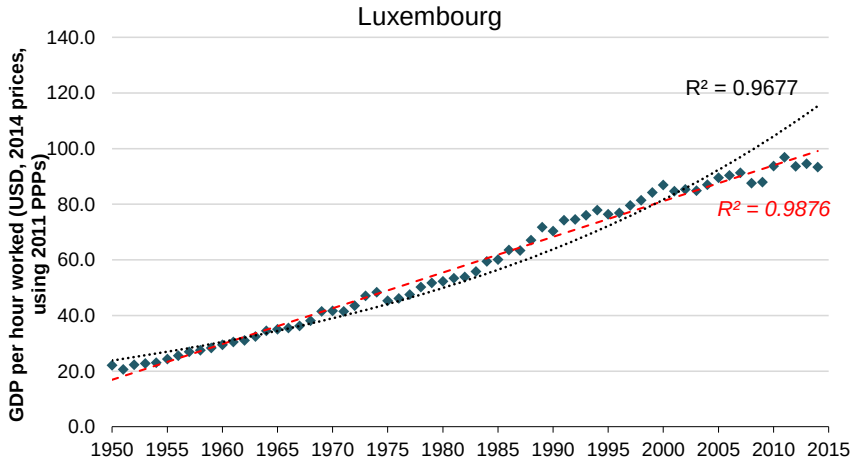
September 2015

Annex: Linear versus exponential best-fit curves for 66 countries

The data source for all charts in this Annex is The Conference Board. 2015. The Conference Board Total Economy Database™, May 2015, http://www.conference-board.org/data/economydatabase/ . Content reproduced with permission from The Conference Board, Inc. © 2015 The Conference Board, Inc.

Advanced economies

As of April 2015, the International Monetary Fund classed 37 countries as 'advanced economies'. Of these, the Conference Board GDP per hour dataset includes 36 (San Marino being the exception). The charts below show the linear (in red) and exponential (in black) best-fit lines for these countries, in descending order of 2014 GDP per hour worked.



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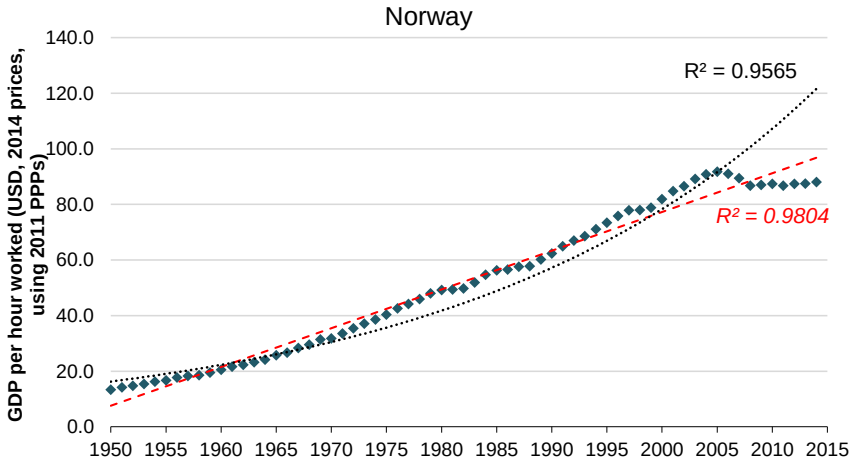
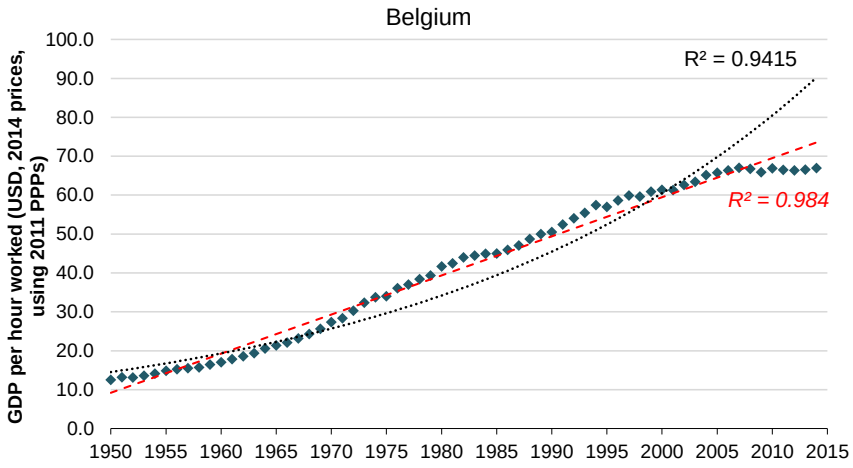
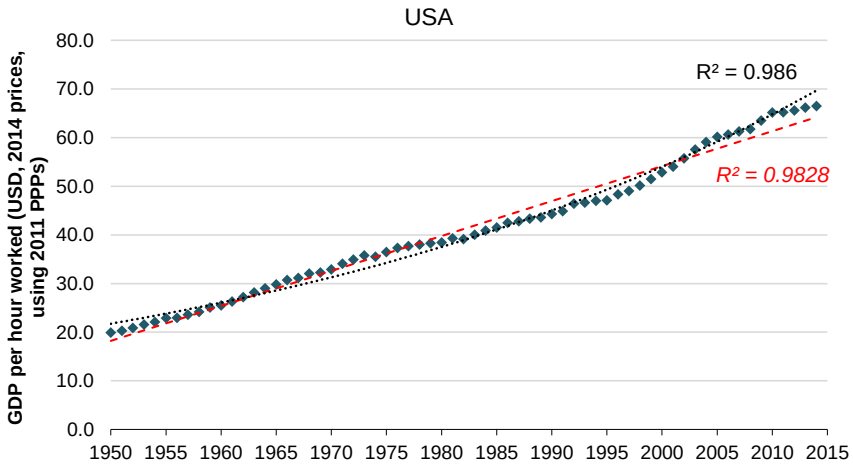
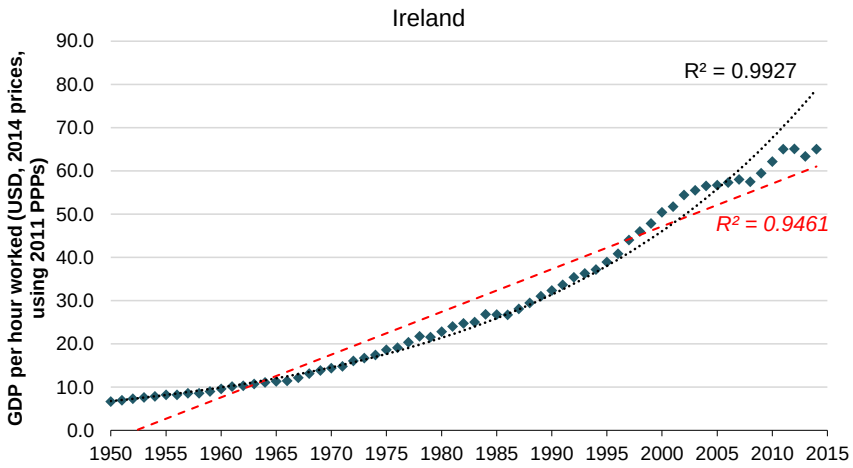
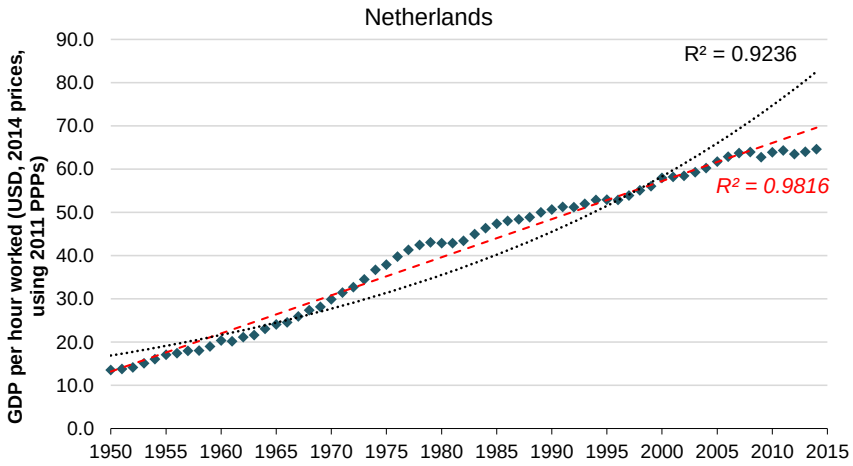
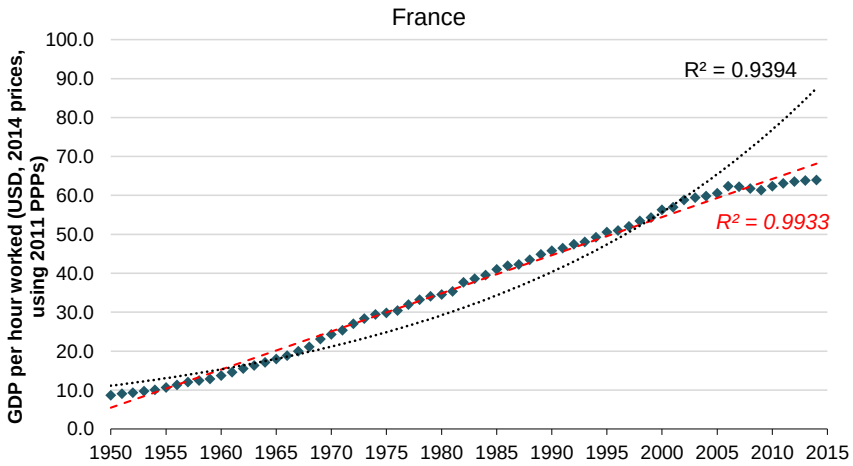


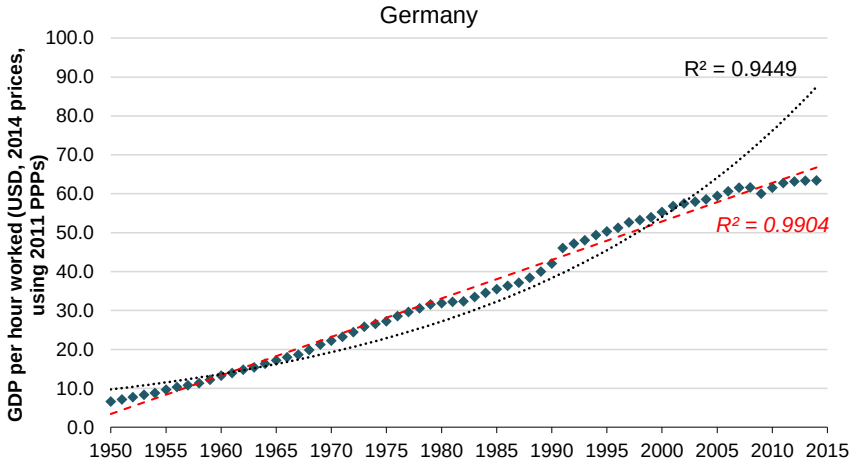

Belgium
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9415
R² = 0.984
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

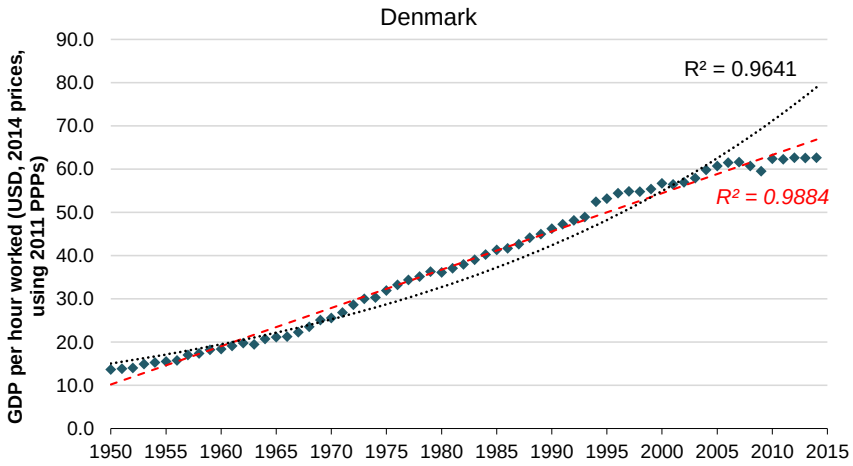

USA
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.986
R² = 0.9828
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

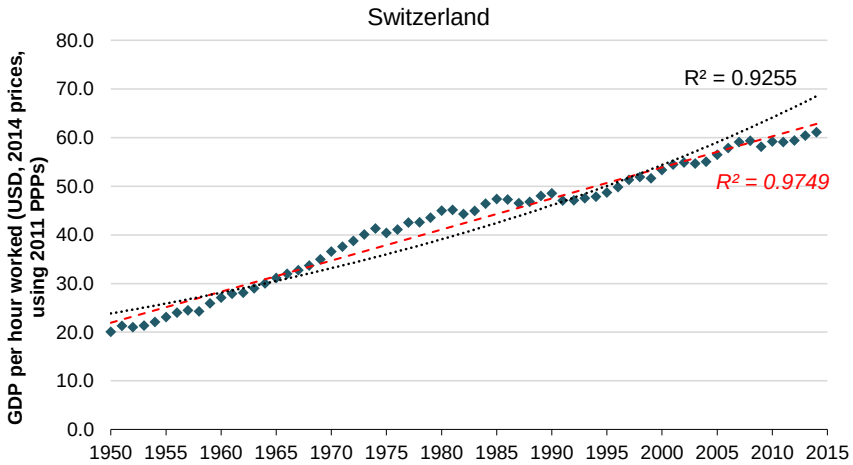

Ireland
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9927
R² = 0.9461
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

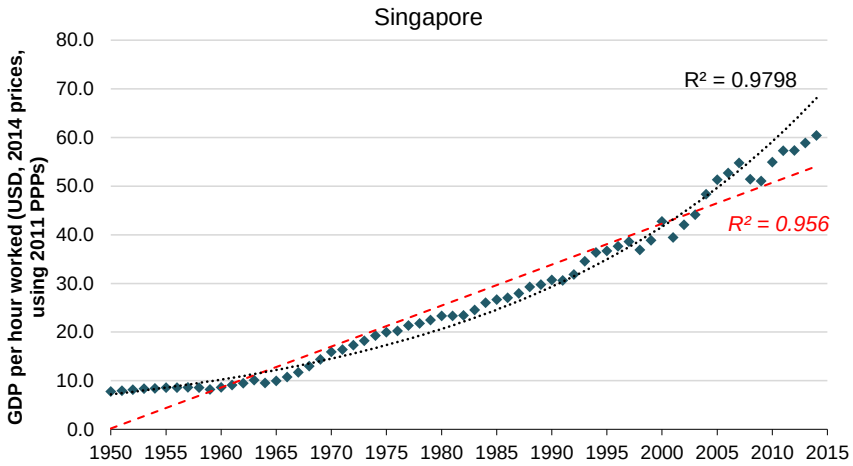

Netherlands
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9236
R² = 0.9816
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

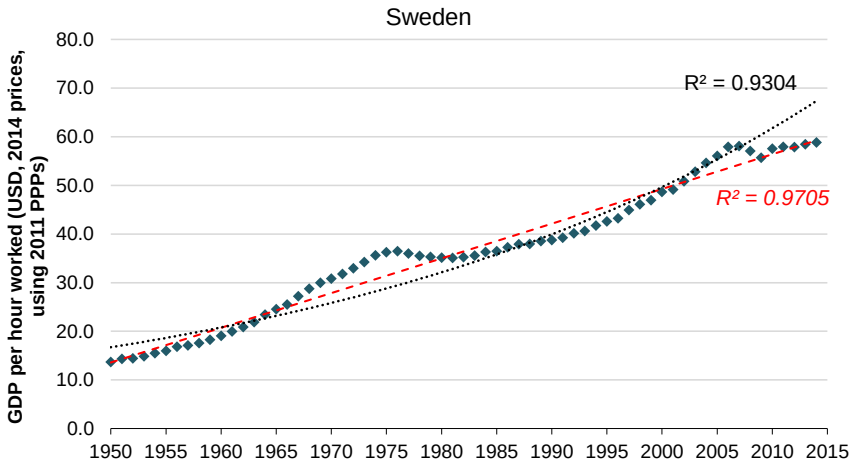

France
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9394
R² = 0.9933
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

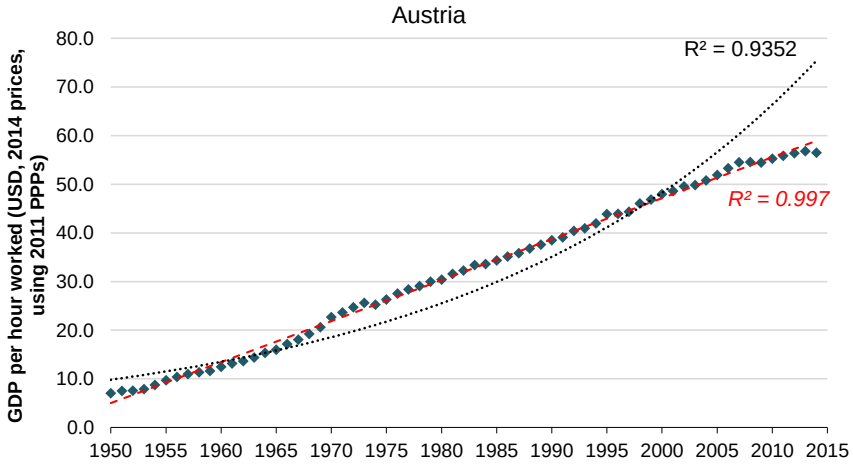

Germany
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9449
R² = 0.9904
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

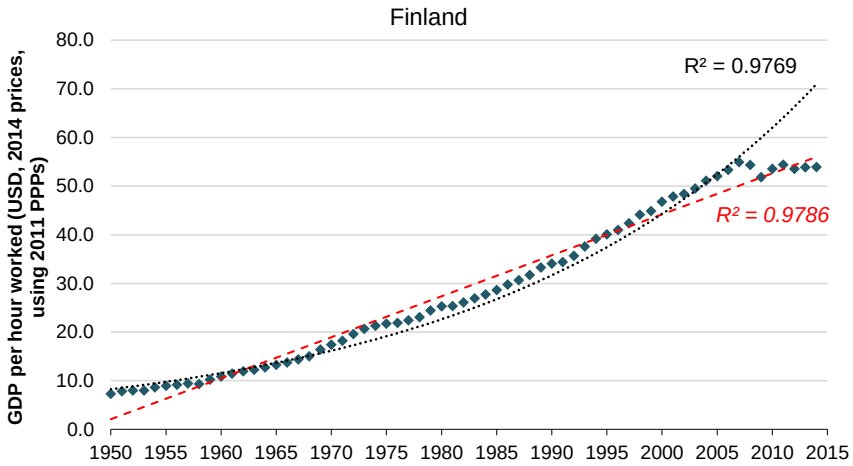

Denmark
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9641
R² = 0.9884
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

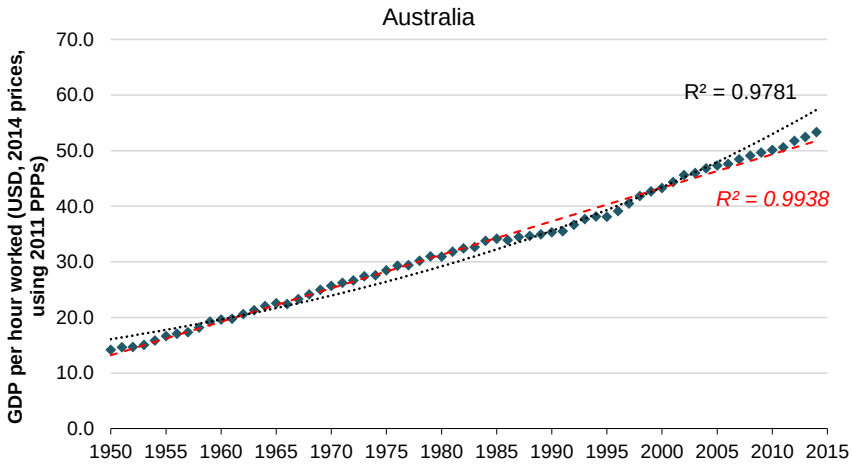

Switzerland
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9255
R² = 0.9749
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

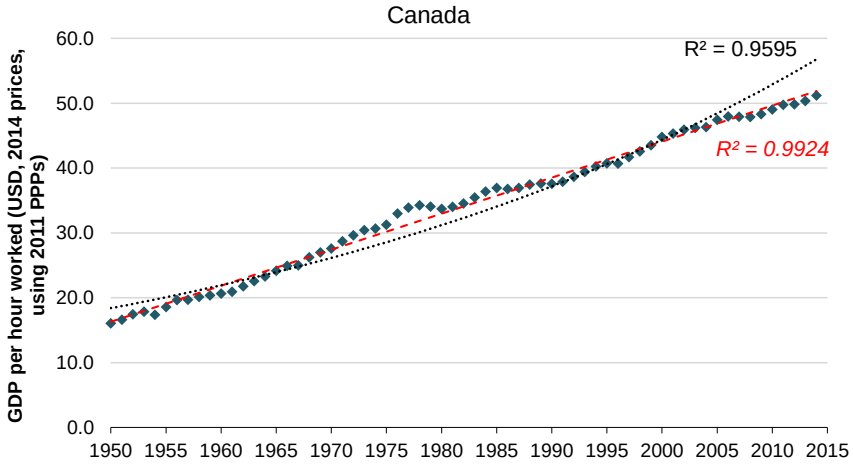

Singapore
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9798
R² = 0.956
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

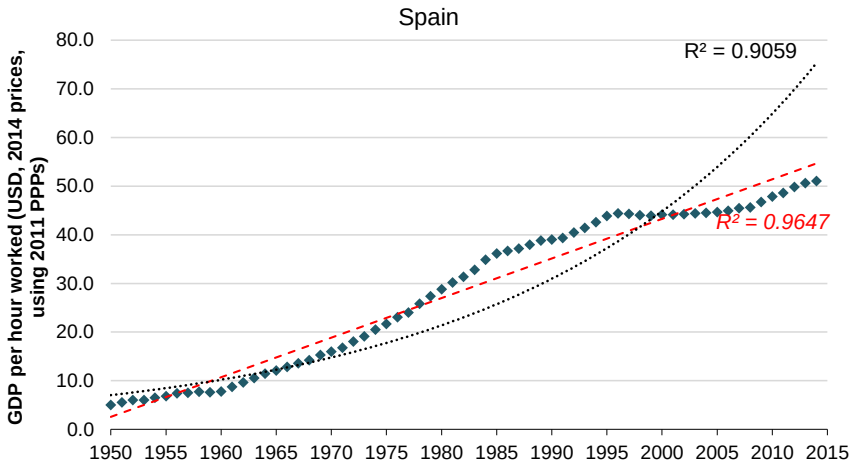

Sweden
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9304
R² = 0.9705
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

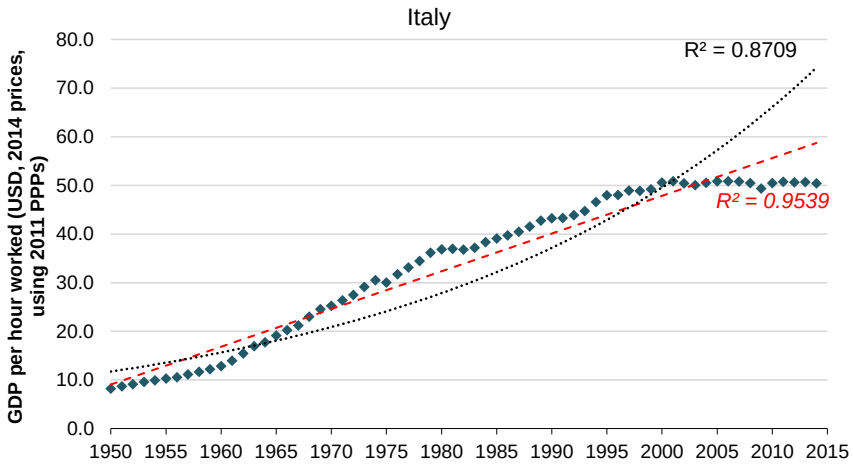

Austria
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9352
R² = 0.997
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

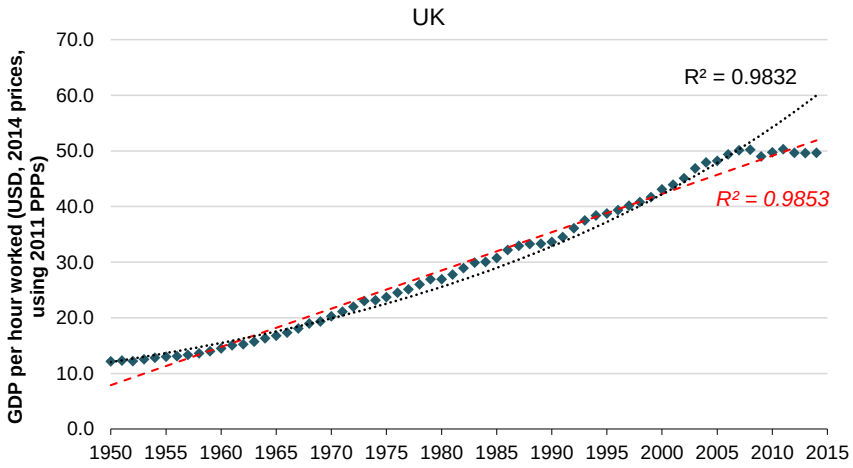

Finland
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9769
R² = 0.9786
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

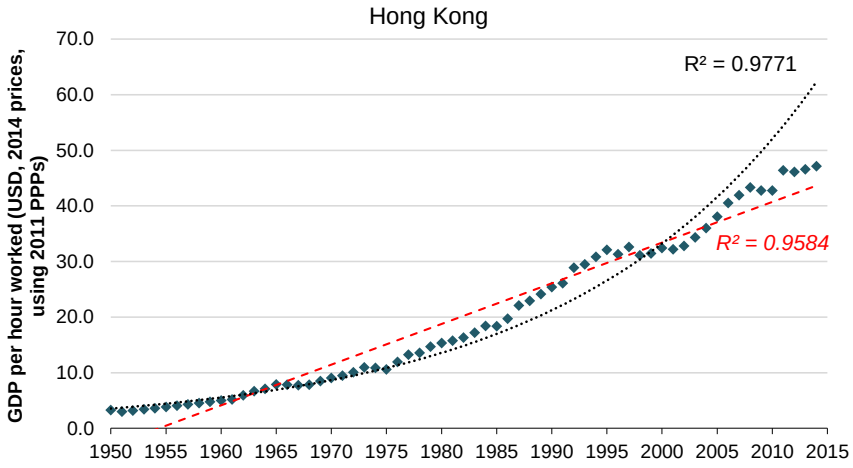

Australia
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9781
R² = 0.9938

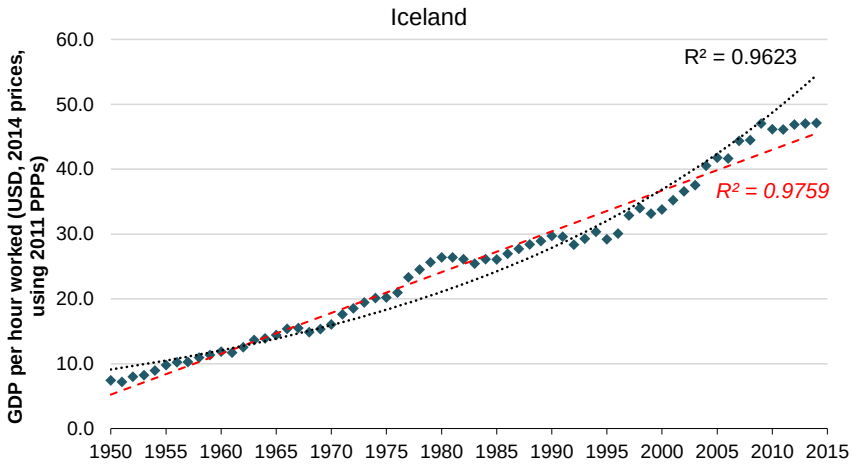

Canada
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9595
R² = 0.9924

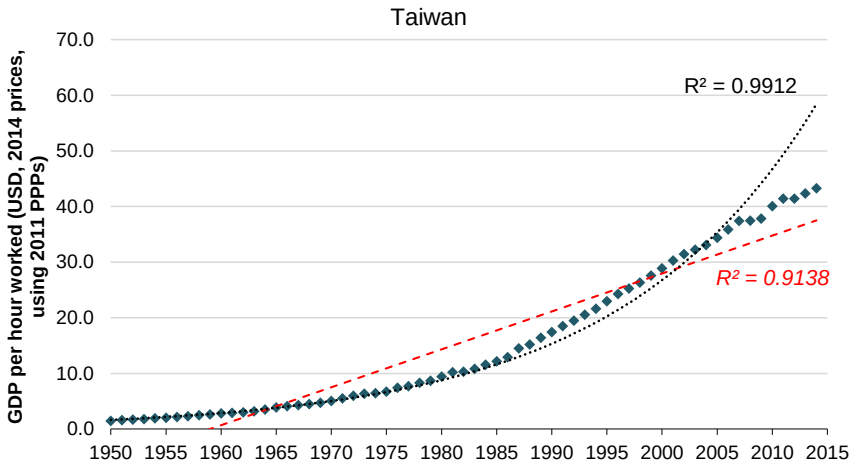

Spain
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9059
R² = 0.9647

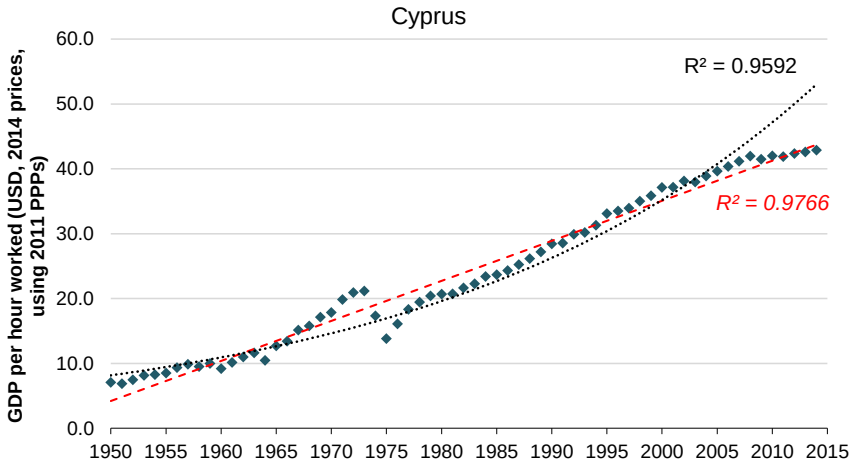

Italy
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.8709
R² = 0.9539
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

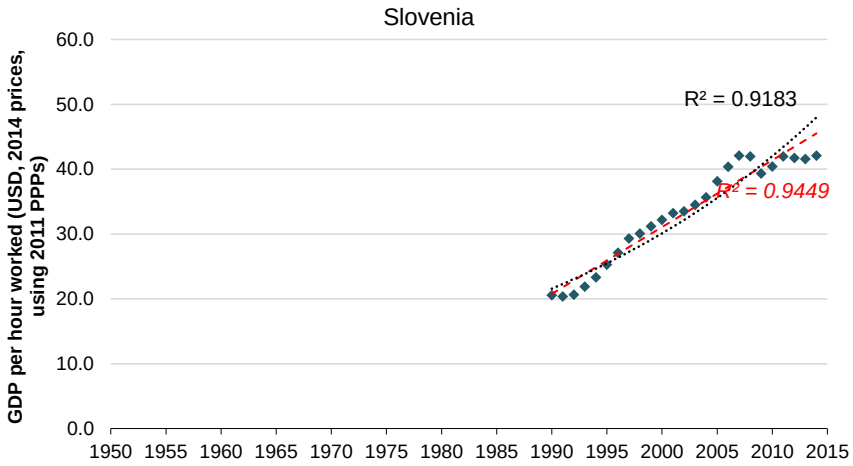

UK
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9832
R² = 0.9853
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

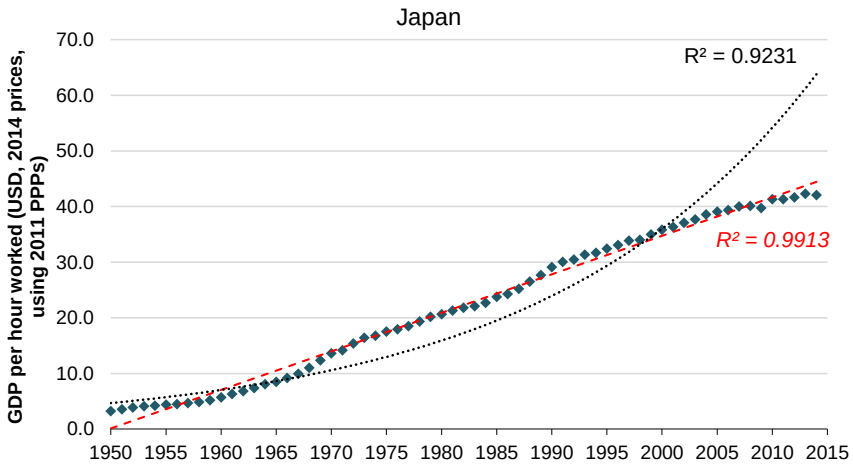

Hong Kong
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9771
R² = 0.9584
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

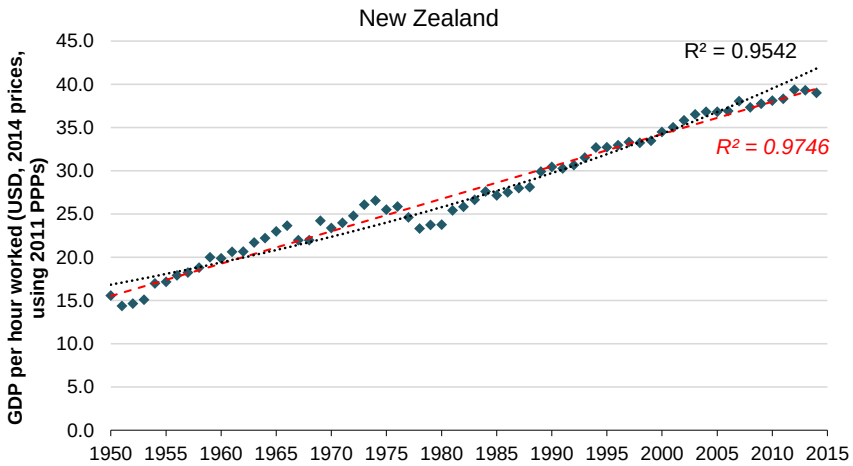

Iceland
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9623
R² = 0.9759
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

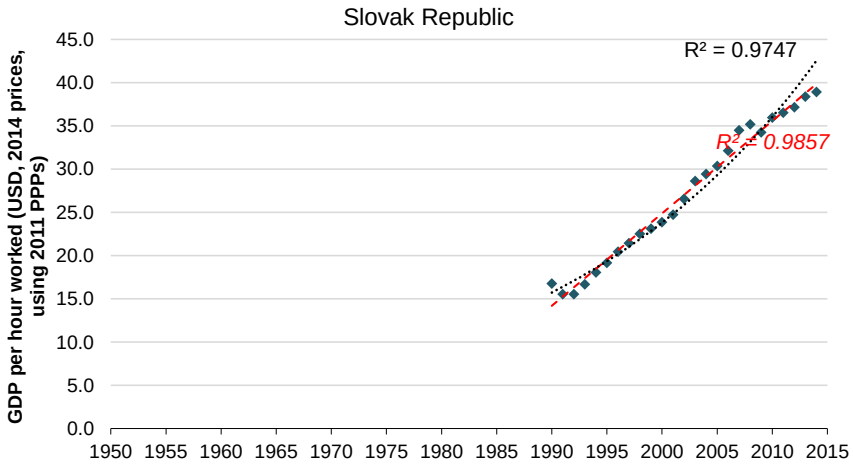

Taiwan
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9912
R² = 0.9138
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

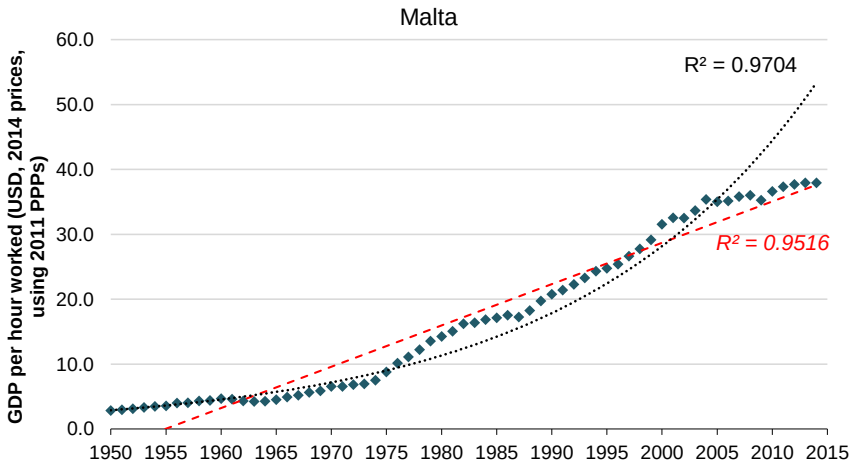

Cyprus
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9592
R² = 0.9766
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

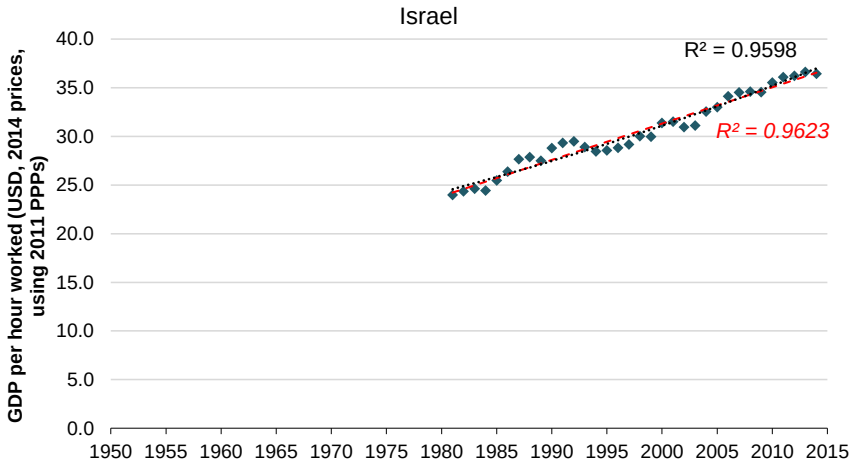

Slovenia
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9183
R² = 0.9449
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

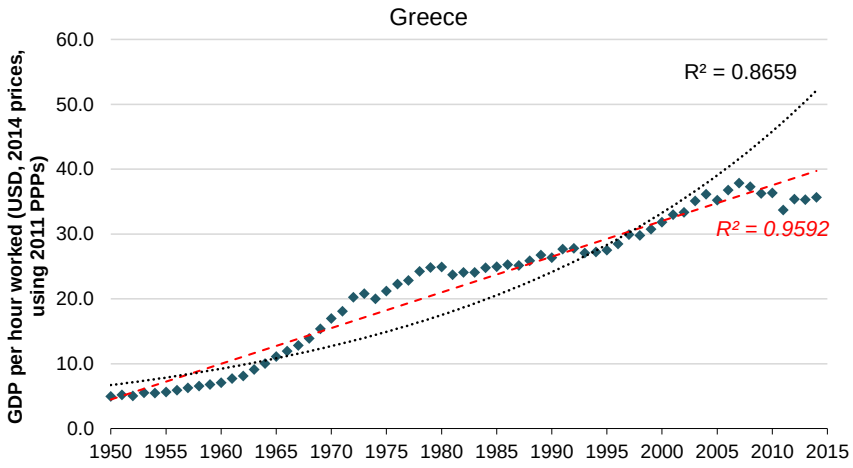

Japan
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9231
R² = 0.9913
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

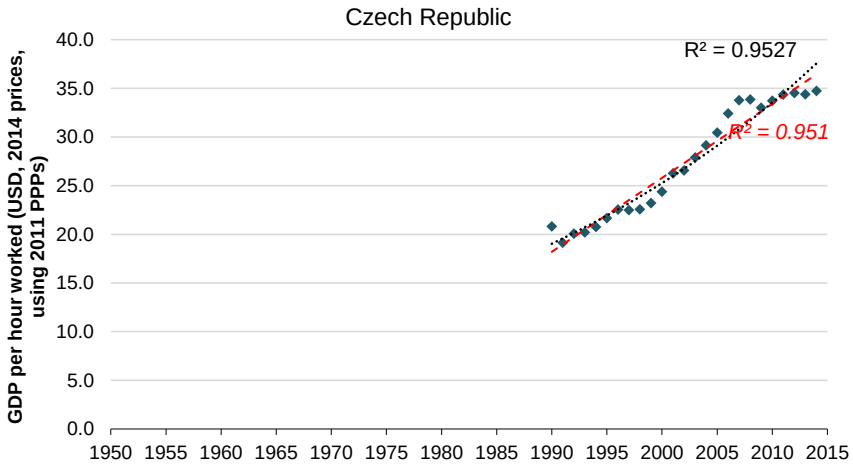

New Zealand
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9542
R² = 0.9746
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

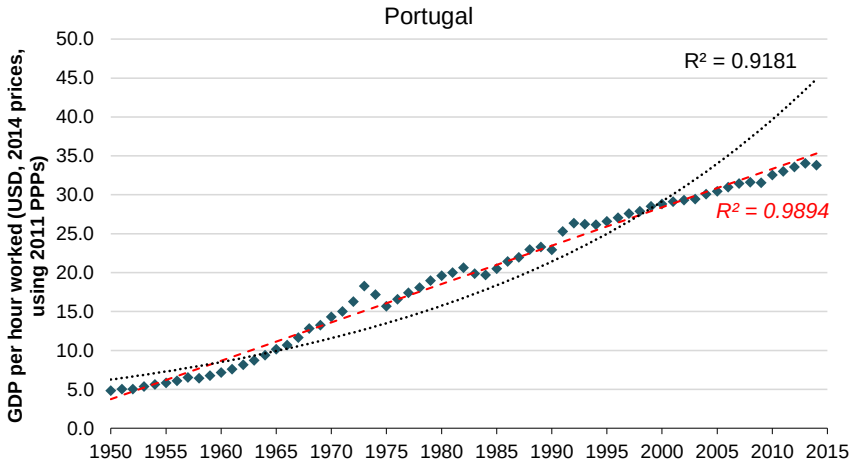

Slovak Republic
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9747
R² = 0.9857
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

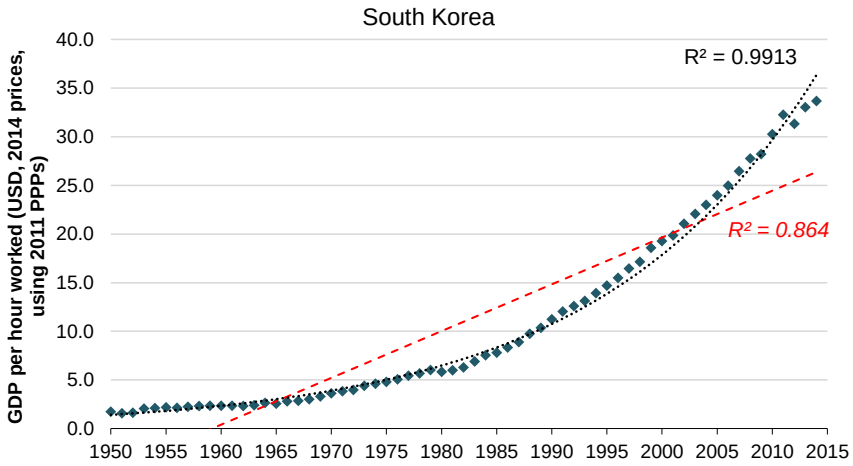

Malta
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9704
R² = 0.9516
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

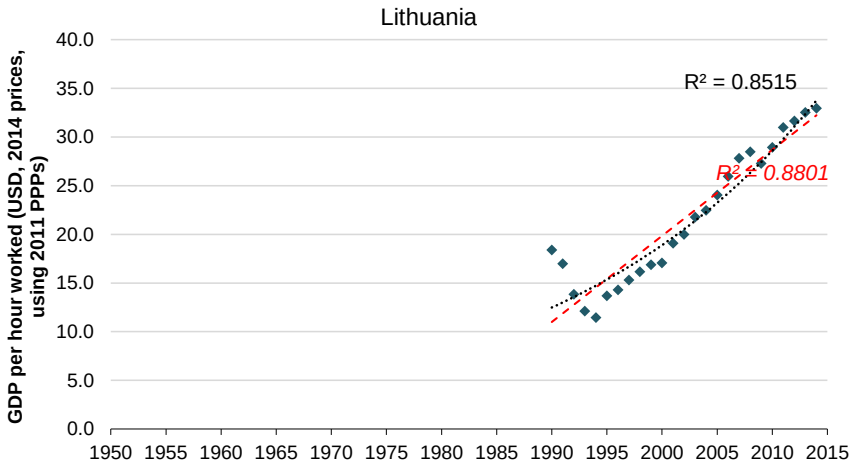

Israel
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9598
R² = 0.9623
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

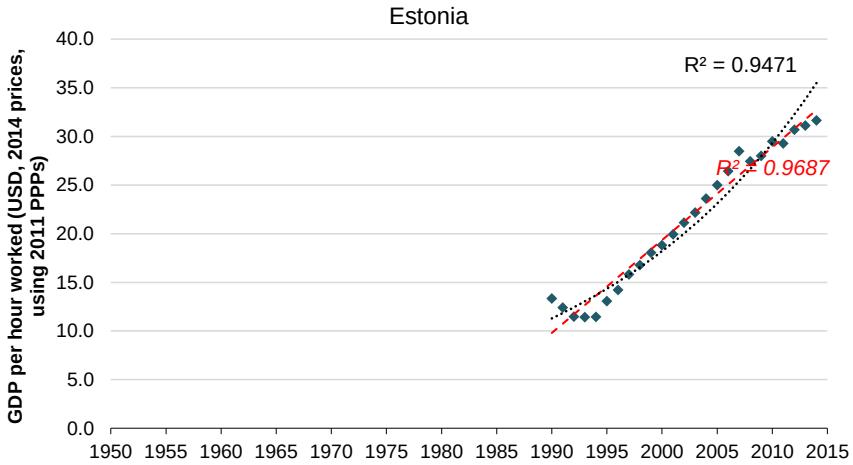

Greece
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.8659
R² = 0.9592
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

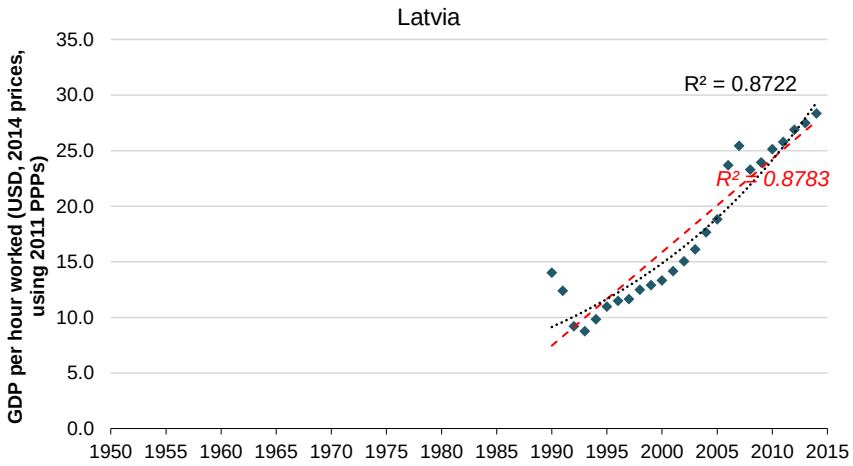

Czech Republic
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9527
R² = 0.951
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015


Portugal
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9181
R² = 0.9894
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015


South Korea
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9913
R² = 0.864
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

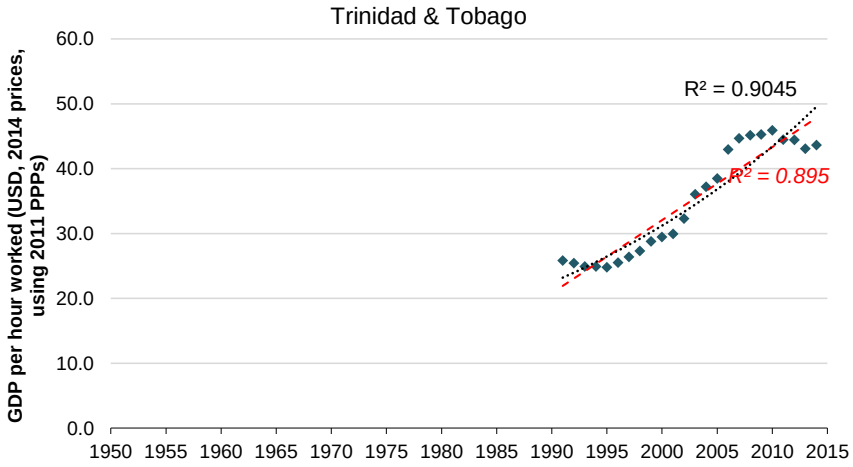

Lithuania
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.8515
R² = 0.8801
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

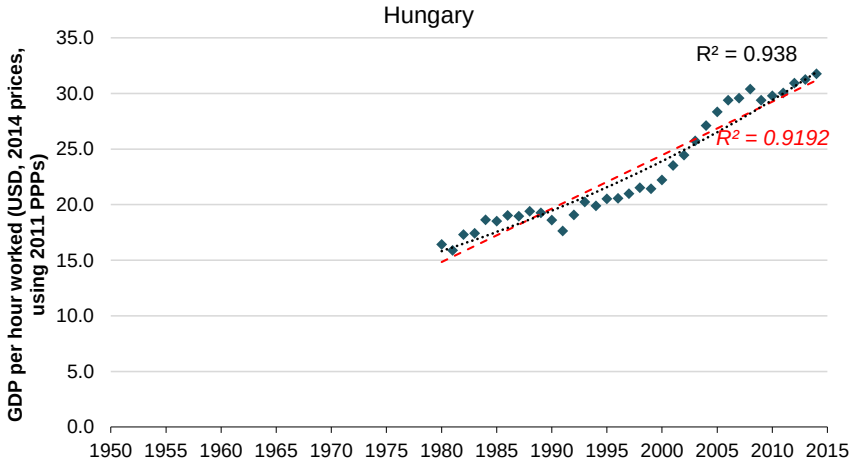

Estonia
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9471
R² = 0.9687
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

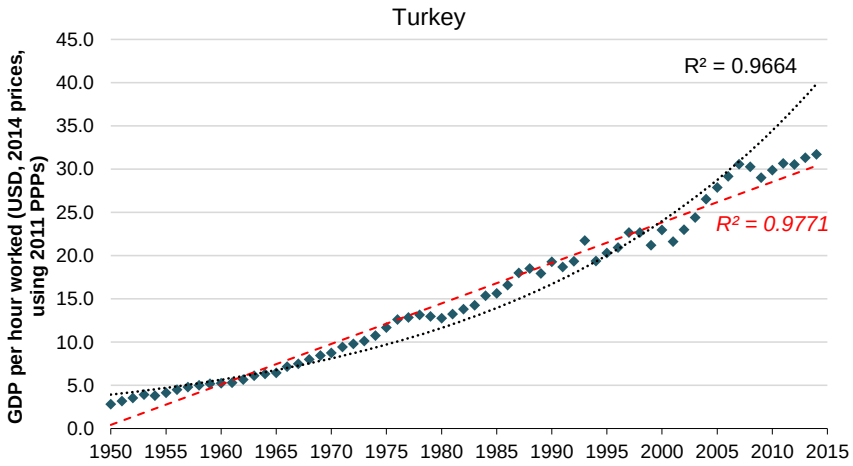


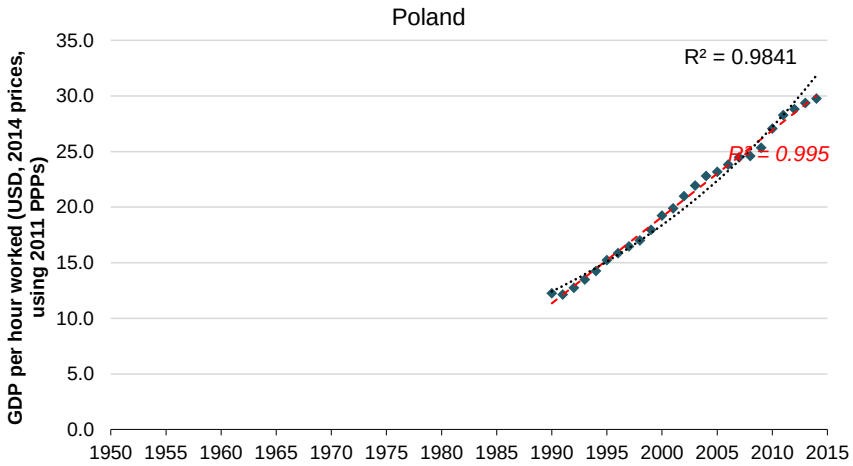
Other economies

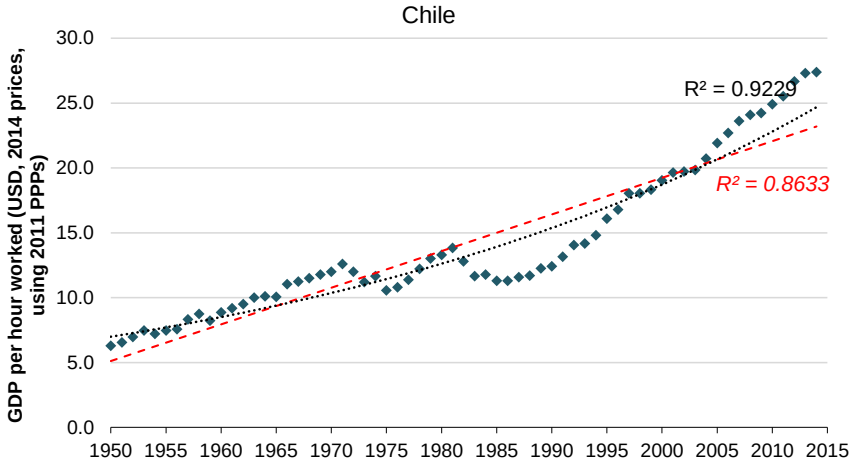
Charts for the remaining 30 countries in the dataset are shown below.

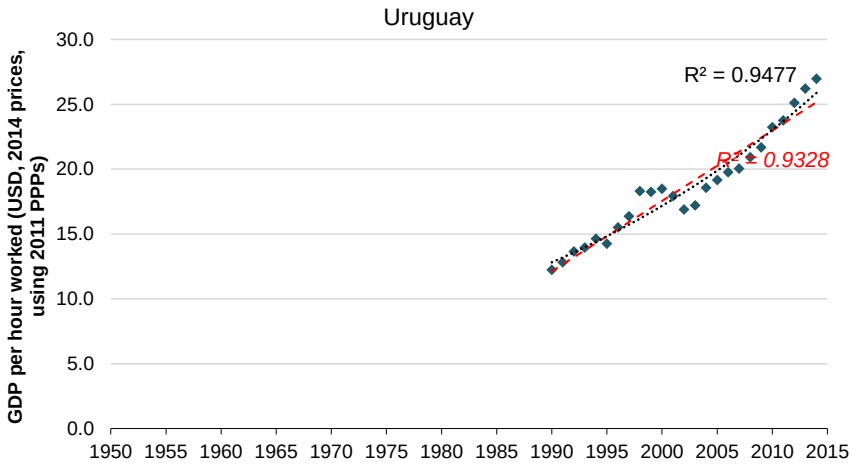


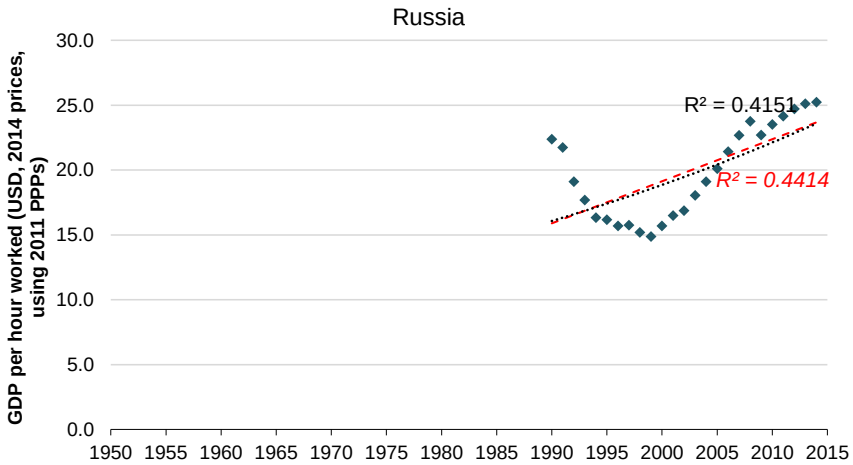


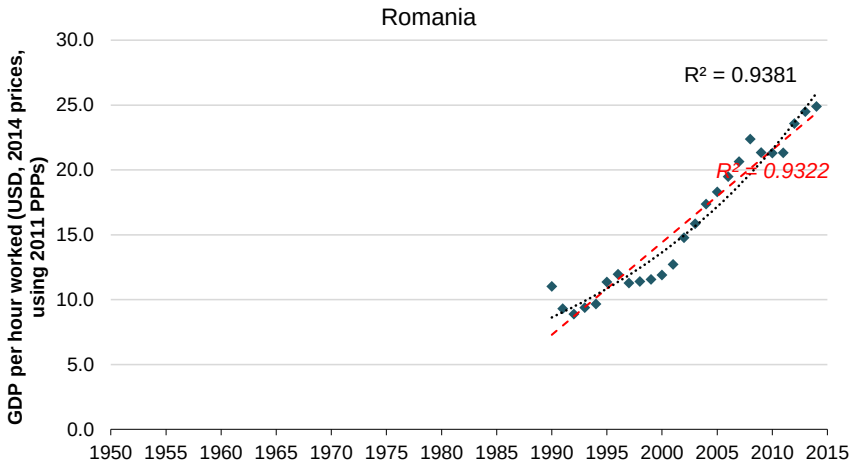

Turkey
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9664
R² = 0.9771
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

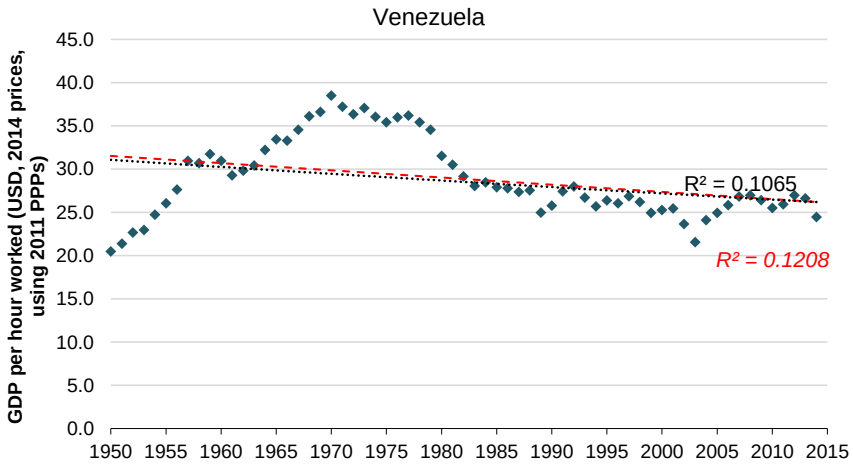

Poland
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9841
R² = 0.995
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

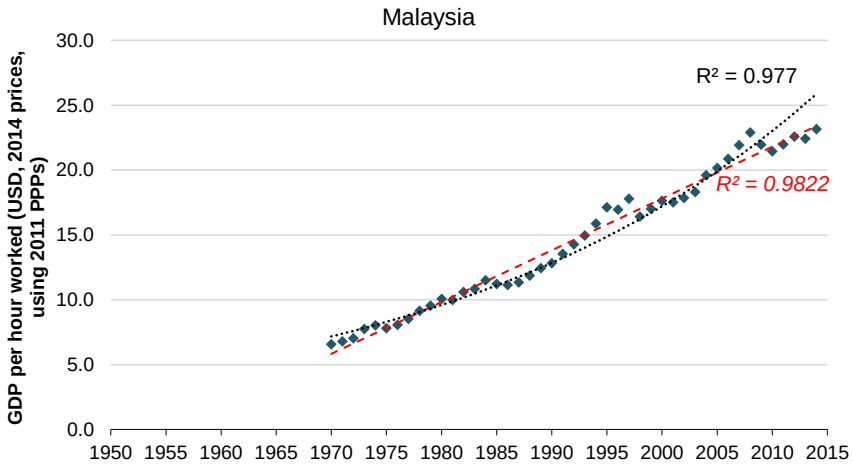

Chile
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9229
R² = 0.8633
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

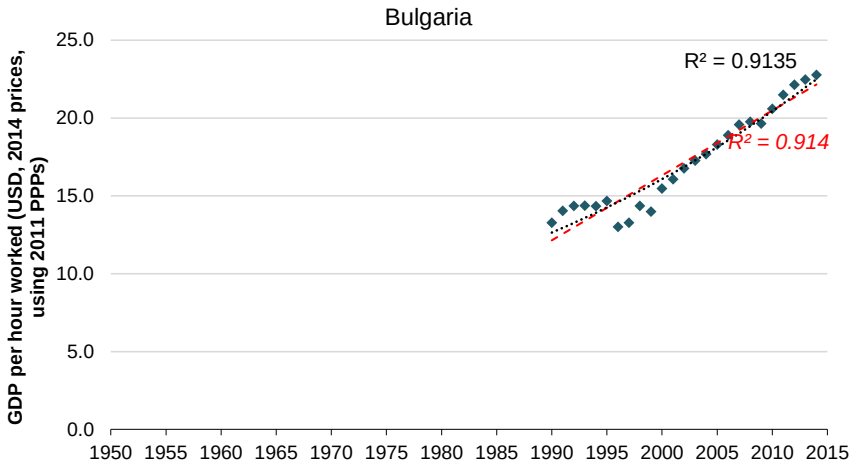

Uruguay
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9477
R² = 0.9328

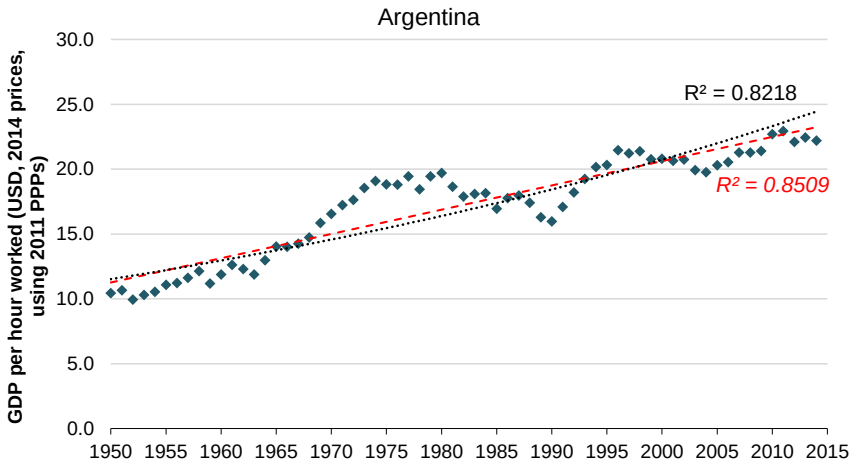

Russia
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.4151
R² = 0.4414

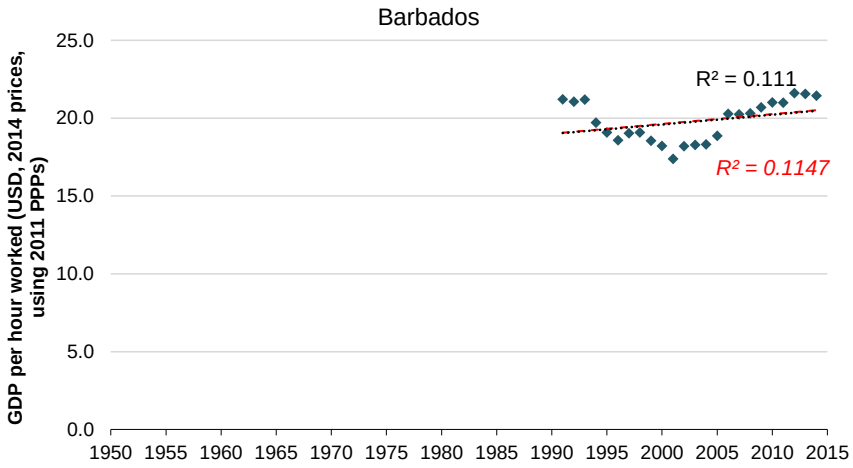

Romania
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9381
R² = 0.9322

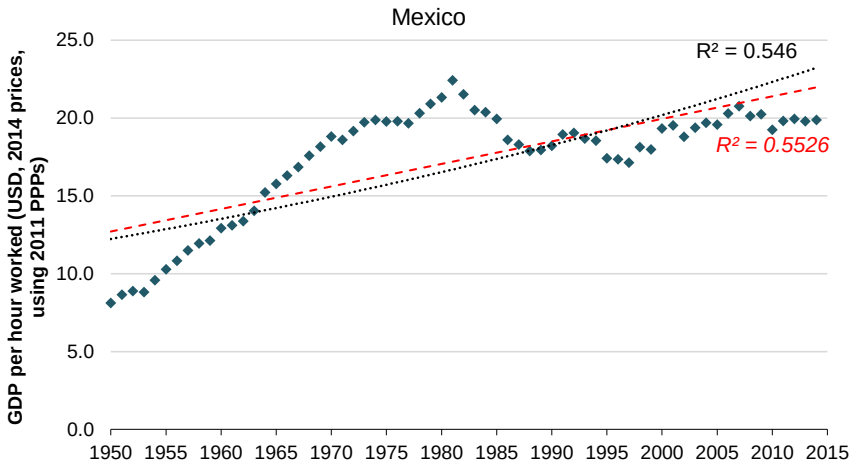

Venezuela
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.1065
R² = 0.1208


Malaysia
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.977
R² = 0.9822

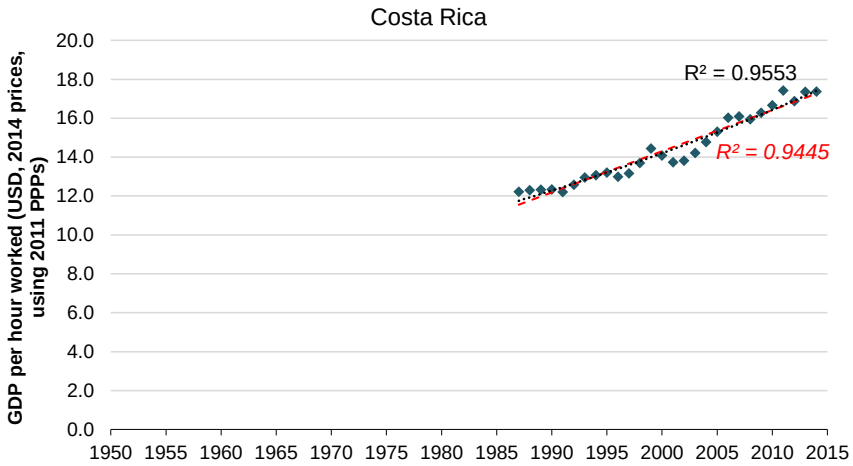

Bulgaria
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9135
R² = 0.914

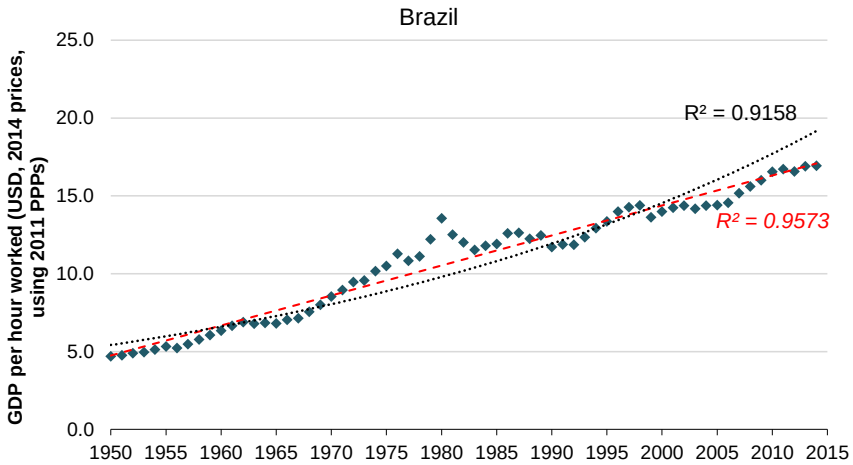

Argentina
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.8218
R² = 0.8509

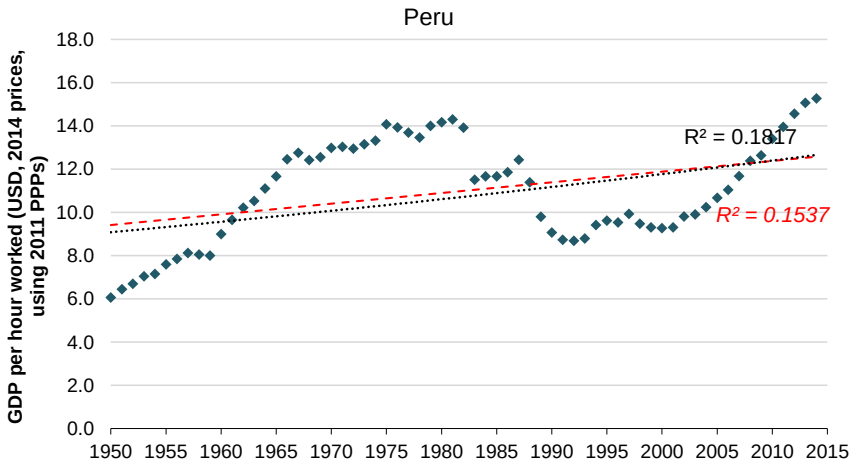

Barbados
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.111
R² = 0.1147

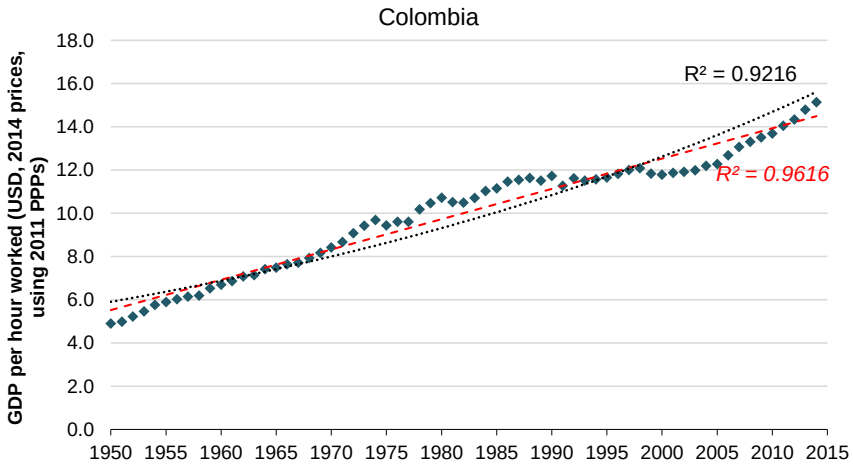

Mexico
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.546
R² = 0.5526

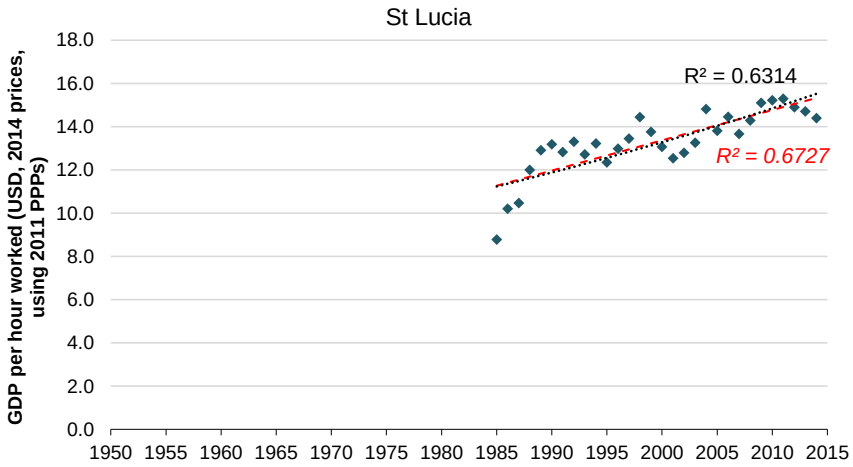

South Africa
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.891
R² = 0.8936

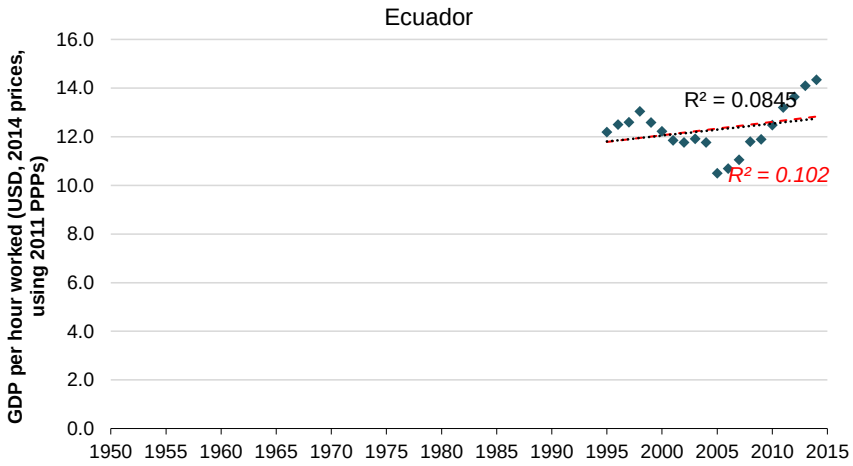

Costa Rica
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9553
R² = 0.9445

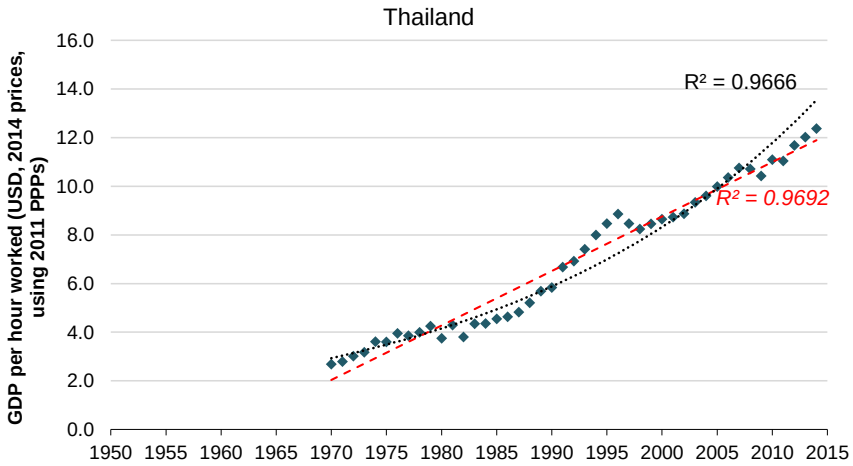

Brazil
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
25.0
20.0
15.0
10.0
5.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9158
R² = 0.9573

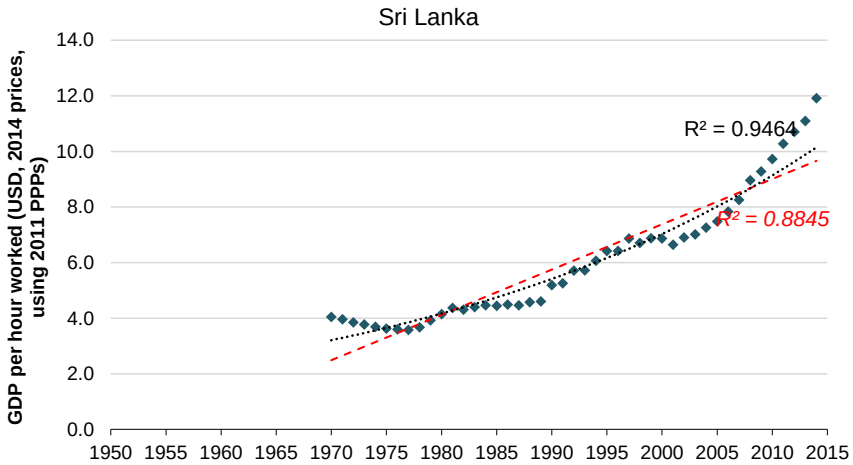

Peru
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.1817
R² = 0.1537
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

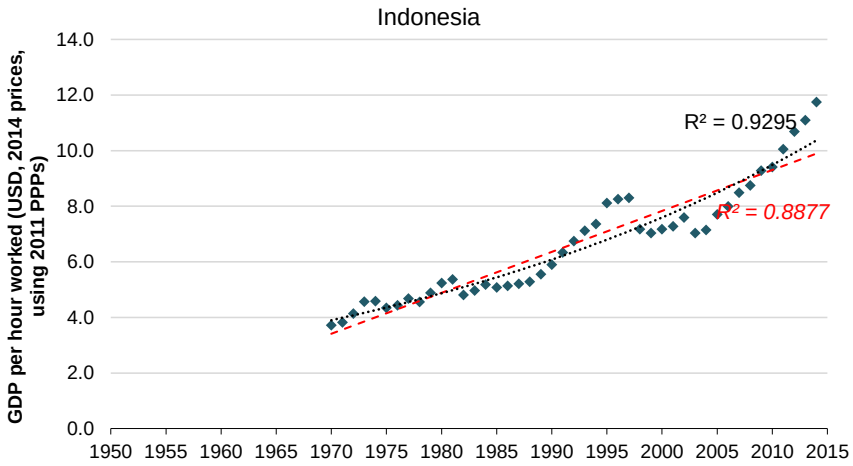

Colombia
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9216
R² = 0.9616
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

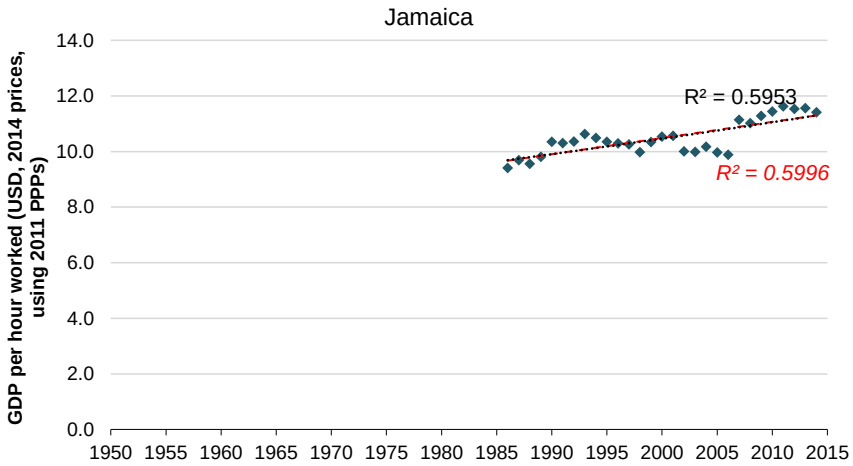

St Lucia
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.6314
R² = 0.6727
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

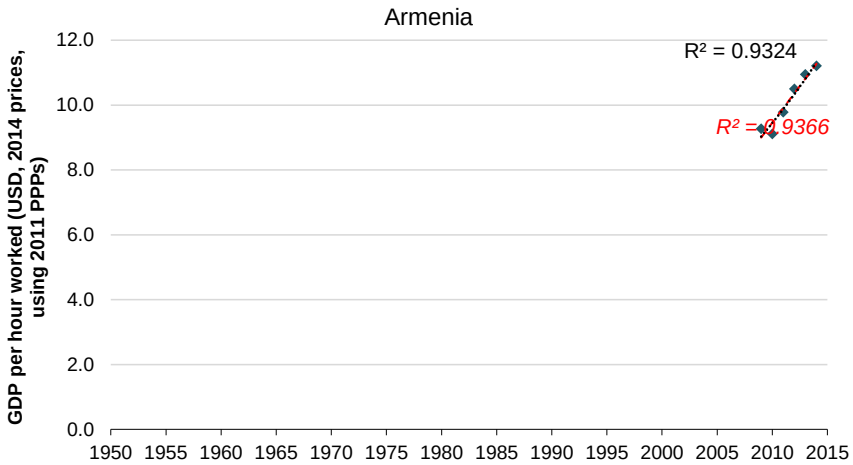

Ecuador
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.0845
R² = 0.102

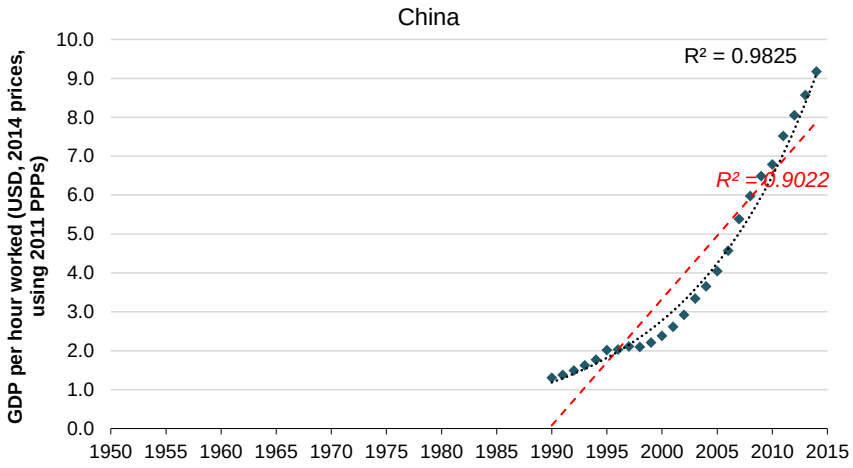

Thailand
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9666
R² = 0.9692

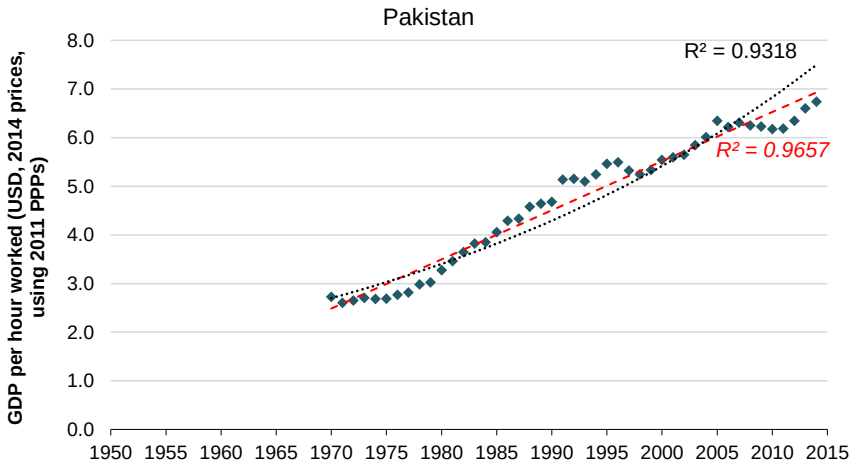

Sri Lanka
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9464
R² = 0.8845

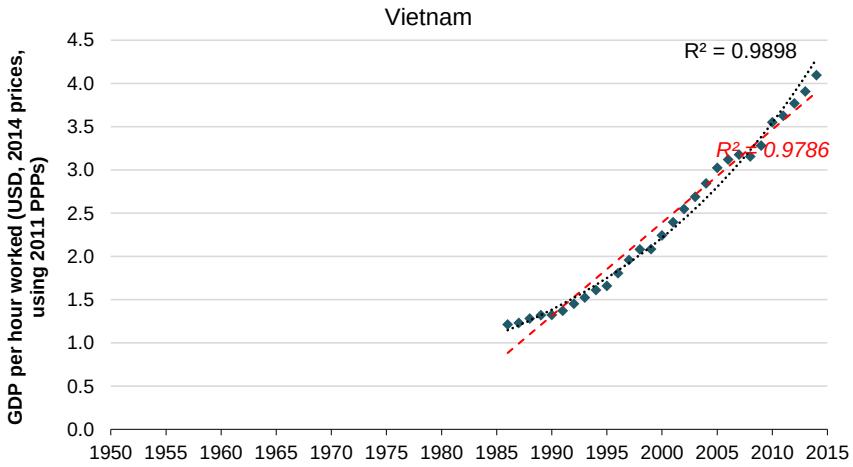

Indonesia
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9295
R² = 0.8877

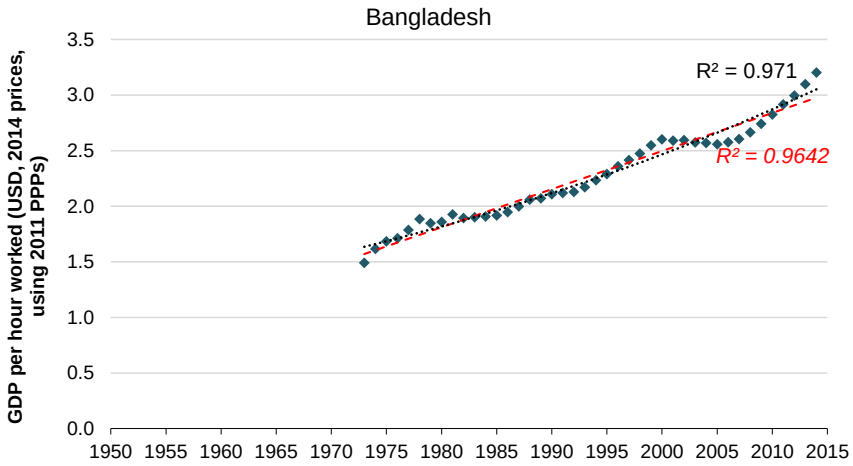

Jamaica
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.5953
R² = 0.5996


Armenia
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.9324
R² = 0.9366


China
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9825
R² = 0.9022
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015


Pakistan
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9318
R² = 0.9657
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015


Vietnam
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
R² = 0.9898
R² = 0.9786
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015


Bangladesh
GDP per hour worked (USD, 2014 prices, using 2011 PPPs)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015
R² = 0.971
R² = 0.9642