Conditional convergence: how long is the long-run?

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Abstract

Mainstream theories of economic growth predict that countries across the world will converge in per capita income. This has not happened. The theory has been modified, hypothesises that conditional convergence takes place not across all countries, but within groups of countries which have similar political and cultural backgrounds.

Much of the literature analyses data sets which cover short periods of just a few decades in the late 20th century. This paper uses a much longer period, in particular 1820-1998. A wide range of countries is examined.

The paper examines two concepts of convergence: the dispersion of incomes across countries at a point in time; the mobility of countries across time

Even within the culturally homogenous group of countries which make up Western Europe, the time scale of convergence is of the order of 150 years from the spread of industrial capitalism some 200 years ago. Data sets which focus purely on the second half of the 20th century alone will give a misleading picture of convergence.

1. Introduction

The neo-classical growth model is still a widely used framework for analysing growth. Its proponents recognise that its prediction of convergence in per capita income has not been fulfilled across the world as a whole.

The concept has therefore been developed of conditional convergence (for example, Mankiw et.al.1992, Hall and Jones 1999). In other words, growth in output per worker depends not just on capital per worker and technology, but on a wide range of factors such as the political and cultural system in which the economy operates. This concept implies that convergence will take place within countries which have similar

political and cultural backgrounds, but not necessarily otherwise. A phrase often used to describe the outcome of such a process is 'growth clubs'.

Much of the applied literature analyses data sets such as that of Summers and Heston (1988) which cover relatively short periods of at most three or four decades, and relate to the period after the Second World War.

The aim of this paper is to examine the evidence for convergence over a much longer period, spanning the entire period over which capitalist organisation can be thought to have existed on any reasonable scale. Data for real per capita GDP over very long periods is provided by Maddison (2001).

Section 2 discusses the data and the approach I adopt. Section 3 sets out the results, and section 4 gives a brief conclusion.

2. Data and methodology

Maddison (1995) provides estimates of real per capita GDP in 1990 dollars for a large range of countries since the early 19th century. Recently, he has extended this further back, providing estimates as far back as 1500, and even before then, for a selected group of countries.

The precise date at which the capitalist mode of production began to develop and spread is open to argument, but it cannot realistically be placed earlier than 1500. Modest increases in per capita GDP are estimated to have taken place during the 16th century in most of Western Europe, with the Netherlands rising by 80 per cent. Growth continued slowly during the 17th century, with the Netherlands again and to some extent the UK showing historically very large increases. During the 18th century, the capitalist mode of production strengthened considerably in Western Europe and its offshoots in North America. By the early nineteenth century, manufacturing had already overtaken agriculture as the largest sector of the UK economy, for example.

I begin by calculating measures of convergence amongst the countries of Western Europe, which have had very similar cultural and historical backgrounds for a very long period. Maddison provides data for the years 1500, 1600, 1700, 1820, 1870, 1913, 1950, 1973 and 1998 for the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK. These countries account for almost the entire GDP of Western Europe

I examine two distinct, though related, concepts of convergence:

- the dispersion, or spread, of incomes across countries at a point in time
- the mobility, or change of position, of countries across time

I calculate dispersion for each of the years given by Maddison. Mobility is estimated a range of periods. To examine this issue, I regress growth in each country over a given period of time against the per capita income levels at the start of the relevant period. Convergence implies that the coefficient in the regression is negatively signed (for example, Barro and Sala-i-Martin 1992).

Initially, I estimate mobility over the periods 1500-1600, 1500-1700, 1500-1820, 1500-1913 and 1500-1998. The base year is advanced to 1600, and 1600-1700, 1600-1820, 1600-1913 and 1600-1998 are estimated. Finally, the base year is advanced to 1700, 1820 and 1913 respectively.

I then examine in finer detail the period in which industrial capitalism has been established unequivocally, namely 1820-1998. Taking the base year 1820, I estimate mobility for each of the possible periods in Maddison's data, namely 1820-1870, 1820-1913, 1820-1950, 1820-1973 and 1820-1998. Again, the base year is moved on to 1870, 1913 and so on, and each possible period is examined.

The next step is then, again within the period of 'unequivocal' capitalism namely 1820-1998, to add to the data set countries or areas in the Maddison data, in order of

their closeness to Western Europe in terms of cultural and historical backgrounds. Details are provided in section 3 below.

3. The results

3.1 Dispersion of income at a point in time

Table 1 sets out information on the dispersion of real GDP per capita across Western Europe on each of the dates for which Maddison provides estimates. In terms of dispersion, I examine:

- the ratio of highest income to the lowest
- the ratio of the inter-quartile range
- the coefficient of variation

Information is also set out for the Western Europe average per capita GDP.

Table 1 Dispersion of real per capita GDP across 14 countries of Western Europe

Date	**Max/Min ratio**	**Inter-quartile ratio**	**Coefficient of variation**	**Average real GDP per capita 1990 US $**
1500	2.43	1.09	0.19	774
1600	2.54	1.21	0.21	894
1700	3.30	1.21	0.32	1024
1820	2.33	1.19	0.22	1232
1870	3.20	1.49	0.34	1974
1913	3.96	1.60	0.31	3473
1950	4.38	1.75	0.38	4594
1973	2.48	1.18	0.21	11534
1998	1.83	1.12	0.15	17921

Dispersion has clearly moved in an irregular fashion:

- the widening in the 17th century and subsequent narrowing 1700-1820 is mainly due to the rise and temporary decline of the Netherlands
- dispersion widened dramatically over the 1820-1950 period[1]
- the narrowing of dispersion is a feature of the second half of the 20th century
- as late as 1973, dispersion was similar to that obtaining in 1820

The evidence shows that even within a group of countries with very similar cultural and historical backgrounds, the concept of the long-run in practice appears to be very long-run indeed. It seems to be at least 150 years, the length of time from the start of the unequivocal capitalist take-off in per capita incomes in 1820 through to 1973, and could arguably be thought of as even longer.

3.2 Mobility of income over time

There is a fairly wide range of permutations of periods available, but I examine growth from 1500, 1600, 1700, 1820 and 1913. The year 1820 is unequivocally at the beginning of the period of take-off into industrial growth rates, and per capita incomes in 1913 describe the outcome of the first century of unequivocal capitalist development.

Table 2. Regression of the difference of the logs of per capita income on the level of per capita income, 1990 US dollars 000s, at the start of the period
14 Western European countries, 1500-1998

Period	**Coefficient**	**T-statistic (absolute)**	**R^2**
1500-1600	-0.026	0.98	0.074
1500-1700	-0.044	0.99	0.075

[1] the 1950 figures are not really distorted by the war. Every country except Germany (1953) had exceeded its pre-war 1938 level of real GDP per capita by 1950

1500-1820	-0.075*	2.06	0.262
1500-1913	-0.058	0.84	0.056
1500-1998	-0.124**	3.84	0.552
1600-1700	+0.023	1.59	0.174
1600-1820	-0.019	1.00	0.077
1600-1913	-0.026	0.53	0.023
1600-1998	-0.099**	3.96	0.567
1700-1820	-0.023**	3.38	0.487
1700-1913	-0.024	0.93	0.067
1700-1998	-0.064**	4.83	0.661
1820-1913	+0.019	0.72	0.041
1820-1998	-0.057**	3.67	0.529
1913-1998	-0.026**	8.52	0.858

*Note: * indicates significantly different from zero at 5 per cent level (one-tail)*
*** indicates significantly different from zero at 1 per cent level (one-tail)*

The table again shows the decisive role of the most recent period of capitalism in Western Europe in the convergence process. Essentially, even within this group of countries with very similar cultural backgrounds, we can only really speak of convergence if the data for the 20th century is included. Convergence did not take place during the first century of industrial capitalism, namely the 19th.

Table 3 looks more finely at the 1820-1913 period.

Table 3. Regression of the difference of the logs of per capita income on the level of per capita income, 1990 US dollars 000s, at the start of the period 14 Western European countries, 1820-1998

Period	**Coefficient**	**T-statistic (absolute)**	**R^2**
1820-1870	+0.031*	1.91	0.233
1820-1913	+0.019	0.72	0.041
1820-1950	+0.007	0.19	0.003
1820-1973	-0.045*	2.23	0.293
1820-1998	-0.057**	3.67	0.529
1870-1913	-0.002	0.26	0.006
1870-1950	-0.009	0.69	0.038

1870-1973	-0.034**	5.05	0.681
1870-1998	-0.041**	7.50	0.824
1913-1950	-0.004	0.49	0.019
1913-1973	-0.020**	5.56	0.681
1913-1998	-0.026**	8.55	0.858
1950-1973	-0.011**	7.68	0.831
1950-1998	-0.015**	14.40	0.945
1973-1998	-0.004**	3.69	0.532

*Note: * indicates significantly different from zero at 5 per cent level (one-tail)*
*** indicates significantly different from zero at 1 per cent level (one-tail)*

Table shows that data during the second half of the 20th century needs to be included in the sample before convergence can be said to have taken place within Western Europe. As with the evidence on the spread of incomes at a point in time, the long run appears to be of the order of 150 years.

We can examine the robustness of results when the sample of countries is extended. Maddison provides information on the United States, 'other Western offshoots' (essentially, Canada, Australia and New Zealand), Eastern Europe, Russia (the former USSR), Latin America, Japan, China, India, other Asia and Africa.

Cultural and historical similarities between countries or groups of countries are not given to precise analysis. But the two Maddison areas most closely linked in this respect to Western Europe are obviously the United States and other Western offshoots. Not surprisingly, the inclusion of these makes no qualitative difference to the results. For example, over the 1820-1998 period, the estimated coefficient in the regression is –0.065 with a t-statistic of –3.97 when these two observations are included, compared to the –0.057 and -3.67 reported above when Western European countries only are included.

The countries of Eastern Europe, excluding Russia but including Poland, the Czech Republic and Hungary, have very long cultural and historical links with Western Europe. Maddison groups these into a single data set, 'Eastern Europe'. The inclusion of just this single additional variable begins to weaken the evidence for convergence.

For example, in Table 3, with all 9 periods which end in either 1973 or 1998, the coefficient in the regression is significantly different from zero at p = 0.05 and is correctly signed. These are the only periods for which this is the case. However, when the Eastern European variable is added to the Western European countries, only 6 out of these 9 remain significant and correctly signed. The periods 1820-1973, 1820-1998 and 1973-1998 give coefficients which are not significantly different from zero even at p = 0.10.

Tables 4a and b summarises the effect of including further variables on the nine sample periods in which the coefficient in the regression is correctly signed and significantly different from zero at p = 0.05.

Russia has had links with the West over many centuries, and Latin America has had close connections for over 400 years. India was the major part of the British Empire, and its elite use English quite naturally.

Table 4a. Significance of the coefficient in the regression of the difference of the logs of per capita income on the level of per capita income, 1990 US dollars 000s, at the start of the period. All Maddison periods ending in 1973

Country /period	**1820-1973**	**1870-1973**	**1913-1973**	**1950-1973**
Western Europe	*	*	*	*
plus US and Western offshoots	*	*	*	*

plus Eastern Europe	*	*	*	
plus Russia	*	*	*	
plus Latin America	*	*	*	
plus India				
full sample of countries				

*Note: * indicates correctly signed and statistically significant from zero at p = 0.05 row 1 is the 14 countries of Western Europe; row 2 is the 14 countries of Western Europe plus the US and Western offshoots, etc.*

The coefficient is correctly signed and significant for all periods when the data set includes either just Western Europe, or Western Europe plus the US and Western offshoots. However, the coefficient is not significant 1820-1973 when Eastern Europe alone, and Eastern Europe plus Russia are included. The same result holds when Latin America is added.

However, the addition of India alone leads the coefficient to become not significant in all four periods.

Table 4b. Significance of the coefficient in the regression of the difference of the logs of per capita income on the level of per capita income, 1990 US dollars 000s, at the start of the period. All Maddison periods ending in 1998

Country /period	**1820-1998**	**1870-1998**	**1913-1998**	**1950-1998**	**1973-98**
Western Europe	*	*	*	*	*
plus US and Western offshoots	*	*	*	*	*
plus Eastern Europe		*	*	*	

plus Russia

plus Latin America

plus India

full sample

*Note: * indicates correctly signed and statistically significant from zero at p = 0.05 row 1 is the 14 countries of Western Europe; row 2 is the 14 countries of Western Europe plus the US and Western offshoots, etc.*

Over the longer period ending in 1998 the evidence of convergence over wider data sets is much weaker. As with the period ending in 1973, the addition of Eastern Europe leads the relevant coefficient to become insignificant for some of the periods. But the simple addition of Russia to the data set leads to the coefficient becoming insignificant in each of the relevant periods.

4 Conclusion

The neo-classical growth model is still a widely used framework for analysing growth. Its proponents recognise that its prediction of convergence in per capita income has not been fulfilled across the world as a whole.

The concept has therefore been developed of conditional convergence. In other words, growth in output per worker depends not just on capital per worker and technology, but on a wide range of factors such as the political and cultural system in which the economy operates. This concept implies that convergence will take place within countries which have similar political and cultural backgrounds, but not necessarily otherwise.

Much of the applied literature uses relatively short data sets which include data purely from the second half of the 20th century. In this paper, I examine convergence using a much longer data set, beginning as early as 1500.

I examine two aspects of convergence: the dispersion of per capita income at a point in time, and mobility in per capita income over time.

I focus initially on 14 countries in Western Europe, which have very close cultural and historical links. On both measures of convergence, evidence for convergence only exists if data for the second half of the 20th century is included in the sample. A range of periods over which convergence can be calculated is available in the primary data source, beginning in 1500 and ending in 1998. But it is only the inclusion of the most recent fifty years of data which generates evidence of convergence.

I then focus more closely on the 1820-1998 period and various sub-periods within this. The addition of the data for the United States and 'Western offshoots' (Australia, Canada, New Zealand) makes no qualitative difference to the results. Both these areas have had strong historical connections with Western Europe.

But the addition of data for Eastern Europe (excluding Russia), which has also had strong cultural links with Western Europe, begins to weaken the evidence for convergence. And over the full sample period, 1820-1998, the inclusion of Russia in the data set removes the evidence supporting the concept of convergence.

Even within the culturally homogenous group of countries which make up Western Europe, the time scale of convergence in per capita incomes appears to be of the order of at least 150 years from the general spread of industrial capitalism some 200 years ago. Data sets which focus on the second half of the 20th century alone will therefore tend to give a misleading picture of convergence, because it is only during this period that convergence can be said to have taken place in any meaningful sense. For much of the history of capitalism, even within Western Europe, evidence for the existence of convergence is at best weak and at worst non-existent.

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