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Abstract

Thomas Friedman's book *the world is flat* has been a bestseller since it appeared in 2005. The remarkable success of the book reflects to a certain extent the present fears with respect to increasing globalization. Using many examples, Friedman argues that distance (however defined) is no longer a dominant characteristic of the world economy, or will cease to be so in the very near future. Competition is thought to be a race to the bottom, with the lowest-wage countries as the big winners. We disagree, and with us many other economists (see, for example, Leamer, 2006). Distance dominates all aspects of international trade and many stylized facts of international trade can only be understood by pointing towards the importance of distance. Furthermore, there is little evidence of income convergence. Using various methods and data sets, we show that many threats of global competition for the position of the traditionally developed (OECD) countries are unwarranted.

JEL Code: E00, F00, N00, O00.

Keywords: income levels, convergence, trade, distance, leapfrogging.

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1 Introduction

"*The rules of the game have changed forever … Professionals everywhere, from China to Costa Rica, can work from home as if they were in offices next door to each other … which requires us to run faster in order to stay in the same place…"* *Friedman (2005, cover)*

It seems almost commonly accepted knowledge that the world is getting smaller in an economic sense. The ICT revolution only just started, and communication with people on the other side of the globe has become a trivial exercise. The ease with which international communications can be established, has convinced some researchers that "distance" is becoming less important than it used to be. The term distance should be viewed as a general concept, not only related to transportation costs, but also reflecting differences in language, culture, religion, legal systems, etc. All these factors might make trading relations more difficult. According to ICT-optimists, such as Cairncross (2001 – also a New York Times bestseller) these differences will disappear or become far less important than they currently are.

In a broad sense, there seem to be two groups of distance-researchers, namely (i) the "death of distance" group, which argues that the location of economic activity becomes rapidly less important, and (ii) the "not so fast" group, which focuses on evidence to determine the extent to which distance still matters in the world economy. As a representative of the death-of-distance group Thomas Friedman provides many anecdotes to convince the reader how small the world has become. Few people, for example, realize that when ordering a burger in a drive-in at McDonalds, one might actually talk to someone in India. As a representative of the not-so-fast group, Feenstra (1998) provides another anecdote. The production cost of a Barbie doll is \$1,-, but it sells for about \$10,- in the USA. This implies that the cost of transportation, marketing, and retailing have an *ad valorem* tax of 900 percent. In a long and careful survey Anderson and Van Wincoop (2004) conclude that the so-called tax equivalent of trade costs for industrialized countries is 170 percent. This is much smaller than the Barbie doll example suggests, but still remarkably high.[2] In

[2] This number breaks down as follows: 21% transportation costs, 44% border related trade barriers, and 55% retail and distribution costs – so, 1+1.7= 1.21*1.44* 1.55. Measuring trade costs, however, is far from trivial. Anderson and Neary (2005) develop index numbers to measure trade restrictiveness.

related macro-monetary economic literature, Obstfeld and Rogoff (2000) point out six major macro-economic puzzles, all based on the apparent relevance of trade barriers.

We illustrate the apparent consequences of trade barriers, whatever their origin. We therefore do not measure distance costs as such (see Anderson and Van Wincoop, 2004, or Anderson and Neary, 2006) but focus on the consequences of these costs, thus illustrating how barriers to trade shape the world economy. We do so by showing that up to the present there is no such thing as a "great global equalizer". Income per capita levels vary greatly across the globe, with only little indication that this situation will change soon. This is an important observation, because neo-classical trade theory predicts that factor prices – income per capita – will be equalized if only free trade would exist.[3] If this is not the case it could be a sign of trade barriers. This is the next step in this paper. We show that indeed geographical trade and investment patterns illustrate the (growing?) importance of "distance". In contrast to Friedman's main line of thought, we argue that: "the world is not flat, nor is distance dead."

The set-up of this paper is as follows. Section 2 discusses (per capita) income developments since 1950 by investigating (changes in) the extent of income dispersion and income convergence in relation to the size of different economies. Section 3 focuses on changes in income inequality since 1950. Section 4 discusses leapfrogging (which country is in the lead and which country is lagging behind) and convergence from a longer perspective (2000 years). Section 5 analyzes the relationship between distance and international trade, while section 6 focuses on investment flows and production networks. Section 7, finally, concludes.

2 Income developments since 1950

The primary objective of our paper is to establish empirically whether or not the (economic) earth is becoming "flat", that is whether or not the death-of-distance group referred to in the introduction is right that the location of economic activity is becoming less important, such that indeed income earners in the OECD countries have to "run faster" than competitors in order to "stay in the same place". This citation suggests that the threat from countries like India or China is such that income

[3] This is known as the Factor Price Equalization (FPE) theorem in standard trade theories.

levels in OECD countries might even fall relative to the new giants. Given the attention views like this receive from policy makers and in the press one likes to know whether these claims have a factual basis. To answer this question, we use several methods and data sets in different periods of time, as explained below.

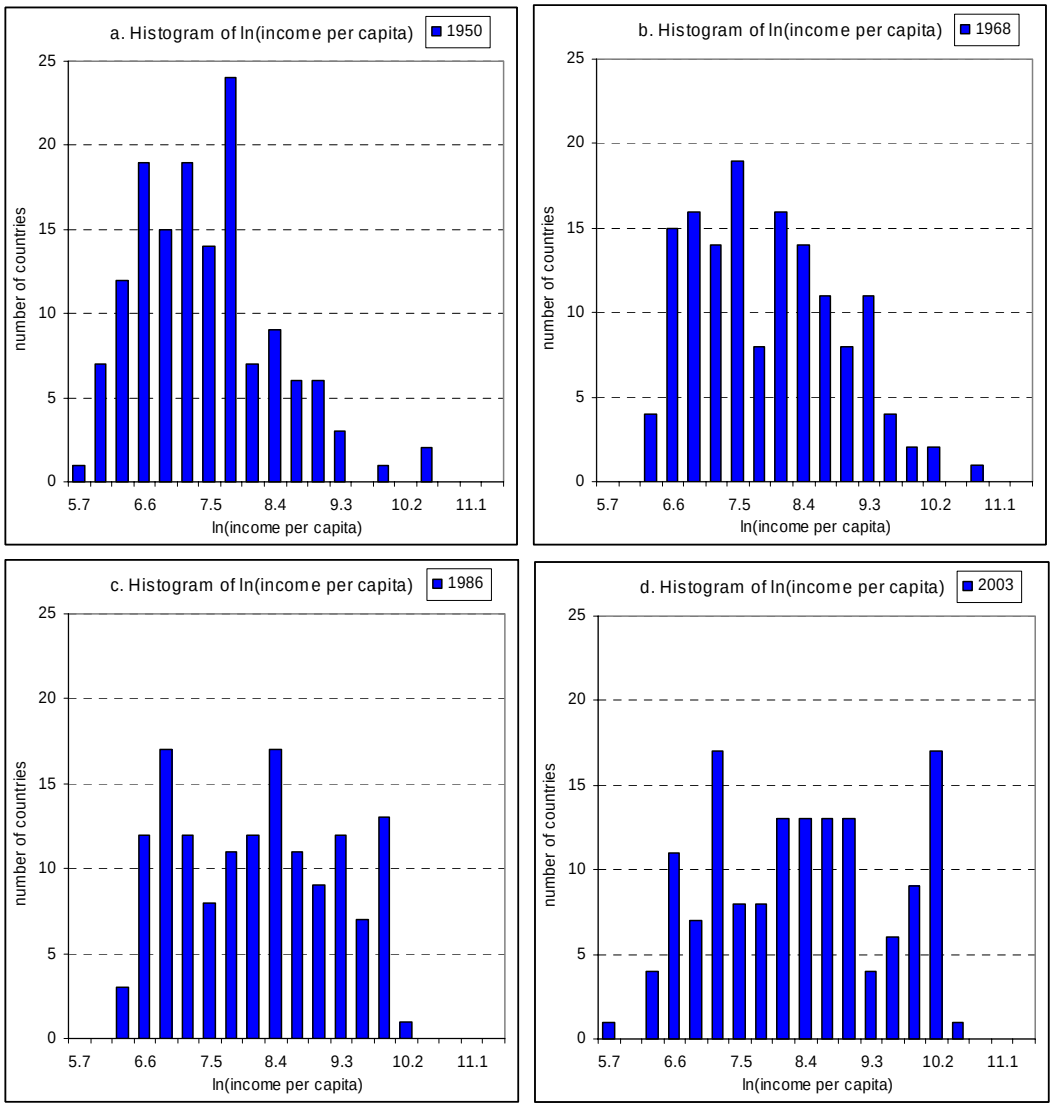
2.1 Income levels

We start off with a discussion of the economic developments since the second half of the 20th century in sections 2 and 3, going back further in time in section 4.[4]

For the period 1950-2003, we have detailed annual information available regarding population and income for 137 countries and 8 regions (groups of smaller countries), together constituting the entire world, see Table A.2 in the Appendix. The most important, and by far largest, "region" consists of the "former USSR" group of countries. The population size of these 145 entities differs enormously, ranging from a low of 80 thousand for the Seychelles to a high of 1.29 billion for China. The same holds for income levels of the 145 countries / regions, ranging from a low of $ 0.2 billion for São Tomé and Principe to a high of $ 8,341 bn. for the USA. Since our main question to be answered regarding the economic "flatness" of the world is based on competition at the individual level, we will mostly focus on the ratio of income and population by discussing developments in income per capita. This does not imply that size is unimportant (see below). The average income per capita level for the 145 countries / regions in 2003 is $ 6,843 with a low of $ 212 for Congo Dem. Rep. (Zaire) and a high of $ 29,037 for the USA (137 times the Zaire level).

[4] Throughout sections 2-4 we use Angus Maddison's magnificent, recently updated data set comprising all countries in the world, as described in Maddison (2007). Maddison's Gross Domestic Product (GDP) estimates are denoted in so-called 1990 international Geary-Khamis dollars (GK$), which is based on purchasing power parity (PPP) converters rather than exchange rates to correct for price differences between countries. Without such corrections, the income levels of developing countries would be grossly underestimated relative to the income levels in the OECD countries. The PPP corrections are based on the International Comparison Project (ICP) of the United Nations, Eurostat, and OECD, as initiated by Kravis, Heston, and Summers (1982). Maddison uses the Geary-Khamis technique to ensure transitivity, base country invariance, and additivity of the data. All GDP data estimates discussed in sections 2-5 are denoted in GK$ and referred to as income. To put the GK$ into proper perspective, Maddison's estimate of income per capita in the USA in 2003 is GK$ 29,037 compared to the World Bank's $37,600 current international PPP dollars. This implies that the (1990) GK$ used in this paper is about 30 percent more valuable than 2003 international US PPP dollars. We will refer to GK$ as $ in the remainder of the paper.

Figure 1 Histogram of per capita income, selected years



Author's calculations based on Maddison (2007); income per capita in GK$; 145 countries / regions; horizontal spacing = 0.3; see the main text for further details.

Figure 1 illustrates the distribution of income per capita for a selection of years (equally spaced across time) in the period 1950-2003 by providing a histogram with the natural logarithm of income per capita on the horizontal axis (to compactify the range) and the number of countries within a certain range on the vertical axis. In 1950, for example, 1 country has ln(income per capita) below 5.7 (= income level of $ 300) whereas 7 countries are in the range between 5.7 and 6.0, and so on. The panels of Figure 1 show a gradual movement from the left to the right, indicating increasing income per capita levels for most countries. Clearly, as noted above, there is considerable variation in income per capita. It is hard to determine any trends in the panels of the figure by visual inspection, although comparing the first panel (with most of the mass on the left hand side) with the last panel (where the mass is more

evenly distributed) seems to suggest an increase (rather than a decrease) in income dispersion. But the graphs also suggest a crude answer to the citation at the beginning of this paper

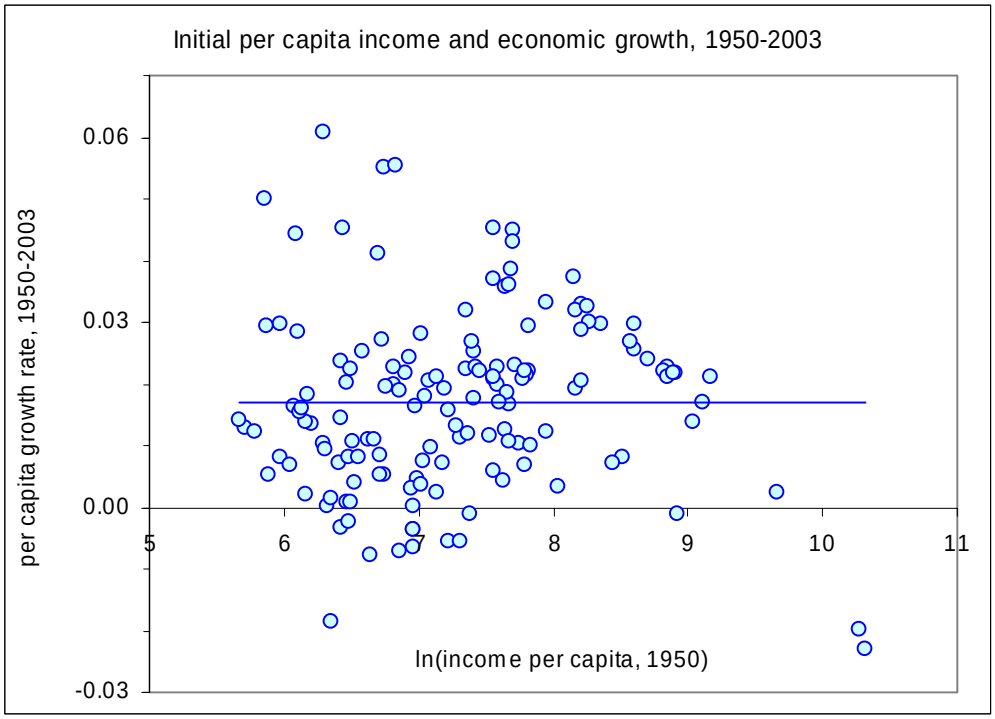
Observation 1 (economic growth):

Most countries do not stay in the same place as far as income per capita is concerned. More importantly, income dispersion has increased between 1950-2003.

2.2 Size matters

It is time to proceed with a more formal analysis. If the world is becoming economically flat and fierce competition between workers, doing more or less the same tasks in different parts of the world, this should ensure that minuscule differences in wage rates disappear. This can be done through trade in tradable commodities, labour migration or through the location decisions of firms. In all these cases competition should result in a tendency for income levels of similar workers to become more equal over time, that is, these income levels should "converge".

Figure 2 Income convergence, 1950-2003



Author's calculations based on Maddison (2007); income per capita in GK$; 145 countries / regions; the horizontal line is a regression line.

Figure 2 gives a standard answer whether or not this is the case, see Barro and Sala-i-Martin (1995) for a detailed explanation. The figure shows on the horizontal axis the (natural logarithm of) initial income levels for the various countries in 1950. On the vertical axis it shows the annualized per capita income growth rate for these countries in the period 1950 – 2003. The line through the scatter plot shows a regression line, which is almost horizontal (slightly upward sloping). This is problematic for the convergence hypothesis because countries with low initial levels of income should grow faster than countries with initially high levels of income in order to converge. Evidently, figure 2 does not support this hypothesis.

Table 1 Convergence; regressions for 1950-2003

Dependent variable: annualized per capita economic growth rate

Explanatory var	1950-1963	1963-1976	1976-1989	1989-2003	1950-2003
Constant (t-stat)	0.020 (1.750)	-0.004 (-0.279)	0.019 (1.111)	-0.026 (-1.728)	0.017 (1.722)
Initial income[#] (t-stat)	0.001 (0.484)	0.004* (2.103)	-0.002 (-0.797)	0.005* (2.480)	0.000 (0.036)
R^2	0.002	0.030	0.004	0.041	0.000

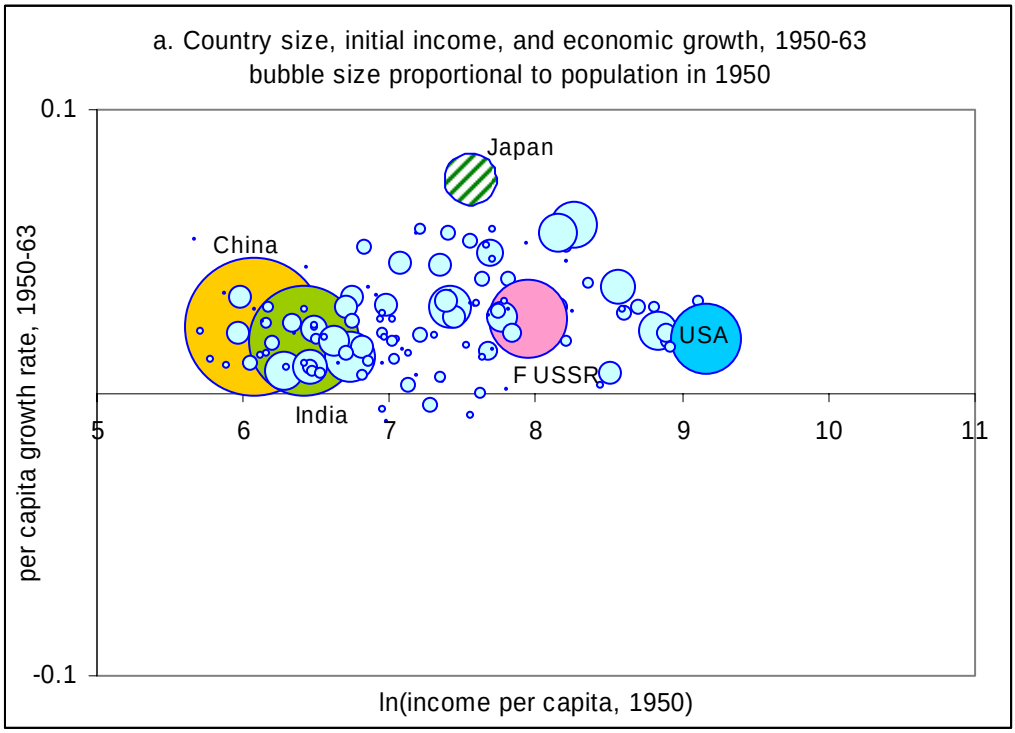
Author's calculations based on Maddison (2007); 145 countries / regions.
[#] ln(initial income per capita); * income effect significant at the 10 percent level.

Table 1 reports simple regressions of the annual economic growth rate of a country / region in a specified (sub-)period on the natural logarithm of initial income per capita. If there is convergence, one expects initially poor countries to grow faster than initially rich countries, so the reported coefficient on initial income in Table 1 should be negative and statistically significant. In contrast, the estimated coefficients on initial income level for the sub-periods is either *not* statistically significant or point at income *divergence*, rather than convergence (for the sub-periods 1963-1976 and 1989-2003, respectively). For the period as a whole, the effect of initial income on economic growth is *nil*. Moreover, the explanatory power of the regression (R^2, the "explained" share of the variance in the economic growth rate) is very poor for the various sub-periods (no more than 4.1 percent) and *nil* for the period as a whole. Although there is an important caveat to this analysis to be discussed below, the following conclusion is warranted:

Observation 2 (no convergence)

The impression from Figure 1, that there is no support for global convergence, is supported by a more formal analysis of the data.

Figure 3 Country size, initial income level, and economic growth, 1950-2003



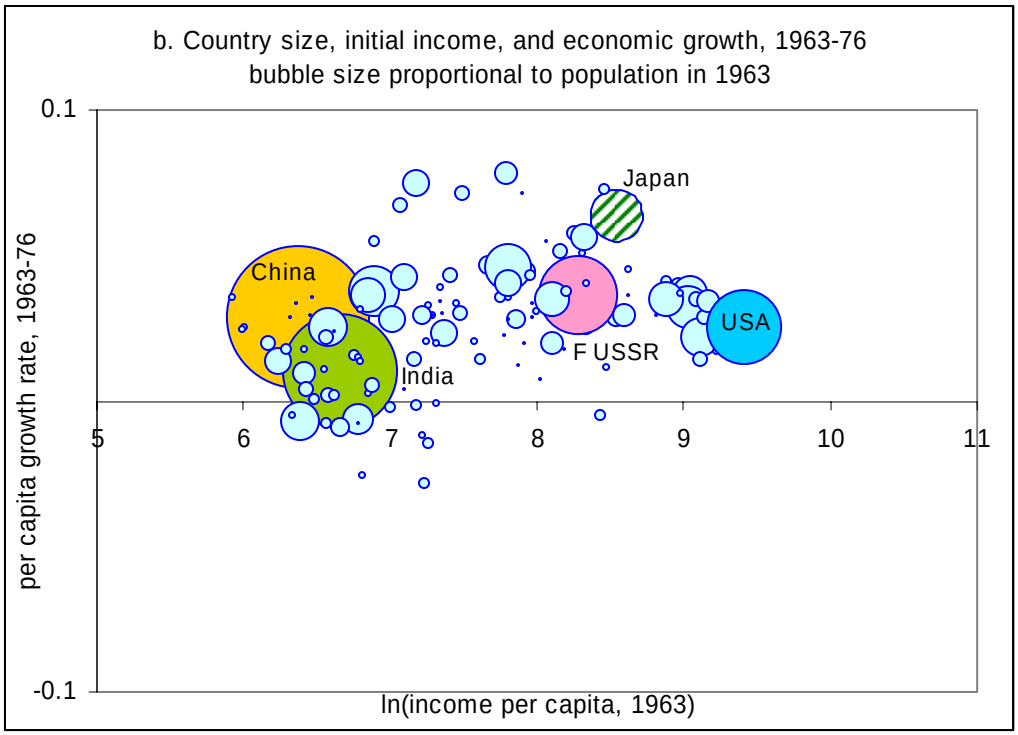
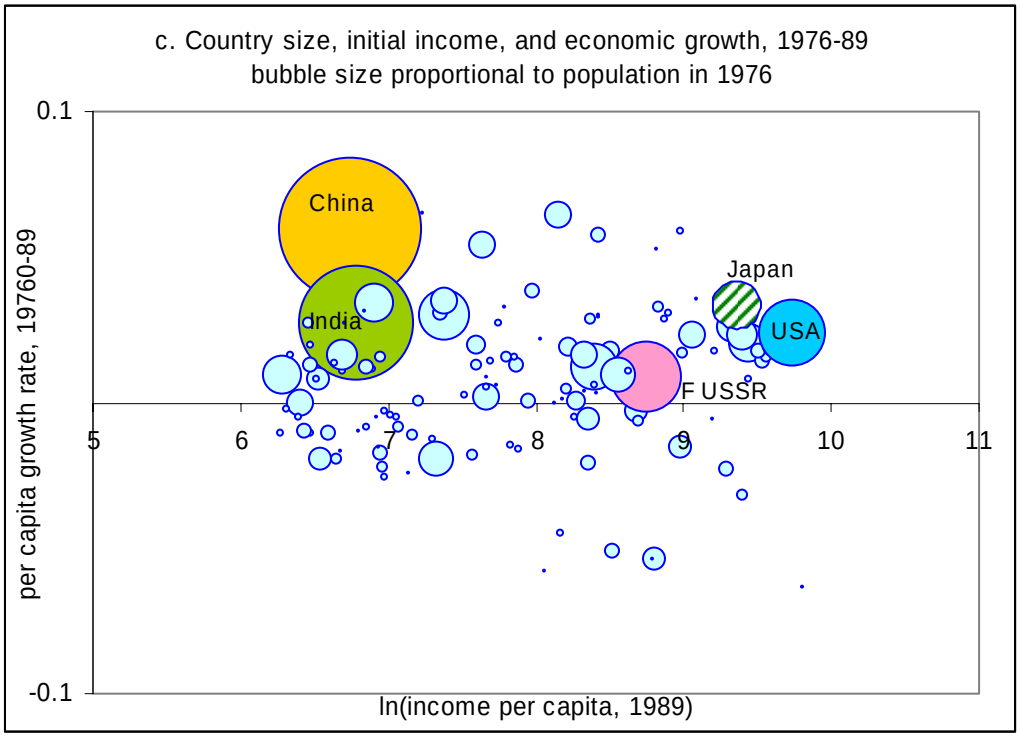
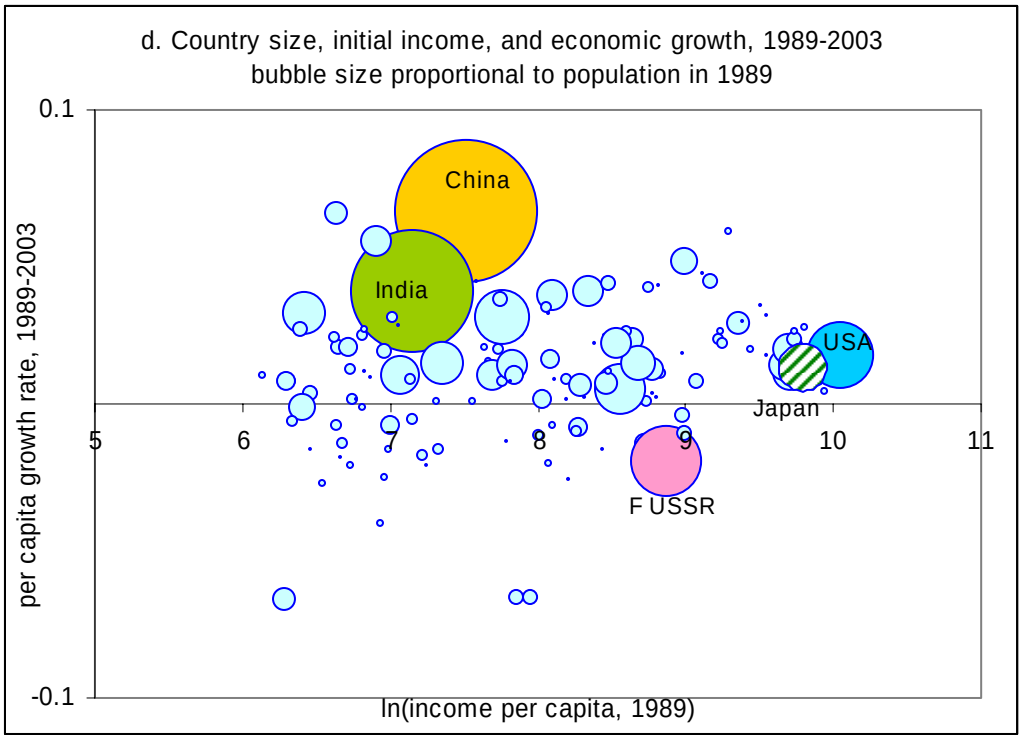


Figure 3 continued





Calculations based on Maddison (2007); 145 countries and regions

The various panels of Figure 3 illustrate that Figure 2 and Table 1 can be misleading regarding the developments in the world economy because all countries are equally

important, independent of the size of the economy.[5] This makes an observation for the Seychelles (with 80 thousand inhabitants in 2003) as important as an observation for China (with a 16,000 times larger population in 2003). Similarly, 13 countries have a population less than 0.1 percent of the Chinese population, with a total of 8.4 million people (less than 0.7 percent of China's population). Nonetheless, In Figure 2 the annual observations for these 13 countries receive a weight 13 times higher than China's single annual observation in the analysis in sections 2 and 3.[6] Figure 3 vividly illustrates the repercussions of these observations for the sub-period regressions summarized in Table 1 using a "bubble" diagram which shows the natural logarithm of initial income per capita of each country on the horizon axis, the annual economic growth rate of the country on the vertical axis, and depicts the country's importance by making the size of the bubble proportional to the size of the initial population.

In view of the size of their populations, China and India are the most important, separately identified observations in Figure 3. Of the high income countries, we separately identify Japan, the USA, and the (former) USSR. In the first two periods (panels 3a and 3b; the period 1950-1976) economic growth in China and India (the largest poor countries) tends to be *lower* (or at least not higher) than in Japan, the USA, and the USSR (the largest high income countries). By contrast, in the last two periods (panels 3c and 3d; the period 1976-2003), economic growth in China and India tends to be *higher* than in Japan, the USA, and the (former) USSR, particularly in the most recent period. The figure therefore shows that the largest developing countries have grown substantially faster in the last 25 years than the largest high income countries. This brings us to observation 3.

Observation 3 (importance of China and India):

The population size of China and India – together about 37 percent of the world population – combined with relatively high growth rates ensures that in the last 25 years there is some evidence for global income convergence. Correcting for country

[5] This remark also holds for more sophisticated analyses of income inequality, like the famous σ and β convergence concepts of Barro and Sala-i-Martin (2004).

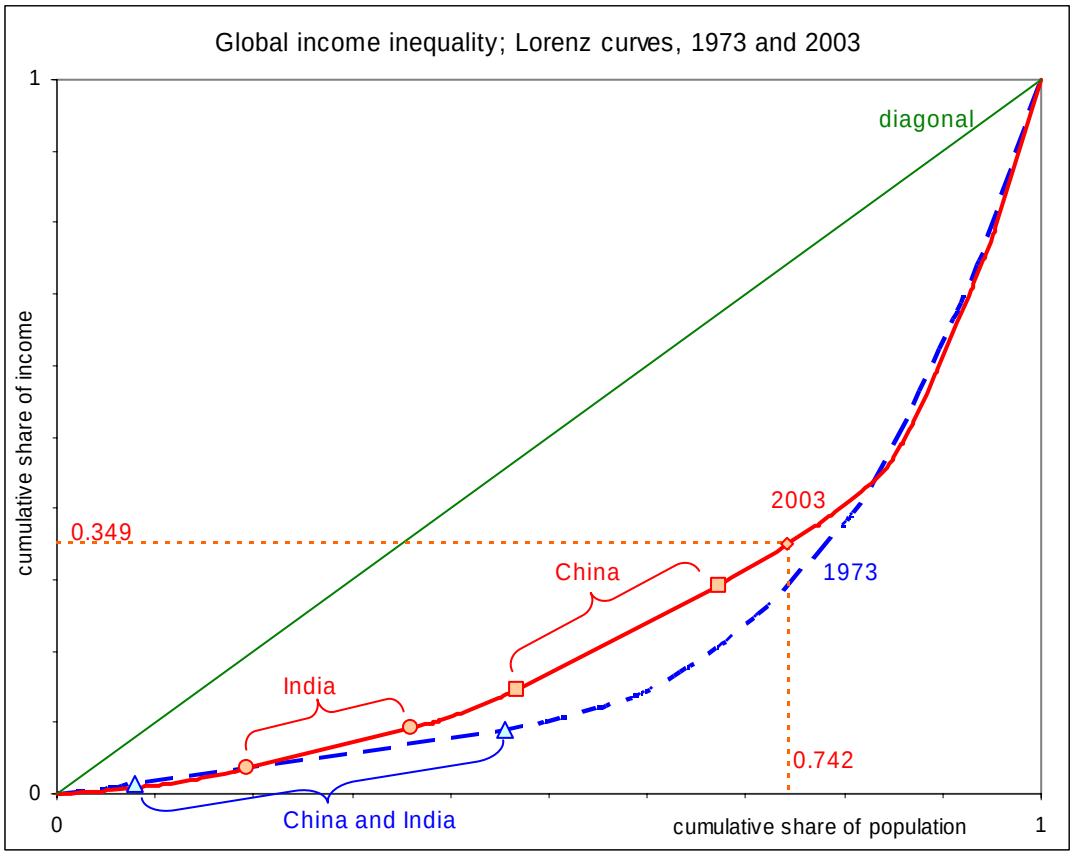
[6] Again similarly, 83 countries have a population smaller than 1 percent of the Chinese population in 2003, with a total of 452 million people (less than 35 percent of China's population).

size therefore lends support to Thomas Friedman's claim that global income per capita levels have started to converge recently.

3 Income inequality

Section 2 has studied income levels and economic growth rates, but not income inequality directly. We now analyze this aspect in more detail. There are various methods to determine income inequality. We will use the popular method of drawing Lorenz curves and calculating the Gini coefficient. The Lorenz curve is obtained by ranking the countries in terms of income per capita from low to high, then calculating the cumulative share of world population and income (which therefore ignores income inequality within countries) and finally plotting the result in a graph. Figure 4 depicts two Lorenz curves for the years 1973 and 2003. In the year 2003 figure 4 shows, for example, that 74.2 percent of the world population earned 34.9 percent of the world income. If income levels across countries would have been the same throughout the world, the Lorenz curve would coincide with the diagonal. The deviation of the Lorenz curve from the diagonal is therefore a measure of income inequality. This statistic is called the Gini-coefficient. It ranges from 0 (perfect equality) to 1 (perfect inequality).

Figure 4 Global income inequality; Lorenz curves in 1973 and 2003

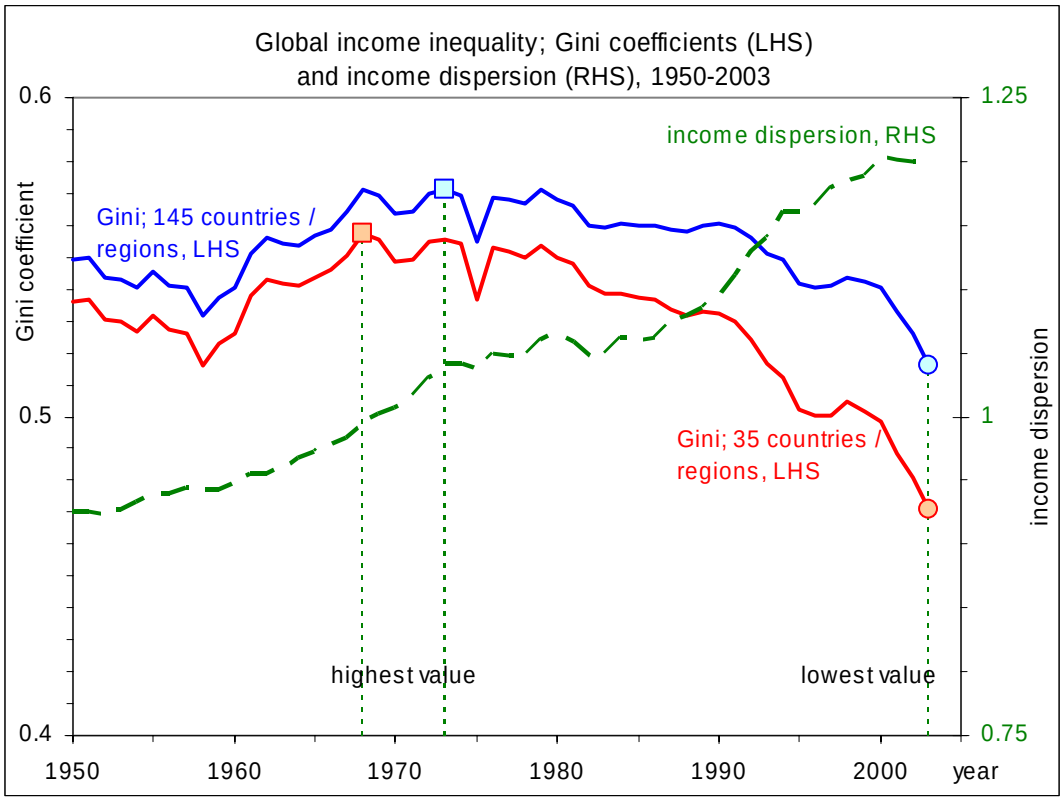


Author's calculations based on Maddison (2007); 145 countries and regions; The range "China and India" in 1973 includes Uganda.

As shown in Figure 4, China and India, with their large populations, were among the poorest countries in the world in 1973. Since then, the rapid economic development of India (since about 1990) and particularly of China (since about 1980) has fundamentally influenced the global Lorenz curve, bringing it closer to the diagonal and therefore reducing global income inequality. Moreover, it is clear from the figure that the share of income going to the high-income countries is about the same in 1973 and 2003. In fact, throughout the period 1950-2003 the top 15 percent of the population earns about half of world income.[7]

[7] Details available from the authors upon request.

Figure 5 Global income inequality (Gini coefficients and income dispersion)



Author's calculations based on Maddison (2007); income dispersion = standard deviation of ln(income per capita) for 145 countries / regions.

Figure 5 depicts the evolution of the global Gini coefficient from 1950 to 2003 as well as a measure of income dispersion (the standard deviation of the natural logarithm of income per capita). Evidently, simple income dispersion has increased in the second half of the 20th century. Again, this supports the impression from Figure 1, and is included here as a 'point' of reference. The top Gini curve, which takes population size into consideration, uses the 145 countries / regions discussed earlier. The bottom Gini curve divides the world into 35 larger countries / regions, as discussed in section 4. Three remarks are worth mentioning. First, as is to be expected, identifying fewer and larger countries (35 instead of 145) provides less detail and leads to a lower index of income inequality. Second, despite the difference in detail, the two curves are very similar with respect to the evolution of income inequality over time. Third, we note in both cases that income inequality declines in the 1950s, rises in the 1960s (to reach a peak in 1968 or 1973, depending on the number of identified countries), is relatively stable in the 1970s, and starts to decline since about 1979.[8] Not coincidentally, this is

[8] The Lorenz curves in Figure 4 therefore depict the most equal (2003) and the most unequal (1973) global income distribution in the period 1950-2003.

the year the economic reform process in China (initiated in December 1978) starts to take effect. The decline in global income inequality seems to speed up around 1991, arguably the year at which the economic reform process in India starts to have an impact. The economic development in these two populous nations therefore surely has an impact on global inequality. We summarize our findings as follows:

Observation 4 (global income inequality peaked in the 1970s)
Global income inequality as measured by the Gini coefficient reached a peak in the 1970s and has declined since about 1980. The Gini coefficient analysis indicates income convergence and corroborates Friedman's contention.

Until now we used two concepts of income inequality. First, income per capita in each country, which assumes that each country can be described by a single representative individual. Second, the population weighted average income per capita in each country, this assumes that all individuals in each country receive the same income (we used this to show that size matters). But we neglected a third measure, that is individual income differences. The assumption that all individuals within a country receive the same income is clearly not true. So looking at income inquality should also measure within country income inequality. This turns out to be very difficult as not all countries have household surveys to provide the necessary data, and if so do not use the same definitions of income (see Milanovic, 2006a,b). From this literature the following picture emerges. There is consensus in the literature that the across-country inequality recently decreases (see observation 4), and also that the across-country differences account for 70 percent of global inequality and the within country inequality for about 30 percent (Sala-i-Martin, 2006). There is no consensus, however, on developments with respect to within-country inequality, which seems to be more volatile than the across-country developments.

The long term analysis so far suggests that over the past 60 years the "forces of globalization" have first given rise to an increase (not a decline) in income dispersion, and only relatively recently (since about 1980) a reduction in global income inequality

(with a large role for India and China).[9] This is, in fact, not surprising since standard trade theory tells us that global competition equalizes wages of identical workers who perform similar tasks under certain conditions. But this is hardly ever the case. Most income differences are based on the fact that workers in rich countries have more and better technology available to do their jobs. This raises productivity and thus wages. Only a limited share of the workforce is in direct competition with the unskilled workers in China or India. There is also some consensus among trade economists that the difficult labour market position of low-skilled workers in developed countries is caused by domestic technological developments instead of global competition (see Feenstra, 2004, for a review).

4 Leapfrogging; leaders and laggards for the last 2000 years

"That is why I introduced the idea that the world has gone from round to flat. Everywhere you turn, hierarchies are being challenged from below…"

(Friedman 2005, p, 45)

The discussion above has focused on the extent of income dispersion and income inequality. The impression we give is that to some extent current developments in the world economy are "business as usual", with the exceptions of India and China. We have not paid any attention, however, to the question whether leading positions of some countries in the world economy might be challenged in the future, or that these positions are stable over time. Friedman might object to our historical analyses in the previous sections that he is looking forward in time instead of backward. We argue that looking further back in history could also be of use in this respect.

Currently the question is: could China be the future leader in the world economy? This brings us to an important psychological, economic, and historical empirical phenomenon: leapfrogging. To identify who is "leading" or "lagging", we continue to focus on the personal level by looking at income per capita levels, but now for a very long time period. The extent of a country's lead or lag is expressed as a country's income per capita as a percentage of the world average income per capita in the year

[9] The weak link between globalization and income convergence is also supported by findings for the 1870-1940 period, see Milanovic (2006).

under consideration. As an added bonus, this will provide us with additional information on the degree of income convergence or divergence, as discussed below.

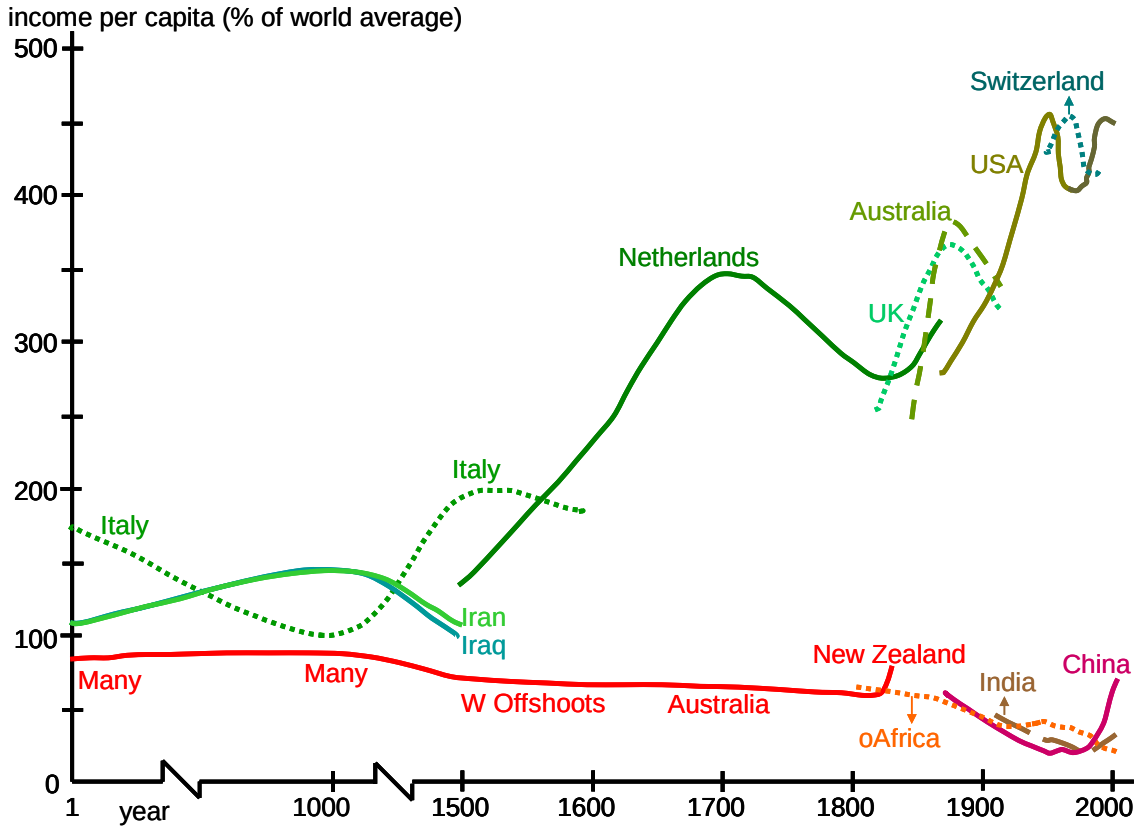
We can identify 28 individual (current) countries from all continents for which fairly reliable population and income data for the last 2000 years has recently been provided by Maddison (2007), namely two countries in Australia, two in Africa, two in the Americas, six in Asia, and fifteen in Europe. Together, these 28 countries (with about 3.7 billion inhabitants in 2007) represent about 82 per cent of the world population in the year 1, gradually declining to about 56 per cent of the world total in 2003. Although detailed information for the remaining 197 countries in the world is not available for the entire period, it is possible to construct 7 different regions – groups of countries for which fairly reliable aggregate population and income data are available for the last 2000 years, see Table 2 for an overview and Table A.1 in the appendix for the list of (current) countries belonging to a particular region. Taken together, this provides us with 35 observations (28 countries plus 7 regions) on the distribution of population and income across the world in the last two millennia.

Table 2 Individual countries and regions

28 individual countries		
Australia	Greece	Norway
Austria	India	Portugal
Belgium	Iran	Spain
Canada	Iraq	Sweden
China	Italy	Switzerland
Denmark	Japan	Turkey
Egypt	Mexico	United Kingdom
Finland	Morocco	United States
France	Netherlands	
Germany	New Zealand	
7 regions – groups of countries (# of countries); see Table A.1 for details		
Eastern Europe (12)	Other East Asia (42)	Other West Asia (12)
Former USSR (15)	Other Latin America (46)	Other West Europe (15)
Other Africa (55)		

Figure 6 depicts the respective leaders and laggards over time in terms of income per capita, see Table A.3 in the appendix for details. In the year 1 Italy (Rome) was the leader, with an income level about 73 percent higher than the world average. The leading position was taken over by Iran and Iraq (44 percent above the average) in the year 1000, before it was regained by Italy (Venice, Florence) in 1500 (94 percent above the average). The Dutch trading power gained prominence from 1600 to about 1820, with a relative income peak in 1700 (246 percent above average). Since then, the lead has switched frequently, going first to the UK, then to Australia, followed by the USA, Switzerland, and again the USA. The highest relative peak (374 percent above average) is reached in 1999. It is not only clear that the leadership changes from one country to another over time, but also that (despite prolonged periods of decline) the relative income position of the leader tends to increase over time.

Figure 6 Leaders and laggards in the world economy, 1-2003



Calculations based on Maddison (2007); oAfrica = other Africa; W Offshoots = Canada, USA, Australia, and New Zealand; See Table A.3 regarding the laggards in the years 1 and 1000.

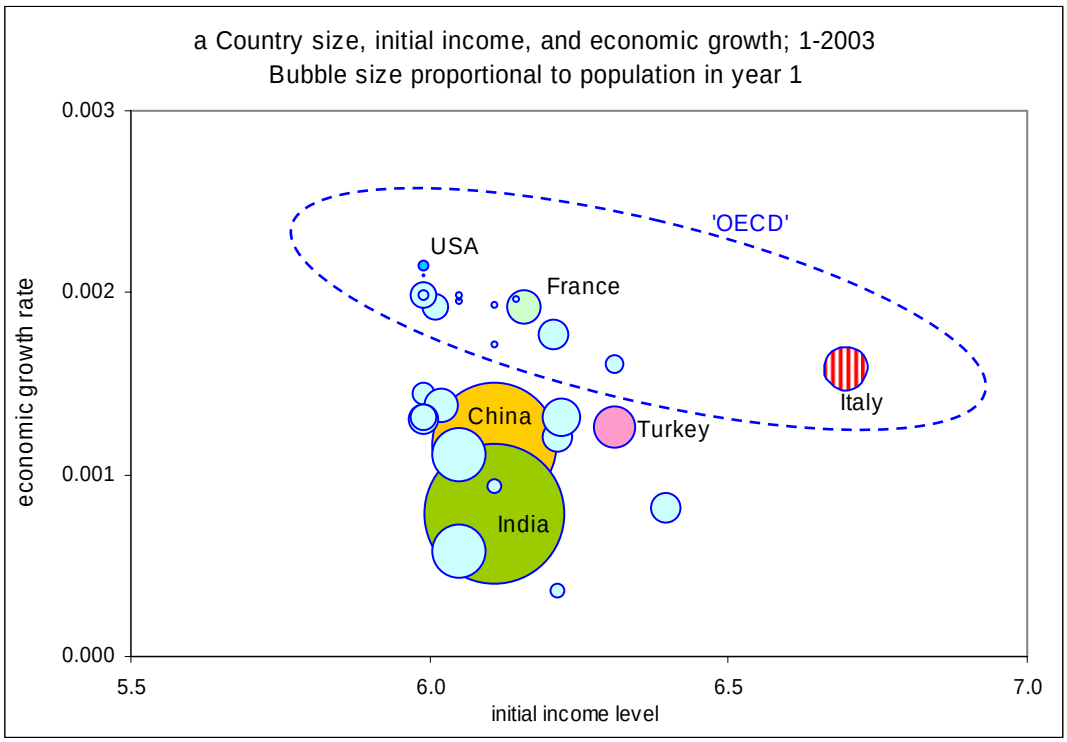
Many countries qualified for the top "lagging" position in the year 1, including all of the Americas, Australia, Japan, and what is now the former USSR; their income level lagged about 14 percent behind the world average. Most of these countries (with the exception of Japan) are still lagging behind in the year 1000 (11 percent below the average). In 1500 and 1600 only what Maddison labels the "Western Offshoots" (Canada, USA, Australia, and New Zealand) still qualify for the top lagging positions (about 30 percent below average), from which the USA and Canada escape after 1600, Australia after 1700, and New Zealand only after 1820. Note the remarkable increase in prosperity for these countries as both Australia and the USA become the world leader relatively shortly afterwards. Africa (excluding Egypt and Morocco) becomes the laggard in 1870 (45 percent below average), a position to which it returned in 1990 (up to 80 percent below average in 2003).[10] For most of the rest of the 20th century India and China (the currently feared top globalization countries from an OECD perspective) took turns in being the world's laggard. It is again clear that there is leapfrogging (the top laggard position changes regularly) and that the relative income position of the laggard tends to decrease over time.

Observation 5 (Relative leapfrogging and income divergence)

Investigating income per capita relative to the world average, we observe that there is frequent leapfrogging (different countries are in the lead or lag behind). Moreover, there is income divergence: the leader's relative position improves and the laggard's relative position deteriorates over time. Hierarchies are indeed challenged over time. However, at present no spectacular leapfrogs can be expected in the near future.

[10] The graph ignores developments in Iraq since 1991, which reached the all time low laggard position (84.2 percent below average) in 2003.

Figure 7 Country size, initial income level, and economic growth
a: 1-2003; b: 1700-2003; c: 1870-2003; and d: 1950-2003



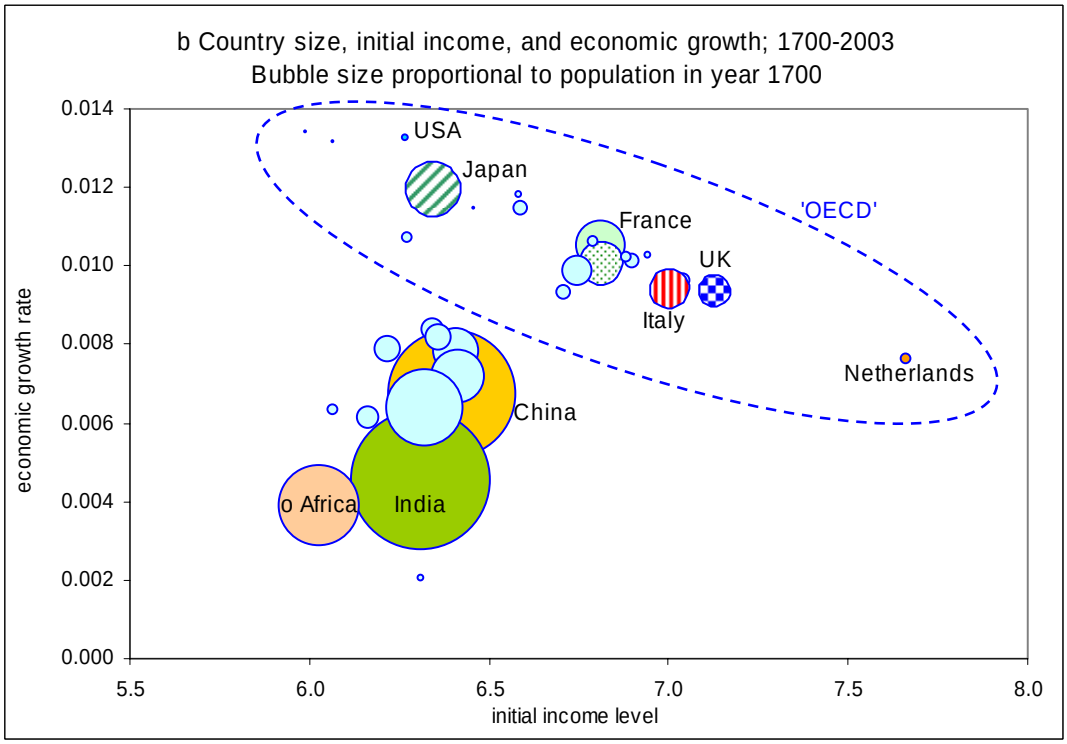
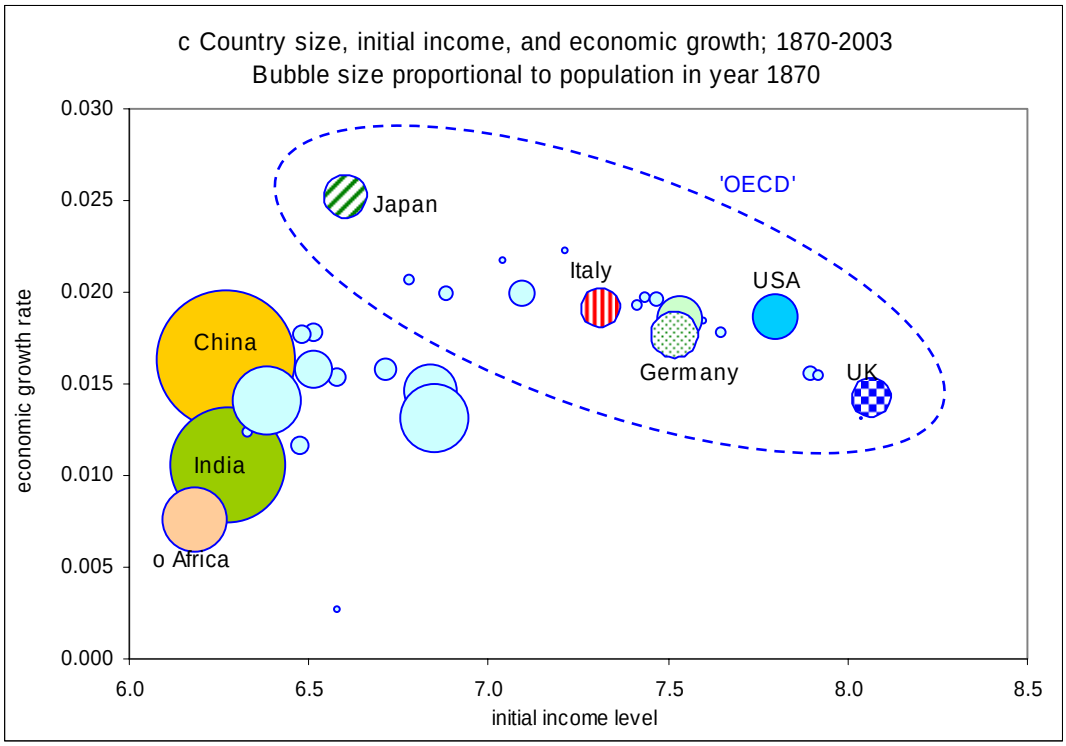
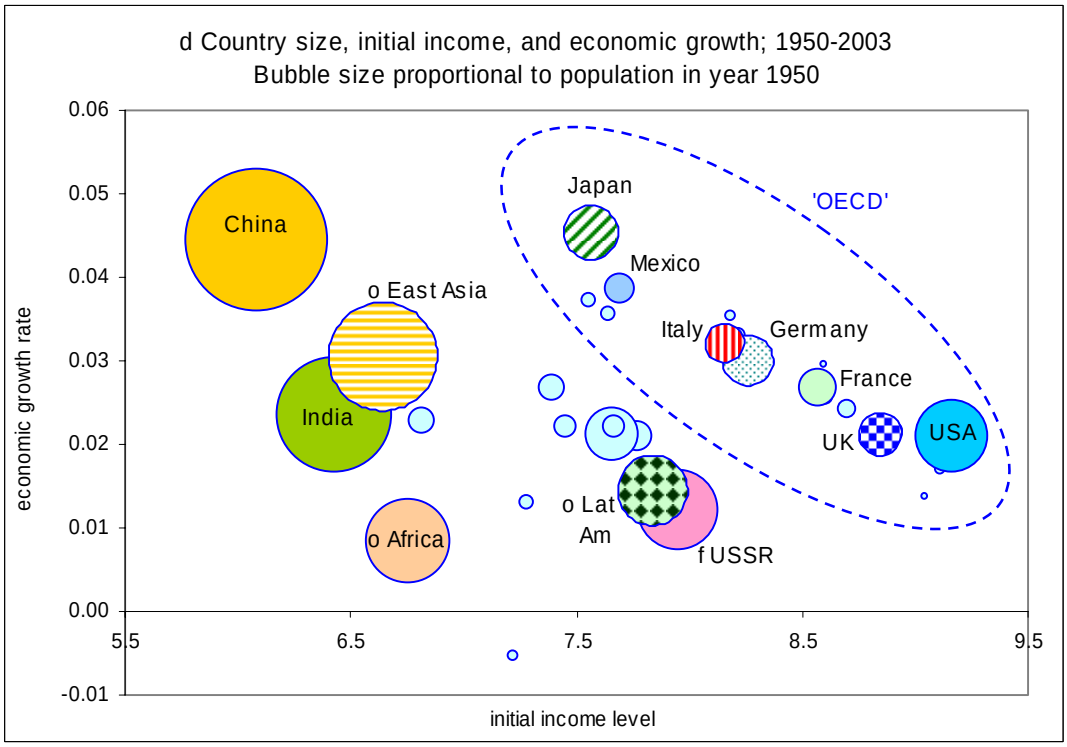


Figure 7 continued





Calculations based on Maddison (2007); the encircled countries labelled 'OECD' exclude Turkey in all panels and Mexico in panels a-c; o = other; f = former; Lat Am = Latin America.

Figure 7 illustrates the discussion above by using bubble diagrams for selected years.[11] Panels a and b show the overwhelming initial influence of India and China in

[11] Note that, unlike Figure 3, the scales are different for the various panels.

terms of total population. Together these two countries account for 60 and 50 percent of the world population in the years 1 and 1700, respectively.[12] Panels a and b also show the rather exceptional leads (an income level far above all other countries) of Italy in the year 1 and of the Netherlands in the year 1700. This contrasts with panels c and d (the years 1870 and 1950), where a range of other countries are close in income level to the leader's position. All panels allow us to identify most of the OECD countries quite easily and track the developments and relative importance of individual countries or regions. Italy, for example, has remained a relatively prosperous nation most of the time. Japan already moved up in the ranks quickly from 1870 to 1950, before the Japanese miracle started. Most impressive is the development for the USA, which is a lagging tiny population speck in panels a and b, to move swiflty up the ranks, take over the lead, and rapidly increase in population size in the 19th and 20th century.[13] The lagging position of Africa (excl. Egypt and Morocco) in these two centuries is evident from panels c and d, where Africa sits firmly at the bottom of the figures, indicating a low growth rate.

Table 3 Convergence; regressions for the last two millennia

Dependent variable: annualized per capita economic growth rate

Explanatory var	1-2003	1000-2003	1500-2003	1600-2003	1700-2003
Constant	0.008	0.029	0.004	0.007	0.005
(t-stat)	(2.601)	(4.741)	(0.490)	(0.958)	(0.566)
Initial income#	-0.001*	-0.004*	0.000	0.000	0.001
(t-stat)	(-2.110)	(-4.215)	(0.268)	(0.021)	(0.561)
R^2	0.119	0.350	0.002	0.000	0.009
Explanatory var	1820-2003	1870-2003	1913-2003	1950-2003	
Constant	-0.008	0.003	0.009	0.035	
(t-stat)	(-0.719)	(0.302)	(0.871)	(2.065)	
Initial income#	0.003*	0.002	0.001	-0.001	
(t-stat)	(2.040)	(1.620)	(0.948)	(-0.632)	
R^2	0.112	0.074	0.072	0.012	

Source: Calculations based on Maddison (2007); 35 countries / regions.
ln(initial income per capita); * income effect significant at the 10 percent level.

[12] It has now declined to 'only' 37 percent in 2003.
[13] On a per capita basis the developments in Australia in the 19th century are even more impressive, but its population remains small, never to exceed 0.3 percent of the world total.

Table 3 provides summary statistics on level regressions corresponding to Figure 7. If we go back long enough in time, namely thousand or two thousand years, there is some support for convergence (the impact of the initial income level is negative and statistically significant). For the most recent 500 years, however, we find *no* support for level convergence, whereas there is some support for level-divergence in the period 1820-2003. Observation 6 summarizes these findings.

Observation 6 (convergence after 1000 years, but not since 1500)
There is support for convergence after 1000 or 2000 years, but no support for convergence since 1500.

5 The death of distance?

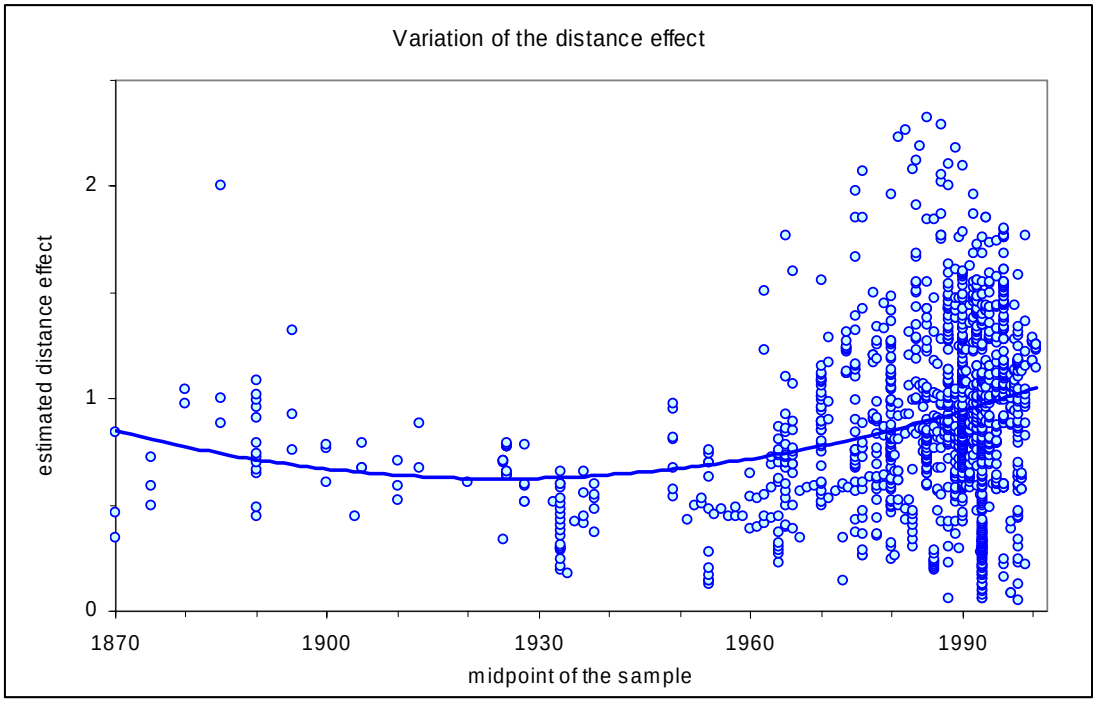
"The net result of this convergence was the creation of a global, Web-enabled playing field that allows for multiple forms of collaboration – the sharing of knowledge and work – in real time, without regard to geography, distance, or in the near future even language..." *(Friedman 2005, pp. 176-177)*

A central theme in Friedman's book is that the world becomes smaller. The citation above indicates that he has 'distance' in mind. On many occasions in the book it is argued that distance, as a broad measure of trade barriers, becomes smaller, such that:
"*it shrank the world from a size large to a size medium…around the year 2000 we entered a whole new era…shrinking the world from a size small to a size tiny…"*
(Friedman, 2005, p9-10).

For trade economists this is a puzzling observation because there is a well-known empirical regularity, the so-called gravity equation, which shows that distance is an important determinant of international trade flows. The export of goods and services from one country to another involves time, effort and hence costs. Goods have to be physically loaded and unloaded, transported by truck, train, ship, or plane, packed, insured, traced, etc. before they reach their destination. There they have to be unpacked, checked, assembled, and displayed before they can be sold to the consumer or an intermediate firm. A distribution and maintenance network has to be established, and the exporter will have to familiarize herself with the (legal) rules and procedures in another country, usually in another language and embedded in a different culture.

All of this involves costs, which tend to increase with "distance". As indicated above this can be both physical distance, which may be hampered or alleviated by geographical phenomena such as mountain ranges or easy access to good waterways, or political, cultural, or social distance, which also require time and effort before one can successfully engage in international business (see on the role of 'time' Harrigan and Venables, 2006).

Figure 8 Estimates of the distance effect over time



Data source: Disdier and Head (2006). The regression line is a simple third degree polynomial. See Disdier and Head for a more sophisticated analysis and extensive discussions.

The gravity-equation impact of distance on the size of trade flows can be summarized as follows. If *A* and *B* are two countries with income levels GDP_A and GDP_B, the hypothesized size of their bilateral trade flow is given by:

$$(1) \qquad trade_{A\ to\ B} = \frac{GDP_A^{\alpha} \cdot GDP_B^{\beta}}{distance_{A\ to\ B}^{\theta}},$$

where the "$distance_{A\ to\ B}$" variable can be measured in various ways (for example in kilometers between the main economic centers of the countries) and the parameters α, β, and θ are to be estimated using actual data. Equation (1) indicates that the larger the two trading partners, measured by their income levels, and the smaller the distance between them, the larger the bilateral trade flow. The empirical evidence in

favour of the gravity equation is overwhelming. As a result, the gravity equation has been used in numerous empirical trade studies.

In view of the frequent use of the gravity equation, Disdier and Head (2006) were able to perform a so-called meta-analysis of gravity model estimates, which leads to a striking conclusion. Disdier and Head analyze 1,467 estimated distance effects (that is, estimates of the parameter θ in equation (1) on the impact of distance on international trade flows) gathered from a wide range of different studies. Their findings can be effectively summarized with the help of Figure 8.[14] The higher the estimated parameter θ, the stronger the negative effect of distance on the size of trade flows, and therefore the more important distance and location is for determining these trade flows. The mean effect of distance on trade for the period as a whole is around 0.9 (with 90 percent of all estimates between 0.28 and 1.55). This implies that a 10 percent increase in distance leads to a 9 percent reduction of international trade flows. The estimates in Figure 8 suggest that the distance effect became less important between 1870 and 1940. Most striking, however, is the *increased* (not decreased) estimated distance effect in the second half of the 20th century (also with some increased variance). In sharp contrast to the opinion of the death-of-distance group, distance is therefore becoming *more* (not less) important for determining international trade flows. See Disdier and Head (2006) for a further discussion.

The next question is how the findings of Disdier and Head manifest themselves in world trade flows. This is illustrated for Europe in Table 4 by providing regional imports and exports for Europe as a percentage of total imports and exports for selected years. The table shows that, despite two world wars, the isolationist period between the wars, and the enormous increase in the volume of world trade from 1950 onwards, the regional distribution of European trade is quite stable, with a dominant (and, if anything, increasing) local component. Europe itself was and still is the most important source and destination of its trade flows. In this sense, world trade is not global but "provincial", since the main trading partners are still to be found among the closest neighbours (various barriers to trade may contribute to this finding; see, however, also section 6). Our findings are summarized in observation 7.

[14] We are grateful to Anne-Célia Disdier and Keith Head for providing us with the data for this figure.

Table 4 Distribution of European trade flows, sel. years (% of total export / import)

a. Export	Europe	USA	S-America	Asia	Africa	ROW
1860	67.5	9.1	7.7	10	3.2	2.5
1910	67.9	7.6	4.2	9.8	4.8	2.4
2005	75.7	6.9	1.3	7.6	2.6	5.9
b. Import						
1860	61.0	14.3	7.8	12.1	3.2	1.7
1910	60.0	14.0	8.2	10.0	4.5	3.4
2005	76.8	3.3	1.5	11.3	2.9	4.1

Source: Baldwin and Martin (1999) for the years 1860 and 1910; author's calculations based on WTO International Trade Statistics 2006 for the year 2005.

Observation 7 (trade is distance-determined)

International trade flows are to a large extent determined by distance; a 10 percent increase in distance reduces trade by about 9 percent. Moreover, the importance of distance seems to *increase*, not decrease, in the second half of the 20th century, which is in strong contrast with the contention of Friedman in this respect.

6 International production networks

Looking only at trade flows might not convince the advocates of the death-of-distance group arguing in favour of a global economy that becomes "flatter". Most international trade is in the hands of multinational corporations, which might benefit the most from a flatter global economy. Arguably, the increased importance of multinational activity is one of the most distinctive features of the present wave of globalization. This allows multinational firms to "slice-up-the-value-chain" in order to increase profitability; this term indicates that different parts of the production process are increasingly placed in different locations to benefit from economies of scale, skill differences, and low wages in order to increase overall multinational profitability. The ICT revolution makes the re-location of firms or parts of firms increasingly possible. Looking only at trade flows might obscure trends in the global re-location of firms. This relatively new aspect of world trade might in fact be the inspiration of Friedman's citation that presented at the beginning of this paper, namely that we have "*to run faster in order to stay in the same place"*. The numerous anecdotes in

Friedman's book suggests that he, indeed, often has the activities of the multinational corporation in mind.

Table 5 Distribution of FDI; by region and selected countries, 1980-2005

	Inflow			
Region	1978-1980	1988-1990	1998-2000	2003-2005
Developed economies	79.7	82.5	77.3	59.4
European Union	39.1	40.3	46	40.7
Japan	0.4	0.04	0.8	0.8
United States	23.8	31.5	24	12.6
Developing economies	20.3	17.5	21.7	35.9
Africa	2	1.9	1	3
Latin America & Caribbean	13	5	9.7	11.5
Asia and Oceania	5.3	10.5	11	21.4
West Asia	-1.6	0.3	0.3	3
South, East & S-E Asia	6.7	10	10.7	18.4
South-East Europe & CIS	0.02	0.02	0.9	4.7
World	100	100	100	100
	Outflow			
Region	1978-1980	1988-1990	1998-2000	2003-2005
Developed economies	97	93.1	90.4	85.8
European Union	44.8	50.6	64.4	54.6
Japan	4.9	19.7	2.6	4.9
United States	39.7	13.6	15.9	15.7
Developing economies	3	6.9	9.4	12.3
Africa	1	0.4	0.2	0.2
Latin America & Caribbean	1.1	1	4.1	3.5
Asia and Oceania	0.9	5.6	5.1	8.6
West Asia	0.3	0.5	0.1	1
South, East & S-E Asia	0.6	5.1	5	7.7
South-East Europe & CIS	..	0.01	0.2	1.8
World	100	100	100	100

Source: World Investment Report 2006, UNCTAD

What about the facts on the relocation of activity through Foreign Direct Investment (FDI)?[15] Recently, many surveys on the behavior of the multinational enterprise have become available (see e.g. Markusen, 2002, or Barba-Navaretti and Venables, 2004). The two main motives for FDI are (i) so-called market seeking investments and (ii) factor cost seeking investments. In the former case firms are interested in the high wages of consumers, whereas in the latter case firms are interested in the low wages of workers (and other cost advantages). The findings of the literature can be illustrated with the help of Table 5. Most striking in the table is that both inflows and outflows of FDI are directed towards, and come from, high wage developed countries. This suggests that most FDI is market seeking, that is, is attracted towards large, high-income, and skilled-labor abundant countries, with a declining relative inflow only very recently. In view of the volatility of FDI, we conclude that the often expressed fears with respect to factor cost seeking FDI are for the moment unwarranted.

What is the relation between this type of investment and distance? Unfortunately, this effect is somewhat ambiguous. On the one hand, the higher trade costs, the higher this type of investment, because exporting becomes a more expensive alternative. On the other hand, distance also increases transaction costs; the further one is from home, the more cultures differ. So with respect to market seeking investment this has to be resolved empirically. Markusen (2002) shows that the net effect tends to be negative. This suggests that international investment flows behave very much like international trade flows: one likes to stay close to home.

Observation 8 (FDI is mostly market-seeking)

The largest part of FDI flows originates from high-income countries and has as a destination another high-income countries (i.e. is market-seeking FDI). Taking into consideration the volatility of FDI flows. In the most recent period there is indication that the share going to developing countries is (last five years) increasing. This is in accordance with Friedman's claim that most of the dynamics with respect to slicing-up-the-value-chain is of recent date.

[15] Note, that FDI flows do not cover all possible ways to slice-up-the-value chain; one does not need to own (share of) a foreign plant.

7 Conclusions

We review empirical evidence regarding per capita income levels and international trade and investment flows in relation to several claims made in Thomas Friedman's book "the world is flat". Using different data and methods, our findings are summarized in eight observations. We note, for example, that most countries exhibit economic growth, and therefore do not stay in the same place as far as income per capita is concerned. We find no support for global convergence at the country level since 1950. We also note that the formidable population size of China and India ensures that developments in these countries have a global impact. It is for this reason, combined with the rapid economic developments in these two countries since 1980, that global income inequality (as measured by the Gini coefficient) reached a peak in the 1970s and has declined since about 1980.

Investigating income per capita relative to the world average, we observe that there is frequent leapfrogging (different countries are in the lead or lag behind). Moreover, over a longer time span of 2000 years, there is clearly income divergence: the leader's relative position improves and the laggard's relative position deteriorates over time. Hierarchies are therefore indeed challenged over time. Going back further in time also shows that there is some support for convergence after 1000 or 2000 years, but no support for convergence since 1500. When focusing on international trade flows rather than income levels we see that trade is to a large extent determined by distance; a 10 percent increase in distance reduces trade by about 9 percent. Moreover, the importance of distance seems to *increase*, not decrease, in the second half of the 20th century. Distance is also important for cross-border investment (FDI) flows, which mostly originate in high-income countries with a destination in another high-income country (market-seeking FDI). Taking into consideration the volatility of FDI flows, there is some indication that the share going to developing countries is recently (last five years) increasing.

Table 6 Friedman's Claims confronted with the evidence

Friedman's claims	Obs.	Support?	Facts
"Run faster to stay in the same place"	1	no	Most countries do not stay in the same place, but grow
Competition creates "a more level playing field"	2, 3, 4, 6	mixed	Income data show divergence, instead of convergence, correcting for country size shows recent – as of 1980 - income convergence. Increasing income in equality within countries has domestic causes (technological developments).
" hierarchies are being challenged from below"	5	no	Hierarchies indeed change over time, there is, however, no sign that this is presently the case or will be the case in the near future (China is too far behind).
"Death of Distance"	7	no	Distance is not dead, nor is it decreasing. If anything, there is a tendency of distance to become more important.
"small companies could suddenly see around the world"	8	mixed	Most FDI takes place between rich countries, indicating that firms look for high wages of consumers rather than for low wages of workers. However, developing countries are increasingly a destination for FDI flows, which is a recent phenomenon.

Obs. = Observation (as discussed in main text)

Taking all eight observations together – as summarized in Table 6 – we find both support for Friedman's the-world-is-flat claims (or those of other death-of-distance proponents), but also more substantial evidence of the opposite. Friedman's most important contention that the world becomes smaller is not supported by the evidence; the influence of distance on world trade is not only strong but also increasing. In contrast to Friedman's "shrinking world" arguments, this leads us to conclude that "it's a big world after all."

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Appendix

Table A.1 Composition of regions – groups of countries

Eastern Europe (12 countries)		
Albania	Czech Republic	Romania
Bosnia	Hungary	Serbia/Montenegro
Bulgaria	Macedonia	Slovakia
Croatia	Poland	Slovenia
Former USSR (15 countries)		
Armenia	Kazakhstan	Russian Federation
Azerbaijan	Kyrgyzstan	Tajikistan
Belarus	Latvia	Turkmenistan
Estonia	Lithuania	Ukraine
Georgia	Moldova	Uzbekistan
Other Africa (55 countries)		
Algeria	Ghana	Rwanda
Angola	Guinea	Saint Helena
Benin	Guinea Bissau	São Tomé and Principe
Botswana	Kenya	Senegal
Burkina Faso	Lesotho	Seychelles
Burundi	Liberia	Sierra Leone
Cameroon	Libya	Somalia
Cape Verde	Madagascar	South Africa
Central African Republic	Malawi	Sudan
Chad	Mali	Swaziland
Comoro Islands	Mauritania	Tanzania
Congo	Mauritius	Togo
Côte d'Ivoire	Mayotte	Tunisia
Djibouti	Mozambique	Uganda
Equatorial Guinea	Namibia	Western Sahara
Eritrea	Niger	Zaire
Ethiopia	Nigeria	Zambia
Gabon	Reunion	Zimbabwe
Gambia		

Table A.1 continued

Other East Asia (42 countries)		
Afghanistan	Laos	Papua New Guinea
American Samoa	Macao	Philippines
Bangladesh	Malaysia	Samoa
Bhutan	Maldives	Singapore
Brunei	Marshall Islands	Solomon Islands
Burma	Micronesia	South Korea
Cambodia	Mongolia	Sri Lanka
Cook Islands	Nauru	Taiwan
Fiji	Nepal	Thailand
French Polynesia	New Caledonia	Tonga
Guam	North Korea	Tuvalu
Hong Kong	Northern Mariana Islands	Vanuatu
Indonesia	Pakistan	Vietnam
Kiribati	Palau	Wallis and Fortuna

Other Latin America (46 countries)		
Anguilla	Dominica	Panama
Antigua & Barbuda	Dominican Republic	Paraguay
Argentina	Ecuador	Peru
Aruba	El Salvador	Puerto Rico
Bahamas	Grenada	St. Kitts Nevis
Barbados	Guadeloupe	St. Pierre and Miquelon
Belize	Guatemala	St. Vincent
Bermuda	Guyana	St.Lucia
Bolivia	Guyana (Fr.)	Suriname
Brazil	Haïti	Trinidad and Tobago
British Virgin Islands	Honduras	Turks and Caicos Islands
Cayman Islands	Jamaica	Uruguay
Chile	Martinique	Venezuela
Colombia	Montserrat	Virgin Islands
Costa Rica	Neth. Antilles	
Cuba	Nicaragua	

Table A.1 continued

Other West Europe (15 countries)		
Andorra	Guernsey	Liechtenstein
Cyprus	Iceland	Luxembourg
Faeroe Islands	Ireland	Malta
Gibraltar	Isle of Man	Monaco
Greenland	Jersey	San Marino
Other West Asia (12 countries)		
Bahrain	Lebanon	Syria
Israel	Oman	United Arab Emirates
Jordan	Qatar	West Bank and Gaza
Kuwait	Saudi Arabia	Yemen

The individual countries listed in Table A.1 are also used for the convergence analysis in the period 1950-2003. The following countries, however, are grouped together:

Table A.2 Grouping of countries for 1950-2003 convergence analysis

Group: 13 small WEC countries		
Andorra	Guernsey	Luxembourg
Cyprus	Iceland	Malta
Faeroe Islands	Isle of Man	Monaco
Gibraltar	Jersey	San Marino
Greenland	Liechtenstein	
Group: 24 small Caribbean countries		
Anguilla	Cayman Islands	Neth. Antilles
Antigua & Barbuda	Dominica	St. Kitts Nevis
Aruba	Grenada	St. Pierre and Miquelon
Bahamas	Guadeloupe	St. Vincent
Barbados	Guyana	St.Lucia
Belize	Guyana (Fr.)	Suriname
Bermuda	Martinique	Turks and Caicos Islands
British Virgin Islands	Montserrat	Virgin Islands

Table A.2 continued

Group: 23 Small East Asian countries		
Bhutan	French Polynesia	Palau
Brunei	Guam	Samoa
Cook Islands	Kiribati	Solomon Islands
Macao	Marshall Islands	Tonga
Maldives	Micronesia	Tuvalu
Fiji	Nauru	Vanuatu
Papua New Guinea	New Caledonia	Wallis and Fortuna
American Samoa	Northern Mariana Islands	
Group: Eritrea and Ethiopia		
Eritrea	Ethiopia	
Group: 3 Small African countries		
Mayotte	Saint Helena	Western Sahara
Group: Czechoslovakia		
Czech Republic	Slovakia	
Group: Former USSR; see Table A.1		
Group: Yugoslavia		
Bosnia	Macedonia	Serbia/Montenegro
Croatia	Slovenia	

Table A3a GDP per capita, regions (% of world average in respective year)

Year	1	1000	1500	1600	1700	1820	1870	1913	1950	2003
East Europe	88	89	88	92	98	102	107	111	100	100
former USSR	86	89	88	93	99	103	108	97	135	83
o Africa	91	91	72	70	68	62	55	40	41	21
o East Asia	91	94	98	95	91	85	68	55	37	60
o Lat America	86	89	72	72	82	99	77	94	120	84
o West Asia	108	136	102	183	94	87	75	56	101	106
o West Europe	100	89	102	107	118	133	200	181	170	363

Author's calculations based on Maddison (2007); o = other, Lat = Latin

Table A3b GDP per capita, countries (% of world average in respective year)

Year	1	1000	1500	1600	1700	1820	1870	1913	1950	2003
Australia	86	89	71	67	65	78	375	338	351	360
Austria	91	94	125	140	161	183	213	227	176	328
Belgium	96	94	154	164	186	198	308	276	259	327
Canada	86	89	71	67	70	136	194	291	345	359
China	96	100	106	101	98	90	61	36	21	71
Denmark	86	89	130	147	169	191	229	256	329	357
Egypt	129	111	84	80	77	71	74	59	43	47
Finland	86	89	80	90	104	117	130	138	201	317
France	101	94	128	141	148	170	215	228	250	338
Germany	87	91	121	133	148	162	211	239	184	296
Greece	118	89	76	81	86	96	101	104	91	211
India	96	100	97	92	89	80	61	44	29	33
Iran	107	144	106	101	98	88	82	66	81	86
Iraq	107	144	97	92	89	88	82	66	65	16
Italy	173	100	194	185	179	168	172	168	166	296
Japan	86	94	88	87	93	100	84	91	91	328
Mexico	86	89	75	76	92	114	77	113	112	110
Morocco	96	96	76	72	70	64	64	47	69	45
Netherlands	91	94	134	232	346	276	316	265	284	332
New Zealand		89	71	67	65	60	355	338	401	271
Norway	86	89	108	112	117	120	156	160	257	402
Portugal	96	94	107	124	133	138	112	82	99	213
Spain	107	100	117	143	139	151	138	135	104	263
Sweden	86	89	123	138	159	180	190	203	319	333
Switzerland	91	91	112	126	145	164	241	280	429	343
Turkey	118	133	106	101	98	96	94	79	77	104
UK	86	89	126	163	203	256	365	322	329	329
USA	86	89	71	67	86	189	280	347	453	448

Author's calculations based on Maddison (2007)

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