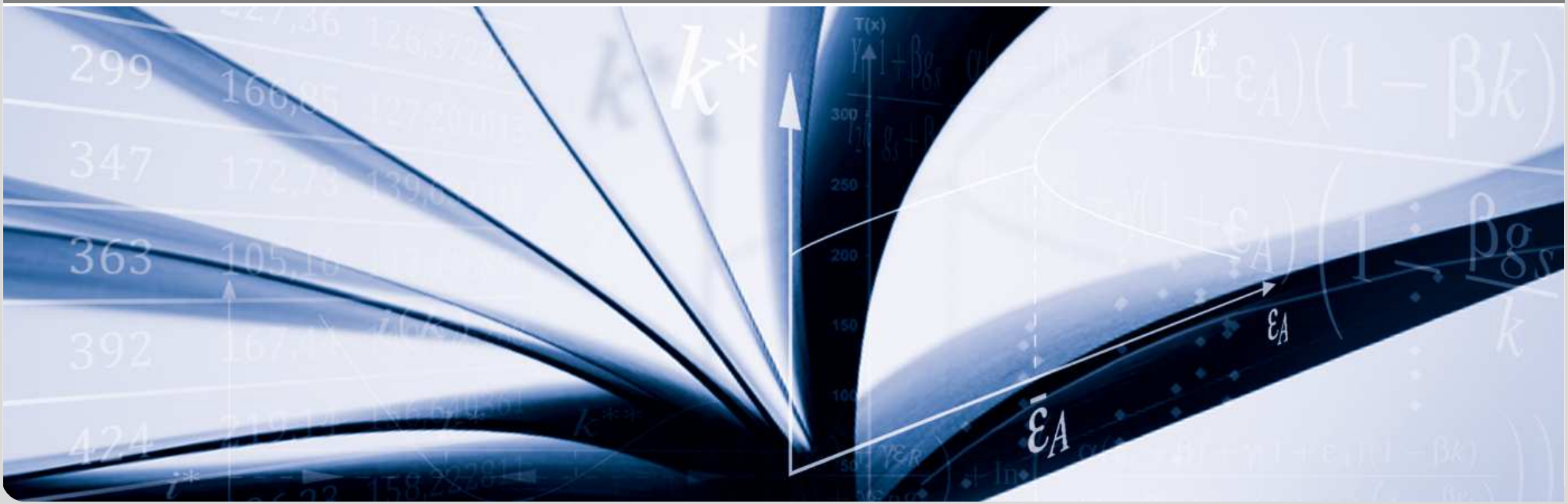
Karlsruhe Institute of Technology

Endogenous Growth Theory

Lecture Notes for the winter term 2010/2011

Ingrid Ott — Tim Deeken | November 26, 2010

CHAIR IN ECONOMIC POLICY



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Proximate vs. Fundamental Causes I

- If technology, physical and human capital can account for the vast differences in income per capita across countries, then why do some countries not invest as much as others or improve their technologies?
- An explanation relying only on these three proximate factors is thus to a certain extent insufficient and incomplete.
- There must be reasons that prevent some countries to e.g. accumulate more human capital.
- These reasons are the fundamental causes of economic growth.
- If the goal of studying economic growth is raising living standards, then gaining an understanding of the fundamental causes of economic growth becomes immensely important.
- As an analogy consider a sick person:
  - Alleviating the symptoms of the disease would be akin to improving the proximate causes.

Proximate vs. Fundamental Causes II

- Might help, but what have you learned? Could have been a fluke, next time round the same “cure” might not work again or worse harm the patient.
- As an example think of the practice of bloodletting. Some survived it, others died.
- If the patients got better, was that really due to the bloodletting or had these patients maybe a particularly robust constitution? (Relate that to the treatment the Washington Consensus prescribed which might have done more harm than good)
- However, fiddling with the symptoms may not always be bad.
- On the upside consider, for instance, cancer: chemo- or radiation therapy may alleviate the symptoms.
- No guaranteed healing though - the cancer may grow back.
- Figuring out what triggers the cells to mutate is the important step.
- This may provide knowledge that serves as a basis for a complete treatment of the disease.

Proximate vs. Fundamental Causes III

- The same holds for countries: A deep understanding of why some countries are rich and some are poor may be helpful for devising successful growth promoting strategies.

- The fundamental factors affecting cross-country income differences and economic growth can be (roughly) categorized in four categories:

  1. The luck hypothesis
  2. The geography hypothesis
  3. The institutions hypothesis
  4. The culture hypothesis

The Luck Hypothesis I

- Multiple equilibria are important in this context.
- For a given initial economic situation (i.e. two countries with identical parameters) more than one equilibrium configuration is possible.
- Luck or a small difference between these countries decides which one of these equilibria will be reached.
- The example on the next slide illustrates this concept via a simple game.

The Luck Hypothesis II

- Consider the following payoff-matrix:

		Everybody else	
		High investment	Low investment
Individual	High investment	y^H, y^H	$y^L - \epsilon, y^L$
	Low investment	$y^L, y^L - \epsilon'$	y^L, y^L

- where $y^H > y^L$ and $\epsilon, \epsilon' > 0$.
- Technological complementarities might be the reason why high investment is more profitable when everybody else also chooses this option.
- Two symmetric equilibria (in pure strategies).

The Luck Hypothesis III

- Two important points:
  1. The differences in the allocations implied by the investment choices might be large and possibly agree with the differences in the data.
  2. The equilibria can be ranked according to the Pareto-criterion.
- Abstracting now from the game, there are also weaknesses of the luck hypothesis.
- Consider Nigeria and the USA. Have the latter simply been lucky in their choice of equilibrium? Is it really possible to reduce the divergent histories of these countries to a single decision or a lucky event?
- This approach might work over a time period of 20 or 50 years.
- But over centuries? Unlikely. Even centuries ago the historical conditions and the institutional setup differed between these countries.

The Luck Hypothesis IV

- Also, suppose Nigeria chose the equilibrium with low investment. Over the centuries they must have figured out this was not the optimal choice (Remember, the equilibria are Pareto ranked).
- However, a switch to the other equilibrium does not seem to have taken place. An easy way to do this has not presented itself.
- Path dependence is an important aspect in this context (think of the QWERTY standard for typewriters and keyboards).
- Once you decide on a path it becomes hard and perhaps even impossible to change behavior and embark on the path to the superior equilibrium.

The Luck Hypothesis V

- If switching to a superior equilibrium path is totally or nearly impossible, then what about the East-Asian growth miracles or, on a larger scale, China? How did they achieve this?
- Maybe the identity of a leader, viewed as a stochastic event, matters?
- This would probably boil down to the policy choices and institutions set up by these leaders. Also, the selection and behavior of leaders is embedded in the respective institutional context.
- Compare Mao's disastrous policies during the Great Leap Forward (backyard steel furnaces in every commune, for instance) and Deng Xiaoping's tentative opening after 1978 that included the creation of Special Economic Zones which were a major factor determining the subsequent export-led growth.

The Luck Hypothesis VI

- This agrees with an empirical result from Jones and Olken (2005) that leaders seem to matter for economic growth only in countries where institutions are nondemocratic or weak (in the sense of not placing constraints on politicians or elites).
- In contrast, in societies where institutions appear to place checks on the behavior of leaders and politicians, the identity of leaders seems to play almost no role in economic performance.
- Upside: Models emphasizing luck and multiple equilibria are useful for the study of the mechanics of economic development, but they are unlikely to provide the fundamental causes of why world economic growth started 200 years ago and why some countries are rich while others are poor today.

The Geography Hypothesis I

- The luck hypothesis has emphasized the homogeneity of countries at some initial point. In contrast the geography hypothesis focuses on the differences between societies.
- How do geographic factors matter for economic growth?
  - Natural resources contribute directly to the wealth of a nation (e.g. oil in the modern Gulf States) and the presence of coal helped in the past to facilitate an industrial revolution in England (though not in China).
  - Topography is a further factor, it may make transport and thus trade more easy (compare Europe's many navigable rivers with access to the sea like the Rhine with Africa's Congo River which has no navigable sea access).
  - Different soil quality influences agricultural productivity (for instance, via a lower *A* in the production function).
  - High temperatures are another possible factor, they may reduce work effort.

The Geography Hypothesis II

- The absence of frost in the tropics, prevents the killing of parasites in these regions.

- A major geographical factor that influences economic growth is the disease burden (e.g. malaria prevalence) which influences
  1. Individual health
  2. Productivity
  3. Incentives to invest in both physical and human capital.
- Productivity suffers, for example, due to a high rate of absenteeism in regions where malaria is endemic. It is not necessarily a fatal disease, but a debilitating one.
- Concerning the disease burden tropical countries are at a particular disadvantage.

The Geography Hypothesis III

- The absence of frost is again to blame, since the parasite that transmits malaria cannot survive in temperate climes.
- Moreover, the effect of malaria is not negligible: reduction in the annual growth rate due to malaria by up to 2.6% found in some studies.
- Possible endogeneity problems exist however.
- To some extent the burden of the disease can be limited by economic development. Witness the successful eradication efforts in Southern Europe in the 20th century.

The Institution Hypothesis I

- At first glance the term “institutions” is a fuzzy concept, so a definition might be helpful.
- According to North (1990, p. 3): “Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction.”
- Still rather general and broad...
- Some examples of (economic) institutions:
  - The structure of property rights (e.g. private property vs. collective ownership).
  - If markets exists, how do they function?
  - The set of contractual opportunities available to firms and individuals.

The Institution Hypothesis II

- From economic theory one expects societies with institutions that encourage factor accumulation, efficient allocation of resources and innovations to prosper relative to societies without such a beneficial set of institutions.
- Consider property rights, in particular land deeds for smallholders. Why invest in your plot, if it can be seized at any time by the government or the ruling elite (The Peruvian economist de Soto, for instance, strongly emphasizes the importance of secure property rights on land for economic development)?
- Furthermore, it is important that property rights are secure for a broad cross section of the society.
- Otherwise many profitable investment opportunities may possibly be foregone for fear of expropriation.

The Institution Hypothesis III

- Again the question, if there is such a beneficial set, then why does not every society adopt it?
- Coordination failures as explained in the luck hypothesis might be at fault, but this explanation is not totally convincing for the same reasons given above.
- Conflicts of interest within a society might offer a better explanation (efficiency and distribution are deeply linked and a change in institutions challenges vested interests and creates winners and losers).
- This suggests that an in depth study of political economy might be beneficial.
- Note that in contrast to the other fundamental causes institutions are endogenous.

The Institutions Hypothesis IV

- This is an advantage since changing them (try influencing luck!) is comparatively easy...
- ...but this characteristic presents problems in empirical studies (simultaneity bias).

The Culture Hypothesis I

- Culture is a major factor in shaping values, beliefs and preferences of individuals.
- Through these culture is supposed to affect economic development.
- In particular religion needs to be mentioned in this context.
- Weber in his “The Protestant Ethic and the Spirit of Capitalism” (1930) argued for a link between Protestant, in particular Calvinistic, beliefs, and economic development.
- The emphasis on hard work, thrift and saving is important in this context as well as the concept of predestination in Calvinism.
- Economic success was a sign of being chosen by God. So people worked even harder to achieve this success and economic development thus became more likely.
- Other religions like Catholicism had their focus elsewhere.

The Culture Hypothesis II

- A possible link then exists for the different development processes of North and South America with their Anglo-Saxon / Protestant and Iberian / Catholic heritage respectively.
- Leaving Weber's thesis aside for now. In general it is conceivable that a certain set of beliefs or values is not conducive to cooperation within a society.
- In terms of the simple game presented above this would mean that a shared set of preferences might prevent a society to reach the superior equilibrium.
- Problems with this hypothesis exist though:
- Culture changes very slowly. How then can one explain growth miracles?
- It is not as if one could impose a different set of beliefs upon a country.

The Culture Hypothesis III

- If, for instance, the famed “Asian values” were responsible for the growth miracles in Hong Kong and Singapore, then why did the growth spurts only begin in the late fifties and not earlier?
- Also, what about North Korea?
- In this light, culture may be best viewed as a complement to institutional factors, acting as one of the forces responsible for institutional persistence.

Institutions and Economic Growth I

- The figure on the next slide shows a positive correlation between the average protection against expropriation risk between 1985 and 1995 and (log) GDP per capita in 1995.
- In line with economic theory, more secure property rights are correlated with higher incomes.
- The particular measure for property rights used here is rather broad and furthermore based on subjective assessments.
- On the plus side, it captures the security of property rights, a characteristic which most certainly affects economic incentives.
- Its relevance may also be inferred from the fact that this measure is sold on the market and businessmen who think about investing in the respective countries are willing to pay for it.

Institutions and Economic Growth II

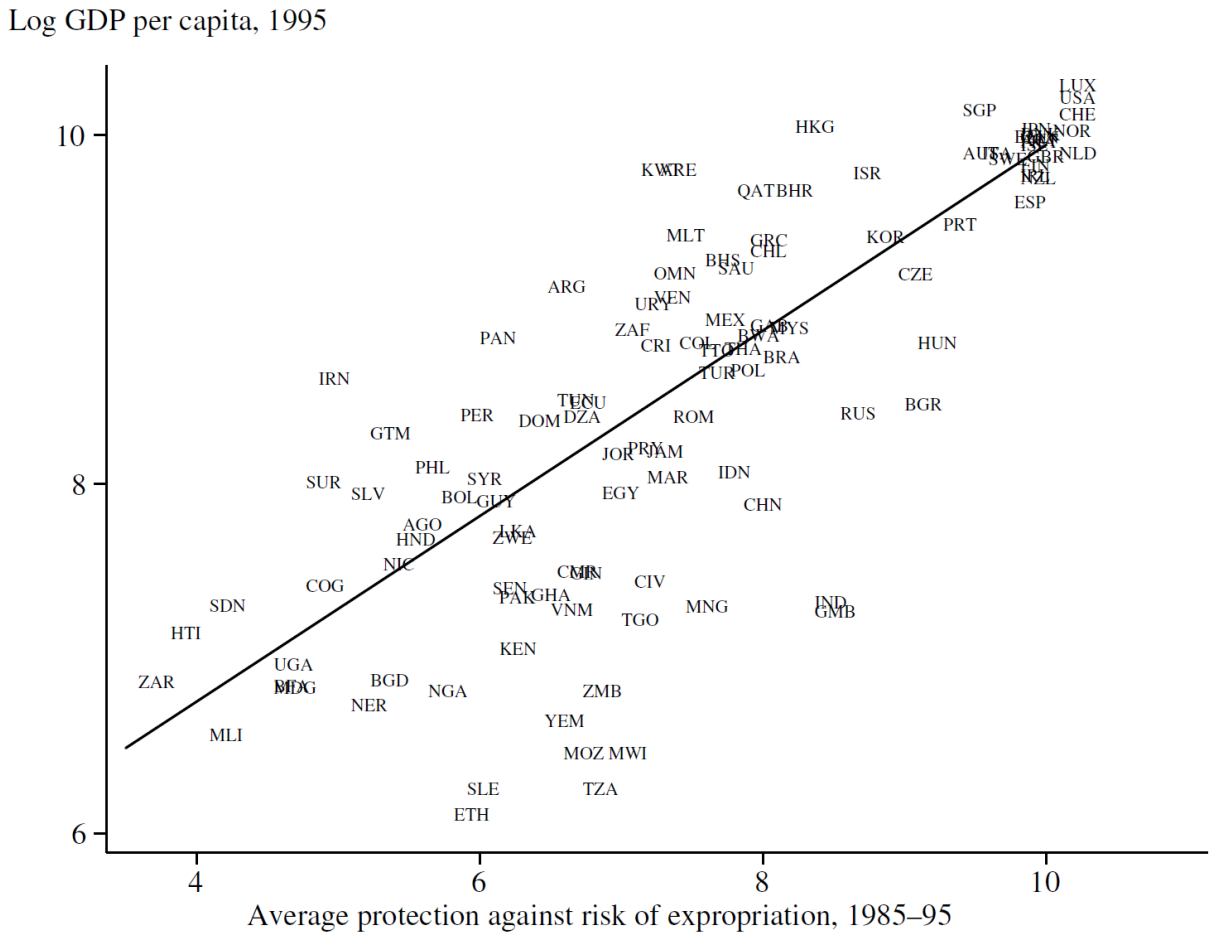

Figure 3.1: Relationship between economic institutions, as measured by average expropriation risk 1985-1995, and GDP per capita.

Institutions and Economic Growth III

- Keep in mind though that correlation does not imply causation and inferring that more secure property rights lead to economic prosperity is not feasible based on the figure alone.
- Two standard (identification) problems:
  - Reverse causality
  - Omitted variables
- Reverse causation in this context would, for example, mean that only sufficiently wealthy countries can afford secure property rights (These do not come for free. Think of the costs required to run an efficient judiciary or police force.)
- Concerning the second aspect, maybe something else, say geography or culture, explains both why countries have insecure property rights and are poor. In such a case the inference that poor economic institutions cause poverty would be spurious.

Geography as a Possible Omitted Variable

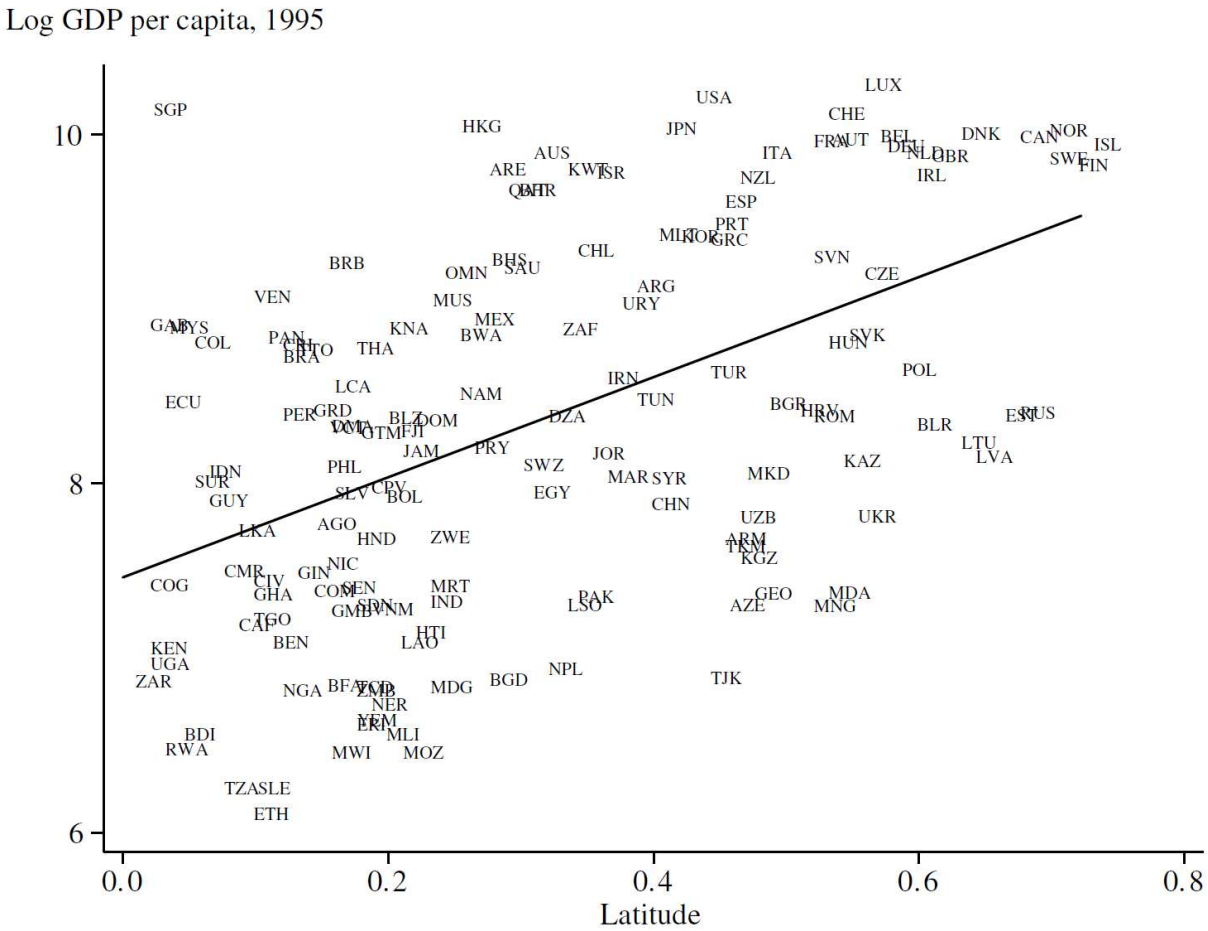

Figure 3.2: Relationship between latitude (distance of capital from the equator) and income per capita in 1995.

Institutions and Economic Growth IV

- Take geography as this common explanatory factor.
- In the figure on the previous slide latitude measures the (absolute) distance from the equator.
- This is a crude measure for geography as, for instance, the climate is not exactly constant along latitude bands (Northwestern Europe is favored by the Gulf Stream).
- Nevertheless, the figure depicts a positive correlation between being located outside the tropics and log GDP per capita in 1995.
- What now? Given these identification problems, is there still a way to establish causality between institutions and income levels?

Institutions and Economic Growth V

- Instrumental variables and a careful study of natural experiments might help.
- Natural experiments here mean unusual historical events during which, while other fundamental causes of economic growth are held constant, institutions change because of potentially exogenous reasons.
- Two natural experiments present themselves:
  1. The two Koreas
  2. Colonizations by Europeans beginning in the fifteenth century.

The Korean Experiment I

- In 1948 the formerly united country of Korea was split into independent North and South Korea along the 38th parallel.
- North and South Korea exhibited a very high degree of ethnic, linguistic, cultural, geographic, and economic homogeneity.
- Per capita income was probably the same in 1948.
- Not only was Korea split in 1948, the countries also adopted a radically different set of economic (and political) institutions.
- The South (under US influence) adopted a system of private property and capitalist economic institutions.
- In the North inspiration was drawn from Russia and China so that collective ownership in land and capital was adopted.
- Hence, a large set of fundamental factors was kept constant, but the institutional set-up changed drastically between the two countries.

The Korean Experiment II

- This potentially allows for the identification of the causal effect of institutions on economic growth.
- How did this natural experiment pan out?
- Having had about the same level of income at the time of separation, the level in the South was 16 times the level in the North in 2000.
- As mentioned geography and culture could not have much to do with this contrasting experience.
- What about luck? The evidence of poverty and famine in the North is legion, the political will for change is missing however in the Communist Party of North Korea.
- So can one now conclude that institutions are the primary factor in determining cross-country differences in economic development?
- Not really, since the Korean example is a singular case (i.e. the sample size is 1, that would not fly in the natural sciences).

The Korean Experiment III

- Also, this is an extreme example. That a prolonged period of totalitarian centrally planned rule entails immense economic costs is not that surprising to most.
- Differences in institutions among capitalist societies would be of interest.
- The next example therefore considers a larger-scale natural experiment.

The Colonial Experiment I

- From the early fifteenth century onwards Europeans conquered much of the world.
- The colonizers not only transformed the institutions in their colonies, but also imposed different sets of institutions in various parts of their empire.
- For example, the institutional structure in the northeastern United States was based on smallholder private property and democracy.
- This contrasts with the Caribbean plantation economies based on repression and slavery.
- In general then geography was held constant while institutions changed with the arrival of European settlers.

The Colonial Experiment II

- What was the result of this institutional shake-up? A reversal of fortune in economic prosperity took place within the European colonies.
- Around 1500 the Aztecs, Incas, and Mughals were among the richest civilizations. Today the people that live in the respective territories are comparatively poor.
- On the other hand the civilizations in North America, Australia, and New Zealand were poor in 1500, but are now among the richest in the world.
- There is no data on GDP per capita in 1500, so for empirical support one has to revert to proxy variables.
- Urbanization rates and population densities in 1500 can serve this role.

The Colonial Experiment III

- Why these proxy variables? Think of the necessary level of agricultural productivity and the system of transport and commerce needed to sustain high population densities.
- There also exists a strong overlap between current urbanization rates and the modern measure of prosperity, GDP per capita, as the next figure shows.
- With these proxy variables at hand the reversal of fortune becomes visible in the figures plotting the proxies for economic development in 1500 against prosperity in 1995.

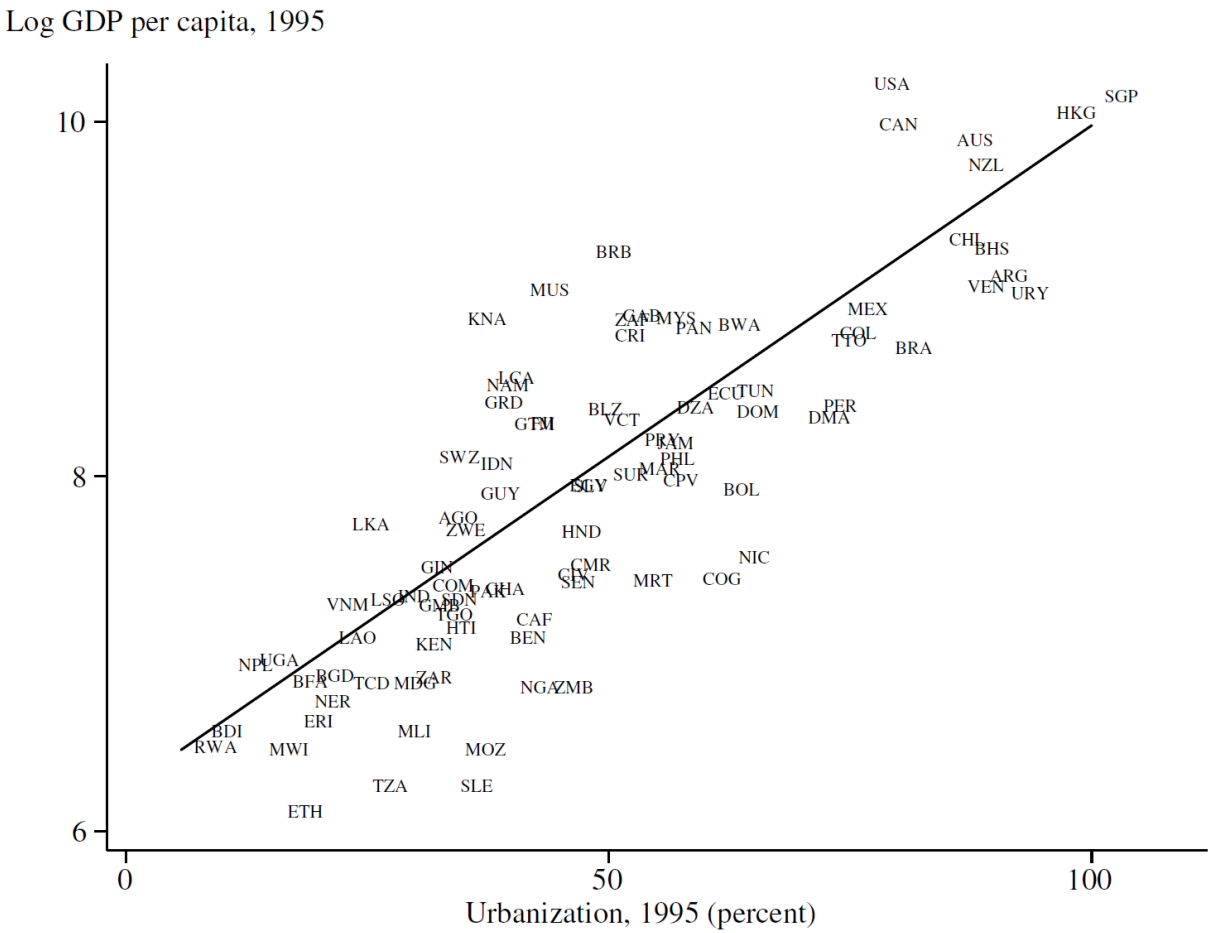

Figure 3.3: Urbanization and Income, 1995.

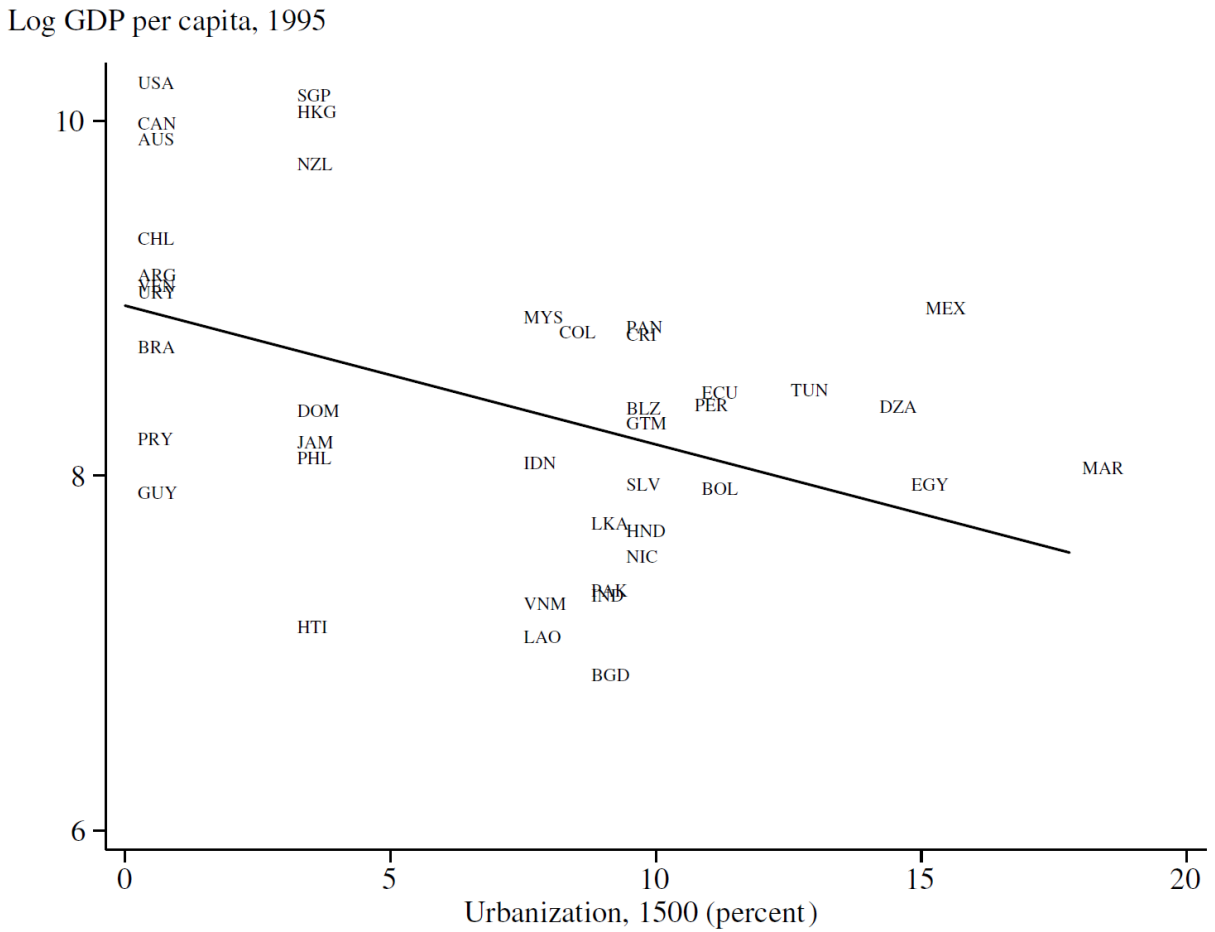

Figure 3.4: Reversal of Fortune: urbanization in 1500 versus income per capita in 1995 among the former European colonies.

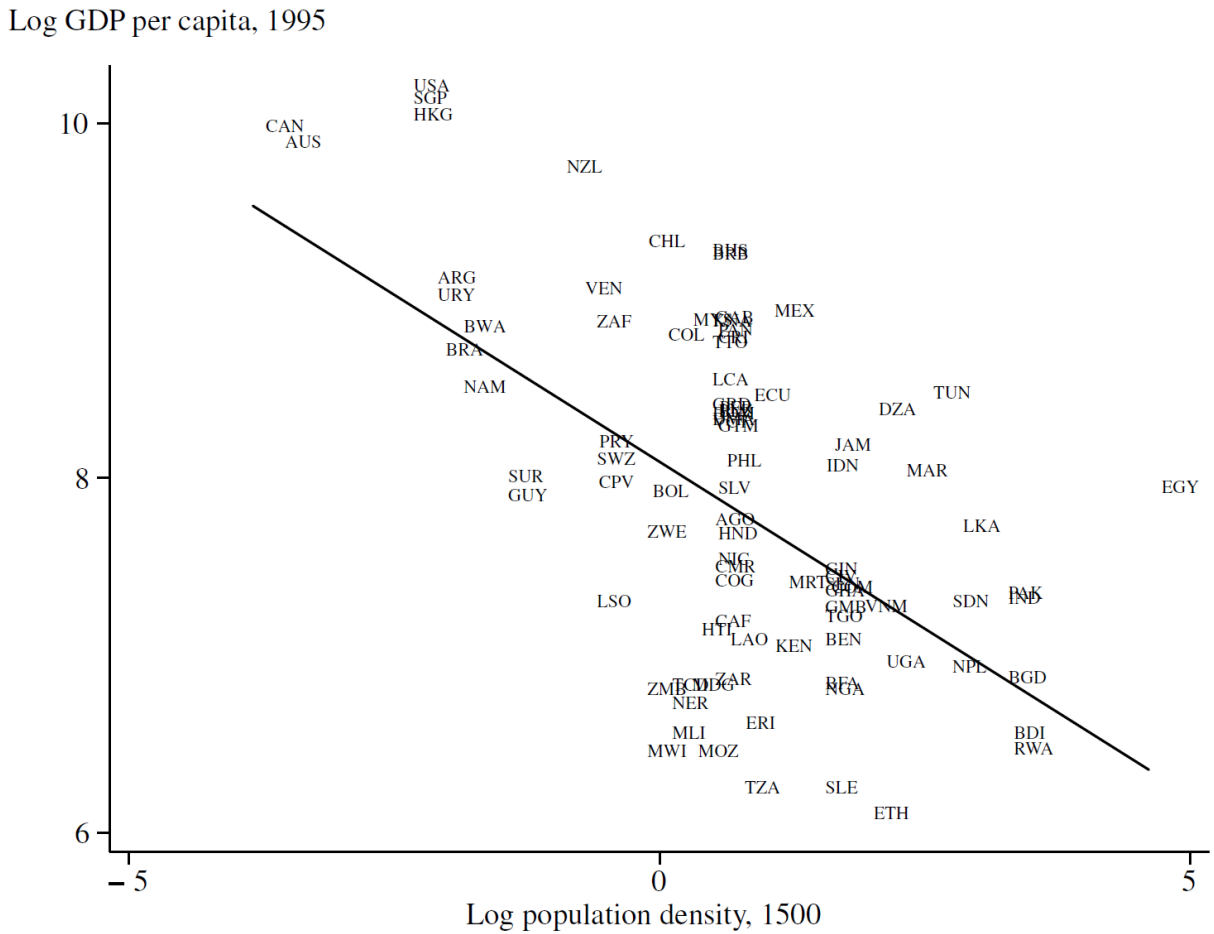

Figure 3.5: Reversal of Fortune: population density in 1500 versus income per capita in 1995 among the former European colonies.

The Colonial Experiment IV

- Might this reversal of fortunes simply reflect a natural reversion to the mean?
- Probably not, since data for the periods before 1500 suggest a remarkable persistence in urbanization rates and population densities.
- Some empires (Rome, Athens, Egypt, etc.) declined and fell, true, but this was not the general pattern.
- Neither did the entire world, excluding the former European colonies, experience a similar reversal in the past 500 years.
- This strongly suggests that the institutional differences between the former colonies were the decisive factor.

The Colonial Experiment V

- Moreover, the reversal occurred largely in the late eighteenth and nineteenth centuries.
- Following Acemoglu this timing speaks against the other hypotheses:
  - Geography is fixed so it is implausible to base a theory of relative prosperity on the intrinsic poverty of the tropics, the climate or the disease environment.
  - He also rules out culture, for instance, on econometric grounds.
  - The variation in the institutions was not random, but very much related to the conditions encountered in the colonies, which limits the role luck plays.

Reversal and the Institution Hypothesis I

- Is the reversal of fortune consistent with a dominant role for economic institutions in comparative development?
- As the next two figures show the higher the proxies for economic development in 1500 were, the worse are economic institutions today.
- These figures document that the relatively densely settled and highly urbanized colonies ended up with worse institutions, while sparsely settled regions received an influx of European migrants and developed institutions that protected property rights.
- An institutional reversal therefore occurred.

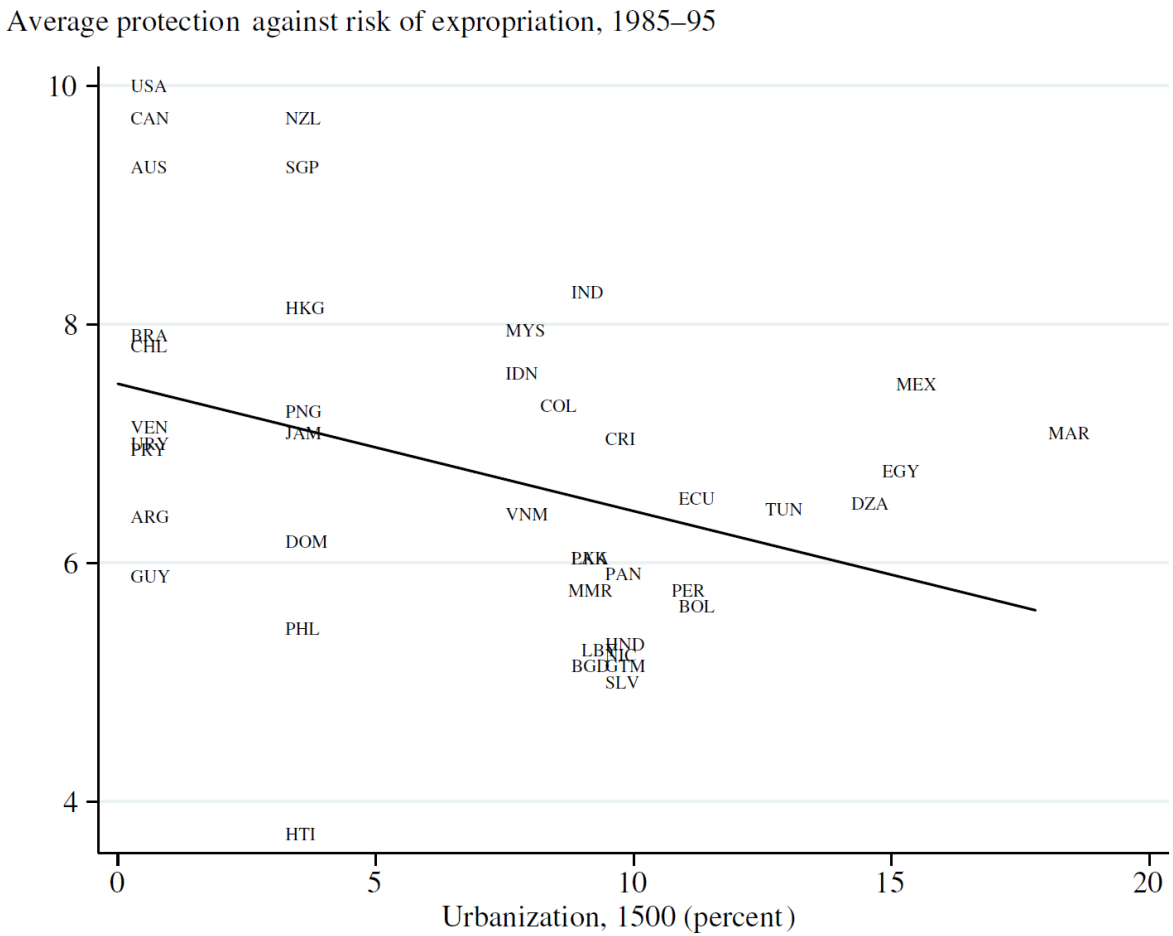

Figure 4.1: The institutional Reversal: urbanization in 1500 and economic institutions today among the former European colonies.

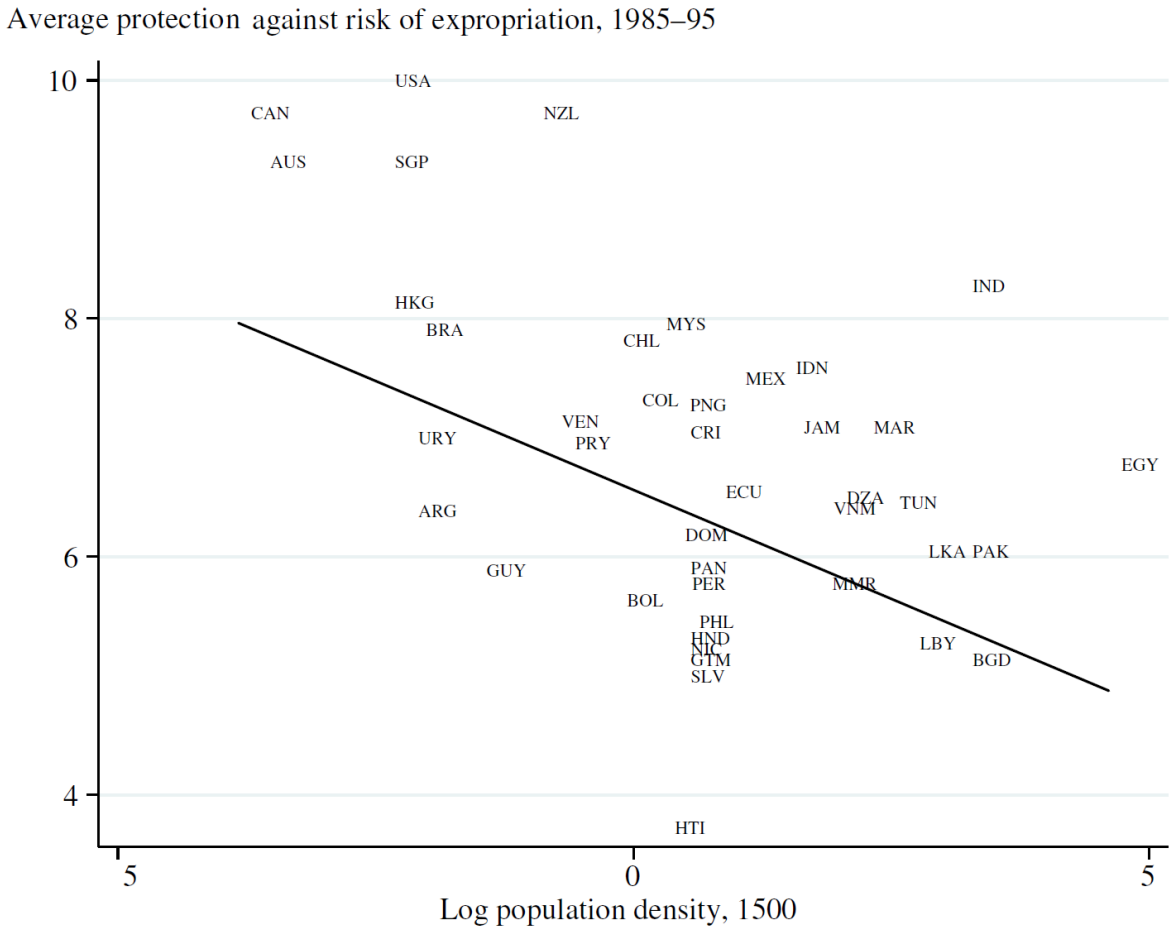

Figure 4.2: The institutional Reversal: population density in 1500 and economic institutions today among the former European colonies.

Reversal and the Institution Hypothesis II

- However, often the Europeans simply took over the existing institutions, when it was in their interest (for example, to extract resources like gold, silver, sugar, but also human labor).
- When the place was sparsely settled with no resources to extract the Europeans became the majority of the population so that it was in their own interest to set up institutions that protected their own property rights.
- Relatively rich places thus ended up with relatively worse institutions (the institutional reversal).
- If these institutions are important (the institution hypothesis), then these countries should become poorer over time (the reversal of fortune).
- Moreover, the timing of the reversal fits this approach:
- The hypothesis links institutions to the incentives to invest and the major opportunity to invest occurred in the nineteenth century.

Settler Mortality and Development I

- As mentioned above when Europeans settled they established institutions they themselves had to live under.
- The disease environment however differed markedly among the colonies.
- Malaria and yellow fever prevalence reduced the attractiveness of settlement notably, as many potential settlers died from these diseases.
- Combining the influence of the disease environment on settlement patterns with the arguments developed so far, the following line of argument by Acemoglu, Johnson, and Robinson (2001) is thus plausible:
- (Potential) settler mortality $\Rightarrow$ Settlements $\Rightarrow$ Early institutions $\Rightarrow$ Current Institutions $\Rightarrow$ Current Performance

Settler Mortality and Development II

- Of interest is the effect of institutions on economic performance. Due to the identification problems mentioned earlier, a causal effect cannot be established easily.
- An instrument that provides an exogenous source of variation in current institutions would help (relevance condition).
- Settler mortality possibly is such an instrument via the chain above.
- From historic records data on the mortality faced by Europeans in the new colonies can indeed be constructed
- The second condition that needs to be fulfilled is that there must not be a direct influence of potential settler mortality on current economic performance (the exclusion restriction).
- Otherwise settler mortality would not be a valid instrument for current institutions.

Settler Mortality and Development III

- The same would be true if settler mortality were not correlated with current institutions, but the figure on the next slide eases that suspicion.

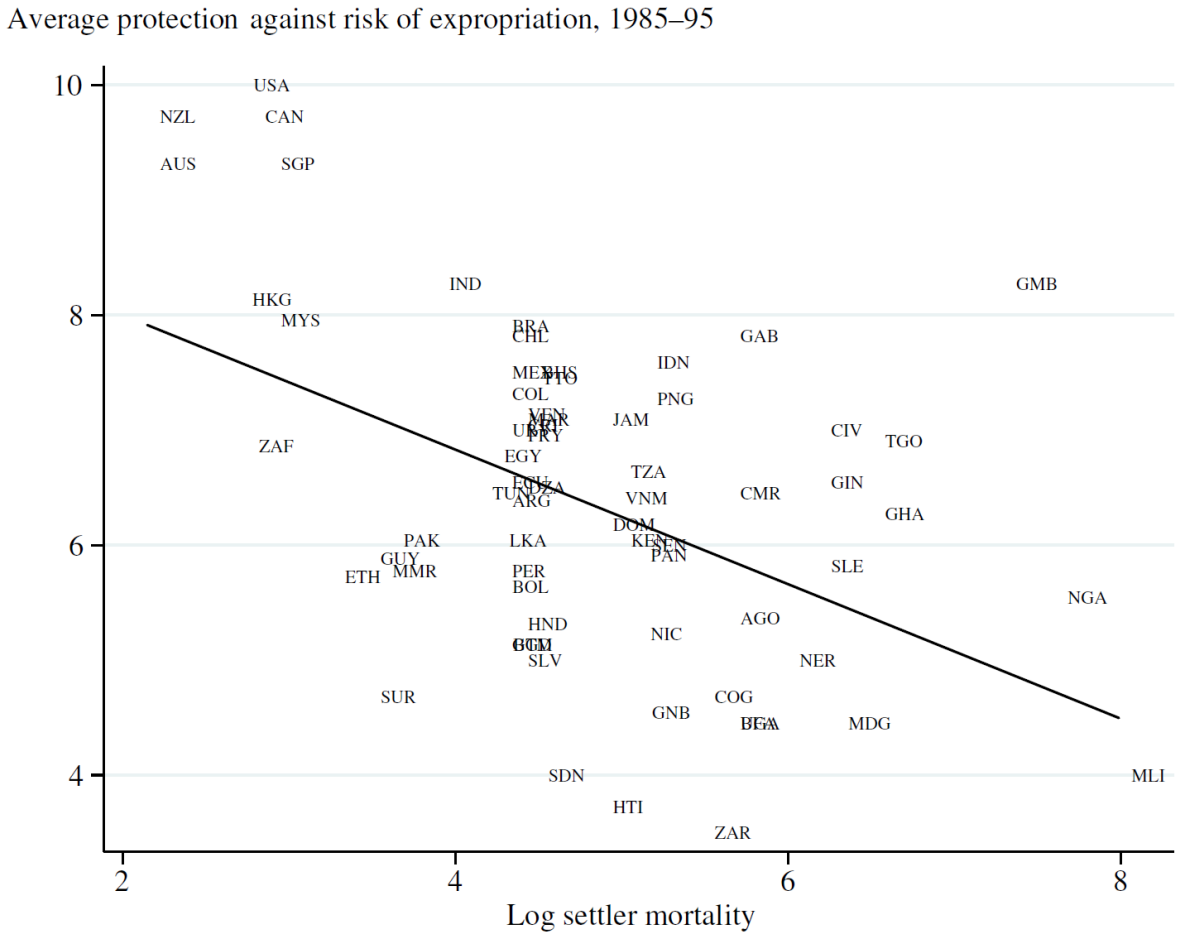

Figure 4.3: Relationship between mortality of potential European settlers and current economic institutions.

Settler Mortality and Development IV

- On the next slide the relationship between settler mortality and current economic performance is shown.
- In the original article the authors provide empirical support that this link only works through institutions and they also provide support for each link in the line of argument.
- In addition the results show that once institutions are accounted for in this way, there no longer is a (significant) effect of latitude on economic development as depicted in Figure 3.2

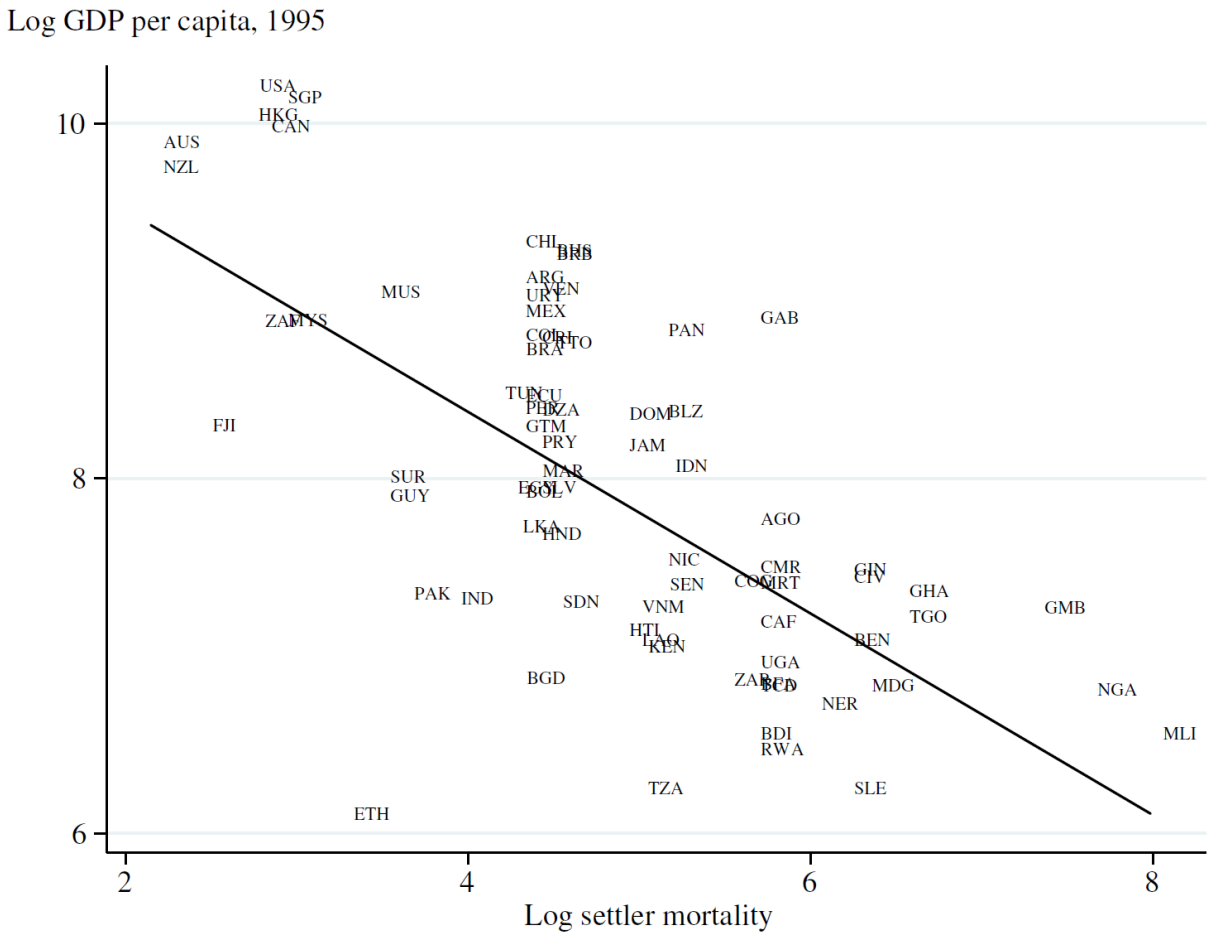

Figure 4.4: Relationship between mortality of potential European settlers and GDP per capita, 1995.

Culture and Development

- One might think that the European settlers not only introduced new institutions, but also new cultures and this was the reason for the economic progress.
- Similar to the effect of latitude the robustness analysis in the original article shows that cultural variables like the identity of the colonial power or religion have no impact on current economic performance once institutions are accounted for properly.
- Some former British colonies have been successful (USA) while others like Bangladesh are poor today.
- The institutions from the homeland were not simply recreated in the colonies.
- While the Dutch had probably the best economic institutions in the seventeenth century, the institutions in the Dutch colonies in South-East Asia were designed for the extraction of resources.

Disease and Development I

- Evidence that individuals with poor health are less productive and possibly acquire relatively little human capital exists.
- The current disease burden differs among countries and is related to geographic factors. Could this then have an effect on economic development?
- Maybe, but as has been noted the disease burden is endogenous. Poor countries lack the funds to invest in health care or clean water.
- Acemoglu and Johnson (2007) investigate the impact of changes in the disease burden that can be viewed as exogenous from the point of view of individual nations.
- Starting in the 1940s new chemicals and drugs (i.e. Penicillin or DDT) became available internationally to combat, for instance, TBC, pneumonia, and malaria.
- This led to massive increases in life expectancy in the countries that were poor around 1940, as shown in the figure on the next slide.

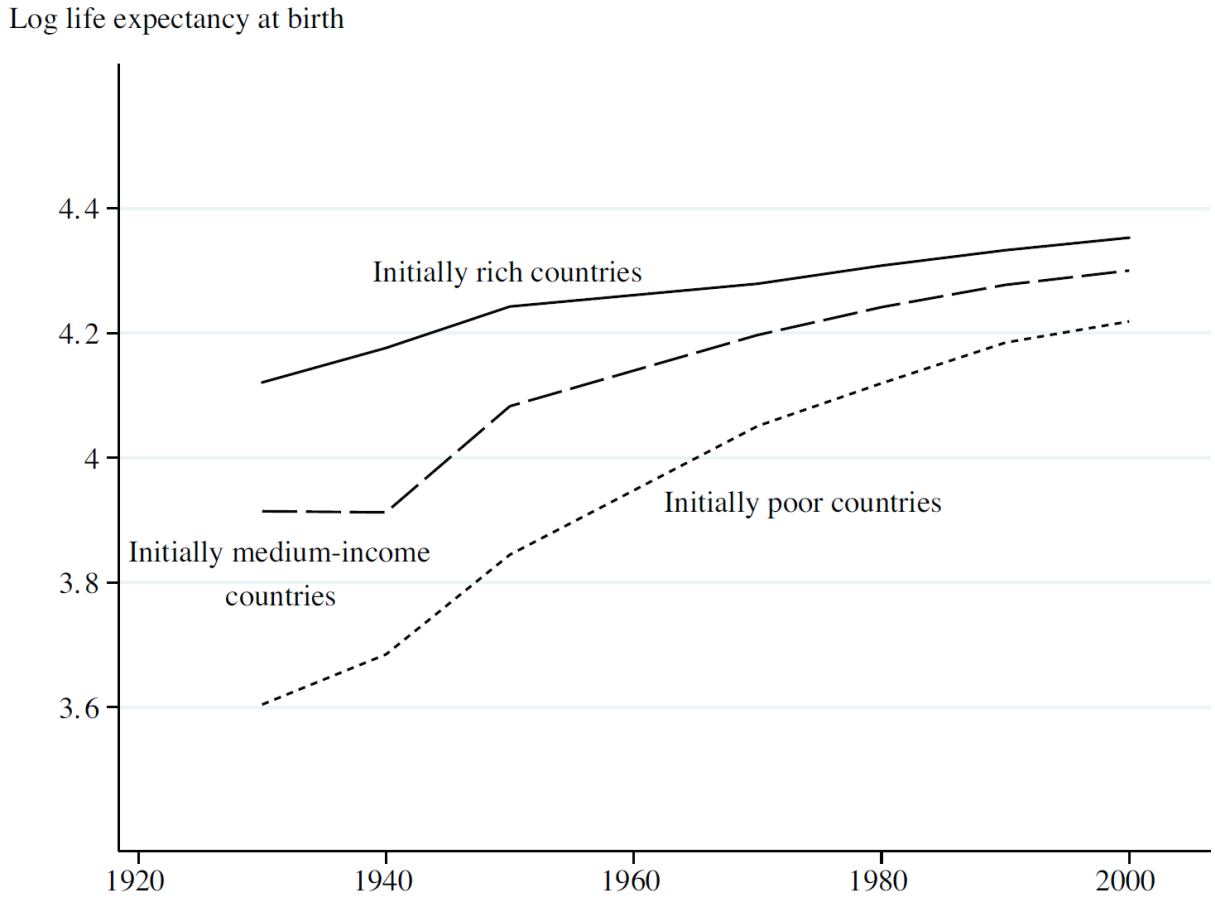

Figure 5.1: Evolution of life expectancy at birth among initially poor, initially middle-income, and initially rich countries, 1940-2000.

Disease and Development II

- The authors coined the term “international epidemiological transition” for these major health improvements.
- Convergence is clearly visible in the figure.
- In their econometric analysis the authors find that the exogenous variation in the disease burden and the changes in life expectancy are related to an increase in population.
- However, there does not seem to be a positive effect on GDP per capita and the next figure shows that there is no convergence in incomes between the three groups.

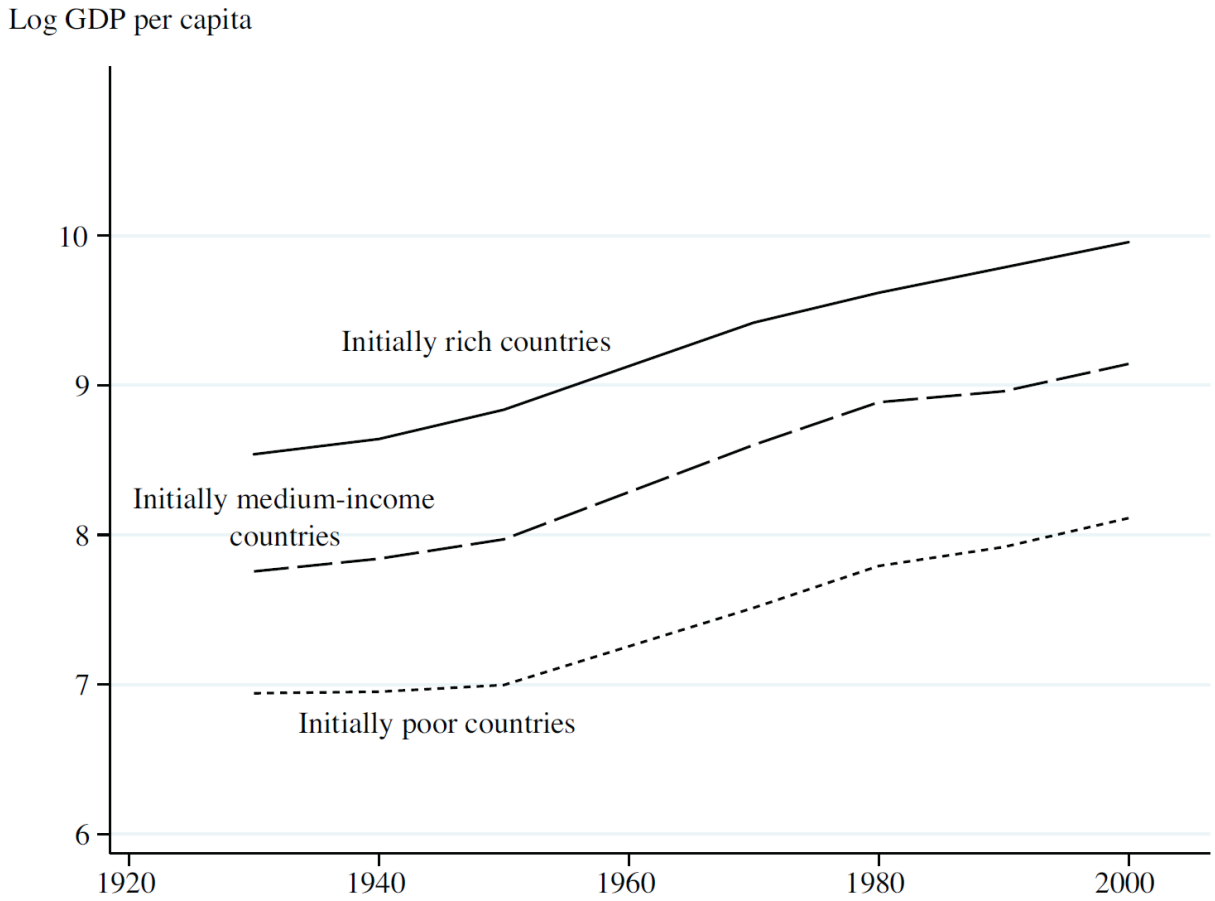

Figure 5.2: Evolution of GDP per capita among initially poor, initially middle-income, and initially rich countries, 1940-2000.

Disease and Development III

- Why is that? Remember the theory developed in chapter 2.
- The direct effect of the health improvements is a higher life expectancy and thus an increase in population.
- Initially this depresses the capital-labor and capital-land ratios and this in turn reduces income per capita.
- At a later point more people enter the labor force so that output per capita increases.
- However, this increase might not be large enough to compensate for the initial decrease.
- Population pressure may thus trump small beneficial effects of health on productivity.

Conclusions

- The study of economic growth requires investigating the fundamental causes of economic growth.
- Four hypotheses have been presented in their broad outlines.
- The institution hypothesis seems to have the strongest empirical support.
- Studying institutional differences is thus of immensely relevant for understanding economic growth.
- This holds for current growth experiences as well as the historical process of economic growth.
- Why do institutions differ and how can they be changed? Political economy is of major importance in this respect.
- Note that Acemoglu is not an objective outsider in this debate.
- For instance, the criticism on his settler mortality data by Albouy (2008) is not even mentioned in the chapter.