8. A historical interpretation of the new growth theories: an overview

1. INTRODUCTION

The main question in this thesis was whether the new growth theories can explain why Japan was a successful economic developer compared to India and Indonesia. Similar questions, why some countries are poor any why others are wealthy, have fascinated historians and economists alike.

The Solowian neo-classical growth theory provided both economists and historians a way to analyze the growth paths of economies. However, already in the 1960s it became clear that also human capital played an important role. This led to the creation of the new growth theories which explained long-run growth from the availability of human capital. Yet, the increasing mathematical sophistication, coupled with the assumption of perfect markets in many of these models, made their use unattractive to many historians. On the other hand, economists remained with models that due to the assumption of perfect markets, made it difficult to explain cross country differences in the relation between human capital and growth.

The lack of testable models in the historical, and the lack of room for country-specific institutional developments in the economic method, made it difficult to answer our main question. Therefore, we had to combine the historical and economic approach. In that process, we ran into three obstacles. First, data, as Behrman (1999, 148) argues, "are essential for empirical analysis, limit the extent to which analyses can be undertaken, and shape most of the estimation problems." Indeed, human capital proxies which exclude aspects as 'experience' or the quality of human capital may bias the estimation results toward the branch of the new growth theories pioneered by Romer (1990). Second, we need to choose an empirical model that can determine the effect of human capital on economic growth. Third, we have to make a historical analysis that determines the differences in the development of educational institutions among India, Indonesia, and Japan from which we can derive some hypotheses on the changes in the relation between human capital and growth. These hypotheses can be used to see what effect institutional differences among countries have on economic growth and convergence.

There is both a historical and a data-centered thread in this thesis. The data, as pointed out in chapter 6, had an influence on the choice of the empirical model. We argued that the choice of data (including or excluding the quality of education) was important for the choice between the Lucas (1988) and Romer (1990) models of endogenous growth. In chapter 7 we argued that the changing institutions had a distinct impact on the relation between human capital and growth in India, Indonesia, and Japan. Hence, even if a plausible model is used with suitable data, it is still necessary to identify institutional developments or else regressions will be unstable.

In section 2, we start with the effects the data have on the choice of the empirical model. In section 3 we turn to the role of cross-country educational institutional changes in the relation between human capital and economic growth. Based on these estimates, we turn in section 4 to a brief analysis of cross-country economic con/divergence. The analysis so far still leaves much room for improvement, therefore in section 5 we make some suggestions for further research, followed by some final comments in section 6.

2. THE EFFECT OF DATA ON THE RELATIONSHIP BETWEEN HUMAN CAPITAL AND GROWTH

The choice of the human capital variable affects the choice of the growth model. We based our human capital estimates on a slightly modified definition of the OECD (2001, 18). We excluded innate ability so that our definition became 'the knowledge, skills, and competencies embodied in individuals that facilitate the creation of personal, social and economic well-being', or, in other words, all forms of knowledge gathering. This allowed us to construct new human capital stock estimates for India, Indonesia, and Japan for the period 1890-2000. The main advantage of this estimation method is that it takes account of all available data, takes all forms of acquiring knowledge into account, and is expressed in monetary units and can therefore be compared over time, across countries, and with other variables such as physical capital.[169]

[169] Of course the choice of estimation technique also has its drawbacks. We tried to include as much data as possible, without restricting ourselves too much in the period over which we can estimate the series. For example, some data on 'on the job training' exist for later periods, but this is certainly not the case for many developing countries, especially not if one goes further back in time. Consequently, we tried to estimate this indirectly. In addition, some parts of the human capital stock such as 'experience' and 'home education' could only be approximated. The main weaknesses, however, are the use of the

This definition has the important advantage that it allows us to better test the Lucas (1988) model. To obtain endogenous growth in this model, the effort needed to produce an extra unit of human capital should be the same, independently of the level of human capital. Possible reasons are that persons with higher levels of education more easily obtain extra knowledge or skills, the quality of human capital rises over time, and there is a rising intergenerational transfer of knowledge (L'Angevin and Laïb 2005). In all cases, the quality of human capital and factors such as 'home education' are important. Because these are left out from 'average years of education', studies using this variable are biased toward the Romer (1990) interpretation.[170]

We used our newly estimated human capital stock to test for the Lucas (1988) and Romer (1990) models. Using the method proposed by Monteils (2002), we found periods with increasing and decreasing marginal returns to human capital accumulation in all three countries. But, while the decreasing returns to scale in India and Indonesia could be explained by the decreasing quality of education or by deteriorating technical efficiency in the Lucasian second sector, this was not the case for Japan after the 1940s. This was confirmed by regressions of per capita GDP growth on the growth and the level of the estimated per capita stock of human capital. In both Indonesia and India we found a negative coefficient for the level and a positive one for the growth of per capita human capital, while in Japan the level of the human capital stock yielded a positive coefficient.

We can conclude from these results that India and Indonesia showed the symptoms of Lucasian growth over the entire twentieth century while in Japan economic growth switched from Lucasian to Romerian growth in the mid-twentieth century. That Japan made this transition while India and Indonesia did not is not surprising if we look at what Lucasian and Romerian growth actually entails. With the risk of oversimplifying, the difference between the two growth models rests on technological leadership. If a country is a technological frontier country, it cannot adopt technologies from other

depreciation/appreciation figures to calculate the stock and the regression to backcast the unobservable components of the human capital stock in the period before circa 1950. However, this regression showed a high R^2. Equally, the fluctuations in the series do not correspond with the changes in estimation technique. Consequently, it is unlikely that these factors have seriously biased the estimates.

[170] Admittedly, although this human capital stock is not directly related to the 'ideas' in the Romer model, it still can be used as an input in the R&D sector. Indeed, the investments in R&D estimated for Japan by Kim and Oh (1999) for the 1970s and 1980s have a highly significant correlation of 0.99 with gross fixed human capital formation as estimated here.

countries. Hence, technology must be endogenous. In those countries, a part of human capital will be used to create new technologies and a part to use these technologies in the productive process (Romerian growth). However, in the follower countries, technologies are adopted from other countries. Hence, human capital is used solely to apply these technologies in the productive process (Lucasian growth).[171] This basically means that if human capital passes a certain threshold level, a switch is made to Romerian growth because the country has become a frontier country in technological development. All factors that reduce GDP (and thus investments in education) and the growth of human capital thus retard the switch to Romerian growth. Although in chapter 7 we extend our argument a little further, in sum we offer three very tentative explanations why Japan moved from Lucasian to Romerian growth and India and Indonesia did not. First, in India and Indonesia, the education systems were less connected to the economy and thus less efficient. Second, periods where we found decreasing marginal returns to human capital accumulation coincided with periods which were likely to be subject to a lower efficiency of human capital accumulation. This means that, for those periods, constant marginal returns were possibly falsely rejected. Third, because India and Indonesia developed later, obstacles in acquiring technologies were more pronounced. To give just two examples, there are economic obstacles (a bias of technology to higher education in which developed countries have a comparative advantage) and political obstacles (institutions and policies that are harmful for technological modernisation).

[171] To phrase this differently it is sometimes argued that a certain level of human capital (or technological externalities with a threshold property (Azariadis and Drazen 1990)) has to be reached before Romerian growth takes place. Therefore, it is possible that Lucasian growth is a transition phase between pre-modern economic growth and Romerian growth. We can also interpret it as a shift from using the increasing personal human capital (Lucas 1988) for adapting or creating new technologies, which can either be sold or made to good practise by the innovators, to large scale R&D departments. In the long run there is a tendency to increase human and physical capital inputs in the innovation process. This makes it necessary to accommodate the innovation process in R&D departments in large scale enterprises (see for example Schumpeter (1950) and for some criticisms Lamoreaux and Sokoloff (1997)). A second argument in favour of the idea that Lucasian growth is a phase in the development toward Romerian growth is that Romer (1990) also inserted human capital as a factor of production in his model. A third way in which we tested the applicability of both models was by estimating in chapter 7 that in all periods in India and Indonesia the coefficients of the growth of human and physical capital together were as large as the coefficient of growth of human capital when inserted in the growth equation without physical capital. This suggested the presence of an imbalance effect just as is present in Lucas theory (Duczynski 2003; Barro and Sala-i-Martin 2004).

3. THE EFFECT OF CHANGING HUMAN CAPITAL FORMING INSTITTIONS ON THE RELATIONSHIP BETWEEN HUMAN CAPITAL AND GROWTH

3.1 Introduction

Both the Lucas (1988) and the Romer (1990) models are human capital models in the sense of chapter 4, i.e. they assume perfect markets and homogenous labour on a national level. Consequently, these models have difficulties in explaining the difference in the relationship between education and growth both between countries and over time. These differences are, however, important both on an economic and econometric level and from a policy-making perspective.

Economically, an analysis of the institutional developments is important because prior knowledge of these developments is necessary to be able to interpret the coefficients of the regressions. For example, if there are two groups of countries of which one group lags behind the other in educational development, inserting country dummies will result in the dummy picking up the effect of the difference in educational development on per capita GDP growth. However, if such breaks are not confirmed and identified in historical analysis, it is difficult to interpret the coefficient of the dummy in this way because it also might pick up the effect of other cross-country differences.

Econometrically, knowledge of these institutional developments is important to determine which variable to add to the regression. For example, most studies either use cross-section or panel analyses. However, when using such techniques, is a change in human capital coefficient between two countries caused by a change over time in which one country is lagging or are there cross-country differences? In the last case, a country dummy will suffice. In the former case it is possible that a country which lags in human capital development also lags in economic development. Inserting a country dummy thus may result in, for example, collinearity with initial GDP if that is inserted to test for conditional convergence.

Finally, although we did not pursue this argument in this thesis, from a policy point of view institutional developments and their effect on economic growth are important because they provide a way to increase growth by modifying these institutions.

3.2 The effect of educational development on economic growth

In chapter 4 we derived two hypotheses about the effect the institutional development has on economic growth. First, the changes in the enrolment composition are to a large extent the cause of the changing relation with economic growth. In other words, in phases dominated by increasing primary enrolments, human capital has a different relationship with economic growth than in phases dominated by increasing secondary or higher enrolments. Second, in India and Indonesia educational institutions developed largely as a result of external factors compared to a development based on an economic and societal demand in Japan. This had to consequences. First, in India and Indonesia, human capital forming institutions are less efficient than in Western countries and Japan.[172] Hence, in the former two countries the coefficient of the relation between education and growth is lower but still changing with the enrolment composition. Second, even though efficiency is less in Indonesia, it still forms the same pattern of educational enrolments as Japan (from increasing primary to increasing secondary and increasing higher education) only with a time lag. In India, however, educational development was top down. A relatively high share of secondary and high enrolments in total enrolments in the late nineteenth century was followed by an almost equal increase in on the one hand primary, and on the other secondary and higher enrolments.

These two hypotheses with their implications for the pattern of the human capital coefficients were discussed in chapter 7. First, the phases we found in the enrolment composition in chapter 4 corresponded well with the breakpoints in the relationship between human capital growth and per capita GDP growth, suggesting that each phase has its unique effect on economic growth. This became especially clear in case of India, which, having a reverse educational development compared to Indonesia, had a reverse structure of human capital coefficients.

[172] We indeed regularly argued that Japan was not colonized, therefore, after taking over some aspects of the Western education system, it could integrate these into her own social and economic structure. This was not the case in many colonies which had the same educational structure but not the same nationally based development. This recurring distinction was important in our study. However, one may argue that, if we go further back in time, the Europeans conquered Indonesia and India around 1600 but not Japan. In other words, Japan apparently had the means to effectively stand up against the Europeans. This may make the introduction of the 'European model of education' in India and Indonesia in the mid-nineteenth century in itself indirectly endogenous.

Second, the phases in educational enrolments started later in Indonesia and India than in Japan. While we found a rise in mass education in Indonesia around 1900, in Japan this had already ended around 1870. It is remarkable that it is exactly in this phase that we find the lowest human capital coefficient. This suggests that in phases when the human capital grows the most, human capital has the lowest effect on per capita GDP growth. Since the coefficient in Japan declined over time while its educational development was bottom-up, we may assume that the first educational phase, characterized by a relative increase in primary enrolments, had already ended when our data started in the 1890s.

Third, we argued that Japan was more efficient than Indonesia and India which would result in on average higher human capital coefficients. Indeed, we found that Japan exceeded India and Indonesia in the magnitude of the human capital coefficient. Of course we have to ignore the coefficients of the second half of the twentieth century in Japan when Romerian growth took place as this cannot be compared directly with the human capital coefficient in Lucasian growth.

These findings indeed suggest that 1) there were comparable educational phases in Japan, India, and Indonesia, 2) Japan is ahead of India and Indonesia in educational development, and 3) Japan has a higher productive efficiency of human capital (higher human capital coefficients).

4. A SIMULATION OF CROSS COUNTRY GROWTH DIVERGENCE: ROMERIAN VERSUS LUCASIAN GROWTH

The institutional developments were thus important to create a development in Japan from Lucasian to Romerian growth. On the other hand, in India and Indonesia they were part of the reason why no transition to Romerian growth was made. The main criticism we levied against some of the economic literature is that it takes the relation between human capital and growth as homogenous among countries. Therefore, it is now important to take a brief look at the share in cross country income divergence that might be explained by these institutional differences.[173]

[173] It is important to note that, although we focus on human capital forming institutions, other factors may have an effect on economic growth as well. However, studies in this field have shown little effect of a

In the previous section we identified three ideas about how human capital forming institutions may influence growth. These were a relatively high level of education in Japan already in the late nineteenth century (thus India and Indonesia are lagging to Japan), a higher efficiency of human capital in Japan, and a changing human capital formation over time due to changing educational enrolments. These three ideas are

Table 8.1: Human capital structure in Japan, India, and Indonesia in the 20th century

			Japan	Indonesia	India
Early start	(per capita human capital stock)	1890	2,761*	65	364
Efficiency	(human capital coefficient)	1890	4.60	1.46	1.96
		1930	4.60	1.55	1.91
		1960	-1.13**	1.55	4.29
		1990	-1.13**	1.48	4.29
Level accumulation	(growth of per capita human capital)	1890	4.8%	7.0%	-0.1%
		1930	3.9%	4.4%	1.5%
		1960	1.5%	1.3%	3.1%
		1990	2.5%	1.5%	1.5%

* 1894
**These coefficients are negative because in these years Japan moved on to Romerian growth. Therefore, the coefficient of the level of human capital became important which was 1.24.
Source: Growth of human capital, Appendix A.12; Efficiency, tables 7.3-7.5; Early start, Appendix A.12.

represented in table 8.1 as the level of human capital in 1890, the human capital coefficient, and the growth of human capital respectively. A fourth factor influencing the relation between human capital and growth is the transition towards Romerian growth. However, this only applies to the second half of the twentieth century.

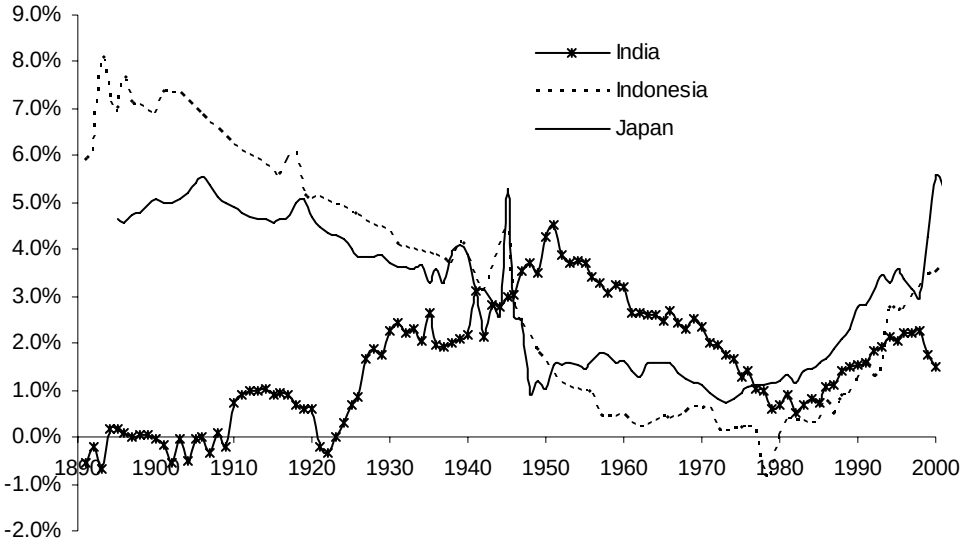
Three points may be noted from table 8.1. First, Japan was much better endowed with human capital around 1890 than India and Indonesia. Initially the per capita human capital stock in India exceeded that of Indonesia but this changed rapidly after the commencement of mass education. Second, efficiency in Japan, in the form of the human

broad range of exogenous factors (Levine and Renelt 1992; Florax, Groot, and Heijungs 2002) (for a study that identifies more exogenous variables see Sala-i-Martin (1997)).

capital coefficients, was much higher than in India and Indonesia. An exception is the second half of the twentieth century when the coefficient of $\Delta \ln hc_{t-1}$ became strongly negative which was caused by the shift to Romerian growth. Third, we mentioned in chapter 4 that Indonesia and Japan had a bottom up educational development, i.e. from primary to higher education. India, however, developed from higher to lower and then back to higher education. This had consequences for human capital accumulation.

Figure 8.1

Growth of the estimated per capita human capital stock of India, Indonesia, and Japan, 1890-2000



Source: estimated using the population data from Appendix A.2 and the human capital stock data from Appendix A. 12.

Whereas Indonesia shows a U-curve where the growth of human capital is especially strong at the start and the end of the century, India shows an inverted U-curve (see also figure 8.1).

We used these three factors to provide a simulation of the growth paths of India and Indonesia relative to Japan in tables 8.2 and 8.3. In table 8.2 we give the estimates for the pre-War period. For India and Indonesia we start by calculating how much per capita GDP growth would increase if they would have had the same human capital coefficients (efficiency) as Japan. In the second row for each country we indicate how much the per

Table 8.2: Simulation effect human capital in India and Indonesia compared with Japan, 1890-1940

	1890-1910	1920-1940
	Indonesia	
Efficiency: Increase in per capita GDP growth if Indonesia had the Japanese human capital coefficients	*8.00%*	*133.32*
Level accumulation: Increase in per capita GDP growth if Indonesia had the Japanese level of human capital accumulation	*-4.98%*	*-15.67%*
Total increase in per capita GDP growth	***3.02%***	***117.65%***
Observed Indonesian per capita GDP	713	1,075
Simulated GDP level (assuming Japanese efficiency and level of accumulation)	715	1,592
Simulated GDP level (early start: assume that per capita GDP in Indonesia was the same as in Japan in 1890)	*1,093*	*1,648*
Total simulated per capita GDP	***1,098***	***2,441***
% gap in per capita GDP with Japan explained by efficiency, the level of accumulation, and the early start	**96.03%**	**133.02%**
	India	
Efficiency: Increase in per capita GDP growth if India had the Japanese human capital coefficients	*2.53%*	*0.86%*
Level accumulation: Increase in per capita GDP growth if India had the Japanese level of human capital accumulation	*3.70%*	*0.19%*
Total increase in per capita GDP growth	***6.23%***	***1.05%***
Observed Indian per capita GDP	386	561
Simulated GDP level (assuming Japanese efficiency and level of accumulation)	389	579
Simulated GDP level (early start: assume that per capita GDP in Indonesia was the same as in Japan in 1890)	*1,113*	*1,618*
Total simulated per capita GDP	***1,120***	***1,672***
% gap in per capita GDP with Japan explained by efficiency, the level of accumulation, and the early start	**100.68%**	**72.11%**

Sources: see table 8.1

capita GDP growth would increase if India and Indonesia had the same human capital growth as Japan. The third row (in bold) gives the sum of the previous two effects.

In the fourth row, we present the per capita GDP of Indonesia and India respectively. The fifth row shows the per capita GDP under the assumption that Indonesia and India experienced Japanese efficiency (human capital coefficients) and human capital growth. Because in table 8.2 we look at the pre-War period when in all three countries Lucasian growth was present, there is no effect of the level of human capital, hence we approximate an early start in economic development by assuming that Indonesia and India had the GDP level of Japan in 1890 in row six. From this, we can in row seven

calculate the total simulated per capita GDP in Indonesia and India under the assumption that their human capital forming institutions are equal to those in Japan. In the last row the difference between the simulated and the real Indonesian/Indian per capita GDP divided by the difference between the real Japanese and the real Indonesian/India per capita GDP gives the gap in per capita GDP between, on the one hand India or Indonesia and, on the other, Japan that is explained by the human capital forming institutions.

In the same way, table 8.3 reports the effect of human capital forming institutions on the gap in per capita GDP for the post-War period. In row 1 we report the actual Indonesian/Indian per capita GDP. Row 2 reports the simulated per capita GDP under the assumption that the efficiency (human capital coefficients) and human capital

Table 8.3: Simulation effect human capital in India and Indonesia compared with Japan, 1950-2000

	1950-1970	1980-2000
	Indonesia	
Observed Indonesian GDP	*982*	*2,040*
Simulated Indonesian GDP using Japanese efficiency and human capital accumulation	*1,015*	*1,555*
Simulated Indonesian GDP assuming the same GDP level as in Japan in 1890	*1,524*	*2,851*
Simulated Indonesian GDP where we added the difference between actual Japanese GDP and Japanese GDP assuming that Japan had the same level of human capital as Indonesia (The effect of Romerian growth)	1,359	4,115
Total simulated per capita GDP for Indonesia	***1,934***	***4,441***
Actual Japanese GDP	4,504	15,390
% gap in per capita GDP with Japan explained by efficiency, the level of accumulation, and the early start, and the existence of Romerian growth	**27.03%**	**17.99%**
	India	
Observed Indian GDP	*725*	*1,083*
Simulated Indian GDP using Japanese efficiency and human capital accumulation	*716*	*1,013*
Simulated Indian GDP assuming the same GDP level as in Japan in 1890	*2,077*	*3,039*
Simulated Indian GDP where we added the difference between actual Japanese GDP and Japanese GDP assuming that Japan had the same level of human capital as India (The effect of Romerian growth)	1,246	3,473
Total simulated per capita GDP for India	***2,589***	***5,359***
Actual Japanese GDP	4,504	15,390
% gap in per capita GDP with Japan explained by efficiency, the level of accumulation, and the early start, and the existence of Romerian growth	**49.33%**	**29.89%**

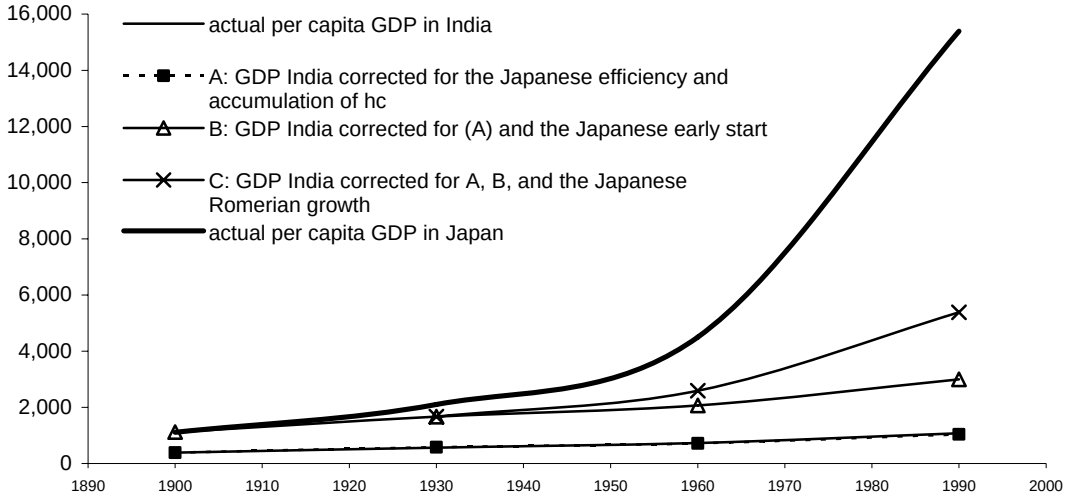
Note: All GDP figures are in 1990 Intl. USD.
Sources: see table 8.1

accumulation were equal in India/Indonesia and Japan. The third row gives the simulated per capita GDP under the assumption that the GDP level in India/Indonesia in 1890 was equal to that of Japan. The fourth row is in fact the only difference with table 8.2. Here we present the simulated Indonesian/Indian per capita GDP where we added the difference between actual Japanese GDP and Japanese GDP assuming that Japan had the same level of human capital as Indonesia (or India) (the effect of Romerian growth). The total effect of row 1-4 gives the total simulated per capita GDP in row five. Finally, just as in table 8.2, row seven reports the difference between the simulated and the real Indonesian/Indian per capita GDP divided by the difference between the real Japanese (row six) and the real Indonesian/India per capita GDP which gives the gap in per capita GDP between, on the one hand India or Indonesia and, on the other, Japan that is explained by the human capital forming institutions.

These four effects of human capital forming institutions on economic growth (an early start, efficiency, human capital accumulation, and (in the post-War period) the existence of Romerian growth) are visualized in figures 8.2-8.3. The bold line is the

Figure 8.2

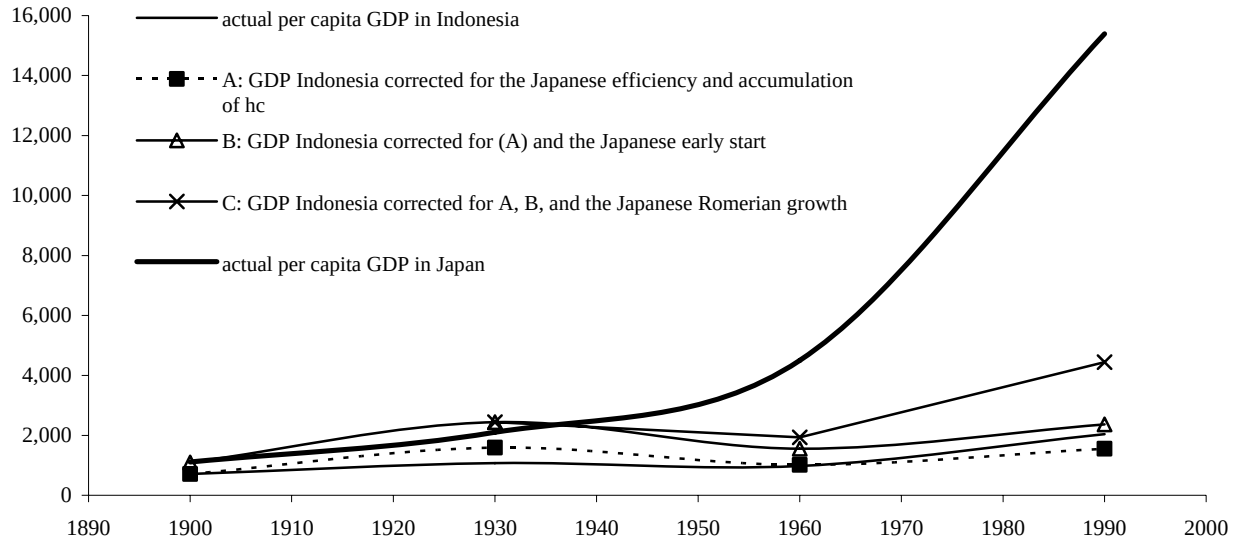
Real and simulated per capita GDP in India and its gap with Japan, 1900-1990, 1990 Intl USD



Source: Tables 8.2 and 8.3.

Figure 8.3

Real and simulated per capita GDP in Indonesia and its gap with Japan, 1900-1990, 1990 Intl. USD



Source: Tables 8.2 and 8.3.

Japanese per capita GDP. The other lines indicate the actual Indonesian and Indian per capita GDP, their GDP corrected for efficiency and the level of accumulation, a correction for an early start in modern economic growth, and for Romerian growth. The difference between actual GDP and GDP corrected for efficiency and the level of human capital accumulation gives the effect of efficiency and level of human capital accumulation on per capita GDP. The difference between the GDP corrected for efficiency and the level of human capital accumulation and the GDP corrected for both the efficiency and level of human capital accumulation and for an early start in economic growth gives the effect of an early start in economic growth on per capita GDP, and so forth.

The effect the human capital institutions had on the gap in per capita GDP was marked. Both in India and Indonesia, in the first half of the century close to 100% of the per capita GDP gap with Japan can be explained by human capital. These shares decrease in the second half when Japan starts to experience Romerian growth. However, the shares

explained by human capital forming institutions are in this period with around 20% in Indonesia and 30% in India still considerable.

5. SOME SUGGESTIONS FOR FURTHER RESEARCH

5.1 Introduction

In human capital theory almost every aspect is eligible for further research. Even today, no standardized human capital stock is available, which means that there is still much to do. We need a large (historical) database of consistent human capital estimates. Once available, these data should be analyzed in a country-specific way in order to evaluate their role in economic historical development. Finally, applying the theses resulting from single country analyses in cross-section or panel analyses might also prove fruitful to test and quantify the many possible hypotheses (Temple 1999, 121). A particular important analysis in this respect is the role of institutions in economic growth. In chapter 4 we historically analysed the development of human capital forming institutions in Japan, India, and Indonesia. This resulted in two hypotheses about the relation between human capital and economic growth which we further empirically tested in chapter 7. However, this method is limited for two reasons. First, the cross-country differences are solely based on a historical analysis. A cross-section or panel approach to quantify the difference among these countries would have been fruitful. Unfortunately, due to our focus on the historical development and our small sample (only 3 countries), such an analysis has to await further research. Second, we focused on human capital forming institutions such as schools, effectiveness of human capital formation, and the later start of India and Indonesia in the formation of human capital compared to Japan. Of course many alternative institutions may also be applicable. Examples may be often used variables such as ‘constraint on the executive’, and ‘ethnolinguistic fragmentation’. Also here, the small sample and the limited research time prevented us from exploring this topic.

In addition to these more general points, there are many topics we have not explored and discussed in this thesis. To name just a few: a closer comparison with Europe (the role of colonisation), the role of firms, the role of individuals, and income

distribution. Yet, in this section we will mainly focus on topics that we touched upon in this thesis, but which, in our opinion, require a more thorough research.

5.2 A fable of economic growth: some suggestions for further research

Looking at 'natural experiments' of economic development is an important way to advance the formation of new theories of economic growth. To this end, it is important to look at questions such as '**when does human capital start to grow and when does this growing human capital start to effect per capita GDP growth in a substantial way?**' In our opinion structural explanations are far too scarce. The economic divergence literature comes up with a lot of different factors such as 'geography', 'marriage patterns', and 'technology' (some examples are Landes 1998; Pomeranz 2000; Mokyr 2002). Equally, some economists, like Abramovitz (1993) and Kuznets (1966), focussed on the shift from physical to human capital and between economic sectors. Still neither of these approaches can completely explain the breakthrough to 'modern economic growth'.

But there is an alternative approach as well: the educational sociology literature that argues that factors as increased levels of per capita GDP, individualisation, and political reforms changed the perception on human capital formation. Human capital became increasingly necessary to operate machines, to transfer knowledge, to correspond with trade partners, and so on. This literature also argues that this process started around 1800 in Europe and the Western Offshoots such as the United States and only at the end of the nineteenth century in the developing countries. In the latter countries the start of this process did not so much take place because of the societal changes in the Western countries but because they wanted to imitate Western (economic) success. We focus on five consequences now.

First, it is likely that, with the rising importance of human capital for economic growth, the relationship between skilled and unskilled labour changed. If human capital is less important for economic growth, it is possible that the elasticity of substitution between skilled and unskilled labour is close to zero because 'skilled' jobs were preserved largely for closed groups. Yet, when human capital became more important for economic growth, the elasticity of substitution increased.

We argued that in many developing economies the education system (the way through which skills can be gained) was not based on economic development but on some "myth of progress". This may mean that the elasticity of substitution between skilled and unskilled labour remained low compared to the developed countries. As we argued briefly in chapter 7, **the effect of technology through the Lucasian imbalance effect, has a positive effect in countries with a relatively high elasticity of substitution and an on average negative effect in countries with a low elasticity of substitution**, most notably developing countries. The reason is that a shortage of human capital is likely to be much faster corrected in countries with a high elasticity and slower in countries with a low elasticity of substitution. Assuming a downward sloping imbalance effect (a shortage of human capital decreases growth) this results in an on average positive effect for developed countries and a negative effect on balanced growth in developing countries.

The second effect of non-societal-based education systems was that an increase in educational opportunities not necessarily directly led to an increase in pupils entering schools. This is likely to increase the **elasticity of substitution between private and public expenditure on education**. This is an interesting topic, which is frequently ignored in the literature. This is largely caused by lack of data on private expenditure, especially for developing countries. The existing studies therefore focus on developed countries after the 1950s.[174] An exception is Tilak (2002) who argues that in the 1990s public and private expenditure on education in India are complements. But, in general we think that the substitution is larger in developing than in developed countries depending on the characteristics and period. If many persons that did not follow formal education entered the formal education system (around 1900 in Indonesia and in the 1930s in India), the elasticity increases because non-formal education is replaced by formal education. The same effect also may take place during periods in which compulsory education is introduced or extended.[175]

[174] See for example Pelzman (1973).
[175] However, the introduction of compulsory education can also be caused by societal pressure. Consequently, most institutional changes have already taken place before this date and the introduction of formal education is thus nothing more than a *de jure* recognition of a *de facto* situation.

The third effect of non-societal based educational development is **decreasing marginal returns in the Lucasian second sector**. We argued that decreases in the efficiency of human capital accumulation seem to coincide in developing countries with decreasing marginal returns. Because the tests for marginal returns assume a constant efficiency of human capital accumulation, when a decrease in this efficiency is present we may be falsely rejecting the presence of constant marginal returns.

The fourth effect of the education system is that **each phase with a focus on a specific level of education causes different human capital coefficients**. We found that primary education had a lower coefficient than had secondary education. In turn, after the mid-twentieth century the human capital coefficient decreased again. This corresponds with the findings of Krueger and Lindahl (2001, 1130) who argue that up to around 7.5 years of schooling the returns to human capital increase, while decreasing afterwards (an inverted U-curve). This corresponds well with Japan where we found a top of around 6.5 years of education. However, in Indonesia the top was around 2.2 years and India around 1.8 years.[176] This once again seems to suggest that developing countries follow the same educational path as the developed countries only at a less efficient level.

Indeed, a fifth important aspect is that **human capital efficiency seems to be much higher in countries with a more society-based educational development**. This might be caused by higher external effects or because of a better connection between education and the labour market.[177] There are some studies which refer to the efficiency of human capital in economic growth but only few studies have tried to estimate (in)efficiency. These are mostly frontier studies, which compare the human capital coefficient of a certain country with that of the most advanced country in the sample (that is: the country with the highest human capital coefficient).[178] But these studies suffer from many

[176] Because India has a reversed educational structure, it is actually a U-shaped development.
[177] It would be interesting to estimate, besides the external effects, the social and private returns. This might, for example, be done using the average wage as a dependent variable. See for example Venniker (2000), Moretti (2004), and Acemoglu and Angrist (1999). The differences between the social and private returns are the externalities of human capital.
[178] See for example Henderson and Russell (2005).

drawbacks: they need much data and assume a general optimum for all countries. Therefore, another option may be tried. For example, one might optimize labour, human- and physical capital in such a way that the difference between these investments and consumption becomes largest. This is an implicit form of the Solowian golden rule (Phelps 1961).

6. SOME FINAL REMARKS

In the process of writing this thesis we had to face some limitations. First, the data used in this study may be updated and improved. This is partly the result of the fact that human capital is not firmly defined in the literature as yet. Also, many data, especially of developing economies, are missing or needed to be interpolated. To give just one obvious example, some estimates of the gross fixed physical capital stock for Indonesia in the 1980s differ a factor 2 or 3 depending on the asset life assumptions (Van der Eng 2005; Yudanto, Wicaksono, and Ariantoro 2005). Up till now, there has been internationally, or nationally for that matter, no consensus on the asset life that should be used in creating the physical capital stock variable. A second limitation we faced was that we were only able to focus on a limited set of three countries. It is clear that for objective estimations and the use of more solid econometric techniques a larger sample is needed.

That being said, we think it is beyond doubt that the new growth theories, with all their limitations, are an important tool to analyze growth patterns in sets of homogenous countries. Yet, to explain why Japan was a successful developer while India and Indonesia were not, two extra ingredients were important. First, it is important to use a series on human capital that reflects all aspects that are also crucial in these theories. If one wants to test whether there are constant marginal returns to human capital accumulation, excluding the quality of human capital (which might be an important source of constant marginal returns) will bias your findings. Second, it is crucial to keep account of the institutional developments both between countries and over time. They are not only necessary for a sound economic interpretation of any regression results but also may hint which variables to include in regressions between human capital and growth.