The Institutional Environment, Human Capital Development and Technology Adaption: Evidence from ASEAN Countries

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Abstract

This paper explores the links between innovation, the development of human capital, the adoption of technology, and the institutional framework in nine Association of Southeast Asian Nations (ASEAN) countries, using canonical correlation and principal component analysis country level data for 2007-2014 from the World Bank, World Economic Forum and Penn World Tables databases. The paper finds that the unequal development of human capital in the ASEAN countries is clearly linked to the institutional background in each country, as this drives technology absorption and consequent innovation. The four transition countries in the region – Laos, Cambodia, Vietnam and Myanmar – are facing difficult challenges in developing an institutional environment that can not only support investment in physical capital and modern technology but can also stimulate human capital development towards higher knowledge intensity so as to support capacity building for technology absorption and innovativeness.

1. Introduction

The importance of innovation for achieving long-term growth has been widely stressed in numerous theoretical and empirical articles, but much less research has concentrated on the development of human capital and how it is connected with the institutional setting so that the differences in innovation and sustained growth in different countries can be better understood in order to reduce the poverty gap between high and low income countries. A lack of technological development in low income countries may be caused by a lack of the human capital that can be engaged in absorbing and utilising new technologies, and the shortage of human capital may be driven by the efficiency of institutions. This paper seeks to find from empirical data for 2007-2014 what the connections are between innovation, human capital development, technology adoption and institutional frameworks in the ASEAN countries.

ASEAN is today the third largest economy in Asia, and the fifth largest economy in the world after the United States, the European Union, China and Japan, with a total GDP of around 2.55 trillion US dollars. Although the importance of ASEAN in the global economy is increasing, the differences between the levels of development and wealth distribution in the member countries are huge. Six of the countries contribute 88% of total ASEAN GDP, and although the four least developed ASEAN countries – Cambodia, Laos, Vietnam and Myanmar – have had higher growth rates since 2008, their GDP is still less than 12 per cent of the total GDP of the ASEAN region, while the per capita income level of Singapore, the richest ASEAN country, is more than 40 times that of Cambodia, the poorest. As the ASEAN region becomes more important in the world economy, the patterns of economic development, human capital development and institutional setting in these countries warrant further study so that the development paths and challenges in these heterogeneous economies can be better understood.
Section 2 of this paper provides some background to the literature and Section 3 outlines the data and methodology. Section 4 presents the results and discussion and the last section concludes the paper.

2. Literature

Looking back in time, the Industrial Revolution set the path for faster economic growth than ever before, at a time when, as discussed by Abramovitz (1993) and Galor and Moav (2004), most of the working population was poorly educated and economic growth was biased towards physical capital, building on an increase in production efficiency that allowed more output to be produced in less time and with less labour. In the twentieth century, the key source of growth and improvements in productivity gradually shifted from physical capital and labour to intangible capital, as growth was created from new processes, knowledge, and innovation. As discussed by Goldin and Katz (1998), the physical and human capital complementarity spread across industries, leading to higher levels of modern physical capital engagement and a constant need for improvements in processes to increase production volumes. Despite the increasing ratio of physical capital to labour, demand for skilled labour increased due to the growing number of machines that were deployed by industries, and their increased complexity. What is important to note from this historical development is the role of different factors that trigger growth at different phases of economic development. Funke and Strulik (2000) show that after the initial phases of development, growth is strongly triggered by innovation, which allows more to be achieved than can be managed from increased capital intensity stemming only from improvements in production efficiency. This, however, requires sufficient human capital to be accumulated for the growing need for innovation to be supported.

The linkage between the level of human capital and the absorption of new technologies has been discussed by a number of authors, including one of the seminal contributions by Nelson and Phelps (1966), who observed in a study of the United States agricultural sector that farmers with more education absorbed technological changes much faster than those with less knowledge, and this gave them increased productivity. Romer (1990) argues that innovation depends upon the existing design of production and human capital, and knowledge is used to augment existing solutions, while Rivera-Batiz and Romer (1991) argue that the role of existing design for output is greater when there is integration between economies that enables the transmission of ideas between them. It follows from endogenous growth theory that human capital does not just trigger technological progress, but higher levels of human capital can also attract modern physical capital. Lucas (1990) argues that economies with more developed human capital are more attractive to foreign direct investment as foreign knowledge can be used to augment the existing design of output creation, while low levels of foreign direct investment may leave human capital endowments inadequate.

A substantial part of the ASEAN region consists of developing economies, where much of the growth reflects the contribution of physical capital accumulation. Hussin and Saidin (2012), who studied Malaysia, Indonesia, Thailand and the Philippines, conclude that gross capital formation played a key role in determining GDP growth for all four countries, while trade openness and the financial environment play a key role in letting production grow to support improvements in efficiency. The argument that there are linkages between investment, the availability of finance, financial performance and the efficiency of institutions in the transition economic context has been found various support (e.g. Männasoo et al., 2018; Cuestas and Staehr, 2013; Hazak, 2008; Männiste et al., 2011; Kotšina and Hazak, 2012). Pradhan et al.
(2017), who studied all the ASEAN countries and others, found that both long-run equilibrium growth and short-run growth are strongly related to the openness of trade. Yet capital intensive development gains growth from production efficiency that is amplified by absorbing contemporary technologies rather than just accumulating human capital (Aghion and Howitt, 1992; Galor and Moav, 2004). Production efficiency is not infinitely diminishing however, and industry-heavy economies eventually tend to support development by shifting towards more intangible values and innovation that require greater development of human capital (see Galor and Moav, 2004; Schumpeter, 1942; Skoloff, 1988; Aghion and Howitt, 1992; Avarmaa et al., 2013). Human capital accumulates through the education and training needed for certain skills and knowledge to be gained (Galor and Moav, 2004; Cervellati and Sunde, 2005) and various studies have proxied the development of human capital with a range of indicators, such as literacy, educational attainment, years of schooling or PISA test results. Questions of the knowledge-intensive development in the ASEAN countries building on institutional considerations are yet to be studied (see Lu et al., 2008; Storz et al., 2013).

High levels of heterogeneity in human capital development are related to differences in institutional development. The importance of institutions for human capital, physical capital and overall development has been stressed by, for example, North and Thomas (1973), Hall and Jones (1999), Acemoglu et al. (2001), and many others. The linkages between the development of human capital and institutions are multidirectional. While there are multiple paths for institutional support for advancements in knowledge intensity (see e.g. Acemoglu and Robinson, 2012; Virkebau and Hazak, 2017; Hazak et al. 2016 among many others), Lipset (1959) for example concludes that changes in human capital formation eventually lead to institutional growth. Glaser et al. (2014) argue that human capital is more important than institutions at first, as the accumulation of human capital leads eventually to stronger institutions and poverty can be overcome by laws and policies that support the development of human capital.

3. Data and Methodology

This study uses data from nine ASEAN countries, which are Cambodia (KHM), Laos (LAO), Myanmar (MMR), Vietnam (VNM), Thailand (THA), Singapore (SGP), Malaysia (MYS), Indonesia (IDN), and the Philippines (PHL). The cross-sectional country level data used in this study are combined from the Penn World Table (PWT) version 9.0, the World Bank database, and the World Economic Forum Global Competitiveness Report for 2007-2014. To understand the sample selection, we need some background on the details of the socio-economic development processes in the sample countries. In 1959, the Southeast Asian Friendship and Economic Treaty (SEAFET) was signed to promote cooperation in economic affairs, trade and education. Although SEAFET was a failure because of the many disagreements between the member countries, the concept inspired the creation in 1961 of a new regional organisation, the Association of Southeast Asia (ASA), which brought Malaysia, Thailand and the Philippines together for cooperation in economic, social and cultural affairs, and facilitated education and training. However, the ASA failed because of some territorial conflicts. After the tensions ended, the 1967 Bangkok Declaration set the foundations for ASEAN, of which with Indonesia, Malaysia, the Philippines, Singapore and Thailand were the five founding countries. The formation of ASEAN was driven by political and security considerations in the region rather than by any desire to benefit from economic integration (Mukim, 2005). ASEAN has by now expanded to take in Brunei, Vietnam, Laos, Cambodia and Myanmar, making a total of 10
countries. Given the small size of Brunei, the sample for our study covers the other nine ASEAN member states.

A key objective of ASEAN is to seek deeper integration between the member countries, with the aim of creating a single market and integrated production base in the region, with coordinated oversight of production factors and conflict resolution mechanisms. This should help increase the inflow of FDI, let both intra-ASEAN and international trade expand through sharply increased production and consumption of a cheaper and broader range of products, lower the cost of capital, and reduce regional labour shortages as flexibility increases in the ASEAN labour market. A broader aim is to reduce significantly the gaps between the ASEAN member states and to achieve substantial increases in rates of economic growth.

Among the ten member countries of ASEAN, Cambodia, Laos, Myanmar and Vietnam are in the group of lower income transition economies. In 2016, GDP per capita in these four countries was USD 1.2-2.4 thousand, while the GDP per capita of the more developed six member states reached USD 16.9 thousand, indicating a vast gulf between the ASEAN economies in their stages of development. While most of the ASEAN countries maintained a high rate of growth of 5.1% on average between 2010 and 2016, the less developed transition economies were able to accelerate their economic growth after the 2008 global economic crisis to an average rate of 6.9% in 2010-2016. Approximately 40% of the overall workforce in ASEAN is engaged in agriculture with a similar number in the services sector, while around 19% work in industry. The sectoral distribution of labour varies across the ASEAN countries though, with more agriculture-heavy labour markets in Cambodia, Laos, Myanmar, Vietnam and Thailand, and a more services-based workforce in Singapore, Malaysia, the Philippines and Indonesia, while the share of the workforce in industry is largest in Malaysia. Figure 1 illustrates the differences in GDP per capita between the ASEAN member countries and the contribution of each country to the ASEAN aggregate GDP.

**Figure 1.** GDP per capita and member country contributions to ASEAN GDP

![GDP per capita and member country contributions to ASEAN GDP](image)

*Source: Authors’ illustration based on ASEANstats 2016 key indicators*
The heterogeneous economic background and historical development paths of the ASEAN countries lead us to study the linkages between the adoption of technology, innovation, the freedom of international trade, and human capital in the nine ASEAN countries using data from PWT, the World Bank and the Global Competitiveness Report for 2014. The methodological approach employed in this study is canonical correlation and principle component analysis.

4. Results and Discussion

First, we investigate the links between innovation, the adoption of technology, the freedom of international trade, and the development of human capital in the sample countries. Our study indicates that the ASEAN economies that have higher levels of innovativeness and adoption of technology have accumulated more human capital and are freer in international trade. The four catching-up ASEAN countries Myanmar, Laos, Vietnam and Cambodia have long been very closed economies with relatively little economic integration outside Asia and they exhibit significantly lower levels of innovativeness. Myanmar, as a very dramatic example, was in economic isolation until 2010 because of its military regime and political issues. Innovativeness in the ASEAN countries ranges from the world leading Singapore to the technologically underdeveloped Myanmar and Cambodia. The links between the variables for innovation, human capital, adoption of technology and freedom of trade are illustrated in Figure 2. These empirical findings are in alignment with the theoretical framework of Romer (1990), which suggests that innovation is determined by the levels of human capital and existing technologies, which can themselves be leveraged to achieve greater economic integration according to Rivera-Batiz and Romer (1991). As adoption of technology is linked with skills and knowledge (Nelson and Phelps, 1966; Aghion and Howitt, 1992), poor innovation is linked to a lack of endowments of human capital, which inhibits the efficient adoption of the latest technologies.

Figure 2. Adoption of technology, innovation, freedom of international trade and human capital in ASEAN countries

Source: Authors’ calculation based on PWT 9.0, World Bank and World Economic Forum Global Competitiveness Index report for 2014
The overall low level of dependency on intangible resources in ASEAN countries is supported by the canonical correlation coefficients between the factors enhancing productivity and the variables for human capital presented in Table I and summarised at country level in Figure 3. The output GDP and capital stock appear to be little described by the development of human capital, which is explained by a large part of the ASEAN economies being agriculture-intensive and basic industry-intensive with little value added in production. FDI inflows, in parallel, are not determined by the competitiveness of these economies, but rather by the supply of cheap labour that is attractive for foreign investors looking to benefit from the possibility of cheap production.

**Figure 3.** First canonical correlation coefficients of the human capital relevant for R&D and the factors for productivity growth in ASEAN countries

![Figure 3](image.png)

*Source: Authors’ calculation based on data from PWT 9.0, the World Bank and the Global Competitiveness Report 2007-2014 (except for Laos and Myanmar where calculations are based on available data for 2013 and 2014)*

*Note: First order canonical correlation 94.00%, p-value 0.000***, F-statistic 44.300*

One potential explanation of the differences in these linkages between the four ASEAN transition economies could be that as foreign investors are looking for alternatives to China, Vietnam has proved itself one of the most attractive destinations for FDI. The attractiveness to foreign investors of Vietnam, which is the closest of the four transition economies to China both geographically and culturally, lies especially in the still unused potential of the domestic market, the abundant working-age population and the low cost of labour even though the level of productivity is higher than in Laos, Cambodia and Myanmar, the other three ASEAN transition countries. In addition, Vietnam has introduced several policies to support investment, providing a better institutional framework for enhanced FDI inflows. Although Cambodia, Laos and Myanmar are playing a growing role as target countries for foreign investors, the FDI inflows to...
them still remain modest compared to those going to the other ASEAN countries which have a higher level of technological readiness, such as Malaysia, Thailand and Singapore.

**Table I.** First order canonical correlation coefficients for the quality of human capital relevant for R&D and factors enhancing productivity in the sample

<table>
<thead>
<tr>
<th>Quality of human capital relevant for R&amp;D</th>
<th>Productivity enhancing factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of scientists and engineers</td>
<td>0.0967</td>
</tr>
<tr>
<td>Human Capital Index</td>
<td>-0.0030</td>
</tr>
<tr>
<td>Tertiary education enrolment (%)</td>
<td>0.0004</td>
</tr>
<tr>
<td>Primary education enrolment (%)</td>
<td>0.0006</td>
</tr>
<tr>
<td>Individuals using the internet (%)</td>
<td>0.0008</td>
</tr>
<tr>
<td>Quality of the education system</td>
<td>0.0482</td>
</tr>
</tbody>
</table>

*Source: Authors` calculation based on data from PWT 9.0, the World Bank and the Global Competitiveness Report 2007-2014 (except for Laos and Myanmar where calculations are based on available data for 2013 and 2014)*

On the other hand, the six more highly developed ASEAN countries show a greater dependency on the human capital relevant for R&D in the factors enhancing productivity. This may be partly because manufacturing sectors with higher value added account for a larger share of these economies, and the service sector for a growing share. In addition, efforts by these countries to keep pace with global demands for the availability of skilled labour encourages them to support advances in the adoption of technology and in innovation. In Singapore, which has the highest indicators for human capital relevant for R&D of the ASEAN group, a large part of the economic activities of the country is directly or indirectly related to advanced technology and innovation.

Next, we will look at the results of our study on human capital development. In the sample countries, as illustrated in Figure 4, the accumulation of human capital is correlated most with the quality of education and access to tertiary education. A high degree of correlation between the urban population and internet access demonstrates the larger shares of knowledge capital in more developed and urbanised economies with better ICT, which enable better information sharing. Singapore, for example, has substantially upgraded its educational system over a long time, putting a lot of effort into the quality of education. The main language of teaching is English and children are already taught English before they start primary school, providing better access to international knowledge and communication. The quality of higher education in Singapore is widely recognised around the world, and higher education has been the most commonly achieved educational attainment level over past five decades for the people of Singapore. The preference for higher education has, however, left Singapore with a shortage of labour with vocational training, which has been revived recently. Other countries in the region have undertaken reforms of their education systems to respond to their development priorities and the requirements for specific skills in the economy.
**Figure 4.** Principal component analysis of human capital development

![Principal component analysis of human capital development](image)

*Source: Authors’ calculations based on data from the World Bank and the Global Competitiveness Report 2014*

**Figure 5.** First order canonical correlation coefficients of the quality of human capital relevant for R&D and institutional factors by countries

![First order canonical correlation coefficients](image)

*Source: Authors’ calculations based on data from PWT 9.0, the World Bank and the Global Competitiveness Report 2007-2014 (except for Laos and Myanmar where calculations are based on available data from 2013 and 2014)*

*Note: First order canonical correlation 98.31%, p-value 0.000***, F-statistic 38.750*
The institutional setting in ASEAN countries is very heterogeneous, possibly because they are elite oriented, as suggested by Beeson (2008). The institutional quality in the sample countries is clearly linked to human capital development, as illustrated in Figure 5, and government effectiveness and improving accountability and property protection are key among the productivity enhancing institutional factors, as outlined in Table II. These factors have been a key concern in the ASEAN transition countries because of their historically dominant Marxist political ideologies.

Institutional efficiency appears to come together with unequal opportunities for human capital development however. From the human capital development perspective, the overall development path in ASEAN appears to be one of producing top-level skills, such as scientists and engineers, and making improvements in overall educational quality. The overall accessibility of education remains low in some parts of ASEAN however, leading to wide gaps in human capital development between the countries.

**Table II.** First order canonical correlation coefficients of the quality of human capital relevant for R&D and productivity enhancing institutional factors in the sample

<table>
<thead>
<tr>
<th>Human capital relevant for R&amp;D</th>
<th>Productivity enhancing institutional factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of scientists and engineers</td>
<td>Government effectiveness</td>
</tr>
<tr>
<td>Human Capital Index</td>
<td>0.0124</td>
</tr>
<tr>
<td>Tertiary education enrolment (%)</td>
<td>Government effectiveness</td>
</tr>
<tr>
<td>Human Capital Index</td>
<td>0.0642</td>
</tr>
<tr>
<td>Tertiary education enrolment (%)</td>
<td>Political stability</td>
</tr>
<tr>
<td>Human Capital Index</td>
<td>0.0018</td>
</tr>
<tr>
<td>Tertiary education enrolment (%)</td>
<td>Voice and accountability</td>
</tr>
<tr>
<td>Primary education Enrolment (%)</td>
<td>0.0799</td>
</tr>
<tr>
<td>Primary education Enrolment (%)</td>
<td>Intellectual property protection</td>
</tr>
<tr>
<td>Individuals using the internet (%)</td>
<td>-0.0024</td>
</tr>
<tr>
<td>Quality of the education system</td>
<td>-0.0001</td>
</tr>
<tr>
<td>Quality of the education system</td>
<td>0.0799</td>
</tr>
<tr>
<td>Quality of the education system</td>
<td>Freedom Index</td>
</tr>
<tr>
<td>Quality of the education system</td>
<td>0.0524</td>
</tr>
<tr>
<td>Quality of the education system</td>
<td>Intellectual property protection</td>
</tr>
<tr>
<td>Quality of the education system</td>
<td>0.0248</td>
</tr>
</tbody>
</table>

*Source: Authors’ calculations based on data from PWT 9.0, the World Bank and the Global Competitiveness Report 2007-2014 (except for Laos and Myanmar where calculations are based on available data from 2013 and 2014)*

The greatest concern about human capital development is in the transition economies Laos, Cambodia and Myanmar, where the share of the population that is rural is higher than it is in the more advanced ASEAN countries and the educational opportunities for the urban and rural populations are unequal. Another issue with the accumulation of human capital in the four transition countries of the ASEAN group is their high level of dependency on economic activities with low value added that do not necessarily require high levels of education, but rather simple skills that can be acquired through working. As argued by Galor and Moav (2004) and Cervellati and Sunde (2005), acquiring education is costly and puts psychological constraints on the benefit gained from the higher level of knowledge and the skills accumulated. The limited opportunities and perspectives for exploiting the benefits of more advanced education in the less developed ASEAN economies tend to adjust the values of educational needs among the population. Furthermore, even in the developed economies of the ASEAN group, technological disruptions such as developments in robotics and machine learning have replaced specific tasks in existing jobs, and this has led to changes in demand for skills in several occupations. The new trends require not only the developing economies of ASEAN but also the more developed ones to carry out educational reforms to respond to the needs of current jobs and to anticipate future economic requirements.
4. Conclusions

This paper studies the links between innovation, human capital, productivity enhancing factors and the institutional background in nine ASEAN countries, using data from 2007-2014. The sample countries are notable for their high levels of heterogeneity in the adoption of technology and in innovation. The four transition countries in the ASEAN group – Laos, Cambodia, Vietnam and Myanmar – are the fastest growing in the region, but they are still heavily dependent on the accumulation of physical capital in the low value added agricultural and production sectors, where there is quite a low level of technology adoption, and even less innovation. Their country characteristics show that Cambodia, Laos and Myanmar have remained closed economies with an institutional background that is largely focused on state control and a low level of human capital development. The other ASEAN countries have advanced faster technologically, which is reflected in their higher levels of income and their productivity enhancing factors.

Although technology adoption and innovation have been understood in the ASEAN strategies to play an important part in achieving long-term sustainable growth and overcoming poverty gaps, the levels of human capital needed for this are yet to be developed in the transition economies of ASEAN or even in the more developed countries in the group. These developments appear to be asymmetric in time and depend on the institutional background.

A key issue for human capital in the ASEAN countries is that the institutional setting appears to be rather elite oriented, as opportunities for human capital development are unequally distributed between countries. The more developed ASEAN countries are more focused on developing top-level skills, having managed to achieve relatively high levels of human capital development, but the transition economies of the ASEAN group are lagging behind. Human capital endowments remain low for these countries and the access to training is biased towards urban areas, leaving a large part of the population with poor choices for education and training.

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