

The link between education and the structure of exports of APEC countries, 1980-2014

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Abstract

This paper addresses the relationship between educational level of four member nations of APEC (Singapore, Korea, Malaysia and Mexico) and the configuration of its exports, between 1980 and 2014. The analysis is done by comparing the increases in average schooling of adults of these countries and the relative importance of their exporting sectors through a Pearson correlation coefficient. The results suggest that there was a significant positive relationship between increases in schooling and increases in exports related to manufactures, machinery and transport equipment, as well as a significant decrease in their dependence on agricultural products, fuels and other minerals.

Keywords: Education, APEC, exports, Singapore, Korea, Malaysia, Mexico

1. Introduction

Education is one of the topics of greatest interest to societies; it is widely accepted its high transformative power in the political, cultural, social and economic aspects of human groups. Its economic benefits have received particular attention from decision and policy makers, trying to find in the increase of the educational level of the population, a coherent long term strategy to achieve growth and development.

However, the link between educational level of societies and their performance in international trade has been little studied. Although some economic theories, such as the endogenous development theory, recognize the influence of education on improving trade performance of countries, empirical evidence of the subject has experienced serious limitations due to the indirect nature of this relationship and the multitude of variables involved in that performance.

However, there are significant difficulties to get empirical evidence of this relationship as different exportable products react differently to increases in human capital and because the effects of these increases usually occur in the long term so it is difficult to quantify how much of present exports is due to knowledge developed in the past (Beyer, 2005).

This paper aims to provide empirical evidence to achieve a better understanding of the relationship between the educational level of nations and their ability to change their business structure, allowing countries to stop relying on the export of its natural resources and modify their trading patterns to exports of higher added value.

It has been chosen the APEC region for this study because of its economic importance and huge diversity; APEC region includes developed and developing countries that are specialized in different goods and services. Among these nations those that showed the most significant growth in their educational level, measured by average schooling of adults aged 25 years or more, were selected.

First, some theoretical background that links education and international trade is commented. After that, the variables considered and the results found are described and finally the conclusions of the study are shown.

2. The theoretical link between education and international trade

The issue of education has been embedded in the theory of international trade at different stages of its history. Heckscher-Ohlin model is a pioneer tool to explore this relationship; it showed that the trade between countries depended on the differences in the abundance of factors among them. Consequently,

imports aimed to overcome the absence of such factors in local production and therefore should reflect those differences. As a consequence, countries with greater abundance of capital would tend to export capital-intensive goods and import labor-intensive goods (Krugman, et. al., 2012; WTO, 2010).

This model was confronted empirically by Leontief in 1953. According to Leontief, US exports during the 25 years after World War II were less capital intensive than its imports. This situation is related with the fact that the United States exported products that were more intensive in skilled labor and technology. This showed that capital wasn't the only way for the United States to have an advantage in international markets, another way to achieve these advantages was through having a better prepared workforce and a higher number of scientist and technicians (Krugman, et. al., 2012).

As a result, industries that produce more sophisticated products and require skilled labor, tend to be located in countries where education is higher so they have better opportunities to find the prepared human resources they need. On the other hand, industries specialized in products that require unskilled workforce, tend to be located in countries where less capacitated labor is abundant so enterprises are able to reduce their costs by paying lower wages (Krugman, et. al., 2012).

The above arguments helped to explain the location of multinational companies around the world and established knowledge as one of the factors that dictated the international trade specialization of economies.

Later, the human capital theory conceived population's education and skills as a form of capital that can be accumulated and used in the production of goods and services, therefore, investments in training people generate returns in the future, both public and private (Keeley, 2007; Urciaga, 2002; Acemoglu and Autor, 2011). Some public returns include a higher qualification of labor, the facilitation of physical mobility of people, innovation and scientific progress, higher productivity, greater comparative advantages and competitiveness in international trade (Becker, 1974; Villalobos and Pedroza, 2009; Krugman, 2010; Menon, 2010; Onkelinx, et. al., 2016).

In mid-eighties, economists such as Romer, Lucas and Barro, strengthened the idea that knowledge can be considered as a factor of production, which increases the marginal productivity of companies in two forms: an internal, in which the company benefits from increased individual productivity of their workers when they are more educated and trained to perform their jobs, and external, which is based on the profits generated by the highest levels of schooling in society and technological advances that spread among companies encouraging quality, differentiation and innovation in exportable products (Cardona et. al. 2004; Lopez et . al. 2009).

But education also has intangible benefits that favor international trade and investment. A better educated society reduces the levels of corruption, increases entrepreneurship, improves governance, reduces social conflicts and regulates speculation (Cardona, 2004).

Education, together with infrastructure development and institutional strength, affects the structure of international trade of nations, especially with regard to natural resources (Cáceres, 2002; Lederman and Maloney, 2012; Lederman and Xu, 2007). Some developing economies, possessing abundant natural resources, tend to over-specialize in extraction and export of these resources which can become a vulnerability, as these resources are often scarce and nonrenewable (WTO, 2010).

For developing countries, export diversification is a strategy that allows their economies to become more resilient to periods of crisis, stay stable to changes in international commodity prices and stimulate their economic growth, per capita income and comparative advantages (Shepherd, 2009; Agosin, 2009). Therefore, many developing countries consider diversifying their exports as an important objective of its trade policies, either through expanding the range of products they offer to the world or increasing the number of export destinations (Shepherd, 2009). To make diversification possible is necessary to establish an environment that combines trade liberalization, foreign direct investment and the availability of educated and skilled human capital (Cáceres, 2002; Keeley 2007; Vinesh, 2014). Some of the member nations of APEC, particularly those located in Southeast Asia, are good examples of trade diversification based on human capital accumulation.

3. Evolution of schooling in the region 1980-2015 APEC

The Asia Pacific Economic Cooperation Forum (APEC) is an international forum to promote regional collaboration, development and free mobility for trade and investment among its members. Currently APEC has 21 members: Australia, Brunei Darussalam, Canada, Chile, China, United States, Hong Kong, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Philippines, Russia, Singapore, Chinese Taipei, Thailand and Vietnam (Gonzalez and Gala, 2008).

For Aponte (1997), all regional integration efforts, such as APEC, share a structure based on *"innovation and efficiency in the technoscientific processes of production and international exchange of goods and services"*, which means that knowledge is one of the elements that enable or hinder integration among nations.

In addition to its economic, demographic and commercial importance, APEC has been scene of exemplary transformations in education. In a classic study of the subject, titled *"The East Asian Miracle"*, edited by the World Bank (1993), it is explained how the East Asian countries based their economic growth on the accumulation of physical and human capital, conditions that allowed them to attract highly productive investments and adopt its technology. This study also indicates that, within the enormous diversity in public policies that emerged in the region, there were always certain common guidelines such as establishing friendly policies with the international markets, maintaining macroeconomic stability and investing in the education of people.

Krugman, et. al. (2010) notes that, in mid-sixties, even though many Asian economies were still quite poor, Southeast Asian countries had relatively high rates of school enrollment compared with other regions of the world, for example, in countries like Singapore, Hong Kong and South Korea basic schooling for children was almost total and in Indonesia (one of the poorest nations in the region) this indicator was up to 70%.

As mentioned above, the APEC region is widely diverse and contents some of the countries with the highest and lowest education levels of the world. Chart 1 shows the average schooling of APEC member countries between 1980 and 2015 except for Taipei, country for which the United Nations Development Program (PNUD) did not report enough data. In 1980, the average schooling of these twenty countries was 6.3 years with a standard deviation of 3.04 suggesting high variability and educational inequality among member countries.

In 1980, the country with the highest schooling was United States with 11.9 years. It was followed by Australia and New Zealand with very similar figures. Educational situation was very different for those countries listed at bottom of the chart: in Papua New Guinea average schooling just over one year of education while countries like Indonesia, Thailand, China and Singapore averaged between 3 and 4 years of

schooling. By observing the data for 2013 can be seen that, although all APEC members reported progress in this indicator, nations leading these statistics remain virtually the same.

Chart 1. Mean years of schooling in APEC 1980-2015

No.	Country	1980	1985	1990	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	United States	11.9	12.2	12.3	12.7	12.8	12.8	12.9	12.9	12.9	12.9	12.9	12.9	12.9
2	Australia	11.6	11.6	11.7	11.9	12.1	12.2	12.2	12.4	12.5	12.6	12.7	12.8	12.8
3	New Zealand	11.6	11.7	11.7	12	12.2	12.3	12.3	12.4	12.4	12.5	12.5	12.5	12.5
4	Canada	9.5	9.9	10.3	11.1	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3
5	Korea	7.3	8.2	8.9	10.6	11.4	11.4	11.5	11.6	11.7	11.8	11.8	11.8	11.8
6	Russian Federation	7.1	8.1	9.2	11.3	11.6	11.6	11.6	11.7	11.7	11.7	11.7	11.7	11.7
7	Japan	8.9	9.4	9.9	10.8	11.1	11.2	11.3	11.3	11.4	11.5	11.5	11.5	11.5
8	Singapore	3.7	5.1	5.8	7.6	8.4	8.8	9.1	9.4	9.4	10.1	10.1	10.2	10.2
9	Hong Kong	6.7	7.6	8.5	8.7	9.4	9.5	9.7	9.8	9.9	10	10	10	10
10	Chile	6.4	7.3	8.1	8.8	9.5	9.5	9.4	9.9	9.9	9.8	9.8	9.8	9.8
11	Malaysia	4.4	5.6	6.5	8.2	8.9	9.1	9.2	9.3	9.4	9.5	9.5	9.5	9.5
12	Peru	5.5	5.9	6.6	8	8.4	8.2	8.1	8.1	8.1	8.8	8.9	9	9
13	Philippines	6.1	6.7	7.1	8	8.6	8.6	8.7	8.8	8.9	8.9	8.9	8.9	8.9
14	Brunei Darussalam	6.1	6.6	7.5	8.2	8.4	8.5	8.5	8.6	8.6	8.7	8.7	8.7	8.7
15	Mexico	4	4.8	5.5	6.7	7.5	7.9	7.9	8	8.1	8.3	8.4	8.5	8.5
16	Indonesia	3.1	3.5	3.3	6.7	7.4	7.6	7	7.1	7.3	7.4	7.5	7.5	7.5
17	China	3.7	4.3	4.9	6.6	7.1	7.2	7.2	7.3	7.4	7.5	7.5	7.5	7.5
18	Thailand	3.7	4.1	4.6	6.1	6.7	6.5	6.7	6.9	7.1	7.3	7.3	7.3	7.3
19	Viet Nam	4.3	4.4	4	4.5	4.9	5.1	5.2	5.3	5.4	5.5	5.5	5.5	5.5
20	Papua New Guinea	1.2	1.8	2.3	3.2	3.5	3.6	3.7	3.8	3.8	3.9	3.9	3.9	3.9

Source: Elaborated by the authors with data from UNDP (2013)

United States was in 2013 the country with the highest average schooling of the whole region. It was followed in importance Australia, New Zealand, Canada and Korea. At the bottom of the chart Papua New Guinea, Vietnam, Thailand and China were found. Mexico was ranked 15 of the 20 countries considered. According to chart 1, the average schooling of the APEC region in 2013 was 9.5 years with a standard deviation of 2.4. This indicates a relatively high variability within this region although considerably lower than that found for 1980.

Although the asymmetry in education persists among the nations of APEC, some countries made significant progress during this period. The most significant breakthrough occurred in Singapore where the average schooling increased from 3.7 to 10.2 years, an important advance of 6.5 degrees in 33 years. Other countries where schooling grew significantly were Malaysia, Russia, Korea and Mexico with advances between 4.5 and 5 years.

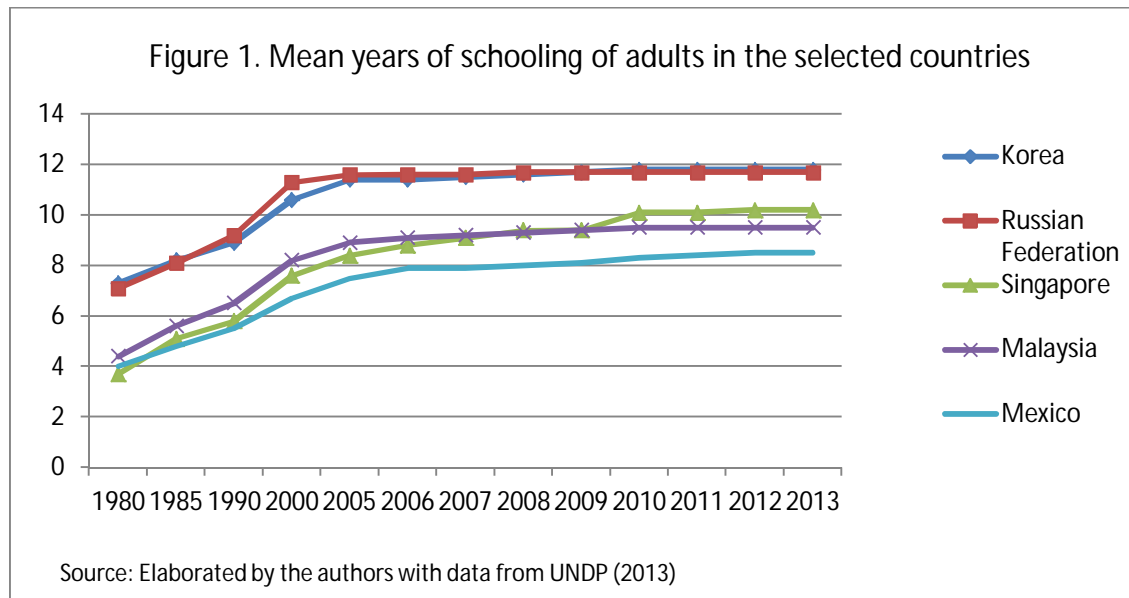


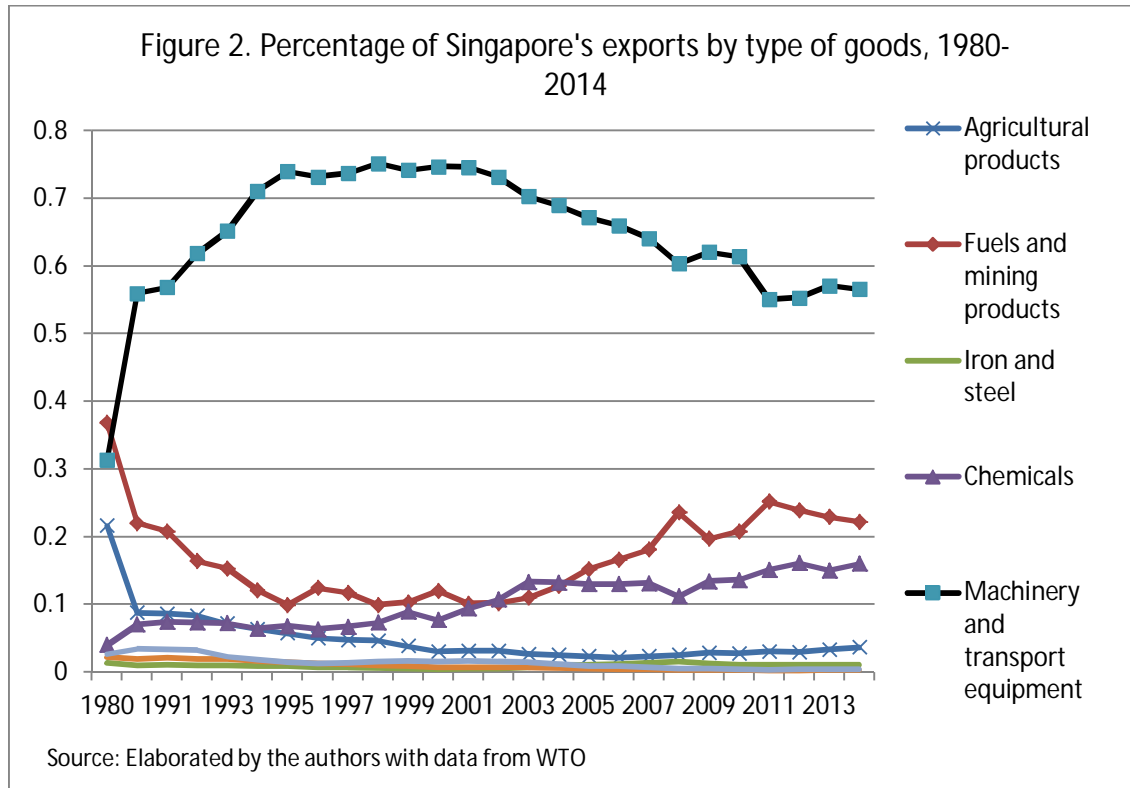
Figure 1 shows the five APEC countries that obtained the largest increases in their average schooling. Korea and Russia followed a similar trend during the study period and in 2013 had very similar average schooling. On the other hand, Mexico, Malaysia and Singapore began this series with very similar figures that with the lapse of time would differentiate.

It was decided to study the APEC countries that obtained the most significant advances in their average schooling between 1980 and 2013 to observe how their exports to the world changed from focusing on commodities and natural resources to manufactured merchandises. Russia was excluded from this analysis because the World Trade Organization (WTO) doesn't report enough data about this country to make a complete comparison.

4. Exports by category in selected countries

Below it is shown how the different export sectors of these countries evolved during the period 1980-2014. These data were extracted from the databases of the World Trade Organization (WTO) which classifies merchandise exports according to Revision 3 of the Standard International Trade Classification (SITC) according to the following major categories: Agricultural Products, Fuels and Mining Products, Iron and steel, Chemicals, Other semi-manufactures, Machinery and Transport Equipment, Textiles, Clothing, Other manufactures and other products.

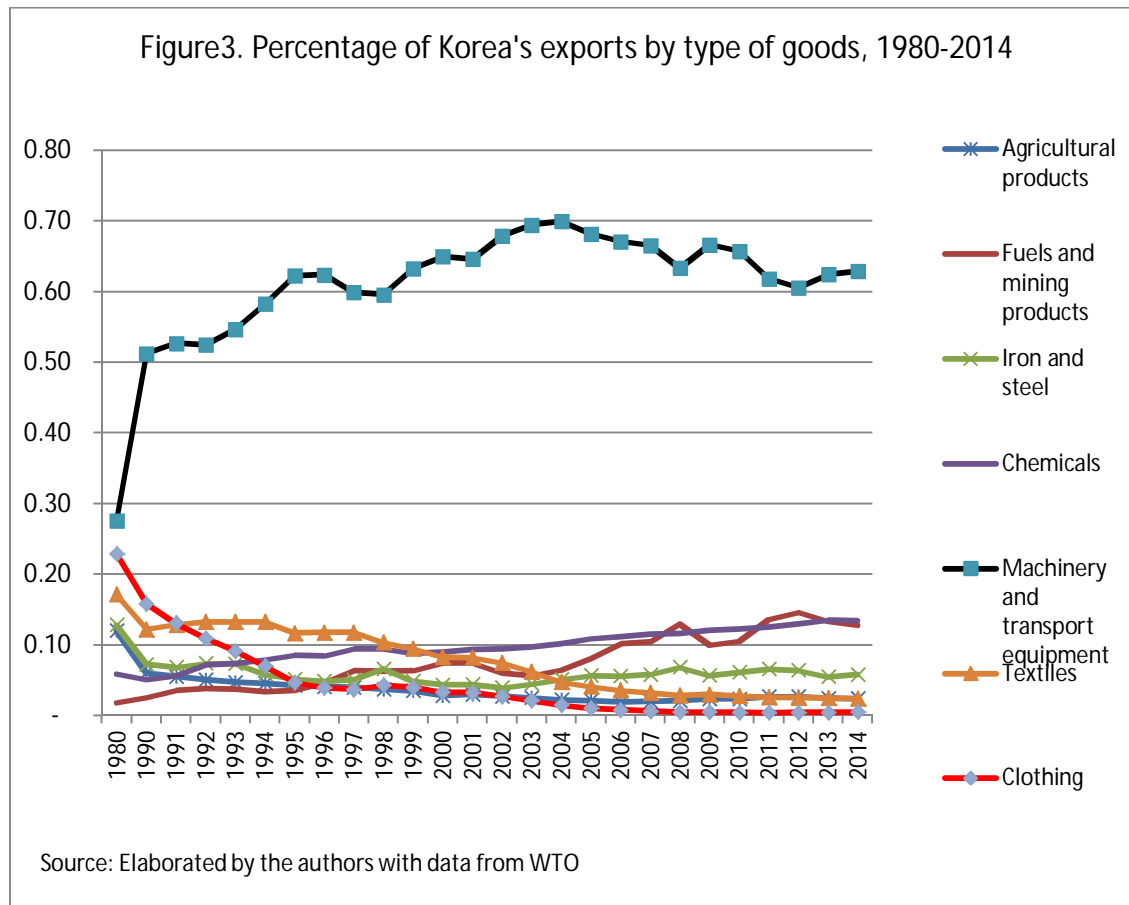
Figure 2 shows exports structure of Singapore between 1980 and 2014. As can be seen, in 1980 the most of Singapore's exports were concentrated on fuels and minerals (about 37% of the total), machinery and transport equipment were also important with a 31% and agricultural products represented a 21%. The rest of the items had small holdings which together accounted 11%.



In 2014 the situation was very different. The importance in exports of the category "Machinery and transport equipment" grew very significantly during this period to become the main source of Singapore's exports (about 56% of the total); "fuels and mining products" represented 22% of total exports and "Chemicals" a 16%; on the other hand, exports of agricultural products fell significantly to represent only a 3%.

Singapore's situation reflects a profound change in the configuration of its international trade to move from being a specialist in exporting commodities, mining products and natural resources to a predominantly manufacturing economy.

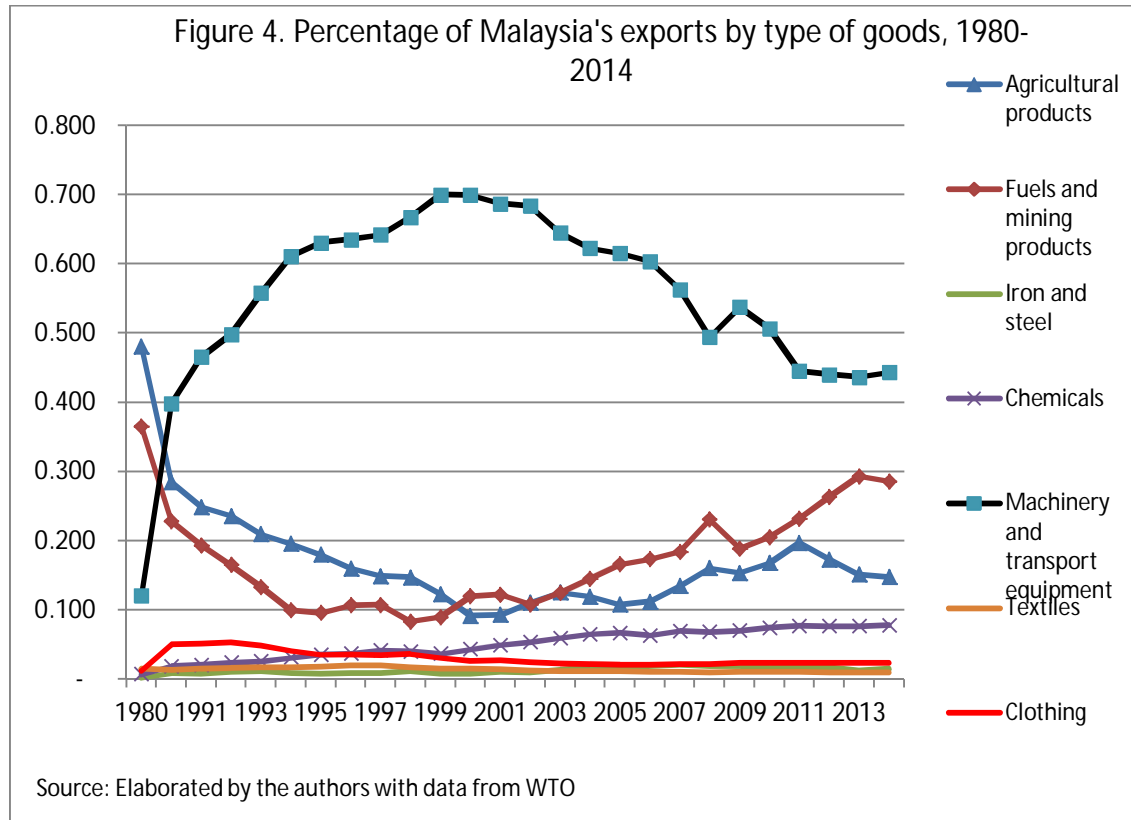
A similar situation occurred in Korea, even more sharply. In 1980 Korea already showed a significant level of industrialization, as shown in Figure 3, about 28% of its exports belonged to category "Machinery and transport equipment". Other important sectors in 1980 were "Clothing" with 23% of the total and "Textiles" with 17%. Its exports of "agricultural products" and "fuels and mining" were insignificant.



By 2014 Korea had become a major exporter of manufactured goods on the global stage. In that year 63% of Korean exports belonged to category "Machinery and transport equipment" that is more than double than in 1980. Likewise the "Chemicals" category nearly doubled its importance when reaching in 2014 13% of the total.

Other items like "Clothing" and "Textiles" represented a small proportion of Korean exports. These settings are consistent with what could be expected: an increase in higher value-added exports had as a result a decrease in other exports -such as agricultural products, textiles and clothing- because these activities need larger amounts of unskilled labor.

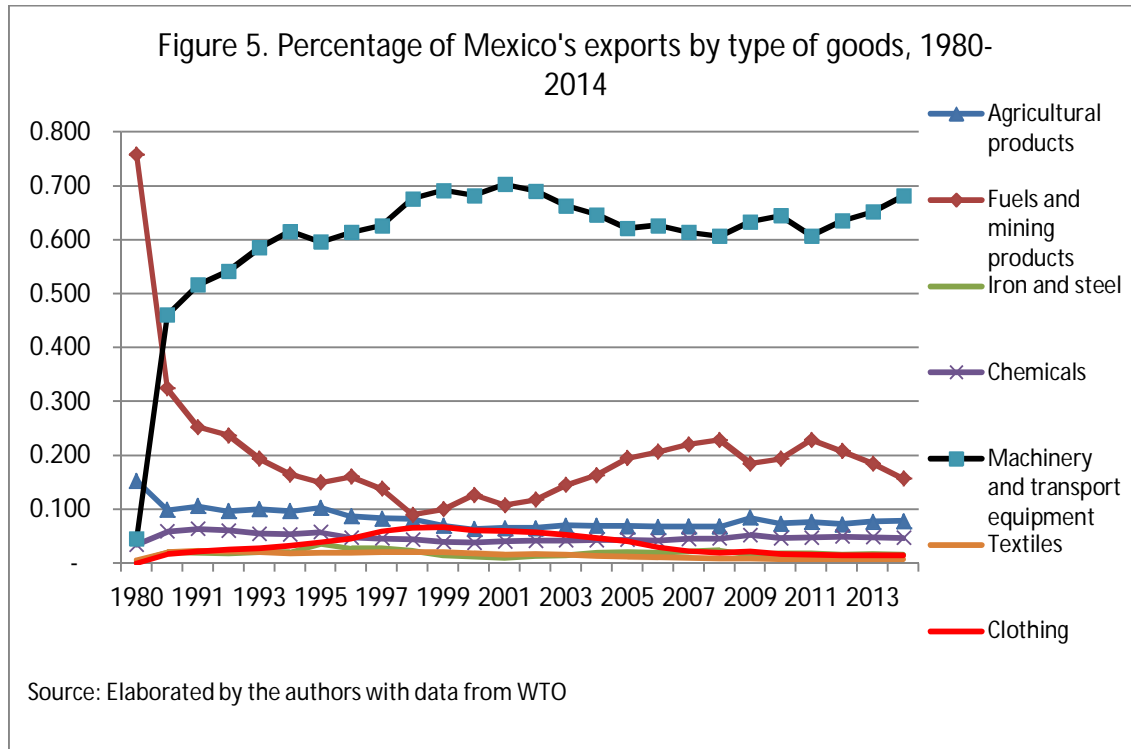
Figure 3 shows the findings for Malaysia. The structure of Malaysia's exports experienced similarities in comparison to Singapore and Korea. In 1980 the most important exporting sectors in Malaysia were "Agricultural Products" with 48%, "Fuels and mining products" with 22% and "Machinery and transport equipment" with 12%; the other items had a combined share of 18%. By 1990 exports of machinery and transport equipment had already overtaken primary products and thereafter the difference between these areas continued to grow. Between 1999 and 2000 machinery and transport equipment represented up to 70% of Malaysia's exports.



In 2014, Malaysia's exports were concentrated in the areas "Machinery and transport equipment", with 44%, followed in importance by the category "Fuels and mining products" with 28%. Agricultural products fell to third place with only 14% of the total.

The advancement of manufacturing during the period studied is consistent with the theory as well as the decline in the importance of agricultural products, however, the increases in "fuels and mining products" exports doesn't agree with the theories mentioned; this might be linked to the high demand for fuels from Malaysia's neighbors and trading partners such as Hong Kong, Singapore and Korea so fuels remained as an important business opportunity for Malaysia despite the increase in its ability to manufacture products.

Mexico behaved similar to Malaysia but with even higher figures. In 1980, the main export sector of Mexico was "Fuels and mining products" with 75% of the total, which shows the importance of fuels and mineral products in Mexican exports. The second most important category in 1980 was "Agricultural products" with 15%; on the other hand, "machinery and transportation equipment" and "chemicals" represented similar percentages of between 3% and 4% of the total. By 1990 the situation had changed considerably and machinery and transport equipment accounted about 46% of the total compared with 32% of fuels and mining products. These data point to a shrinking of exports of mineral resources and a significant increase in exports of Mexican manufactures.



Since 1990, the consolidation of manufacturing as the main exporting sector of Mexico can be perceived; from 1990 to 2013 "Machinery and transport equipment" represented from 50 to 70% of the total Mexican exports; in 2014, this category accounted approximately 68% of Mexican exports of goods, "Fuels and mining products" reached a 15% followed by "Agricultural products" with 7%.

5. Methodology

To verify the hypothesis proposed and confirm the relationship between increases in schooling and increases of value-added exports of the four countries mentioned, the Pearson correlation coefficient was calculated, finding a statistically significant positive relationship. Results are shown below in chart 2.

Chart 2. Correlations between schooling and value added exports for Singapore, Korea, Malaysia and Mexico from 1980 to 2014

		MACHINERY	ESCOL
MACHINERY	Pearson correlation	1	.594**
	Sig. (bilateral)		.000
	N	48	48
ESCOL	Pearson Correlation	.594**	1
	Sig. (bilateral)	.000	
	N	48	48

** . The correlation is significant at 0.01 level (bilateral).

Source: Calculated by the authors with data from WTO (several years) and UNDP (2013)

6. Conclusions

The relationship between the educational level of nations and their ability to move into higher value-added exports and become less dependent on the sale of its natural resources has consistent theoretical basis and has been recognized by various authors throughout the economic literature.

However, this relationship has been little studied from empirical perspectives and the existing examples are controversial. This may be due to different reasons: first, it is difficult to find a consensus on what should be the mathematical way to represent education given the diversity of international indicators that can represent it; secondly, the benefits of increases in the educational level of a society are usually seen in the long term (Beyer, 2005), ie the benefits in the current trade of the nations studied is due to investments in education made in the past, this prevents that certain statistical techniques can model these effects because they try to find the correspondence between figures of the same year; thirdly, when using a univariate model, the influence of other classical variables of the study of the determinants of manufactured exports is lost, for example the size of the exporting economy, foreign direct investment, international demand for manufactured goods, opening and trade liberalization, productivity, among others, however, the inclusion of these variables along with some variable representing education can make the latter lose statistical representativeness.

Finally, one of the main difficulties in modeling education as a determinant of a country's exports is in the nature of the variables: education, measured by schooling, tends to increase over time, this happens in virtually every country of the world despite their economic performance, but very few economic variables tend to grow in that way. Another difficulty is that developed nation's schooling tend to grow more slowly than underdeveloped nation's schooling; where the population of a country has already reached an educational level nearby tertiary education is difficult to make further progress, however when the population has few years of schooling, educational changes are more noticeable. This does not necessarily happen with economic variables, particularly to international trade data, which are sensible to global economic changes, to moments of crisis, to decisions made by multinational companies, to technological changes and even to historical events (Krugman, 2010).

Increases in schooling have differentiated country effects, however, at least for the cases analyzed in this paper; its effects have encouraged the change in the structure of its exports, encouraging growth in manufacturing and the removal of primary and extractive products.

Despite the difficulties in modeling the data, the results found and the literature revised support the idea that the increase in the educational level of a society is a valid and decisive strategy for countries to improve their international trade, participate more favorably in the production and commercialization of merchandises with higher value-added, facilitate their integration into economic regions and reduce their dependence on the sale of their natural resources.

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