# Failure to Upgrade?

# Thailand and the middle-income trap

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**Abstract:** Thailand has struggled with modest growth for 20 years. Two explanations are possible. One explanation resides in a series of political and economic disturbances that include two coups, social unrest, the global financial crisis, and a major flood. The second explanation is structural and best described as a middle-income trap problem in which a loss in competitiveness in low-wage production has not been offset by upgrading production into higher-value sectors. The paper examines this second argument through an analysis of wage, production and export data. The key finding is that the country has made progress up the value chain but is now plateauing.

Keywords: industrial upgrading, middle-income trap, Thailand

JEL: O14, O33, O53

## 1. Introduction

Thailand's economy grew rapidly during a golden decade that started in the mid-1980s and ended abruptly with the financial crisis in 1997. In those years the economy diversified from agriculture into industry, received large inflows of foreign investment, and expanded into the production of automobiles and electronics. It also became a travel and services hub in the region. Gross domestic product (GDP) expanded at an average annual rate of 9.2% between 1986 and 1996.

The financial crisis was a watershed but not because it revealed the poor management of capital flows. That problem was fixed relatively quickly. Instead, growth did not rebound to the levels of previous years and the country has not kept pace either with its neighbours or what might be expected from an emerging market economy. Since the crisis, the economy has grown more slowly than all other members of the Association of Southeast Asian Nations (ASEAN), except Brunei (Table 1). The prospect of becoming an advanced economy by 2020 and joining the success stories of northeast Asia has faded.

What ails Thailand? There are two potential explanations. One is that the country has experienced a series of economic and political disturbances that started with the financial crisis and have continued. Each disturbance stymies new investment, both domestic and foreign. Investors wait for the shock to subside but the economy gets hit by a new shock and investment never fully recovers. In particular, the political environment has been unstable.[1]

The second explanation is structural. The Thai economy is not growing rapidly because it is failing to upgrade its technological capabilities and move into the production of higher value goods and services. This failure, if it does exist, is characteristic of a middle-income trap. Despite the controversy surrounding the concept of a trap, it does offer a possible explanation for Thailand's modest growth performance over two decades.

The paper investigates the structural upgrading or middle-income trap explanation. Wage, production and export data are analysed using the concepts of economic complexity and product complexity developed by Hidalgo and Haussman (2009). The paper is divided into sections. Following this introduction, the second section considers growth theory from the perspective of technology and upgrading and shows the link with the middle-income trap. The third section provides an analysis of wages in Thailand. The fourth section analyses domestic production and exports to map changes over time in the complexity of the country's output. The fifth section concludes.

[1] There is a large literature on economic growth and (political) stability. See, for example, Alesina, Ozler, Roubini and Swagel (1996), Jong-a-Pin (2009), and Aisen and Veiga (2013).

## 2. Growth, structural change and the trap

(i) Review of growth theory

Economic growth is an increase in output over time. It is generally thought that the economy produces more by adding inputs, notably capital and labor, and by increasing productivity. However, economic growth over an extended period is much more dynamic and complex. An economy increases not only *how much* it produces but changes *what* it produces, and it is not that growth drives this change in the products produced but rather that this change is what drives growth.

The obvious manifestation of this process is the structural transformation from agriculture to industry in which economic growth is generated by the addition of industrial goods to the on-going production of agricultural products. This change is *inter*sectoral but change also occurs as a process of *intra*sectoral transformation and is commonly called 'upgrading' or moving up the value chain. Such change occurs in industry as the emphasis of the economy moves from say garments to automobiles. It also occurs in agriculture with a shift to higher value crops or livestock. The diversification of production is not agnostic, in the sense that the new goods produced tend to be of higher value and involve greater technological sophistication that existing goods. This is implied in the concept of 'upgrading'.

Early empirical work on economic growth showed that capital and labor did not account for a large share of output growth.[2] Something else was important. Solow (1957) assumed this was technology – a plausible choice – without being able to measure it or explain how it was generated. Subsequent theorizing took on the challenge of explaining the generation of technology. The process was variously termed "technological progress", "innovation", "learning" and the creation of new "ideas". We can divide technology into process technology (how to make things) and product technology (what things to make). The two are related: making new things often requires new process technology, but new processes can also help to make existing products more efficiently.

Early efforts at conceptualization suggested that learning was not a separate purposeful activity but was generated during production, a process called "learning by doing" (Arrow 1962). Under new growth theory, Romer (1985) initially suggested a similar genesis in which technological advance was a product of capital investment. He later changed tact and modelled a process in which ideas were generated by focused research and development (Romer 1990). The number of

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[2] According to Solow (1957), four-fifths of economic growth was accounted for by technical change (as opposed of factor inputs).

innovations produced was a function of the number of researchers, the level of technology they had to work with, and the rate of discovering new ideas.

A parallel branch of growth work suggests that competition drives innovation, which, in turn, drives growth. These Schumpeterian models suggest that firms compete by generating improvements in the technology used and the products produced (Grossman and Helpman 1991, Aghion and Howitt 1992). Firms that are not able to innovate get pushed aside and decline. Schumpeter famously called this "creative destruction"; the creativity, or innovation, of some firms leads to the destruction of others. The overall process, however, is positive for, and indeed drives, growth.

A third strand of growth theory has focused on institutions and their role in creating the conditions for investment and innovation (Acemoglu and Robinson, 2012). Good institutions that protect property – physical and intellectual – provide incentives for innovation. Firms can capture returns from investments in research if intellectual property rights are protected.

Thus, a key thread that runs through the growth literature is the importance of technological innovation. Growth is certainly about an economy producing more but a key driver of producing more is having the capability to produce different goods. Understanding whether that process is occurring or not, can help to explain the long run growth of a country.

The importance of upgrading to growth is evident by casual reference to the history of successful industrialized economies in Asia, namely Japan, South Korea, Taiwan, and Singapore. These countries sustained growth, at high levels, not by relying on food processing, garments and assembly but by moving into the innovation, development and production of higher value products in electronics, vehicles, machine tools, and services. The growth and industrialization strategies of these countries were based on moving up the value chain. Countries sourced, innovated and applied technology and educated the workforce to be able to do so. The importance of technology in these countries' developed is well recognized:

> It is also not surprising that some East Asian economies have focused on technologies that have enabled them successfully to grow through middle-income status to become high-income economies over the past generation. (Gill and Kharas 2007, p. 18).[3]

If upgrading and technological progress can explain growth, the lack of such progress should help to explain extended periods when growth is weak.

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[3] The study also noted that "around 60 per cent of export growth seems to take place through new product varieties, rather than through the exportation of greater volumes of the same goods (Gill and Kharas 2007: 13-14).

(ii) Middle-income trap

The middle-income trap concept focuses on the problem of technological upgrading to explain slow growth at the upper-middle-income stage of development. Technology does not improve or does so only at a slow rate. At the same time, wages rise as the labor market tightens due to the end of surplus labor. Higher wages reduce competitiveness in low-wage activities, which move to other countries. The economy gets trapped between a move out of low-wage goods and an inability to produce new high value goods. Gill and Kharas (2007), who introduced the concept of a middle-income trap over a decade ago, explained it in this way:

> Middle-income countries…are squeezed between the low-wage poor-country competitors that dominate in mature industries and the rich-country innovators that dominate in industries undergoing rapid technological change. This is the challenge that confronts East Asian countries today, especially those in Southeast Asia" (p. 7).

Why might upgrading not happen? There are a number of possible and inter-related reasons: the economy does not provide incentives to innovate; the entrepreneurial class is weak; research and development (R&D) is low; or the education system does not educate sufficient young people in sciences and engineering to create and adapt technology.

The framers of the middle-income concept realized back in the mid-2000s that ASEAN countries possessed few of the characteristics of the more successful knowledge-based economies of northeast Asia. The depiction was particularly direct and somewhat harsh: these middle-income countries exhibited a "mediocre quality of…higher education systems and low enrolment rates, the lack of domestic patents, low levels of innovation and technological diffusion, an absent venture capital eco-system, and assembly-type firms that were not moving rapidly up the value chain" (Gill and Kharas, 2015: 15).

Furthermore, key segments of manufacturing in Southeast Asia are dominated by foreign multinationals. Such investment is by driven cost savings, notably labor costs. There is little doubt that foreign direct investment (FDI) creates jobs, output, and exports and thereby contributes to economic growth. However, innovation and higher value segments of value chains remain in the home countries of global enterprises. Baldwin (2011, 3) has argued that global production chains make "industrialization is easier and faster [but also]…less meaningful". Emerging economies are able to industrialize faster than they would have without FDI but it is less meaningful in the sense that it is based on technological *lending* by foreign firms and not actual technological transfer. As a result, a deep industrial base is not developed.

(iii) Gauging technological progress

Technological progress has always been difficult to gauge due to the lack of quantifiable variables. As a result, new growth theory and related strands of growth analysis are difficult to test empirically. Krugman suggested that the new theory did not advance, after its initial breakthrough, because it lacked testability: "too much of it involved making assumptions about how unmeasurable things affected other unmeasurable things" (Krugman 2013).

There are no direct measures of the technological level of an economy; instead proxy measures are used both on the input side and, more recently, on outputs. Input measures include R&D spending, the number of researchers, and the number of patents. These variables are seldom included in cross-country growth regressions, however, because data is not available for a large number of countries over a long time span. More success has been achieved with human capital because good education time-series data exists for many countries (Barro and Lee, 2018). The results show a strong positive correlation between human capital and economic growth (Mankiw, Romer and Weil, 1992; Hanushek and Woessmann 2007).

More recent work has focused on the output side; which means gauging technological capability by the types of goods produced. This is sometimes referred to as product complexity or sophistication. More technology will allow a country to produce more technologically sophisticated goods and trend changes in the goods produced can show structural change and upgrading. The task then is to create a way of measuring the sophistication of goods. Two approaches have emerged. Both rely on exports instead of domestic production data because of the availability of good data.

Hausmann, Hwang and Rodrik (2007) gauge a product's sophistication by the income level of the countries that export it. The assumption is that higher-income countries produce more complex goods. Their variable is called PRODY and the sum of the sophistication of the products that a country exports gives an economy-wide measure called EXPY.

Hidalgo and Hausmann (2009) pioneered a second approach that generates "complexity" scores on the basis of ubiquity and diversity. A product is considered more complex if it is less ubiquitous (exported by fewer countries) and if the countries that do export the good also export a more diverse range of goods. The idea is that fewer countries export a complex good because it is difficult to make, and that the ability to export a more sophisticated good means that the country should have the capability to make and export a diverse range of other goods. At the product level, the measure is used to create a product complexity index (PCI) of all the goods traded in the world. An economic complexity index (ECI) is used to gauge the overall complexity of an economy's export basket. These two indices are used below to assess the upgrading process in Thailand. ECI is plotted over several decades for Thailand and comparisons are made with other countries. PCI is used more extensively below to gauge complexity upgrading within key sectors in Thailand.

## 3. Changes in Thailand's structure of production

Thailand's slow growth might be explained by a lack of adequate change in the structure of production and the failure to upgrade to producing more technologically sophisticated goods. Domestic production data is considered followed by a more detailed looked at export data using ECI and PCI. The section begins with a review of wage trends.

In most of the analysis we use variables from three discrete years (1996, 2006 and 2016) and calculate the growth rates between them. This approach provides a 20-year time frame to assess change. These specific years were chosen to avoid major economic and political disturbances. 1996 is one year before the onset of the Asian financial crisis and thus is not affected by the crisis, although there were signs of an impending downturn (although not collapse) at that stage. 2006 is after the Asian financial crisis and indeed after the recovery phase (i.e. GDP moved beyond its pre-crisis level). While a coup did take place in that year, it was instigated in the latter months (September) and growth, as measured by the full year, remained strong. Finally, 2016 is chosen as a recent year. It is roughly midway between the coup takeover of 2014 and the transition back to democracy in 2019.

### (i) Wage increase

The concept of a middle-income trap suggests that the growth of output will be constrained by a loss of competitiveness in low-wage goods. Thailand certainly has experienced wage growth, as would be expected for a growing economy. Such wage growth may be impinging on the competitiveness of sectors that are highly wage-sensitive, such as textiles and apparel. As we will see in subsequent analysis, this sector, in fact, has been in decline and this likely reflects increasing wage costs and the shift of production to lower-cost countries.

Figure 1 presents nominal and real wage growth since the early 2000s. The period includes phases of high wage growth and years of minimal growth or decline. Nominal wage growth was negative in 2002, 2009 and 2017. All other years experienced positive growth with a particularly strong phase between 2005 and 2014; wages increased in those 10 years at above 6% in all by two years and peaked at nearly 12%. If we take 2006-2016 as our reference period, the cumulative annual growth rate in nominal wages was 5.7%.

When deflated by the consumer price index (CPI), the increases are, of course, muted but still significant. Real wages increased more than 3% annually in 2010-2014 with more modest increases in prior and subsequent years. The annual growth rate of real wages for 2006-2016 is still a healthy 3.7%.

While wage growth is important, competitiveness is based on the *level* of wages relative to other countries. Here we find that Thailand is clearly in the middle strand of Asian economies. Figure 2 provides data for manufacturing workers from a survey of Japanese-affiliated firms operating in Asia. It provides a rough but useful gauge of wage costs faced by firms. Three groups of economies are discernable. A high-wage group above $18,000 includes Hong Kong, Singapore, and South Korea. A low-wage group below $5,000 includes most other countries in South and Southeast Asia. In the middle is a small group comprising Thailand, China and Malaysia with remuneration between $7,000 and $8,500. Thailand is an upper-middle-income country with middle-level wages.

Rising wages (and the lost of output from wage-sensitive sectors) indicates neither that a country is caught in a middle-income trap nor that it has escaped such a trap. What is important is whether the loss of output (which dampens GDP growth) is offset by increases in the output of less wage-sensitive, more complex goods. It is to this question that we now turn.

(ii) Domestic production

Table 2 presents the data on domestic production for 14 sectors of industry. Overall, industrial output increased 4.3% per year in the first period (1996-2006), but then fell to 2.4% in the second period (2006-2016). That fall manifests itself across the sectors with only the catchall category of ”various” showing a higher growth rate in the second period. In the earlier period half of the sectors grew at more than 5%; in the second period, only one did. Thus the rate of industrial expansion is constrained and contributes to the low GDP figures presented earlier.

The five main sectors are highlighted. Each accounts for more than 10% of industrial output and combined account for about two-thirds of the total. These sectors are food, electronics, petroleum and chemicals, vehicles, and power and water.

To get a sense of structural change and upgrading, we would need to see growth rates in higher tech sectors outpacing growth in the lower tech sectors. Do we see evidence of this? In the first period we certainly do: electronics is the fastest growing sector and is clearly outpacing lower tech sectors such as food and textiles and garments. The high tech sectors, including electronics, machinery and vehicles, along with electrical and plastics, are all growing at more than 5%. In the second phrase we see a similar process but it is weaker as the higher tech sectors are growing more slowly than in the first period. Nonetheless, vehicles and machinery are the fastest growing and are ahead of low-tech sectors. Textiles and garments post a 3% annual decline. However, electronics is among the four slowest-growing sectors.

(iii) Broad changes in the structure of exports

We can a take a slightly more detailed look at upgrading by considering the broad sector aggregates of exports. Export data at the 2-digit level are used to see broad changes between product groups. Nominal export data from the UN Comtrade database were deflated using Thailand's total real and nominal exports provided by the World Bank's *World Development Indicators*, with a base year of 2011.

The top 20 sectors, out of a total of 100, are presented in Table 3 and account for over 80% of all exports. Indeed, the top 5 sectors alone account for over 50% of exports. Over time, exports are concentrating in fewer sectors. The share of the top 5 in total exports increased from 49% to 56%. The share of the top 10 and top 20 show similar increases.

In the top 5, electrical and electronics and machinery maintain their positions as the top exports over two decades. In the most recent 10-year period growth is fairly small in machinery, only 1.7% per year, and there is an average annual decline in electrical and electronics. Thus the two top sectors maintain their dominance but are growing slowly or not at all. They are thus not contributing much to the growth of the overall economy.

For the other sectors in the top 5, there is evidence of a shift from lower to higher value goods. Rubber drops from 3$^{rd}$ place to 5$^{th}$ and shows annual growth of less than 1%. Much of the country's rubber exports are in the form of raw and semi-processed rubber rather than more valuable end products, but there is some shift to more final products as noted later in the paper. Automobiles rise from 17$^{th}$ to 3$^{rd}$ whereas fish, which includes shrimp, moves in the opposite direction from 3$^{rd}$ to 16$^{th}$. In other words, cars have replaced fish in terms of export importance.

Among the next five sectors, we see some similar movements in which commodities and low-value manufactured goods are replaced with higher-value goods. One the biggest changes occurs with apparel. Non-knit items and knitwear are both in the top 10 in 1996. Non-knit later drops out of the 20 and knitwear falls to 19$^{th}$. Staple fibres also drop out of the list. This decline in apparel and fibres is expected for a middle-income country because they are one of the lowest-valued manufactured goods and highly sensitive to wage increases.

Cereals, mostly rice, drop from 6$^{th}$ to 10$^{th}$ place and sugar falls from 10$^{th}$ to 13$^{th}$. Rounding out the full list, we see furniture, toys and aircraft drop out of the top 20. Meanwhile, iron and steel and organic chemicals are added. For the most part, this suggests a transition from lower to higher value exports. Optical products – eyeglass lens are ground and finished in Thailand – rise into the top 10.

(iv) Economic complexity

Thailand's level of economic complexity and its progress over time are assessed using the economic complexity index (ECI). As noted, this a measure of the overall sophistication of exports and can be used to represent the technologically capability of the economy and its businesses.[4] For 2015, index scores range from -3.5 for Sudan as the least complex economy to 1.6 for Japan as the most complex. Thailand's score is 0.99.

Thailand's complexity increased rapidly between 1986 and 1996, the high-growth period of the golden decade (Figure 3). Its global country rank improved from 44 to 27. Since the mid-1990s the increases in complexity have been less rapid and some periods show a slight decline. For example, the trajectory flattens and falls in the late 1990s before increasing again. As well, Thailand's score peaked in 2011 and has been lower in subsequent years, suggesting that technological progress may have stalled. Overall, there has been progress, and in 2015 Thailand was the second highest-ranking country in ASEAN, after Singapore (a figure for Brunei is not available).

Other countries have also flat lined over the past decade or more. Malaysia is a case in point and has actually experienced a fall in complexity in recent years. The trajectories for South Korea and Singapore have also had flat periods and the latter has seen, somewhat surprisingly, a slight but long-term decline after reaching a high level in the early 1990s. This may be the result of the major shift to services, which are not included in the export data.

A key difference between Thailand and Malaysia, on one hand, and South Korea and Singapore, on the other, is that the latter two reached a high level of complexity before beginning to flatten. They continue to rank among the most complex economies in the world; 4th and 7th respectively in 2015. Thailand and Malaysia appear to be flattening at a markedly lower level. Indeed, if economic complexity is a fairly accurate gauge of a country's technological sophistication, then Figure x presents strong corroborating evidence that Thailand and its neighbour may have hit a middle-income trap.

Thailand's progress contrasts sharply with that of China. The latter's trajectory does not flatten after reaching a score of about 1.00 but continues and has surpassed the levels of Singapore and South Korea in recent years.

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[4] We present ECI+ scores (and ranking), which are considered more refined and accurate than ECI scores. ECI+ scores currently exist to 2015, whereas ECI scores are available to 2017.

(vi A closer look at specific sectors

In the sections below, we take a deeper look at product complexity in five sectors: textiles and apparel; rubber; electrical goods (TVs, air conditioners and washing machines); computers, including hard disk drives; and, automobiles.  These products are major export goods for Thailand.

Textiles and wearing apparel

Textiles and garments, in particular, are one of the first steps on the ladder of industrialization due to its low technology requirements and need for abundant low-cost labor. It is also a sector that countries later exit as wages rise and production shifts to lower cost sites. This is what appears to be happening in Thailand.

Table 4 provides data on the exports of 15 product categories of fibres, textiles and apparel.  Apparel (garments and footwear) is in the last four categories and account for nearly half of total exports. Overall, the sector grew between 1996 and 2006 with some product categories experiencing annual growth above 10%.  However, the more recent period has seen a wholesale decline.  Only 3 of the 15 categories grew and growth in these categories was below 5%. All of the other categories experienced negative growth, with the main category of knit and crochet wear falling 5% annually. Overall, the real value of exports fell from about $10 billion to $7 billion in 10 years.

The sector exhibits low product complexity has evidenced by the PCI scores in the right-most column of the table. All the categories show a negative score, except for one, relatively small component. The PCI scores are the lowest in the apparel categories.

The above analysis includes shoes. Thailand has seen a decline in the shoe industry as part of the loss of competitiveness due to rising labor costs.  The shoe sector is varied with many small producers and some medium and larger ones.  The latter sub-contracted the production of key global brands such as Nike and Adidas (TIME 2008).  In 1996, the real value of shoe exports was $1.5 billion, which fell to just over a third, $0.6 billion, by 2016.  Production shifted to Viet Nam, Indonesia and other countries, due mainly to lower labor costs.

Rubber

Thailand is the world's largest producer of natural rubber, with a climate suitable to growing the trees and a tradition stretching back to the introduction of rubber in the early 20th century. The country's main competitors are also in ASEAN, notably Indonesia and Malaysia which are ranked second and third in the world. Traditionally, Thailand tapped rubber and exported it with minimal processing and produced only a relatively small quantity of final goods. This has been changing.

Table x provides a breakdown of the share of production by product complexity, our proxy measure of technology. The trade data lists 84 product categories for rubber. In the table, these categories are grouped into quartiles based on complexity (PCI). The value of exports in each quartile is summed and used to compute the share of each quartile in total rubber exports. The categories include the full range of products from unprocessed or lightly processed natural rubber to synthetic rubber to finished goods.

More than half of the rubber products, by value, are in the lowest category of complexity. Thailand continues to export a large part of its output as natural rubber. Indeed, more than a third (36%) of all exports are from the four categories of natural rubber and these four have the lowest complexity out of all 84 product categories. However, there has been significant change over the past decade. As shown in the table, the share of output from the lowest category has fallen from 73% to 57% and the shares accounted for by more complex categories have risen. The bulk of the movement has been into the moderate level, which is dominated by automobile tyres. There has also been some increase in the medium category, which has increased from 6% to 10%. The category includes tubes and belts (such as conveyor belts). There has, however, been no change in the share of the most complex category.

This is a pattern that is similar in other product categories. There is an advance into more sophisticated goods but that advance remains at a preliminary stage. It is from low complexity to a next stage but there is still much room for growth into more advanced stages of complexity.

TVs, air conditioners and washing machines

Electrical goods are an important part of the export basket of Thailand. The technological sophistication of these goods ranges considerably. This section focuses on television sets (TVs), air conditioners and washing machines.

The production and export of TVs has experienced a rise and then a fall over the past two decades. The real value of the export of TVs and video monitors rose from $1.2 to $2.5 billion between 1996 and 2006 but then fell back to $1.3 billion by 2016. The recent decline is affected by the high profile shift of production to Viet Nam by South Korean conglomerates Samsung and LG, the two largest set producers in the world. Both companies announced their moves in 2015.[5] LG suggested that labor costs, along with quality issues and logistics, were the key factors for the move. Samsung has built a large consumer appliances production facility in Viet Nam and shifted TV production there.

From the trade data presented in Table 6, we consider television sets along with other types of video monitors. 6-digit trade codes do not match across the three years so we use the 4-digit code (8528). TVs are the dominant product in this group. For the 10 years up to 2016, there has been an average annual fall in exports of 6%. Product complexities for TVs are in the negative range and thus the decline of the category is probably not dampening overall economic complexity very much, even as it shows up as lower output.

Thailand is the second-largest exporter of air conditioners in the world, after China. Shipments totalled $4.8 billion in 2016 and there has been a 5% annual increase in since 2006 (Table 6). This suggests a healthy increase in output. However, the sector remains squarely anchored in the lowest product complexity category, which is negative (-0.692). In addition, it has become more concentrated in that type of air conditioner over time. Some 62% of air conditioner exports were in the bottom category in 2016, compared to 53% a decade earlier. Furthermore, there has been an absolute decline in exports from two higher-level product categories.

The third type of electrical good is washing machines. Exports of the 5 types of machines surpassed $1 billion in 2016 and the product segment has seen a 4% annual increase over the previous decade. There has also been movement from less to more complex machines. The share of machines in the least complex category fell by half from 72% to 35% by 2016 (Table 6). The current distribution of machines between three main categories is balanced – each has between 29% and 35%. However, two of those categories are in the negative area in terms of product complexity. Therefore, overall there has been positive growth in production and a move from less to more complex types over 10 years, however overall complexity remains low.

In summary, washing machines and air conditioners have experienced a healthy increase in exports. However, while the mix of washing machines has become more complex, that of air conditioners has become less complex. TVs have experienced a significant decline in total exports.

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[5] Nipon Wongsaengarunsri, marketing director of LG Electronics (Thailand) Co, said, "Our parent company has considered Vietnam as the most worthwhile country to invest in. Wages are one factor... but the main one is to ensure quality, as well as for logistics". LG Electronics to shift TV production in Thailand to Vietnam. Reuters, 17 Mar. 2015. https://www.reuters.com/article/lg-elec-thailand-vietnam-idUSL3N0WJ2HF20150317

Computer electronics

Thailand has an important electronics sector, with a specialization in hard disk drives (HDDs). The assembly of drives began in the early 1980s as Western and Singaporean based producers sought a cheaper production site within the region. The world's top HDD producers have operations in Thailand: Western Digital, Seagate, Toshiba and others.

Table 7 provides a breakdown of exports of computers and related parts and accessories. It includes HDDs, which are listed as storage units.[6] The dominance of drives is shown in the table: 72% computer electronics exports were in this product line alone in 2016. Moreover, computer exports are increasingly concentrated in this product: a decade earlier only 47% of exports where in HDDs. Most of the remaining share (22%) is in the form of parts and accessories, including for disk drives. Thailand does not have a large focus on exporting whole computers. This segment has been growing rapidly (33% per year for a decade) but it is from a very small base and still only represents 1% of computer-related exports.

An HDD is a fairly complex good; it is at the top of the 3rd quartile when the product categories are broken down by product complexity, as they are in Table x. Parts and accessories, the other significant product category, tops the 2nd quartile. Because HDDs are fairly complex products, the increase in their share of exports lifts the overall complexity of this product range. Segments at the lower levels of complexity have seen their shares fall. There is one category that has a higher complexity than HDDs and it has seen its share fall from 3.7% to less than 1%. This fall has put some downward pressure on the average complexity of the product range.

In addition to changes within this product range, it is important to note that the range has seen a decline in exports over the decade. Real exports fell on average by 3.3% annually. This is not a negligible rate and is somewhat surprising for a sector of such importance to the economy. Shipments of HDDs have increased over the decade but only at an average annual rate of 1%. The next biggest category, parts and accessories, has seen an annual decline of 4.5%. Other categories show high rates of both growth and decline but these mostly involve low volume categories.[7]

Automobiles

Thailand is the largest automobile producer in ASEAN and the 11th largest in the world. It produced nearly 2 million vehicles in 2017 (OICA 2019). Japan sought a low-cost location for its auto firms following the Plaza Accord of 1985 and the

[6] It excludes printers.

[7] Electronic integrated circuits (microchips) are included under commodity code 8542 and not included in the above analysis. Circuits show a nominal increase over 10 years of 8% but a decrease of 17% when adjusted for inflation.

attendant exchange rate appreciation that made domestic production less competitive. Thai production rose considerably after the elimination of local content requirements and other restrictions in the 1990s and early 2000s. Following the Asian financial crisis, foreign firms shifted their strategies from serving the domestic market to also using Thailand as a production base in the region. Exports totalled $18 billion in 2016.

We might think of an automobile as a highly complex product but its complexity ranges considerably depending on the type of car or truck. The product complexity for all types of cars is above zero but it is negative for some types of trucks. Generally, complexity rises with the size of the vehicle, in which size is based either on engine capacity (cars) or the weight of goods that can be transported (trucks).

Thailand has one, very small, nationally owned vehicle producer, Thai Rung. Japan has a leading presence and Toyota maintains a large operation. Foreign companies have for the most part brought their automotive technology to Thailand rather than invested in R&D in the country. Toyota does have an R&D facility but it is mainly for making local modifications.

Thailand is specialized in light (pickup) trucks although that specialization has diminished in recent years and cars constitute an increasing portion of the vehicles produced. Table 8 shows the export share of 15 types of vehicles in three discrete years over two decades. The categories include all cars and trucks but exclude buses and specialized vehicles. The vehicles are listed in descending order of product complexity.

The declining share of light trucks, with a capacity of less than 5 tonnes, is noticeable. These pickups accounted for 92% of all vehicles exported in 1996 but the share dropped to 33% three decades later. Pickups register a low product complexity, as indicated by the PCI scores of 0.15 or less and the lowest of the three groups in the table. The shifting share from pickups to other categories has raised the overall complexity of the vehicles the country exports and suggests a rise in technological capability in the automobile sector after 1996.

The decline in the share of small trucks is mostly accounted for by an increase in small and mid-sized cars, those with an engine capacity of up to 3000 cc. Most of these cars are in the mid complexity range, as shown in the table (with scores between 0.42 to 0.84). This range accounts for about 44% of all vehicles.

Of the five types of vehicles in the highest complexity range, only one holds a share above 1%, that is for midsized cars with engines of 1500 cc and 3000 cc. This share is nonetheless significant and accounts for 19% of all vehicles in 2016, up from only 2% in 1996.

Thus, over 20 years the automotive sector has shifted to more complex vehicles. If we consider the past 10 years, the process has been slightly more muted. The mid complexity segment continues to increase its share relative to the low complexity share as the importance of pickups declines. However the share of the high complexity share has fallen. Vehicles with an engine capacity of 1500-3000 cc have fallen from 23% to 19%. A decline from 3% to 1% also occurs for cars over 3000 cc. There appears to be an increasing concentration in the middle complexity group, contributed by declining shares in both the high and low complexity groups – a type of movement to the middle.

## Conclusion

Thailand has experienced slow growth for two decades. One possible explanation is structural. The economy may not be increasing its productive capabilities sufficiently to produce more higher-valued, sophisticated products. At the same time, it may be losing competitiveness in low-technology, price-sensitive products due to rising wages. An inability to upgrade at the high end and losing output at the low end is the definition of a middle-income trap and provides an explanation for slow growth.

Gauging whether a country is upgrading its productive capability is difficult. No direct measure is available. A useful proxy is to consider the complexity of the goods that are produced and exported. The paper uses the indexes of economic complexity and product complexity developed by Hidalgo and Hausmann (2009) to assess the Thai economy and key sectors within it.

On aggregate, the economic complexity of Thailand's exports grew briskly in the decade before the Asian financial crisis. In the decade after, there continued to be progress but at a slower pace. Complexity peaked in 2011 and has dipped slightly in subsequent years. This suggests that Thailand may be falling into the trap but only in recent years.

At the sector level, the evidence is also mixed and follows a similar pattern to aggregate complexity. There was certainly an intra-sectoral transition within industry in the first period (1996-2006) that increased the importance of more complex goods relative to less complex goods. In the second period (2006-2016) such a shift is less pronounced. Across the five sectors reviewed, we see a movement up from the lowest complexity segments toward the middle, but little movement into the highest segments. Rubber and automobiles are key examples of this trend. In other cases, there is actually some movement downward from the high to the middle.

As might be expected, the sector that encompasses fibres, textiles and apparel is in decline with exports falling across nearly all products in the second period. The export of TVs sets has also fallen, partly as a result of a recent shift of Korean producers to Viet Nam. More worryingly, electronics shows a decline in the second period, although hard disk drives, the largest single product, show a modest increase.

Is Thailand upgrading? Yes, it is. Is it upgrading rapidly enough to sustain high or even moderately high growth? It may not be. If the country is not caught in a middle-income trap, it may nonetheless be making a weak structural transition that is hampering economic growth.

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**Table 1: Economic growth and GDP per capita**

| | GDP Growth rate | | GDP p.c. | |
|---|---|---|---|---|
| | 1996-2006 | 2006-2016 | 2017 | |
| | | | $ | PPP $ |
| | | | | |
| Singapore | 5.4 | 4.9 | 57,714 | 93,905 |
| Brunei | 1.9 | 0.4 | 28,291 | 78,836 |
| Malaysia | 4.3 | 4.8 | 9,945 | 29,431 |
| **Thailand** | **3.0** | **3.2** | **6,594** | **17,871** |
| Indonesia | 2.5 | 5.6 | 3,847 | 12,284 |
| Philippines | 4.0 | 5.6 | 2,989 | 8,343 |
| Lao PDR | 6.4 | 7.7 | 2,457 | 7,023 |
| Viet Nam | 6.7 | 6.0 | 2,343 | 6,776 |
| Cambodia | 8.9 | 6.5 | 1,384 | 4,002 |
| Myanmar | 11.3 | 8.4 | 1,299 | 6,139 |
| | | | | |
| China | 9.5 | 9.0 | 8,827 | 16,807 |
| India | 6.6 | 7.3 | 1,940 | 7,056 |
| | | | | |

Source: Data from World Development Indicators. Growth rate calculations by the author.
Notes: Growth rate: cumulative annual growth rate. p.c.= per capita. GDP = gross domestic product

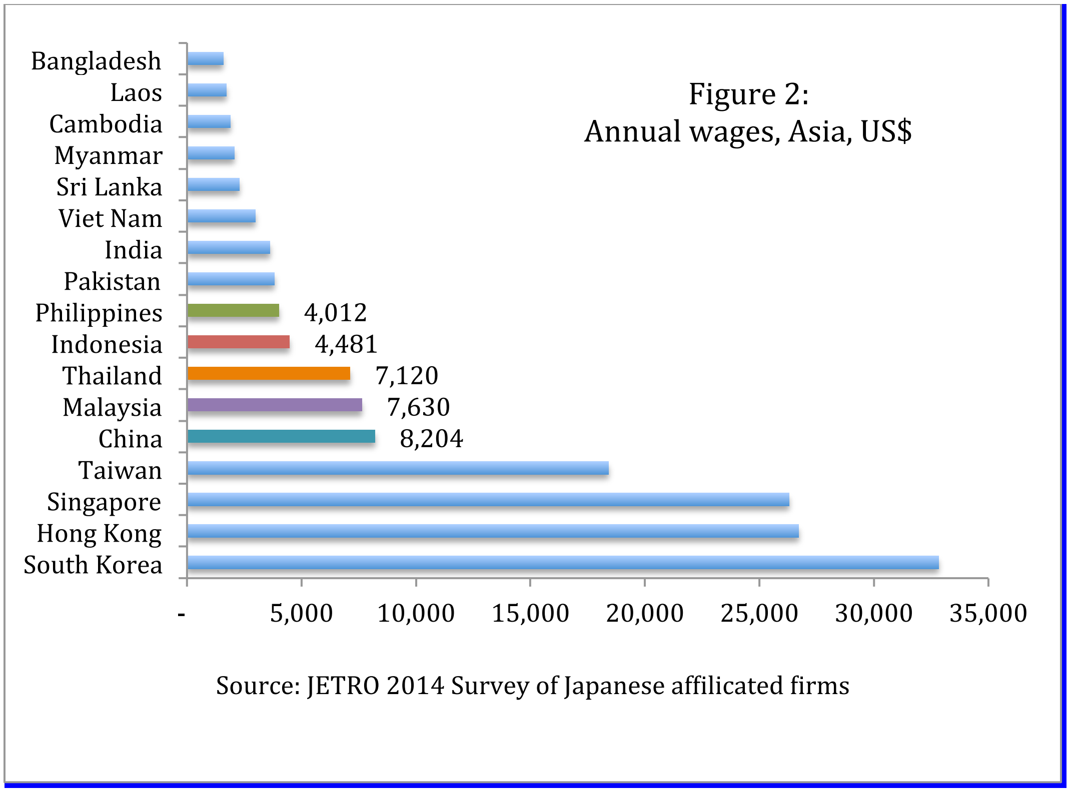
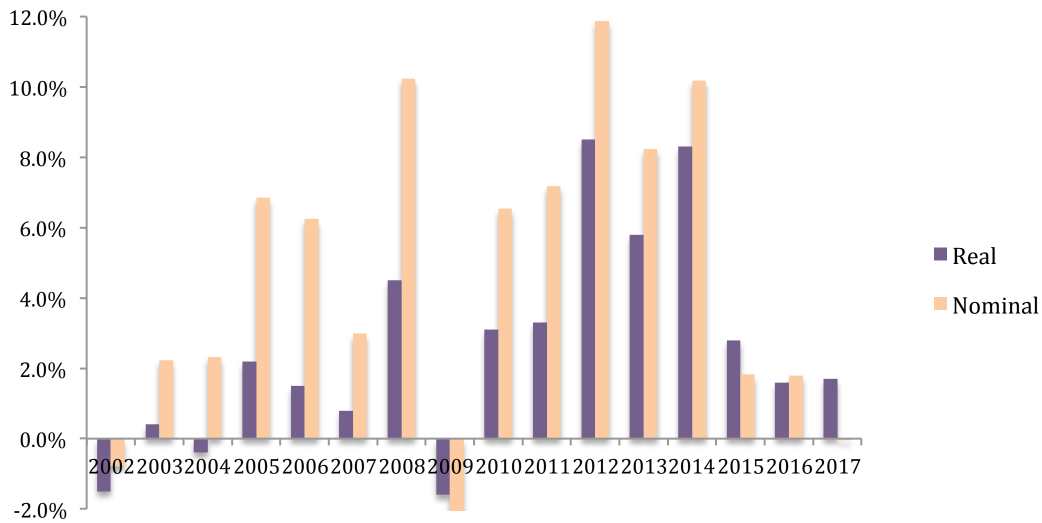


Figure 2:
Annual wages, Asia, US$
Bangladesh
Laos
Cambodia
Myanmar
Sri Lanka
Viet Nam
India
Pakistan
Philippines
Indonesia
Thailand
Malaysia
China
Taiwan
Singapore
Hong Kong
South Korea
4,012
4,481
7,120
7,630
8,204
-
5,000
10,000
15,000
20,000
25,000
30,000
35,000
Source: JETRO 2014 Survey of Japanese affilicated firms

Figrue 1: Real and nominal wages increases, Thailand



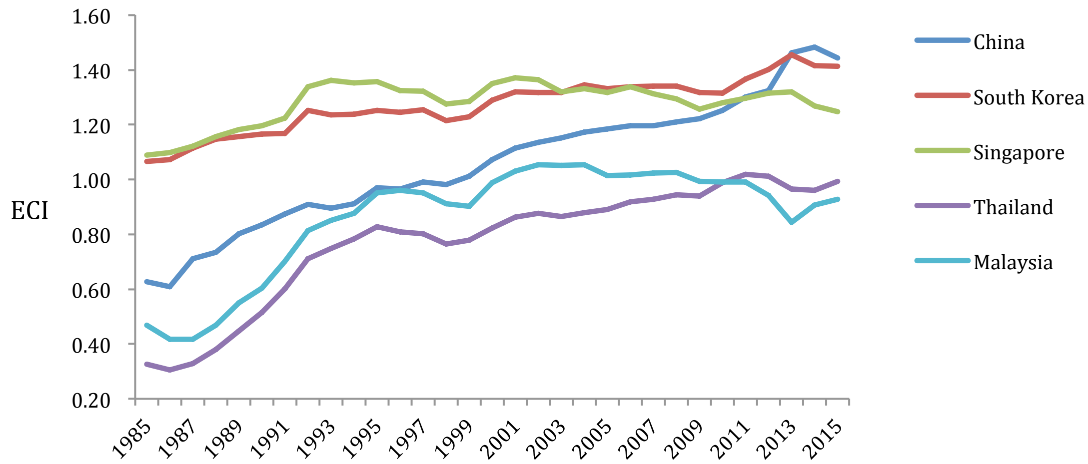

Notes: Real wages calculated using consumer price index (CPI).
Sources: Bank of Thailand for nominal wages, using a simple average of quarterly average wages.
ILO (personal communication) for real values.

**Table 2: Sector production growth, Thailand**

| | | Share of Total Output 2016 | CAGR 1996-2006 | CAGR 2006-2016 |
|---|---|---|---|---|
| | | % | % | % |
| 1 | Food and Beverages | 18.3 | 2.5 | 2.0 |
| 2 | Textiles and Garments | 7.0 | 2.1 | -3.0 |
| 3 | Paper and Wood | 3.0 | 4.2 | 1.6 |
| 4 | Petro and chemicals | 11.1 | 3.7 | 3.2 |
| 5 | Rubber | 2.2 | 7.7 | 3.1 |
| 6 | Plastics | 3.0 | 8.2 | 3.5 |
| 7 | Glass, clay, cement, etc. | 3.8 | 2.2 | 0.5 |
| 8 | Metal and products | 4.5 | 4.1 | 0.7 |
| 9 | Electronics, etc. | 12.2 | 9.4 | 2.0 |
| 10 | Electrical | 2.7 | 8.4 | 4.2 |
| 11 | Machinery | 4.7 | 6.3 | 5.0 |
| 12 | Vehicles | 12.5 | 5.7 | 4.9 |
| 13 | Various | 3.8 | 0.9 | 3.5 |
| 14 | Power and water | 11.1 | 5.4 | 4.4 |
| | | | | |
| | | 100.0 | 4.3 | 2.4 |

Notes: Shares above 5% are shaded.
Source: Thailand Stats Office, ???

Figure 3: Economic Complexity Index, 1985-2015




Source: Observatory of Economic Complexity,
https://atlas.media.mit.edu/en/rankings/country/eci/

| Table 3: Top 20 exports products, by value, Thailand<br>1996, 2006, 2016 | | | | |
|---|---|---|---|---|
| **Rank** | **1996** | **2006** | **2016** | **Annual growth % 2006-2016** |
| 1 | EE | Machinery | Machinery | 1.7 |
| 2 | Machinery | EE | EE | -0.3 |
| 3 | Rubber | Vehicles | Vehicles | 7.5 |
| 4 | Fish | Rubber | Precious stones | 11.5 |
| 5 | Precious stones | Fuel | Rubber | 0.6 |
| | | | | |
| 6 | Cereals | Plastics | Plastics | 3.1 |
| 7 | Apparel, non knit | Meat-fish proc. | Fuel | -3.0 |
| 8 | Meat-fish, proc. | Precious stones | Meat-fish proc. | 1.3 |
| 9 | Apparel, knit | Cereals | Optical and photo | 6.6 |
| 10 | Sugar | Organic chemicals | Cereals | 2.8 |
| | | | | |
| 11 | Footwear | Fish | Iron and steel | 4.3 |
| 12 | Plastics | Optical and photo | Organic chemicals | 1.2 |
| 13 | Fuel | Iron and steel | Sugar | 8.5 |
| 14 | Optical | Apparel, knit | Wood | 5.7 |
| 15 | Veg.-fruit, proc. | Not specified | Veg.- fruit, proc. | 3.3 |
| | | | | |
| 16 | Furniture | Clothing, not knit | Fish | -3.4 |
| 17 | Vehicles | Iron and steel | Misc. food, proc. | 7.6 |
| 18 | Staple fibres | Furniture | Essential oils | 7.6 |
| 19 | Aircraft | Veg.-fruit, proc. | Apparel, knit | -4.8 |
| 20 | Toys | Aircraft | Paper | 1.5 |
| | | | | |
| **Share of total exports** | | | | |
| Top 5 | 49.2 | 55.6 | 56.3 | |
| Top 10 | 64.5 | 70.4 | 72.0 | |
| Top 20 | 80.5 | 83.6 | 83.5 | |
| | | | | |
| Notes: proc. = processed; prod. = products; rice = all cereals; Precious stones, includes pearls, metals such as gold, coins, etc.; EE = electric and electronics products; fish = unprocessed seafood including shrimp. Rubber includes articles made from rubber, plastics includes articles made from plastic. Iron and steel includes products made thereof. Fuel is mostly petroleum oil. Exports, 2-digit level, HS92. Average cumulative growth, in real terms.<br>* or shaded: Column 1996: products not in the top 20 in 2016. Column 2006: products whose real export value fell between 2006 and 2016. Column 2016: products that were not in the top 20 in 2006. | | | | |
| Source: UN Comtrade, website | | | | |

Table 4: Textiles and apparel: growth rates

| Code | Product | Share of total value | CAGR 1996-2006 | CAGR 2006-2016 | PCI |
|---|---|---|---|---|---|
| 50 | Silk | 0.00 | -0.01 | -0.14 | -0.58 |
| 51 | Wool, animal hair, horsehair yarn and fabric | 0.01 | -0.01 | -0.05 | -0.49 |
| 52 | Cotton | 0.07 | 0.04 | -0.04 | -1.08 |
| 53 | Vegetable textile fibres nes, paper yarn, woven | 0.00 | 0.01 | 0.02 | -0.96 |
| 54 | Manmade filaments | 0.10 | 0.06 | -0.00 | -0.23 |
| 55 | Manmade staple fibres | 0.16 | 0.04 | -0.01 | -0.42 |
| 56 | Wadding, felt, nonwovens, yarns, twine, cordage | 0.07 | 0.09 | 0.04 | -0.17 |
| 57 | Carpets and other textile floor coverings | 0.02 | 0.13 | -0.00 | -0.65 |
| 58 | Special woven or tufted fabric, lace, tapestry etc | 0.03 | 0.10 | -0.01 | -0.57 |
| 59 | Impregnated, coated or laminated textile fabric | 0.02 | 0.08 | -0.03 | 0.61 |
| 60 | Knitted or crocheted fabric | 0.04 | 0.16 | 0.04 | -0.52 |
| 61 | Articles of apparel, accessories, knit or crochet | 0.23 | 0.04 | -0.05 | -1.66 |
| 62 | Articles of apparel, accessories, not knit or crochet | 0.11 | -0.00 | -0.09 | -1.49 |
| 63 | Other made textile articles, sets, worn clothing | 0.05 | 0.07 | -0.01 | -1.26 |
| 64 | Footwear, gaiters and the like, parts thereof | 0.09 | -0.02 | -0.06 | -1.09 |

Notes: Share of total value: share of each product category out of all products in the table.
Shares above 5% are shaded.

CAGR = cumulative average growth rate. PCI: product complexity index

Based on 2-digit trade codes

Source: Author's calculations, based on UNComtrade data

Table 5: Rubber exports, by product complexity

| Product complexity quartiles | Product complexity range | | Share of total rubber exports % | |
|---|---|---|---|---|
| | Lower bound | Upper bound | 2006 | 2016 |
| High | 0.75 | 2.68 | 4 | 4 |
| Medium | 0.34 | 0.74 | 6 | 10 |
| Moderate | -0.16 | 0.34 | 17 | 29 |
| Low | -2.88 | -0.32 | 73 | 57 |

Notes: Exports divided into quartiles based on product complexity index, PCI
Sources: Author's calculations. Export data from UNComtrade and PCI rates from Observatory of Economic Complexity (OEC)
https://atlas.media.mit.edu/en/rankings/product/sitc/

| Table 6: Washing machines, air conditioners and TVs, exports | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Commodity** | **Share 2006** | **Share 2016** | **Total, 2016 $, millions** | **PCI** | **Growth rate CAGR 2006-2016** |
| **Washing machines** | | | | | |
| Fully automatic | 0.17 | 0.33 | 344 | 0.156 | 0.11 |
| Built in drier | 0.72 | 0.35 | 368 | -1.052 | -0.04 |
| Without built in dryer | 0.07 | 0.00 | 4 | -0.909 | -0.22 |
| Exceeding 10 kg | 0.01 | 0.29 | 309 | -0.311 | 0.45 |
| Parts | 0.02 | 0.03 | 32 | 0.615 | 0.07 |
| | 1.00 | 1.00 | 1,057 | | 0.04 |
| **Air conditioners** | | | | | |
| Window or wall | 0.53 | 0.62 | 3,021 | -0.692 | 0.07 |
| Used in cars | 0.01 | 0.01 | 30 | 0.899 | 0.02 |
| Not window or wall | | | | | |
| with reversible heat pump | 0.10 | 0.09 | 450 | 0.178 | 0.04 |
| with refrigerating unit | 0.11 | 0.07 | 322 | 0.333 | -0.01 |
| without refrigerating unit | 0.16 | 0.10 | 482 | 1.057 | -0.00 |
| Parts | 0.09 | 0.11 | 541 | 0.707 | 0.07 |
| | 1.00 | 1.00 | 4,846 | | 0.05 |
| **TVs and monitors** | | | | | |
| Code 8528 | n/a | n/a | 1,348 | n/a | -0.06 |
| | | | | | |
| Notes: CAGR = cumulative average growth rate | | | | | |
| PCI = product complexity index | | | | | |
| Source: Author's calculations based on UNComtrade data, PCI is from OEC | | | | | |

| | **Table 7: Data processing machines, including computers** | | | | |
|---|---|---|---|---|---|
| | | | 2006 | 2016 | CAGR |
| | | PCI | Share | Share | 2006-2016 |
| 847141 | Other data processing machines: in same housing | 1.38 | 0.000 | 0.001 | 0.242 |
| 847149 | Other data processing machines: systems | 1.30 | 0.000 | 0.001 | 0.057 |
| 847150 | Data processing units other than 8471.41/8471.49 | 1.25 | 0.037 | 0.003 | -0.245 |
| 847180 | Other data processing machines, excl. 8471.50, 8471.60, 8471.70. | 1.17 | 0.029 | 0.028 | -0.037 |
| | | | | | |
| 847170 | Storage units | 1.02 | 0.467 | 0.719 | 0.010 |
| 847290 | Other office machines (eg. duplicating, banknote dispensers, etc. | 0.67 | 0.000 | 0.002 | 0.117 |
| 847340 | Parts and accessories of the machines of heading 84.72 | 0.60 | 0.000 | 0.002 | 0.381 |
| 847350 | Parts and accessories, for two/more of 84.69 to 84.72 | 0.48 | 0.000 | 0.003 | 0.336 |
| | | | | | |
| 847330 | Parts and accessories of the machines of heading 84.71 | 0.47 | 0.255 | 0.224 | -0.045 |
| 847329 | Other arts and accessories for 84.70 (i.e. calculators) | 0.46 | 0.000 | 0.000 | -0.114 |
| 847190 | Magnetic/optical readers | 0.37 | 0.100 | 0.003 | -0.329 |
| 847321 | Parts and accessories 84.70 (i.e. calculators) | 0.27 | 0.000 | 0.000 | -0.056 |
| | | | | | |
| 847130 | Portable data processing machines, up to 10 kg | 0.22 | 0.000 | 0.010 | 0.322 |
| 847310 | Parts and accessories of 84.69 (i.e. word processors) | 0.15 | 0.002 | 0.001 | -0.148 |
| 847210 | Duplicating machines | -0.21 | 0.000 | 0.003 | 0.585 |
| 847160 | Input/output units | -0.26 | 0.108 | 0.000 | -0.437 |
| | | | | | |
| | Total | | 1.000 | 1.000 | -0.033 |
| | | | | | |
| PCI = product complexity index. Product are listed in descending order based on PCI score. | | | | | |
| CAGR: Cumulative average growth rate, based on real exports | | | | | |
| Source: Author's calculation from UNComtrade data | | | | | |

| Table 8: Vehicle exports (cars and trucks) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Type** | **Diesel Semi-diesel** | **Size** | **PCI** | **1996** | **2006** | **2016** | **Growth rate, 2006-2016** |
| | | | | | | | |
| Car | | station wagons, n.e.c. | 1.50 | 0.00 | 0.00 | 0.00 | 0.68 |
| Car | | 1500-3000 cc | 1.34 | 0.02 | 0.23 | 0.19 | 0.15 |
| Car | | > 3000 cc | 1.31 | 0.01 | 0.03 | 0.01 | 0.06 |
| Truck | * | > 20 tonnes | 1.04 | 0.00 | 0.00 | 0.00 | -0.01 |
| Truck | | > 20 tonnes | 0.86 | 0.00 | 0.00 | 0.00 | 0.85 |
| | | | | | | | |
| Car | * | 1500-2500 cc | 0.84 | 0.00 | 0.06 | 0.12 | 0.20 |
| Car | * | < 1500 cc | 0.83 | 0.00 | 0.00 | 0.00 | 0.16 |
| Car | * | d 1500 2500 cc | 0.75 | 0.00 | 0.04 | 0.13 | -0.02 |
| Car | | 1000-2500 cc | 0.49 | 0.02 | 0.09 | 0.17 | 0.09 |
| Car | | < 1000 cc | 0.42 | 0.00 | 0.00 | 0.02 | 0.04 |
| | | | | | | | |
| Truck | * | < 5 tonnes | 0.15 | 0.84 | 0.47 | 0.33 | 0.00 |
| Truck | | n.e.c | 0.04 | 0.00 | 0.00 | 0.00 | 0.28 |
| Truck | | < 5 tonnes | -0.21 | 0.08 | 0.08 | 0.02 | -0.06 |
| Truck | | > 5 tonnes | -0.52 | 0.00 | 0.00 | 0.00 | 0.24 |
| Truck | | dumpers, off-highway | -0.75 | 0.01 | 0.00 | 0.00 | -0.06 |
| | | | | | | | 0.08 |
| Notes: Based on 6-digit data, PCI = product complexity index. Shares above 5% are shaded Source | | | | | | | |
| Source: Calculations by author based on UNComtrade data,<br>PCI data is from Observatory of Economic Complexity<br>https://atlas.media.mit.edu/en/rankings/product/sitc/ | | | | | | | |

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