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EQuIP

Enhancing the Quality of Industrial Policies

TOOL 3

Industrial and Export Upgrading

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EQuIP Tool 3:

Industrial and Export Upgrading

Summary Sheet

Enhancing the Quality of Industrial Policies (EQuIP) – Tool 3	
Name of the tool:	Industrial and Export Upgrading
Objective:	Upgrading a country's industrial sector and exports towards more attractive and higher value-added activities is an important dimension of industrial development. This tool aims to outline methodologies to analyse upgrading processes within a country's industrial sector at various levels, including the macro level (i.e. the industrial sector as a whole), the sub-sectoral level and the product level.
Key questions addressed:	At the macro level, how fast have the country's production and export structures moved towards higher-technology activities or products, relative to its comparators? Within a given sub-sector, what are the products that generate higher returns? How well did the country tap into those products, relative to its comparators? What have been the upgrading strategies for different products within a sub-sector? Do they contribute to higher value-added relative to a given sub-sector's total output?
Indicators used:	Share of medium- and high-tech (MHT) activities in Manufacturing Value Added (MVA) Share of MHT exports in total manufacturing exports Share of high-value products in sub-sector's total production Share of high-value products in sub-sector's total exports Change in export unit values Change in world export market share Share of value-added in total output of a sub-sector

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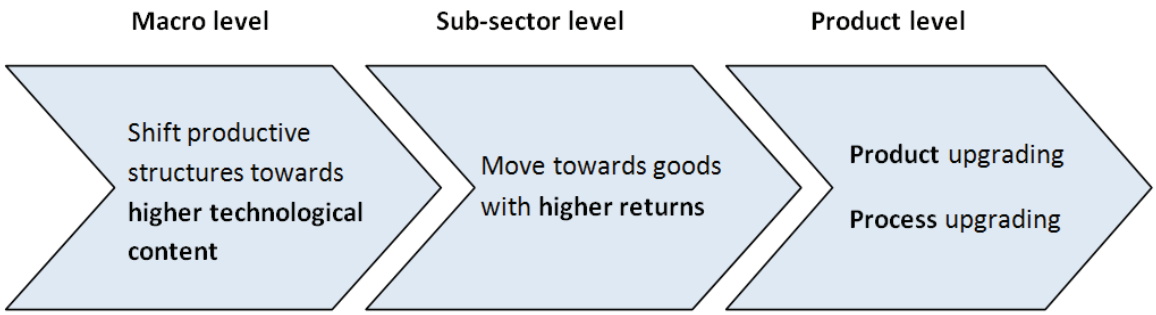
1.Introduction

A pervasive problem in many developing countries today is the reliance on simple productive activities which generate little value-added and hardly any positive externalities to the rest of the society. Unsophisticated products often leave the economy highly vulnerable to external shocks in weather, commodity prices, and fierce foreign competition due to their low barriers to entry. The terms of trade for simple commodities tend to decline over time, i.e. it will often take more and more export of simple products to be able to import the same amount of complex goods. Developing countries facing declining terms of trade will consequently find it harder to boost their economic growth. In terms of employment, unproductive activities are unable to create adequate (i.e. quality and productive) jobs to lift poor people out of poverty. Linkages to other sectors are often non-existent, especially in the case of 'enclave' activities or sub-sectors where capital-intensive agricultural plantations, mines, or oil wells are owned by foreigners. Reliance on simple activities, such as natural resource extraction, can also pose real threats to the environment in developing countries.

It is thus important for developing economies to *upgrade* their productive structures toward more attractive activities (see Figure 1). At the *macro* level, upgrading entails a gradual shift towards producing and exporting goods with higher technological content. Higher-technology goods tend to have higher barriers to entry and less vulnerability to price shocks than simple commodities. Further, externalities and rents are not associated with all goods equally, and structural transformation towards more complex production can generate strong linkages and positive externalities (i.e. knowledge spillovers) that benefit the whole society. At the *sub-sector* level, where products contain similar technological content, upgrading emphasises the movement towards goods that generate higher returns, and consequently contribute more to economic development. At the *product* level, upgrading comprises product upgrading and process upgrading. A successful case of the former is characterised by better product quality, leading tohigher unit prices and higher market shares. A successful case of the latter entails more efficient production processes, which helps lower the unit cost and gain market shares.

Figure 1: Different tiers of upgrading



The shift towards more attractive activities, while important, does not happen automatically. Developing economies are ridden with market failures which prevent upgrading. One such failure is the lacking supply of innovation and new knowledge, since benefits would likely externalise to the whole society while upgrading costs are internalised only to the innovators. Successful industrial and export upgrading also requires simultaneous improvements across multiple input markets – for instance finance, skills, and infrastructure - which are beyond the capacity of individual firms to achieve. Indeed, no developing country has ever transformed their productive structures successfully without positive intervention from the state.

In this context, the tool aims to contribute to the formulation of sound upgrading strategies in low-income and lower-middle income countries. It first provides diagnostic methodologies that

help inform policy-makers of their countries' past upgrading performance at the macro, sub-sector and product levels. The use of benchmarking exercises further assists the setting of sensible upgrading targets for the coming years. While the list of indicators covered in this tool is by no means exhaustive, it is able to give policy-makers a rather detailed picture of their country's export and industrial upgrading performance, as well as potential room for improvement. Additionally, the tool also specifies its linkages to other areas of inclusive and sustainable industrial development, presenting (possible) implications of economic upgrading on industrial growth, productive employment and energy efficiency level in the country. It is thus important that analysts do not use this tool in isolation, but rather in conjunction with other tools in the *Enhancing the Quality of Industrial Policies* (EQuIP) toolbox.

Since the manufacturing sector plays a key role in the transformation of low-income countries' productive structures, it will serve as the focus of this tool. The methodology, however, can also be applied to the (tradable) services sector. Overall, the tool addresses the following key questions:

- At the **macro** level, how fast have the country's production and export structures evolved towards higher-technology activities/products, relative to its comparators?
- Within a **sub-sector**, what are the products that generate higher returns? How well did the country tap into those products, relative to its comparators?
- What have been the upgrading strategies for different **products** within a sub-sector? Do they contribute to higher value-added relative to the sub-sector's output?

The rest of the tool is structured as follows. Section 2 presents the methodology. Section 3 illustrates how to interpret findings resulting from its application. Section 4 introduces possible extensions to the current tool. The last section links the current tool to other areas of inclusive and sustainable industrial development.

2.Methodology and Analytical Steps

This section provides a guide to calculate the indicators of industrial and export upgrading, which are grouped into three sub-sections: macro, sub-sector, and product indicators. For each sub-section, the tool looks at both the domestic and export dimensions, and addresses questions such as: Which indicators can be used to measure industrial and export upgrading at the macro, sub-sector, and product levels? What are their rationales? How are they calculated? Which data sources can analysts use? What are the analytical steps to be taken? The next section on *Interpretation of findings* will illustrate how these indicators can be graphically represented and interpreted.

2.1 Macro indicators

There are two indicators to be used at the macro level: (1) Technological content of a country's manufacturing production; and (2) Technological content of a country's export basket[1]. These two indicators explore the technological structure of a country's production and exports and are based on the methodology of UNIDO's Competitive Industrial Performance (CIP) Index.

The technological classification used in this tool has been developed by the Organization for Economic Cooperation and Development (OECD). This is a well-known classification scheme, which divides manufacturing products and sub-sectors into four groups: resource-based, low-tech, medium-tech, and high-tech, based on research and development (R&D) expenditure data. The tables in Annexes 1 and 2 give the detailed classification for all manufacturing sub-sectors which analysts can use r he computation of the following indicators.

2.1.1 Technological content of a country's manufacturing production

The first indicator looks at a country's technological structure from the domestic side, and is calculated as the country's *share of medium- and high-tech activities in total manufacturing value added*. An increase in the share of medium- and high-tech value-added means that more technological upgrading has taken place in the country.

To calculate this indicator, analysts must have data on *value-added of medium- and high-tech sub-sectors* and *total manufacturing value-added* for all benchmarking countries (see Table 1). Both can be extracted from the United Nations Industrial Development Organization (UNIDO)'s Industrial Statistics (INDSTAT) database. The technological classification of sub-sectors is done using the International Standard Industrial Classification (ISIC[2]) Revision 3, and is provided in the Appendix of the tool.

This indicator should be analysed in conjunction with either the *industrial structure* indicator from the *Industrial capacity and growth* tool (Tool 1), or the *technological content of a country's export basket* indicator from this tool. The former joint analysis will shed light on the industrialization intensity of a country, that is, whether the country has been able to gradually shift from primary activities to manufacturing activities, and within manufacturing from resource-based and low-tech activities to medium- and high-tech ones.

The rationale for the latter is that an analysis based solely on either indicator of technological content would likely give a misleading picture of the actual upgrading performance in manufacturing. For instance, it may be the case that a country has a high technological content of manufactured

1 Export hereafter refers to manufacturing exports, unless specified otherwise.

2 ISIC is the acronym for International Standard Industrial Classification of All Economic Activities, which is a system for classifying economic data. Categorisation schemes like this are revised from time to time in order to reflect changes in the product range available. Here we suggest using Revision 3 (rev. 3) of the ISIC data classification scheme.

exports but only assembles high-tech products for multinational corporations which generates very little domestic (high-tech) value added. In contrast, high technological content of manufacturing value added may result from over-protecting the domestic market at the expense of international competitiveness.

Table 1: Technological content of a country's manufacturing production

Indicator	Variable	Source
Share of medium- and high-tech activities in manufacturing value added	Value added of medium- and high-tech sub-sectors	INDSTAT
	Manufacturing value added (MVA)	INDSTAT

2.1.2 Technological content of a country's manufacturing export basket

This indicator looks at a country's technological structure from the export side, and is calculated as the *share of medium- and high-tech manufacturing exports in total manufacturing exports*. A higher share indicates a more technologically-advanced export structure. As discussed earlier, this indicator should be investigated together with its counterpart on the domestic side to see whether a more advanced export structure results from actual upgrading or only from assembling medium- and high-tech products which are then re-exported.

To calculate this indicator, analysts need to have data on *medium- and high-tech manufacturing exports* and *total manufacturing exports* for all benchmarking countries (see Table 2). Both variables can be extracted from the United Nations Commodity Trade Statistics (UN Comtrade) database. The technological classification of export products is done using the Standard International Trade Classification (SITC[3]) Revision 3 at the three-digit level, and is provided in the Appendix of the tool.

Analysts can interpret this indicator together with the *export structure* indicator, measured by the share of manufacturing exports in total merchandise exports, from the *Industrial capacity and growth* tool (Tool 1). Together, these two indicators reveal the role of manufacturing in the country's export activity and the technology complexity of the country's export basket. The desired path is to export more manufactured goods relative to total exports and within manufacturing to increase the share of technologically-complex products.

Table 2: Technological content of a country's export basket

Indicator	Variable	Source
Share of medium- and high-tech exports in total manufacturing exports	Medium- and high-tech manufacturing exports	UN Comtrade
	Total manufacturing exports	UN Comtrade

So far, we have discussed the shift towards producing and exporting goods with higher technological content. Within a sub-sector, where products have similar technological level, the focus should be on goods that generate higher returns. The following part will outline indicators used for sub-sector upgrading.

3 SITC stands for Standard International Trade Classification and refers to an internationally standardised system of names and numbers to categorise and classify traded products. These categorisation schemes are revised from time to time in order to reflect changes in the product range available. Here we suggest using Revision 3 (rev. 3) of the SITC data classification scheme.

2.2 Sub-sector indicators

Dividing manufacturing production and exports by sub-sectors gives a good understanding of the types of productive activities a country has been engaging in. Yet sub-sectors are still a very broad category. Each sub-sector includes a wide range of products, some of which may be more similar to each other (for example in terms of their main input, production processes or level of technological content), while others may be quite different. This tool recognises that it may be more beneficial to produce a higher amount of certain products than others.

The question then is which products are considered to be 'better' to produce/export within a sub-sector? There are many factors one could use to determine this. The OECD's technological classification uses R&D expenditure at the three-digit level of disaggregation to determine those product groups which are medium- and high-tech. While this classification makes sense for the overall manufacturing level, it is not sufficiently disaggregated for an analysis within sub-sectors as most product groups within the sub-sectors are classified alike in terms of technological content.

In view of this, UNIDO has developed a further classification to determine which product groups within each sub-sector can be considered to be 'better' to produce and export. This classification splits the product groups within each sub-sector into low-value and high-value products. The criterion used for this splitting are the average global export unit values[4] of products at the 3-digit level of disaggregation of the SITC categorization scheme. That is, UNIDO has calculated average global export unit values of every three-digit product group in order to create a list of products that ranks them according to their export unit value and that allows us to determine the higher-value products within each sub-sector (as opposed to lower-value products within each sub-sector at the bottom of the ranking).[5] In the cases where there is already a distinction in the OECD's technological classification, the products were usually separated accordingly. Table 3 provides one example for each sub-sector of products which are considered to have high value and one example of a product that is considered low-value. The complete list is included in the Appendix.

Table 3: Examples of product classifications by sub-sector

Sub-sector	Example Product Groups (with SITC rev 3 codes)			
	High Value Product Groups		Low Value Product Groups	
1 Food, Beverages and Tobacco	062	Sugar confectionery	061	Sugar/mollasses/honey
2 Textiles, Wearing Apparel and Leather Products	654	Woven textile fabric nes	651	Textile yarn
3 Wood and Paper Products	6354	Domestic/decor wood art.	247	Wood in rough/squared
4 Metal Products	678	Iron/steel wire	676	Iron/steel bars/rods/etc
5 Coke, Refined Petroleum, Non-metallic Mineral	625	Rubber tyres/treads	334	Heavy petrol/bitum oils
6 Machinery, Equipment and Telecommunications	752	Computer equipment	762	Radio broadcast receiver
7 Transport Equipment	792	Aircraft/spacecraft/etc	784	Motor veh parts/access
8 Chemical and Plastic Products	541	Pharmaceut exc medicamnt	597	Oil etc additives/fluids

This classification created by UNIDO is a suggestion only. There are indeed various ways in which higher-value products can be identified and grouped. One could use, for example, the extent

4 See Table 8 below for how export unit values are calculated.

5 It is important to emphasize that here we are really only talking about average unit *values* (which are proxies for unit *prices*) but we do not say anything about technology content or technological sophistication of products. In fact, some high-value products might actually have low technology content.

of R&D expenditure (as suggested by the OECD), profit margins, average wages of workers, and information from industry experts.

Drawing on UNIDO's classification, this sub-section outlines a methodology to assess the degree of upgrading towards high-value products within a sub-sector. It comprises two indicators: (1) Share of high-value products in sub-sector's production; and (2) Share of high-value products in sub-sector's exports.

2.2.1 Share of high-value products in sub-sectoral production

This indicator is calculated as the *share of value-added from high-value products in a sub-sector's total value-added*. That is, this indicator helps to observe how much of the total value-added generated in any given sub-sector is derived from the production of high-value products.[6] A larger share implies better capabilities of firms to produce goods with high returns. Observing changes in this indicator over time will give us a sense of whether upgrading has taken place in any given sub-sector towards those products that generally provide better returns.

To calculate this indicator, analysts need to have data on *value-added of high-value products within a sub-sector* and *total value-added of a sub-sector* (see Table 4). The former can be extracted from INDSTAT4 (for product groups at the 4-digit level of disaggregation), while the latter from INDSTAT2 (for two-digit groups). Please note, however, that INDSTAT data are grouped by *activities* rather than *products*. Analysts, thus, have to match the list of high-value products within a sub-sector (which, as outlined above, were identified in the SITC Rev. 3 data classification scheme using UNIDO's methodology) with their corresponding industrial activities (in ISIC Revision 3). However, such a correspondence table between SITC codes and ISIC codes has not yet been established by UNIDO.[7] Moreover, data availability at such high level of disaggregation can be an issue for many lower-income countries.

An increase in this indicator can be interpreted as upgrading towards higher-value products within a given sub-sector. The interpretation of this indicator should look at its trend as well as compare a country's level to that of its competitors or 'role models'. The latter shows the country's current standing relative to other benchmarking economies, and can assist the setting of upgrading targets for the coming years. Further, this indicator can also be jointly analysed with the *sub-sector industrial capacity* indicator (from Tool 2) to explore how increased production of high-value goods has translated into higher capacity of the sub-sector.

Table 4: Share of high-value products in a sub-sector's total production

Indicator	Variable	Source
Share of high-value products in sub-sector's total production	Value-added of high-value products within a sub-sector	INDSTAT4 (for 4-digit product groups)
	Total sub-sector value-added	INDSTAT2 (for 2-digit product groups)

6 Two comments are warranted: First, it is important to note that upgrading can also take place by transforming low-value into high-value products within a sub-sector. This will be discussed under the heading of "product upgrading" in section 2.3 below. Second, while high-value products can be expected to have higher returns *per unit*, shifting sub-sectoral output towards these high-value products does not necessarily lead to higher *overall* returns. This is because producing and selling low-value products in bulk, i.e. at large scale, can lead to a situation where the volume of (mass) production more than compensates for lower unit prices.

7 Note that a variety of such correspondence tables can be downloaded from the United Nation Statistic's Division's website (http://unstats.un.org/unsd/cr/registry/regot.asp?Lg=1) and the World Integrated Trade Solution (WITS) website (http://wits.worldbank.org/).

2.2.2 Share of high-value products in sub-sectoral exports

This indicator is complementary to the previous one, and is calculated as the *share of high-value exports in sub-sector's total exports*. A higher share implies a more upgraded export structure of a sub-sector.

To calculate this indicator, analysts need to have data on *exports of high-value products within a sub-sector* and *total exports of a sub-sector* (see Table 5). Both of these are available to download from UN Comtrade database. The list of high-value exports is included in Appendix 3 of this tool.

The interpretation of this indicator should look at its trend as well as compare a country's level to that of its competitors or 'role models'. Further, this indicator should also be analysed together with its counterpart on the industry side, to see whether a more upgraded export structure is truly the result of higher production capabilities or simply from engaging in the assembling stage of production where little value added is generated.

Table 5: Share of high-value products in a sub-sector's total exports

Indicator	Variable	Source
Share of high-value products in sub-sector's total exports	Exports of high-value products within a sub-sector	UN Comtrade
	Total sub-sector exports	UN Comtrade

The previous two sub-sections have looked at the shift towards new and 'better' sub-sectors/products. Upgrading, however, also entails improvements in *existing* products and processes. The following part will take into considerations these factors.

2.3 Product-level indicators

The current age of globalisation offers firms in developing countries both opportunities and threats. On the one hand, local firms now have various ways to participate in the global economy, gaining economies of scale and higher technological expertise. On the other hand, globalisation also implies increasing competition in both the domestic and international markets. To utilise globalisation's opportunities and minimise its threats of competition, firms have to frequently *upgrade* their activities and products.

Based on a value chain perspective, Humphrey and Schmitz (2002) point out four types of upgrading that firms can adopt: product upgrading; process upgrading; functional upgrading; and chain upgrading. Functional upgrading refers to a movement towards *new* activities within the firm's current value chain, while chain upgrading is the movement towards a *new* chain, when the current chain presents too few prospects for upgrading. To a certain extent, the first two sub-sections have dealt with these issues. What this sub-section focuses on is the former two, namely product and process upgrading. Product upgrading is often characterised by better product quality, leading to higher unit prices and larger market shares. Successful process upgrading implies higher production efficiency, which enables firms to lower unit cost and gain larger market shares through pursuing cost-based competition. Given the context of low- and lower-middle-income countries where upgraded exports often simply reflect assembling activities, this sub-section also includes an indicator on value-added contribution of upgraded products/processes.

Overall, the sub-section contains two indicators: (1) Product and process upgrading; and (2) Value-added contribution in output.

2.3.1 Product and process upgrading

There are several rationales for firms to undertake product and process upgrading. For one, upgrading raises barrier to entry and makes it more difficult for their competitors to copy. Further, upgrading helps firms develop dynamic capabilities and avoid rigid dependence on past competences. Yet upgrading is not an easy process and can yield successes as well as failures. Given this, the indicator aims to classify upgrading performance into four categories: *successful product upgrading*; *process competitiveness*; *failed product upgrading*; and *product and process downgrading*(see Figure 2). Changes in relative export unit values and world export market shares are used to make the classification.

The formulas for calculating relative export unit values and world export market share, respectively, are as follows:

$$Relative\ export\ unit\ value = \frac{Unit\ value\ of\ a\ country's\ export\ product}{Average\ global\ export\ unit\ value\ of\ the\ same\ product}$$

$$WMS_{i,j} = \frac{Country\ \text{j's}\ export\ of\ product\ \text{i}}{World\ exports\ of\ product\ \text{i}}$$

where $WMS_{i,j}$ denotes country *j*'s world export market share in product *i*. Changes in relative export unit value and world export market share are calculated using the compound annual growth rate (CAGR).

A product where the exporting country manages to increase its world market share along with a rising relative export unit value is considered a *successful upgrade*. The rationale for using both indicators simultaneously is that an increase in relative unit values *per se* may also result from higher input costs or process inefficiency rather than from product upgrading. Similarly, an increase in world market share *per se* may be associated with an expansion in the export of cheap products, suppressed wages and 'immiserising' growth[8].

Another interesting category is that of *process competitiveness*, which includes products that experience a fall in relative unit values and a rise in world market share. This can be due to either process innovation, which increases efficiency and reduces production costs, or a fall in standards of living in the exporting country. More in-depth analysis will be needed to disentangle these two effects, but is out of the scope of this tool.

The last two categories are *failed product upgrading,* meaning a fall in world market shares and a rise in relative unit values, and *product and process downgrading,* which indicates a fall in both world market shares and relative unit values.

8 The concept of 'immiserising growth' refers to a situation where the pattern of economic growth is such that it actually reduces the welfare of the individuals in a country. In theory, this can happen when a developing country expands the growth of a single commodity by reducing the price so that incomes in the country actually fall. In particular, if growth is heavily export biased it might lead to a fall in the terms of trade of the exporting country. In rare circumstances this fall in the terms of trade may be so large as to outweigh the gains from growth. If so, this situation would cause a country to be worse off after growth than before.

Figure 2: Classification of product and process upgrading performance

	WORLD EXPORTMARKET SHARE DECREASES	WORLD EXPORTMARKET SHARE INCREASES
RISING RELATIVE EXPORT UNIT VALUES	Quadrant 1 Failed product upgrading	Quadrant 2 Product upgrading
FALLING RELATIVE EXPORTUNIT VALUES	Quadrant 3 Product and process downgrading	Quadrant 4 Process competitiveness

Source: Kaplinsky and Readman (2005).

To derive this indicator, analysts need to calculate changes in *export unit values of products within a sub-sector* and *changes in products' world market shares* (see Table 6). The data needed for the calculation of both of these variables can be extracted from UN Comtrade database. The export unit value of a product in a given year is calculated by dividing the value of the country's exports of that product by the volume (or quantity) of these exports. We suggest to take the average value of three consecutive years, with the selected year being the most recent, to smooth out abnormal fluctuation in prices.

Analysts should first look at the number of products in each of the four quadrants of Figure 2 to see the (dominant) pattern of upgrading within a sub-sector. If there are products in the *process competitiveness* quadrant, analysts should investigate further into the country's context to see whether these actually result from higher efficiency or from suppressed wages. Having products in the *product and process downgrading* quadrant is not necessarily a bad thing, as this may suggest a move away from uncompetitive products to focus more on competitive ones. Besides, analysts should benchmark their country's performance against that of their competitors or 'role models'.

Table 6: Product and process upgrading data sources

Sub-indicator	Variable	Source
Change in export unit values	Export	UN Comtrade
	Net weight in kg equivalent	UN Comtrade
Change in world export market shares	Country's export	UN Comtrade
	World export	UN Comtrade

Domestic upgrading indicator

One drawback of the product and process upgrading indicator is its over-emphasis on the export side. For many developing economies, especially large ones such as China or India, a significant part of product and process upgrading happens within the domestic market, which is not necessarily reflected in export data. Thus we would ideally want to analyse an indicator of domestic upgrading by looking at changes over time in domestic unit values and domestic market shares of products within a sub-sector. Such an indicator helps reveal how a country's producers in a given sub-sector compete in their home market (i.e. through product upgrading/process competitiveness), how firms' strategies differ between domestic and international competition, and is able to shed light on domestic or export upgrading potential.

The main problem with calculating such an indicator is the lack of available data. Disaggregated information on product sales and physical outputs in domestic markets are often unavailable, meaning that we are unable to track domestic unit values for detailed-level products.

2.3.2 Value-added contribution inoutput

This indicator looks at the *share of value added in output for different activities within a sub-sector.* For this indicator, the important conceptual (and real) difference between *output* and *value added* has to be highlighted and explained. In fact, value added equals the difference between an industry's or a sub-sector's gross output (consisting of sales or receipts and other operating income, commodity taxes, and inventory change) and the cost of its intermediate inputs (including raw materials, semi-finished goods, energy, and services that are purchased from different sources and suppliers).

Product and process upgrading are often believed to help increase value-added per unit of output; that's why this indicator looks at the share of value added in output. Yet this is not always the case, and depends on which stage of production firms in a sub-sector are engaging in.

To calculate this indicator, analysts need to have data on *value-added of activities in a sub-sector* and *output of the same activities* (see Table 7). Both these data can be extracted from the INDSTAT database at different levels of disaggregation. Analysts can match (export) products in a sub-sector (which were the focus of analysis in the preceding sub-section 2.3.1) with their corresponding activities (which are the focus of analysis in this sub-section) to facilitate a joint analysis of the two indicators in this section on product-level upgrading.

The interpretation of this indicator should look at changes in the ratio of value-added over output for a specific manufacturing sub-sector in a country and benchmark it against the country's main competitors or role models. Further, analysts can, for instance, use the findings from analysing the previous indicator (i.e. product and process upgrading at the export side) to look at which product groups are successfully upgraded and see whether they lead to higher value-added contribution in output.

Table 7: Value-added contribution in output

Indicator	Variable	Source
Share of value-added in total output of a sub-sector	Value added of productive activities in a sub-sector	INDSTAT
	Output of productive activities in a sub-sector	INDSTAT

3.Interpretation of Findings and Conclusions

3.1 Macro-level upgrading analysis

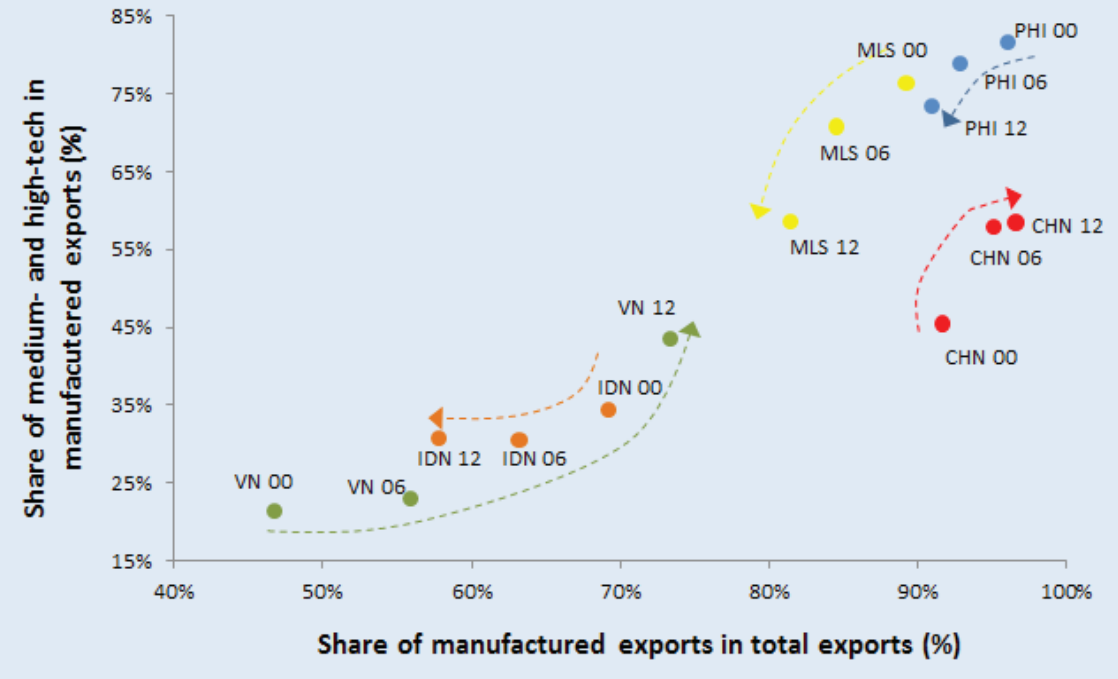
At the aggregated level, it is strategically important to see *how a country's export and production structure have evolved towards higher levels of technology intensity*. Regarding exports, upgrading indicators should be linked with structure indicators (from EQuIP Tool 1) to address two questions: (1) Has the country been able to increase its share of manufactured exports in total exports? and(2) Has it been able to raise the technology content of manufactured exports?

The following provides an example analysis for Vietnam and four comparator countries. Figure 3 shows the evolution of export structures towards manufactured goods and technology intensive exports. The *desirable path* would be to raise the share of manufactures in total exports (moving right along the X axis) while shifting the export structure towards more technologically-complex sectors (upwards along the Y axis).

Two trends are discernible from the selected countries. On the one hand, Vietnam and China display an upward trend, meaning an increase in the share of manufactured exports in total exports as well as a rise of medium- and high-tech in manufactured exports from 2000 to 2012. On the other hand, Indonesia, Malaysia, and Philippines show a sharp decline in both dimensions during the same period.

One caveat should be highlighted: Just because a country is moving downwards on the Y axis and to the left on the X axis doesn't mean that its export of sophisticated products has gone down. It may be the case that the country simply has responded to a growing demand in world markets for raw materials so that the share of sophisticated products in total exports has declined even when they have grown in absolute values. A further step is to look at key products that lead to the rise/ decline in either dimension.

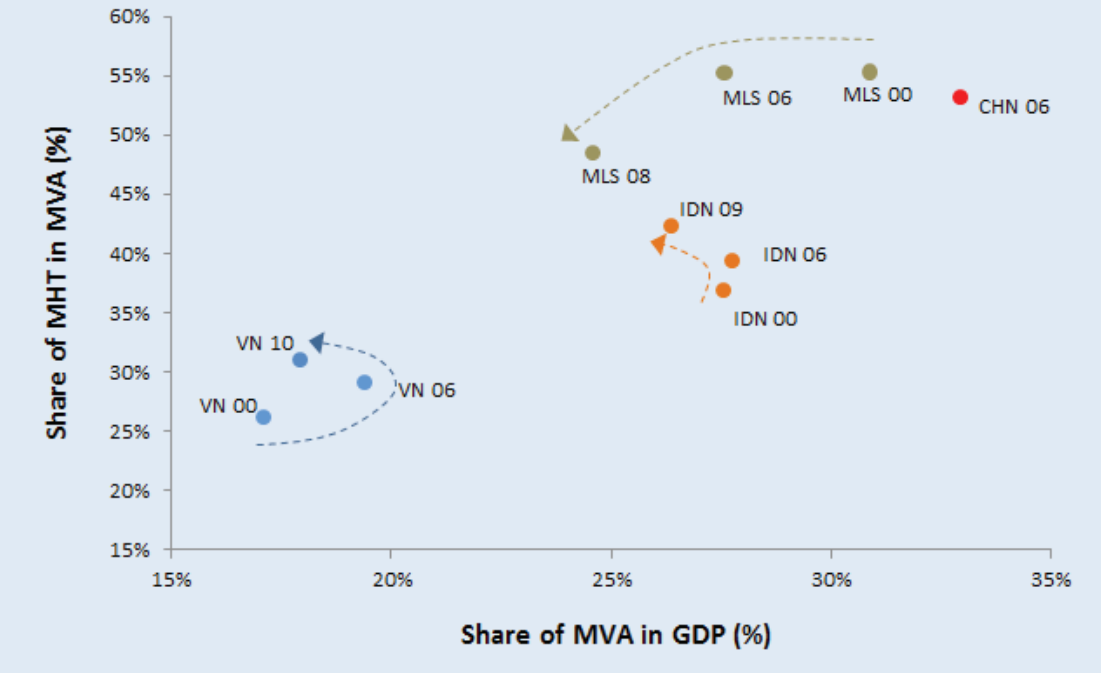
Figure 3: Evolution of export structure and technological content of manufactured exports for Vietnam and comparators



Source: UN Comtrade.

On the industry side, upgrading and structure indicators (the latter again from EQuIP Tool 1) can also shed light on two important questions: (1) Has the country been able to increase its share of manufacturing value-added in GDP? and (2) Has it been able to raise the technology content of manufacturing value-added?

Figure 4: Industrialization intensity for Vietnam and comparators



Source: INDSTAT; World Development Indicators.

Vietnam, Indonesia, and Malaysia show quite different patterns in industrialisation intensity (see Figure 4). Overall, Vietnam has been able to increase both the share of MVA in GDP and that of medium- and high-tech activities in MVA from 2000 to 2010. However, this is not a steady increase: the share of MVA in GDP has slightly declined from 19% in 2006 to 18% in 2010. A further step of analysis can be to investigate whether this is because of a fall in MVA, or due to a fast growth rate of other sectors that contribute to GDP (e.g. agriculture or services).

Indonesia has also seen a rise in the share of medium- and high-tech activities in the country's MVA from 2000 to 2009. However, the share of MVA in GDP fell from 28% in 2000 to 26% in 2009. Malaysia shows a more concerning pattern, with both dimensions declining steadily from 2000 to 2008.

Looking at the export and industry sides together, one can see that the growth rate of Vietnam's manufacturing value-added is not commensurate with the country's rapid manufactured export growth (see Table 8). While the share of manufactured exports in total exports jumped from 47% to 73%, the share of manufacturing value-added increased modestly from 17% to 18%. Further, although Vietnam is ahead of Indonesia in terms of export performance, it quite trails behind regarding industrial structure and upgrading performance.

Table 8: Evolution patterns of export and industrial structures

		Year	China	Indonesia	Malaysia	Philippines	Vietnam
UPGRADING	Export	2000	45%	34%	76%	81%	21%
		2012	58%	31%	59%	73%	44%
	Industry	2000		39%	55%		26%
		Latest year	53%	42%	49%		31%
STRUCTURE	Export	2000	92%	69%	89%	96%	47%
		2012	97%	58%	81%	91%	73%
	Industry	2000		28%	31%		17%
		Latest year	33%	26%	25%		18%

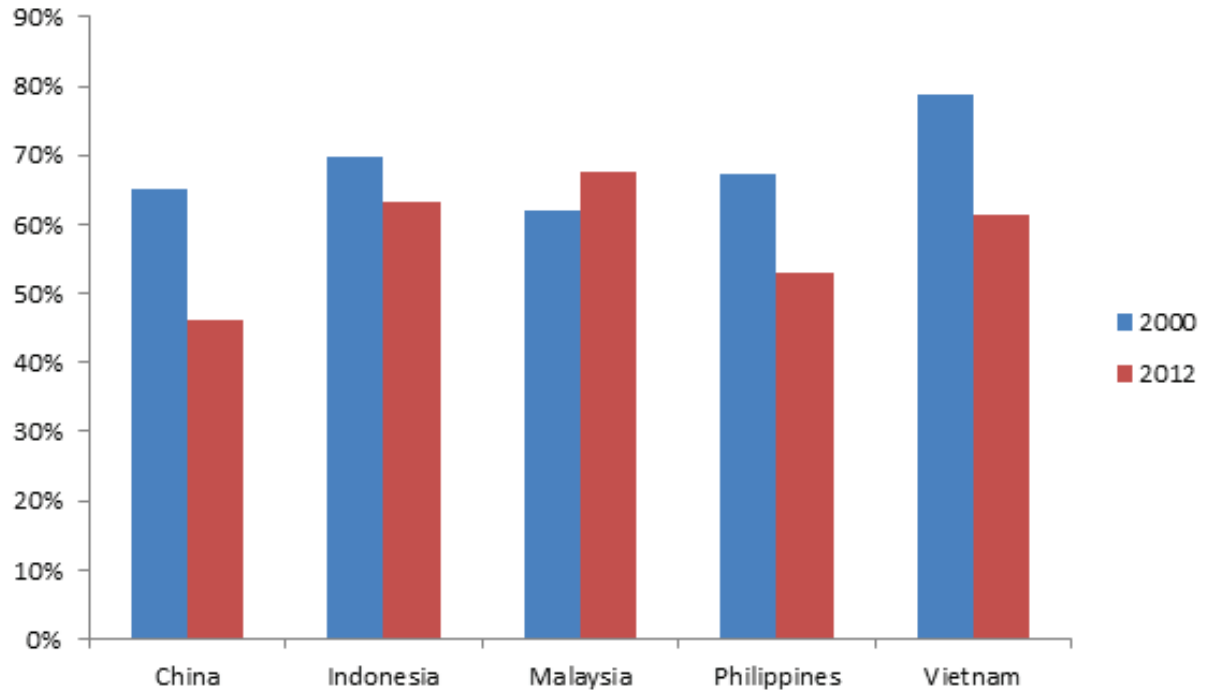
Source: UN Comtrade; INDSTAT.

3.2 Sub-sector upgrading analysis

Here we use the example of the *textile, leather and apparel* sub-sector to illustrate the indicators presented above. Since most products in this sub-sector have low technological content, the use of a technological classification (like the one suggested above for the macro-level analysis which, as mentioned, was developed by the OECD) cannot help determine which of its products can generate better returns. Thus, we use UNIDO's classification which, as described above, splits product groups belonging to a given sub-sector into low-value and high-value products (see Appendix 3). The list in the Appendix was created by calculating average global export unit values of every three-digit-level product group (according to the SIT classification scheme) within the sub-sector and ranking them to determine high-value products.

Figure 5 illustrates changes in the share of high-value products in textile, leather and apparel exports for Vietnam and four benchmarking countries. It can be seen that, except for China, in all countries high-value products accounted for more than 50% of total exports of the sub-sector. Among them, Malaysia is the only one that has been able to increase the share of high-value products from 62% in 2000 to 68% in 2012, the highest share among the benchmarking group.

Figure 5: Share of high-value products in textile, leather and apparel exports



Source: UN Comtrade

3.3 Product-level upgrading analysis

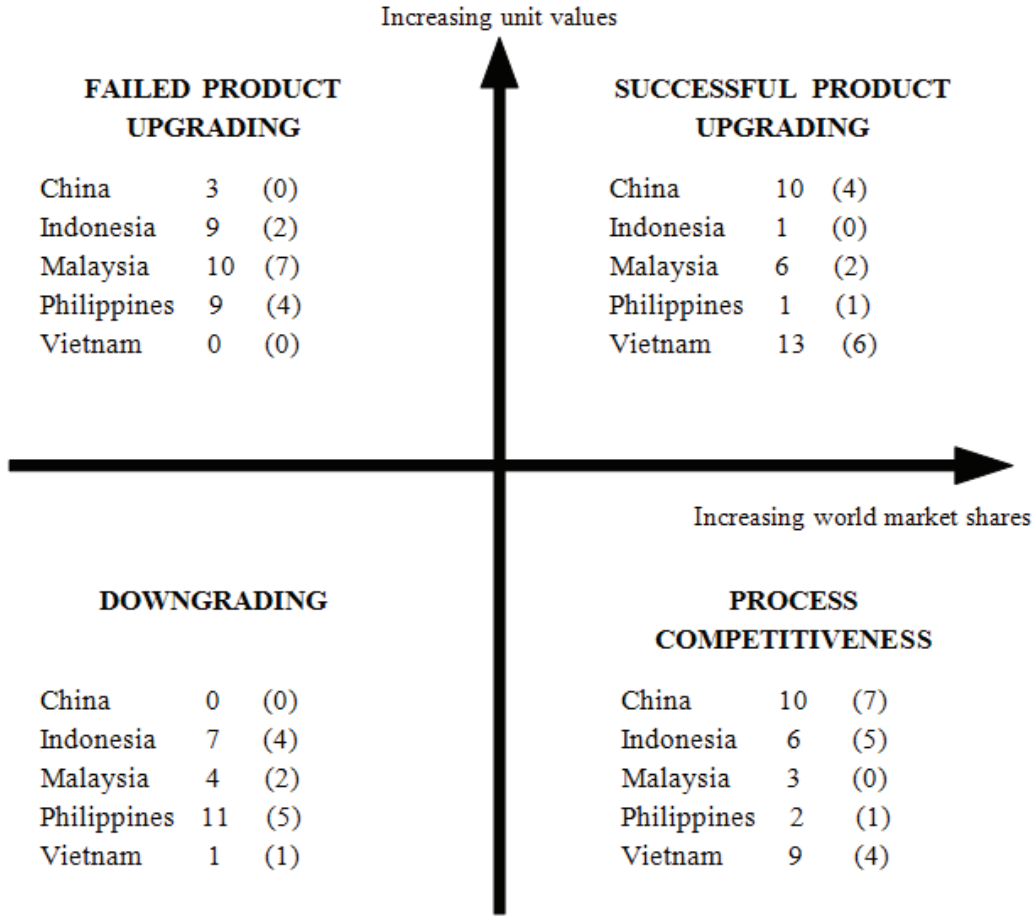
The following part also uses the textile, leather and apparel sector to illustrate how analysts can interpret product-level upgrading indicators.

As can be seen in the upper right-hand quadrant of Figure 6, among the five benchmarking countries, Vietnam and China top the list of comparator countries with the largest number of successfully upgraded products (namely 13 in the case of Vietnam and 10 in the case of China). For China, the majority of textile, apparel and leather exports have seen either successful upgrading (10 products showing up in the upper right-hand quadrant of Figure 6) or very competitive in the production process (10 products showing up in the lower right-hand quadrant of Figure 6) .

Similarly, more than half of Vietnamese textile, apparel and leather exports have experienced successful upgrading during 2000-2012, meaning a rise in world market shares along with higher relative unit values (13 products showing up in the upper right-hand quadrant of Figure 6). Except for *fur skins tanned/dressed* (the one product showing up in the lower left-hand quadrant of Figure 6), the remaining exports are very competitive in unit prices (being located in the lower right-hand quadrant of Figure 6). Whether this is due to higher efficiency or suppressed wages requires further investigation, and analysts are highly recommended to do so.

Despite its high share of sophisticated products (as we have seen in Figure 5 above), the Philippines have been experiencing a loss of competitiveness for the majority of its exports in the sector. Among its 23 products at the three-digit level of SITC, nine failed to upgrade (those reported in the upper left-hand quadrant of Figure 6) and eleven have seen downgrading (showing up in the lower left-hand quadrant of Figure 6). Nearly all its high-value exports (which are reported in brackets in Figure 6) fall in either of these two categories as well.

Figure 6: Product and process upgrading, 2000 - 2012



Source: UN Comtrade. *Number in brackets are number of high-value products in the category.

Although both Vietnam and China have shown remarkable performance in terms of export upgrading, the two countries experience opposite patterns regarding industrial upgrading (see Table 9). While the share of value-added in total textile, apparel and leather output for China has risen steadily since 2000, the figures for Vietnam have decreased sharply in all three sub-sectors (textile, apparel, and leather). This is mainly because the growth rate of exports has outstripped that of value-added. This implies that while Vietnam has been able to expand its exports, the country mostly engages in low value-added stage of textile, apparel and leather production. How to move up the value chain into higher value-added activities should be a priority concern to Vietnamese policy makers.

Table 9: Value-added contribution in sub-sectoral outputs

		Share of value-added (VA) in industry's total output (%)			
		2000	Latest year available	VA growth rate (%)	Export growth rate (%)
TEXTILE	China	25%	27% (2007)	24%	19%
	Indonesia	34%	31% (2011)	7%	4%
	Malaysia	32%	24% (2010)	-3%	7%
	Philippines	39% (2001)	23% (2008)	-12%	-2%
	Vietnam	31%	22% (2008)	18%	23%
APPAREL	China	25%	41% (2007)	21%	18%
	Indonesia	37%	50% (2011)	12%	5%
	Malaysia	32%	30% (2010)	0%	7%
	Philippines	43% (2001)	34% (2008)	-6%	-3%
	Vietnam	40%	30% (2008)	21%	22%
LEATHER	China		30% (2007)		15%
	Indonesia	41%	45% (2011)	12%	4%
	Malaysia	31%	31% (2010)	8%	1%
	Philippines	46% (2001)	37% (2008)	3%	-5%
	Vietnam	31%	22% (2008)	18%	52%

Source: UN Comtrade; World Development Indicators; INDSTAT.

4.Possible Extensions

At the macro level, two additional indicators could be used: (1) **Diversification of a country's medium- and high-tech production**; and (2) **Diversification of a country's medium- and high-tech exports**. These two indicators look deeper into whether higher-technological content is diversified or concentrated in a few sub-sectors/products only.

Diversification of a country's medium- and high-tech production

This indicator investigates whether a country's medium- and high-tech production is diversified across multiple sub-sectors or concentrated in only a few. It uses the Hirschman-Herfindahl Index (HHI), which is calculated by summing up the squares of individual medium- and high-tech sub-sectors' shares in total medium-and high-tech value-added. The formula is as follows:

$$HHI_{dom} = \sum_{i=1}^{N} (s_i)^2$$

where s_i is the share of medium- and high-tech sub-sector *i* in the country's total medium- and high-tech value-added, and N is the total number of medium- and high-tech sub-sectors. HHI values range from 1/N (most diversified) to 1 (most concentrated).A diversified structure means that a developing country is able to reap benefits from multiple medium- and high-tech sub-sectors, which lowers the country's vulnerability to external shocks from relying on simply few activities.

To calculate this indicator, analysts need to have data on *value-added of medium- and high-tech sub-sectors* for all benchmarking countries (see Table 10). These should be readily available from the previous calculation of *technological content of manufacturing production* indicator. Total medium- and high-tech value-added is simply the sum of all individual medium- and high-tech sub-sectors' figures.

This indicator should be interpreted by looking at its trend and by comparing a country's level to other benchmarking countries. This helps reveal whether the country has been able to diversify its medium- and high-tech production and where the country stands relative to its competitors or 'role models'.

Table 10: Diversification of a country's medium- and high-tech production

Indicator	Variable	Source
Hirschman-Herfindahl Index for medium- and high-tech production	Value-added of medium- and high-tech sub-sectors	INDSTAT

Diversification of a country's medium- and high-tech exports

This indicator is complementary and has the same intuition as the previous indicator. It explores how diversified a country's medium- and high-tech exports are, using the Hirschman-Herfindahl Index (HHI). The HHI is calculated by summing up the squares of individual medium- and high-tech export product's shares in total medium-and high-tech export. The formula is as follows:

$$HHI_{exp} = \sum_{i=1}^{N} (s_i)^2$$

where s_i is the share of medium- and high-tech product *i* in a country's total medium- and high-tech exports, and N is the total number of medium- and high-tech export products from the country.

HHI values range from 1/N (most diversified) to 1 (most concentrated). The desirable path is to have a diversified medium- and high-tech export structure, as this reduces vulnerability to external shocks.

To calculate this indicator, analysts need to have data on individual *medium- and high-tech export products* for all benchmarking countries (see Table 11). These data can be extracted from the UN Comtrade database. Total medium- and high-tech export is simply the sum of all individual medium- and high-tech products' figures.

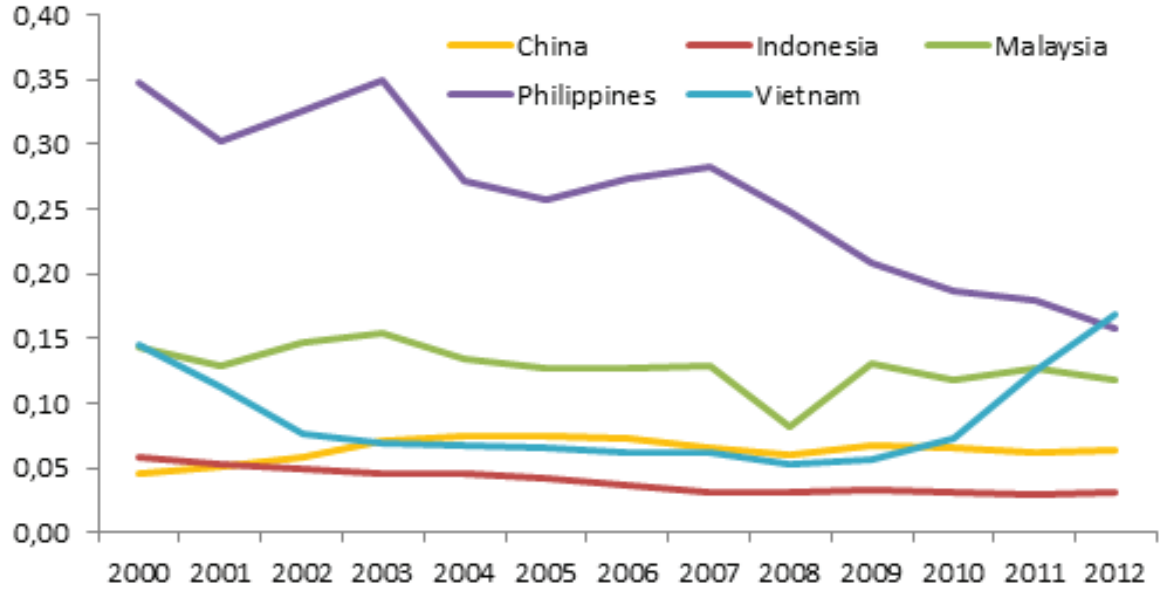
This indicator should be interpreted by looking at its trend and by comparing a country's level to other benchmarking countries. Further, it can also be jointly analysed with the previous indicator on medium- and high-tech production to shed more light on the degree of diversification among technologically-complex activities and exports. For instance, a low HHI in medium- and high-tech production, but a high HHI in medium- and high-tech export implies that there are only a few complex activities with a very high degree of export diversification.

Table 11: Diversification of a country's medium- and high-tech exports

Indicator	Variable	Source
Hirschman-Herfindahl Index for medium- and high-tech exports	Medium- and high-tech export values	UN Comtrade

Calculating these indicators for our sample of countries, we find that, in terms of diversification, Vietnam has the least diversified medium- and high-tech export structure among the five benchmarking countries in 2012 (see Figure 7). This is because the country's medium- and high-tech exports are relying on two product groups, *Telecommunication equipment* and *Office Equipment,* whose respective shares rose from merely 3.5% and 0% in 2000, respectively, to 39% and 9% in 2012. These are the two product groups that have driven the fast growth of Vietnam's medium- and high-tech exports during 2000-2012.

Figure 7: Diversification of medium- and high-tech exports, 2000-2012



Source: UN Comtrade

On the industry side, Vietnam is the most diversified among the benchmarking countries in terms of medium- and high-tech production, with even a lower HHI score than China (see Table 12). On the one hand, this shows that the country does not over-concentrate its production on a few medium- and high-tech activities. On the other hand, it implies that while the country's exports rely on telecommunication equipment and office machines, these two groups do not generate a proportional amount of value added. Indeed, while these two product groups accounted for 31% of total medium- and high-tech exports in 2010, they contributed only 16.5% to total medium- and high-tech value added. Additional (qualitative) research may reveal that this discrepancy is due to the fact that most electronic production in the country has been organized by multinational corporations who locate primarily those production stages in Vietnam that generate only relatively low value-added locally.

Table 12: Diversification of medium- and high-tech production, 2000-2012

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
China				0.071	0.077	0.077	0.075	0.076			
Indonesia	0.087	0.095	0.122	0.100	0.103	0.122	0.105	0.106	0.126	0.130	
Malaysia	0.146	0.139	0.109	0.115	0.111	0.118	0.121	0.113	0.128		
Philippines		0.178		0.151		0.132	0.152				
Vietnam	0.080						0.073	0.079	0.079	0.083	0.075

Source: UNIDO INDSTAT

In addition, the following data/indicators can also be utilised to further improve the analysis of export and industrial upgrading:

Contribution of domestic enterprises to medium- and high-tech exports and to medium- and high-tech value-added	This indicator helps address the issue of how much upgrading results from domestic efforts – compared to how much results from multinational corporations locating some operations in the country. Data typically come from national sources.
Export upgrading based on Trade in Value-Added (TiVA)	Conventional trade statistics are typically reported as gross figures. That is, conventional trade data do not take into account the share of imported inputs or imported intermediate goods (i.e. foreign value-added) in a country's exports. TiVA addresses this issue by netting out the share of foreign value-added from a country's export data. That is, TiVA provides data on the value added in a given country in the production of goods that are consumed abroad. This is increasingly important in the context of an increasing international fragmentation of production. TiVA data-based indicators can, therefore, complement indicators based on traditional trade data: A country may have relatively high exports in a certain sub-sector but relatively low domestic content / low domestic value-added and TiVA data can help to reveal that. Against this background, an increase in the share of local content of value added in exports can be interpreted as upgrading. TiVA data can be extracted from the OECD and the World Input-Output Database (WIOD) databases: http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_OECD_WTO www.wiod.org/ However, at the moment TiVA data are available for a rather small set of (mostly advanced) economies.

Revealed Factor Intensity (RFI)	RFI data show the revealed factor intensity of individual export products. That is, they show which factor of production typically dominates in the production of a certain good. These data are based on calculations that look at the intensities in the use of different factors of production (e.g. human and physical capital) for individual products across all countries in the world in order to determine the dominant factor. This indicator, thus, helps determine the physical and human capital content of a country's exports and changes therein. One possible way to use this indicator is to categorize products into labour-intensive and capital-intensive goods and to analyse whether a country's export basket is moving towards capital-intensive or skill-intensive exports – which could be considered export upgrading. Data on RFI can be found on the United Nations Conference on Trade and Development's (UNCTAD) website (latest year available is 2007): http://ro.unctad.org/ditc/tab/research.shtm
Import Rejection Analysis	In order to be able to access foreign (export) markets, products coming from developing countries have to comply with international trade standards (such as technical requirements or sanitary and phytosanitary standards). Non-compliance with such trade standards is often sanctioned with rejection of the incoming shipment by authorities in the importing country (i.e. 'import rejection'). The idea of this indicator is to show the capability of developing countries to comply with such trade standards for their exports, which to a certain extent also reveals their export quality. Currently, this indicator is only available for agro-products. Data can be found in UNIDO database: http://www.unido.org/tscfootprints.html
Social upgrading	For a given sub-sector, social upgrading is considered to happen when there is both an increase in sub-sectoral employment and an increase in sub-sectoral real wages. For an inclusive and sustainable industrial strategy, it is important to consider how industrial and export upgrading is translated into more and better employment in the country (see Tool 5). An example of how economic upgrading and social upgrading can be jointly analysed is presented in Bernhardt and Milberg (2011) (also see EQuIP Tool 7).

Further, as discussed in the sub-section on Sub-sector indicators, there are various ways analysts can identify and classify products that generate higher returns, each with its own pros and cons (see Table 13 below). The PRODY, for instance, is one popular proxy for the 'sophistication' of products. Sophisticated products are believed to have higher barriers to entry and to generate more benefits to countries which produce and export them. The indicator assumes that product sophistication is likely to correlate with the income-level of countries that produce and export them, and thus bases its measurement on income-content and revealed comparative advantage of countries

producing a given goods. Its main weakness is that results are not suitable to be compared across sectors. For instance, cheese can be found to have a higher sophistication level than computers simply because the former is often produced in and exported by high-income countries (such as France, the Netherlands or Switzerland) while the latter tend to be assembled and exported from developing economies. For resource-based manufactures, the PRODY scores often do not reflect product sophistication, as in the case of wheat (which is often produced in Western countries) versus rice (which is produced more in developing nations). Thus, based on purpose of study or country's priorities, analysts can select the appropriate classification of higher-value products.

Table 13: Pros and Cons of different methods of classifying high-value products

Method	Pros (+)	Cons (-)
UNIDO's Technology Classification	+ Based on OECD classification and R&D expenditure data + A coherent methodology for all products + Widely used	- Not sufficiently disaggregated for sub-sector level analysis
PRODY	+ Based on income-content and revealed comparative advantage + Data are largely available + Widely used	- Not suitable to compare across sectors - Income-content of exporters may not always reveal sophistication of products
R&D Expenditure	+ In line with UNIDO's and OECD's technological classifications + A proxy for innovation	- Limitations on data availability
Unit Values	+ Data are largely available + Good proxy for sophistication	- May mistake rising input costs for higher sophistication - Tricky when different measurements are used for the volume of exports
Wages	+ Proxy for higher skills, therefore assumed to be more sophisticated production process	- Limitations on data availability - Assumption does not always hold
Profit margins	+ Good proxy for sophistication	- Limitations on data availability
Information from Industry Experts	+ More solid understanding of production processes within sectors + Classification will correspond to reality of the country	- Time-consuming and costly process to establish classification - Difficult to compare across countries

5. Link to Other Areas

Developing economies' efforts to upgrade their productive structures also influence other dimensions of inclusive and sustainable industrial development, such as growth, diversification, productive employment generation and resource efficiency. Analysts should be aware of these links when applying the EQuIP toolkit to their country context.

One implication of industrial and export upgrading is on a country's industrial capacity and growth (see Tool 1). Developing countries often have a small industrial sector and a low capacity to produce and export. Their economies also rely on the production of unsophisticated products which makes economic growth very vulnerable to external shocks. It is thus important to see how upgrading activities/products contributes to the growth and capacity of developing countries. One way to do this is to analyse changes in the share of medium- and high-tech exports/value-added in total exports/GDP of a country.

Upgrading also has a strong link with industrial diversification (see Tool 4), since at the macro and sub-sector levels, both tools imply the shift towards new activities/products. One way to strengthen the analysis of the current tool is to look at market diversification of a country's high-value exports, in order to identify promising markets to be targeted in the near future.

The discussion of industrial upgrading also links to debates on domestic (backward and forward) linkages (see Tool 5). Recall that one rationale for a country to undertake upgrading is to generate stronger linkages and positive externalities to the rest of the society. Yet while strong domestic linkages help reduce dependency on foreign inputs or foreign demand, they do not build automatically. For instance, when higher-tech sub-sectors in a developing country are dominated by 100% foreign-owned firms, domestic firms may not have the capability or the opportunity to learn. In cases when large multinationals prefer their own foreign suppliers rather than domestic ones, there will be little to no knowledge, technology and/or productivity spillovers happening in the country. This is not an unusual scenario, especially when foreign firms come to a low-income country simply because of abundant, cheap labour and generous tax incentives. Analysts should thus pay attention to the industrial organization characteristics of sophisticated activities in the country (see Tool 8).

Industrial and export upgrading also link closely to global value chain analysis (see Tool 7). There are various ways in which a low-income country can try to integrate into the global value chains(GVCs) of production. In fact, integration into GVCs is often considered a key driver of upgrading. However, a country needs to be aware of the nature of its participation in GVCs and of the nature of the relationship between local producers and multinationals. In particular, two key determinants of how beneficial GVC participation is for the host country are, first, the degree of control local actors have over local GVC operations and, second, how "sticky" its insertion into GVC is (which depends on how easily a country can be replaced as production location). Intel's plan to move its high-tech manufacturing operations out of Costa Rica in 2014, for instance, was expected to lead to 1,500 employees being laid off, equivalent to 5% of the country's workforce. Further, in the context of low-income country with significant poverty and malnutrition rate, it is also important not to ignore the domestic market by focusing solely on export.

Industrial upgrading certainly requires improved industrial, business and technological capabilities. A thorough analysis of drivers of industrial development – including skills, technology, and finance – can help identify the country's upgrading potential in the future (see Tool 9).

Upgrading can also have ecological and environmental implications for developing countries. On the one side, industrialised sectors may require more amount and types of natural resource inputs, which pose environmental risks to the country, particularly regarding industrial wastes and pollution. On the bright side, upgrading can be geared towards promoting resource efficiency and aiming at 'greening industries' (i.e. improving industries' environmental performance) (see Tool

6). Upgrading strategies can also include the establishment of 'green industries', which provide environmental goods or technologies that reduce negative environmental impacts.

In terms of inclusive development (see Tool 5), analysts should link economic upgrading with social upgrading, as suggested in the possible extensions section. Often it is assumed that upgrading will automatically translate into more decent employment. However, this can be vastly different across sub-sectors and is often not true when the upgrading process utilises labour-saving technologies and aims for competitiveness based on low costs. To be socially sustainable, industrial and export upgrading should be inclusive and broad-based. This implies the creation of more decent jobs and thus allows as large a number of people as possible to participate in and get a return for value generation.

6. References and Further Reading

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7. Appendix

1. Technology classification of products (SITC Revision 3, three-digit)

Techology classification	Product	Product Name
Primary	1	Live animals except fish
Primary	11	Beef, fresh/chilld/frozn
Primary	12	Meat nes,fresh/chld/froz
Resource-based	16	Meat/offal preserved
Resource-based	17	Meat/offal presvdn.e.s
Primary	22	Milk prexcbuttr/cheese
Resource-based	23	Butter and cheese
Resource-based	24	Cheese and curd
Primary	25	Eggs, albumin
Primary	34	Fish,live/frsh/chld/froz
Resource-based	35	Fish,dried/salted/smoked
Primary	36	Crustaceans molluscs etc
Resource-based	37	Fish/shellfish,prep/pres
Primary	41	Wheat/meslin
Primary	42	Rice
Primary	43	Barley grain
Primary	44	Maize except sweet corn.
Primary	45	Cereal grains nes
Resource-based	46	Flour/meal wheat/meslin
Resource-based	47	Cereal meal/flour n.e.s
Resource-based	48	Cereal etc flour/starch
Primary	54	Vegetables,frsh/chld/frz
Resource-based	56	Veg root/tuber prep/pres
Primary	57	Fruit/nuts, fresh/dried
Resource-based	58	Fruit presvd/fruit preps
Resource-based	59	Fruit/veg juices
Resource-based	61	Sugar/mollasses/honey
Resource-based	62	Sugar confectionery
Primary	71	Coffee/coffee substitute
Primary	72	Cocoa
Resource-based	73	Chocolate/cocoa preps
Primary	74	Tea and mate
Primary	75	Spices
Primary	81	Animal feed ex unmlcer.
Resource-based	91	Margarine/shortening
Resource-based	98	Edible products n.e.s.
Resource-based	111	Beverage non-alcohol nes
Resource-based	112	Alcoholic beverages
Primary	121	Tobacco, raw and wastes
Resource-based	122	Tobacco, manufactured

Primary	211	Hide/skin (ex fur) raw
Primary	212	Furskins/pieces, raw
Primary	222	Oil seeds etc - soft oil
Primary	223	Oil seeds-not soft oil
Primary	231	Natural rubber/latex/etc
Resource-based	232	Rubber synth/waste/etc
Primary	244	Cork natural/raw/waste
Primary	245	Fuel wood/wood charcoal
Primary	246	Wood chips/waste
Resource-based	247	Wood in rough/squared
Resource-based	248	Wood simply worked
Resource-based	251	Pulp and waste paper
Primary	261	Silk
Primary	263	Cotton
Resource-based	264	Jute/bast fibre raw/retd
Resource-based	265	Vegtext fibre ex cot/ju
Medium-tech	266	Synthetic spinning fibre
Medium-tech	267	Man-made fibres nes/wast
Primary	268	Wool/animal hair
Primary	269	Worn clothing etc
Primary	272	Fertilizers crude
Primary	273	Stone/sand/gravel
Primary	274	Sulphur/unroastd pyrites
Primary	277	Natural abrasives n.e.s.
Primary	278	Other crude minerals
Resource-based	281	Iron ore/concentrates
Resource-based	282	Ferrous waste/scrap
Resource-based	283	Copper ores/concentrates
Resource-based	284	Nickel ores/concs/etc
Resource-based	285	Aluminium ores/concs/etc
Resource-based	286	Uranium/thorium ore/conc
Resource-based	287	Base metal ore/concnes
Resource-based	288	Nf base metal waste nes
Resource-based	289	Precious metal ore/conc.
Primary	291	Crude animal mterialnes
Primary	292	Crude veg materials nes
Primary	321	Coal non-agglomerated
Resource-based	322	Briquettes/lignite/peat
Primary	325	Coke/semi-coke/retort c
Primary	333	Petrol./bitum. oil,crude
Resource-based	334	Heavy petrol/bitum oils
Resource-based	335	Residual petrol. prods
Resource-based	342	Liquid propane/butane
Primary	343	Natural gas
Resource-based	344	Petrol./hydrocarbon gas

Resource-based	345	Coal gas/water gas/etc
Other	351	Electric current
Resource-based	411	Animal oil/fat
Resource-based	421	Fixed veg oil/fat, soft
Resource-based	422	Fixed veg oils not soft
Resource-based	431	Animal/veg oils proces”d
Resource-based	511	Hydrocarbons/derivatives
Medium-tech	512	Alcohols/phenols/derivs
Medium-tech	513	Carboxylic acid compound
Resource-based	514	Nitrogen function compds
Resource-based	515	Organo-inorganic compnds
Resource-based	516	Other organic compounds
Resource-based	522	Elements/oxides/hal salt
Resource-based	523	Metal salts of inorgacd
Resource-based	524	Other inorganic chemical
High-tech	525	Radio-active etcmatrial
Resource-based	531	Synth org colour agents
Resource-based	532	Dyeing/tanning extracts
Medium-tech	533	Pigments/paints/varnish
High-tech	541	Pharmaceutexcmedicamnt
High-tech	542	Medicaments include vet
Resource-based	551	Essent.oil/perfume/flavr
Medium-tech	553	Perfume/toilet/cosmetics
Medium-tech	554	Soaps/cleansers/polishes
Medium-tech	562	Manufactured fertilizers
Medium-tech	571	Primary ethylene polymer
Medium-tech	572	Styrene primary polymers
Medium-tech	573	Vinyl chloride etcpolym
Medium-tech	574	Polyacetals/polyesters..
Medium-tech	575	Plastic nes-primary form
Medium-tech	579	Plastic waste/scrap
Medium-tech	581	Plastic tube/pipe/hose
Medium-tech	582	Plastic sheets/film/etc
Medium-tech	583	Monofilament rods/sticks
Medium-tech	591	Household/garden chemcal
Resource-based	592	Starches/glues/etc.
Medium-tech	593	Explosives/pyrotechnics
Medium-tech	597	Oil etc additives/fluids
Medium-tech	598	Misc chemical prods nes
Low-tech	611	Leather
Low-tech	612	Leather manufactures
Low-tech	613	Furskins tanned/dressed
Resource-based	621	Materials of rubber
Resource-based	625	Rubber tyres/treads
Resource-based	629	Articles of rubber nes

Resource-based	633	Cork manufactures
Resource-based	634	Veneer/plywood/etc
Resource-based	635	Wood manufactures n.e.s.
Resource-based	641	Paper/paperboard
Low-tech	642	Cut paper/board/articles
Low-tech	651	Textile yarn
Low-tech	652	Cotton fabrics, woven
Medium-tech	653	Man-made woven fabrics
Low-tech	654	Woven textile fabric nes
Low-tech	655	Knit/crochet fabrics
Low-tech	656	Tulle/lace/embr/trimetc
Low-tech	657	Special yarns/fabrics
Low-tech	658	Made-up textile articles
Low-tech	659	Floor coverings etc.
Resource-based	661	Lime/cement/constrmat”l
Resource-based	662	Clay/refractory material
Resource-based	663	Mineral manufactures nes
Resource-based	664	Glass
Low-tech	665	Glassware
Low-tech	666	Pottery
Resource-based	667	Pearls/precious stones
Medium-tech	671	Pigironetcferroalloy
Medium-tech	672	Primary/prods iron/steel
Low-tech	673	Flat rolled iron/st prod
Low-tech	674	Rolled plated m-steel
Low-tech	675	Flat rolled alloy steel
Low-tech	676	Iron/steel bars/rods/etc
Low-tech	677	Iron/steel railway matl
Medium-tech	678	Iron/steel wire
Low-tech	679	Iron/steel pipe/tube/etc
Primary	681	Silver/platinum etc
Primary	682	Copper
Primary	683	Nickel
Primary	684	Aluminium
Primary	685	Lead
Primary	686	Zinc
Primary	687	Tin
Resource-based	689	Misc non-ferr base metal
Low-tech	691	Iron/stl/alum structures
Low-tech	692	Metal store/transptcont
Low-tech	693	Wire prod exc ins electr
Low-tech	694	Nails/screws/nuts/bolts
Low-tech	695	Hand/machine tools
Low-tech	696	Cutlery
Low-tech	697	Base metal h”holdequipms

Low-tech	699	Base metal manufacnes
Medium-tech	711	Steam generating boilers
Medium-tech	712	Steam/vapour turbines
Medium-tech	713	Internal combust engines
Medium-tech	714	Engines non-electric nes
High-tech	716	Rotating electr plant
High-tech	718	Power generating equnes
Medium-tech	721	Agric machine ex tractr
Medium-tech	722	Tractors
Medium-tech	723	Civil engineering plant
Medium-tech	724	Textile/leather machinry
Medium-tech	725	Paper industry machinery
Medium-tech	726	Printing industry machny
Medium-tech	727	Food processing machines
Medium-tech	728	Special industmachnnes
Medium-tech	731	Mach-tools remove mtrial
Medium-tech	733	Mtl m-tools w/o mtl-rmvl
Medium-tech	735	Metal machine tool parts
Medium-tech	737	Metalworking machine nes
Medium-tech	741	Indust heat/cool equipmt
Medium-tech	742	Pumps for liquids
Medium-tech	743	Fans/filters/gas pumps
Medium-tech	744	Mechanical handling equi
Medium-tech	745	Non-electr machines nes
Medium-tech	746	Ball/roller bearings
Medium-tech	747	Taps/cocks/valves
Medium-tech	748	Mech transmission equmnt
Medium-tech	749	Non-elec parts/accmachn
High-tech	751	Office machines
High-tech	752	Computer equipment
High-tech	759	Office equip parts/accs.
Medium-tech	761	Television receivers
Medium-tech	762	Radio broadcast receiver
Medium-tech	763	Sound/tv recorders etc
High-tech	764	Telecomms equipment nes
High-tech	771	Elect power transm equip
Medium-tech	772	Electric circuit equipmt
Medium-tech	773	Electrical distrib equip
High-tech	774	Medical etc el diagequi
Medium-tech	775	Domestic equipment
High-tech	776	Valves/transistors/etc
Medium-tech	778	Electrical equipment nes
Medium-tech	781	Passenger cars etc
Medium-tech	782	Goods/service vehicles
Medium-tech	783	Road motor vehicles nes

Medium-tech	784	Motor veh parts/access
Medium-tech	785	Motorcycles/cycles/etc
Medium-tech	786	Trailers/caravans/etc
Medium-tech	791	Railway vehicles/equipmt
High-tech	792	Aircraft/spacecraft/etc
Medium-tech	793	Ships/boats/etc
Medium-tech	811	Prefabricated buildings
Medium-tech	812	Sanitary/plumb/heat fixt
Medium-tech	813	Lighting fixtures etc
Low-tech	821	Furniture/stuff furnishg
Low-tech	831	Trunks and cases
Low-tech	841	Mens/boys wear, woven
Low-tech	842	Women/girl clothing wven
Low-tech	843	Men/boy wear knit/croch
Low-tech	844	Women/girl wear knit/cro
Low-tech	845	Articles of apparel nes
Low-tech	846	Clothing accessories
Low-tech	848	Headgear/non-text clothg
Low-tech	851	Footwear
High-tech	871	Optical instruments nes
Medium-tech	872	Medical/etc instruments
Medium-tech	873	Meters and counters nes
High-tech	874	Measure/control app nes
High-tech	881	Photographic equipment
Medium-tech	882	Photographic supplies
Other	883	Cine fild developed
Medium-tech	884	Optical fibres
Medium-tech	885	Watches and clocks
High-tech	891	Arms and ammunition
Other	892	Printed matter
Low-tech	893	Articles nes of plastics
Low-tech	894	Baby carr/toy/game/sport
Low-tech	895	Office/stationery supply
Other	896	Art/collections/antiques
Low-tech	897	Jewellery
Low-tech	898	Musical instrums/records
Low-tech	899	Miscmanuf articles nes
Other	961	Coin nongoldnon current
Other	971	Gold non-monetary ex ore

2. Technological classification of industries (ISIC Revision 3) (whereby: RB=resource-based, LT=low-tech; MHT=medium- and high-tech)

Technology classification	ISIC Code	Industry
RB	151	Processed meat,fish,fruit,vegetables,fats
RB	1520	Dairy products
RB	153	Grain mill products; starches; animal feeds
RB	154	Other food products
RB	155	Beverages
RB	1600	Tobacco products
LT	171	Spinning, weaving and finishing of textiles
LT	172	Other textiles
LT	1730	Knitted and crocheted fabrics and articles
LT	1810	Wearing apparel, except fur apparel
LT	1820	Dressing & dyeing of fur; processing of fur
LT	191	Tanning, dressing and processing of leather
LT	1920	Footwear
RB	2010	Sawmilling and planing of wood
RB	202	Products of wood, cork, straw, etc.
RB	210	Paper and paper products
OTHER	221	Publishing
OTHER	222	Printing and related service activities
OTHER	2230	Reproduction of recorded media
LT	2310	Coke oven products
RB	2320	Refined petroleum products
MHT	2330	Processing of nuclear fuel
MHT	241	Basic chemicals
MHT	242	Other chemicals
MHT	2430	Man-made fibres
RB	251	Rubber products
MHT	2520	Plastic products
RB	2610	Glass and glass products
RB	269	Non-metallic mineral products n.e.c.
MHT	2710	Basic iron and steel
RB	2720	Basic precious and non-ferrous metals
RB	273	Casting of metals
LT	281	Struct.metalproducts;tanks;steam generators
LT	289	Other metal products; metal working services
MHT	291	General purpose machinery
MHT	292	Special purpose machinery
MHT	2930	Domestic appliances n.e.c.
MHT	3000	Office, accounting and computing machinery
MHT	3110	Electric motors, generators and transformers
MHT	3120	Electricity distribution & control apparatus
MHT	3130	Insulated wire and cable

MHT	3140	Accumulators, primary cells and batteries
MHT	3150	Lighting equipment and electric lamps
MHT	3190	Other electrical equipment n.e.c.
MHT	3210	Electronic valves, tubes, etc.
MHT	3220	TV/radio transmitters; line comm. apparatus
MHT	3230	TV and radio receivers and associated goods
MHT	331	Medical, measuring, testing appliances, etc.
MHT	3320	Optical instruments & photographic equipment
MHT	3330	Watches and clocks
MHT	3410	Motor vehicles
MHT	3420	Automobile bodies, trailers & semi-trailers
MHT	3430	Parts/accessories for automobiles
MHT	351	Building and repairing of ships and boats
MHT	3520	Railway/tramway locomotives & rolling stock
MHT	3530	Aircraft and spacecraft
MHT	359	Transport equipment n.e.c.
LT	3610	Furniture
LT	369	Manufacturing n.e.c.
OTHER	3710	Recycling of metal waste and scrap
OTHER	3720	Recycling of non-metal waste and scrap

3. List of high-value versus low-value product groups in sub-sectors (SITC Revision 3)

Product Groups (with SITC rev. 3 codes)				Notes
High value product groups		Low value product groups		
Sector 1: Food, Beverages and Tobacco				
122	Tobacco, manufactured	58	Fruit presvd/fruit preps	
35	Fish,dried/salted/smoked	98	Edible products n.e.s.	(excl. 981, 985, 989)
37	Fish/shellfish,prep/pres	48	Cereal etc flour/starch	
16	Meat/offal preserved	91	Margarine/shortening	
24	Cheese and curd	56	Veg root/tuber prep/pres	
73	Chocolate/cocoa preps	59	Fruit/veg juices	
17	Meat/offal presvdn.e.s	421	Fixed veg oil/fat, soft	
23	Butter and cheese	411	Animal oil/fat	
62	Sugar confectionery	431	Animal/veg oils procesd	
112	Alcoholic beverages	422	Fixed veg oils not soft	
981	Homogenized food preps.	61	Sugar/mollasses/honey	
985	Soups and broths	47	Cereal meal/flour n.e.s	
989	Food preparations n.e.s.	46	Flour/meal wheat/meslin	
616	Natural honey	111	Beverage non-alcohol nes	
Sector 2: Textiles, Wearing Apparel and Leather Products				
613	Furskins tanned/dressed	655	Knit/crochet fabrics	
845	Articles of apparel nes	658	Made-up textile articles	
612	Leather manufactures	846	Clothing accessories	
654	Woven textile fabric nes	831	Trunks and cases	
656	Tulle/lace/embr/trimetc	851	Footwear	(excl. 8511,2,4)
848	Headgear/non-text clothg	657	Special yarns/fabrics	
653	Man-made woven fabrics	651	Textile yarn	
652	Cotton fabrics, woven	267	Man-made fibres nes/wast	
611	Leather	266	Synthetic spinning fibre	
8511	Footwear metal toe-cap	265	Vegtext fibre ex cot/ju	
8514	Footwear leather uprnes	264	Jute/bast fibre raw/retd	
8512	Sports footwear	843	Men/boy wear knit/croch	
842	Women/girl clothing wven	844	Women/girl wear knit/cro	
841	Mens/boys wear, woven	659	Floor coverings etc.	
Sector 3: Wood and Paper Products				
633	Cork manufactures	635	Wood manufactures n.e.s.	(excl. 6352,4)
642	Cut paper/board/articles	248	Wood simply worked	
6352	Cooprageprod,inc staves	641	Paper/paperboard	
6354	Domestic/decor wood art.	634	Veneer/plywood/etc	
		251	Pulp and waste paper	
		247	Wood in rough/squared	
Sector 4: Metal Products				
695	Hand/machine tools	689	Misc non-ferr base metal	
696	Cutlery	699	Base metal manufacnes	

697	Base metal hholdequipms	694	Nails/screws/nuts/bolts	
692	Metal store/transptcont	691	Iron/stl/alum structures	
678	Iron/steel wire	693	Wire prod exc ins electr	
671	Pigironetcferroalloy	679	Iron/steel pipe/tube/etc	
672	Primary/prods iron/steel	675	Flat rolled alloy steel	
		677	Iron/steel railway matl	
		674	Rolled plated m-steel	
		676	Iron/steel bars/rods/etc	
		673	Flat rolled iron/st prod	
Sector 5: Coke, Refined Petroleum, Non-metallic Mineral				
625	Rubber tyres/treads	345	Coal gas/water gas/etc	
629	Articles of rubber nes	663	Mineral manufactures nes	
621	Materials of rubber	344	Petrol./hydrocarbon gas	
666	Pottery	662	Clay/refractory material	
232	Rubber synth/waste/etc	334	Heavy petrol/bitum oils	
664	Glass	342	Liquid propane/butane	
665	Glassware	335	Residual petrol. prods	
		661	Lime/cement/constrmatl	
		322	Briquettes/lignite/peat	
		667	Pearls/precious stones	
Sector 6: Machinery, Equipment and Telecommunications				
716	Rotating electr plant	711	Steam generating boilers	
718	Power generating equnes	712	Steam/vapour turbines	
751	Office machines	713	Internal combust engines	
752	Computer equipment	714	Engines non-electric nes	
759	Office equip parts/accs.	721	Agric machine ex tractr	
764	Telecomms equipment nes	722	Tractors	
771	Elect power transm equip	723	Civil engineering plant	
774	Medical etc el diagequi	724	Textile/leather machinry	
776	Valves/transistors/etc	725	Paper industry machinery	
871	Optical instruments nes	726	Printing industry machny	
874	Measure/control app nes	727	Food processing machines	
881	Photographic equipment	728	Special industmachnnes	
		731	Mach-tools remove mtrial	
		733	Mtl m-tools w/o mtl-rmvl	
		735	Metal machine tool parts	
		737	Metalworking machine nes	
		741	Indust heat/cool equipmt	
		742	Pumps for liquids	
		743	Fans/filters/gas pumps	
		744	Mechanical handling equi	
		745	Non-electr machines nes	
		746	Ball/roller bearings	
		747	Taps/cocks/valves	
		748	Mech transmission equmnt	

		749	Non-elec parts/accmachn	
		761	Television receivers	
		762	Radio broadcast receiver	
		763	Sound/tv recorders etc	
		772	Electric circuit equipmt	
		773	Electrical distrib equip	
		775	Domestic equipment	
		778	Electrical equipment nes	
		872	Medical/etc instruments	
		873	Meters and counters nes	
		882	Photographic supplies	
		884	Optical fibres	
		885	Watches and clocks	
Sector 7: Transport Equipment				
792	Aircraft/spacecraft/etc	791	Railway vehicles/equipmt	
783	Road motor vehicles nes	793	Ships/boats/etc	(excl. subg-roups under high soph)
782	Goods/service vehicles	784	Motor veh parts/access	
781	Passenger cars etc	785	Motorcycles/cycles/etc	
79322	Tanker ships/boats	786	Trailers/caravans/etc	
79328	Passenger ships/boats			
79329	Warships, lifeboats			
79351	Dredgers			
79359	Light/fire/crane vessels			
7937	Tugs and pusher craft			
Sector 8: Chemical and Plastic Products				
541	Pharmaceutexcmedicamnt	515	Organo-inorganic compnds	
542	Medicaments include vet	531	Synth org colour agents	
525	Radio-active etcmatrial	591	Household/garden chemcal	
551	Essent.oil/perfume/flavr	581	Plastic tube/pipe/hose	
553	Perfume/toilet/cosmetics	582	Plastic sheets/film/etc	
		893	Articles nes of plastics	
		514	Nitrogen function compds	
		583	Monofilament rods/sticks	
		524	Other inorganic chemical	
		593	Explosives/pyrotechnics	
		533	Pigments/paints/varnish	
		597	Oil etc additives/fluids	
		598	Misc chemical prods nes	
		574	Polyacetals/polyesters..	
		532	Dyeing/tanning extracts	
		575	Plastic nes-primary form	
		572	Styrene primary polymers	
		592	Starches/glues/etc.	

		516	Other organic compounds	
		554	Soaps/cleansers/polishes	
		513	Carboxylic acid compound	
		571	Primary ethylene polymer	
		573	Vinyl chloride etcpolym	
		511	Hydrocarbons/derivatives	
		579	Plastic waste/scrap	
		522	Elements/oxides/hal salt	
		512	Alcohols/phenols/derivs	
		523	Metal salts of inorgacd	
		562	Manufactured fertilizers	

i Nelson and Winter 1982; Lall, Albaladejo, and Morreira 2004.

ii Hausmann, Hwang and Rodrik 2007; Lederman and Maloney 2012;Stiglitzet al. 2014

iii UNCTAD 2002; Kaplinsky 2005

iv Lee and Stone 1994; Kaplinsky and Readman 2005

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