# Box 4.2

# The Position of Turkey in Global Value Chains

When we take a look at the general tendency in the global economy, we see that production, trade and investments are subject to a process called global value chains, where different stages of production are conducted in different countries. The fact that stages of production take place in different sectors and countries has led to a significant rise in the volume of global trade. Therefore, countries that create the greatest amount of value added in the value chains have become important players in world trade. Thus, understanding the position of countries in global value chains and how this position evolves over time is an important consideration in terms of the size of share obtained from the global trade pie.

Recently, the international trade literature has shown growing interest in the notion of *upstreamness* in, which has been developed as a metric to measure the distance of a certain industry from its final use (Antrás et al. 2012). It shows the required number of production stages until the final usage and reflects the capability of countries in creating value added. For an economy where there is N-available number of industries, the upstreamness measure of an industry $i \in \{1,…,N\}$ is defined as follows:

$$U_i = 1 \cdot \frac{F_i}{Y_i} + 2 \cdot \frac{\sum_{j=1}^{N} d_{ij}F_j}{Y_i} + 3 \cdot \frac{\sum_{j=1}^{N} \sum_{k=1}^{N} d_{ik}d_{kj}F_j}{Y_i} + 4 \cdot \frac{\sum_{j=1}^{N} \sum_{k=1}^{N} \sum_{l=1}^{N} d_{il}d_{lk}d_{kj}F_j}{Y_i} + \cdots \qquad (1)$$

Here the total output of industry i and its use as a final good are denoted as $Y_i$ and $F_i$, respectively. And $d_{ij}$ is the dollar amount of industry i's output required to produce one dollar's worth of industry j's output. The more upstream an industry is, the greater number of production stages its output visits, and the more value added is created in each respective sector. Notice that the output of industry i is used both as a final good and as an intermediate good by other sectors in the value chain. It can be seen from equation (1) that the initial industry in the value chains is denoted as i and the terminal industry where its output is finally converted to final good is shown as j. Other intermediate industries between i and j are described as l and k (in this case we assume there are four different industries in the economy). The output of industry i is processed in both of these intermediate sectors to gain value until it meets the industry j, i.e., final demand. To better grasp the tendency of the usage of the output of sector i by the other sectors, Antrás and Chor (2013) suggest computing the (weighted) average position of industry i's output in the value chain, by multiplying each terms in equation (1) by their distance from final use plus one and dividing by the output of sector i. To illustrate, let's consider the initial industry i. If the output of sector i is not used by the other sectors in value chains as an intermediate good, then only the first term at the right hand side of equation (1) will be meaningful and since the total output equals the final use, upstreamness will take a value of one. If the output of sector i is used as an input only by sector j, then the first two terms at the right hand side of the equation will constitute the related upstreamness measure. Furthermore, if the output of sector i is first processed by sector k and then then used as an input by sector j, the upstreamness of sector i will depend on first three terms. Thus, upstreamness is an analytical measure showing the required number of stages until the final use. The industries whose outputs are directly consumed are expected to have an upstreamness value close to 1 whereas those whose outputs are supplied to other sectors as an input are expected to have an upstreamness value largely above 1. Values closer to 1 imply that the respective output is destined directly for final use.

For example, Antrás et al. (2012) provide the upstreamness values for a list of industries, in which upstreamness of the petrochemical industry is 4.65. That means the output of petrochemical industry is used in at least four different sectors before meeting the final demand. Similarly, the upstreamness of the breakfast cereal industry is 1.05. In other words, the upstreamness value of a sector producing intermediate goods will inevitably be different from that of a sector producing final goods.

This box explores the position of Turkey in global value chains in comparison with OECD countries within the context of upstreamness. To this end, we compute export and import upstreamness values of Turkey[1] and show how they have evolved in time.[2] We use the following measures by Antrás and Chor (2013):[3]

$$U_{TUR,t}^{M} = \sum_{i=1}^{N} \frac{M_{TUR,it}}{M_{TUR,t}} U_i \qquad U_{TUR,t}^{X} = \sum_{i=1}^{N} \frac{X_{TUR,it}}{X_{TUR,t}} U_i$$

Here $M_{TUR,it}$ ($X_{TUR,it}$) shows the value of Turkey's imports (exports) for product type i at time t; $M_{TUR,t}$ ($X_{TUR,t}$) denotes the total value of imports (exports) at time t . $U_i$ is the upstreamness value for each sector i. An increase in import upstreamness means Turkey processes the imported goods within its domestic plants to create more value added in each production stage instead of consuming as final goods. If the export upstreamness falls, Turkey's export composition starts consisting of final products aimed to be directly served to the final foreign demand. Following the same reasoning, if the import upstreamness decreases, Turkey starts losing its capability to create value added to the imported products in domestic plants while the increase in export upstreamness shows the tendency for Turkish export composition to comprise relatively intermediate goods in world markets. In the latter case, other countries can have an advantage to seize the opportunity to bring more value added to the products imported from Turkey.
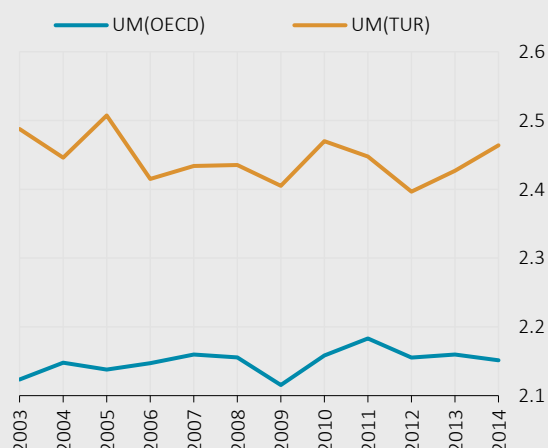
The charts below depict the evolution of export and import upstreamness between 2003 and 2014.

**Chart 1: Evolution of Turkey's Export Upstreamness relative to OECD Countries**
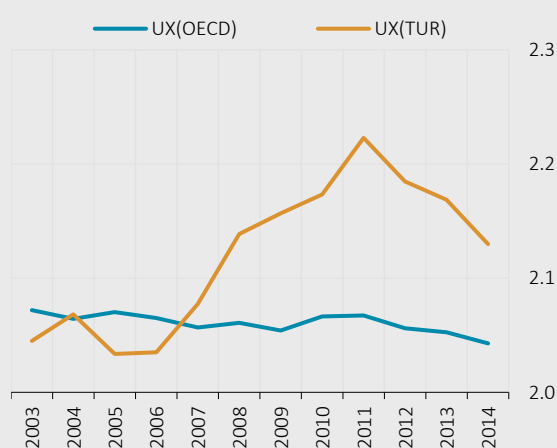


Source: CBRT calculations.

**Chart 2: Evolution of Turkey's Import Upstreamness relative to OECD Countries**



Source: CBRT calculations.

1 United Nation's UN Comtrade Database provides the export and import values of countries between 2003 and 2014 at available HS4 product categories.
2 Antrás et al. (2012) list the upstreamness values of 426 different industries in terms of 6-digit IO codes. Export and import upstreamness values are computed by weighting the upstreamness value of each industry in the list of 426 different sectors with their corresponding export and import values in UN Comtrade Database using a concordance mapping between HS4 and IO codes.
3 Antrás et al. (2012) conduct a series of rank correlation tests to stress that industry level upstreamness values of 426 sectors are indeed stable attributes across OECD countries and the export and import upstreamness values computed using these upstreamness values are assumed to be standard comparison measures.

While Turkey was mostly exporting final goods compared to the OECD average towards 2007, its relative position changed subsequently. Until 2011, Turkey's export composition became more intermediate goods-oriented. Given the relative fall in the average OECD export upstreamness, we can affirm that other countries had an opportunity to contribute more value added to Turkey's export products during the respective period (Chart 1). On the other hand, Turkey's import upstreamness displayed a rather wavy pattern well above the OECD average during the same period (Chart 2). This means Turkey was able to add more value to the products it imported from foreign markets relative to OECD countries. The difference between the import and export upstreamness denotes the span of production stages, which shows the depth of production stages operated within the domestic economy that can create value added. When we consider the rise in export upstreamness between 2006 and 2011 together with the import upstreamness that took relatively similar values both in the beginning and at the end of the same period, we observe a fall in the number of production stages that can create value added. However, after 2011, these factors worked in the opposite direction: the rise in import upstreamness, accompanied by the rapid fall in export upstreamness, had a positive impact enlarging production stages, hence creating more value added.

## References

Antrás, P., Chor, D., Fally, T., & Hillberry, R. (2012). Measuring the Upstreamness of Production and Trade Flows. American Economic Review Papers and Proceedings, 102(3), 412–416.

Antrás, P. & Chor, D. (2013). Organizing the Global Value Chains. Econometrica, 81(6), 2127–2204.

United Nations Commodity Trade Data (2010) https://comtrade.un.org/