POSITIONING IN GLOBAL VALUE CHAIN AND FIRM PRODUCTIVITY: A FIRM-LEVEL STUDY OF TURKISH MANUFACTURING INDUSTRY

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ABSTRACT

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Participation in Global Value Chains (GVCs) has played a crucial role in driving economic growth, expanding trade, and enhancing productivity over the past few decades. However, the benefits of GVC participation may vary depending on the production stages in which specialization occurs. The literature analyzing this linkage mainly concentrates on the country level. However, with the availability of detailed micro-level data, there is room for exploring the relationship from a firm standpoint. In this context, this paper aims to examine the position of Turkish manufacturing firms in the value chain and its effect on firm productivity, utilizing firm-level data. We have developed a novel firm-based upstreamness (FBU) measure by applying the underlying principles of the upstreamness index to firm-to-firm transaction data. Findings indicate that firms positioned more upstream are less productive.

Keywords: Global value chain, upstreamness, labor productivity.

ÖZ

KÜRESEL DEĞER ZİNCİRİNDE KONUMLANMA VE FİRMA VERİMLİLİĞİ: TÜRK İMALAT SANAYİ ÜZERİNE FİRMA DÜZEYİNDE BİR ARAŞTIRMA

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Küresel Değer Zincirlerine (KDZ) katılım, son yıllarda ekonomik büyümeyi hızlandırmada, ticaretin genişlemesinde ve verimliliğin artırılmasında önemli bir rol oynamıştır. Ancak, KDZ'ye katılımın faydaları, uzmanlaşmanın gerçekleştiği üretim aşamalarına göre farklılık gösterebilir. Bu ilişkiyi inceleyen literatür genellikle ülke düzeyinde odaklanmıştır. Ayrıntılı mikro verilerin erişebilirliği, bu ilişkinin firma perspektifinden incelenmesine olanak sağlamıştır. Bu bağlamda, bu çalışma, Türk imalat firmalarının değer zincirindeki konumunu ve bunun firma verimliliği üzerindeki etkisini firma düzeyinde veriler kullanarak incelemeyi amaçlamaktadır. Çalışmada, firma-firma işlem verilerine, "Nihai Talebe Uzaklık" endeksi ilkelerini uygulayarak geliştirdiğimiz yeni bir ölçüt olan firma tabanlı nihai talebe uzaklık ölçüsü kullanılmıştır. Sonuçlar, firma tabanlı nihai talebe uzaklık endeks değerinin yüksek olduğu firmaların daha az verimli olduğunu göstermektedir.

Anahtar Kelimeler: Küresel Değer Zinciri, Nihai Talebe Uzaklık Endeksi, İşgücü Verimliliği.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CPA	Statistical Classification of Products by Activity in the European Economic Community
EIS	Entrepreneur Information System
FBU	Firm Based Upstreamness
HS	Harmonized Commodity Description and Coding System
IBU	Industry Based Upstreamness
I-O	Input-Output
ISIC	International Standard Industrial Classification of All Economic Activities
NACE, Rev.2	Statistical Classification of Economic Activities in the European Community, Revision 2
NAICS	North American Industry Classification System
SSI	Social Security Institution
TURKSTAT	Turkish Statistical Institute

CHAPTER 1

INTRODUCTION

Participation in Global Value Chains (GVCs) has played a crucial role in driving economic growth, expanding trade, and enhancing productivity over the past few decades. Around two-thirds of global trade now involves intermediate goods and services (Johnson & Noguera, 2012). On a macroeconomic level, GVC participation has been linked to poverty reduction and economic development. For instance, a 1 percent increase in GVC participation raises per capita income by over 1 percent, significantly more than the 0.2 percent increase from traditional trade (World Bank, 2020). Between 1990 and 2017, the rise of GVCs coincided with a substantial increase in low- and middle-income countries' share of global exports, from 16 percent to 30 percent, and a sharp decline in the global extreme poverty rate, from 36 percent to 9 percent (Brenton et al., 2022).

At the micro level, firms involved in GVCs tend to be more productive and capital-intensive than those not engaging in international trade. GVC participation allows firms in developing countries to enter foreign markets at lower costs, specialize in specific tasks, and access larger markets for their products. Additionally, these firms gain access to cheaper, higher-quality inputs, productivity-boosting technologies, and advanced management practices from abroad, enabling them to grow more rapidly (World Bank 2020).

Despite the overall advantages, the distribution of the benefits of GVC participation is uneven across the production stages. Countries and firms specializing at different stages of the value chain experience different economic outcomes. Generally, the position in high-value-added activities is associated with higher economic benefits.

Regarding their position within the value chain, firms make strategic decisions determining which segments to specialize in and whether to integrate or disintegrate certain production stages to enhance profitability. One notable example is Apple's acquisition of most of Intel's smartphone modem business in 2019, which enhanced its ability to develop in-house technology for its devices. (Apple, 2019) By gaining control over semiconductor manufacturing, Apple has enhanced its capability to produce its own chips for iPhones, iPads, and Macs. Numerous factors may influence these decisions, with entry barriers, investment requirements, and market conditions being the foremost. Nevertheless, the ultimate question is whether such a strategy is profitable.

Within this context, this paper aims to reveal the position of Turkish manufacturing firms in the value chain and examine its impact on firm productivity. We employ one of the GVC-related position indexes, the upstreamness measure, to detailed firm-level data and examine its relationship with value generation. To the best of our knowledge, it is the first attempt to examine the position of Turkish manufacturing firms in the value chain within the context of upstreamness utilizing firm-level data. A distinctive feature of this study is that we develop a firm-based upstreamness measure relying on firm-to-firm transaction data, unlike the common practice of focusing on industry-level linkages inherited in Input-Output tables.

The relationship between the position in a value chain and its impact on value generation has been explored extensively in trade literature. In the 90s, Stan Shih, founder of Acer, proposed the concept of smile-curve in value-added for the computer industry in order to explain that the assembly operations, which lie in the middle, have the lowest value-added. According to that, the value is generated most at the two ends of the value chain: pre-production services, such as design and R&D, and post-production services, such as marketing, logistics, and after-sale services (Shih, 1996). Since then, several firm-level studies presented evidence supporting U-shaped value generation for different industries (Mudambi, 2008; Shin et al., 2012). The "smile-curve" concept allows companies to move along the curve and increase the value added by acquiring new activities or abandoning existing ones, a process referred to as functional upgrading, as defined by Humphrey and Schmitz (2002). However, the challenge arises in the identification of the activities. For instance, the value added by manufacturing establishments is typically associated with fabrication activities, which are positioned in the middle of the “smile curve” (Vries et al., 2021). A firm may perform many activities besides its main activity. For instance, in Türkiye, nine of the top 10 companies “in the Top 250 Companies by R&D Expenditure” list are classified as manufacturing companies (Turkishtime, 2023) Indeed, there are different approaches to measure specialization in trade. One group concentrates on the product composition of trade statistics (Hummels et al., 2001; Johnson & Noguera, 2012; Koopman et al., 2014), and the other concentrates on the activities, tasks performed by the economic units (Timmer et al., 2019; Vries et al., 2021).

This study examines the position of firms in Türkiye by introducing a novel measure based on firm-to-firm transaction data, incorporating the position index proposed by Fally (2011) and Antràs et al. (2012). The position index, known as upstreamness, refers to the value chain position of an industry based on its distance from the final use. For instance, raw materials industries, such as steel or oil, which serve as inputs for producing other goods, are considered upstream. Conversely, industries that include assembled products, such as automobiles and footwear, intended for end consumers are classified as downstream. Using this industry-based upstreamness index, the position of countries in the value chain has been investigated in several studies (Antràs et al., 2012; Miller & Temurshoev, 2017; Antràs & Chor, 2018). Recently, with the increased availability of firm-level data, industry-based upstreamness has been used for measuring the position of firms in the value chain (Ju &Yu, 2015; Chor et al., 2021; Mahy et al., 2022). The common approach in these studies involves determining the position of firms or countries in the value chain by incorporating the trade data as industry weights into the position index, which is based on Input-Output (I-O) tables revealing the interlinkages between industries. In this regard, our study is distinctive because it integrates the underlying principles of index construction and applies them to firm-to-firm transaction data, denoted as firm-based upstreamness measure (FBU). To our knowledge, few studies (Dhyne & Duprez, 2015; Mahy et al., 2022) have used firm-to-firm transaction data to evaluate the position of firms in the value chain. The advantage of using firm-to-firm transaction data is that it can be constructed annually. In contrast, in many countries, I-O tables, which are fundamental for the industry-based upstreamness measure, are published periodically by statistical institutes. For example, the most recent I-O table for Türkiye was published in 2012. Given that the input-output linkages within an economy are likely to evolve over time, FBU can capture these dynamic interactions better.

Another advantage of using FBU is that it does not contain issues related to aggregation. To clarify, when industry-based upstreamness (IBU) is used, engines and motor vehicles are categorized under the same industry - "C29-Motor vehicles, trailers, and semi-trailers." according to the Turkish I-O Table 2012. Hence, they are considered as two products with the same upstreamness value. However, it is noticeable that engines would have higher upstreamness levels than motor vehicles. In FBU, this is eliminated since upstreamness will be calculated separately for the engine and motor vehicle manufacturer.

Besides the quantitative features of FBU, it also allows us to explore the relationship between the firm performance and its position in the value chain. The ex-ante relationship between the position of a firm in the value chain and its impact on firm performance is ambiguous. Firms can move "upstream" in the value chain by extending their control over the supply chain by acquiring or merging with their suppliers or establishing facilities to produce intermediates by in-house production. By adding more upstream activities to their current activities, firms may have the advantage of reduced costs by avoiding supplier markups. Moreover, the ability to customize the inputs to fit better with the production needs and easier technology transfers between production stages within a firm can enhance productivity.

Nevertheless, there is also a significant risk of inefficiencies that may emerge when altering the composition of production, as engaging in additional upstream activities requires both specialized expertise and the development of new capabilities. Insufficiency in these aspects can strain competitiveness with other external suppliers who have already established these stages. Furthermore, investment costs can be large in acquiring the upstream stages of the production, the anticipated returns on these investments might fall short of covering the costs associated with moving further "upstream" within the value chain.

Empirically, the relationship between the position in a value chain and its impact hasn't been explored much at the firm locus. However, recently, the increased availability of firm-level data attracted interest in this issue. Ju & Yu (2015) argue that firms operating in more upstream industries tend to be more productive and profitable within the Chinese economy. Chor et al. (2021) document that as Chinese firms import more upstream products, export goods closer to final demand, and expand production stages domestically, they become larger, more experienced, and more productive. Mahy et al. (2022) also assert that firms positioned further upstream generate greater value, with productivity gains outweighing wage costs, leading to higher profitability.

On the contrary, de Vries et al. (2021) found that not only firms in upstream stages, such as R&D activities, but also firms specialized in downstream stages, such as marketing activities, have higher productivity compared to ones specialized in fabrication. Similarly, Rungi and Prete (2018) assess that a smile curve exists when all activities, such as primary, manufacturing, and services, are included. When the manufacturing firms are isolated, firms generate more value the closer they are to final consumption. Our results coincide with those of Rungi and Prete (2018), such that as upstreamness increases, labor productivity declines.

The organization of the dissertation is as follows: In the next chapter, we will begin by reviewing the literature on the concept of upstreamness, a measure originally introduced by Fally (2011) and Antràs et al. (2012). This index has become a widely used tool in the study of global value chains, helping to conceptualize and analyze the relative position of countries. However, its application at the firm level is a more recent development. In this regard, we will explore the literature on firm-level upstreamness, highlighting key findings and methodological approaches. Additionally, there are theoretical frameworks that explore sequential trading and the optimal integration decisions of firms within the value chain. We will review these studies in detail in the following chapter.

In the third chapter, we introduce the methodology of the industry-based upstreamness measure and then construct our firm-based upstreamness measure relying on firm-to-firm transaction data. Employing both of these measures to Turkish manufacturing firms, we first highlight the different outcomes resulting from the two approaches and discuss the characteristics of the measures causing this variation. At the end of the chapter, we summarize the patterns in our data according to FBU from 2008 to 2019 and examine the decomposition of the changes in it.

The fourth chapter explores the relationship between the FBU and the productivity of a firm. We first identify some key facts observed in our empirical dataset. Then, we apply the System Generalized Method of Moment (GMM) estimation method by controlling year and sector dummies to examine the relationship between labor productivity and upstreamness at the firm level and present the estimation results. Finally, in the last chapter, we provide the main findings, the limitations of our study, policy implications, and recommendations for future research.

CHAPTER 2

THE LITERATURE REVIEW

2.1. LITERATURE RELATED TO THE UPSTREAMNESS MEASURE

International trade grew rapidly after 1990, driven by the global value chains (GVCs). Meanwhile, the concept of GVC has improved from "commodity chain" to "global commodity chain" and then to "global value chain" (OECD, 2013). Currently, it can be defined in a broad context as "a series of stages involved in producing a product or service that is sold to consumers, with each stage adding value, and with at least two stages being produced in different countries." (Antràs & Chor, 2022).

As discussed by Amador and Cabral (2016), the progress in information, telecommunications, and transportation technologies is the key driver of the emergence and rise of GVCs. Another key factor behind the rise of GVCs is the reduction of economic and political barriers to trade, facilitated by the increase in the number and scope of trade agreements and China's accession to the WTO in 2001. These developments have led to an increase in the amount and flow of intermediate goods crossing borders and more fragmented production processes.

The evolution of GVCs has changed our perspective on international trade. The conventional trade accounts have been replaced with trade accounts of value-added terms, the impact of foreign inputs in production processes has gained importance, and the exact gains from international trade have been re-interrogated.

In this section, our focus will be on the fragmented nature of the production process within GVCs. GVCs enable countries to carry out and specialize in different segments of production, i.e., upstream or downstream stages of the production process. Therefore, the degree of the increased fragmentation in the production processes across national borders, the evolution of the fragmentation over the years, and the position of the countries in that progress, whether they are specialized in relatively upstream or downstream stages of the production process, has become a demanding question. Answering this question exhibits new insights for understanding the changing dynamics of global production linkages.

2.1.1. Empirical Studies on the Level of Upstreamness

To address the question, Fally (2011) analyzes the average length of the production chain and the evolution of production fragmentation in the USA from 1947 to 2002. In this pursuit, he introduces two key measures denoted respectively by N_i and D_i. The former represents the average number of stages required to produce a good, whereas the latter represents the average number of stages before reaching final demand. The variable D_i contains the fundamentals of the upstreamness measure and relies on the premise that industries purchasing a lot of inputs from other upstream industries should themselves be upstream. The major finding of his study is that the weighted number of stages in the US economy is, on average, below 2 and has declined by more than 10% over the last 50 years.

Simultaneously with Fally's study, Antràs et al. (2012) introduced a new concept in the form of a relative production line position measure, the industry "upstreamness" measure. This measure relies on the share of the goods used by the final consumers: households, government, and investors. It considers the position of industries within the production process. Some industries are closer to final consumers by selling a large portion of their outputs directly to final consumers. In contrast, other industries are positioned further from final consumers because a significant portion of their outputs is used as intermediate inputs by other industries. This measure, also referred to as the average distance to the final demand, is a way of understanding the use of the industry's output at different positions in the production chain with respect to final demand. Higher values of the measure indicate the presence of several production stages for an industry until its output meets the final demand, providing a new perspective on the production process.

Antràs et al. (2012) calculate the industry upstreamness measure for 426 industries in the USA using the 2002 Input-Output (I-O) Tables. According to their findings, the upstream levels range from 1 to 4.65, with the average value being 2.09, indicating that, on average, an industry's output meets final demand after entering at least one production stage. "Automobiles," "furniture," and "footwear" are the most downstream ones among all industries, selling most of their output directly to the final consumer. In contrast, the most upstream industries are "petrochemicals" and "smelting of aluminum." The authors also assess the stability of the measure across different countries by computing industry upstreamness values for various countries using I-O tables from the OECD STAN Database. Spearman rank correlations among country pairs indicate that the industry upstreamness measure is stable. They further apply their US-based measure to trade data by combining export information from various countries between 1996 and 2005. They calculate each country's export upstreamness using industry exports as weights and examine how various country-specific factors affect this measure. Among the factors considered—per capita GDP, rule of law, strength of financial markets, capital intensity, and human capital—strong institutions and a prevailing rule of law are associated with higher downstream exports.

By implementing the upstreamness measure, Dhyne et al. (2015) evaluate the Belgian production network by constructing a unique dataset of all commercial transactions between Belgian firms. To establish the dataset, they used VAT declarations of Belgian firms for 2002-2012 with additional information for firm characteristics from other sources, such as the national accounts database and the international trade statistics database. Incorporating the above-mentioned constructed dataset for the domestic production network and World Input-Output Database (WIOD) for the international trade linkages into the upstreamness and downstreamness measures, Dhyne and Duprez (2015) present the total length of the production chain and the relative position of each firm in that chain. According to their findings, the firms in the Belgian economy specialize at an early stage of the production chain. Although %5 of the Belgian firms directly export, with the inclusion of the domestic network, 82% of

Belgian firms directly or indirectly sell products abroad. They also assert that firms have higher total factor productivity growth rates when they are part of a highly fragmented production chain. They further analyze how the economic crisis affects the sectors, concluding that those farthest from the end user are the most affected.

Significant advancements have been made in measuring global value chains and assessing the position of countries through the development and use of global input-output tables, which utilize trade data and national input-output tables. This enables the extension of coverage of the countries investigated under the upstreamness literature.

In this context, Miller and Temurshoev (2017) compute the production line position of 35 industries across 40 countries using the international input-output tables from the WIOD. Alongside the upstreamness measure proposed by Antràs et al. (2012), they introduce the input downstreamness measure as an indicator of the industry's relative position along the global output supply chain and input demand chain. Consistent with previous studies, industries such as “mining and quarrying,” “basic metals and fabricated metal sectors,” and “chemicals” are identified as highly upstream. In contrast, sectors such as “construction” and “education” are the least upstream industries. Country-specific results reveal that China is positioned the furthest from final consumers in the global output supply chain. Additionally, countries such as Korea, Türkiye, Austria, Bulgaria, Germany, and Luxembourg have experienced the largest increases in their upstream levels from 1995-2011.

In another study utilizing the data from WIOD, Antràs and Chor (2018) investigate the evolution of upstreamness and downstreamness across various countries and industries in global value chains from 1995 to 2011. They find a positive correlation between upstreamness and downstreamness in both country and country-industry measures, indicating that countries or county-industries farther from final demand are also more distant from primary inputs. They further investigate the possible explanations for the observed result and analyze the impact of reducing trade costs and shifting demand from the goods sector to the services sector.

2.1.2. Empirical Studies on the Effects of Upstreamness on Firm Performance

While many studies have quantified upstreamness across countries or industries, fewer have examined how a firm's position in global value chains impacts its performance, including profitability and productivity. As a result, the relationship between upstreamness and firm productivity remains unclear in the literature. However, Mahy et al. (2022) identifies several channels through which upstreamness can affect firm productivity.

Mahy et al. (2022) categorizes these channels into two types: positive and negative. Positive channels include the benefits of exporting for upstream firms, interactions with more productive downstream partners, control over high-value downstream activities, and greater R&D and capital intensity. Negative channels are related to the challenges of having less control over the value chain.

One study that highlights a positive relationship between upstreamness and firm performance is by Ju and Yu (2015). Their research, which applies the upstreamness measure to the Chinese economy using I-O tables of 2002 and 2007, calculates regional, firm-level, and export upstreamness levels based on the industry-level upstreamness. Consistent with Antràs et al. (2012), they find that the “energy” and “raw material” sectors are the most upstream, while the “services” and “construction” sectors are the most downstream. They also confirm that upstream manufacturing industries are more capital-intensive. Their study provides evidence that firms in upstream industries are more productive and profitable compared to those in downstream industries after controlling for firm, industry, and province attributes. Moreover, they assert that with the increase of upstreamness, exporter firms’ performance is higher than that of non-exporters.

Rungi and Prete (2018) examine the relationship between the value generation of a firm and its distance from final consumption, using data from 2.3 million firms in the European Union in 2015. They find a non-linear U-shaped relationship indicating that tasks at both the early and late stages of the supply chain, such as R&D, design, marketing, and aftersales services, generate higher value added. When focusing specifically on manufacturing firms, they observe the producers create more value the closer they are to final consumption. Hence, a "smile curve" is evident when primary and service activities are included in the analysis.

Chor et al. (2021) compute the production line position of Chinese firms using the matched firm-level customs and manufacturing survey data and I-O tables for China. They explore the evolution of the position with productivity and performance over the firm lifecycle. They first construct two measures for the production line position of firms: the firm-level import and export upstreamness by using the industry-level measure of upstreamness weighted by each firm's import and export shares of commodities. The difference between these upstreamness measures gives information about the range of production stages that firms coordinate within China. According to their findings, from 1992-2014, Chinese imports became significantly more upstream, while Chinese exports became more downstream. The firm life cycle analysis shows that as firms become more productive, larger, and more experienced, their imports become more upstream, and exports become move closer to final demand. This implies that firms span more production stages in China, accompanied by increases in input purchases, value added in production, and profits.

Another study incorporating the export upstreamness, as Chor et al. (2021) do, is de Vries et al. (2021). Their main focus is to investigate the relationship between functional specialization and total factor and labor productivity based on two surveys of Dutch firms in 2012 and 2017. The functional specialization measure is conceptualized as comparing the firm's business activity employment share with the average employment share of that activity across all firms. Firms with higher shares of the given activity are thought to specialize in that activity. Firms specialized in R&D and marketing have higher productivity levels than those in fabrication. When replicating the analysis with the upstreamness measure, they find no significant relationship between upstreamness and productivity. They argue that the upstreamness measure gives information about the position of goods rather than firms in the global value chain, so the upstreamness measure is unrelated to functional specialization.

Mahy et al. (2022) investigate the relationship between upstreamness and productivity. They examine the impact of firm-level upstreamness on productivity and wage costs in Belgium, covering all years from 2002 to 2010. Utilizing the business-to-business (B2B) transactions data constructed by Dhyne and Duprez (2015), their analysis indicates a positive relationship exists between upstreamness and firm performance, and the impact of firm-level upstreamness is stronger on productivity than on wage costs. Their study is a rare contribution to the upstreamness literature, as it computes the upstreamness measure at the firm level using a B2B transactions dataset.

2.1.3. Theoretical Studies Related to the Upstreamness

Modeling the fragmented production in international trade is challenging. Hence, the theory of fragmented production is captured analytically in a few studies, including Yi (2010), Costinot et al. (2013), Fally and Hillberry (2018), and Antràs and de Gortari (2020).

Within the context of the upstreamness measure, two theoretical studies are particularly noteworthy. The first, by Antràs and Chor (2013). explores the organizational structure of sequential production in global value chains within a property rights model and incomplete contracting environment. Their major finding is that when demand for the final good is sufficiently elastic, firms are more likely to outsource upstream stages and integrate downstream stages. Conversely, when demand is inelastic, firms tend to outsource downstream stages and integrate upstream stages.

The second study, by Alfaro et al. (2019) investigates the choices of production process along the supply chain by developing a property rights model combining firm-level data with information from I-O tables. They find that a firm’s decision to integrate upstream or downstream suppliers depends on the relative elasticity of demand for its final good and the elasticity of substitution across production stages. They conclude that a higher elasticity of demand faced by the parent firm is associated with lower average upstreamness of its integrated inputs compared to its non-integrated inputs.

2.2. SUPPLEMENTARY LITERATURE

The upstreamness measure has been developed to conceptualize the linkages within the global value chain by focusing on the position of countries and/or industries depending on the length of the production process with respect to the end user. There are also other measures to quantify the size and share of GVC-related trade flows, such as domestic value added in exports, foreign value-added, and vertical specialization. Although these measures seem to capture the different aspects of the same flow, they have some intersections. For instance, by mathematically showing the relationship between the upstreamness index and the forward linkages, Johnson (2018) asserts that upstream industries have stronger forward linkages.

Johnson (2018) surveys the measurement of GVC linkages on two fronts: macro and micro approaches to measuring GVCs. From the macro standpoint, global input-output data enables the measurement of value-added content of trade, the length of GVCs, the location of firms in that chain, and price linkages across countries. The studies on the micro side include firm-level analyses of input sourcing decisions, joint participation in exporting and importing, and the network structure of multinational firms.

From a macro perspective, many papers have contributed to the GVC literature in conceptualizing and quantifying production sharing and trade-in value added (Hummels et al., 2001; Johnson & Noguera, 2012; Koopman et al., 2014).

A considerable amount of research has focused on examining the impact of global value chains (GVCs) on various performance indicators. This branch of GVC studies differs in the measurements of GVC participation, i.e., forward/backward participation or in the affected economic unit (country, sector, or firm). The literature often neglects the firm-level issue due to the limited availability of detailed micro-level data. In recent years, however, there has been a growing recognition of the importance of examining firm-level dynamics within GVCs. This has led to an increasing demand for more micro-level analyses that use firm-specific data to better understand how firms participate in GVCs and it affects their performance.

Given that our primary interest lies in investigating the relationship between the upstreamness measure and firm performance, we will focus our review in this subsection on studies that explore how GVC-related concepts, particularly upstreamness, are linked to key performance indicators in general. These studies provide a valuable framework for understanding how firms' positions within GVCs influence their productivity and profitability.

2.2.1. Empirical Studies on the Effects of GVC Participation

It is estimated that, in cross-country studies, a 10% increase in the level of GVC participation leads to a nearly 1.6% increase in average productivity and an 11-14% increase in per capita GDP. Although participation in GVCs stimulates income growth and productivity through specialization in specific tasks and technology transfers, the distributional effects of GVC participation are not equal across and within countries. (World Bank, 2020).

Alongside the effects of GVC participation, Kummritz (2016) and Kummritz, Taglioni, and Winkler (2017) emphasize the role of institutional and political attributes of countries in the success of the integration. Kummritz (2016), using inter-country I-O tables (ICIOs) provided by the OECD, analyzes the industry-level effect of GVC participation, measured by backward and forward linkages, on countries across all income levels. Independent of the income levels, increased GVC participation leads to higher domestic value added and productivity for all countries. While backward and forward linkages increase domestic value added, evidence supports that only forward linkages raise labor productivity. Kummritz, Taglioni, and Winkler (2017) advocate a similar result: GVC integration promotes the domestic value of the industry with stronger effects through forward links. They additionally emphasize the importance of country-specific characteristics and policies for benefitting from integration.

Constantinescu et al. (2019) investigate the impact of global value chain participation, explicitly the impact of vertical specialization, which is defined as the sum of the foreign value added embodied in a country's gross exports and the country's domestic value added embodied in other countries' gross exports, on the productivity of countries. Using data on trade in value added from the WIOD covering 13 manufacturing sectors in 40 countries over 15 years, they conclude that participation in global value chains is a significant driver of labor productivity.

Various explanations have been proposed for the significant productivity gains that firms experience by integrating into global value chains. Fragmented production allows firms in developing countries to enter foreign markets at lower costs, benefit from specialization in niche and high-productivity tasks, and access larger markets for their outputs. Additionally, firms in GVCs can obtain cheaper and higher-quality inputs, productivity-enhancing technologies, and improved management practices developed elsewhere, contributing to faster growth. Furthermore, firms participating in GVCs often exhibit higher productivity and capital intensity compared to non-trading or less integrated firms. (World Bank 2020).

In their review, Criscuolo and Timmis (2017) categorize the studies of the performance implications of GVCs. The first group of studies focuses on the effects of GVCs via specialization and offshoring possibilities due to fallen trade costs and progress in ICT associated with the rise of GVCs. This channel allows firms to specialize in core tasks more efficiently and offshore the less efficient parts of the production process. A body of empirical studies examines this link between productivity and offshoring (Grossman & Rossi-Hansberg, 2008; Amiti & Wei, 2009; Schwörer, 2013; Winkler, 2010). The second group of studies concentrates on the effects of GVCs via the advantages of the increased variety and quality of foreign inputs on firm productivity. Criscuolo and Timmis (2017) state that the availability of previously unobtainable varieties of imported inputs creates new opportunities for production, enables cost reductions, and allows firms to upgrade the quality of the inputs. Many studies in this group support positive productivity enhancements from imported inputs (Amiti & Konings, 2007; Goldberg et al., 2010; Halpern et al., 2015).

The studies exploring the effects of technology spillovers through foreign direct investment (FDI), i.e., multinational firms, on firm performance, are gathered in the third group. Javorsik (2004) studies the relationship between the productivity of domestic local firms in the presence of multinationals in downstream sectors, i.e., productivity spillovers through backward linkages, and finds evidence for positive spillovers. In their quantitative review of FDI spillovers, Havranek and Irsova (2011) also find supporting evidence that the spillover to suppliers through backward linkages is economically significant. Moreover, they also document significant but smaller effects for forward linkages.

The impact of backward linkages is not only considered in the FDI context. Dine and Chalil (2021) investigate how sectoral and domestic value-added exports influence labor productivity and employment. After controlling for industry-specific and time-fixed effects, they found that employment and labor productivity declined with foreign value added to exports and increased with domestic value added to exports in Japan.

2.3. LITERATURE ON TÜRKİYE

GVC studies on Türkiye have generally examined the effects of Türkiye's integration into GVCs at the sectoral level.

One of the early studies in this area is by Yasar et al. (2006), who examine the productivity effects of exporting status for Turkish firms in the apparel, food, and textile industries from 1990 to 1996. They analyze how different exporting statuses (e.g., new exporters, continuous exporters) impact productivity across various points of the conditional output distribution. Their findings indicate that exporting status generally improves productivity across the distribution, with a more substantial impact at higher output levels. Additionally, they find that firms with continuous export activities during the study period experience a more pronounced productivity boost compared to other types of firms, such as new exporters, those that exit the market, or those that change their exporting practices.

Taymaz et al. (2011) argue that the structure of the Turkish economy’s integration with the international economy is one of the reasons why Türkiye has not been able to close the gap with the developed economies. Türkiye's export structure in the 1970s was agricultural product-oriented; in the 1980s, it specialized in labor-intensive sectors such as textiles, and then in the mid-1990s, specialization turned towards products such as machinery and automotive, which are classified as medium-technology sectors. They analyze the evolution of the global production chain in five significant sectors in Türkiye's export structure and evaluate Türkiye's position in these chains from 1970-2010. It is asserted that Türkiye is competitive in sectors with low growth rates and low-priced commodities. Due to its lack of competitiveness in sectors with high growth rates or technologically advanced products, Türkiye has not improved its relative position in the international economy.

Saracoglu and Gündoğdu (2016) examine the trends in Türkiye's participation in GVCs, mainly through backward integration between 1995 and 2011, using WIOD. They assess the foreign value-added content of Turkish manufacturing exports at sector-partner dimensions. They find that Türkiye's backward participation in GVCs has increased between 1995 and 2011 from 13.9 percent to 22.3 percent. They assert that this increase is due to Türkiye's integration into the GVCs via the mid-high and high technology sectors such as transport, electrical, and optical equipment. Meanwhile, China, Germany, France, and Italy are the countries that contribute the most to Türkiye's vertical specialization in exports.

Kılıçaslan et al. (2021) is one of the few studies that use firm-level data to explore the impact of integration into GVCs on productivity generation. They examine the impact of the position of firms (supplier, final, and both) in Türkiye in both global and domestic value chains on productivity by studying the manufacturing firms with 20 or more employees. Based on data covering 2003 to 2015, they document that while supplier position on the domestic chain has a negative effect on productivity, the same position in GVC vanishes this effect. They also conclude that being a final firm enhances productivity for both chains.

Pointing out the importance of effective integration policies for the success of export markets, Yanıkkaya et al. (2024) investigate the relationship between integration into

GVCs and sectoral productivity/export performance. Using various GVC-related measures on two sample periods, i.e., 1995-2009 and 2000-2014, they explore how openness affects sectoral total factor productivity (TFP), value-added, and export growth for the Turkish sectors. It is observed that between 1995 and 2014, the index based on the measure of distance increased for almost all sectors, indicating that these industries are more specialized in intermediate inputs and positioned upstream of the production stages. They assert that domestic value added in exports stimulates sectoral value-added in the first sample period, whereas imports and backward linkages are crucial for sectoral TFP and exports in manufacturing.

Other GVC studies in Türkiye concentrate on the employment generation of GVC participation (Mıhcı et al., 2015; Dine, 2019) and the effects of FDI on productivity (Arısoy, 2012; Fatima, 2016).

CHAPTER 3

THE UPSTREAMNESS MEASURE

3.1. DATA

3.1.1. Data Sources

Our study relies on the Entrepreneur Information System (EIS) database administered by the Ministry of Industry and Technology. The database consists of administrative records of enterprises, which are collected by different public institutions and organizations covering the years of 2006-2021. Information for the same enterprise is integrated within the system with a unique firm identification number (ID).

We use various datasets from EIS. The first dataset is customs data of Turkish firms from the Ministry of Trade. It reports the total exports and imports in US dollars for each firm ID and Harmonized System (HS) 12-digit product code. We use customs data to calculate the corresponding weights for measuring firms' import and export upstreamness levels.

The second dataset is Turkish firms' balance sheets and income statements from the Ministry of Treasure and Finance. It reports all balance sheet items such as tangible assets, intangible assets, stocks of finished and semi-finished goods, and income statement items such as total profits, gross sales, and net sales for each firm ID and each year. Another dataset is monthly firm-to-firm transaction data from the Revenue Administration. In accordance with the Tax Procedure Law No. 213, individuals or institutions that keep books on a balance sheet basis are required to report purchases of goods and services worth 5.000 TL or more, excluding VAT, to the tax office with

BA, BS forms which comprise the firm-to-firm transaction dataset. The fourth dataset is from Social Security, which reports employment and total wages paid quarterly in a year for each firm ID. Using information from TURKSTAT, Revenue Administration, and Social Security, EIS also provides the main activity of each firm classified in NACE Rev.2.

Our panel of Turkish manufacturing firms from 2008 to 2019 was created by merging the abovementioned datasets. We determined the firms operating in the manufacturing sector by selecting the ones whose main activity is classified in 2-digit NACE Rev.2 sectors between 10-32 (excluding 33- repair and installation of machinery and equipment).

Besides the administrative datasets, we use the 2012 Turkish Input-Output (I-O) table provided by TURKSTAT to compute the industry-level upstreamness measures.

We compute firms' upstreamness based on two methods: industry-based upstreamness and firm-based upstreamness. In the first method, defined as the industry-based upstreamness, similar to the related literature, we calculate the industry upstreamness value for each sector by using the I-O table and then use this index with the import and export shares of the firm in the related industry as weights to calculate the firm-level upstreamness level. Since the sectors are defined in CPA 2008 in the 2012 Turkish I-O table, we use the concordance tables to convert export and import values reported in HS 6-digit product code to the NACE Rev.2 classification, which is precisely matched with CPA classification on a two-digit level.

Our second method, firm-based upstreamness, relies on firm-to-firm transaction data. Every observation in the data includes information about the seller firm, the buyer firm, the transaction value, the transaction year, and the month the transaction occurred. We use “net sales” from the balance sheet as a proxy for a firm's output. We calculate the intermediate sales from firm-to-firm transaction data by summation of a firm's transactions as a seller. Hence, we obtain a firm's sales to the end user by subtracting the intermediate sales from the firm's output and construct the final demand share of a firm by dividing the sales to the end user by its output. By iterating over the firm-to-firm transaction data with additional information on the final demand shares of each firm, we get the firm-level upstreamness levels.

The following subsection explains these two methods in more detail, and the consecutive section compares the results based on different methods by aggerating over various variables of interest.

3.1.2. Data Preparation

We first match and restrict the firm-to-firm transaction data with balance sheet and income statement data so that both buyer and seller have a record in the later data set. Then, we keep observations where net sales are non-missing and positive in a given year. We also eliminate within-firm transactions where the buyer and the seller ID are identical. Firm-to-firm transaction data is administrative data, so records exist that duplicate the value of transactions between two parties in the sense that only the buyer and the seller IDs switch, which is probably refunding the value. On a monthly base, we also check such transactions and eliminate them. We include only domestic transactions in the firm-to-firm transaction data, which also covers the imports and exports of a firm.[1]

Our datasets have been stored with different classification systems. The I-O 2012 table of TURKSTAT is published using the Statistical Classification of Products by Activity in the European Economic Community, CPA 2008 for products, whereas customs data is classified in the Harmonized System (HS). The harmonized system is updated every five years; the classification updates during our analysis period are in the years 2007, 2012, and 2017. Therefore, we use correlation tables[2] between HS 2017 to HS 2007 and HS 2012 to HS 2007 to standardize the trade data. Our sector division is based on the Statistical classification of economic activities in the European Community, NACE

[1] All firms report the same seller ID, a standardized unique number for the import transactions. This is valid for buyer ID in export transactions.
[2] Correlation tables between different classifications are available at https://unstats.un.org/unsd/classifications/Econ

Rev.2. which is a one-to-one match between CPA 2008 at a two-digit level[3]. Therefore, we also use correlation tables between HS 2007 and NACE Rev.2. in order to calculate the weights of traded goods in a given sector to the firms' overall imports/exports. This enables us to reconcile industry-based upstreamness measures calculated at CPA 2008, which is similar to that of NACE Rev.2 with firm-level weighted trade data, and obtain the upstreamness measure at the firm level.

3.2. METHODOLOGY

3.2.1. Industry-Based Upstreamness (IBU)

Upstreamness is a measurement that has arisen as the production process has become more fragmented, and trade accounts have been reconsidered within this framework. It refers to the position of an industry in the value chain relative to the end user. Fally (2012) and Antràs et al. (2012) are pioneering studies that quantify the concept of upstreamness.

Antràs et al. (2012) developed the industry-level measure of relative production line position, the measure of "industry upstreamness" or average distance to final use. Using their representation in an N-industry closed economy with no inventories, for each industry $i \in \{1,2, \ldots, N\}$, the value of gross output (Y_i) equals the sum of its use as a final good (F_i) and its use as an intermediate input to other industries(Z_i):

$$\begin{aligned} Y_i &= F_i + Z_i \\ &= F_i + \sum_{j=1}^{N} d_{ij} Y_j \quad (1) \end{aligned}$$

where d_{ij} refers to the dollar amount of the sector i's output needed to produce one dollar's worth of industry j's output. By iterating the above equation, the sector i's output can be expressed as an infinite sequence of terms that reflects the use of sector

[3] "The link between the CPA and NACE Rev. 2 is evident in the CPA code: at all levels of the CPA, the coding of the first four digits is identical with that used in NACE Rev. 2, with very few exceptions." (Eurostat, NACE Rev. 2 – Statistical classification of economic activities in the European Community, p.41)

i's output at different positions in the value chain, where the first term reflects the final use.

$$Y_i = F_i + \sum_{j=1}^{N} d_{ij}F_j + \sum_{j=1}^{N}\sum_{k=1}^{N} d_{ik}d_{kj}F_j + \sum_{j=1}^{N}\sum_{k=1}^{N}\sum_{l=1}^{N} d_{il}d_{lk}d_{kj}F_j + \cdots \quad (2)$$

From the above identity, Antràs et al. (2012) calculate the weighted average position of an industry's output in the value chain by multiplying each of the terms in (2) by their distance from final use plus one and divided by Y_i:

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

By construction, $U_i \geq 1$. The lowest value of 1 is attained when the sector i's output is fully and directly absorbed by the end consumer. If, instead, some of its output is used as an intermediate input in the value chain, larger values are attained. Larger values are associated with higher levels of upstreamness of the sector.

Equation (3) can also be expressed in matrix form:

$$U = \frac{[I-D]^{-2}F}{[I-D]^{-1}F} \quad (4)$$

where D denotes the matrix of direct requirement coefficients – the NxN matrix whose i^{th} row and j^{th} column is equal to d_{ij}, F denotes $Nx1$ final demand matrix whose i^{th} row is F_i, and I is the NxN identity matrix.[4]

For the open economy, the coefficient d_{ij} is replaced with $\hat{d}_{ij}$=$d_{ij}\frac{Y_i}{Y_i-X_i+M_i}$ to account for the trade flows under the assumption that the input shares for a given sector are

[4] Using similar matrix algebra, Johnson (2018) asserts that upstream industries have stronger forward linkages by showing the upstreamness index as the row sum of the Ghosh Inverse matrix, a standard measure of the strength of total forward linkages in the production process.

identical at home or abroad. On the empirical side, Antràs et al. (2012) calculated the above industry upstreamness measure for 426 industries using 2002 US I-O tables. They applied these industry measures to trade data to evaluate each country's export composition, whether the pattern is towards upstream or downstream industries.

The upstreamness literature has been developed within the framework of determining the positions of countries by using industry-based measures. Recently, this analysis has expanded to micro studies, where firm-level upstreamness measures are at the center.

Using the above industry upstreamness measure, Chor et al. (2021) calculated the average upstreamness of exports and imports of a firm.

$$U_{ft}^{M} = \sum_{i=1}^{N} \frac{M_{fit}}{M_{ft}} U_i \quad (5)$$

$$U_{ft}^{X} = \sum_{i=1}^{N} \frac{X_{fit}}{X_{ft}} U_i \quad (6)$$

$$U_{ft}^{M} - U_{ft}^{X} = \sum_{i=1}^{N} \left(\frac{M_{fit}}{M_{ft}} - \frac{X_{fit}}{X_{ft}} \right) U_i \quad (7)$$

where M_{fit} denotes firm f's imports and X_{fit} denotes firm f's exports in the sector i in year t. Hence, equations 5-6 show respectively the weighted average upstreamness of imports/exports of a firm. Chor et al. (2021) define the production line position of each firm as a measure of the average positioning of a firm's activities within GVCs relative to final demand. They assert that U_{ft}^{M} captures the upstreamness of materials and inputs that are brought into the home country by the firm and U_{ft}^{X} captures the average upstreamness of the semifinished goods sold to buyers worldwide. The difference between these two indicates the span of the production stages that the firm coordinates within the home country. Using matched customs and annual survey of industrial firms' data with 2007 China I-O Tables, they calculated industry upstreamness for 135 industries and corresponding firm-level measures for China.

We replicate the above-mentioned analysis for Türkiye using the 2012 I-O table provided by TURKSTAT and the trade dataset from EIS. Before presenting the results, we continue with an alternative calculation for the upstreamness measure, which uses the firm-to-firm transactions dataset. The main advantage of using the firm-to-firm transactions dataset is that it is available annually. Therefore, we can track the changes in the input and output linkages. On the other hand, I-O tables, the basis of the industry-based upstreamness measures, are published at certain periods. In Türkiye, the most current version of it was published in 2012; the previous version was in 2002. It should be stressed that the yearly I-O tables of countries are also available in international databases such as WIOD and OECD TIVA. However, they also use information from national supply and use tables with different methodologies to iterate for consecutive years.

For the sake of simplicity, we call the traditional method of calculating the upstreamness "Industry-Based Upstreamness" (IBU) measure and the alternative method "Firm-Based Upstreamness" (FBU) measure.

3.2.2. Firm-Based Upstreamness (FBU)

The industry upstreamness measure developed by Antràs et al. (2012) is based on input-output tables, which reveal linkages between industries. However, it is also possible to identify the equation at the firm level.

In an economy of N-firms, for each firm $i \in \{1,2, \ldots, N\}$, the gross output (sales) of a firm can be broken into two components: its direct sales to meet the final demand (FD_i) and its sales of intermediate supplies to other firms (Z_i)

$$Y_i = FD_i + Z_i \quad (8)$$

We obtain the above equation if we write the intermediate supplies as part of other firms' output. By the iteration of equation (8), an output of firm i can be expressed as the sum of the direct sales and indirect sales (supplying to other firms) to the end user.

$$Y_i = FD_i + \sum_{j=1}^{N} d_{ij} Y_j \quad (9)$$

$$Y_i = FD_i + \sum_{j=1}^{N} d_{ij} FD_j + \sum_{j=1}^{N}\sum_{k=1}^{N} d_{ik} d_{kj} FD_j + \sum_{j=1}^{N}\sum_{k=1}^{N}\sum_{l=1}^{N} d_{il} d_{lk} d_{kj} FD_j + \cdots \quad (10)$$

We can express the upstreamness measure at the firm level by incorporating the number of stages to reach the final demand as weights.

$$U_i = 1.\frac{FD_i}{Y_i} + 2.\frac{\sum_{j=1}^{N} d_{ij} FD_j}{Y_i} + 3.\frac{\sum_{j=1}^{N}\sum_{k=1}^{N} d_{ik} d_{kj} FD_j}{Y_i} + 4.\frac{\sum_{j=1}^{N}\sum_{k=1}^{N}\sum_{l=1}^{N} d_{il} d_{lk} d_{kj} FD_j}{Y_i} + \cdots \quad (11)$$

The upstreamness defined here measures the average number of stages that goods produced by a firm undergo before reaching the final demand. It is a similar expression as in the industry-based upstreamness measure explained in the previous section, with the only difference in the economic unit here being the firm rather than the industry.

To our knowledge, there are only a few studies that utilize firm-to-firm transaction data in order to calculate firm-level upstreamness (Dhyne & Duprez, 2015; Mahy et al, 2021). Most of the other studies employ the industry-based upstreamness. Our study, using firm-to-firm transaction data, provides an unconventional approach to calculating the firm-based upstreamness measure relying on the iteration of the information from the transaction data.

First, we obtain the intermediate sales from firm-to-firm transactions data by summating all transactions of a firm as the seller. We then calculate FD_i for each firm *i* by subtracting the intermediate sales of the firm from the output (i.e., Y_i, net sales) of the firm, which we acquire from the balance-sheet data and then compute the final demand share of each firm *i* as the division of $\frac{FD_i}{Y_i}$. This is the first component in the upstreamness equation, which shows the direct sales to the end user. The other terms in the upstreamness equation indicate the indirect sales to the end user via other firms, depending on the stages they enter into the production chain. In the second iteration, we include what we find in the first iteration as shares for the buyers and merge it with our firm-to-firm transaction data. Hence, we obtain data on each firm as the seller, its customers, the final demand shares of its customers, and the transaction value between the firm and its customers. Again, we calculate the final demand share of each firm depending on the new information that a certain amount (i.e., final demand share of the customer) of transaction value goes to the end user. We use the final demand share of a firm calculated in the preceding iteration as an extra variable for the buyer firms in the current iteration and continue over 15 iterations in which final demand shares of more than %99 of firms reach almost unique.

To illustrate the procedure, suppose a firm has *S* customers. From the first step, we will know the initial and final demand shares of each firm in *S*. Hence, in the second iteration, we calculate each firm's second step's final demand shares, including indirect sales to the end user in the second stage.

$$\left(\frac{FD_i}{Y_i}\right)_{2^{nd}} = \left(\frac{FD_i}{Y_i}\right)_{1^{st}} + \frac{\sum_{j=1}^{S} Z_{ij} * \left(\frac{FD_j}{Y_j}\right)_{1^{st}}}{Y_i} \quad (12)$$

where Z_{ij} denotes the annual transaction value between the seller firm *i* and the buyer firm *j*. In general, in the n^{th} iteration the formula is as follows:

$$\left(\frac{FD_i}{Y_i}\right)_{n^{th}} = \left(\frac{FD_i}{Y_i}\right)_{1^{st}} + \frac{\sum_{j=1}^{S} Z_{ij} * \left(\frac{FD_j}{Y_j}\right)_{n-1^{th}}}{Y_i} \quad (13)$$

We can calculate the upstreamness of a firm by equation (13):

$$U_i = 1\left(\frac{FD_i}{Y_i}\right)_{1^{st}} + 2\left[\left(\frac{FD_i}{Y_i}\right)_{2^{nd}} - \left(\frac{FD_i}{Y_i}\right)_{1^{st}}\right] + 3\left[\left(\frac{FD_i}{Y_i}\right)_{3^{rd}} - \left(\frac{FD_i}{Y_i}\right)_{2^{nd}}\right] + \dots \quad (14)$$

Again, the lower bound of the U_i is 1.

Here, it is essential to emphasize that a firm's exports are taken as part of the final demand of a firm. We also compute the upstreamness (adjusted U_i) by changing the output of a firm as the domestic sales, extracting the exports of a firm from its net sales, which indeed implies the proportionality assumption that the division of the sales between final usage and the intermediate usage is the same for the home and abroad. It is clear that the adjusted U_i will be higher than the original U_i since the denominator would be lower $(Y_i - EX_i)$ in equation (14). Hence, we can think of U_i as the lower bound of the true upstreamness of the firm's production process.

In the following session, we present the results of the industry- and firm-based upstreamness measures for Türkiye and compare the two approaches.

3.3. RESULTS

3.3.1. Results of IBU for Türkiye

Using the 2012 I-O table published by TURKSTAT and the upstreamness equation developed by Antràs et al. (2012) explained in Section 3.2.1., we have calculated industry upstreamness measures for 63 industries, 19 of which are manufacturing sectors.

Table 3.1 Summary Statistics of IBU for Türkiye (Year=2012)

	Mean	Std. Dev.	Min	Max	N
All sectors	2.05	0.74	1.00	3.58	63
Manufacturing	2.12	0.64	1.24	3.17	19

Source: TURKSTAT and authors' calculations.

Table 3.1 presents the summary statistics of IBU for Türkiye. The measure of IBU ranges from 1 to 3.58. When the data is restricted to the manufacturing industries, the range is between 1.24 to 3.17. The mean value across 63 industries is 2.05, with a standard deviation of 0.74. The corresponding values for manufacturing industries are respectively 2.12 and 0.64. In Türkiye, the average industry enters into the value chain at least one stage before reaching the final demand.

Table 3.2 Ten Least and Most Upstream Sectors in Türkiye Based on IBU

Product Code-Definition (CPA 2008)	**Upstreamness**
B-Mining and quarrying	3.58
E37-E39-Sewerage services; sewage sludge; waste collection. treatment and disposal services; materials recovery services; remediation services	3.45
H52-Warehousing and support services for transportation	3.32
J59-J60-Motion picture, video, and television program production services, sound recording and music publishing; programming and broadcasting services	3.23
D35-Electricity, gas, steam, and air conditioning	3.19
C20-Chemicals and chemical products	3.17
M73-Advertising and market research services	3.15
H50-Water transport services	3.12
C24-Basic metals	2.93
C18-Printing and recording services	2.93
…………………………………………………………………	-
I-Accommodation and food services	1.27
C30-Other transport equipment	1.24
R90-R92-Creative arts, entertainment, library, archive, museum, other cultural services; gambling and betting services	1.20
N79-Travel agency, tour operator and other reservation services and related services	1.19
Q86-Human health services	1.07
P85-Education services	1.07
O84-Public administration and defense services; compulsory social security services	1.04
S96-Other personal services	1.04
Q87-Q88-Residential care services; social work services without accommodation	1.00
M72-Scientific research and development services	1.00

Source: TURKSTAT and authors' calculations.

The most and the least upstream ones among 63 industries are listed in Table 3.2. Most upstream sectors are "Mining and quarrying" (3.58), "Sewage services" (3.45), and

"Warehousing Services" (3.32), whereas the least upstream sectors are "Scientific research and development services", "Residential care services", and "Other personal services".

Table 3.3 Upstreamness of the Manufacturing Sectors in Türkiye Based on IBU

Product Code-Definition (CPA, 2008)	**Upstreamness**
C20-Chemicals and chemical products	3.17
C24-Basic metals	2.93
C18-Printing and recording services	2.93
C17-Paper and paper products	2.80
C19-Coke and refined petroleum products	2.73
C16-Wood and of products of wood and cork. except furniture; articles of straw and plaiting materials	2.66
C23-Other non-metallic mineral products	2.49
C22-Rubber and plastic products	2.49
C33-Repair and installation services of machinery and equipment	2.21
C13-C15-Textiles, wearing apparel, leather and related products	2.12
C25-Fabricated metal products except machinery and equipment	1.97
C27-Electrical equipment	1.89
C29-Motor vehicles. trailers and semi-trailers	1.59
C26-Computer, electronic and optical products	1.50
C10-C12-Food, beverages and tobacco products	1.48
C28-Machinery and equipment n.e.c.	1.41
C21-Basic pharmaceutical products and pharmaceutical preparations	1.39
C31-C32-Furniture and other manufactured goods	1.28
C30-Other transport equipment	1.24

Source: TURKSTAT and authors' calculations.

If we narrow our focus to the manufacturing sectors, as shown in Table 3.3, the most upstream industries include "Chemicals and chemical products" with a value of 3.17, followed closely by "Basic metals" at 2.93, and "Printing and recording services" also at 2.93. On the other hand, the least upstream sectors within manufacturing are "Other transport equipment" with a value of 1.24, "Furniture and other manufactured goods" at 1.28, and "Basic pharmaceutical products and pharmaceutical preparations" at 1.39.

3.3.2. Results of FBU for Türkiye

Using firm-to-firm transactions data and implementing the iteration approach explained in Section 3.2.2., we calculate the upstreamness measure at the firm level. We obtain the sector aggregates by taking the weighted average of upstreamness values of firms whose main activity code is identical at the two-digit level.[5,6] In order to compare the results with those of IBU, we document sector aggregates for 2012.

Table 3.4 Summary Statistics of FBU for Türkiye (Year=2012)

	Mean	Std. Dev.	Min	Max	Number of firms	N
All sectors	2.40	0.71	1.02	4.06	420,882	63
Manufacturing	2.69	0.53	1.48	4.00	93,071	19

Source: EIS and authors' calculations.

The measure of FBU ranges from 1.02 to 4.06, with a mean of 2.4 and a standard deviation of 0.71. The manufacturing sectors range between 1.48 and 4.00, with a mean of 2.69 and a standard deviation of 0.53. Clearly, upstreamness values are higher when they are calculated based on FBU rather than IBU.

Table 3.5 Ten Least and Most Upstream Sectors in Türkiye Based on FBU

Product Code-Definition (CPA, 2008)	**Upstreamness**
J59-J60-Motion picture, video and television program production services, sound recording and music publishing; programming and broadcasting services	4.06
C19-Coke and refined petroleum products	4.00
M73-Advertising and market research services	3.58
J58-Publishing services	3.53
E37-E39-Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services	3.34
C21-Basic pharmaceutical products and pharmaceutical preparations	3.20

5 Otherwise stated, the weights are taken as firms' output, i.e., net sales in our analysis.
6 In EIS, the main activity codes of firms are reported in NACE Rev.2 at a four-digit level.

Table 3.5 (continued)

B-Mining and quarrying	3.18
C17-Paper and paper products	3.16
C24-Basic metals	3.16
H49-Land transport services and transport services via pipelines	3.07
…………………………………………………………………	-
R93-Sporting services and amusement and recreation services	1.59
C30-Other transport equipment	1.48
A02-Products of forestry, logging and related services	1.44
E36-Natural water; water treatment and supply services	1.27
Q87-Q88-Residential care services; social work services without accommodation	1.27
P85-Education services	1.21
O84-Public administration and defense services; compulsory social security services	1.21
Q86-Human health services	1.20
H51-Air transport services	1.13
K66-Services auxiliary to financial services and insurance services	1.02

Source: EIS and authors' calculations.

The most and the least upstream industries based on FBU measures are listed in Table 3.5. The most upstream sectors are "Motion picture, video, and television program production services, sound recording and music publishing" (4.06), "Coke and refined petroleum products" (4.00) and "Advertising and market research services" (3.58). In contrast, the least upstream sectors are "Services auxiliary to financial services and insurance services," "Air transport services," and "Human health services."

If we focus on only manufacturing sectors according to FBU values, the ranking of the sectors has changed compared to the IBU. The most upstream sectors are "Coke and refined petroleum products" (4.00), "Basic pharmaceutical products" (3.20), and "Paper and paper products" (3.16). The least upstream sectors in manufacturing sectors are "Furniture and other manufactured goods" (2.30), "Computer, electronic and optical products" (2.18) and "Other transport equipment" (1.48).

Table 3.6 Upstreamness of the Manufacturing Sectors in Türkiye Based on FBU

Product Code-Definition (CPA, 2008)	Upstreamness
C19-Coke and refined petroleum products	4.00
C21-Basic pharmaceutical products and pharmaceutical preparations	3.20
C17-Paper and paper products	3.16
C24-Basic metals	3.16
C10-C12-Food, beverages and tobacco products	2.95
C20-Chemicals and chemical products	2.95
C16-Wood and of products of wood and cork except furniture; articles of straw and plaiting materials	2.93
C25-Fabricated metal products except machinery and equipment	2.75
C29-Motor vehicles, trailers and semi-trailers	2.73
C18-Printing and recording services	2.70
C23-Other non-metallic mineral products	2.67
C22-Rubber and plastic products	2.58
C13-C15-Textiles, wearing apparel, leather and related products	2.47
C27-Electrical equipment	2.38
C28-Machinery and equipment n.e.c.	2.31
C31-C32-Furniture and other manufactured goods	2.30
C26-Computer, electronic and optical products	2.18
C30-Other transport equipment	1.48

Source: EIS and authors' calculations.

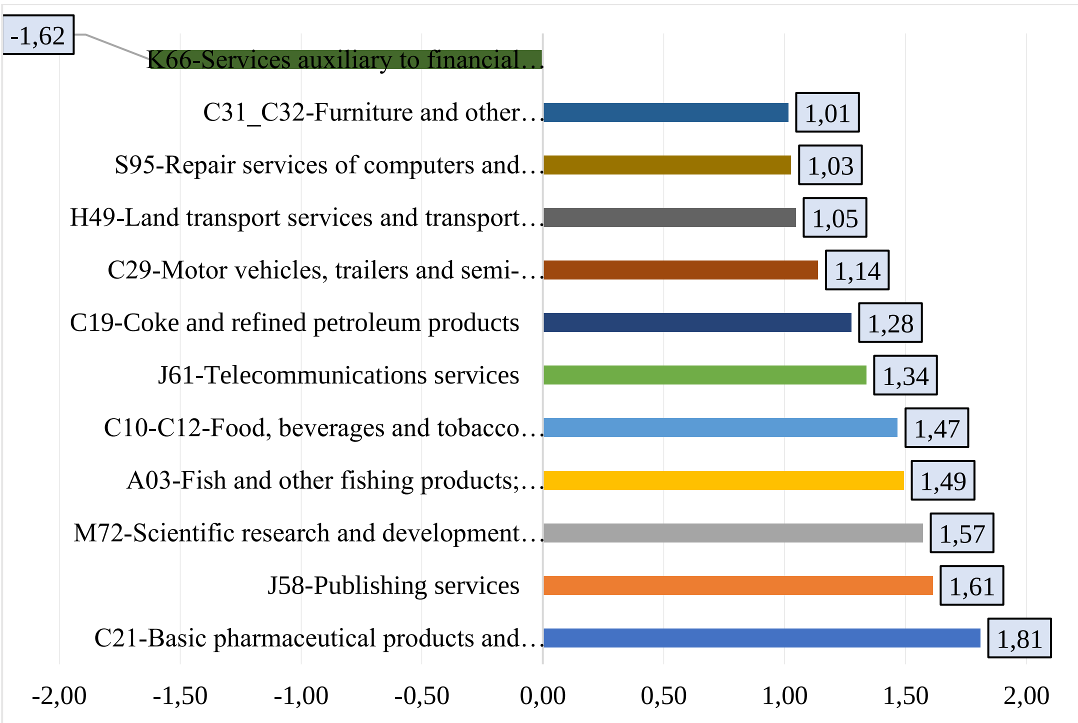
3.3.3. Comparison of Results of FBU & IBU

3.3.3.1. Benchmark Year (=2012) Comparison

Since we utilize the 2012 I-O Table to calculate industry-based upstreamness, we use the year 2012 as a benchmark for comparing the two calculation methods. When we compare the most and the least upstream sectors according to different calculations of upstreamness measure, ten industries are common in both of the tables (Table 3.2 & Table 3.5). These are "J59-J60-Motion picture, video, and television program production services, sound recording and music publishing; programming and broadcasting services", "M73-Advertising and market research services", "E37-E39-

Sewerage services; sewage sludge; waste collection, treatment, and disposal services; materials recovery services; remediation services", "B-Mining and quarrying", "C24-Basic metals" in the most upstream sectors and "C30-Other transport equipment", "Q87-Q88-Residential care services; social work services without accommodation", "P85-Education services", "O84-Public administration and defense services; compulsory social security services", "Q86-Human health services" are in the least upstream sectors.

It is interesting that upstream sectors such as "C19-Coke and refined petroleum products", "J58-Publishing services", and "C21-Basic pharmaceutical products and pharmaceutical preparations" are taking place in the top ten upstream sectors based on FBU. Still, they have not been included in the corresponding table of IBU. Indeed, these sectors are among the ones where the highest differences in values between the two methods of upstreamness measures are observed. 46 out of 63 industries have higher upstreamness values in FBU than IBU, and in 17 out of 63 sectors, upstreamness values are lower.



Source: TURKSTAT, EIS and authors' calculations.

Figure 3.1 Sectors that Differ Most Between the Two Calculations, FBU and IBU

In Figure 3.1, the difference in values between the two measures, FBU and IBU, is higher than 1 is shown. The discrepancy is the highest in the "C21-Basic pharmaceutical products and pharmaceutical preparations" sector. The only industry in which its IBU value is higher than its FBU value with the magnitude of the difference higher than 1 is "K66- Services auxiliary to financial services and insurance services".

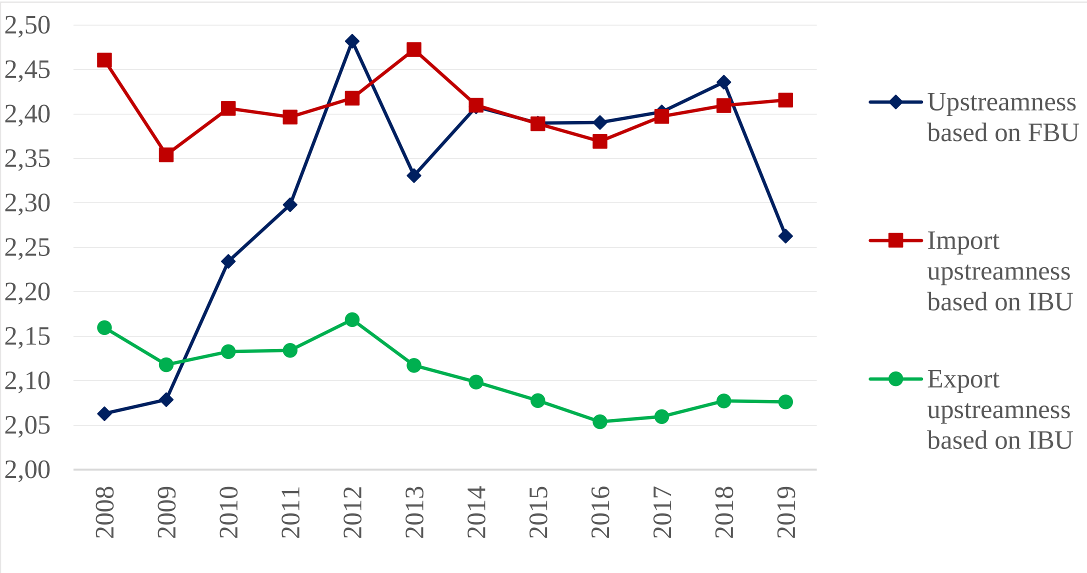
It is worth noting that among the sectors given in Figure 3.1, two of them consist of Türkiye's main exporting products: "C29-Motor vehicles, trailers and semi-trailers" and "C10-C12-Food, beverages and tobacco products". FBU values and IBU values are respectively 2.73 and 1.59 in the "C29-Motor vehicles, trailers, and semi-trailers" sector and 2.95 and 1.48 in the "C10-C12-Food, beverages, and tobacco products" sector. In both of these two sectors, the products of the sectors are used as an intermediate input in more stages before final demand when the measure is FBU rather than IBU.

The main difference between the two calculations is in the order of the aggregation process and the computation of the upstreamness measure. IBU calculation is grounded on the unique value of upstreamness for each activity code using the sectoral linkages in the I-O table. As stated in TURKSTAT, the construction of the I-O table is based on data obtained from census, surveys, and administrative records. The basic data source is the "2012 Supply and Use Table Survey," with additional information obtained from the questionnaire, various statistics, and administrative records from the Revenue Administration and Social Security Institution.[7] Hence, IBU calculation focuses first on sector-to-sector transactions, which are aggregated from firm-level data, and then computes the upstreamness measure, whereas FBU calculation depends on more disaggregated data, firm-to-firm transactions, computes the upstreamness for each firm and then aggregates them with respect to the main activity of the firm. In the former, we calculate how an industry is far from the end user, and in the latter, how a given firm's production is distant from the end user. For the purpose of our study, we believe FBU is a better proxy for firm-level upstreamness.

[7] https://data.tuik.gov.tr/Kategori/GetKategori?p=ulusal-hesaplar-113&dil=2

3.3.3.2 Yearly Comparison

Figure 3.2 presents the aggregate upstreamness values in Türkiye between 2008-2019.[8] For yearly comparisons, we calculate the import and export upstreamness values based on the IBU at the firm level, as in Equations 5-6. To obtain aggregate levels, IBU measures of firm-level magnitudes are weighted by firm imports/exports, and FBU measures of firm-level magnitudes are weighted by firm net sales. Therefore, FBU refers to the overall upstreamness of Türkiye's production, and export/import upstreamness based on IBU refers to the overall upstreamness of Türkiye's exported/imported products.



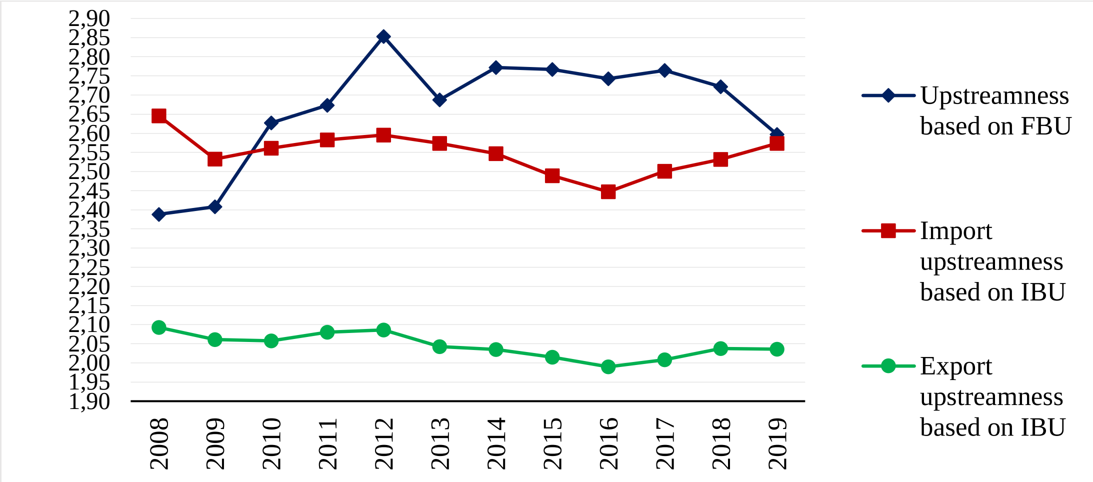
Source: TURKSTAT, EIS and authors' calculations.
Figure 3.2 Annual Upstreamness Based on Different Calculations (All Sectors)

According to Figure 3.2, the values of the import upstreamness based on IBU are significantly higher than those of the other calculations of upstreamness values. The lowest values are observed when the calculation is the export upstreamness based on IBU. The largest discrepancies are seen in FBU.

Considering all sectors, the mean value of import upstreamness based on IBU is 2.41 with a standard deviation of 0.033, and export upstreamness based on IBU is 2.11 with

[8] See the corresponding tables A.3 and A.4 in Appendix A.

a standard deviation of 0.038. The mean value of FBU is 2.31, with a standard deviation of 0.13.



Source: TURKSTAT, EIS and authors' calculations.

Figure 3.3 Annual Upstreamness of the Manufacturing Sector Based on Different Calculations

Figure 3.3 presents the results when the sample is restricted to the manufacturing firms. The highest value of upstreamness is attained by the FBU calculation. The mean values of import upstreamness, export upstreamness, and FBU are correspondingly 2.55, 2.05, and 2.66; respectively, the standard deviations are 0.053, 0.032, and 0.143. Excluding "agriculture, forestry and fishing", "mining and quarrying," and "all service sectors" has led to an increase in the mean value of upstreamness values except export upstreamness.

An initial assessment of Figures 3.2 and 3.3 shows that the imported products are more upstream than exported ones in Türkiye. The difference between import and export upstreamness is even higher for the manufacturing industries, which use intermediate product imports heavily. This fact is expected since Türkiye is one of the countries that use the processing trade extensively. The processing trade enables exporters to supply inputs at world market prices for the production of their exports without being subject to customs duties, including VAT and trade policy measures. However, as Chor et al. (2021) point out, this tendency is not common for all countries, such that countries rich in natural resources have the opposite pattern.

We also check Spearman rank correlations between different calculations of upstreamness for year and sector groups of the manufacturing industries (Table 3.7). All pairwise correlations of FBU are significant at the %1 significance level. The correlation between FBU and import upstreamness based on IBU is stronger than that of between FBU and export upstreamness based on IBU.

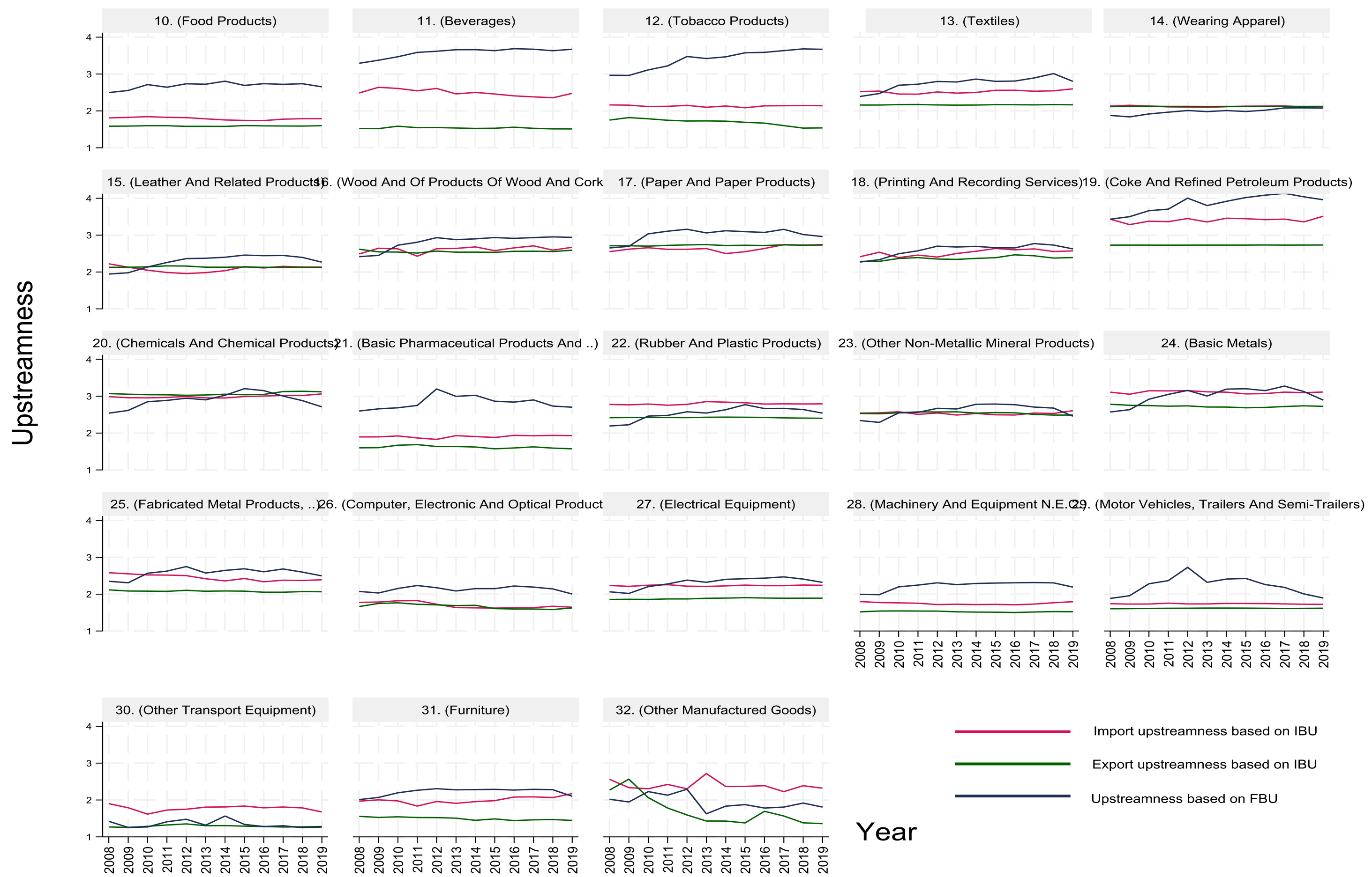
Table 3.7 Spearman Rank Correlations between Different Calculations of Upstreamness

	Import upstreamness based on IBU (1)	Export upstreamness based on IBU (2)	FBU (3)
(1)	1.000		
(2)	0.796*	1.000	
(3)	0.582*	0.467*	1.000

Source: TURKSTAT, EIS and authors' calculations.

Another observation from Figures 3.1 and 3.2 is that FBU falls between import and export upstreamness values for all sectors but is higher than both when only manufacturing sectors are considered. In the related literature, export upstreamness is sometimes used as an approximation to its production upstreamness, as Yu (2015) states that the products produced and exported by a given firm usually fall into similar industries. In Türkiye, export upstreamness is much lower than FBU, which we believe is more likely to reflect the true production upstreamness. The relationship remains valid when using different calculations of upstreamness across sectors (Figure 3.4).

Figure 3.4 shows the FBU, export upstreamness based on IBU, and import upstreamness based on IBU for the firms grouped by their main activities. Except for a few sectors, the firms' production is more upstream than the exported/imported products of these firms. Since FBU represents the minimum value of production upstreamness, it is suggested that the export upstreamness based on IBU underestimates the true upstreamness.



Source: TURKSTAT, EIS and authors' calculations.

Figure 3.4 The Comparison of the Various Upstreamness Calculations by Sector Groups

It should also be noted that the yearly evolution of export (import) upstreamness essentially reflects the changing composition of exported (imported) products in Türkiye's export (import) bundle, given that the input-output dynamics remain constant throughout the analysis period by utilizing the 2012 Input-Output (I-O) table. As a result, when export (import) upstreamness is calculated at the firm level over time, any observed change in upstreamness is driven by shifts in the firm's exported (imported) product mix, specifically towards more upstream products.

A reasonable explanation for the underestimation of export upstreamness is that calculating it requires correspondence between the Harmonized System of the traded products and the activity classification of CPA. Trade data comprises more detailed information. When constructing export upstreamness, more detailed trade codes are gathered under smaller activity code categories. Hence, the diversity in export composition is not fully reflected. For instance, "840751-Engines; reciprocating piston engines, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity not exceeding 50cc" and all six-digit codes under "8703- Motor cars and other motor vehicles; principally designed for the transport of persons (other than those of heading no. 8702), including station wagons and racing cars" fall into the same activity-"C29-Motor vehicles, trailers, and semi-trailers" with the sector upstreamness-1.591 although the former product has absolutely will have higher upstreamness level compared to the latter one. When calculating the export upstreamness, they will be treated as having the same level of upstreamness. FBU, on the other hand, will treat them differently; the former one is part of the intermediate good, and the second one is part of the final good in the calculation.

3.3.4. Changes in the FBU

Figures 3.2 and 3.3 demonstrate that the firm-based upstreamness values are notably higher when the sample is limited to manufacturing industries, which account for an average of %22 of all firms[9]. Observing the trend of FBU, there is a continuous increase until 2012, followed by a significant decline in 2013, and a stable trend

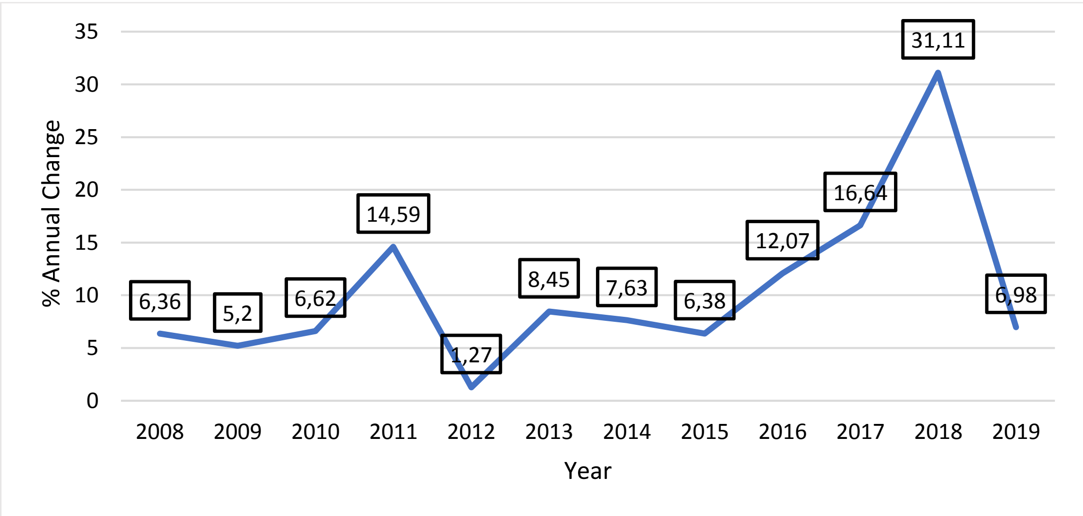
[9] See Table A.5 in Appendix A.

thereafter till 2019, when a sharp decline occurred. The peak value was observed in 2012.

The patterns of the FBU over the years can be explained by the fluctuations in two components of the FBU calculation: the changes in the shares of the more upstream sectors and the upstreamness change within the sector. The overall change in aggregate upstreamness between time *t*-1 and *t* can be expressed as follows where *i* denotes the sub-sector in the manufacturing sector.

$$\Delta upstrm_t^{manuf} = \sum_{i=1}^{N}\left[\left(\frac{Net\ Sales_i}{Net\ Sales_{manuf}}\right)_t - \left(\frac{Net\ Sales_i}{Net\ Sales_{manuf}}\right)_{t-1}\right] upstrm_{i,t} + \sum_{i=1}^{N}(upstrm_{i,t} - upstrm_{i,t-1})\left(\frac{Net\ Sales_i}{Net\ Sales_{manuf}}\right)_{t-1} \quad (15)$$

Since the increase in 2012 seems to be temporary, not followed by the trend in 2013, the change in the shares of the net sales of the sub-sectors is a possible reason. In order to confirm this, we compare the share of the net sales of the sectors between 2012 and 2013. Salient increases in the shares of the net sales are observed in two sectors: "C10-C12-Food, beverages and tobacco products" (from 17.54% to 19.02%) and "C19-Coke and refined petroleum products" (from 6.27% to 9.19%), both of which are the most upstream sectors of Türkiye.



Source: TURKSTAT

Figure 3.5 Producer Price Index (2003=100) for the Manufacturing Sector

Another piece of evidence is that the annual change in the Producer Price Index (PPI) was observed to be the lowest in 2012 during the analysis period, which will enhance the net sales. The PPI by sub-sectors[10] also favors the argument of low prices and increased sales in the abovementioned two sectors.

To better understand the sources of the change, following Chor et al. (2021), we decompose the change in aggregate upstreamness into three components at the firm level:

$$\begin{aligned}\Delta Upstrm_t^{manuf} = & \sum_{i \in EN_t} \left(\frac{Net\ Sales_i}{Net\ Sales_{manuf}} \right)_t upstrm_{i,t} \\ & - \sum_{i \in EX_t} \left(\frac{Net\ Sales_i}{Net\ Sales_{manuf}} \right)_{t-1} upstrm_{i,t-1} \\ & + \sum_{i \in C_t} \left(\frac{Net\ Sales_i}{Net\ Sales_{manuf}} \right)_{t-1} \Delta upstrm_{i,t} \\ & + \sum_{i \in C_t} \left(\frac{Net\ Sales_{i,t}}{Net\ Sales_{manuf,t}} - \frac{Net\ Sales_{i,t-1}}{Net\ Sales_{manuf,t-1}} \right) upstrm_{i,t} \quad (16)\end{aligned}$$

The first component refers to the firms that do not report net sales in year *t*-1 but do so in year *t*, EN_t-the entrant firms in year *t*. The second component refers to the firms that report net sales in year *t* but do not in year *t*, EX_t-the ones that exit in year *t*, and the last two components show the continuing firms that report net sales in both years. The net of the first two components generates the extensive margin of the overall change.

Continuing firms can be further divided into two sub-components: the first reflects the within-firm change, where the firm's net sales share is held constant, capturing changes in the firm's upstreamness. The second component reflects shifts across continuing firms, where the within-firm upstreamness remains constant, focusing on reallocating market shares between these firms. The net of these two components generates the intensive margin of the overall change. The overall change is comprised of both the intensive margin and the extensive margin.

[10] See Figure A.1 in Appendix A.

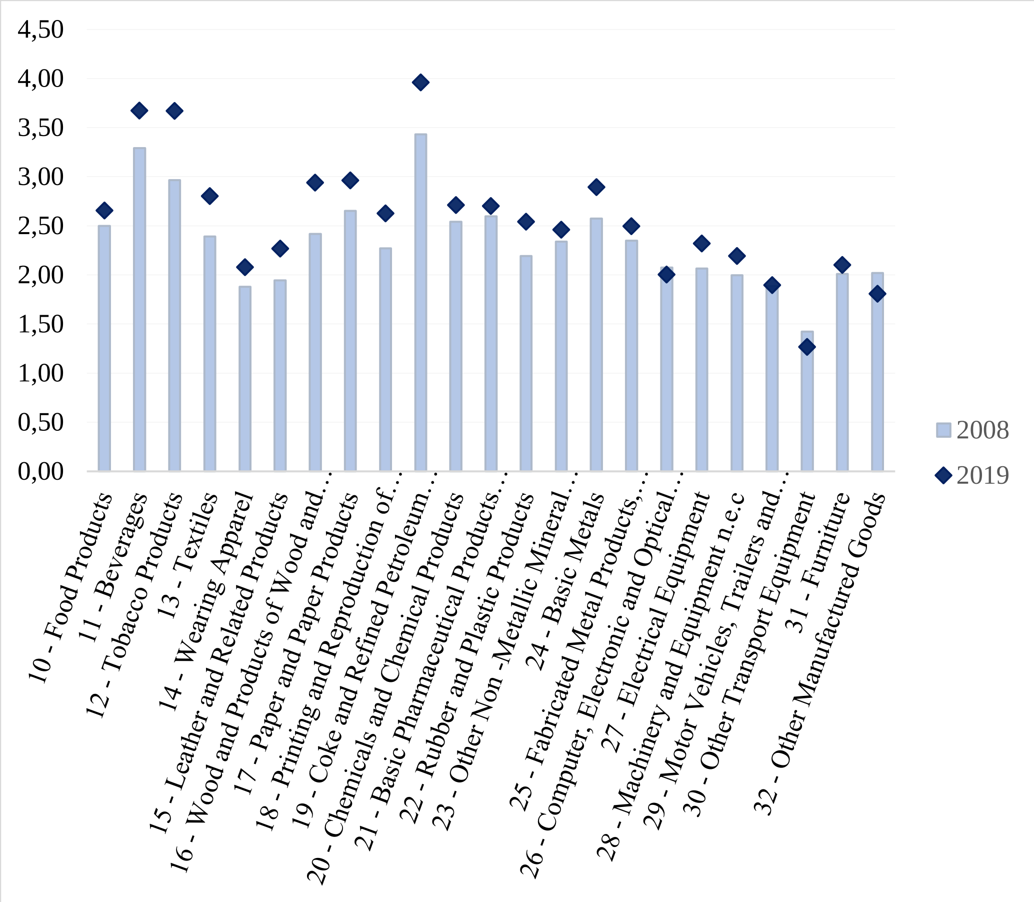
Table 3.8 Decomposition of Overall Change in Aggregate Upstreamness

Year	Extensive Margin			Intensive Margin			Overall Change
	Firm Entry	**Firm Exit**	**Net**	**Change in Firm Upstreamness**	**Change in Firm Shares**	**Net**	
2009	0.0490	0.0653	-0.0163	0.0471	-0.0105	0.0365	0.0202
2010	0.0554	0.0434	0.0120	0.2063	0.0002	0.2065	0.2185
2011	0.0530	0.0492	0.0038	0.0456	-0.0031	0.0425	0.0463
2012	0.0634	0.0922	-0.0288	0.1346	0.0737	0.2083	0.1795
2013	0.1701	0.1874	-0.0173	-0.0855	-0.0625	-0.1480	-0.1654
2014	0.1585	0.1640	-0.0055	0.0842	0.0055	0.0897	0.0842
2015	0.1069	0.1235	-0.0166	0.0140	-0.0020	0.0120	-0.0046
2016	0.1142	0.1386	-0.0245	-0.0137	0.0140	0.0003	-0.0242
2017	0.1086	0.1326	-0.0241	0.0092	0.0365	0.0457	0.0217
2018	0.0738	0.0869	-0.0131	-0.0551	0.0258	-0.0293	-0.0423
2019	0.1057	0.1111	-0.0054	-0.1030	-0.0168	-0.1199	-0.1253

Source: EIS and authors' calculations.

Table 3.8 provides a detailed summary of the decomposition of the overall change in FBU across the years. The results show that the contribution of the intensive margin consistently outweighs that of the extensive margin in driving the overall change in FBU. Notably, the net extensive margin is negative in all years except for 2010 and 2011, indicating that the impact of exiting firms is greater than that of new entrants during most of the period. However, in 2010 and 2011, in the early post-crisis years, the entrant firms contributed positively to the rise in overall upstreamness, in contrast to other years.

The continuing firms, particularly in 2010 and 2012, made positive and significant contributions to the overall change, which can be attributed to the fact that their production processes moved further upstream. This reflects the within-firm changes where firms, over time, adopted more upstream products. Interestingly, in 2019, the same within-firm effect dominated but in the opposite direction, suggesting that firms shifted toward more downstream products, contributing to a decline in overall upstreamness during that year.

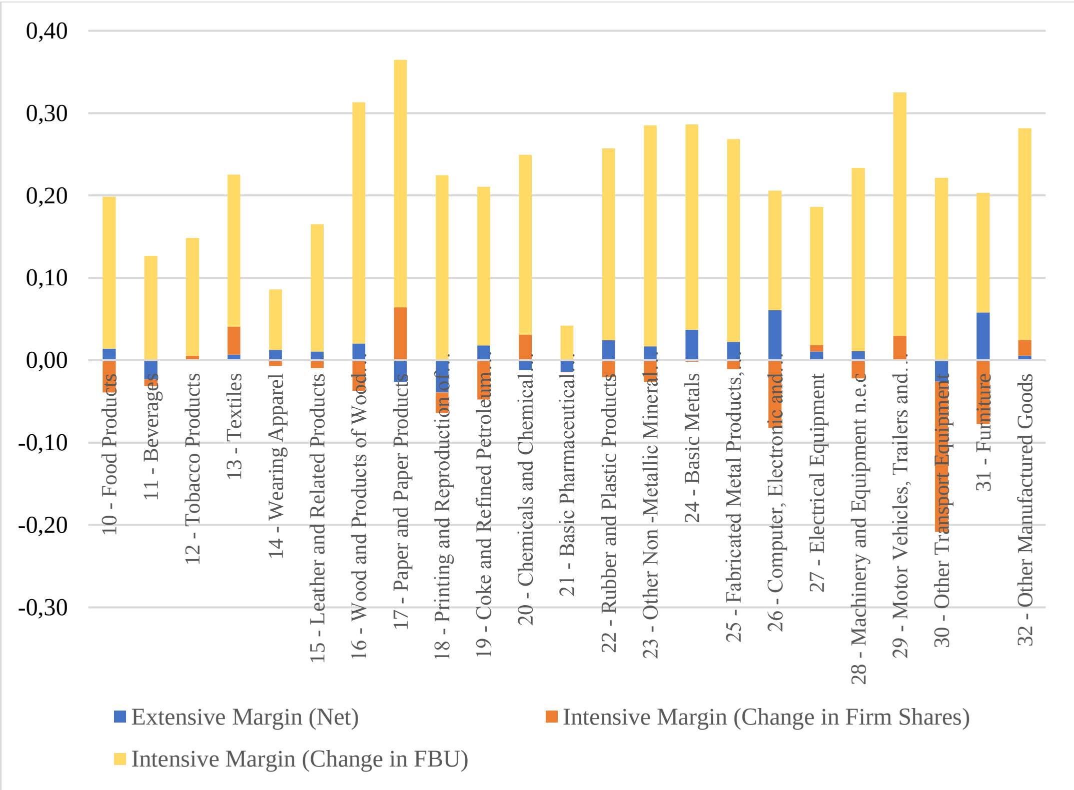


Source: EIS and authors' calculations.
Figure 3.6 The Change of the FBU by Sector Groups

Figure 3.6 shows the changes in the FBU by sector during the analysis period. Almost all sectors have experienced positive increments in their upstreamness. In absolute terms, the highest change is observed in the "12-Tobacco Products", "19-Coke and Refined Petroleum Products," and "16-Wood and the Products of Wood and Cork, …". These sectors are positioned more upstream in the value chain in 2019 compared to 2008.

We replicate the decomposition of the change in FBU for the manufacturing industries, specifically analyzing the shifts between the initial and terminal years of the study period, as outlined in Table 3.9. We compute year-to-year changes in the components of the overall change in FBU and add them to obtain the cumulative contribution of each term over 2008-2019. Likewise, the yearly decomposition of aggregate change in FBU shows that the effect of the intensive margin dominates the effect of the extensive margin, except for five industries[11]. Examining the intensive margin in continuing firms shows that the within-firm effect outweighs the shift effect between firms in industries such as "Beverages", "Tobacco Products", "Leather and Related Products", "Other Non-Metallic Mineral Products", "Basic Metals", "Fabricated Metal Products, except Machinery and Equipment", and "Furniture". "Paper and Paper Products," "Coke and Refined Petroleum Products," and "Other Manufactured Goods" are the industries in which the change in firm shares has a significant role in the overall change.

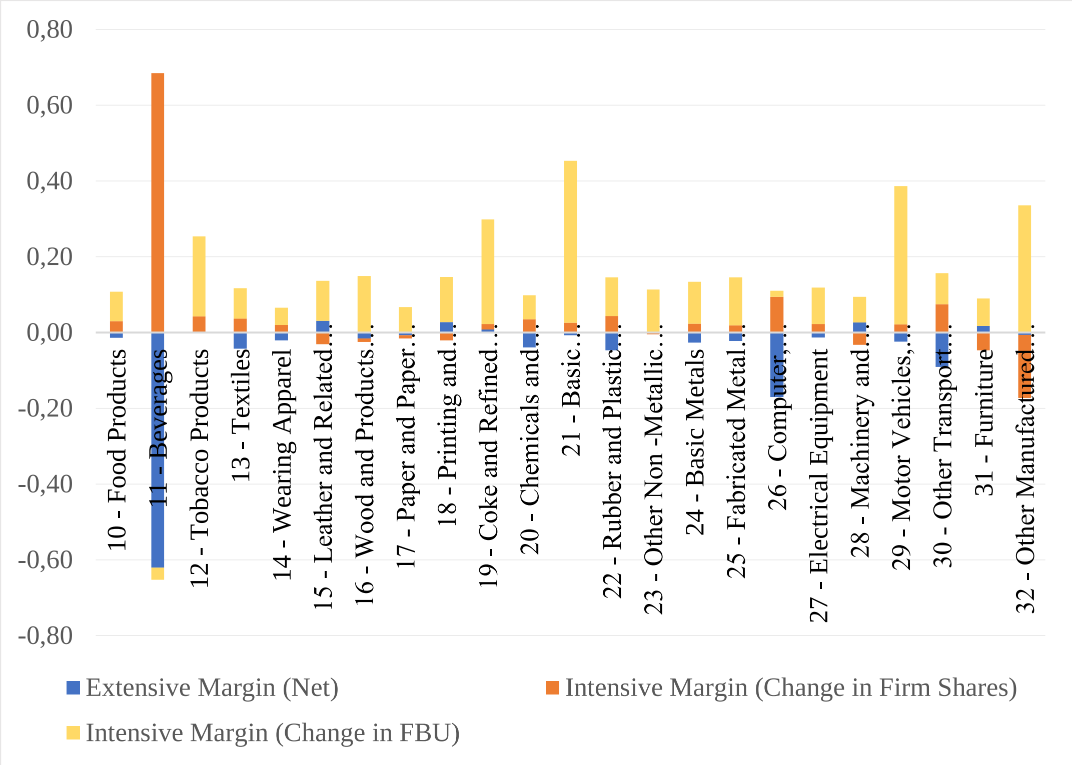
Notably, the significant increases in 2010 and 2012 observed in the aggregate FBU coincide with a strong contribution of the intensive margin effect, more specifically, a strong contribution of the change in the firm upstreamness in all sectors. (Figures 3.7 & 3.8).



Source: EIS and authors' calculations.

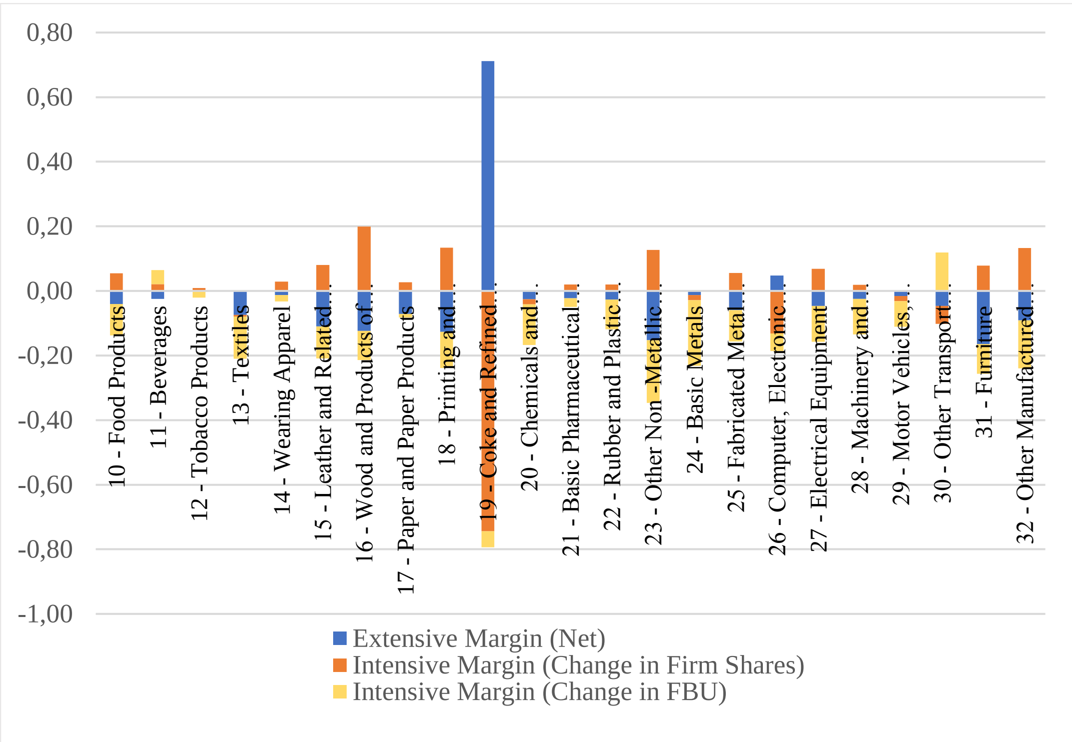
Figure 3.7 The Decomposition of the Change of FBU by Sector Groups (Year=2010)

[11] These are "17 - Paper and Paper Products", "19 - Coke and Refined Petroleum Products", "26 - Computer, Electronic and Optical Products", "30 - Other Transport Equipment" and "32 - Other Manufactured Goods".



Source: EIS and authors' calculations.

Figure 3.8 The Decomposition of the Change of FBU by Sector Groups (Year=2012)



Source: EIS and authors' calculations.

Figure 3.9 The Decomposition of the Change of FBU by Sector Groups (Year=2019)

Table 3.9 Decomposition of the Change of FBU in the Manufacturing Industries

Sectors	Extensive Margin			Intensive Margin			FBU in 2008	FBU in 2019	Overall Change
	Firm Entry	Firm Exit	Net	Change in Firm Upstreamness	Change in Firm Shares	Net			
10-Food Products	1.134	1.313	**-0.179**	0.173	0.163	**0.336**	2.498	2.655	**0.157**
11-Beverages	1.076	1.24	**-0.164**	0.436	0.109	**0.545**	3.293	3.674	**0.381**
13-Textiles	1.425	1.66	**-0.235**	0.288	0.359	**0.647**	2.391	2.803	**0.412**
14-Wearing Apparel	1.828	2.044	**-0.215**	0.253	0.163	**0.415**	1.879	2.079	**0.2**
15-Leather and Related Products	1.935	2.039	**-0.104**	0.327	0.1	**0.427**	1.944	2.267	**0.323**
16-Wood and Products of Wood,..	1.645	1.912	**-0.266**	0.436	0.352	**0.788**	2.417	2.939	**0.521**
17-Paper and Paper Products	1.77	1.416	**0.354**	0.323	-0.37	**-0.046**	2.654	2.962	**0.308**
18-Printing and Reproduction of Record..	3.809	4.456	**-0.647**	0.505	0.498	**1.003**	2.271	2.627	**0.356**
19-Coke and Refined Petroleum Products	1.036	0.332	**0.704**	0.52	-0.698	**-0.178**	3.433	3.959	**0.526**
20-Chemicals and Chemical Products	1.743	2.211	**-0.468**	0.4	0.241	**0.64**	2.541	2.713	**0.172**
21-Basic Pharmaceutical Products	0.872	1.191	**-0.319**	0.267	0.156	**0.423**	2.599	2.702	**0.104**
22-Rubber and Plastic Products	1.597	1.736	**-0.139**	0.305	0.182	**0.487**	2.193	2.541	**0.348**
23-Other Non -Metallic Mineral Products	1.354	1.686	**-0.332**	0.401	0.05	**0.45**	2.341	2.459	**0.118**
24-Basic Metals	1.093	1.131	**-0.038**	0.284	0.076	**0.36**	2.573	2.895	**0.322**
25-Fabricated Metal Products	2.549	2.737	**-0.188**	0.326	0.007	**0.334**	2.351	2.497	**0.146**
26-Computer, Electronic and Optical …	1.214	1.289	**-0.074**	0.43	-0.426	**0.004**	2.074	2.004	**-0.07**
27-Electrical Equipment	1.046	1.126	**-0.079**	0.263	0.071	**0.334**	2.065	2.32	**0.255**
28-Machinery and Equipment	1.891	1.871	**0.02**	0.309	-0.135	**0.174**	1.997	2.192	**0.194**
29-Motor Vehicles, Trailers and Semi - Trailers	0.469	0.707	**-0.238**	0.118	0.133	**0.25**	1.885	1.897	**0.012**
30-Other Transport Equipment	1.1	1.72	**-0.619**	0.222	0.242	**0.464**	1.422	1.267	**-0.155**
31-Furniture	1.976	2.132	**-0.156**	0.352	-0.105	**0.247**	2.011	2.102	**0.091**
32-Other Manufactured Goods	2.466	3.23	**-0.764**	0.077	0.475	**0.552**	2.021	1.809	**-0.212**

Source: EIS and authors' calculations.

Notes: Information of some sectors, i.e. "12-Tobacco Products" are not available.

3.3.5. Main Findings

In this Chapter, we construct a novel firm-based upstreamness measure utilizing firm-to-firm transaction data. This approach differs from the literature, which predominantly uses industry-based upstreamness measures relying on input-output tables. We find that firm-based upstreamness values are significantly higher than their industry-based counterparts. We propose that firm-based upstreamness, calculated for each individual firm, provides a more accurate representation of a firm's position in the value chain due to its reliance on more disaggregated data. Another advantage of firm-based upstreamness is that it provides information annually, which is more frequent than the input-output tables.

In Türkiye, trends in firm-based upstreamness from 2008 to 2019 indicate an increase in overall upstreamness during this period. The decomposition analysis of this change reveals that the increase in upstreamness of continuing firms contributes the most.

CHAPTER 4

FIRM UPSTREAMNESS AND PRODUCTIVITY

We have computed upstreamness value at the firm level with different approaches and evaluated the disadvantages and advantages of both methods in Chapter 3. Besides quantifying the firm-level upstreamness, related literature uses the concept to evaluate its relationship with the firm attributes, such as productivity and profitability (Ju & Yu, 2015; Chor et al., 2021; Mahy et al., 2022).

The ex-ante relationship between the position of a firm in the supply chain and its productivity is ambiguous. Firms can move “upstream” in the value chain by extending their control over the supply chain by acquiring or merging with their suppliers or establishing facilities to produce intermediates by in-house production. By adding more upstream activities to their current activities, firms may have the advantage of reduced costs by avoiding supplier markups. Moreover, the ability to customize the inputs to fit better with the production needs and easier technology transfers between production stages within a firm can enhance productivity.

Apple’s acquisition of the majority of Intel's smartphone modem business in 2019 serves as a concrete example. By gaining control over semiconductor manufacturing, Apple has enhanced its capability to produce its own chips for iPhones, iPads, and Macs. Similarly, in 2013, Starbucks acquired a coffee farm in Costa Rica, transforming it into an innovation hub in order to better understand the challenges faced by coffee farmers and determine best practices and solutions. Another notable instance is from 2021 when Ülker Bisküvi, a major food company in Türkiye, acquired Önem Gıda, a supplier of key inputs such as chocolate dough, flour, and hazelnuts, to streamline its production processes. Şişecam A.Ş., one of the major glass manufacturers of Türkiye, has made its production more upstream by establishing a facility for soda ash in U.S.A, a crucial input in glass manufacturing. These examples demonstrate that although global value chains facilitate fragmented production, there still exist opportunities to reintegrate certain production processes that firms are willing to engage in[12].

Control over the input chain may also result in better coordination in production stages by reducing the delivery times and maintaining a more stable process management. However, there is also a risk of inefficiencies that arise from running a larger production scale. It requires expertise and new capabilities for the additional upstream activities. Insufficiency in these aspects can strain competitiveness with other external suppliers. Moreover, investment costs can be large in acquiring the upstream stages of the production, and expected returns may not be enough to cover the costs of moving "upstream" in the value chain.

Empirical studies indicate that the relationship between upstreamness and firm attributes is positively correlated, suggesting that firms positioned further upstream in the production process tend to be more productive and profitable. Chor et al. (2021) document the evolution of Chinese firms' export/import upstreamness with their operations and performance. They assert that as firms become more productive, bigger, and more experienced, they import more upstream products, export products closer to final demand, and span more production stages in the home country. Ju & Yu (2015) explain the link between upstreamness and productivity, stating that fixed capital is assumed to be higher in a more upstream industry. Thus, fixed costs are larger, and a higher fixed cost causes the average firm in a more upstream industry to be more productive and profitable. They find that, in China, upstream industries are more capital-intensive, and firms in upstream industries are more productive and profitable than downstream firms. Mahy et al. (2022), using firm-level upstreamness, which measures the position of a firm in the value chain yearly, investigate its impact on the wage costs and productivity of a firm. They assert that firms positioned more upstream create more value, and the effect on productivity is higher than on wage costs.

[12] These examples refer to what is known as 'vertical integration' in the literature. As discussed at the end of the chapter, backward integration, a type of vertical integration, can lead to an increase in a firm's upstreamness. This is the case when the firm not only produces but also sells its newly integrated upstream products, as we define FBU based on the firm's sales.

This chapter is devoted to exploring the relationship between the two features of a firm, its upstreamness versus its productivity, for Turkish manufacturing firms with regard to different calculations of upstreamness measurement. For this purpose, Section 4.1 will introduce the data sources and the construction of our empirical dataset and then present the summary statistics of the related dataset. Section 4.2 explains the empirical framework, and Section 4.3 provides the results of the empirical analysis.

4.1 DATA

4.1.1 Variable Definitions

As described in Section 3.1, our primary data source is EIS, which consists of multiple administrative datasets. Upstreamness analysis in the previous chapter mainly utilizes two data sets: firm-to-firm transaction data from the Revenue Administration and trade data from the Ministry of Trade. We are now exploring the relationship between upstreamness and firm performance, which requires additional information about firm attributes.

First, we obtain the number of employees quarterly and the wages paid annually by a firm for the reference period from the dataset the Social Security Institution provided to EIS. We computed a simple average of the number of employees for a firm's employment.

Second, we utilize the firm's balance sheet and income statements, provided by the Revenue Administration to EIS, to construct different variables of interest. These are the sum of the tangible and intangible assets, defined as the firm's capital stock, and net sales, defined as the firm's output. We deflate capital stock with PPI for capital goods and output with two-digit sectoral PPI for the manufacturing industry to get real values.

In addition, we define firm productivity as the value added per worker and use the firm-to-firm transaction dataset to construct the "value-added" of a firm. The value -

added of a firm is defined as the difference between the value of a firm's production and the value of the material inputs used by the firm. However, there is no separate balance sheet item, such as “material inputs.” Hence, as a proxy for material inputs the firm uses, we use the purchases from other firms reported in the firm-to-firm transaction dataset plus the firm's imports, with the capital goods excluded from each. Thus, we construct the value-added of a firm by subtracting the estimated material inputs from the net sales. An alternative calculation is also applied for robustness analysis, such that the sum of total operating profits, total wages, and depreciation of tangible and intangible assets refers to the value added (World Bank, 2019). A comparison of different calculations of value added at the sectoral level is given in Appendix B.2[13].

4.1.2 Incorporating Balance Sheet and Upstreamness Datasets

Our empirical analysis combines the firms' financial statements in EIS with those of the upstreamness dataset we constructed from the firm-to-firm transactions dataset in Chapter 3. The financial statements available in EIS exclude the financial and public sectors. There are also records with negative and missing values in net sales. Therefore, we keep observations of positive net sales. Then, these two datasets are merged by year using the unique firm identifier[14].

Table 4.1 reports the number of firms, total employment, and output of the firms in all sectors covered in balance sheet records (column (1)) and the corresponding statistics for the manufacturing sector (column (2)) to give information about the coverage of the analysis. The third column, on the other, reflects the manufacturing sector aggregates for the matched balance sheet and upstreamness datasets.

Based on the firm's financial statements, on average, 16.8% of the total firms operating in the manufacturing sector. These constitute 30.6% of total employment and 26.4% of total net sales. When we use the matched balance sheet and upstreamness datasets

[13] TURKSTAT also publishes the value-added at factor costs by economic activities annually. We use the official values as a benchmark for comparison.
[14] All firms are encrypted with an identification number in EIS for confidentiality purposes.

(column (3)), 82.4% of the manufacturing firms, according to the balance sheet records, are included. They employ 95.9% of total manufacturing employees and generate 98.5% of the manufacturing net sales.

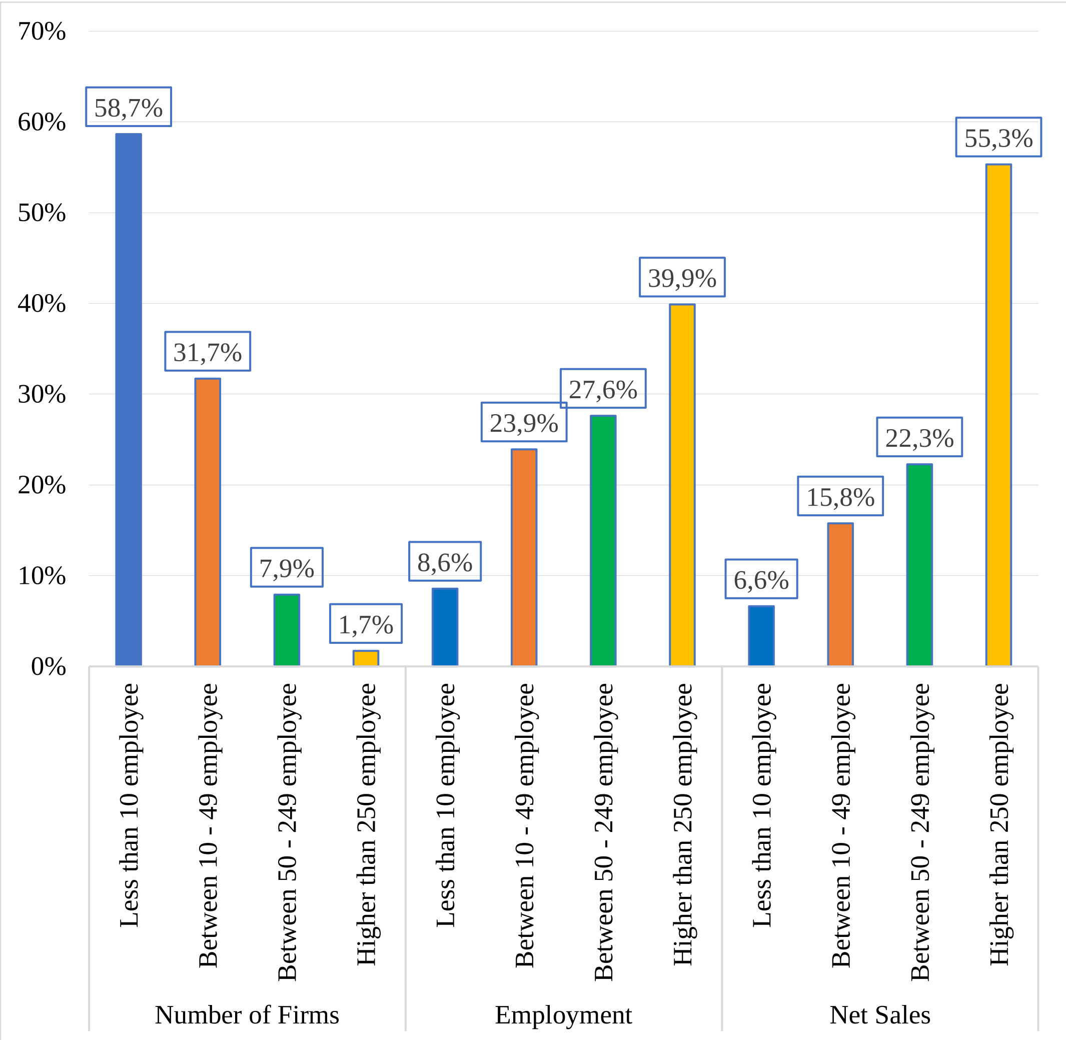
According to the matched dataset, in 2008, in the initial year of the reference period, the number of firms was 69,000. In 2019, the number of firms reached 116,000, with an increase of 1.7 times. In the same period, the corresponding increases in total employment and net sales for the manufacturing firms were 1.4 and 4.8 times, respectively.

Table 4.1 The Coverage of the Matched Balance Sheet and Upstreamness Datasets

Year	Number of firms (thousand)			Employment (million)			Sales (billion TL)		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
2008	505.58	92.77	69.04	6.9	2.4	2.2	1,784.2	500.5	491.3
2009	521.96	93.59	69.87	6.8	2.2	2.1	1,759.8	462.7	454.1
2010	545.83	95.21	78.02	7.5	2.4	2.3	2,112.8	552.3	545.1
2011	587.76	100.09	83.54	8.5	2.6	2.6	2,680.2	735.8	726.9
2012	633.89	106.15	89.33	9.3	2.8	2.8	3,064.3	811	796.9
2013	670.09	112.18	95.72	9.9	3	2.9	3,508.2	893.7	883.8
2014	711.17	117.87	101.86	10.6	3.2	3.1	4,045.7	1,029.5	1,018.4
2015	759.75	124.48	106.86	11.5	3.4	3.3	4,586.3	1,149.6	1,133.8
2016	787.32	129.36	108.54	11.6	3.4	3.2	4,957.5	1,260.1	1,237.4
2017	818.23	130.93	111.53	12	3.5	3.3	6,140.3	1,611.2	1,587.2
2018	876.08	140.10	116.60	12.4	3.6	3.4	7,603.7	2,114.2	2,076.8
2019	880.71	144.30	116.03	10.9	3.4	3.2	8,944.4	2,394.6	2,346.4

Source: EIS.
Notes: Based on the balance sheet records, (1) and (2), respectively, show the firms operating in all sectors and the manufacturing sector. (3) shows manufacturing firms in the matched balance sheet and upstreamness datasets.

Figure 4.1 summarizes the key indicators by employment group. On average, about 60% of manufacturing firms are micro-sized firms with less than 10 employees. These firms constitute 8.6% of the total manufacturing employment and generate 6.6% of the manufacturing output. Although firms with more than 250 employees are the smallest group with respect to the number of firms, they dominate the manufacturing sector with an employment share of 40% and an output share of 55%. Firms that employ 10-49 employees are the second largest group in terms of the number of firms. They constitute 24% of the manufacturing employment, and their output covers 15.8% of the manufacturing output. The last group consists of firms with employees between 50-249. Their share in the manufacturing sector is 27.6% of total employment and 22.3% of total output. To summarize, firms employing ten or more people in the manufacturing sector dominate the industry with 91.4% of total employment and 93.4% of total output.



Source: EIS.
Figure 4.1 The Statistics of the Manufacturing Sector across Employment Groups

4.1.3 Comparison of Key Indicators

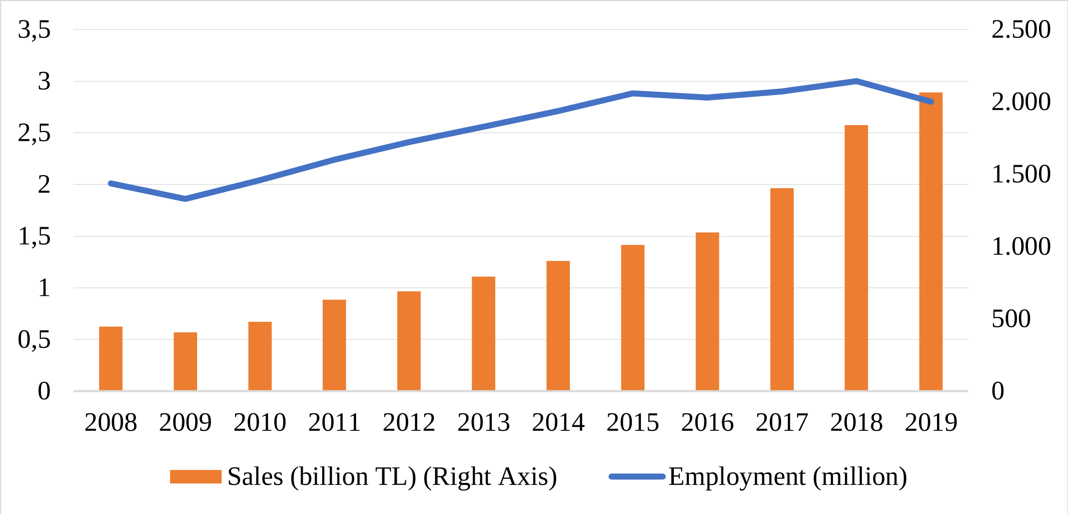
Our empirical analysis encompasses all firms with ten or more employees, ensuring a focus on substantial business entities that contribute significantly to the economy. Additionally, because our definition of value-added relies on firm-to-firm transaction data, we integrate another dataset with the matched balanced sheet and upstreamness datasets previously described in Section 4.1.2. This newly incorporated dataset consists of firms reporting purchases from other suppliers. However, the inclusion of this dataset results in a reduction of 4% in the total number of observations within the matched dataset.

Table 4.2 Statistics of the Empirical Dataset

Year	Number of firms	Employment (million)	Sales (billion TL)
2008	32,326	2.0	445.02
2009	29,970	1.9	406.53
2010	32,150	2.0	479.56
2011	34,630	2.2	632.07
2012	37,216	2.4	689.95
2013	38,657	2.6	792.18
2014	40,887	2.7	899.00
2015	41,740	2.9	1009.84
2016	40,811	2.8	1096.57
2017	40,960	2.9	1402.83
2018	41,087	3.0	1838.48
2019	38,652	2.8	2063.85

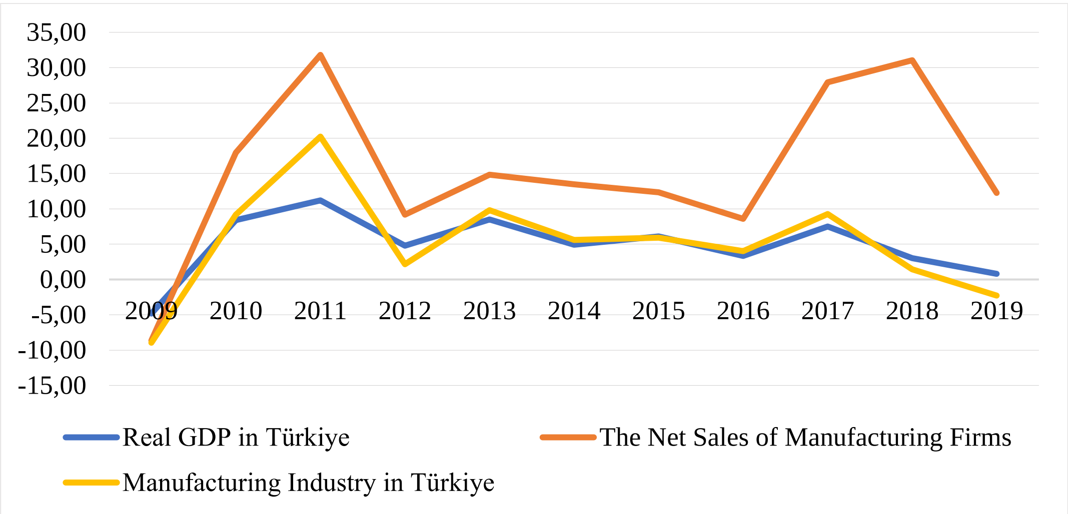
Source: EIS.

Table 4.2 shows the statistics of the finalized empirical dataset, which consists of firms operating in the manufacturing industry, employing ten or more employees, and having records in the firm-to-firm transaction data both as supplier and buyer. According to that, as of 2019, our empirical dataset comprises a total of 38,652 firms, which collectively employ approximately 2.8 million individuals and generate net sales amounting to 2,063.85 billion TL.



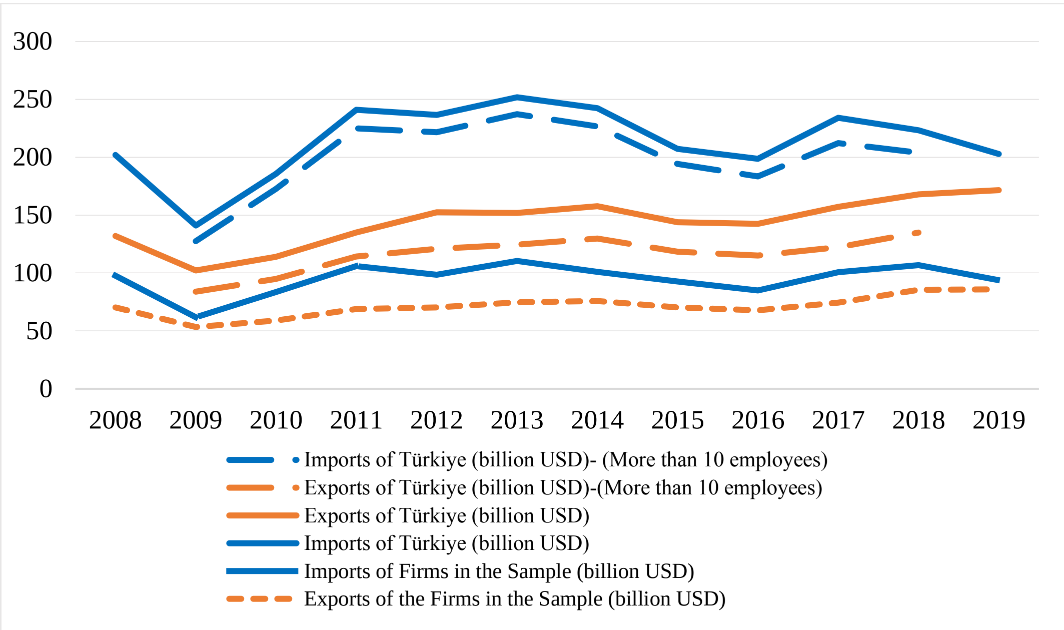
Source: EIS.
Figure 4.2 The Employment and Sales of the Manufacturing Firms

Figure 4.2 reflects the evolution of the number of employees and net sales of the firms included in our empirical analysis. The total employment level, which is 2 million in the initial year of the reference period, reaches 2.8 million in the terminal year. Except for 2009 and 2016, the growth rate of employment is positive. However, after 2015, there is a slowdown in the growth trend. This trend can be associated with minimum wage increases during the period. Akçigit et al. (2019) have a similar argument regarding the decline in 2016, stating a shift towards informal employment following the minimum wage increase as the likely cause.



Source: TURKSTAT, EIS.
Figure 4.3 Growth Rates of Output (%)

Figure 4.3 reflects the output fluctuations in the overall economy, manufacturing industry, and our empirical sample. Despite the global economic crisis of 2008, there has been a strong recovery in Türkiye, with average growth rates of 5% in real GDP between 2010-2017. Strong domestic demand, expansion in the construction sector, and substantial foreign investment are considered to be the main drivers of the growth during that period. However, in the final years of the reference period, there was a slowdown in economic activity, which corresponds with the currency depreciation and increased inflation in Türkiye (Appendix B.1, Figure B.1 and B.2). During this period, the manufacturing sector in Türkiye also followed a similar trend with gross output. The net sales of manufacturing firms have a similar pattern with higher fluctuations, possibly due to our sample excluding firms with fewer than 10 employees. The increase in the net sales of the manufacturing firms is noteworthy. A consistent rise in net sales led to 2.063 billion TL in 2019, which is 4 times the initial level. Declines in growth rates are substantial in 2012 and 2019.



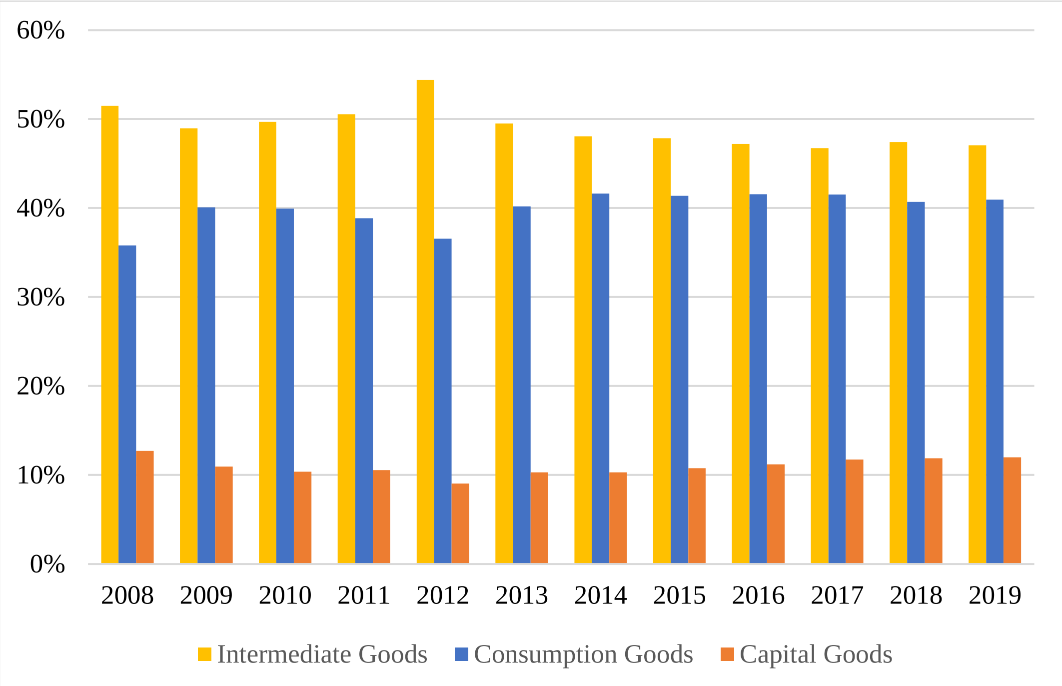
Source: TURKSTAT, EIS.

Figure 4.4 Trade Statistics (billion USD)

Notes: Foreign trade statistics of Türkiye for enterprises with 10 or more employees are available between 2009-2018, published by TURKSTAT. For a detailed table, see Appendix B.1.

Figure 4.4 presents the trade statistics with respect to different aggregations. Trade statistics of our sample show that during the 2008-2019 period, exports rose from about

$70.2 billion to $85.6 billion. In contrast, imports declined from $97.5 billion to $93.6 billion. On average, our empirical sample constitutes 49.7% of the exports of Türkiye, whereas it constitutes 44.4% of overall imports. These shares increased to 60% and 47%, respectively, when only enterprises with 10 or more employees were considered.[15]

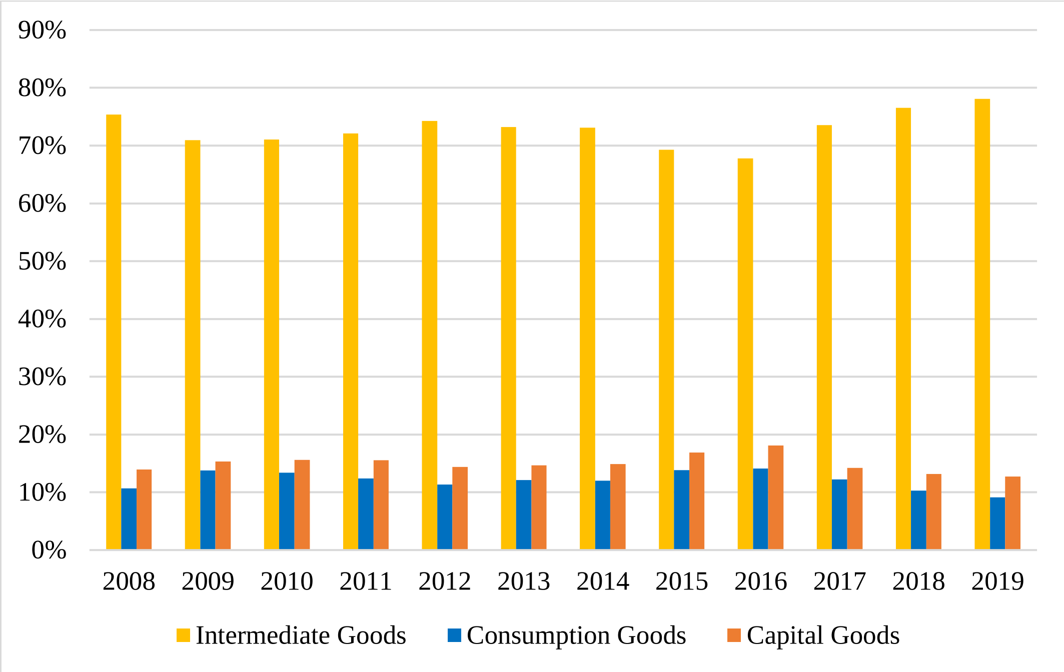


Source: TURKSTAT
Figure 4.5 The Exports of Türkiye with respect to BEC (%)

Since the concept of upstreamness is related to the production allocation of a firm between intermediate and final usages, the composition of Türkiye's trade with respect to the Classification by Broad Economic Categories (BEC) can give some insights. Figures 4.5 and 4.6 show the percentage share of consumption, capital, and intermediate goods in Türkiye's exports and imports. The highest share of intermediate goods in exports of Türkiye was achieved in 2012 with 54.4%, which is bigger than the average of 49% from 2008 to 2019. Correspondingly, the lowest share of consumption goods was observed in the same year, at 36%, whereas the average level

[15] In Appendix B.1 (Table B.1), the official table provided by TURKSTAT for the trade statistics for economic activity (NACE Rev.2) and employment size class is given. According to that, on average, the industry, which includes sections B, C, D, and E, constitutes 67% of the exports and 56% of the imports in Türkiye when only enterprises with 10 or more employees are included.

was 40%. This coincides with the peak values of FBU and the export upstreamness values in Chapter 3, which were also observed in 2012.



Source: TURKSTAT

Figure 4.6 The Imports of Türkiye with respect to BEC (%)

On the import side, the dominance of the usage of intermediate goods is apparent. The highest shares were observed in 2019 (78%), 2018 (76.5%), and 2008 (75.4%), which is different from the year of the peak value of the import upstreamness, 2013.

4.1.4 Descriptive Statistics

Table 4.3 shows the descriptive statistics related to our sample with respect to different calculations of upstreamness. It should be noted that the different calculations of upstreamness measures are based on different groups of observations. When FBU is the related measure, it reflects the weighted averages of all manufacturing firms in the sample. In contrast, the calculation of the export upstreamness based on IBU reflects the weighted averages of the manufacturing firms who are exporters in that year.[16] In

[16] The weights are net sales of firms and exports/imports of firms, respectively, in FBU calculation and export/import upstreamness based on IBU.

order to obtain a better comparison, we also report the statistics for a common sub-sample, two-way traders.

Part I of Table 4.3 summarizes the mean averages of yearly statistics for the sample of manufacturing firms with 10 or more employees. It provides statistics for two additional sub-samples: traders, who either export or import, and two-way traders, who export and import in a given year. Trading firms have higher value-added, capital stock, net sales, and employment, whereas two-way traders have higher levels in all aspects. Although trading firms have higher upstreamness levels than an average firm, restricting the sample with two-way traders does not alter the results. It implies that for production processes, being a part of the global value chain is what causes the difference, not participation as an exporter or an importer. We have a similar interpretation with other calculations of upstreamness.

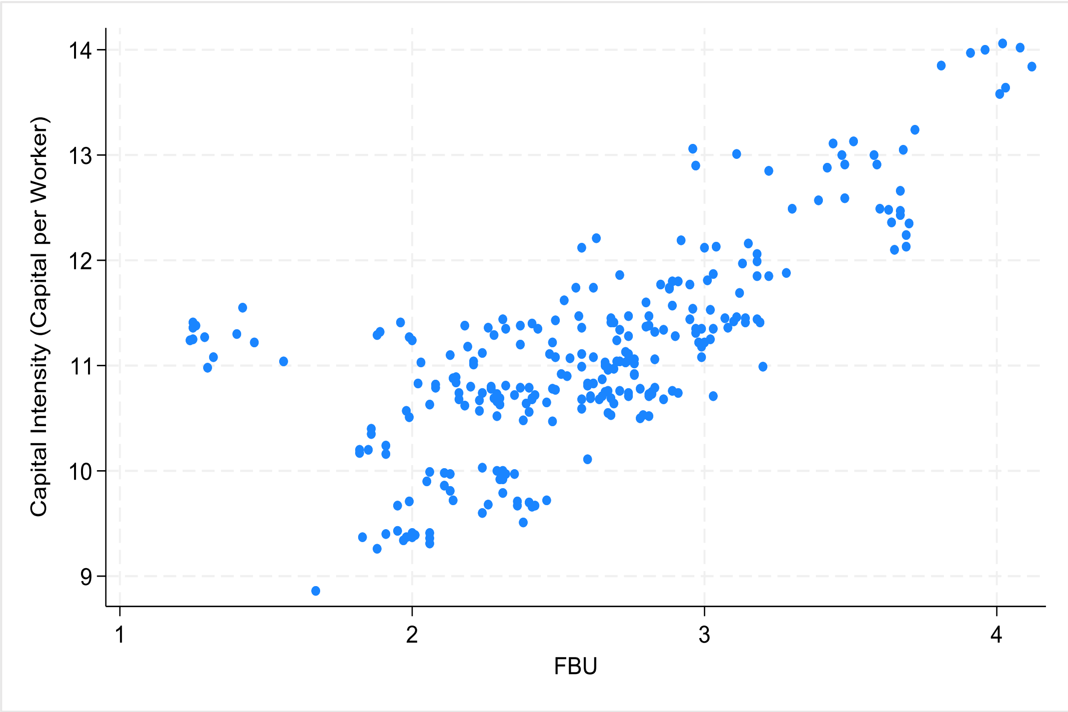
Part II of Table 4.3 replicates the analysis when the upstreamness is calculated with export upstreamness based on IBU. Our sample is the manufacturing firms with 10 or more employees with positive exports in a given year. As in Chapter 3, the difference in calculation methods leads to lower levels of upstreamness compared to FBU. The mean average of FBU is 2.69 for two-way traders, while it is 2.04 for the export upstreamness. Our remark between traders and two-way traders in Part I still holds in Part II. Firms have higher value-added, capital stock, net sales, and employment but nearly the same level of upstreamness when they are two-way traders. The same interpretation applies when the calculation is import upstreamness based on IBU.

One of the disadvantages of using export upstreamness based on IBU as a proxy for production upstreamness is revealed here. Since the sample is restricted to the exporters when the export upstreamness is calculated, firms' production is indeed taken as the exporters' production. The relationship between upstreamness and the firm performance, i.e., the value added per worker of a firm, is inspected inherently only for the firms participating in GVCs by exporting when the calculation method is export upstreamness. This can bias the results because there is strong evidence that exporting firms are considered to be more productive than non-exporters (Bernard, A. B., & Jensen, J. B. (1999); Melitz (2003)).

Table 4.3 Descriptive Statistics for Various Upstreamness Calculations (2008-2019)

	FBU Calculation								
Part I	All Firms			Traders			Two-way Traders		
	N	Mean	St Dev.	N	Mean	St Dev.	N	Mean	St Dev.
ln Real Value Added	37424	17.63	2.33	18796	17.9	2.21	10389	18.2	2.11
Upstreamness	37424	2.66	0.85	18796	2.69	0.84	10389	2.69	0.84
ln Capital Stock	37424	11.25	1.38	18796	11.38	1.3	10389	11.5	1.25
ln Net Sales	37424	19.05	2.46	18796	19.37	2.32	10389	19.69	2.2
ln Employ	37424	6.08	1.84	18796	6.31	1.74	10389	6.55	1.65
	Export upstreamness based on IBU								
Part II				Exporters			Two-way Traders		
				N	Mean	St Dev.	N	Mean	St Dev.
ln Real Value Added				15520	18.27	2.25	10389	18.39	2.19
Upstreamness				15520	2.04	0.54	10389	2.04	0.54
ln Capital Stock				15520	11.24	1.24	10389	11.29	1.2
ln Net Sales				15520	19.72	2.39	10389	19.85	2.31
ln Employ				15520	6.65	1.85	10389	6.75	1.79
	Import upstreamness based on IBU								
Part III				Importers			Two-way Traders		
				N	Mean	St Dev.	N	Mean	St Dev.
ln Real Value Added				13666	18.76	2.08	10389	18.85	2.03
Upstreamness				13666	2.55	0.68	10389	2.56	0.68
ln Capital Stock				13666	11.83	1.19	10389	11.85	1.18
ln Net Sales				13666	20.48	2.16	10389	20.58	2.11
ln Employ				13666	7	1.59	10389	7.07	1.55

Source: EIS.



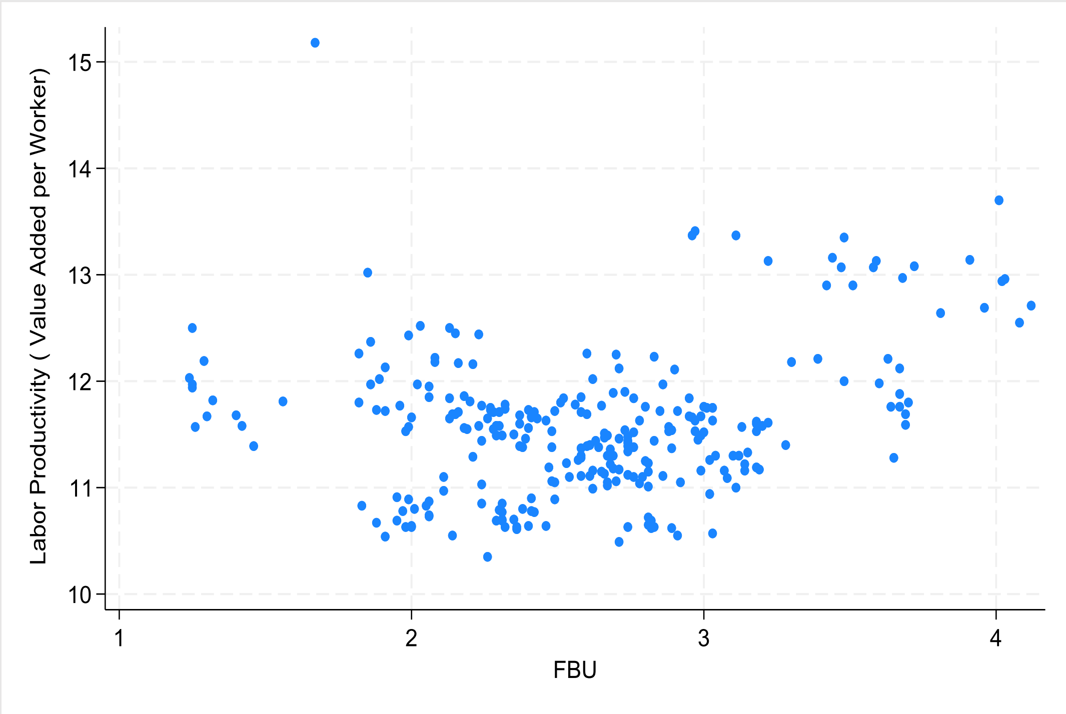
Source: EIS.

Figure 4.7 Capital Intensity and Firm Based Upstreamness (FBU)

Notes: Each point in the scatter plot represents an industry and annual weighted averages.

Figure 4.7 illustrates the relationship between the upstreamness and the capital intensity, measured by the real capital stock per worker. It is notable that the industries concentrate on the upstreamness of range [2,3]. There is a clear positive association between the two variables, with higher levels of capital intensity corresponding to higher levels of upstreamness. It seems reasonable since the industries, position distant from the final demand, such as “C19-Coke and refined petroleum products” (4.00), “C21-Basic pharmaceutical products and pharmaceutical preparations” (3.25), “C17-Paper and paper products” (3.14), are industries of which require significant investments in infrastructure, machinery, and technology. These requirements can also function as entry barriers to the industry, ensuring that only firms capable of making substantial capital investments can survive.

Similarly, for the Chinese manufacturing industry, Ju &Yu (2015) document that the upstream industries are more capital-intensive. They assess that the underlying reasoning is that initial capital stock and subsequent fixed investment are higher in upstream industries, rendering these industries more capital-intensive.



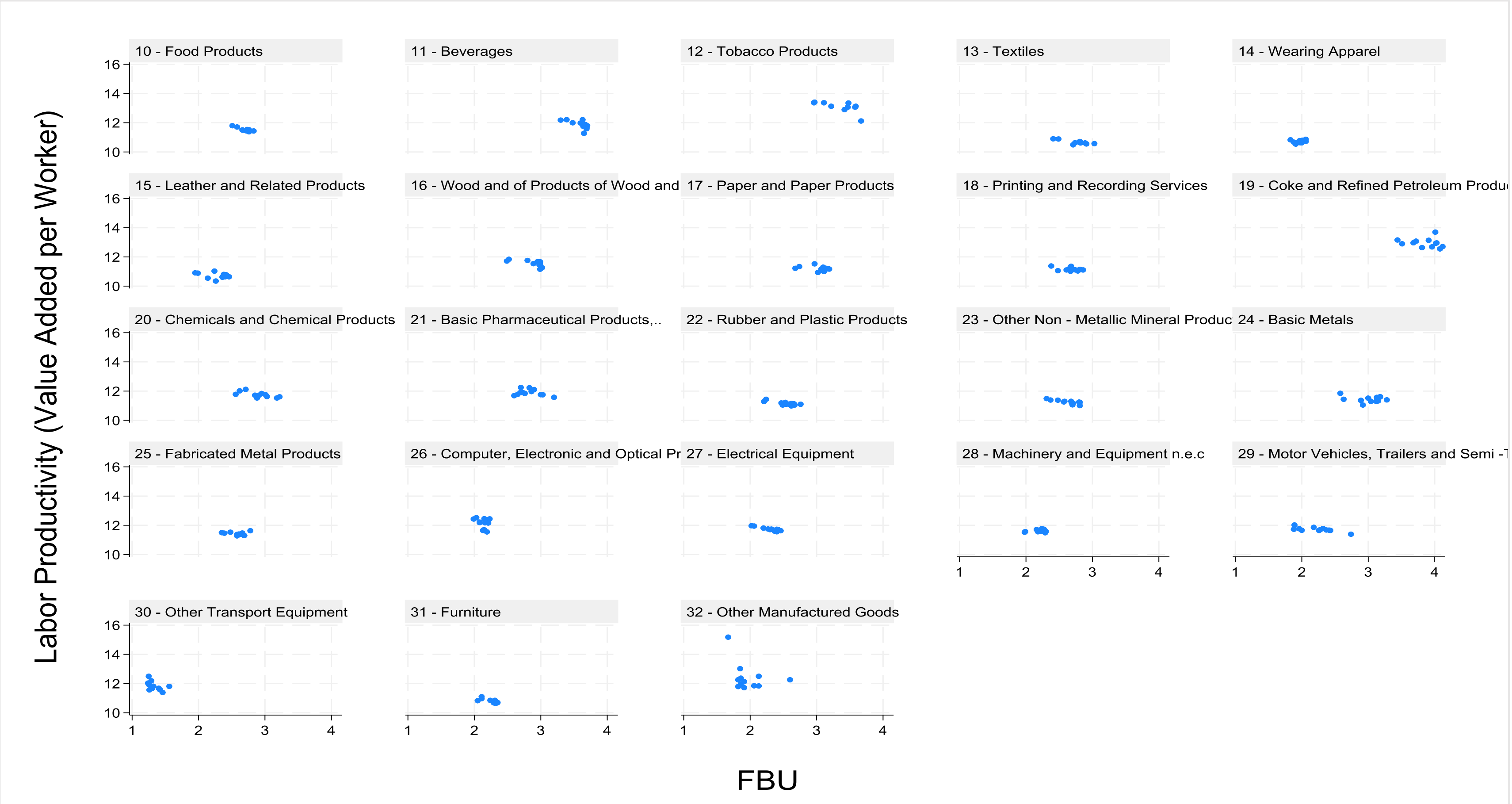
Source: EIS.

Figure 4.8 Labor Productivity and FBU

Notes: Each point in the scatter plot represents an industry and year weighted averages.

Figure 4.8 illustrates the relationship between upstreamness and labor productivity, measured by value-added per worker. The scatter plot reveals that most industries cluster around upstreamness values between 2 and 3. Industries with higher upstreamness values, closer to 3 and 4, tend to exhibit slightly higher labor productivity compared to those in the 2 to 3 range. Additionally, industries with the highest productivity levels, above 13, are positioned further upstream. However, a few industries show notably high labor productivity even at lower upstreamness levels, indicating some variation in the relationship.

When we examine this relationship closely by sector groups, as in Figure 4.9, a negative association between two variables is more apparent; as upstreamness increases, labor productivity declines. Another inference is that “30-Other Transport Equipment,” “32-Other Manufactured Goods,” and “14-Wearing Apparel” are the least upstream located industries, “10-Beverages”, “12-Tobacco Products,” and “19-Coke and Petroleum Products” are the most upstream ones. The other industries’ upstream values are cumulated between [2,3].



Source: EIS.

Figure 4.9 Labor Productivity and FBU by Sector Groups

Notes: Each point in the scatter plot represents yearly weighted averages.

Source: EIS.

Figure 4.10 Capital Intensity and Labor Productivity across Upstream Quantiles

Notes: Every year, the upstream quantiles are calculated, and then the mean of the corresponding values is given for each category.

Figure 4.10 exhibits the relationship by upstreamness quantiles. Firms that fall in the 1st quantile have the lowest capital intensity. As before, the capital intensity increases as we move to the right of the axis, indicating that upstream firms have higher capital intensity, which aligns with the findings of Ju & Yu (2015). We observe a smile curve in labor productivity distribution across upstream quantiles. Firms have higher labor productivity when they are positioned in the 1st and 4th quantiles. This finding aligns with the previous studies that suggest that the downstream and upstream stages of production are the most value-generating stages.

However, when examining this finding by sector groups (Figure 4.11), we observe that the shape of the curve varies. Although industries like “24-Basic Metals”, “19-Coke and Petroleum Products”, and “12-Tobacco Products” exhibit a “smile-curve” shape, industries “14-Wearing Apparel” and “29-Motor Vehicles, Trailers, and Semi-Trailers” follow a downward sloping trend. This implies that the relationship between firm upstreamness and performance may vary depending on the sector in which the firm operates. “Smile-curve” concept is a sectoral phenomenon that requires further investigation. In Figure 4.12, to examine how employment affects these trends, we concentrate on the value-added by upstream quantiles in each quantile. Although in most of the industries we observe similar patterns, “24-Basic Metals” no longer exhibits a “smile-curve”.

It should be stressed that the “Smile-curve” concept, in the literature, refers to the stages in the production process. Upstream stages coincide with the R&D and design activities; middle stages imply the fabrication of the products, and downstream stages refer to the after-sales services, marketing, and distribution of the product. What is measured by the upstreamness measure is not what firms do along the value chain, but rather where the products of the firms are positioned in the value chain. de Vries et al. (2021) also point out this distinction. They argue that measures of upstreamness inform where goods are positioned in a supply chain, not what firms producing these goods do in the value chain. They also suggest that measures of upstreamness are unrelated to the measures of functional specialization, and the former does not significantly relate to productivity.

We support the argument that the upstreamness measures and the functional specialization measures are different in the aspects they address. Our firm-based upstreamness measure is constructed using the percentage of final use in the firms' net sales. Consequently, this approach does not capture information regarding whether a firm engages in extensive R&D activities or handles design internally rather than outsourcing; instead, we focus on the ultimate outcome of these processes.

The reasonable question is how the products that firms produce and their distance to final consumption can affect productivity. We suggest that a change in the upstreamness of a firm reflects a change in the production structure. For instance, the farmers can change the upstream products, such as milk production, to downstream products, such as processing the milk into cheese and selling it to final demand locally (Mahy et.al, 2022) in order to obtain higher market power. An assembly manufacturer can extend its production by producing the parts and accessories of its product. In this manner, the upstreamness is more related to the vertical integration decisions of the firms.

Source: EIS.

Figure 4.11 Labor Productivity across Upstream Quantiles (by Sector Groups)

Source: EIS.

Figure 4.12 Value-Added across Upstream Quantiles (by Sector Groups)

4.2 METHODOLOGY

Our analysis is based on estimating a Cobb-Douglas production function defined as follows:

$$Q_{it} = A_{it} + \beta_K K_{it} + \beta_L L_{it} + \varepsilon_{it} \quad (17)$$

where Q is output (value added), K is capital stock, L is the number of workers, A is the firm-level productivity, and all variables are in logarithmic form with subscripts i and t denoting firm and time (year). The equation above can be reformulated in terms of labor productivity as follows:

$$prod_{it} = A_{it} + \beta_K k_{it} + \beta_S L_{it} + \varepsilon_{it} \quad (18)$$

where *prod* is the (log) labor productivity calculated as the value added per worker, and k is the (log) capital intensity calculated as the capital per worker. The coefficient β_S is equal to $\beta_K + \beta_L - 1$ and shows the degree of returns to scale[17]. The model can be made dynamic by introducing the lagged dependent variable as an explanatory variable:

$$prod_{it} = A_{it} + \gamma prod_{it-1} + \beta_K k_{it} + \beta_S L_{it} + \varepsilon_{it} \quad (19)$$

The productivity variable A_{it} includes other productivity related measures, in our case, the variable of interest, the upstreamness variable. Within this context, our empirical analysis depends on estimating a value-added function per worker at the firm level to study the impact of upstreamness on firms' productivity. Finally, the estimated equation becomes:

$$prod_{it} = \alpha + \gamma prod_{it-1} + \theta upstrm_{it} + \beta_K k_{it} + \beta_L L_{it} + \delta_t + \partial_j + \varepsilon_{it} \quad (20)$$

where i stands for firm, j stands for industry, and t stands for year. The dependent variable in Equation (20) is labor productivity expressed in logarithms, obtained by dividing the total value added of firm i in period t by the total number of workers in firm i during the same period. In the benchmark regression, the independent variable

[17] There are constant returns to scale if $\beta_S = 0$.

$upstrm_{it}$ is FBU, firm-based upstreamness, which we construct from firm-to-firm transaction data and compute for each firm yearly. In additional specifications, the variable of $upstrm_{it}$ expresses export upstreamness based on IBU, respectively, for exporters, and the production line position of firms, the difference between the import and export upstreamness, for two-way traders. k_{it} denotes real capital stock per worker (in logarithm) and L_{it} denotes firm size (number of workers, in logarithm). δ_t denotes year dummies and ∂_j denotes sector dummies at the 2-digit industry level.

Our baseline estimation technique is system GMM (Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1998). Roodman (2009) lists the situations where the mentioned dynamic panel estimator is suitable:

> 1) "small T, large N" panels, meaning few time periods and many individuals; 2) a linear functional relationship; 3) one left-hand-side variable that is dynamic, depending on its own past realizations; 4) independent variables that are not strictly exogenous, meaning they are correlated with past and possibly current realizations of the error; 5) fixed individual effects; and 6) heteroskedasticity and autocorrelation within individuals but not across them. (p. 86)

Labor productivity is suggested to be dynamic such that past realizations of productivity affect the current level. We include up to three lags of the dependent variable on the right side of the equation (20). The capital stock per worker and upstreamness are taken as pre-determined variables. Our dataset includes 12 years and around 200,000 observations. In this way, our dataset fits the items in Roodman's list.

In the related literature of the relationship between upstreamness and productivity on the firm level, the fixed effects model (FE) is commonly used as the estimation technique (Chor et al., 2021; Ju & Yu, 2015). However, as Mahy et al. (2022) point out, the FE estimator does not address the potential simultaneity between a firm's level of upstreamness and its productivity. They explain this phenomenon by expressing the literature supporting the correlation between exporting activity and upstreamness. To check its relevancy, we estimate equation (20) by interchanging the dependent variable, $prod_{it}$ and the independent variable, $upstrm_{it}$ and find evidence that productivity also significantly affects the upstreamness of the firms. Thus, the system GMM is considered the appropriate technique for all the above reasons. In addition to our benchmark results, we also report the results of the FE estimator following the common practice.

4.3 RESULTS

4.3.1 Estimation Results with FBU

4.3.1.1 Fixed Effects Estimation Results

We first estimate the static productivity equation where our upstreamness variable is FBU with a fixed effects estimation technique[18]. Table 4.4 summarizes the results. The first column refers to our benchmark case, which includes FBU. In column 2, we add controls for the exporter status. EXP dummy takes the value of 1 if the firm has positive exports in a given year and 0 otherwise.

Table 4.4 FBU and Labor Productivity, Fixed Effects Estimates

Dependent Variable	**ln Value added per worker**	
	(1)	(2)
FBU	-0.0998***	-0.0689***
	(0.0034)	(0.0039)
EXP		0.2587***
		(0.0118)
FBU * EXP		-0.0610***
		(0.0045)
ln (Capital per worker)	0.0636***	0.0621***
	(0.0020)	(0.0020)
ln (Employment)	-0.2907***	-0.2992***
	(0.0043)	(0.0043)
Constant	11.229***	11.149***
	(0.0269)	(0.0273)
Number of Observations	414,240	414,240
R-squared	0.6803	0.6814
Firm FE	Y	Y
*Sector*year FE*	Y	Y

Notes: Robust standard errors in parentheses (*** $p<0.01$, ** $p<0.05$, * $p<0.1$)

[18] We use “reghdfe” command in Stata with firm and industry-year fixed effects.

After controlling for firm and industry-year fixed effects, firm size, and capital per worker, we observe that the coefficient associated with the upstreamness variable is significant and negative (-0.099). Our finding suggests that when a firm's upstreamness increases by one unit, the firm's productivity decreases on average by 10%.

The results also indicate that capital stock per worker has a positive and significant impact, implying capital-intensive firms have higher labor productivity. The negative and significant coefficient associated with firm size indicates that the production exhibits a decreasing return to scale.

When we add controls for export status and its interaction term with upstreamness, the coefficient associated with the upstreamness variable remains negative and significant with a smaller magnitude (-0.0689). The coefficient on EXP dummy is positive and significant at 1%. This is consistent with the literature suggesting exporters are more productive compared to non-exporters (Bernard & Jensen, 1999; Melitz, 2003). The negative and significant coefficient on FBU*EXP term implies that exporters' labor productivity worsens off compared to non-exporters with increasing upstreamness.

This finding differs from previous studies suggesting a positive relationship between upstreamness and firm productivity (Ju & Yu, 2015; Mahy et al., 2022). Using OLS estimation, Ju and Yu (2015) found that the firms in upstream industries are more productive than downstream firms, regardless of how firm productivity is measured. They also found a positive and significant coefficient on the interaction term, suggesting exporters' relative performance compared with non-exporters is improving with increased upstreamness. It should be noted that Ju and Yu (2015) conceptualize firm upstreamness by two approaches. First, they utilize industry-based upstreamness measures and weigh the share of the exports of firms in each industry. In another approach, they use the upstreamness of the industry in which the firm's main activity is classified as an approximation to its upstreamness. In both approaches, their study is based on IBU. The associated coefficients in their paper are respectively (0.117 and 0.074). We will compare the results in IBU and FBU in Section 4.3.3.

4.3.1.2 System GMM Estimation Results

The results of the fixed effects estimation are valid under the assumption that productivity is determined in a static framework. However, it has been suggested that regressing a producer's current Total Factor Productivity (TFP) on its one-year lagged TFP typically yields autoregressive coefficients ranging from 0.6 to 0.8 (Sveryson, 2011). This implies that productivity tends to be persistent over time and exhibits a dynamic nature. The past realizations of productivity are most likely to affect the current value. Therefore, we add the lags of the dependent variable into the equation and estimate with the system GMM[19].

Table 4.5 FBU and Labor Productivity, System GMM Estimates (2008-2019)

Dependent Variable	ln Value added per worker	
	(1)	(2)
ln (Value added per worker) $_{t-1}$	0.2998***	0.2873***
	(0.0190)	(0.0201)
ln (Value added per worker) $_{t-2}$	0.1283***	0.1204***
	(0.0170)	(0.0177)
ln (Value added per worker) $_{t-3}$	0.0584***	0.0513**
	(0.0207)	(0.0217)
FBU	-0.0484***	0.1022
	(0.0142)	(0.1666)
EXP		0.8023
		(0.8182)
FBU * EXP		-0.2520
		(0.3357)
ln (Capital per worker)	0.0622***	0.0639***
	(0.0067)	(0.0079)
ln (Employment)	-0.0070	-0.0327***
	(0.0063)	(0.0047)
Constant	4.9028***	4.8013***
	(0.5780)	(0.7815)
Number of Observations	198,243	198,243
Number of firms	43,022	43,022
Arellano-Bond statistic (AR1) (p-value)	0	0
Arellano-Bond statistic (AR2) (p-value)	0.0657	0.0368
Arellano-Bond statistic (AR3) (p-value)	0.402	0.623
Hansen statistics (p-value)	0.350	0.290
Sargan statistics (p-value)	0.221	0.156

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

[19] We use the "xtabond2" command in Stata.

Table 4.5 shows the system GMM results when the upstreamness variable is FBU. The benchmark case with FBU is presented in Column (1). As before, the interactions of the upstreamness variable with being an exporter are given in Columns (2).

In estimating the dynamic productivity function, we include three lags of the dependent variables for additional controls since the regression results for AR (2) are found to be significant. Supporting our practice, Kripfganz (2019) also states that higher-order lags of the dependent variable, $y_{i,t-2}$, $y_{i,t-3}$,..., and the other regressors, $x_{i,t-1}$,$x_{i,t-2}$,..., might have predictive power and could help to prevent serial correlation of the error term u_{it} when included as regressors. Also, we include the second and third lags of the explanatory variables as instruments in the system GMM, excluding time, sector dummies, and firm size.

Although Hansen test statistics, which shows the validity of the instruments used in the model, is satisfied in both estimations, the other diagnostic test, which detects the presence of serial correlation, the Arellano-Bond statistic, is not satisfied in column (2). Therefore, with regard to diagnostic tests, only estimation in Column (1) satisfies the model requirements to evaluate.

Similar to FE estimation, the coefficient of the upstreamness variable is negative and significant (-0.0484). It is suggested that when a firm's upstreamness increases by one unit, hence, when the position of a firm in the value chain moves one step away from the final demand, the firm's productivity decreases on average by 4.8%. Rungi and Prete, (2018) reached a similar conclusion using a fractional probit response model. They assess that manufacturing firms generate more value the closer they are to final consumption, although a smile curve exists when all activities, such as primary, manufacturing, and services, are included.

In another study based on the system GMM, Mahy et. al (2022) found out that when a firm's upstreamness increases by one unit, the firm's productivity increases on average by 4.5%. One reason for the opposite signs of the coefficient, besides economic reasonings, may be due to the coverage of the analysis. In their study, all economic activities within sections B to N of the NACE Rev.2 are examined.[20] Nevertheless, we have observed previously that the relationship between productivity and upstreamness varies depending on the sector under examination.

The results also indicate that capital stock per worker has a positive and significant impact, supporting the argument that capital-intensive firms have higher labor productivity. However, the logarithm of firm employment, an indicator of firm size, exerts a negative but statistically insignificant impact on productivity when we use the system GMM. The coefficients associated with the lagged dependent variable are positive and significant, supporting the dynamic nature of the productivity function.[21]

The system GMM corresponds to short-run effects. So, we additionally compute the long-run impact of upstreamness on productivity. Our findings show that moving one step further from final demand in the value chain reduces a firm's productivity by an average of 9.4%, which is close to the FE estimate. This suggests that upstreamness has a greater negative impact on productivity in the long run than in the short run.

4.3.2 Robustness

We estimate several functions to assess the robustness of our finding that the upstreamness variable has a detrimental effect on the firms' productivity. We estimate the model for i) shorter reference periods, ii) adjusted FBU, iii) labor productivity with an alternative value-added definition, and iv) total factor productivity measures.

4.3.2.1 Reference Period

Our reference period spans from 2008 to 2019, encompassing the global financial crisis, during which significant disruptions in production occurred. We estimate the

[20] These include “mining and quarrying”, “manufacturing”, “electricity, gas, steam, and air conditioning supply; water supply, sewerage, waste management, and remediation activities”, “construction”, “wholesale and retail trade, repair of motor vehicles and motorcycles”, “accommodation and food services”, “transport and storage”, “financial and insurance activities”, “real estate activities”.

[21] The coefficient of the lagged dependent variable (0.2998) in system GMM lies between the corresponding estimates of FE (-0.039) and OLS (0.4412) supporting the appropriateness of the system GMM.

same productivity equation for the post-crisis period from 2010 to 2019. Table 4.6 presents the results for the shorter time period. The diagnostic tests yield improved outcomes. In both specifications, the Hansen test of overidentifying restrictions does not reject the null hypothesis of instrument exogeneity. Additionally, the autocorrelation test AR (2), which detects second-order autocorrelation of the residuals, is insignificant when the reference period is shorter.

Table 4.6 FBU and Labor Productivity, GMM-SYS Estimates (2010-2019)

Dependent Variable	**ln Value added per worker**	
	(1)	(2)
ln (Value added per worker) $_{t-1}$	0.2614***	0.2498***
	(0.0349)	(0.0372)
ln (Value added per worker) $_{t-2}$	0.0957***	0.0861***
	(0.0293)	(0.0321)
ln (Value added per worker) $_{t-3}$	0.0248	0.0141
	(0.0346)	(0.0385)
FBU	-0.0847***	-0.0800
	(0.0209)	(0.2028)
EXP		0.0744
		(0.9825)
FBU*EXP		0.0590
		(0.4043)
ln (Capital per worker)	0.0523***	0.0500***
	(0.0095)	(0.0110)
ln (Employment)	0.0133	-0.0187***
	(0.0114)	(0.0069)
Constant	6.0788***	6.4700***
	(1.0336)	(1.4099)
Number of Observations	157,102	157,102
Number of firms	39,211	39,211
Arellano-Bond statistic (AR1) (p-value)	0	0
Arellano-Bond statistic (AR2) (p-value)	0.216	0.113
Arellano-Bond statistic (AR3) (p-value)	0.714	0.542
Hansen statistics (p-value)	0.570	0.336
Sargan statistics (p-value)	0.265	0.111

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

The primary finding that a firm's upstreamness negatively affects labor productivity remains unchanged. However, it has a higher magnitude in absolute terms. When the position of a firm in the value chain moves one step away from the final demand, the firm's productivity decreases on average by 8.5%. The finding that capital intensity positively affects labor productivity holds again. When the reference period is shorter, the estimation with export status as a control variable in Column (2) also satisfies the model requirements. However, adding exporter status as a control to the estimation yields insignificant coefficients for the related variables.

4.3.2.2 Adjusted-Upstreamness

We have calculated FBU by assuming that a firm's exports constitute a portion of its final demand. We relax this premise with the proportionality assumption that the firm maintains the same production structure for its domestic and exported products and denote the newly computed variable as adjusted upstreamness.

Table 4.7 Adjusted FBU and Labor Productivity, SYS-GMM Estimates

Dependent Variable	**Value Added per Worker**	
	2008-2019	2010-2019
	(1)	(2)
ln (Value added per worker) $_{t-1}$	0.2951***	0.2530***
	(0.0192)	(0.0358)
ln (Value added per worker) $_{t-2}$	0.1245***	0.0881***
	(0.0172)	(0.0302)
ln (Value added per worker) $_{t-3}$	0.0535**	0.0144
	(0.0211)	(0.0357)
Adjusted FBU	-0.0144	-0.0402**
	(0.0117)	(0.0182)
ln (Capital per worker)	0.0629***	0.0514***
	(0.0067)	(0.0096)
ln (Employment)	-0.0043	0.0223*
	(0.0069)	(0.0131)
HHI	-0.0000	-0.0001
	(0.0001)	(0.0001)
Constant	4.9628***	6.2655***
	(0.5815)	(1.0605)
Number of Observations	198,243	157,102
Number of firms	43,022	39,211
Arellano-Bond statistic (AR1) (p-value)	0	0
Arellano-Bond statistic (AR2) (p-value)	0.0431	0.141
Arellano-Bond statistic (AR3) (p-value)	0.551	0.510
Hansen statistics (p-value)	0.141	0.386
Sargan statistics (p-value)	0.0627	0.201

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

We estimate the productivity equation incorporating adjusted upstreamness for 2008-2019 and 2010-2019. Again, the autocorrelation test AR (2) is significant when the reference period is 2008-2019. However, diagnostic tests are well-suited when the reference period is shorter. In Column (2), we observe similar findings with the previous estimations, the only difference is observed in the coefficient of the firm size variable. The coefficient associated with ln (Employment) is positive and significant at a 10% significant level, which exhibits an increasing return to scale.

4.3.2.3 Alternative Value-Added Measure

Appendix B.2 explains an alternative method for defining a firm's value-added, which includes the sum of depreciation on tangible and intangible assets, annual wages, and total operating profits, adjusted by sectoral deflators. We replicate the productivity estimation using this alternative definition of value added. Despite the coefficients of the upstreamness variable being negative and significant, the model fails to pass the overidentification and autocorrelation tests (see Appendix, Table B.3).

4.3.2.4 Technology Classification

Additionally, we examine the effects of the technology intensity of the sectors in which firms operate. Using the high-tech classification of manufacturing industries published by the Eurostat[22], we include technology dummies in the estimation equation. The insignificant coefficients for the technology intensity variable and its interactions with the upstreamness variable suggest there is no evidence that technology intensity impacts labor productivity. (see Appendix B, Table B.5).

4.3.2.5 Total Factor Productivity

We estimate production functions with total factor productivity (TFP) using the following methods: Levinsohn and Petrin (LP) and Woolridge (WRDG). By adding

[22] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:High-tech_classification_of_manufacturing_industries

the upstreamness variable as a state variable and material input as the proxy variable into the control function approach, we estimate the corresponding TFP functions (Rovigatti & Mollisi, 2018)[23]. The results show that the coefficient for the upstreamness variable is significant and negative, consistent with our previous findings.

Table 4.8 Estimation Results for Total Factor Productivity

Value Added	**LP**	**WRDG**
FBU	-0.0654***	-0.0655***
	(0.0052)	(0.0036)
ln (Capital)	0.0491***	0.0497***
	(0.0034)	(0.0026)
ln (Employment)	0.5268***	0.5408***
	(0.0031)	(0.0019)
Observations	426,745	319,016

4.3.3 Comparison of FBU with Alternative Upstreamness Calculations

In the upstreamness literature, the standard approach is to calculate the industry-based upstreamness measure using input-output (I-O) tables, as described in Section 3.2.1. In this section, we will compare the results of FBU with those of the other indicators that relied on IBU. One of these indicators is the export upstreamness of a firm, which is a combination of IBU with trade data such that export shares are weighed.

Table 4.9 summarizes the FE estimation results for the sub-sample of exporters, which enables us to compare FBU with the export upstreamness that relies on IBU. When we estimate the productivity equation in our benchmark setting with FBU for exporter firms, the negative coefficient still remains, even with a higher magnitude (-0.152), and is significant.

In the second column in Table 4.9, the upstreamness variable is taken as the export upstreamness, which we compute by incorporating export data of firms with IBU. Although the sign of the relevant coefficient is negative (-0.0133), it is now statistically

[23] We use the “prodest” command in Stata for estimating TFP functions.

insignificant. Again, capital intensity has a positive, and firm size has a negative coefficient in both estimations.

Table 4.9 FBU, Export/Import Upstreamness based on IBU and Labor Productivity, Fixed Effects Estimates (exporters)

Dependent Variable	**ln Value added per worker**	
	(1)	(2)
FBU	-0.1517***	
	(0.0052)	
Export Upstreamness based on IBU ($\boldsymbol{U_f^{EX}}$)		-0.0133
		(0.0088)
ln (Capital per worker)	0.0513***	0.0499***
	(0.0032)	(0.0032)
ln (Employment)	-0.3553***	-0.3512***
	(0.0064)	(0.0064)
Constant	12.0761***	11.754***
	(0.0443)	(0.0463)
Number of Observations	174,900	174,900
R-squared	0.6651	0.6621
Firm FE	Y	Y
*Sector*year FE*	Y	Y

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

The other indicator that relies on IBU is introduced by Chor et al. (2021), the production line position of a firm, which is the difference between the import and export upstreamness. To compare indicators of FBU with the production line position of a firm, a sub-sample of two-way traders who import and export in a given year is necessary.

Table 4.10 summarizes the estimation results for the sub-sample of two-way traders. The first 1-2 columns are similar to the ones in Table 4.9; the third and fourth columns represent, respectively, the import upstreamness and the production line position. As Chor et al. (2021) highlight, the production line position can be interpreted as the span of production stages that the firm oversees or coordinates within the home country.

Similar to the results in Table 4.9, the coefficient associated with the export upstreamness is negative and insignificant, while the coefficient associated with FBU is negative but significant when the sample consists of two-way traders. The positive coefficient of the production line position implies that their productivity is induced as firms span more production stages in Türkiye. It indicates that the more stages a firm is responsible for, the greater the value generation within firm operations.

Table 4.10 FBU, Export/Import Upstreamness based on IBU, Production Line Position and Labor Productivity, Fixed Effects Estimates (two-way traders)

Dependent Variable	**ln Value added per worker**			
FBU	-0.159***			
	(0.0062)			
Export Upstreamness based on IBU ($\boldsymbol{U_f^{EX}}$)		-0.0093		
		(0.0108)		
Import Upstreamness based on IBU ($\boldsymbol{U_f^{IM}}$)			0.019***	
			(0.0061)	
Production Line Position ($\boldsymbol{U_f^{IM} - U_f^{EX}}$)				0.0172***
				(0.0054)
ln (Capital per worker)	0.048***	0.046***	0.047***	0.047***
	(0.0041)	(0.0041)	(0.0041)	(0.0041)
ln (Employment)	-0.386***	-0.381***	-0.381***	-0.381***
	(0.0078)	(0.0079)	(0.0079)	(0.0079)
Constant	12.463***	12.105***	12.041***	12.081***
	(0.0581)	(0.0600)	(0.0583)	(0.0564)
Number of Observations	116,983	116,983	116,983	116,983
R-squared	0.6719	0.6686	0.6686	0.6686
Firm FE	Y	Y	Y	Y
*Sector*year FE*	Y	Y	Y	Y

Notes: Robust standard errors in parentheses (*** $p<0.01$, ** $p<0.05$, * $p<0.1$)

Table 4.11 presents the results of the dynamic panel estimation using the system GMM method for the exporters' dataset. Columns 1 and 2 refer to the estimation results between 2008 and 2019, while columns 3 and 4 correspond to a shorter time frame. Notably, the model in column 3 is the only one with a shorter reference period that successfully passes the Hansen and autocorrelation tests. According to that, previous results with FBU continue to hold across exporters. However, if we use export upstreamness instead of FBU, the results are inconclusive.

Table 4.11 FBU, Export Upstreamness based on IBU, SYS-GMM Estimates (exporters)

Dependent Variable	**ln Value added per worker**			
	2008-2019		2010-2019	
	(1)	(2)	(3)	(4)
ln (Value added per worker) $_{t-1}$	0.263***	0.242***	0.243***	0.285***
	(0.0341)	(0.0393)	(0.0593)	(0.0702)
ln (Value added per worker) $_{t-2}$	0.108***	0.089**	0.093*	0.128**
	(0.0304)	(0.0350)	(0.0498)	(0.0589)
ln (Value added per worker) $_{t-3}$	0.0288	-0.0021	0.0183	0.0501
	(0.0372)	(0.0432)	(0.0589)	(0.0702)
FBU	-0.068***		-0.106***	
	(0.0218)		(0.0290)	
Export Upstreamness based on IBU ($\boldsymbol{U_f^{EX}}$)		0.0261		-0.0195
		(0.0658)		(0.0759)
ln (Capital per worker)	0.053***	0.052***	0.0423**	0.055***
	(0.0133)	(0.0135)	(0.0192)	(0.0202)
ln (Employment)	-0.024***	-0.026***	-0.010	-0.022**
	(0.0057)	(0.0056)	(0.0091)	(0.0092)
Constant	6.421***	7.039***	7.067***	5.546**
	(1.201)	(1.372)	(2.019)	(2.384)
Number of Observations	77,479	77,479	61,777	61,777
Number of firms	17,284	17,284	15,740	15,740
Arellano-Bond statistic (AR1) (p-value)	0	0	0	0
Arellano-Bond statistic (AR2) (p-value)	0.0220	0.00233	0.180	0.179
Arellano-Bond statistic (AR1) (p-value)	0.965	0.465	0.958	0.653
Hansen statistics (p-value)	0.589	0.0245	0.550	0.00245
Sargan statistics (p-value)	0.417	0.00232	0.283	0.00013

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table 4.12 repeats the analysis for the two-way traders. First column replicates the system-GMM estimation using FBU for the sub-sample of two-way traders. Columns 2-3 exhibit estimation results when the upstreamness variable is defined as export upstreamness and import upstreamness, respectively, both of which are derived from IBU. The final column provides the results when the upstreamness variable is defined as the production line position of a firm, which is calculated as the difference between the import and export upstreamness of a firm. However, none of the models meet the requirements for the system GMM.

Table 4.12 FBU, Export/Import Upstreamness based on IBU, Production Line Position and Labor Productivity, GMM-SYS Estimates (two-way traders, 2008-2019)

Dependent Variable	**ln Value added per worker**			
	(1)	(2)	(3)	(4)
ln (Value added per worker) $_{t-1}$	0.2231***	0.2062***	0.2003***	0.2034***
	(0.0437)	(0.0522)	(0.0510)	(0.0501)
ln (Value added per worker) $_{t-2}$	0.0759**	0.0602	0.0552	0.0580
	(0.0375)	(0.0444)	(0.0437)	(0.0429)
ln (Value added per worker) $_{t-3}$	0.0013	-0.0241	-0.0279	-0.0223
	(0.0449)	(0.0533)	(0.0528)	(0.0519)
FBU	-0.0611**			
	(0.0272)			
Export Upstreamness based on IBU ($\boldsymbol{U_f^{EX}}$)		0.0119		
		(0.0900)		
Import Upstreamness based on IBU ($\boldsymbol{U_f^{IM}}$)			-0.0207	
			(0.0598)	
Production Line Position ($\boldsymbol{U_f^{IM} - U_f^{EX}}$)				0.0051
				(0.0506)
ln (Capital per worker)	0.0271	0.0276	0.0253	0.0246
	(0.0168)	(0.0171)	(0.0176)	(0.0177)
ln (Employment)	-0.048***	-0.052***	-0.052***	-0.052***
	(0.0056)	(0.0066)	(0.0063)	(0.0064)
Constant	7.928***	8.438***	8.682***	8.523***
	(1.528)	(1.809)	(1.793)	(1.736)
Number of Observations	50,119	50,119	50,119	50,119
Number of firms	11,013	11,013	11,013	11,013
Arellano-Bond statistic (AR1) (p-value)	0	0	0	0
Arellano-Bond statistic (AR2) (p-value)	0.0456	0.0134	0.0162	0.0255
Arellano-Bond statistic (AR3) (p-value)	0.543	0.300	0.272	0.324
Hansen statistics (p-value)	0.897	0.00612	0.0921	0.596
Sargan statistics (p-value)	0.876	0.000211	0.0207	0.513

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

4.3.4 Main Findings

This chapter investigates the relationship between the upstreamness we constructed in the previous chapter and the firm productivity. First, following the common practice, we apply the fixed effects estimation technique to our model. After controlling for firm and industry-year fixed effects, firm size, and capital per worker, we find that labor productivity will decrease in response to an increase in the upstreamness variable. Capital intensity has a positive and significant coefficient: Capital-intensive firms have higher labor productivity. Employment, as a proxy for firm size, has a negative and significant coefficient, i.e. there is a decreasing return to scale. When the exporter dummy is added to the model as an additional control, exporters are found to be more productive than non-exporters. The negative and significant coefficient on the interaction of upstreamness and export dummy terms implies that exporters' labor productivity worsens off compared to non-exporters with increasing upstreamness.

We estimate our model with system GMM as the productivity of a firm exhibits persistence. We include three lags of the dependent variables for additional controls since the regression results for AR (2) are found to be significant. The second and third lags of the explanatory variables are used as instruments in the system GMM, excluding time, sector dummies and firm size. Similar to FE estimation, the coefficient of the upstreamness variable is negative and significant (-0.0484). It is suggested that when a firm's upstreamness increases by one unit, hence, when the position of a firm in the value chain moves one step away from the final demand, the firm's productivity decreases on average by 4.8%. Different than FE results, the coefficient of the firm size variable is found to be insignificant. The coefficients of all three lags of the dependent variable are positive and significant, supporting the dynamic nature of the productivity function. Again, firms with higher capital intensity are more productive. When the exporter dummy is included in the model, the model does not satisfy the requirements of the autocorrelation tests.

Our finding is similar to Rungi and Prete (2018), who assess that manufacturing firms generate more value the closer they are to final consumption using a fractional probit response model. In another study based on the system GMM, Mahy et. al (2022) find out that when a firm's upstreamness increases by one unit, the firm's productivity increases on average by 4.5%. It should be noted that their analysis includes a broader range of sectors beyond just the manufacturing sector.

We assess the robustness of our main findings across various specifications. We obtain similar results when using a shorter reference period and the adjusted FBU as the upstreamness variable. The estimation results with total factor productivity are also consistent with our findings on labor productivity. However, when using an alternative value-added measure, although the coefficient signs remain consistent, the model does not meet the necessary requirements for system GMM.

At the end of the chapter, we compare the results of FBU with those of the other indicators that relied on IBU: the export upstreamness of a firm and the production line of a firm. For exporters, the FBU estimation results are similar to those observed when all firms are included. However, the estimations with the export upstreamness exhibit statistically insignificant coefficients. For the two-way traders, the fixed effects estimation technique results in a negative and significant coefficient for the FBU and a positive and significant coefficient for the production line position. However, system GMM estimations for both indicators are inconclusive since model requirements are unsatisfied.

CHAPTER 5

CONCLUSION

This dissertation examines the attributes of the upstreamness measure, a Global Value Chain (GVC) position index, at the firm level and its association with firm productivity in the Turkish manufacturing sector. We employ firm-level data from the EIS, spanning 2008 to 2019, to exclude the potential effects of the COVID-19 pandemic.

This study contributes to the GVC literature by analyzing for the first time the benefits of GVC participation in Türkiye within the context of the upstreamness measure at the firm level. A distinctive feature of this study, in contrast to common practice, is the construction of the upstreamness measure using firm-to-firm transaction data rather than industry-based input-output tables.

Our findings can be gathered into two main areas: those related to the measurement of upstreamness and those concerning its economic interpretation within the value chain.

5.1 MAIN FINDINGS

5.1.1 The Measurement of Firm-Based Upstreamness

The upstreamness measure captures the positioning of a country/industry relative to final demand (i.e., consumption or investment) in the value chain. The underlying principle of the measure is that it is an indicator of the average number of production stages in which an industry's output is used before reaching final demand (Fally, 2011; Antràs et al., 2012). By construction, the lowest value of an upstreamness index is 1, and higher values indicate that the country/industry is positioned more upstream in the value chain.

In constructing the upstreamness index, input-output tables have been used widely. The extent of information and the level of the product/industry classification provided in I-O tables may vary. In the USA, there exist I-O tables of 402 industries, classified under the North American Industry Classification System (NAICS). The I-O tables in the World Input-Output Database (WIOD) include 56 sectors, which are classified according to the International Standard Industrial Classification (ISIC, Rev. 4).

Türkiye's latest I-O table, published in 2012, covers 63 industries classified under the Statistical Classification of Products by Activity (CPA, 2008). This allows us to calculate the industry-based upstreamness (IBU) measure for 63 industries, which may result in an underestimation of the outcomes due to aggregation issues. For instance, according to our calculations, in Türkiye, two of the Harmonized System codes of trade data, "840751-Engines; reciprocating piston engines, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity not exceeding 50cc" and all six-digit codes under "8703- Motor cars and other motor vehicles; principally designed for the transport of persons (other than those of heading no. 8702), including station wagons and racing cars" fall into the same activity-"C29-Motor vehicles, trailers, and semi-trailers" and IBU for that sector upstreamness is 1.591. However, the former product will have a higher upstreamness value than the latter. This cannot be captured when the upstreamness is measured by IBU.

Therefore, we construct a novel firm-based upstreamness (FBU) measure, relying on the firm-to-firm transaction data, which can be regarded as an input-output table at the firm level. This enabled us to assess the fragmentation of the production chain in more detail.

When we calculate the weighted averages across sectors, the FBU values are found to be significantly higher than their industry-based counterparts (IBU). 46 out of 63 industries have higher upstreamness values in FBU than IBU. Notably, the sectors where high differences are observed consist of Türkiye's main exporting products: "C29-Motor vehicles, trailers, and semi-trailers" and "C10-C12-Food, beverages, and tobacco products". FBU values and IBU values are, respectively, 2.73 and 1.59 in the

"C29-Motor vehicles, trailers, and semi-trailers" sector and 2.95 and 1.48 in the "C10-C12-Food, beverages, and tobacco products" sector. In both of these two sectors, the products of the sectors are positioned more upstream when the measure is FBU rather than IBU.

Also, in FBU approach, the activities related to motor engines and motor vehicle manufacturing can now be separable and treated as differently. The corresponding upstreamness values are respectively 2.55 and 2.08. It implies that aggregation inherited in IBU underestimates the true position of the industries in the value chain, and using information at the firm-level data reveals the position in a value chain more realistically.

Another advantage of using FBU is its constructability on an annual basis. National statistical offices periodically publish input-output (I-O) tables, which are fundamental to industry-based upstreamness (IBU) measures. This presumes a fixed relationship between industries in terms of input-output linkages for a certain time period. FBU is more likely to capture the change in the network dynamics between industries.

Besides the quantitative features of the FBU, we also investigate the evolution of upstreamness patterns in Türkiye between 2008 and 2019. We found that there was a continuous increase until 2012, followed by a significant decline in 2013 and a stable trend thereafter until 2019 when a sharp decline occurred. The peak value was observed in 2012.

Furthermore, we study the decomposition of the overall change in upstreamness in two dimensions: the intensive margin, reflecting the change associated with continuing firms, and the extensive margin, reflecting the change associated with entrants and exiters to the manufacturing industry in that year. The analysis reveals that the contribution of the intensive margin to the overall change is greater than that of the extensive margin, and this pattern holds true for the majority of the sub-sectors examined. This suggests that adjustments made within existing firms play a more significant role than the entry or exit of firms in influencing overall changes.

Consequently, we conclude that from 2008 to 2019, Turkish manufacturing firms have moved further upstream in the value chain.

5.1.2 The Effects of Firm Based Upstreamness

In Chapter 4, we investigate the relationship between the upstreamness and the labor productivity of a firm. We initially identified key facts through the descriptive analysis of our empirical dataset. The first key fact is that firms positioned more upstream have higher capital intensity. This is in line with the observation that the most upstream industries such as "C19-Coke and refined petroleum products" (4.00), "C21-Basic pharmaceutical products and pharmaceutical preparations" (3.25) are associated with requirements of significant investments in infrastructure, machinery and technology. Secondly, we observe a smile curve in labor productivity distribution across upstream quantiles. Firms have higher labor productivity when positioned in the 1^{st} and 4^{th} quantiles. However, when the "smile-curve" concept is examined at the sectoral division, different outcomes are observed, indicating that the relationship between firm upstreamness and performance may vary depending on the sector in which the firm operates. This is consistent with the previous studies supporting "smile-curve" such that they mainly concentrate on specific sectors, such as electronics and computers.

Then, we apply the system-GMM estimation technique by controlling year and sector dummies to examine the relationship between labor productivity and upstreamness at the firm level. Our main finding is that the increase in the upstreamness of a firm leads to a decrease in labor productivity. Firms positioned more distant from the end user create less value-added. This is supported by the findings of Rungi and del Prete (2018) for the manufacturing firms in the European Union, although the rest of the literature suggests the contrary (Ju &Yu, 2015; Mahy, 2022).

It is widely accepted that most of the value is created in upstream activities such as R&D, design and downstream activities such as marketing, branding, logistics. In contrast, the value created 'in-between,' which is associated with pure manufacturing or assembling stages, is less value-added. The concept of the "smile curve" dates back to the 1990s (Shih, 1996) and has been validated by several studies. However, it should be stressed that “smile-curve” concept, in the literature, refers to the stages from conception to production, production to after-sale services. Upstream stages coincide with the R&D and design activities, middle stages imply the fabrication of the products, and downstream stages refer to the after-sales services, marketing, and distribution of the product. Though, the upstreamness measure does not reflect firms' actions along the value chain, but rather the positioning of the firms' products in the value chain. Vries et al. (2021) also point out this distinction. They argue that measures of upstreamness inform on where goods are positioned in a supply chain, not what firms producing these goods do in the value chain.

We support the argument that the upstreamness measures and the functional specialization measures are different in the aspects they address. Our firm-based upstreamness measure is constructed using the percentage of final use in the firms' net sales. Consequently, this approach does not capture information regarding whether a firm engages in extensive R&D activities or handles design internally rather than outsourcing; instead, we focus on the ultimate outcome of these processes.

Hence, a change in the upstreamness is more related to the change in the composition of the products of a firm. A firm is positioned more upstream as its production consists of more upstream products. This can be accomplished via extending their control over the supply chain by acquiring or merging with their suppliers or establishing facilities to produce intermediates by in-house production. For instance, the farmers can change their upstream products, such as milk production, to downstream products, such as processing the milk into cheese and selling it to final demand locally in order to obtain higher market power (Mahy et.al, 2022). An assembly manufacturer can extend its production by producing the parts and accessories of the original product. This refers to the backward integration in the literature, where a company expands its business operations into a previous stage of its production process, moving closer to the raw materials or components necessary for its products. In this manner, the upstreamness measure is more related to the vertical integration decisions of the firms rather than functional specialization literature.

Eventually, we interpret the finding that firms positioned further upstream in the value chain in Türkiye generate less value-added as an indication that expanding production by incorporating more upstream products is not profitable. This could be attributed to the substantial investment requirements of upstream stages, which may not yield sufficient returns, inefficiencies arising from increased production scope, and the potential loss of specialization and flexibility between stages.

5.2 MAIN LIMITATIONS

We've interpreted the impact of an increase in the upstreamness of a firm within the context of vertical integration, especially a specific type of it, backward integration. In this regard, the upstreamness of a firm increases with incorporating upstream stages. However, a firm may also choose to shift its production focus entirely and move to a more upstream position in another value chain, which could be considered a form of inter-sectoral upgrading. If this is the case, the negative relationship between productivity and upstreamness is hard to interpret. We would expect a positive relationship since more upstream firms are associated with higher capital intensity and the cutoff productivity for these firms to operate in the upstream stages would probably be higher. However, we cannot distinguish from our dataset the origin of the upstreamness change, whether the firm expands its production by incorporating upstream products or switches its production focus, as firm-to-firm transaction data does not include any information about the products. Measurement of FBU relying on the production statistics of a firm rather than net sales would be better to capture this difference. However, firm-to-firm transaction data based on production statistics is currently unavailable.

One limitation of our study lies in the nature of the dataset itself. Our analysis is based on firm-to-firm transaction data, which is derived from administrative records. Although we have implemented many data-cleaning procedures to minimize potential measurement errors, our findings are ultimately constrained by the accuracy of the information reported by the firms. Additionally, when constructing FBU from firm-to-firm transaction data, our approach includes all types of firms in the analysis. We didn't distinguish firms that sell intermediate goods and investment goods. However, in the national accounts, investment goods are a component of final demand, not intermediate consumption. A more precise methodology would involve distinguishing investment goods and retailer firms in the computation of intermediate use.

5.3 MAIN POLICY IMPLICATIONS and FUTURE RESEARCH

Identifying the true position of firms in the value chain has recently become more vital when recent disruptions in trade, notably due to the COVID-19 pandemic, caused a reassessment of the benefits of GVC participation. The focus of the GVC literature has shifted towards supply chain sustainability and resilience. Within the context, a firm's position determines the types of shocks it is more exposed to (Criscuolo and Timmis, 2017). Upstream industries are more exposed to demand shocks, whereas downstream industries are more vulnerable to supply shocks (Acemoglu et al., 2016). Hence, an effective policy against unexpected global shocks foremost requires the examination of the status quo. This study should be considered the initial phase of a more in-depth upcoming sector-based analysis of value chain positioning. The scale of the network and relationships with upstream and downstream partners should be interrogated for a more precise picture of value chain interconnectedness.

An accurate understanding of the domestic network and the upstream and downstream relationships between them is also significant for evaluating the possible impacts of the trade agreements on various sectors. Such interpretations are essential for implementing effective trade policies. For instance, the imposition of import tariffs or export restrictions can have significant spillover effects on industries beyond the one directly targeted.

Our argument that the upstreamness measure is closely related to the vertical integration literature warrants further exploration. Although we've listed possible explanations for the negative relationship between upstreamness and productivity, a more detailed investigation is required, particularly examining the types of vertical integration, such as mergers and acquisitions, and their connection to upstreamness.

Our analysis assumes that the relationship between productivity and the upstreamness is linear. However, it is possible that the relationship between upstreamness and productivity may be nonlinear[24]. While some firms may experience productivity gains as they move upstream in the value chain due to greater control over inputs or specialization, others may face diminishing returns or even negative impacts due to increased complexity, coordination costs, or inefficiencies. This suggests that the link between a firm's position in the production process and its productivity might vary across different stages or industries. Therefore, a deeper investigation is needed to explore potential nonlinearities in this relationship and the factors that could influence its direction and magnitude. Identifying these dynamics could provide more nuanced insights into how upstreamness impacts firm performance.

Recently, the upstreamness concept has been used to analyze the impact of green economy regulations on firm performance. A potential extension of this study could involve examining this relationship for the Turkish manufacturing firms.

[24] We estimate the productivity equation by incorporating the squared term of the upstreamness variable to identify potential signs of nonlinearity (see Appendix B, Table B.4).

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APPENDICES

A. SUPPLEMENTARY MATERIAL FOR CHAPTER 3

Table A.1 Industry-Based Upstreamness (All Sectors)

Product Code-Definition (CPA, 2008)	**Upstreamness**
A01-Products of agriculture, hunting and related services	1.94
A02-Products of forestry, logging and related services	2.35
A03-Fish and other fishing products; aquaculture products; support services to fishing	1.35
B-Mining and quarrying	3.58
C10-C12-Food, beverages and tobacco products	1.48
C13-C15-Textiles, wearing apparel, leather and related products	2.12
C16-Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	2.66
C17-Paper and paper products	2.80
C18-Printing and recording services	2.93
C19-Coke and refined petroleum products	2.73
C20-Chemicals and chemical products	3.17
C21-Basic pharmaceutical products and pharmaceutical preparations	1.39
C22-Rubber and plastic products	2.49
C23-Other non-metallic mineral products	2.49
C24-Basic metals	2.93
C25-Fabricated metal products, except machinery and equipment	1.97
C26-Computer, electronic and optical products	1.50
C27-Electrical equipment	1.89
C28-Machinery and equipment n.e.c.	1.41
C29-Motor vehicles, trailers and semi-trailers	1.59
C30-Other transport equipment	1.24
C31-C32-Furniture and other manufactured goods	1.28
C33-Repair and installation services of machinery and equipment	2.21
D35-Electricity, gas, steam and air conditioning	3.19
E36-Natural water; water treatment and supply services	1.63
E37-E39-Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services	3.45

Table A.1 (continued)

F-Constructions and construction works	1.34
G45-Wholesale and retail trade and repair services of motor vehicles and motorcycles	1.93
G46-Wholesale trade services, except of motor vehicles and motorcycles	2.18
G47-Retail trade services, except of motor vehicles and motorcycles	1.31
H49-Land transport services and transport services via pipelines	2.03
H50-Water transport services	3.12
H52-Warehousing and support services for transportation	3.32
H53-Postal and courier services	2.37
I-Accommodation and food services	1.27
J58-Publishing services	1.92
J59-J60-Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services	3.23
J61-Telecommunications services	1.65
J62-J63-Computer programming, consultancy and related services; Information services	2.18
K64-Financial services, except insurance and pension funding	2.18
K65-Insurance, reinsurance and pension funding services, except compulsory social security	2.37
K66-Services auxiliary to financial services and insurance services	2.64
L68B-Real estate services excluding imputed rents	1.46
M69-M70-Legal and accounting services;Services of head offices; management consulting services	2.65
M71-Architectural and engineering services; technical testing and analysis services	2.31
M72-Scientific research and development services	1.00
M73-Advertising and market research services	3.15
M74-M75-Other professional, scientific and technical services and veterinary services	2.44
N77-Rental and leasing services	2.65
N78-Employment services	2.89
N79-Travel agency, tour operator and other reservation services and related services	1.19
N80-N82-Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	2.53
O84-Public administration and defence services; compulsory social security services	1.04
P85-Education services	1.07
Q86-Human health services	1.07
Q87-Q88-Residential care services; social work services without accommodation	1.00

Table A.1 (continued)

R90-R92-Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services	1.20
R93-Sporting services and amusement and recreation services	1.38
S94-Services furnished by membership organisations	1.45
S95-Repair services of computers and personal and household goods	1.31
S96-Other personal services	1.04

Source: TURKSTAT and authors' calculations.

Table A.2 Firm Based Upstreamness (All Sectors)

Product code-Definition (CPA, 2008)	**Upstreamness**
A01-Products of agriculture, hunting and related services	2.64
A02-Products of forestry, logging and related services	1.44
A03-Fish and other fishing products; aquaculture products; support services to fishing	2.85
B-Mining and quarrying	3.18
C10-C12-Food, beverages and tobacco products	2.95
C13-C15-Textiles, wearing apparel, leather and related products	2.47
C16-Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	2.93
C17-Paper and paper products	3.16
C18-Printing and recording services	2.70
C19-Coke and refined petroleum products	4.00
C20-Chemicals and chemical products	2.95
C21-Basic pharmaceutical products and pharmaceutical prep.	3.20
C22-Rubber and plastic products	2.58
C23-Other non-metallic mineral products	2.67
C24-Basic metals	3.16
C25-Fabricated metal products, except machinery and equipment	2.75
C26-Computer, electronic and optical products	2.18
C27-Electrical equipment	2.38
C28-Machinery and equipment n.e.c.	2.31
C29-Motor vehicles, trailers and semi-trailers	2.73
C30-Other transport equipment	1.48
C31-C32-Furniture and other manufactured goods	2.30
C33-Repair and installation services of machinery and equipment	2.29
D35-Electricity, gas, steam and air conditioning	3.04
E36-Natural water; water treatment and supply services	1.27
E37-E39-Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services	3.34

Table A.2 (continued)

F-Constructions and construction works	2.01
G45-Wholesale and retail trade and repair services of motor vehicles and motorcycles	2.59
G46-Wholesale trade services, except of motor vehicles and motorcycles	2.57
G47-Retail trade services, except of motor vehicles and motorcycles	1.80
H49-Land transport services and transport services via pipelines	3.07
H50-Water transport services	2.17
H51-Air transport services	1.13
H52-Warehousing and support services for transportation	2.56
H53-Postal and courier services	1.98
I-Accommodation and food services	1.75
J58-Publishing services	3.53
J59-J60-Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services	4.06
J61-Telecommunications services	2.99
J62-J63-Computer programming, consultancy and related services; Information services	2.63
K64-Financial services, except insurance and pension funding	1.61
K65-Insurance, reinsurance and pension funding services, except compulsory social security	2.37
K66-Services auxiliary to financial services and insurance services	1.02
L68B-Real estate services excluding imputed rents	2.09
M69-M70-Legal and accounting services;Services of head offices; management consulting services	2.65
M71-Architectural and engineering services; technical testing and analysis services	2.17
M72-Scientific research and development services	2.57
M73-Advertising and market research services	3,58
M74-M75-Other professional, scientific and technical services and veterinary services	2,16
N77-Rental and leasing services	2,88
N78-Employment services	3,01
N79-Travel agency, tour operator and other reservation services and related services	1,63
N80-N82-Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	2,13
O84-Public administration and defence services; compulsory social security services	1,21
P85-Education services	1,21
Q86-Human health services	1,20
Q87-Q88-Residential care services; social work services	1,27

Table A.2 (continued)

R90-R92-Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services	1,95
R93-Sporting services and amusement and recreation services	1,59
S94-Services furnished by membership organizations	2,19
S95-Repair services of computers and personal and household goods	2,34
S96-Other personal services	2,01
T-Services of households as employers; undifferentiated goods and services produced by households for own use	2,85

Source: EIS and authors' calculations.

Table A.3 Annual Upstreamness of Türkiye Using Various Calculation Methods (All Sectors)

Year	Import Upstreamness based on IBU	N	Export Upstreamness based on IBU	N	FBU	N
2008	2.461	39,129	2.160	34,343	2.063	272,391
2009	2.354	37,914	2.118	35,351	2.079	285,380
2010	2.406	42,929	2.133	38,487	2.234	348,703
2011	2.397	47,058	2.134	40,699	2.298	384,170
2012	2.418	48,445	2.169	44,140	2.482	420,882
2013	2.472	49,470	2.117	46,667	2.331	447,455
2014	2.410	50,668	2.099	49,184	2.408	478,164
2015	2.389	51,355	2.078	49,715	2.390	505,874
2016	2.369	49,957	2.054	50,028	2.391	513,221
2017	2.397	46,279	2.060	47,646	2.403	540,211
2018	2.409	46,894	2.077	51,050	2.436	563,026
2019	2.416	50,143	2.076	58,531	2.263	550,450

Source: TURKSTAT, EIS and authors' calculations.
Notes: Import and export upstreamness based on IBU are calculated by integrating trade data of firms with the IBU dataset. For each firm, the export and import upstreamness is derived by using the import and export shares of industries within firm's trade composition. The overall upstreamness values represent the weighted averages of the upstreamness levels of firms, calculated based on their respective market shares.

Table A.4 Annual Upstreamness of Türkiye Using Various Calculation Methods (Manufacturing)

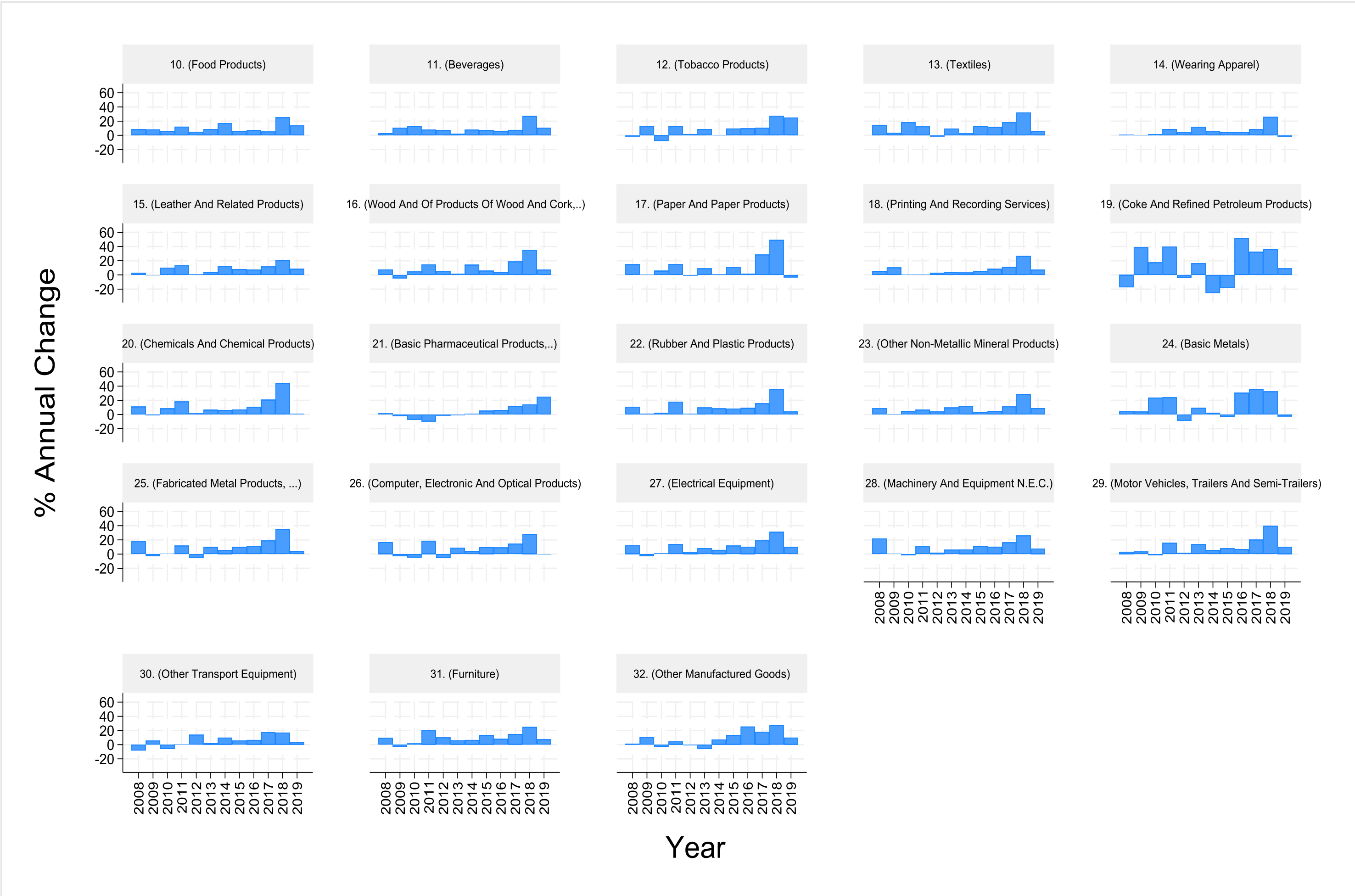
Year	Import Upstream-ness based on IBU	N	Export Upstream-ness based on IBU	N	FBU	N
2008	2.646	16,441	2.093	17,423	2.388	69,039
2009	2.532	15,666	2.061	17,804	2.408	69,868
2010	2.561	17,298	2.058	18,891	2.627	78,021
2011	2.583	18,499	2.080	19,558	2.673	83,537
2012	2.595	18,791	2.086	20,629	2.853	89,329
2013	2.573	19,196	2.043	22,194	2.687	95,720
2014	2.547	19,817	2.035	23,814	2.772	101,863
2015	2.489	20,101	2.015	24,117	2.767	106,861
2016	2.447	19,596	1.990	24,552	2.743	108,542
2017	2.501	18,612	2.008	22,830	2.764	111,527
2018	2.532	18,838	2.038	24,209	2.722	116,602
2019	2.573	20,109	2.036	27,793	2.597	116,032

Source: TURKSTAT, EIS and authors' calculations.

Table A.5 The number of Firms in the Upstreamness Dataset

Year	All	Manufacturing firms	Share (of all firms)	Manufacturing (two-way traders)	Share (of Manufacturing firms)
2008	272,391	69,039	25.3%	10,858	15.7%
2009	285,380	69,868	24.5%	10,703	15.3%
2010	348,703	78,021	22.4%	11,456	14.7%
2011	384,170	83,537	21.7%	12,041	14.4%
2012	420,882	89,329	21.2%	12,534	14.0%
2013	447,455	95,720	21.4%	13,014	13.6%
2014	478,164	101,863	21.3%	13,580	13.3%
2015	505,874	106,861	21.1%	13,723	12.8%
2016	513,221	108,542	21.1%	13,663	12.6%
2017	540,211	111,527	20.6%	13,444	12.1%
2018	563,026	116,602	20.7%	13,716	11.8%
2019	550,450	116,032	21.1%	14,539	12.5%

Source: EIS.

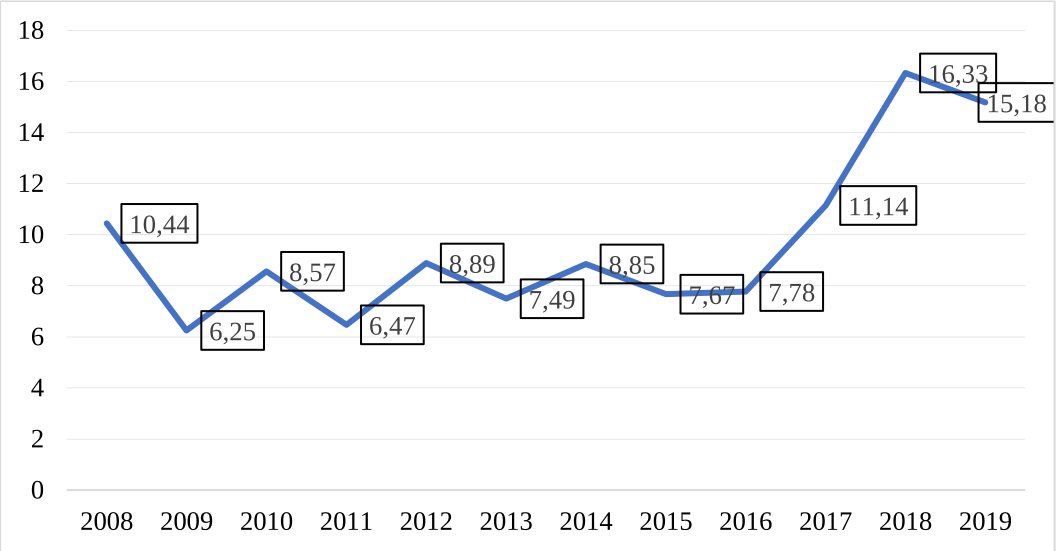


Source: TURKSTAT.

Figure A.1 Producer Price Index (2003=100) by Sector Groups

B. SUPPLEMENTARY MATERIAL FOR CHAPTER 4

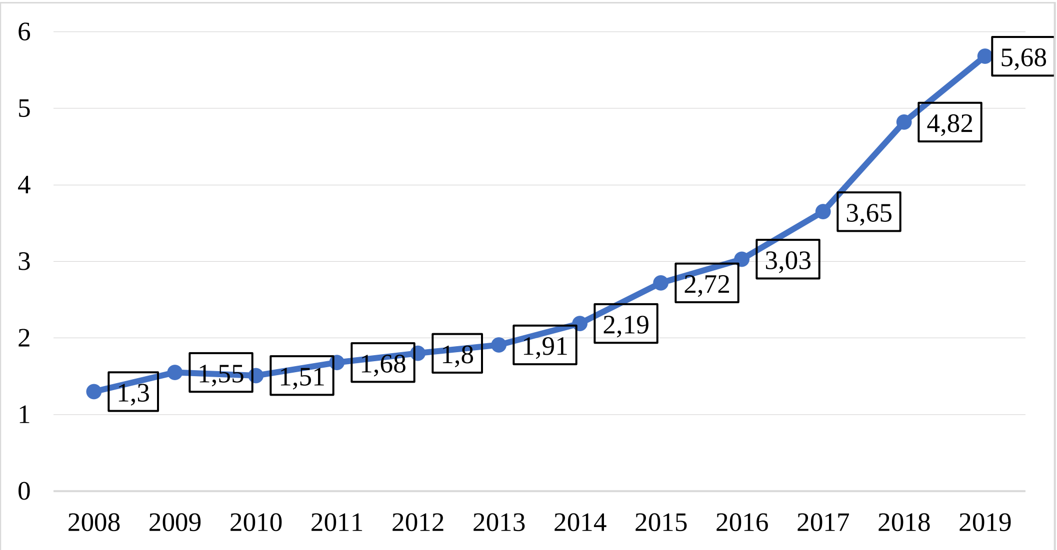
B.1. Related Economic Indicators of Türkiye between 2008-2019



Source: TURKSTAT

Figure B.1 Consumer Price Index (%)

Notes: The figure shows the rate of change in twelve months' moving averages.



Source: TCMB

Figure B.2 The Exchange Rate (TL/USD)

Table B.1 External Trade by Economic Activity (NACE, Rev.2) and Employment Size Class, 2009-2018

Year	Number of employees	Exports of Türkiye (billion USD)	Exports of Industry (B-E) (billion USD)	Share of Industry	Imports of Türkiye (billion USD)	Imports of Industry (B-E) (billion USD)	Share of Industry
2009	10 and more	83.8	57.2	68.20%	127.4	72.7	57.10%
2009	Total	101.4	60.7	59.90%	139.2	76	54.60%
2010	10 and more	94.8	64.7	68.20%	172.6	98.3	56.90%
2010	Total	113.4	68.5	60.40%	185	100.8	54.50%
2011	10 and more	114.2	76.3	66.80%	224.7	123.9	55.10%
2011	Total	134.7	80	59.40%	240.3	127	52.90%
2012	10 and more	120.9	82	67.80%	221.6	123.2	55.60%
2012	Total	152.3	86.5	56.80%	236.3	126.5	53.50%
2013	10 and more	124.5	82.5	66.30%	237.1	127.6	53.80%
2013	Total	151.6	86.3	57.00%	251.4	129.7	51.60%
2014	10 and more	129.7	85.3	65.80%	226.4	121.7	53.80%
2014	Total	156.9	89.2	56.90%	241.4	124.3	51.50%
2015	10 and more	118.4	76.7	64.80%	194	105.8	54.50%
2015	Total	143.8	80.2	55.80%	207.2	108.1	52.20%
2016	10 and more	115	76.1	66.20%	183.3	101.9	55.60%
2016	Total	142.4	80.5	56.50%	198.5	105.9	53.30%
2017	10 and more	122.1	85.3	69.90%	212.2	118.5	55.80%
2017	Total	157	88.8	56.60%	233.4	121.6	52.10%
2018	10 and more	134.9	92.7	68.70%	203.9	123.4	60.50%
2018	Total	167.9	96.6	57.50%	223	125.9	56.50%

Source: TURKSTAT

Notes: The statistics are based on foreign trade statistics under the Special Trade System. The above statistics are from the latest available dataset; TURKSTAT no longer updates. Industry covers sectors classified under headings of B-E in NACE Rev.2, with our sample falling under category “C.o

B.2. Different Calculations of the Value-Added

Defining the "value-added" of a firm with different components is possible in practice. We have used two definitions of "value-added," one of which is developed in this analysis from the firm-to-firm transaction dataset, and the other is borrowed from the Technical Appendix of the Turkey Productivity Report (World Bank, 2019). According to that, the value added of a firm is defined as the sum of depreciation on tangible and intangible assets, annual wages, and total operating profits, adjusted by sectoral deflators.

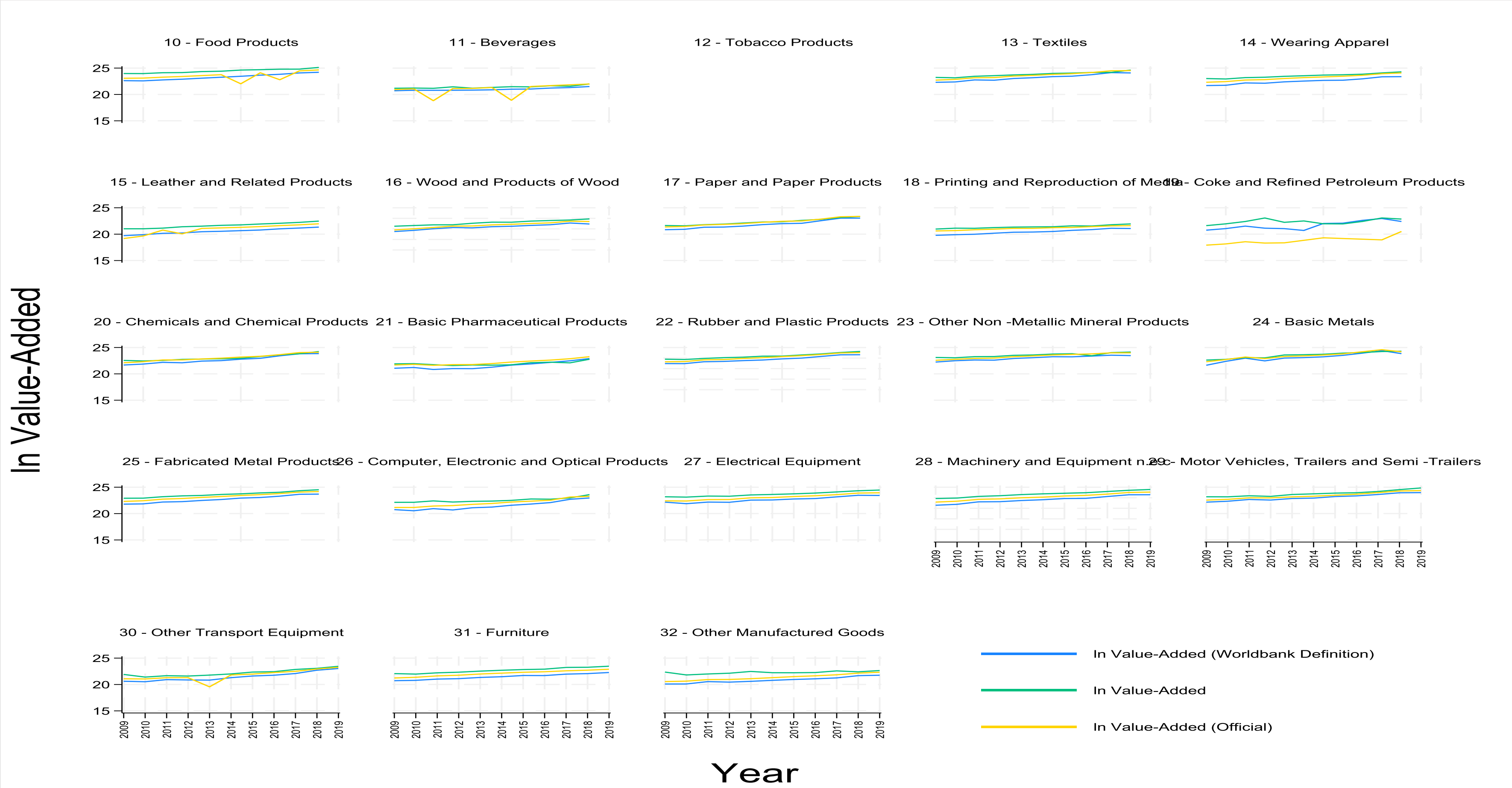
We compare the results of different definitions of value-added with the officially announced aggregates by TURKSTAT in Figure B.3. Both 'The World Bank definition' and the definition used in this analysis are calculated at the firm level. By aggregating firms based on their activity codes, sector-level results are obtained for comparison with the official data. In the majority of sectors, the official results fall between the two definitions, with our firm-level definition of value-added, derived from firm-to-firm transaction datasets, showing a higher magnitude.

Table B.2 further illustrates the Spearman rank correlation between the various definitions of value-added, all significant at the 1% level. The results reveal a strong positive correlation between any two of the three definitions of value-added.

Table B.2 The Correlation Table Between Different Calculations of Value-Added Measures

	(1)	(2)	(3)
(1)	1.0000		
(2)	0.9153*	1.0000	
(3)	0.9464*	0.9299*	1.0000

Source: TURKSTAT, EIS and authors' calculations.
Notes: (1) refer to officially announced ln value-added. (2) refers to the value-added definition we developed from the firm-to-firm transactions dataset in this study. (3) refers to the value-added definition of the World Bank Report.



Source: TURKSTAT, EIS and authors' calculations.

Figure B.3 The Comparison of Different Calculations of Value-Added by Sector Groups

Table B.3 FBU and Labor Productivity Defined by an Alternative Value-Added Measure, GMM-SYS Estimates (2010-2019)

Dependent Variable	**ln Value added per worker**
ln (Value added per worker) $_{t-1}$	0.3478***
	(0.0141)
ln (Value added per worker) $_{t-2}$	0.0759***
	(0.0113)
ln (Value added per worker) $_{t-3}$	-0.0288*
	(0.0151)
FBU	-0.0471***
	(0.0136)
ln (Capital per worker)	0.0903***
	(0.0070)
ln (Employment)	0.1119***
	(0.0111)
Constant	4.4881***
	(0.3416)
Number of Observations	199,117
Number of firms	42,877
Arellano-Bond statistic (AR1) (p-value)	0
Arellano-Bond statistic (AR2) (p-value)	0.000231
Arellano-Bond statistic (AR3) (p-value)	2.92e-05
Hansen statistics (p-value)	0

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table B.4 Estimation Results for Nonlinear Relationship

Dependent Variable	ln Value added per worker
FBU	-0.2255***
	(0.0129)
FBU*FBU	0.0241***
	(0.0024)
ln (Capital per worker)	0.0642***
	(0.002)
ln (Employment)	-0.2901***
	(0.0043)
Constant	11.3695***
	(0.0304)
Number of Observations	414,240
R-squared	0.6804
Firm FE	YES
Sector*year FE	YES

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table B.5 Estimation Results for Technology Intensity

Dependent Variable	**ln Value added per worker**	
	(1)	(2)
ln (Value added per worker) $_{t-1}$	0.2562***	0.3132***
	(0.0374)	(0.0448)
ln (Value added per worker) $_{t-2}$	0.0889***	0.1348***
	(0.0323)	(0.0392)
ln (Value added per worker) t-3	0.0162	0.0699
	(0.0380)	(0.0458)
FBU	-0.6682	-0.2636
	(4.3478)	(0.1749)
Medium-High	1.4808	
	(11.6025)	
Medium-Low	-1.0423	
	(1.8865)	
Low	-1.0215	
	(2.6880)	
FBU*Medium-High	0.8944	
	(4.6135)	
FBU*Medium-Low	0.8055	
	(3.8661)	
FBU*Low	0.3576	
	(4.6470)	
ln (Capital per worker)	0.0486***	0.0563***
	(0.0137)	(0.0140)
ln (Employment)	0.0134	0.0004
	(0.0177)	(0.0185)
HT		-2.0300
		(1.7983)
FBU*HT		0.8933
		(0.7429)
Number of Observations	157,102	157,102
Number of firms	39,211	39,211
Arellano-Bond statistic (AR1) (p-value)	0	0
Arellano-Bond statistic (AR2) (p-value)	0.154	0.248
Arellano-Bond statistic (AR3) (p-value)	0.577	0.496
Hansen statistics (p-value)	0.338	0.107

Notes: Column (1) presents the estimation equation where technology intensity is classified into four dummy variables. The reference category, 'High-Technology,' is excluded to prevent the dummy variable trap. Column (2) refers to the case where the variable HT equals 1 if the firm's main activity is in high or medium-high technology sectors and 0 otherwise.

B.3. Adjusted Firm Based Upstreamness (adjusted FBU)

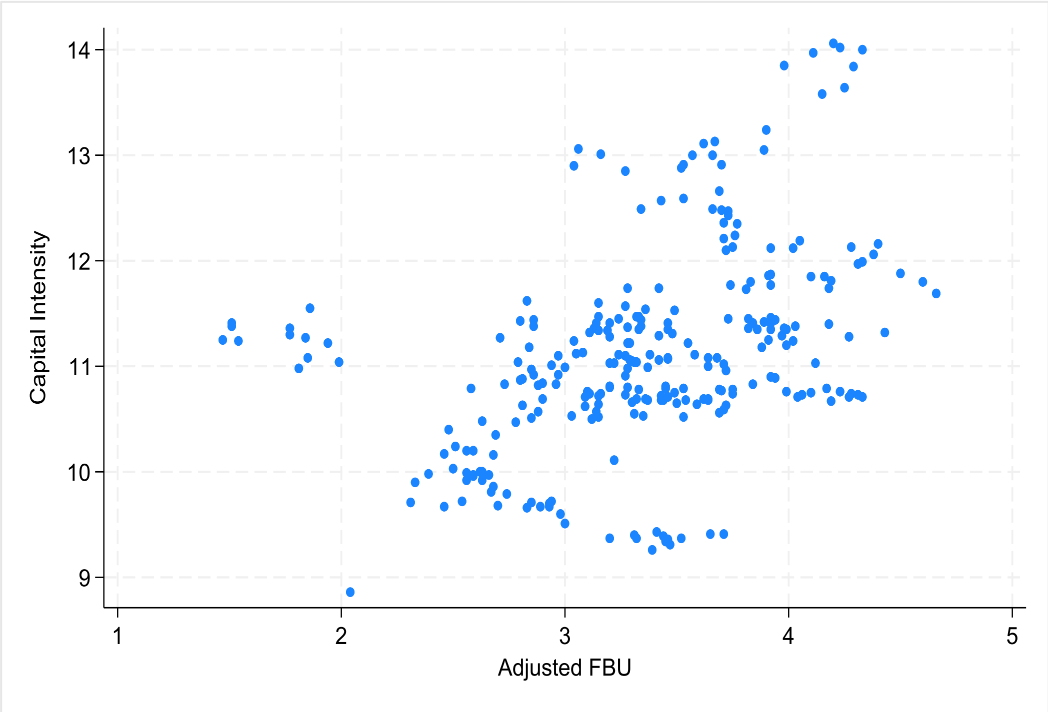
Table B.6 Adjusted Firm-Based Upstreamness (All Sectors)

Product Code-Definition (CPA, 2008)	**Upstreamness**
A01-Products of agriculture, hunting and related services	3.00
A02-Products of forestry, logging and related services	1.50
A03-Fish and other fishing products; aquaculture products; support services to fishing	3.59
B-Mining and quarrying	4.05
C10-C12-Food, beverages and tobacco products	3.32
C13-C15-Textiles, wearing apparel, leather and related products	3.93
C16-Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	3.38
C17-Paper and paper products	3.88
C18-Printing and recording services	3.00
C19-Coke and refined petroleum products	4.15
C20-Chemicals and chemical products	3.88
C21-Basic pharmaceutical products and pharmaceutical preparations	3.37
C22-Rubber and plastic products	3.53
C23-Other non-metallic mineral products	3.18
C24-Basic metals	4.38
C25-Fabricated metal products, except machinery and equipment	3.61
C26-Computer, electronic and optical products	3.72
C27-Electrical equipment	3.51
C28-Machinery and equipment n.e.c.	3.28
C29-Motor vehicles, trailers and semi-trailers	4.25
C30-Other transport equipment	1.95
C31-C32-Furniture and other manufactured goods	2.69
C33-Repair and installation services of machinery and equipment	2.63
D35-Electricity, gas, steam and air conditioning	3.27
E36-Natural water; water treatment and supply services	1.39
E37-E39-Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services and other wa...	3.76
F-Constructions and construction works	2.13
G45-Wholesale and retail trade and repair services of motor vehicles and motorcycles	2.83
G46-Wholesale trade services, except of motor vehicles and motorcycles	3.01
G47-Retail trade services, except of motor vehicles and motorcycles	1.90
H49-Land transport services and transport services via pipelines	3.38
H50-Water transport services	2.48
H51-Air transport services	1.20

Table B.6 (continued)

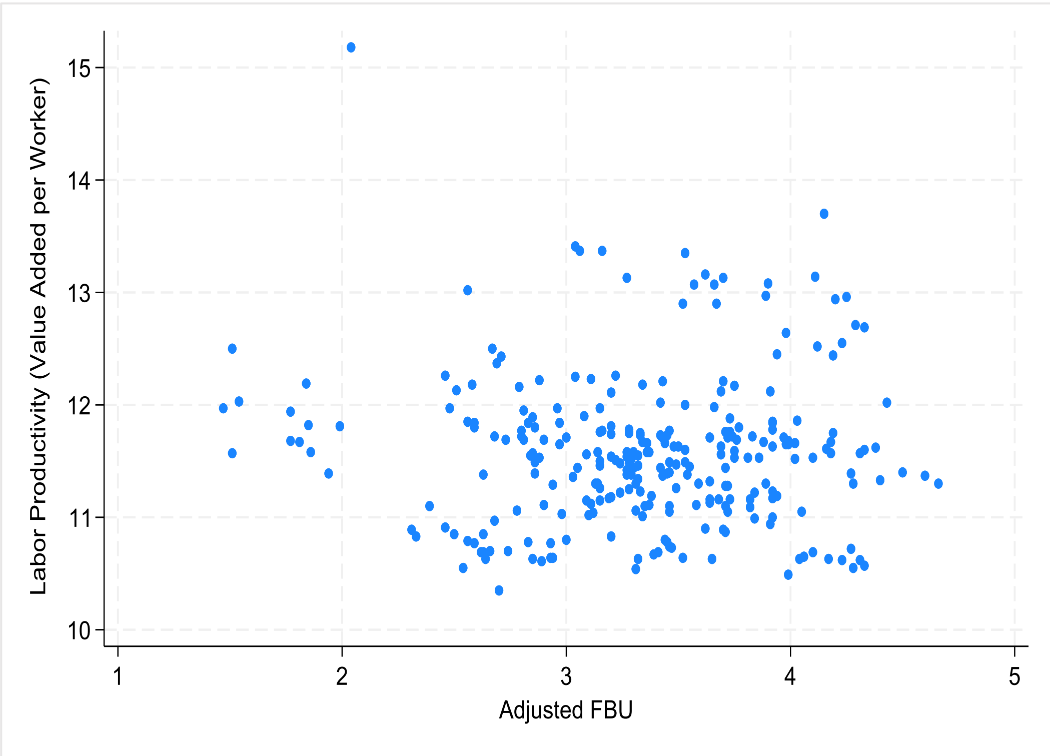
H52-Warehousing and support services for transportation	2.93
H53-Postal and courier services	2.09
I-Accommodation and food services	1.83
J58-Publishing services	3.61
J59-J60-Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services	4.16
J61-Telecommunications services	3.02
J62-J63-Computer programming, consultancy and related services; Information services	2.74
K64-Financial services, except insurance and pension funding	1.67
K65-Insurance, reinsurance and pension funding services, except compulsory social security	2.48
K66-Services auxiliary to financial services and insurance services	1.02
L68B-Real estate services excluding imputed rents	2.18
M69-M70-Legal and accounting services; Services of head offices; management consulting services	2.95
M71-Architectural and engineering services; technical testing and analysis services	2.35
M72-Scientific research and development services	2.95
M73-Advertising and market research services	3.82
M74-M75-Other professional, scientific and technical services and veterinary services	2.36
N77-Rental and leasing services	3.07
N78-Employment services	3.35
N79-Travel agency, tour operator and other reservation services and related services	1.70
N80-N82-Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	2.28
O84-Public administration and defence services; compulsory social security services	1.23
P85-Education services	1.24
Q86-Human health services	1.22
Q87-Q88-Residential care services; social work services	1.30
R90-R92-Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services	2.00
R93-Sporting services and amusement and recreation services	1.63
S94-Services furnished by membership organisations	2.25
S95-Repair services of computers and personal and household goods	2.59
S96-Other personal services	2.32
T-Services of households as employers; undifferentiated goods and services produced by households for own use	3.27

Source: EIS and authors' calculations.



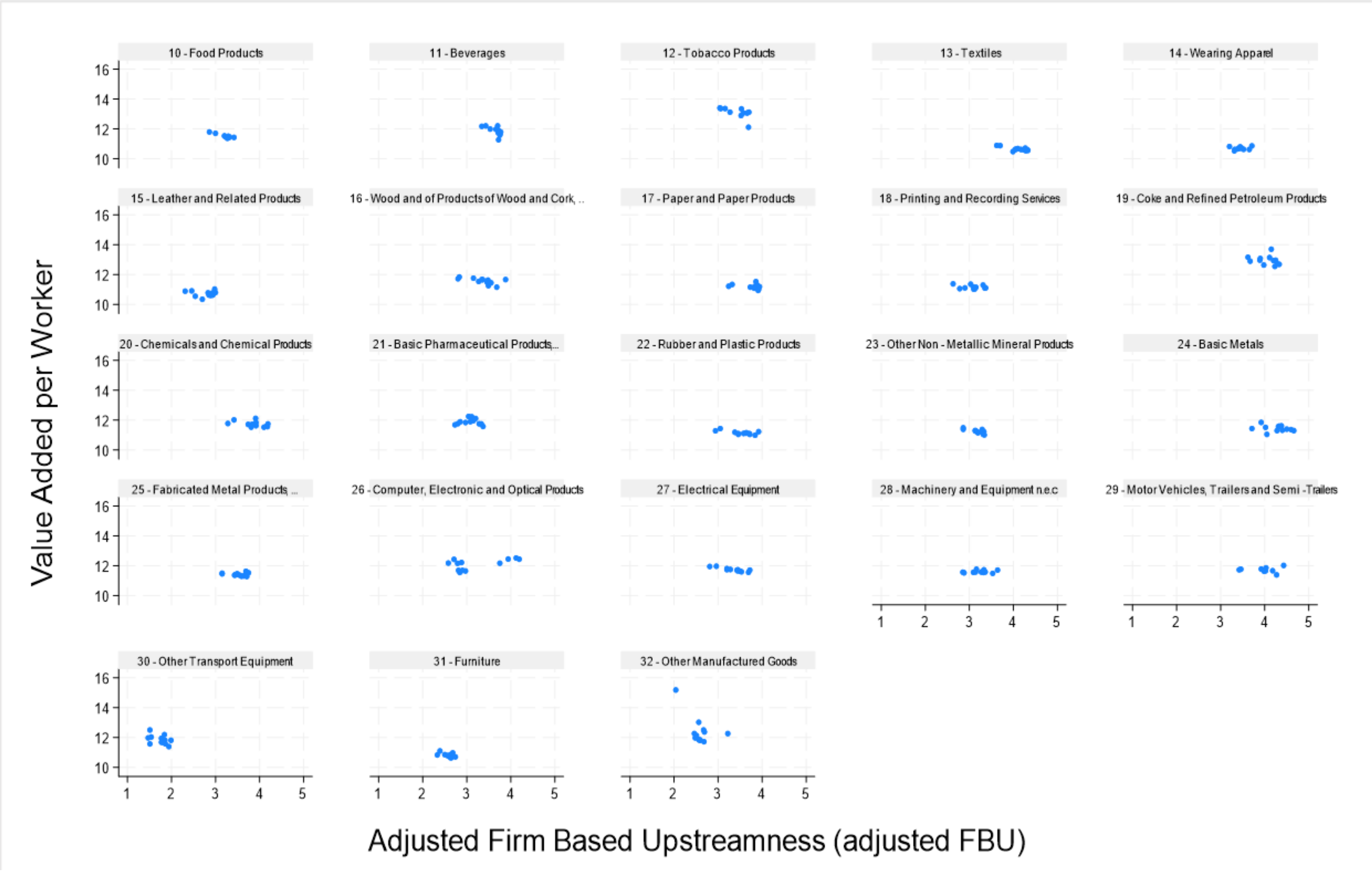
Source: EIS and authors' calculations.

Figure B.4 Capital Intensity and Adjusted FBU



Source: EIS and authors' calculations.

Figure B.5 Labor Productivity and Adjusted FBU



Source: EIS and authors' calculations.

Figure B.6 Labor Productivity and Adjusted FBU by Sector

C. CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Atıl, Aysun

EDUCATION

Master of Science in Economics, 2007
Bilkent University
Thesis Title: *Product Innovation in Durable Goods Monopoly with Partial Physical Obsolescence*
GPA: 3.47/4.00

Bachelor of Science in Economics, 2004
Bilkent University
GPA:3.85/4.00

High School, 2000
İzmir Science High School

WORK EXPERIENCE

Trade Expert, Ministry of Trade, 2008- Present

COMPUTER SKILLS

Stata, SAS.

LANGUAGE

Turkish (Native), English (Fluent).

D. TURKISH SUMMARY / TÜRKÇE ÖZET

Uluslararası ticaret, 1990'dan sonra küresel değer zincirlerinin (KDZ) yükselişiyle hızla genişlemiştir. Bu süreçte, KDZ'ye katılım, ekonomik büyümeye, ticaretin genişlemesine ve verimlilik artışlarına önemli ölçüde katkıda bulunmuştur. Günümüzde uluslararası ticaretin yaklaşık üçte ikisi ara malı ve hizmetlerden oluşmaktadır (Johnson ve Noguera, 2012). KDZ'ye katılım, makro düzeyde, ülkelerin yoksullukla mücadelesine yardımcı olmakta ve ekonomik büyümesini olumlu yönde etkilemektedir. Ortalama yüzde bir oranındaki KDZ'ye katılımdaki artışın, kişi başına düşen geliri standart ticarete kıyasla yüzde birin üzerinde artırdığı tahmin edilmektedir (Dünya Bankası, 2020). Ayrıca, 1990 ve 2017 yılları arasında düşük ve orta gelirli ülkelerin küresel ihracattaki payının % 16'dan % 30'a çıkması ve aşırı yoksulluk içinde yaşayan dünya nüfusunun oranının % 36'dan % 9'a düşmesi, KDZ'lerin büyümesiyle ilişkilendirilmektedir (Brenton vd., 2022).

Mikro düzeyde ise, KDZ'lere katılan firmalar, ticaret yapmayan firmalardan daha verimli ve sermaye yoğunluğu yüksek olma eğilimindedir. Gelişmekte olan ülkelerdeki firmalar, KDZ'lere katılarak daha düşük maliyetlerle dış pazarlara erişim sağlayabilmekte, niş görevlerde uzmanlaşabilmekte ve üretimlerini daha büyük pazarlara açabilmektedirler. Firmalar ayrıca daha uygun fiyatlardan ve daha çeşitli girdileri tedarik ederek, verimliliği artırıcı teknolojilere ve dünyanın diğer yerlerindeki iyi uygulama örneklerine erişerek daha hızlı büyüme imkanına sahip olmaktadırlar (Dünya Bankası, 2020).

Tüm avantajlarına rağmen, KDZ'lere katılımın faydaları üretim aşamalarının farklı yerlerinde konumlanmış ülkeler ve firmalar için eşit dağılmamaktadır. Ülkeler ve firmalar, değer zincirinin farklı aşamalarında uzmanlaşarak farklı ekonomik sonuçlar deneyimleyebilirler. Buna ilişkin olarak, 90'lı yıllarda Acer'ın kurucusu Stan Shih, değer zincirinin ortasında yer alan montaj operasyonlarının, fabrikasyon faaliyetlerinin düşük katma değere sahip olduğunu açıklamak suretiyle bilgisayar endüstrisi için katma değerin üretim aşamalarına göre bir U eğrisi izlediğini öne sürmüştür (Shih, 1996). Buna göre, değer zincirinin iki ucunda yer alan üretim öncesi hizmetler, ürün tasarımı ve Ar-Ge gibi faaliyetler ile üretim sonrası hizmetler, pazarlama, lojistik ve satış sonrası hizmetler gibi faaliyetler en fazla katma değerin yaratıldığı aşamalardır. Farklı endüstriler için U eğrisi katma değer üretimini destekleyen birçok firma düzeyinde çalışma bulunmaktadır (Mudambi, 2008; Shin vd., 2012).

Bu çerçevede, değer zincirindeki konumlarına ilişkin olarak, firmalar, karlılığı artırmak için hangi aşamalarda uzmanlaşacaklarına ve belirli üretim aşamalarını entegre edip etmeyeceklerine ilişkin stratejik kararlar almaktadırlar. Bu kararları etkileyen birçok etmen vardır; piyasaya giriş engelleri, yatırım gereksinimleri ve piyasa koşulları bunların arasında sayılabilir. Ancak mikro düzeydeki temel soru, değer zincirindeki konumlara ilişkin alınan kararların firmayı olumlu etkileyip etkilemediği sorusudur.

Bu bağlamda, bu çalışma Türk imalat firmalarının değer zincirindeki konumunu ortaya koymayı ve bu konumun firmanın işgücü verimliliği üzerindeki etkisini incelemeyi amaçlamaktadır. Çalışmada, KDZ literatüründe kullanılan konum endekslerinden biri olan "Nihai Talebe Uzaklık" endeksi[25] (upstreamness index) Türkiye'deki detaylı firma düzeyindeki verilere uygulanmış, söz konusu endeks sonuçlarının emek verimliliği ile ilişkisi incelenmiştir. Bildiğimiz kadarıyla, bu çalışma firma düzeyinde veri kullanılarak Türk imalat firmalarının değer zincirindeki konumunu nihai talebe uzaklık (NTU) endeksi bağlamında inceleyen ilk çalışmadır. Çalışmanın diğer bir ayırt edici özelliği ise, firma düzeyindeki NTU endeks değerinin, literatürdeki yaygın uygulamanın aksine girdi-çıktı tablolarında yer alan endüstri düzeyindeki bağlantılar yerine firma-firma arasındaki işlem verilerine dayanılarak hesaplanmış olmasıdır.

Çalışmamızda öncelikle analizde kullanılan veri setlerine ilişkin bilgi verilmiş olup, izleyen bölümde Fally (2011) ve Antràs vd., (2012) tarafından geliştirilen endüstri tabanlı nihai talebe uzaklık (ENTU) endeksi detaylı olarak açıklanmıştır. Firma

[25] "Yukarı yönlülük" olarak da tanımlanabilmektedir.

düzeyinde nihai talebe uzaklığın hesaplanması nispeten yeni bir olgu olup bu konudaki çalışmalar temelde ENTU endeksine dayanmaktadır. Bu çalışmada geliştirmiş olduğumuz firma tabanlı nihai talebe uzaklık (FNTU) endeksi ise yaygın kullanımın aksine girdi-çıktı tablolarından ziyade firma-firma düzeyindeki işlem verilerine dayanmaktadır. Çalışmamızda, her iki endeks Türk imalat firmalarına ilişkin verilere uygulanmış, iki yaklaşımın sonuçları özetlenmiş ve sonuçlardaki farklılıklara neden olan endeks özellikleri tartışılmıştır. Sonrasında, Türkiye'de 2008-2019 yılları arasındaki FNTU endeks değerinde gözlemlenen değişimler ile bu değişimlerdeki temel etkenlere yer verilmiştir.

Çalışmanın ilerleyen bölümünde ise, firmaların küresel değer zincirindeki konumu ile firmanın verimliliği arasındaki ilişki araştırılmış, veri setindeki firmaların FTNU endeks değerleri ile firma özellikleri arasında gözlemlenen bazı temel bulgular özetlenmiştir. Ardından, yıl ve sektör kuklaları kontrol edilerek tahmin modeli oluşturularak Arellano ve Bover/Bundell ve Bond Sistem Genelleştirilmiş Momentler Tahmincisi (Sistem-GMM) kullanılmış, tahmin sonuçları üzerinden bulgular tartışılmıştır.

Veri Seti

Bu çalışmada yer alan analiz, Sanayi ve Teknoloji Bakanlığı tarafından yönetilen Girişimci Bilgi Sistemi (GBS) veri tabanına dayanmaktadır. Bu veri tabanı, 2006-2021 yıllarını kapsayan, farklı kurum ve kuruluşların idari kayıtlarında bulunan işletmelere ait verileri içermektedir.

Çalışmada, GBS'de yer alan çeşitli veri setlerinden yararlanılmıştır: Bunlardan ilki, Ticaret Bakanlığı tarafından sağlanan Türk firmalarına ait dış ticaret verileridir. Bu veri seti, firmaların Armonize Sistem (HS) 12 haneli ürün kodu düzeyinde ihracat ve ithalat değerlerini ABD doları cinsinden sunmaktadır. Dış ticaret verileri, firmaların konumunu ENTU'ya dayalı belirlerken, ENTU değerleri bilinen endüstrilerin dış ticaretteki ağırlıklarını hesaplamak amacıyla kullanılmıştır. Bunun için her firmanın ihracat ve ithalat verisi sektör grupları itibariyle toplulaştırılmıştır.

İkinci veri seti, Gelir İdaresi Başkanlığı tarafından sağlanan Türk firmalarının bilanço ve gelir tablolarını içeren finansal tablolardır. Bu veri seti, her firma ve yıl için maddi varlıklar, maddi olmayan varlıklar, mamul ve yarı mamul stokları gibi tüm bilanço kalemleri ile toplam kar, brüt satışlar, net satışlar gibi gelir tablosu kalemlerini içermektedir. Üçüncü veri seti, yine Gelir İdaresi Başkanlığı'ndan temin edilen aylık firma-firma işlem verileridir. 213 sayılı Vergi Usul Kanunu'na göre, bilanço esasına göre defter tutan kişiler veya kurumlar, 5.000 TL veya daha fazla, KDV hariç, mal ve hizmet alımlarını Beyan Alış (BA), Beyan Satış (BS) formları ile bildirmek zorundadırlar. Bu formlar, firma-firma işlem veri setinin dayanağını oluşturmaktadır.

Dördüncü veri seti ise Sosyal Güvenlik Kurumu'ndan sağlanan ve her firmanın çeyreklik dönemler itibariyle çalışan sayısı ve ödenen ücret verilerini içermektedir. GBS ayrıca TÜİK, Gelir İdaresi Bakanlığı ve Sosyal Güvenlik Kurumu'ndan elde edilen bilgilere dayanarak, her firmanın "Avrupa Topluluğunda Ekonomik Faaliyetlerin İstatistiki Sınıflaması", NACE Rev.2'ye göre sınıflandırılmış ana faaliyet bilgisini sunmaktadır.

Analizimiz için 2008-2019 yılları arasındaki Türk imalat firmalarına ilişkin veri seti, yukarıda bahsedilen veri setlerinin firma-yıl düzeyinde birleştirilmesiyle oluşturulmuştur. İmalat sektöründe faaliyet gösteren firmalar için ana faaliyetleri 10-32 arasında yer alan 2 haneli NACE Rev.2 sektörlerinde sınıflandırılmış firmalar ele alınmıştır (33- makine ve ekipmanların onarımı ve montajı hariç).

İdari veri setlerinin yanı sıra, ENTU endeks değerini hesaplamak için TÜİK tarafından yayımlanmış olan 2012 yılına ait girdi-çıktı tablosu kullanılmıştır.

GBS'de yer alan veri setleri farklı sınıflandırma sistemleriyle sunulmaktadır. TUİK 2012 girdi-çıktı tablosu, ürünler için Avrupa Ekonomik Topluluğunda Faaliyete Göre Ürünlerin İstatistiki Sınıflaması, CPA 2008 kullanılarak yayınlanırken, dış ticaret verileri Uyumlaştırılmış Mal Tanım ve Kod Sistemi (Harmonized System- HS) ile sınıflandırılmıştır. Armonize Sistem her beş yılda bir güncellendiğinden analiz dönemindeki sınıflama güncellemeleri 2007, 2012 ve 2017 yıllarını içermektedir. Bu nedenle, ticaret verilerini standart hale getirmek için HS 2017 ile HS 2007 ve HS 2012 ile HS 2007 arasındaki korelasyon tabloları kullanılmıştır. Çalışmada yer alan sektör gruplaması, iki haneli CPA 2008 ile bire bir eşleşen NACE Rev.2'ye dayanmaktadır. Bu nedenle, ENTU hesabında kullanılan sektörlerin ihracat ve ithalat ağırlıklarını hesaplamak için HS 2007 ve NACE Rev.2 arasında korelasyon tabloları kullanılmıştır.

Firma düzeyinde NTU endeks değeri iki yöntemle hesaplanmıştır: ENTU ve FNTU. İlk yöntemde, ilgili literatüre benzer şekilde, girdi-çıktı tablosu kullanılarak her sektör için ENTU endeks değeri hesaplanmış ve bu endeks, firmanın ilgili sektördeki ithalat ve ihracat paylarıyla ağırlıklandırılarak firmaya ait nihai talebe uzaklık değeri hesaplanmıştır.

İkinci yöntemde ise, firmaya ait nihai talebe uzaklık değeri, firma-firma işlem verilerine dayanılarak hesaplanmıştır. Firma-firma işlem verilerindeki her bir gözlem, satıcı firma, alıcı firma, işlem değeri, işlem yılı ve işlemin gerçekleştiği ay hakkında bilgi içermektedir. Firma üretim çıktısı için bilanço verilerindeki "net satışlar" kullanılmış olup, firma-firma işlem verilerinden ise bir firmanın satıcı olarak gerçekleştirdiği işlemler toplanmak suretiyle diğer firmalara gerçekleştirdiği ara satışlar elde edilmiş, bu şekilde nihai talebin firmaların satışları içindeki payı iterasyon yoluyla hesaplanarak FNTU ölçülmüştür.

Analizin ikinci kısmında, FNTU ile firma performansı arasındaki ilişki incelenirken, firma çalışan sayısı olarak çeyreklik dönemlerin basit ortalaması alınmıştır. Diğer taraftan, firmanın bilanço ve gelir tabloları kullanılarak çeşitli değişkenler oluşturulmuştur: Firmanın sermaye stoğu olarak tanımlanan maddi ve maddi olmayan varlıkların toplamı, firmanın çıktısı olarak tanımlanan net satışlar, vb. Sermaye stoğu, sermaye malları için Üretici Fiyat Endeksi (ÜFE) ile üretim çıktısı ise imalat sektörü için iki haneli ÜFE ile reel değerlere dönüştürülmüştür. Firmanın emek verimliliği, çalışan başına katma değer olarak tanımlanmıştır. Firmanın "katma değeri" hesaplanırken yine firma-firma işlem veri setinden yararlanılmıştır. Literatürde, bir firmanın katma değeri, firmanın üretim değerinden firmanın kullandığı malzeme girdilerinin değerinin çıkarılması olarak tanımlanmaktadır. Ancak, firmaların finansal tablolarında "malzeme girdileri" gibi ayrı bir bilanço kalemi bulunmamaktadır. Bu nedenle, malzeme girdi değerinin bir göstergesi olarak, firma-firma işlem veri setinde beyan edilen diğer firmalardan yapılan alımlarının ve firmanın ithalatının (sermaye malları hariç tutularak) toplamından elde edilen değer kullanılmıştır. Böylece, tahmin edilen malzeme girdileri net satışlardan çıkartılarak bir firmanın katma değeri hesaplanmıştır.

Endüstri ve Firma Tabanlı Nihai Talebe Uzaklık Endeksleri (ENTU ve FNTU)

Çalışmamızda, Fally (2011) ve Antràs vd. (2012) tarafından önerilen küresel değer zincirindeki konum endeksini temel alan, firma-firma işlem verilerine dayalı yeni bir endeks oluşturularak Türkiye'deki firmaların konumu incelenmiştir. Nihai talebe uzaklık endeksi olarak bilinen konum endeksi (ENTU), bir endüstrinin nihai tüketiciye olan mesafesini göreceli olarak hesaplayarak değer zincirindeki konumunu belirlemektedir. Örneğin, çelik veya petrol gibi ham madde endüstrilerinin, diğer malların üretimi için girdiler sunmaları gerekçeleriyle ENTU değerleri yüksek kabul edilir. Buna karşılık, otomobil ve ayakkabı gibi son tüketiciler için üretilmiş ürünleri içeren endüstrilerin ENTU endeks değerleri düşüktür.

Bu endekse ilişkin olarak, Fally (2011), ABD ekonomisinin 1947'den 2002'ye kadar üretim zincirinin ortalama uzunluğunu ve üretimdeki parçalanmanın gelişimini incelemiştir. Bu doğrultuda, iki gösterge öne sürmüştür. Bunlardan ilki, bir malın üretiminde yer alan ortalama aşama sayısını temsil ederken, ikincisi, nihai talebe ulaşmadan önce geçilmesi gereken ortalama aşama sayısını temsil etmektedir. İkinci değişken ENTU endeksinin temelini oluşturmaktadır. Bu gösterge, nihai talebe uzak olan endüstrilerden çok fazla girdi satın alan endüstrilerin kendilerinin de nihai talebe uzak olması gerektiği varsayımına dayanmaktadır. Çalışmasının en önemli bulgusu, ABD ekonomisinde üretim aşama sayısının ortalama olarak 2'den az olduğu ve son 50 yılda bu değerin % 10'dan daha fazla azaldığı yönündedir.

Fally'nin çalışmasının yanı sıra, Antràs vd. (2012), göreceli bir üretim hattı pozisyon ölçüsü olan "endüstri tabanlı nihai talebe uzaklık (ENTU)" endeksini geliştirmişlerdir.

Endeksin değeri, minimum 1 değerini almaktadır. En düşük değer olan 1, sektör çıktısının tamamen ve doğrudan nihai tüketici tarafından tüketildiği durumda elde edilmektedir. Bunun yerine, üretim çıktısının bir kısmı değer zincirinde ara girdi olarak kullanılıyorsa, daha yüksek endeks değerlerine ulaşılmaktadır. Daha büyük değerler, sektörün daha yüksek ENTU değerine sahip olduğunu gösterir. Bu şekilde, nihai tüketicilere büyük miktarda ürün satan endüstrilerin son tüketiciye daha yakın konumda olduğu, diğerlerinin ise çıktılarını ara girdi olarak diğer endüstriler aracılığıyla yoğun şekilde kullandırdıkları için son tüketiciye daha uzak konumda bulunduğu bir endeks elde edilmiş olur. Bu endeks, aynı zamanda “nihai talebe olan ortalama mesafe” olarak da adlandırılmakta olup, endüstrinin nihai çıktısının üretim zincirindeki farklı pozisyonlarda nihai talebe göre nasıl kullanıldığını gösteren bir hesaplamadır.

Antràs vd. (2012), ABD’deki 426 endüstri için 2002 yılı girdi-çıktı tablolarını kullanarak ENTU endeks değerlerini hesaplamışlardır. Bulgularına göre, ENTU endeks değerleri 1 ile 4,65 arasında değişmekte olup, ortalama değer 2,09’dur; bu da bir endüstrinin çıktısının nihai talebe ulaşmadan önce ortalama olarak en az bir üretim aşamasına girdiğini göstermektedir. “Otomobiller,” “mobilya” ve “ayakkabı” ENTU endeks değeri düşük olan endüstriler arasında yer almakta olup bu endüstriler üretim çıktılarının çoğunu doğrudan nihai tüketiciye satmaktadır. Buna karşılık, ENTU endeks değeri en yüksek olan endüstriler “petrokimyasallar” ve “alüminyum eritme” dir. Çalışmalarında ayrıca farklı ülkeler için girdi-çıktı tabloları kullanarak ENTU endeks değerlerini hesaplamış ve bu endeksin ülkeler arasında ne kadar tutarlı olduğunu kontrol etmişlerdir. Ülkeler arası Spearman sıralama korelasyonları, ENTU endeksinin istikrarlı olduğunu göstermiştir. Ayrıca, söz konusu endeks ile ülkelerin 1996-2005 arasındaki ihracat verilerini birleştirerek, ülkelerin ihracat ürünlerinin ENTU endeks değerlerini hesaplamışlar, ülkeye özgü çeşitli faktörlerin bu değeri nasıl etkilediğini tahmin etmeye çalışmışlardır. Bu faktörler arasında kişi başına Gayri Safi Yurt İçi Hasıla (GSYİH), hukukun üstünlüğü, finansal piyasaların gücü, sermaye yoğunluğu ve beşeri sermaye yer almakta olup kurumların yeterliliği ve hukukun üstünlüğünün ENTU endeks değerinin düşük olduğu ihracat kompozisyonu ile ilişkili olduğu sonucuna varmışlardır.

Literatürde ENTU kullanılarak, ülkelerin değer zincirindeki konumu birçok çalışmada araştırılmıştır (Antràs vd., 2012; Dhyne vd., (2015); Miller ve Temurshoev, 2017). Son zamanlarda, firma düzeyindeki verilerin erişilebilir olması ile ENTU endeksi, firmaların değer zincirindeki konumunu ölçmek için de kullanılmaktadır (Ju ve Yu, 2015; Chor vd., 2021). Firma düzeyindeki çalışmalarda yaygın olan yaklaşım, endüstriler arasındaki bağlantıları ortaya koyan girdi-çıktı tablolarından elde edilen ENTU endeksi ile firmaların ihracatlarındaki ve ithalatlarındaki endüstri paylarının ağırlıklandırılarak, firmaların değer zincirindeki konumunun belirlenmesidir. Bu bağlamda, çalışmamız, endeksin mantığını endüstri yerine firma olarak temel alması, söz konusu yaklaşımı firma-firma işlem verilerine uygulayarak firma tabanlı nihai talebe uzaklık (FNTU) endeksi olarak adlandırdığımız yeni bir yaklaşım geliştirmesi bakımından özgündür. Bildiğimiz kadarıyla, firmaya ait nihai talebe uzaklık değerinin hesabında firma-firma işlem verilerini kullanan yalnızca birkaç çalışma bulunmaktadır (Dhyne ve Duprez, 2015; Mahy vd., 2021).

Çalışmamızda geliştirdiğimiz FNTU endeksi, bir firmanın ürettiği malların nihai talebe ulaşmadan önce geçirdiği ortalama aşama sayısını göstermektedir. Bu endeks, ENTU endeksine benzer bir ifadedir, iki endeks arasındaki temel fark ekonomik birim olarak endüstri yerine firmanın kullanılmasıdır. Çalışmada, FNTU endeksini hesaplamak için firma-firma işlem verilerinden elde edilen bilgileri döngüsel olarak kullanıldığımız yinelemeli bir hesaplama gerçekleştirilmiştir. İlk olarak, firma-firma işlem verilerinden firmanın satıcı olarak yaptığı tüm işlemler toplanarak firmanın diğer firmalara olan satışları elde edilmiş, ardından, firmanın bilançosunda yer alan net satış değerinden firmanın diğer firmalara olan satışları çıkartılarak firmanın nihai tüketiciye ulaştırdığı değer ve bu değerin net satışlara oranı hesaplanarak firmaya ait birinci yinelemedeki nihai talep oranı bulunmuştur. Bu oran, nihai talebe olan ortalama uzaklığı hesaplarken doğrudan satışları gösteren FNTU endeksi hesabındaki ilk bileşendir. FNTU endeksi hesabındaki diğer bileşenler, üretim zincirine girdikleri aşamalara bağlı olarak nihai talebe göre diğer firmalar aracılığıyla gerçekleştirilen dolaylı satışları göstermektedir. İlk yinelemede bulunan oranlar firma-firma işlem verileriyle birleştirilerek firmanın ikinci yinelemedeki nihai talebe ilişkin satış oranı yeniden hesaplanmıştır. Bu süreç, firmalarının % 99'undan fazlasının nihai talep oranlarının neredeyse 1’e ulaştığı 15 yineleme boyunca devam ettirilmiştir. Firmanın nihai talep oranları arasındaki her yinelemedeki artış, bu aşamada nihai talebe diğer firmalar aracılığıyla giden çıktı payını göstermektedir. Böylece, her yinelemedeki firmanın nihai talep oranları arasındaki farkların alınması ve bulundukları aşama ile ağırlıklandırılması suretiyle nihai olarak FNTU endeksi ölçülmüştür. FNTU endeksi, firma düzeyinde bir girdi-çıktı tablosu olarak değerlendirilebilir, böylece üretim zincirinin aşamalarının daha ayrıntılı irdelenmesine imkân sağlanmıştır.

Firma düzeyinde ENTU ile FNTU endekslerinin karşılaştırılmasında iki özellik ön plana çıkmaktadır. İlk olarak, firmaya ait NTU hesabında firma-firma işlem verilerinin kullanılmasının avantajı, bu ölçütün yıllık olarak oluşturulabilmesidir. Buna karşılık, birçok ülkede ENTU’nun temelini oluşturan girdi-çıktı tabloları, ülkelerin istatistik birimleri tarafından periyodik olarak yayınlanmaktadır. Bu durumda, belirli bir zaman diliminde endüstriler arasındaki girdi-çıktı bağlantıları açısından sabit bir ilişki olduğu varsayılmaktadır. Bu çerçevede, FNTU’nun, endüstriler arasındaki dinamiklerde gerçekleşen değişiklikleri yansıtma olasılığı daha yüksektir.

Diğer taraftan, girdi-çıktı tablolarında sağlanan bilgi kapsamı ve ürün/endüstri sınıflandırma düzeyi de değişkenlik göstermektedir. ABD'de, Kuzey Amerika Endüstri Sınıflandırma Sistemi (NAICS) altında sınıflandırılmış 402 endüstrinin girdi-çıktı tabloları bulunmaktadır. Dünya Girdi-Çıktı Veritabanı'ndaki (WIOD) girdi-çıktı tabloları ise Uluslararası Standart Endüstri Sınıflandırmasına (ISIC, Rev. 4) göre sınıflandırılmış 56 sektörü içerir. Türkiye’de ise en güncel girdi-çıktı tablosu 2012 yılında yayınlanmış olup 63 endüstriyi kapsamaktadır.

FNTU endeksi kullanmanın bir diğer avantajı ise, verilerin toplulaştırılması ve uyumlaştırılması ile ilgili sorunları içermemesidir. ENTU hesabında, ihracat yapılan ve Armonize Sistem ile beyan edilen ürünler ile faaliyet sınıflandırması arasında bir korelasyon tablosu kullanılmaktadır. Bu ise daha ayrıntılı ticaret kodları altında yer alan ürünlerin daha dar faaliyet kodu kategorileri altında toplanmasına neden olmaktadır. Bu nedenle, ihracat bileşimindeki çeşitlilik tam olarak yansıtılmayabilmektedir. Örneğin, “840751- Motorlar; 87 inci bölümdeki araçların itiş gücü için kullanılan, silindir hacmi 50 cc'yi geçmeyen pistonlu motorlar" ve "8703- Motorlu taşıtlar ve diğer motorlu taşıtlar; esas olarak insan taşımak için tasarlanmış (87.02 pozisyonundakiler hariç), istasyon vagonları ve yarış arabaları dahil" altındaki altı haneli tüm kodlar, ENTU değeri 1.591 olan "C29- Motorlu taşıtlar, römorklar ve yarı römorklar" faaliyet kategorisine dahil edilmektedir. Oysa ilk ürünün ikincisine göre daha yüksek bir NTU değerine sahip olması beklenmektedir. Firmaya ait ENTU hesaplanırken, bu ürünlerin farklı NTU değerine sahip olması göz ardı edilir. Öte yandan FNTU hesabında, bu ürünler farklı şekilde ele alınacaktır; ilk ürünün ara girdi, ikinci ürünün ise nihai ürünün bir parçası olarak değerlendirilmesi mümkün olabilecektir.

Bu çerçevede, Türkiye'deki tüm firmalar esas alınarak ENTU ve FNTU endeks değerleri 2008-2019 yılları için ölçülmüştür. İki endeksin değerleri sektörler bazında kıyaslandığında, FNTU endeks değerlerinin ENTU endeksi temel alınarak hesaplanan muadillerinden önemli ölçüde daha yüksek olduğu bulunmuştur. 63 endüstriden 48'inde, FNTU değerleri ENTU değerlerinden daha yüksektir. Türkiye'nin ana ihracat ürünlerinden olan "C29- Motorlu taşıtlar, römorklar ve yarı römorklar" ve "C10-C12- Gıda, içecek ve tütün ürünleri" sektörlerinin, iki endeks arasında en yüksek fark gözlemlenen sektörler arasında yer alması dikkat çekicidir. "C29- Motorlu taşıtlar, römorklar ve yarı römorklar" sektöründe FTNU ve ETNU değerleri sırasıyla 2,73 ve 1,59 iken, "C10-C12- Gıda, içecek ve tütün ürünleri" sektöründe ise 2,95 ve 1,48 olarak bulunmuştur.

Ayrıca, FNTU endeks hesabında motorlar ile motorlu araç üretimi ile ilgili faaliyetlerin ayrıştırılabildiği de gözlenmiştir. İki ürünün ilgili FNTU endeks değerleri sırasıyla 2,55 ve 2,08'dir. Bu durum, ENTU hesabında arka planda yer alan toplulaştırmanın endüstrilerin değer zincirindeki gerçek konumunu yansıtmadığını ve firma düzeyinde verilerle elde edilen bilgilerin, değer zincirindeki konumu daha gerçekçi bir şekilde gösterdiğine ilişkin güçlü bir kanıttır.

Çalışmamızda FNTU endeks değerinin nicel özelliklerinin yanı sıra, Türkiye'deki 2008 ile 2019 arasındaki gelişimi de incelenmiştir. Söz konusu dönemde, endeks değerinde 2012 yılına kadar sürekli bir artış, ardından 2013'te önemli bir düşüş ve 2019'da keskin bir düşüş yaşanana kadar istikrarlı bir seyir izlediği bulunmuştur. Zirve değeri 2012 yılında gözlemlenmiştir. Bu endeks değerindeki genel değişim iki boyutta araştırılmıştır: yoğunluk marjı, devam eden firmalarla ilişkili değişimi yansıtırken, yaygınlık marjı o yıl imalat sanayine giriş yapan ve çıkan firmalarla ilişkili değişimi yansıtmaktadır. Analizimiz, yoğunluk marjının katkısının yaygınlık marjından daha yüksek olduğunu ortaya koymaktadır; bu, çoğu alt sektör için geçerli bulunmuştur. Dolayısıyla, 2008-2019 yılları arasında Türk imalat sanayi firmalarının değer zincirinde konumlarına ilişkin NTU değerinin yükseldiği sonucuna ulaşılmıştır.

FNTU ve Firma İşgücü Verimliliği

Çalışmanın bu bölümünde, firmanın FNTU değeri ile işgücü verimliliği arasındaki ilişki incelenmiştir. Ülkeler ve sektörler için ENTU endeks değerini kullanarak yapılan birçok çalışma bulunmasına rağmen, firmaların KDZ'deki pozisyonunu ve bunun firmanın performansını, örneğin kârlılığını ve verimliliğini nasıl etkilediğini araştıran sınırlı sayıda çalışma mevcuttur. Bu nedenle, ENTU ve FNTU ile firmanın verimliliği arasındaki etkileşim literatürde net bir şekilde belirtilmemiştir. Ancak, FNTU değeri ile firmanın verimliliği arasındaki etkileşimin olası nedenlerine, Mahy vd. (2022) çalışmasında yer verilmiştir.

Mahy vd. (2022), FNTU değeri ile firmaların verimliliği arasındaki etkileşimin nedenlerini ikiye ayırmaktadır: pozitif ve negatif etkileyen hususlar. Pozitif etkileyen kanallar arasında FTNU değeri yüksek olan firmaların ihracatçı konumlarından elde ettikleri avantajlar, daha üretken partnerlerle olan etkileşimler, firmaların katma değer yaratan FTNU değeri düşük faaliyetleri kontrol etme yeteneği ve daha yüksek FTNU değerine sahip firmaların daha büyük Ar-GE ve sermaye yoğunluğuna sahip olması sayılmaktadır. Negatif etkileyen kanallar ise, daha çok firmaların değer zinciri üzerinde kontrol eksikliği ile ilişkilendirilmektedir.

Bu çerçevede, firmalar, tedarikçi firmaları satın alarak, tedarikçi firmalarıyla birleşerek ya da girdileri kendi bünyelerinde üretmek için tesisler kurarak tedarik zincirindeki kontrolünü genişletmek suretiyle değer zincirinde nihai talepten daha uzak bir konumda yer alabilir ve FNTU değerlerini artırabilirler. Mevcut faaliyetlerine FNTU değeri yüksek faaliyetleri ekleyerek, firmalar, tedarikçi kâr marjlarından kaçınarak maliyetleri azaltma avantajına sahip olabilirler. Ayrıca, girdilerin üretim ihtiyaçlarına daha iyi uyum sağlayacak şekilde özelleştirilmesi ve firma içindeki üretim aşamaları arasında teknoloji transferlerinin kolaylaşması gibi unsurların da etkisiyle firma verimliliğini artırabilir.

Günümüzde firmaların değer zincirinde farklı aşamaları entegre etmelerine yönelik örnekler oldukça fazladır. Apple'ın 2019 yılında Intel'in akıllı telefon modem üretiminin çoğunluğunu satın alması somut bir örnek olarak gösterilebilir. Yarı iletken üretimi üzerindeki kontrolünü artıran Apple, iPhone, iPad ve Mac'ler için kendi çiplerini üretme kabiliyetini geliştirmiştir. Benzer şekilde, Starbucks 2013 yılında Kosta Rika'da bir kahve çiftliği satın alarak, kahve çiftçilerinin karşılaştığı zorlukları daha iyi anlamak ve en iyi uygulamalar ve çözümler belirlemek için burayı bir inovasyon merkezi haline getirmiştir. 2021'de Türkiye'de büyük bir gıda firması olan Ülker Bisküvi, çikolata hamuru, un ve fındık gibi önemli girdilerin tedarikçisi olan Önem Gıda'yı satın alarak üretim süreçlerini daha verimli hale getirmiştir. Türkiye'nin önde gelen cam üreticilerinden Şişecam A.Ş., cam üretiminde kritik bir girdi olan soda külü üretimi için ABD'de bir tesis kurmuştur. Bu örnekler, küresel değer zincirlerinin parçalı üretimi kolaylaştırmasına rağmen, firmaların belirli üretim süreçlerini yeniden entegre etmek istedikleri fırsatların hâlâ mevcut olduğunu göstermektedir.

Entegrasyonun avantajları arasında, girdi zinciri üzerindeki kontrolün üretim aşamalarında daha iyi bir koordinasyon sağlayarak teslimat sürelerini azaltması ve daha istikrarlı bir süreç yönetimine sebep olması sayılabilir. Bu durum, işletmenin genel verimliliğini olumlu yönde etkileyebilir. Ancak, daha büyük bir üretim ölçeğini yürütmekten kaynaklanan verimsizliklerin ortaya çıkma riski de bulunmaktadır. İlave faaliyetlerin eklenmesi, uzmanlık ve yeni yetkinliklerin geliştirilmesini gerektirebilir; bu konulardaki yetersizlikler ise dış tedarikçilerle rekabet gücünü zorlayabilir. Ayrıca, üretimdeki ilave faaliyetleri üstlenmenin yatırım maliyetleri oldukça yüksek olabilir ve bu durumda beklenen getirinin, maliyetleri karşılamama ihtimali söz konusu olabilir.

Ampirik çalışmalar, nihai talebe uzaklık endeksi ile firma özellikleri arasındaki ilişkinin pozitif yönde olduğunu öne sürmektedir. Chor vd. (2021), Çinli firmaların ihracat/ithalat ürünlerinin ENTU değerlerinin firma performansları ile birlikte nasıl geliştiğini incelemişlerdir. Bulgularına göre, firmalar daha verimli, daha büyük ve daha tecrübeli hale geldikçe, ENTU değeri yüksek ürünleri ithal etmekte, aynı zamanda nihai talebe daha yakın ürünler ihraç etmekte ve böylece ülke içinde daha fazla üretim aşamasını gerçekleştirmektedirler. Ju ve Yu (2015), ENTU değeri ile verimlilik arasındaki bağlantıyı açıklayarak, ENTU değeri yüksek bir sektörde sabit sermayenin daha yüksek olduğunu, bu nedenle sabit maliyetlerin yüksek olmasının ENTU değeri yüksek bir sektördeki ortalama firmanın daha verimli ve kârlı olmasına neden olduğunu açıklamışlardır. Çin'de, ENTU değeri yüksek endüstrilerin daha sermaye yoğun olduğu ve bu endüstrilerdeki firmaların, endeks değeri düşük olan firmalara kıyasla daha verimli ve kârlı olduğu sonucuna varmışlardır. Mahy vd. (2022), bir firmanın değer zincirindeki konumunu yıllık olarak ölçen FNTU endeksini kullanarak, bunun firmanın işgücü maliyetleri ve verimliliği üzerindeki etkisini araştırmışlardır. FNTU değeri yüksek olan firmaların daha fazla değer yarattığını ve verimlilik üzerindeki etkinin işgücü maliyetlerinden daha yüksek olduğunu, bu durumun ise daha yüksek kârlılık anlamına geldiğini belirtmişlerdir. Buna karşılık, de Vries vd. (2021), yalnızca Ar-Ge faaliyetleri gibi ENTU değeri yüksek aşamalarda değil, aynı zamanda pazarlama faaliyetleri gibi ENTU değeri düşük aşamalarda da uzmanlaşmış firmaların, ara aşamalarda yer alan montaj gibi faaliyetlerde uzmanlaşmış firmalara kıyasla daha yüksek verimliliğe sahip olduğunu bulmuşlardır. Benzer şekilde, Rungi ve Prete (2018), tüm faaliyetler, yani birincil, üretim ve hizmetler dahil edildiğinde katma değerin aşamalara göre U eğrisi izlediğini değerlendirmişlerdir. Sadece imalat firmaları ele alındığında ise, firmaların nihai talebe ne kadar yakınsa o kadar fazla değer ürettiklerini belirtmişlerdir.

Bu çalışmada, ampirik analiz için GBS'teki firmaların finansal tablolarını içeren veri seti ile firma-firma işlem veri setinden oluşturduğumuz FTNU veri seti birleştirilmiştir. Şirketlerin finansal tablolarına göre, ortalama olarak, imalat sektöründe faaliyet gösteren toplam şirketlerin % 16,82’si imalat sektöründe yer almaktadır. Bu şirketler toplam istihdamın % 30,6'sını ve toplam net satışların % 26,4'ünü oluşturmaktadır.

Eşleştirilmiş bilanço ve FTNU veri setlerini kullandığımızda, bilanço kayıtlarına göre imalat sektöründeki şirketlerin % 82,4'ü dahil edilmiştir. Bu şirketler, toplam imalat çalışanlarının % 95,9'unu istihdam etmekte ve imalat net satışlarının % 98,5'ini gerçekleştirmektedir. Buna ek olarak, analizimize 10 veya daha fazla kişiyi istihdam eden firmalar edilmiştir. Bu firmalar, imalat firmalarının % 40'ını kapsamakta olup, imalat sektöründeki toplam istihdamın % 91,4'ünü ve toplam üretimin % 93,4'ünü oluşturmaktadır.

Çalışmada öncelikle, ampirik veri setinin tanımlayıcı analizi ile bazı temel bulgular özetlenmiştir. İlk temel bulgu FNTU değeri yüksek olan firmaların daha yüksek sermaye yoğunluğuna sahip olmasıdır. Bu, FNTU değeri yüksek olan endüstrilerin, "C19-Kok ve rafine petrol ürünleri" (4,00) ve "C21-Temel eczacılık ürünleri ve eczacılık müstahzarları" (3,25) gibi, altyapı, makine ve teknolojiye önemli yatırımlar gerektiren sektörler olması nedeniyle beklenen bir sonuçtur. İkinci bulgu olarak, FNTU değerlerinin yüzdelik dilimler itibariyle işgücü verimliliği dağılımına bakıldığında U eğrisi gözlenmiştir. Firmalar, 1 inci ve 4 üncü yüzdelik diliminde yer aldıklarında ortalama olarak daha yüksek işgücü verimliliğine sahiptir. Ancak, U eğrisi konsepti sektörel düzeyde incelendiğinde, farklı sektörlerde firmanın FTNU değeri ile performansı arasındaki ilişkinin farklılık gösterdiği gözlemlenmiştir. FTNU ile işgücü verimliliği arasındaki ilişki, "Ana Metaller", "Kok ve Petrol Ürünleri" ve "Tütün Ürünleri" gibi sektörlerde U eğrisi sergilese de "Giyim Eşyası" ve "Motorlu Taşıtlar, Römorklar ve Yarı Römorklar" sektörlerde aşağı eğimli bir trend izlemektedir.

Çalışmamızda, firma düzeyinde işgücü verimliliği ile FTNU arasındaki ilişkiyi incelemek için yıl ve sektör kuklalarını kontrol edilerek dinamik panel tahmincilerinden Genelleştirilmiş Momentler Metodu Tahmincisi (Sistem-GMM) kullanılmıştır (Arellano ve Bond, 1991; Arellano ve Bover, 1995; Blundell ve Bond, 1998).

Bu kapsamda, FTNU değerinin firmaların verimliliği üzerindeki etkisini incelemek amacıyla firma düzeyinde işçi başına katma değer fonksiyonunu tahmin edilmiştir. Buna göre, bağımlı değişken işçi başına katma değer iken, denklemin sağında firmanın

FTNU değeri ile işçi başına reel sermaye stoğu ve firma büyüklüğünü temsilen çalışan sayısı yer almaktadır. FTNU değeri dışındaki değişkenler logaritmik olarak denklemde yer almıştır.

Firmanın katma değeri hesabında firma-firma işlem veri setinden yararlanılmıştır. Bir firmanın katma değeri, en basit tanımıyla, firmanın üretim değeri ile kullandığı girdilerin değeri arasındaki fark olarak tanımlanmaktadır. Firmanın kullandığı girdiler için gösterge olarak, firma-firma işlem veri setinde bildirilen sermaye malları hariç, diğer firmalardan yapılan alımlar ile firmanın ithalatlarının toplamı kullanılmıştır. Bu şekilde belirlenen girdi maliyetleri net satışlardan çıkarılarak firmanın katma değeri hesaplanmıştır.

İş gücü verimliliğinin dinamik olduğunu, yani verimliliğin geçmiş gerçekleşmelerinin mevcut seviyeyi etkilediğini varsayımı altında, regresyon sonuçlarının AR (2) için anlamlı bulunması nedeniyle denkleminin sağ tarafına bağımlı değişkenin üç gecikmesi dahil edilmiştir.

Regresyon sonuçlarına göre, ana bulgumuz, bir firmanın FTNU değerindeki artışın işgücü verimliliğinde bir azalmaya yol açtığıdır. Nihai tüketiciye daha uzak konumlanan firmalar, daha az katma değer yaratmaktadır.

Sonuçların dayanıklılığı, çeşitli spesifikasyonlar tahmin edilerek test edilmiştir. Referans dönemi olan 2008-2019 yıllarında, küresel finansal kriz dahil olmak üzere önemli üretim kesintileri yaşanmıştır. Kriz sonrası dönemi kapsayan 2010-2019 yıllarını içeren dönem için tahmin modelimizi yinelediğimizde, ana bulgu olan FTNU ile işgücü verimliliği arasındaki negatif ilişki anlamlı bulunmuştur.

Diğer taraftan, FTNU değeri hesabında firmaların ihracatlarının nihai talebin bir parçası olduğu varsayılmıştır. Bu varsayım, firmanın iç talebe yönelik üretiminde ve ihracat ürünlerinde nihai ürün – ara girdi üretiminde aynı üretim yapısını koruduğu varsayımı ile değiştirilerek, FTNU değeri-düzeltilmiş FTNU yeniden hesaplanmıştır. Düzetilmiş FTNU, 2008-2019 ve 2010-2019 dönemleri için verimlilik denklemine dahil edilmiştir. Yine, referans dönemi 2008-2019 olduğunda, otokorelasyon testi anlamlı bulunmuştur. Ancak, referans dönemi 2010-2019'a değiştiğinde sistem GMM için modelin geçerliliği için testler uygun sonuç vermiş olup, düzeltilmiş FTNU ile işgücü verimliği arasındaki katsayı yine negatif ve anlamlı bulunmuştur.

İlave olarak, alternatif bir katma değer ölçüsü kullanıldığında, katsayıların işaretleri tutarlı kalmasına rağmen, model gereksinimleri sağlanamamıştır. Toplam faktör verimliği de Levinsohn and Petrin (LP), and Woolridge (WRDG) metotlarıyla test edilmiştir. FTNU ile ilişkilendirilen katsayı anlamlı ve negatif bulunmuştur. Toplam faktör verimliği ile işgücü verimliğinde benzer sonuçlara ulaşılmıştır.

FTNU sonuçları ENTU'ya dayanan diğer göstergelerle de karşılaştırılmıştır. İhracatçılar için, FTNU kullanılarak yapılan tahminler, tüm firmaların dahil olduğu durumlarda gözlemlenen sonuçlarla benzerlik göstermektedir. Ancak, ENTU’ya dayalı ihracat ürünlerinin nihai talebe uzaklığı ile yapılan tahminler istatistiksel olarak anlamlı olmayan katsayılar elde edilmiştir. Ancak, her iki gösterge için sistem GMM tahminleri, model gereksinimlerinin karşılanmaması nedeniyle kesin sonuçlar vermemektedir.

Ana bulgumuz olan bir firmanın FTNU değerindeki artışın işgücü verimliliğinde bir azalmaya yol aması, Avrupa Birliği'ndeki imalat sanayi firmaları için Rungi ve del Prete (2018) tarafından yapılan çalışmadaki bulgularla uyumludur. Ancak literatürün geri kalanı aksi görüşü savunmaktadır (Ju ve Yu, 2015; Mahy vd., 2022).

Daha önce belirtilen katma değerin üretim aşamalarında U eğrisi izlemesi, en çok değerin Ar-Ge, tasarım gibi ENTU değeri yüksek faaliyetlerde ve pazarlama, marka oluşturma, lojistik gibi endeks değeri düşük faaliyetlerde yaratılmasını içermektedir. Buna karşılık, yalnızca üretim/montaj aşamaları ile ilişkilendirilen ara aşamalarda üretilen değer, en az katma değer sağlanan bölümdür. Bu argüman çeşitli çalışmalarla doğrulanmıştır.Ancak, vurgulanması gereken bir nokta, literatürde U eğrisinin, tasarımdan üretime, üretimden satış sonrası hizmetlere kadar olan üretimin tüm aşamalarını ifade etmesidir.

ENTU ve FTNU değerlerinin yüksek olduğu aşamalar Ar-Ge ve tasarım faaliyetleri gibi faaliyetler ile örtüşürken, orta aşamalar ürünlerin üretimini, ENTU ve FTNU değerlerinin düşük olduğu aşamalar ise satış sonrası hizmetler, pazarlama ve ürün dağıtımı ile örtüşmektedir. Ancak, FTNU endeks değeri, firmaların değer zincirindeki faaliyetlerini değil, firmaların ürünlerinin değer zincirindeki konumlarını yansıtmaktadır. Vries vd. (2021) de bu ayrımı vurgulamaktadır. Çalışmalarında, ENTU endeks değerlerinin malların tedarik zincirinde nerede konumlandığını bildirdiği, ancak bu malları üreten firmaların değer zincirinde ne yaptıklarını yansıtmadığı belirtilir. Çalışmamızda da benzer şekilde, FTNU değeri firmaların net satışlarındaki nihai kullanım yüzdesini kullanılarak oluşturulduğu için, FTNU değerinin firmaların fonksiyonel faaliyetlerini yansıtmadığı düşünülmektedir. Daha açık ifade etmek gerekirse, bir firmanın Ar-Ge ya da tasarım ya da lojistik gibi faaliyetlerde bulunup bulunmadığının değerlendirilmesi yapılmamakta, nihai üretim çıktısının nerede konumlandığı bilgisi elde edilmektedir.

Dolayısıyla, FTNU değerindeki değişiklik, bir firmanın ürünlerinin bileşimindeki değişiklikle daha çok ilgilidir. Bir firmanın üretimi FTNU değeri yüksek ürünlerden oluştuğunda, nihai talebe daha uzak konumda yer alır. Bunu, tedarik zinciri üzerindeki kontrollerini genişleterek, tedarikçi firmalarını satın alarak veya onlarla birleşerek ya da ara girdileri üretmek için kendi tesislerini kurarak başarabilirler. Örneğin, pazar güçlerini artırmak amacıyla, süt üretimi gibi FTNU değeri yüksek faaliyetler peynir üretimi gibi endeks değeri daha düşük faaliyetlerle birleştirilip üretimin FTNU değeri değişebilir. Benzer şekilde, FTNU değeri daha düşük bir montaj üreticisi, orijinal ürünün parçalarını ve aksesuarlarını üretmeye başlayarak daha yüksek bir FTNU değerine ulaşabilir. Bu, bir şirketin üretim sürecinin girdilerine ait üretim kapasitesinin genişletilerek, ürünleri için gerekli hammaddelere veya bileşenlere daha yakınlaşması anlamına gelen geri entegrasyon ile ilintilidir. Bu anlamda, FTNU değerinin, firmaların dikey entegrasyon kararlarıyla ilişkili olduğunu düşünülmektedir.

Sonuç olarak, Türkiye'de değer zincirinde nihai talebe uzak olarak konumlanan firmaların daha az katma değer yarattığı bulgusu, firmaların üretimlerini FTNU değeri daha yüksek faaliyetlerini kapsayacak şekilde genişletmelerinin işgücü verimliğini olumsuz etkilediği şeklinde yorumlanmaktadır. Bu sonuç, FTNU değeri yüksek faaliyetlerin önemli sermaye yatırımları gerektirmesine, artan üretim kapsamından kaynaklanan verimsizliklere ve aşamalar arasında uzmanlık ve esneklik kaybı ile açıklanabilir.

Firmaların değer zincirindeki gerçek konumlarını belirlemek, özellikle COVID-19 pandemisi gibi dış ticaretin son dönemlerde yaşadığı kesintiler nedeniyle küresel değer zincirine katılımının faydalarını yeniden değerlendirildiği günümüzde giderek daha önemli hale gelmiştir. KDZ literatürünün odağı, tedarik zinciri sürdürülebilirliği ve dayanıklılığına kaydırılmıştır. Bu bağlamda, bir firmanın konumu, maruz kaldığı şok türlerini de belirlemektedir (Criscuolo ve Timmis, 2017). ENTU değeri yüksek olan endüstriler talep şoklarına daha fazla maruz kalırken, değerin düşük olduğu endüstriler tedarik şoklarına daha duyarlıdır (Acemoglu ve diğerleri, 2016). Bu nedenle, beklenmedik küresel şoklara karşı etkili bir politika, öncelikle mevcut durumun incelenmesini gerektirir. Bu bağlamda çalışmamız, firmanın değer zinciri konumunun ve etkilerinin daha derinlemesine incelenebileceği çalışmalara katkı sağlayacaktır.

Yerel ticaret ağının ve bu ağ içindeki karşılıklı ilişkilerin doğru anlaşılması, ticaret anlaşmalarının çeşitli sektörler üzerindeki olası etkilerini değerlendirmek için de önemlidir. Bu tür yorumlar, etkili ticaret politikalarının uygulanması için gereklidir. Örneğin, ithalat tarifeleri veya ihracat kısıtlamalarının, doğrudan hedeflenen sektörün ötesinde önemli yan etkileri olabilir ve bu etkileri incelemek için sektörler arası ilişkileri firma düzeyinde verilerle incelemek önemli katkı sağlayacaktır.

Diğer taraftan, FTNU değerinin dikey entegrasyon literatürü ile yakından ilişkili olduğu argümanımız daha fazla araştırmayı gerektirmektedir. FTNU değeri ile verimlilik arasındaki negatif ilişkinin olası açıklamalarını listelemiş olsak da özellikle firma birleşmeleri ve satın almalar gibi dikey entegrasyon türlerini ve bunların Türkiye'deki FTNU ile bağlantısını daha ayrıntılı irdelemek gerekmektedir.

Çalışmamızdaki göz ardı edilmemesi gereken diğer bir husus, verimlilik ile FTNU arasındaki ilişkinin doğrusal olduğu varsayımıdır. Ancak, FTNU ile verimlilik arasındaki ilişkinin doğrusal olmaması da mümkündür. Bazı firmalar, girdi kontrolü veya uzmanlaşma yoluyla değer zincirinde FTNU değerini artıracak şekilde strateji izlediklerinde verimlilik kazançları elde edebilirken, diğerleri artan karmaşıklık, koordinasyon maliyetleri veya verimsizlikler nedeniyle azalan getiriler veya hatta negatif etkilerle karşılaşabilirler. Bu, bir firmanın üretim sürecindeki konumu ile verimliliği arasındaki bağlantının farklı aşamalarda veya sektörlerde değişebileceğini düşündürmektedir. Bu nedenle, bu ilişkideki potansiyel doğrusal olmayan özelliklerin ve etkileyen faktörlerin araştırılması gerekmektedir.

Son olarak, literatürde nihai talebe uzaklık endeksleri yeşil ekonomi düzenlemelerinin firma performansı üzerindeki etkisini analiz etmek için kullanılmaya başlanmıştır. Bu çalışmanın potansiyel bir uzantısı, bu ilişkinin Türk imalat firmaları için incelenmesini içerebilir.

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