論　説

# Role of SMEs in Uzbekistan: Input-output Approach

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## ABSRACT

Small and medium enterprises (SMEs) and their contribution to the economy have become one of the most crucial development issues in countries with transition economies. The roles of SMEs in terms of export earnings and shares of domestic production are different from those achieved by their large enterprises (LEs). Nevertheless, the number of previous studies on input-output analysis that have investigated the role of SMEs is limited.

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This paper compiles an applicable input-output table (IOT) in Uzbekistan by firm size and analyzes the interindustry structure for 2005 and 2015. The enterprises' survey data provided by the World Bank is used to compile the extended IOT by firm size. This study uses the RAS approach to balance the annual national IOT and disaggregate it into two categories: SMEs and LEs.

The backward linkage decreased except that of LEs in service sector. The forward linkage reveals a higher value of the index of sensitivity dispersion in the agricultural sector of SMEs, and while this index is high for LEs in textile and chemical industries, those industries are serving as main contributors to other industries.

Structural decomposition analysis shows that SMEs' exports expansion reached 39%. Its share was higher compared with LEs (29%), and the implementation of new technologies (20%) in their production process is also higher than in LEs (−2%).
**Keywords:** SMEs, large enterprises, Input-output table, RAS method.

## 1. Introduction

The Uzbekistan economy has undergone a period of transitional adjustment to market economy since 1991. Indeed, the country has transitioned into the next economic stage since September 2017. Many new manufacturing firms have emerged during the economic life of Uzbekistan. As of January 1, 2019, the total number of operating enterprises compared with the previous year increased 38 thousand units (13.3%) and reached 323.5 thousand units.[1)]

Small and medium-sized enterprises (SMEs) have become the essential components of Uzbekistan's economy and are expected to generate many opportunities for increased employment, including female entrepreneurship. In particular, the role of SMEs in job creation for less educated and unskilled workers in both urban and rural areas is crucial. Along with the fact that Uzbekistan is the largest in terms of country population in Central Asia, nearly 800[2)] thousand young people join the labor market annually. Therefore, SMEs' promotion and development have become an urgent issue in the country's development.

Eventually, to simplify and stimulate entrepreneurial activity, a number of procedures have been critically revised in Uzbekistan in recent years. Based on the revision results, a number of mandatory inspections were reduced Especially, tax and customs burdens were eased, granted easy access to entities registration, and so on.

However, to clarify the effective policies for SMEs, it is crucial to understand the current situation of SMEs in national economies, as they mostly benefit from indirect exports and serve as suppliers to large enterprises (LEs). Therefore, this study investigates the relations between SMEs and LEs in national economy, particularly in the contribution of SMEs to the economy.

Madgazieva and Inaba (2019) examined the interindustry relations in Uzbekistan using the input-output tables (IOTs) in comparison to the other Central Asian countries (Kazakhstan, Tajikistan, and Kyrgyzstan). Unfortunately, standard IOTs do not provide any information on the interaction between SMEs and LEs within an industry. One of the difficulties is that all enterprises in the same industry are supposed to use the same proportion of goods and services for their production process. Therefore, irrespective of firm size, their market and technological position will be the same within an industry.

For an analysis of the role of SMEs within an interindustry, this study must compile the so-called augmented IOTs in which SMEs and LEs are divided in an industry. The purpose of this paper is to estimate the IOTs in Uzbekistan by firm size and discuss the activities of SMEs and LEs as well as their interrelations.

In this paper, we make the first attempt to investigate interindustry relations with a focus on the roles of SME and LEs in Uzbekistan.

The structure this paper is as follows. Chapter 2 overviews the SMEs in Uzbekistan. Chapter 3 summarizes the previous studies where the IOTs are divided by firm size.

We discuss the compiling of IOTs in Uzbekistan in Chapter 4 and followed by some preliminary analyses in Chapter 5. Chapter 6 is the conclusion.

## 2. Overview of SMEs in Uzbekistan

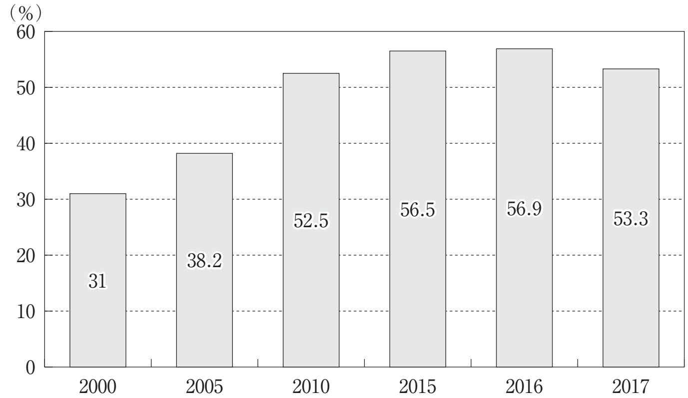
The definition of SMEs in Uzbekistan differs from that of the conventional international standard[3], and the SME sector includes individual entrepreneurs, as well as micro, small, and medium enterprises, and depends on the number of employees by industry, as shown in Table 1[4], whereas the international definition includes, besides the number of employees, the firm's annual turnover by industry.

**Table 1.** SME criteria in Uzbekistan

| Category | Number of employees |
|---|---|
| Individual | 1−3 employees |
| Micro-firms | <25 employees |
| Small enterprises | <100 employees |
| Medium enterprises | <250 employees |

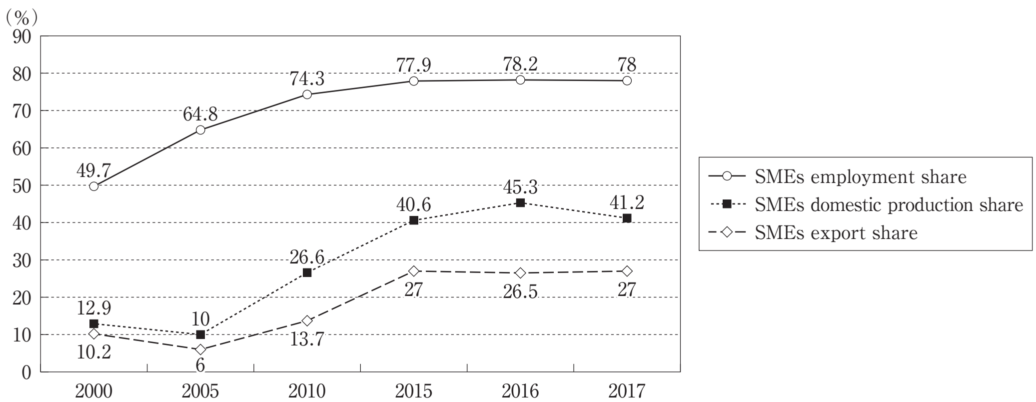
Source: Decree of the President of the Republic of Uzbekistan No PD639 dd Sep. 22, 2018, "On measures to further stimulate the expansion of small businesses and private entrepreneurship in order to create competitive companies."

**Figure 1.** Share of SMEs in country GDP, %.




Source: State Statistics Committee and Ministry of Economy of the Republic of Uzbekistan.

**Figure 2.** Share of SMEs in employment, domestic product and export.




Source: State Statistics Committee and Ministry of Economy of the Republic of Uzbekistan.

In general, the contribution of SMEs in the economy is defined by four commonly used indicators: the number of enterprises, job creation, domestic production, and export share.

SMEs' percentage share to GDP has been increasing since 2000. As Figure 1 shows, its share accounted for 56.9% of the total GDP in 2016. Although the share of small businesses in 2017 slightly decreased, they serve a significant role in the country's economy.

Figure 2 shows that SMEs' share in employment generation, domestic production, and export has gradually increased. While the employment share was 64.8% in 2005, this number accounted for 78.3% of the total in 2017, which is equal to 10.4 million people. In 2016, the sector of small business and private entrepreneurship produced finished goods worth 50.6 trillion Uzbek Som (15.7 billion USD), 45.3% of the total industrial output, and its export share also increased by 16.4% points from 10.2% in 2000 to 26.5% in 2016. In

2017, the share of SMEs in industrial production amountes to 41.2% against 12.9% in 2000, and the SMEs share in the total export is 27%.

## 3. Literature review

Since the original IOTs are industry based, an analysis of the IOT by firm size must be compiled by the firm-level survey data that provide the income statement. Although the limited availability of the necessary data has set constraints in constructing such tables, the number of countries that have conducted tables by the firm size has gradually increased.

Several previous studies have developed methods to divide IOT. The United States International Trade Commission (USITC) (2010) split USA's IOT for 2007 into SMEs and LEs using the firm's exports in each industry as size-specific disaggregation indicators. According to the results, SMEs account for 41% of the total domestic value added that is embodied in USA exports, even though its share in direct exports is only 28%. Further, Piacntini and Fortanier (2015) revealed that European SMEs have a larger share in the value added that is embodied in exports rather than in direct exports.

Tang et al. (2016) divided Chinese IOT into processing and non-processing industries. They tried to extend IOT based on Chinese firm-level data and developed a quadratic optimization method using data from standard IOTs along with other constraints implied by industry-and firm-level data. Their results have revealed that state-owned enterprises and SMEs in China have much higher value-added exports to gross exports ratios compared to the other type of firms.

Chong, Hoekstra, and Lemmers et. al (2018) examined the role of SMEs in the Dutch economy using an extended supply and use table. They constructed the supply and use table by utilizing firm-level data, and this allowed them to derive an extended IOT distinguished by SMEs and LEs. Based on their study, SMEs are less dependent on imports than LEs, and SMEs benefit more from Dutch exports.

Moreover, other characteristics of firm heterogeneity can be implemented in the IOTs. Joint research on the statistical institution of the Nordic countries and the OECD (2017) has emphasized that the difference across foreign and domestically owned enterprises is related to their direct exports and value added embodied in exports.

The Japan Small and Medium Enterprise Agency (JSMEA) has a long history of compiling IOTs by firm size. They compiled the tables for 1973, 1978, and every 5 years up to 2005. The tables before 1980 were confined to manufacturing sectors. Using the extended IOT in 1979, the Japan Applied Research Institute (1987) compiled a table which is divided by the firm size in service sectors. These tables were used to assess the impacts of the changing circumstances in the Japanese economy on the SMEs' activities. Shimoda et al. (2005) investigated the structural changes of the Japanese industries from 1980 to 2000 using the IOTs. JSMEA (2002) examined the impact of the increase in Japanese foreign direct investment on the SMEs' employment using the 1994 and 1998 IOTs and find that there was a stronger negative effect compared to the LEs.[5] JSMEA (2013) also examined the impact of increased electricity prices on the SMEs' profit using 2005 IOT.[6]

Lee et al. (2014), through the collaboration with the Japan Applied Research Institute, created a compilation of IOTs and conducted analyses of Korean SMEs. They compiled the 2005 and 2009 IOTs by firm size and estimated the backward and forward linkages. The results show that many SMEs benefit from indirect contribution in terms of value added and from job creation.

The next chapter discusses the method of compiling IOTs by firm size based on the previous studies in Korea and Japan.

## 4. Methodology of constructing extended input-output tables by firm size

### 4.1 Input-output table by firm size

Table 2 shows the two conventional industries' (A and B) IOTs of competitive import type. Investigation of SMEs' role requires the table to be divided into two subindustries, as seen in Table 3.

Basically, an IOT describes interindustry relations where goods and services were sold (supply side) and bought (demand side) in a particular country for a certain period of time. Specifically, IOTs are used to show the interdependencies among industries and the connection between consumers and producers.

In Table 3, industries A and B are divided into the subindustries As, Al, Bs, and Bl. "s" and "l" indicate the SMEs and LEs of each industry, respectively. The Japan Applied Research Institute (1987) used the Census of Manufacturing and Census of Commerce to

**Table 2.** Conventional input-output table

| | | Intermediate demand | | Final demand | | Import | Total output |
|---|---|---|---|---|---|---|---|
| | | A | B | Domestic demand | Export | | |
| Intermediate input | A | | | | | | |
| | B | | | | | | |
| Value added | | | | | | | |
| Total input | | | | | | | |

identify detailed information on the domestic production (control total, CT) of small medium firms and large firms of each industry. The initial input-output (I-O) matrix on the current period (cf. 2005) is estimated as the input coefficient of the previous period (cf. 2000) multiplied by the CT of the current period. The RAS method is usually applied to balance the row and column of the initially given matrix. The Korean Institute for Industry, Economy and Trade (KIET) followed almost the same procedure to compile the 2005 and 2009 Korean IOTs by firm size.

**Table 3.** Input-output table by firm size

| | | Intermediate demand | | | | Final demand | | Import | Total output |
|---|---|---|---|---|---|---|---|---|---|
| | | As | Bs | Al | Bl | Domestic demand | Export | | |
| Intermediate input | As | | | | | | | | |
| | Bs | | | | | | | | |
| | Al | | | | | | | | |
| | Bl | | | | | | | | |
| Value added | | | | | | | | | |
| Total input | | | | | | | | | |

### 4.2 Compiling the input-output tables for Uzbekistan

Madgazieva and Inaba (2019) integrated the EORA multiregional database to investigate the economic structure in Uzbekistan. Using this IOT, we extended the table that shows the inter-sector relations between two main types of firms. To compile the IOT by firm size, we used the Business Environment and Enterprise Performance Survey (BEEPS) data provided by the World Bank for the years 2005 and 2015.[7]

The main criteria to distinguish firm size (i.e., SMEs and LEs) is based on the number of permanent employees. According to the World Bank Survey, enterprises with a permanent number of employees up to 249 are referred to as SMEs, and enterprises with a permanent number of employees more than 250 were referred to as LEs. This classification is also used in Uzbekistan. We unite those firms' classifications with the regular industry classification to obtain 26 industries.[8]

This study uses the firm-level data from the Business Environment and Enterprises Performance Survey (BEEPS) done by the World Bank and European Bank for Reconstruction and Development, as well as the EORA I-O dataset.

Figure 3 shows a flowchart of compiling the IOT by firm size. The following is description of the process of constructing the extended IOT by firm size through the following steps.

1. Estimation of control total (CT), etc.

**Table 4.** Compiling IOT demand and supply side components.

| IOT | BEEPS |
|---|---|
| Supply side components | |
| Intermediate input | Firms' material input cost (primary input) |
| Total output | Firms' total sales are treated as output |
| Demand side components | |
| Export | Firms' export as a % from total sales |
| Import | Firms' import as a % from material inputs |

To estimate IOT by firm size, IOT information on the supply and demand structure is required. As we notice CT is not available, and we use BEEPS to estimate CT, total intermediate input, and exports and imports by firm size. Table 4 shows how the demand and supply components are taken from BEEPS.

2. Industry classify by firm size

We classified the industries of the BEEPS dataset using regular 2-digit classification. The industries of the BEEPS correspond to 21 industries for 2005 and 19 industries for 2015 in Uzbekistan. Thus, we integrate some industries of the BEEPS in accordance with the classification of IOT.

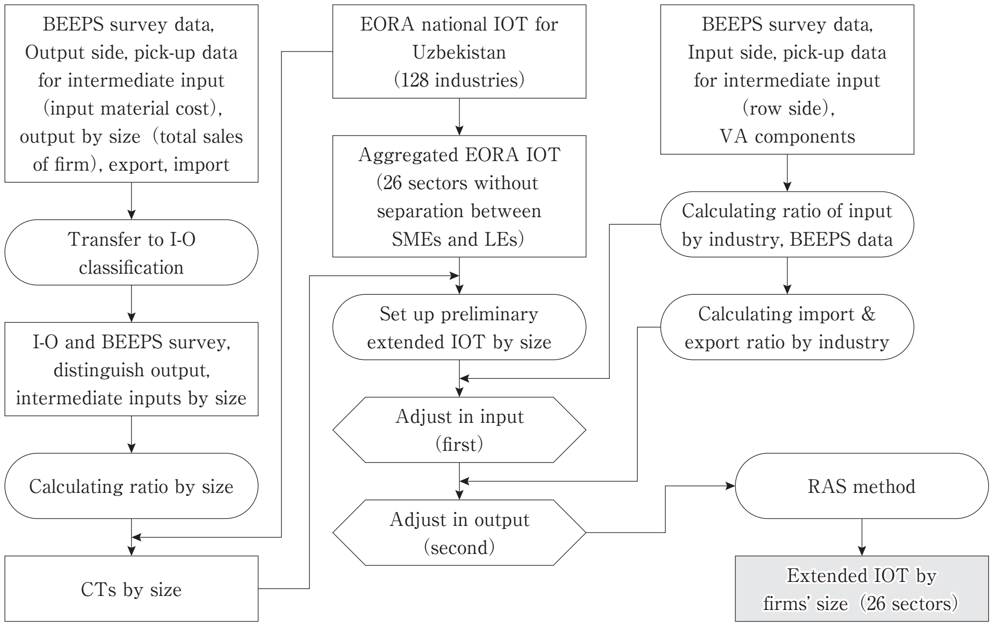
3. Modification of general IOT to IOT by firm size

The national IOT of Uzbekistan consists of 128 industries. Therefore, to match the industry classification of BEEPS, we aggregate the national IOT into 26 industries.

4. We use the CT and total intermediate inputs for SMEs and LEs for the estimation of IOT by firm size.
5. Finally, we use the RAS method, as described in Figure 3, to balance IOT and split it by firm size, as well as connecting the intermediate inputs, export/import, and value added to each industry by each firm size.

We only use the RAS method[9] when only the row and column sums of the IOT are given. Further, we estimate the table from the previous period of IOT so that the obtained table was consistent with the given row and column sums. Mathematically, it multiplies each row or column value by a factor that is taken in such a way that the summary of all values in the row and column matches its target summary.[10] In addition, the IOT can be divided into different dimensions,[11] e.g., by time (annual tables divided into quarterly, semi-annual), by area (national wide tables divided into regional). This study, we divide IOT by firm size, SMEs and LEs. In turn, this separation provides more detailed insight into I-O analysis.

**Figure 3.** Process of constructing extended IOT by firm size.




## 5. Results and interpretations

### 5.1 Supply and demand structure

Table 5 shows the composition of total inputs by firm size. The total inputs recorded 93.7 billion USD in 2015 compared to 24 billion USD in 2005, where the total inputs of SMEs increased 4.4 times (from 16.6 bullion USD in 2005 to 72.8 billion UDS in 2015), and that of LEs increased 3.9 times (from 24.0 billion in 2005 USD to 20.8 billion USD in 2015). Thus, the share of total input in SMEs slightly increased from 69.2% in 2005 to 77.8% in 2015.

Regarding the inputs' composition, the SMEs' share of the intermediate total input to the total input is one-third (32.9%), more labor intensive in comparison to that of LEs (44.2%) in 2005. In 2015, while the input share of SMEs decreased to one-fourth (25.4%), the share of LEs increased to 68% of the total inputs. The import share of SMEs (4.5%) and LEs (5.0%) was not so different in 2005, and the average share decreased to 3.4% in 2015.

Table 6 presents the demand side decomposition for extended IOT by size for 2005 and 2015. Uzbekistan's total demand for 2015 was 93.7 billion USD, whereas SMEs' contribution was 69.5 billion USD (74.2%), and LEs' contribution was 24.2 billion USD (25.8%), respectively. Detailed description of demand composition reflects that the largest part

**Table 5.** Composition of total inputs, billion USD, % in parenthesis

| | 2005 | | | 2015 | | |
|---|---|---|---|---|---|---|
| | SMEs | LEs | Total | SMEs | LEs | Total |
| Total inputs (billion USD) | 16.6 (69.9) (100) | 7.4 (30.1) (100) | 24.0 (100) (100) | 72.8 (77.8) (100) | 20.8 (22.2) (100) | 93.6(100) (100) |
| Intermediate inputs | 5.4 (32.9) | 3.3 (44.2) | 8.7 (36.3) | 18.5 (25.4) | 14.4 (68.6) | 32.9 (35.1) |
| Value added | 10.3 (62.5) | 3.7 (50.2) | 14.0 (58.3) | 51.5 (70.8) | 6.0 (29.0) | 57.5 (61.4) |
| Import | 0.8 (4.5) | 0.4 (5.5) | 1.2 (5.0) | 2.7 (3.7) | 0.5 (2.2) | 3.2 (3.4) |

Source: EORA dataset and extended IOT for Uzbekistan by firms' size, authors' calculations.

**Table 6.** Composition of total demand, billion USD % in parenthesis

| | 2005 | | | 2015 | | |
|---|---|---|---|---|---|---|
| | SMEs | LEs | Total | SMEs | LEs | Total |
| Total demand | 16.7 (69.5) (100) | 7.3 (30.5) (100) | 24 (100) (100) | 69.5 (74.2) (100) | 24.2 (25.8) (100) | 93.7 (100) (100) |
| Intermediate demand | 5.9 (35.3) | 2.9 (39.7) | 8.8 (36.7) | 26.0 (37.4) | 6.9 (28.5) | 32.9 (35.1) |
| Final demand: | 10.9 (65.3) | 4.4 (60.3) | 15.3 (63.7) | 43.6 (62.7) | 17.3 (71.4) | 60.9 (65.0) |
| Of which consumption and investment | 8.4 (50.3) | 4.0 (54.8) | 12.4 (51.7) | 36.5 (52.5) | 16.3 (67.3) | 52.8 (56.4) |
| Of which 1Exports | 2.5 (15.0) | 0.4 (5.5) | 2.9 (12.0) | 7.1 (10.2) | 1.0 (4.1) | 8.1 (8.6) |

Source: EORA dataset and extended IOT for Uzbekistan by firms' size, authors' calculations.

comes from SMEs' final demand, including export, and it makes up almost 62.7% of the total demand, whereas consumption, investment, and export make up to 71.4% of LEs in total demand composition.

Over the observed period of time, SMEs' dependency ratio on intermediate inputs from other industries had not increased outstandingly in percentage share. However, in monetary value, the change was drastic and increased nearly 4 times from 5.9 billion USD to 26 billion USD. On the other hand, exports share decreased for all firms in the final demand structure. Generally, we can observe the positive tendency toward increases in the total demand composition, i.e., the total demand of the Uzbek economy has grown by 3.9 times in 10 years.

### 5.2 Backward and forward linkages

Along with various multipliers used in I-O analysis to estimate economy-wide impacts whose change affects the overall economy, there is analysis measuring the effect that an industry's output has on other industries, also known as spillover effects. The scale of spillover effects can be evaluated through interindustry linkages or backward or forward linkages.

Theoretically, backward linkage indicates the dependency of one industry (e.g., food and beverage) in obtaining intermediate input from other industries. Forward linkage indicates other industries' consumption level on the output produced by that particular industry (e.g., food and beverage). Based on Rasmussen (1956), industries with backward linkages equal to 1 or higher indicate a strong dependency on the other industries' inputs, whereas industries with forward linkage equal to 1 or higher can have a great impact on other industries' output.

Table 7 represents the backward linkage of the integrated 8 industrial sectors for 2005 and 2015. Those industries with values greater than 1 show an above-average dependency on other industries' input materials, or they reveal a strong backward linkage effect. Appendix 1 presents the results of backward linkage using 26 sectors.

**Table 7.** Index of power of dispersion-backward linkage

| | 2005 | | 2015 | |
|---|---|---|---|---|
| | SME | LE | SME | LE |
| Agriculture, forestry and fishing | 0.246 | 0.471 | 0.186 | 0.378 |
| Mining and quarrying | 0.302 | 0.302 | 0.253 | 0.418 |
| Chemicals | 1.379 | 1.684 | 1.217 | 1.475 |
| Metals | 0.962 | 1.475 | 0.812 | 1.271 |
| Machinery | 0.843 | 0.893 | 0.689 | 0.889 |
| Other manufacturing | 1.828 | 2.369 | 1.384 | 1.815 |
| Construction | 0.295 | 0.295 | 0.247 | 0.433 |
| Services | 1.906 | 2.799 | 1.482 | 3.253 |

Source: Extended IOT for Uzbekistan by firm size, authors' calculations.

Over the course of the 10 years, except of the linkage for LEs in some industries, all of the SMEs linkages decreased slightly. The linkage of LEs in services is the largest, i.e., 3.66 in 2015. In most of the cases, the backward linkage in LEs is larger than that of SMEs, and the differences are large in manufacturing and services. Table 8 shows the results of forward linkage for the industrial sectors for 2005 and 2015.

When the industries' forward linkage value was higher, this industry's influence on other industries' production was stronger through its supplied inputs. Consequently, those indus-

**Table 8.** Index of sensitivity of dispersion-forward linkage

| | 2005 | | 2015 | |
|---|---|---|---|---|
| | SME | LE | SME | LE |
| Agriculture, forestry and fishing | 1.116 | 0.166 | 1.105 | 0.144 |
| Mining and quarrying | 0.492 | 0.539 | 0.990 | 0.144 |
| Chemicals | 0.946 | 1.203 | 1.109 | 0.982 |
| Metals | 1.071 | 0.497 | 1.076 | 0.431 |
| Machinery | 0.549 | 0.678 | 0.453 | 0.629 |
| Other manufacturing | 1.869 | 1.624 | 2.021 | 1.203 |
| Construction | 0.250 | 0.226 | 0.249 | 0.197 |
| Services | 2.699 | 2.077 | 3.166 | 2.102 |

Source: Extended IOT for Uzbekistan by firms' size, authors' calculations.

tries with values of forward linkage more than 1 had an above-average influence on other industries' production or revealed a strong forward linkage effect. Appendix 2 presents the detailed results of forward linkage using 26 sectors.

The forward linkages of SMEs in agriculture etc. and services are much larger than those of LEs. While the linkages of SMEs in mining etc. and manufacturing in 2005 were smaller than that of LEs, these became larger in 2015. Thus, SMEs are much more affected than LEs.

### 5.3 Structural decomposition analysis

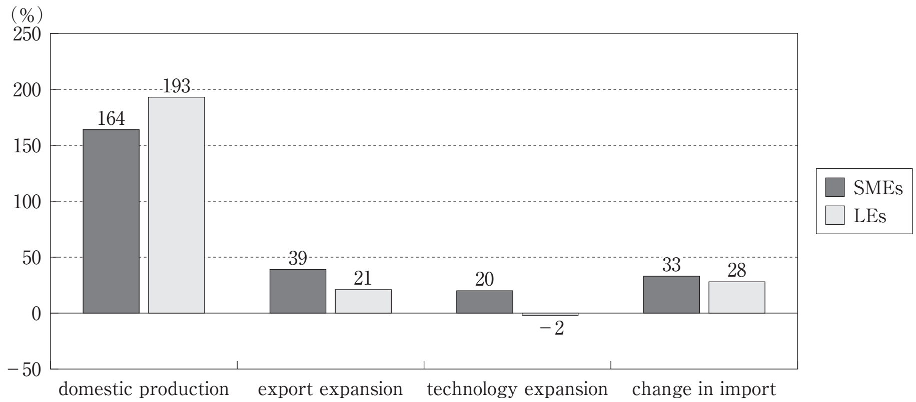
We decomposed the change in the final demand into the change in exports expansion, change in technology and import, and domestic production.[12)]

Figure 4 shows that there has been increasing tendency in domestic final demand across all firms in the country. In particular, SMEs' domestic production capacities increased to 164%, and LEs' domestic production capacities increased to 193% during the 10 years. The total output exhibited this growth by 14.8%.

LEs experienced lower export expansion in comparison with SMEs, and LEs have the lowest coefficient reflecting the application of new technologies in their manufacturing process (−2%), whereas SMEs demonstrated a 20% increase in the implementation of new technologies. Import maintained almost the same level of increase in both enterprises and average companies' spending for importing goods and services increased 32%. Thus, most of the final demand comes from domestic demand.

Moreover, for a more detailed analysis of the degree change in the sector composition of production in terms of deviation from proportional growth, we applied deviation proportion growth (DPG) analysis (Fujikawa and Kuan-hui, 1995). Appendix 3 describes the method of defining deviation from proportional growth. In this part of the analysis, we consolidated

**Figure 4.** Structural shifts in national economy by firms' size over a 10-year period.




Source: extended IOT for Uzbekistan by firms' size, authors' calculations.

**Table 9.** DPG analysis results for SMEs and LEs in Uzbekistan (billion USD)

| | | DPG by industry | Source of DPG | | | |
|---|---|---|---|---|---|---|
| | | | Domestic final demand | Technology change | Export | Import |
| SME | Agriculture, forestry and fishing | 916.10 | 2027.28 | 979.72 | −2532.66 | −441.77 |
| | Mining and quarrying | 1771.44 | 133.45 | 1867.25 | −460.15 | −230.89 |
| | Chemicals | 1845.76 | 294.25 | 2020.40 | −429.56 | 39.33 |
| | Metals | −527.08 | 102.51 | −184.21 | −611.51 | −166.13 |
| | Machinery | −645.47 | −433.36 | −325.49 | −152.40 | −265.77 |
| | Other manufacturing | −2735.74 | −3402.94 | 3808.07 | −3497.39 | −356.52 |
| | Construction | 9577.53 | 10514.96 | −115.82 | 630.71 | 1452.32 |
| | Services | 435.48 | 870.82 | 340.29 | −1632.16 | −856.53 |
| LE | Agriculture, forestry and fishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Mining and quarrying | −2538.72 | −90.80 | −2447.92 | 0.00 | 0.00 |
| | Chemicals | −2500.51 | −191.00 | −2636.21 | −122.53 | −449.23 |
| | Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Machinery | 545.47 | 728.62 | −84.53 | −94.10 | 4.52 |
| | Other manufacturing | −1834.72 | 6161.63 | −8675.87 | −274.64 | −954.16 |
| | Construction | −5516.92 | −6562.91 | −299.89 | −836.32 | −2182.20 |
| | Services | 1207.38 | 1571.92 | 149.29 | −513.84 | 0.00 |
| | Total | 0.00 | 11724.43 | −5604.91 | −10526.54 | −4407.03 |

Source: Extended IOT by size, author's calculations.

26 sectors into 8 main industries covering agriculture, manufacturing, chemicals, construction, and others.

Table 9 shows the results for DPG decomposition analysis. We applied Equation (2) in

**Table 10.** Normalized DPG analysis results, %

| | | DPG by industry | Source of DPG | | | |
|---|---|---|---|---|---|---|
| | | | Domestic final demand | Technology change | Export | Import |
| SME | Agriculture, forestry and fishing | 5.62 | 12.44 | 6.01 | −15.54 | −2.71 |
| | Mining and quarrying | 10.87 | 0.82 | 11.46 | −2.82 | −1.42 |
| | Chemicals | 11.32 | 1.81 | 12.40 | −2.64 | 0.24 |
| | Metals | −3.23 | 0.63 | −1.13 | −3.75 | −1.02 |
| | Machinery | −3.96 | −2.66 | −2.00 | −0.94 | −1.63 |
| | Other manufacturing | −16.78 | −20.88 | 23.36 | −21.46 | −2.19 |
| | Construction | 58.76 | 64.51 | −0.71 | 3.87 | 8.91 |
| | Services | 2.67 | 5.34 | 2.09 | −10.01 | −5.26 |
| LE | Agriculture, forestry and fishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Mining and quarrying | −15.58 | −0.56 | −15.02 | 0.00 | 0.00 |
| | Chemicals | −15.34 | −1.17 | −16.17 | −0.75 | −2.76 |
| | Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Machinery | 3.35 | 4.47 | −0.52 | −0.58 | 0.03 |
| | Other manufacturing | −11.26 | 37.80 | −53.23 | −1.69 | −5.85 |
| | Construction | −33.85 | −40.27 | −1.84 | −5.13 | −13.39 |
| | Services | 7.41 | 9.64 | 0.92 | −3.15 | 0.00 |
| | Total | 0.00 | 71.93 | −34.39 | −64.58 | −27.04 |

Source: Extended IOT by size, author's calculations.

the Appenix 3. The results represent deviations from two components of final demand (domestic final demand and export) and changes in two coefficients (import and input coefficients). The latter one represents technological change.

Table 9 indicates, in terms of DPG, the degree of change in output composition and represents results for SMEs and LEs in Uzbekistan during the 2005-2015 period, and it provides values in billion USD, deflated by PPP based on 2005.

The relative degree of change may not be measured by currency units and is divided by the sum of positive DPGs and multiplied by 100. Therefore, they are been normalized in such a way that the sum of all positive (separately negative) DPGs is equal to 100, as shown in Table 10.

In Table 10, the DPG shows that SMEs in agriculture, services, construction, and mining increased their output deviations in Uzbekistan, whereas, almost all LEs except those in the service sector is negative in their output deviations. SMEs in agriculture, services, and construction accounted for 67% of the positive deviations, whereas LEs of only the service sector was 7% positive from deviation growth.

The last total row of Table 10 indicates how input coefficients influence and produce positive deviations. The highest positive deviation was achieved by domestic final demand in the Uzbek economy. In detail, SMEs accounted for an increase of 62%, and LEs contributed to 10% deviations. However, deviation from the proportional growth analysis of exports throughout all sectors and across all firms showed negative deviation, and this shows that both SMEs and LEs' export performance became rather weak for the 10 years and we need to reconsider the existing procedures or regulations in stimulation whether these reforms can support the export performance of Uzbek manufacturers and producers.

The deviation from technology expansion is the second factor that yielded positive deviations for SMEs. In particular, technological improvement can be observed in the mining and quarrying, manufacturing, and chemical sectors. However, based on the DPG analysis results, technological improvement has not demonstrated increased level of improvement. Instead, that coefficient is negative in its deviation from the proportional growth value in total productivity.

Finally, the third factor which affects the decisive change in proportional growth is expected to be reflected in import coefficients that indicate whether import substitution took place. Import substitution shows negative DPGs across all sectors in Uzbekistan, and this is fully consistent with our previous study's results.

## 6. Conclusion

This study investigated the economic structure of Uzbekistan with compiled IOTs by firms' size for 2005 and 2015.

In general, the government has set up the support and development of SMEs in Uzbekistan as a priority in the country's economic development. Within the last two decades, the government tried to ease and remove burdens which hindered the development of the private sector. As the most influential and important recent measures were, establishment of the agency for the development of small businesses and private entrepreneurship, based on the President of the Republic of Uzbekistan's decree No. 5789 dd on August 13, 2019 and President of the Republic of Uzbekistan's resolution No. PP-4525 dd November 20, 2019, to improve the business environment and entrepreneurship support system in the country.

Disaggregated I-O analysis by firm size reveals a different picture. The forward linkage analysis represents the above-average dependency of SMEs in the agricultural and manufacturing sectors, so inputs from these sectors are crucial for output of LEs. The backward linkage analysis highlighted that the metal-producing sector has the largest demand for LEs along with the manufacturing sector, and SMEs in the chemical and service sectors are serving as the main consumers of other industries' inputs. On this threshold, we may say that SMEs benefit more as suppliers for other LEs.

The results of structural decomposition analysis stressed that changes appeared in 10 years of domestic production, export earnings, and import spending for both company types.

Based on those results, LEs' capacities in domestic production increased to 193%, while SMEs benefitted more from embedding new technologies (20%), their export earnings increased 39%, and LEs experienced a 21% increase in their exports.

In addition, deviation from proportional growth analysis revealed that SMEs in agriculture, services, and construction contributed as a main component in the production of positive deviations in Uzbekistan, and their contribution accounts for 67% of all positive deviations. Moreover, the results showed the weak export performance of Uzbek producers in the observed time. On the other hand, the final demand composition shows that SMEs are more export oriented than LEs. In facing the fierce international competition, SMEs can become more flexible and active to overcome the difficult situation.

This study has two main aspects. First, we explored the detailed process of compiling extended IOT for Uzbekistan using firm-level survey data that utilize the national IOT taken from the EORA global dataset. This elaboration has enabled further analysis of the current issues on the activities of SMEs. Second, this study highlighted the role of SMEs in the industrial structure of Uzbekistan.

However, the analysis does not cover the economic situation after the 2017 reform. We need to investigate how the role of SMEs has changed. If the recent IOTs compiled by the State Statistics Committee of Uzbekistan are available, we could try a more extensive analysis instead of using the EORA database, which is compiled based on the non-survey method.

## Notes

1) State Statistics Committee of the Republic of Uzbekistan.
2) State Statistics Committee of the Republic of Uzbekistan.
3) The international standard to classify SMEs includes the number of employees and annual turnover by industry.
4) Based on the Decree of the President of the Republic of Uzbekistan No PD639 dd Sep. 22, 2018, small business is defined as such: "On measures to further stimulate the expansion of small businesses and private entrepreneurship in order to create competitive companies".
5) JSMEA (2002), Appendix 1-1-3.
6) JSMEA (2013), Appendix 1-1-1.
7) In Uzbekistan, there are no official statistical data on CT by firm size.
8) Some industries were excluded from the survey.
9) The first use of the RAS method for the estimation of IOT was discovered by Stone (1962) and Stone and Brown (1962). The main purpose of the RAS method is to update components

of the IOT in that approach, and this makes it more coherent with the predefined row and column summary.

10) The short note on the RAS method done by Trinh and Phong (2013) allowed us to better understand how to balance the supply and use or I/O tables.

11) Holy and Karel's (2019) recent research on the disaggregation of the Czech Republic's industrial IOT, when only its row and column sums were known using the multidimensional RAS method, provided us more accurate estimation results as applications of Leontief inverse and others.

12) See Madgazieva and Inaba (2019) for mathematical deviations, pp. 12-15.

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# APPENDIX 1. Backward linkage of SMEs and LEs by industry

| | 2005 | | 2015 | |
|---|---|---|---|---|
| | SME | LE | SME | LE |
| Agriculture, forestry and fishing | 0.711 | 1.360 | 0.606 | 1.227 |
| Mining and quarrying | 0.873 | 0.873 | 0.821 | 1.358 |
| Beverages and foods | 1.202 | 1.202 | 1.089 | 1.089 |
| Textile products | 1.213 | 1.213 | 1.058 | 1.058 |
| Pulp, paper and wooden products | 1.057 | 1.531 | 1.020 | 1.020 |
| Printing, plate making and book binding | 0.824 | 1.470 | 0.406 | 1.345 |
| Chemical products | 1.053 | 1.053 | 1.024 | 1.024 |
| Petroleum and coal products | 0.987 | 1.364 | 1.043 | 1.448 |
| Plastic and rubber products | 1.090 | 1.595 | 1.057 | 1.492 |
| Ceramic, stone and clay products | 0.853 | 0.853 | 0.830 | 0.830 |
| Iron and steel | 0.857 | 1.342 | 0.891 | 1.398 |
| Non-ferrous metals | 0.999 | 1.449 | 0.905 | 1.358 |
| Metal products | 0.922 | 1.471 | 0.843 | 1.376 |
| Production machinery | 0.896 | 0.896 | 0.815 | 0.815 |
| Information and communication electronics equipment | 0.805 | 0.805 | 0.722 | 0.722 |
| Transportation equipment | 0.735 | 0.735 | 0.703 | 0.703 |
| Miscellaneous manufacturing products | 0.984 | 1.426 | 0.927 | 1.386 |
| Construction | 0.852 | 0.852 | 0.802 | 1.406 |
| Electricity, gas and heat supply | 0.810 | 1.333 | 0.814 | 1.400 |
| Commerce | 0.733 | 1.375 | 0.615 | 1.237 |
| Finance and insurance | 0.576 | 1.291 | 0.490 | 1.152 |
| Real estate | 0.637 | 0.637 | 0.538 | 1.315 |
| Transport and postal services | 0.648 | 0.648 | 0.565 | 1.370 |
| Information and communication | 0.630 | 0.630 | 0.573 | 1.388 |
| personal services | 0.740 | 0.740 | 0.602 | 1.370 |
| Activities not elsewhere classified | 0.733 | 1.434 | 0.618 | 1.341 |

# APPENDIX 2. Forward linkage of SMEs and LEs by industry

| | 2005 | | 2015 | |
|---|---|---|---|---|
| | SME | LE | SME | LE |
| Agriculture, forestry and fishing | 3.627 | 0.538 | 3.591 | 0.467 |
| Mining and quarrying | 1.598 | 1.751 | 3.217 | 0.467 |
| Beverages and foods | 1.225 | 1.253 | 0.930 | 1.328 |
| Textile products | 1.766 | 2.412 | 2.902 | 0.927 |
| Pulp, paper and wooden products | 0.927 | 0.538 | 0.525 | 0.720 |
| Printing, plate making and book binding | 0.543 | 0.538 | 0.469 | 0.467 |
| Chemical products | 0.560 | 1.845 | 0.591 | 1.556 |
| Petroleum and coal products | 1.191 | 0.538 | 1.563 | 0.467 |
| Plastic and rubber products | 0.780 | 0.538 | 0.700 | 0.467 |
| Ceramic, stone and clay products | 0.545 | 0.987 | 0.750 | 0.701 |
| Iron and steel | 1.040 | 0.538 | 0.911 | 0.467 |
| Non-ferrous metals | 1.761 | 0.538 | 1.991 | 0.467 |
| Metal products | 0.681 | 0.538 | 0.597 | 0.467 |
| Production machinery | 0.679 | 0.891 | 0.525 | 0.849 |
| Information and communication electronics equipment | 0.539 | 0.681 | 0.480 | 0.599 |
| Transportation equipment | 0.566 | 0.631 | 0.468 | 0.595 |
| Miscellaneous manufacturing products | 1.612 | 0.538 | 1.743 | 0.467 |
| Construction | 0.812 | 0.734 | 0.809 | 0.640 |
| Electricity, gas and heat supply | 1.970 | 0.538 | 2.450 | 0.467 |
| Commerce | 0.639 | 0.538 | 0.559 | 0.491 |
| Finance and insurance | 0.745 | 0.538 | 0.772 | 0.467 |
| Real estate | 0.570 | 0.595 | 0.575 | 0.467 |
| Transport and postal services | 0.832 | 2.542 | 0.863 | 3.287 |
| Information and communication | 0.728 | 0.720 | 0.945 | 0.467 |
| personal services | 1.470 | 0.740 | 1.885 | 0.718 |
| Activities not elsewhere classified | 1.817 | 0.538 | 2.239 | 0.467 |

## APPENDIX 3. The deviation from proportional growth

To define deviation proportional growth, at first, we defined corresponding growth in two periods (2005 as period 1, 2015 as period 2). Therefore, the total average ratio of expansion of production, got by the division of the total gross production in period 2 by that of period 1.

$$\lambda=\frac{\sum_i X_{i2}}{\sum_i X_{i1}} \quad (1)$$

Consequently, we find the difference between actual values in period 2 and difference in total outputs, domestic demand, technology expansion, exports and imports between two observed periods, called *deviations from proportional expansion* as:

$$\delta X_{i12}=X_{i2}-\lambda X_{i1},$$
$$\delta Y_{i12}=Y_{i2}-\lambda Y_{i1},$$
$$\delta T_{i12}=T_{i2}-\lambda T_{i1}$$
$$\delta E_{i12}=E_{i2}-\lambda E_{i1},$$
$$\delta M_{i12}=M_{i2}-\lambda M_{i1}.$$

Based on these deviations, we can determine deviations in production levels

$$\delta X_{i12}=\sum_j b_{ij2}(\delta Y_{j12}+\delta E_{j12}+\delta T_{j12}-\delta M_{j12}) \quad (2)$$

Where, $T_{j12}$- the change in intermediate use of industry $j$ caused by the change in technology between period 1 and period 2 (2005 and 2015 respectively). In this regard, the deviation of production in each sector from proportional growth between the two periods was represented as a summary of four components:

i) The change in domestic demand: $\sum_j b_{ij2}\delta Y_{j12}$;

ii) The change in export expansion: $\sum_j b_{ij2}\delta E_{j12}$;

iii) The change in imports: $-\sum_j b_{ij2}\delta M_{j12}$;

iv) The change in technological aspect: $-\sum_j b_{ij2}\delta T_{j12}$.

$\delta X$ is a vector of DPGs and its value is zero if all the sectors expand at the average ratio, $\lambda$, which corresponds to the situation of proportional growth (Fujikawa and Kuang-hui, 1992). Each element of $\delta X$ is the DPG of each sector. $\lambda$ was determined based on equation (1), which means that:

- DPG is positive when the sector is growing faster than the average;
- DPG is zero when the sector's expansion ratio is equal to $X$;

• DPG is negative when the sector's growing ratio is less than $X$.

Thus, the sign of DPG shows whether a sector has increased its output share, and its absolute value depends on the actual growth rate and production level of the sector. The summary of DPG is therefore zero（Fujikawa and Kuang-hui, 1995）.