

SECTORAL PRODUCTIVITY IN HUNGARIAN ECONOMY: AN INPUT-OUTPUT LINKAGES APPROACH

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ABSTRACT

Depending on the pace of economic development and structural reforms in an economy, the sectoral output level also changes. Usually, sectoral capital accumulation, labor reallocation across sectors, and total factor productivity contributes to sectoral performance. This paper explores the pace of economic development and sectors' role in the Hungary economy in the context of the demand and supply side. The current study aims to analyze input-output linkages to locate structural changes and inter-connectivity in the Hungarian economy. The main findings have shown that on the demand and supply sides, key sectors, such as manufacturing, metals, wholesale and retail trade, and telecommunications, are prominent. These sectors have an important place in the economy and need continuous monitoring to enhance productivity and output levels. The results lead to an important recommendation that the Hungarian economy needs to implement careful planning in order to attract Foreign Direct Investment (FDI) to be a hub of investment. There is also utmost importance to promote education to have human capital in order to meet long-term challenges. Lastly, the country still has a high level of global competitiveness, which sheds light on its new economic policies and its readiness for technical innovation, a successful marketplace, and specialization processes.

Keywords: Input-Output Model, Backward Linkages, Forward Linkages, key sectors, competitiveness

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INTRODUCTION

Global growth forecasted for the coming year shows that there are various challenges, such as

financial risks, trade tensions, market uncertainty, tariffs, and oil price fluctuations. In Central and Eastern Europe, there is change in growth due to consumer spending and

investment rates, but the region is still facing some challenges regarding aging populations, declining productivity, weakening investment, structural reforms, and climate change. Overall, there have been ongoing efforts and various monetary and fiscal plans to strengthen the region so as to be able to achieve long-term sustainable economic growth (World Bank, 2019).

In the Eastern European region, the Hungarian economy has gone through various challenges, such as unemployment, high costs of living, and social security. Over time, however, there has been a vital change in economic performance due to various market reforms, trade liberalization measures, and financial reforms. The OECD (2019) shed light on the fact that western and central parts of Hungary, namely Budapest, are the main foreign direct investment recipients in the country, but overall, there is still a need for balanced growth, regional integration, and enhanced supply chains to achieve economic progress. On top of that, the Hungarian government has plans to use sectoral taxes to manage budget deficits and public debt to avoid any further economic challenges.

After 1995, there was a prominent shift in Hungarian economic reforms because of a wave of privatization processes, which resulted in a market-oriented economy. This led to more effective allocation of resources, resulting in improved levels of productivity. Shen, Liu and Zeng (2018) pinpointed an interesting fact, applicable to the Hungarian economy, that the transition process can affect the speed of reforms. As such, reform strategy includes the spillover effect through different sectors in addition to the initial economic governance structure and leadership. The country achieved a prominent global role with high external trade, manufacturing value added, and strong disposable income. The International Monetary Fund (2019) report elaborated that with the economic expansion process, reducing fiscal vulnerabilities and enhancing structural reforms is necessary. Having the implication of new economic policies mix in order to moderate the external account surplus by driving domestic demand is important. Sajedi and Steinbach (2019) suggested that market reforms and fiscal deficit rules might not show immediate growth, but they can curtail long term economic benefits.

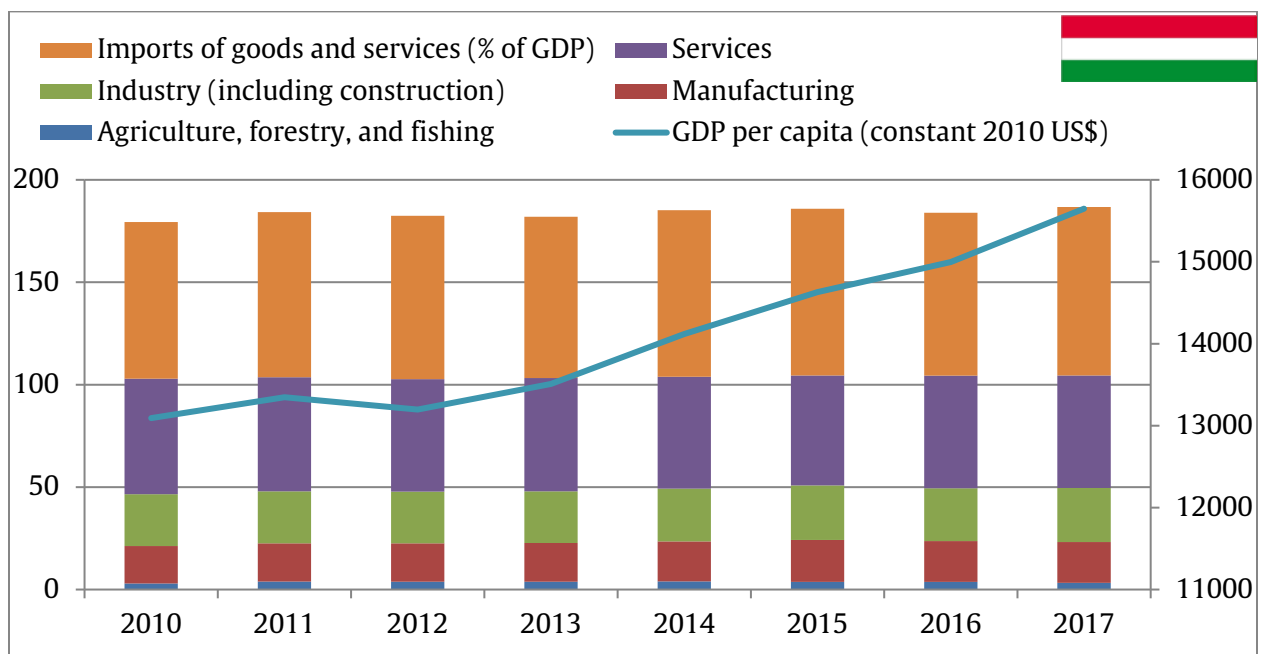


Figure 1: Contribution to GDP growth on production side in Hungary.

Source: World Bank Database (2019).

In the context of policy changes in Hungary during 2018, setting growth-friendly fiscal measures to achieve smaller deficits, which will reduce the burden on monetary policy, is desirable. Furthermore, improvements in tax administration will also boost revenue collection. Transformation of the real estate tax can help the government raise additional revenues to spend on healthcare, education, and infrastructure. Hungary's external position has strong fundamentals, but still has a need to improve productivity and competitiveness. This point further highlights the main aim of current study to analyze sectoral interaction to design effective policies to enhance productivity because structural reforms are a key to attaining economic growth and a high standard of living. In this regard, examining the demand and supply side economic activities in Hungarian economy is crucial.

Considering two aspects of the Hungarian economy – economic growth and sectoral performance at the production side – there is a rapid change in manufacturing and service sectors. There is also upward trend in GDP per capita and imports of goods and services as part

of GDP during the period between 2010 and 2017. At this point, increasing imports due to high domestic demand will put downward pressure on the current account surplus. The agriculture sector started off in relatively good shape, but due to its small weight, the effect of the sector remained neutral. Overall, various economic indicators highlight that there is strong economic performance and a retreat of the shadow economy (see Figure 1).

In contrast, Figure 2 displays various economic indicators from the expenditure side in the Hungarian economy. Household and government expenditures show high shares because of a boost in domestic demand and government fiscal measures. Exports are rising, but at the same time, FDI inflows show a sudden decline after 2016, which later began to recover. In this context, the government introduced the Hungarian Trade and Investment Agency (HITA) to implement protection measures for investment, bilateral trade, and small/ medium enterprises. This initiative has enabled more transparency and predictability to attract new investment opportunities in country.

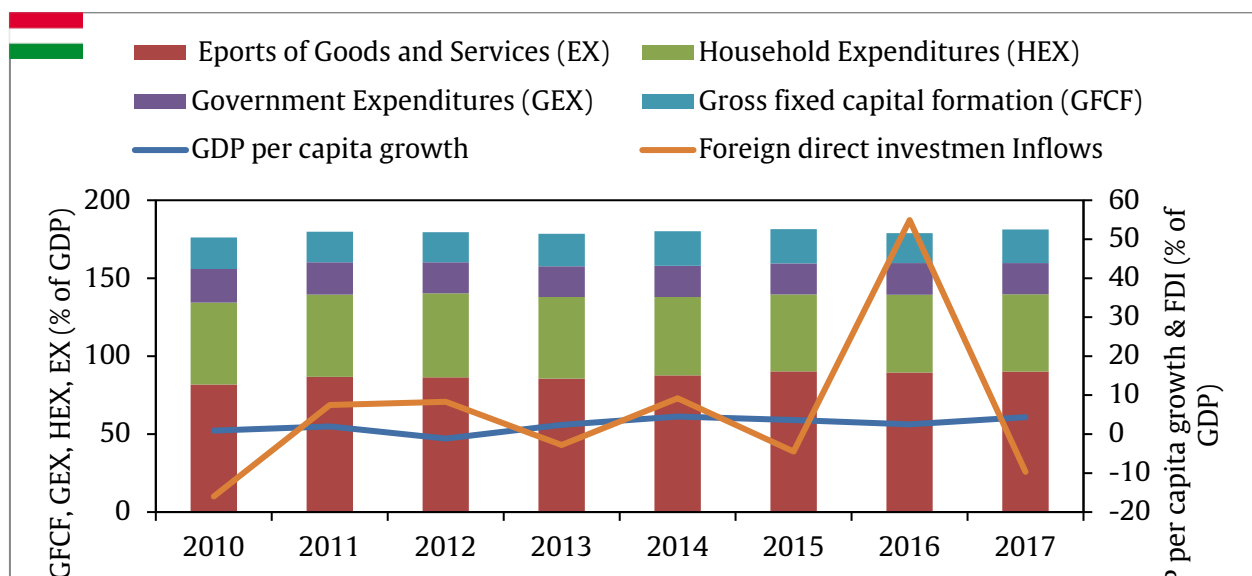


Figure 2: Contribution to GDP growth on expenditure side in Hungary.

Source: World Bank Database (2019).

In light of the aforementioned facts, there are various economic changes as a result of the pace

of development and relevant policies for the Hungarian economy. The country's economy is

one of the most globalized, making it more exposed to external threats; on the other hand, the economy's development can capitalize on relatively easy access to FDI, creating jobs, moving up the added value chain, and attracting cutting-edge technologies. Moreover, there are ongoing efforts to encourage investment in manufacturing and value-added sectors, such as research and development centers, manufacturing facilities, and service centers. As such, considerable opportunities are believed to exist in biotechnology, information and communications technologies, software development, the automotive industry, and tourism that will generate change in the sectoral share of the economy (U.S. Department of State, 2015). As such, in light of all policies, the objective of the current study is to highlight inter-sectoral relationships in the Hungarian economy. Moreover, using an input-output linkages approach allows the study to reveal details about how the economic structure functions and determine key sectors on the demand and supply side. The set of these important sectors that have been obtained can provide additional information about the main paths of long-term investment allocation.

The remainder of the paper is organized as follows: Section 2 summarizes the literature review and findings of past studies; the data sources and methodology used are presented in Section 3; the main results are discussed in Section 4; and finally, the conclusions and policy suggestions are presented in Section 5.

LITERATURE REVIEW

General equilibrium theory highlights the theoretical foundations for input-output analysis and is very helpful for investigating the growth and involvement of producer services in an economy (Daver, 1989). Luo (2013) explained that another important aspect of the sectoral level is pull and push effects, which means to quantify the demand and supply side with the pace of development. He mentioned that this process can enable us to establish feedback, not only between supply and demand, but between theory and application; a great advantage and an important tool for planners and decision-makers.

Sectoral linkages of financial services in the

Nigerian and Kenyan economies has been examined by Freytag and Fricke (2017), who highlighted the vital role of mobility of money in both economies. The results showed that there are high forward and backward linkages of the financial sector in Nigeria. As a key sector, this means that changes in final demand for any primary input widely impacts the economy. In the Kenyan economy, however, the linkages are lower because of a well-developed financial market.

Putten, Cvitanovic, and Fulton (2016) examined the connectedness of sectors with the marine sector to suggest better future policies. Their results shed light on the fact that fishing and aquaculture overlapped up and downstream industries, meaning that locating specific needs in relevant sectors for better performance and enhancement is important. Jun, Lee, and Choi (2018) reviewed the economic impacts of the small port industry on the Korean economy by using input-output linkages. They found that this industry is dominated by forward linkages, meaning that smart ports are used to provide intermediate materials to other industries. This also shows that this sector has a high impact on overall productivity, value added, and employment. In another study, Wang and Wang (2019) captured the direct and indirect contributions of the port industry in the Chinese economy. These results help to design new policy implications to enhance sectoral performance.

In any economy, locating key sectors is important, as they contribute highly to economic growth. Not only this, there should be appropriate policies to enhance that specific sector performance. Lee and Yoo (2016) examined the economic impact of the transportation sector in Korea. The main findings highlighted that there is a change in forward and backward linkages due to production, supply, and price effects. Furthermore, Yu (2017) also elaborated that the input-output model is a standard economic analysis tool that has the advantage of capturing interdependencies in an economy. He reviewed studies from 2000 onward regarding transportation-economic linkages, suggesting that it is important to very carefully aggregate sectors to get prominent results.

Government fiscal policies play a vital role in enhancing aggregate demand and supply with increased economic growth, but the main element is how to allocate the right amount in the appropriate sector. The Global Financial Crisis (GFC) has had a prominent effect on various world economies. Due to economic shock, there were various fiscal and monetary measures for key sectors to observe post-crisis performance. Bekhet and Yasmin (2015) analyzed the impact of the GFC on the Malaysian economy by looking at the pre- and post-crisis period. They found that government fiscal measures improved the performance of some sectors after the crisis, but some sectors appear to be in a rehabilitation stage. They also suggested that to harness the economic growth process there should be appropriate monitoring processes for the long run. Similarly, Borghi (2017) presented the impact of various policy measures on the Brazilian economy after the crisis. He concluded that industrial sectors saw better performance as they improved production and employment. In further support of this finding, Morrone (2017) emphasized that during the post-crisis period in Brazil, locating which sectors should be stimulated, on a priority basis, is important. As such, key sectors should be focused on first because they have a huge multiplier effect on the economy.

With changing various economic policies, there will also be changes in sectoral performance, specifically with the pace of development. Gurgul and Lach (2018) pinpointed the role of the Polish economy in the 21st century as a result of the introduction of many policies in the EU region. This analysis proposed various changes that can bring further economic growth on a regional basis in terms of allocation of resources. In another study, Emerick (2018) mentioned that reallocation of resources is important to sectoral performance. He elaborated that, due to increased demand, the output level in the agricultural sector was also enhanced, leading it to require a larger labor force.

Technical innovation and knowledge development have also changed the production process and factor input. This impact was examined by Malhotra, Schmidt, and Huenteler (2019), whose study mentioned that inter-

sectoral learning patterns generate long term innovation. They believed that learning and innovation processes can change a sector's productivity and also impact other economic activities. The innovation aspect was also elaborated by Du, Li, Guo, and Tang (2019), who proposed a knowledge tracking model for biomedical innovation based on analysis of input-output linkages. They suggested that R&D inputs are an effective knowledge strategy which can result in fundamental changes in sectors' performance.

In summary, input-output inter-sectoral linkage analysis has been carried out for various countries, as it helps to determine supply-demand relationships. In this regard, examining the role of various sectors is critically important, since they indicate the role of these sectors in any economy is their share in GDP. Determining the sectors that provide inputs to other sectors and have a certain level of production due to changes in economic activities and aggregate demand policies is also important. Most previous studies have examined the various dimensions of sectoral analysis; however, there is a still need for in depth analysis of Eastern Europe economies such as Hungary. Thus, the current study fills the gaps from previous studies and highlights key sectors, which play vital roles in the innovation and development process, while suggesting various policy implications for the Hungarian economy.

DATA AND METHODOLOGY

The present study uses secondary data based on the latest available input-output table compiled for the Hungarian economy, from 2011. This table is managed by the OECD database, with 34 sectors. For analytical and in-depth analysis purposes, the original table has been used, with 34 sectors based on International Standard Industrial Classification (ISIC). These sectors are shown in the appendices (see Appendix Table A1).

Input-output linkage analysis is an effective methodology for analyzing the economic effect of production in a particular sector on other sectors in any economy. From the demand side model, if a particular sector j increases its output, there will be increased demand of inputs from this sector as a purchaser. This

direction, called “backward linkages,” displays the interconnections of a specific sector with upstream sectors. With increased output in sector j , there will be an additional amount available from this sector as a supplier. This mechanism is on the supply side and is called “forward linkages” to indicate the interconnection in the downstream sectors where it sells its output.

Input-output linkages provide sectoral connectedness in an economy and also highlight the key or leading sectors. Early research includes Rasmussen (1957), Hirschman (1958), and Chenery and Watanabe (1958), who emphasized the identification of key sectors and their role in development plans. With the passage of time, there were some further suggestions about combining backward and forward linkages (see Cella, 1984; Clements, 1990 and Adamou and Gowdy, 1990).

As mentioned in the previous section, Leontief (1966), a pioneer of input-output analysis, mentioned that the I-O tables serve as a dataset for in depth analysis, providing the tools to perform economic modelling, construct a structural analysis of the economy, and identify sectors’ composition and the effect changes have on final demand. The fundamental concept of input-output analysis is based on the fact that any economy consists of various n sectors and there is total output as X_i , which means the production of specific sector i and final demand f_i as represented in Equation (1):

$$x_i = z_{i1} + z_{i2} + \dots + z_{in} + f_i = \sum_{j=1}^n z_{ij} + f_i \quad (1)$$

The variable z_{ij} represents interconnect-tedness as intermediate sales to all other economic sectors j . This leads to the input coefficients matrix, a_{ij} , which consists of intermediate inputs as a share of total inputs, x_j , including value added. Mathematically, we can represent it as Equation (2):

$$a_{ij} = \frac{z_{ij}}{x_j} \quad (2)$$

In the early literature, Hirschman’s (1958) study emphasized that industry linkages were essential for various economic development policies. These linkages serve as important tools, especially in poor countries, to target appropriate investment in industries with the strongest linkages. Later, the one sector model became the standard framework to study growth and has also been used as a tool to analyze sector productivity (see Chenery, Robinson and Syrquin, 1986; Ciccone, 2002; Acemoglu, Antras and Helpman, 2007; Miller and Blair, 2009 and Jones, 2011). Table 3 shows the application of the key-linkage hypothesis as the concept of backward and forward linkage indices, as well as direct and indirect effects.

Table 1: Backward and Forward Linkages Mechanism

	Backward Linkages	Forward Linkages
Direct	$BL(d)_j = \sum_{i=1}^n a_{ij}$	$FL(d)_j = \sum_{j=1}^n b_{ij}$
Total	$BL(t)_j = \sum_{i=1}^n l_{ij}$	$FL(t)_i = \sum_{j=1}^n g_{ij}$

Source: Author’s Illustration.

Furthermore, Rasmussen (1957) suggested that having a normalization process, by comparing the average values, is an important

step. The $(I-A)^j$ matrix captures the increase in output of the i th industry (see Equation 4). This index can be taken into account as a dispersion

index, which displays that high $q_j > 1$ on the backward linkage side means this industry needs a comparatively large production increase to fulfill the increased final demand. Thus, the coefficient of variation, J_j can be seen in Equation (5)

$$q_j = \frac{\frac{1}{n} i'(I-A)^{-1}}{\frac{1}{n^2} i'(I-A)^{-1}} \quad (4)$$

$$J_j = \sqrt{\frac{\left(\frac{1}{n-1}\sum_{i=1}^n (c_{ij} - \frac{1}{n}\sum_{i=1}^n c_{ij})\right)^2}{\frac{1}{n}\sum_{i=1}^n c_{ij}}} \quad (5)$$

On the other hand, on the forward side, it implies that the index $q_j > 1$ means this industry needs to increase the level of output as compared to other economic sectors in order to supply more inputs. Here, the $(I-O)^{-1}$ matrix represents output enhancement from j th sector (see Equation 6). For further justification, Carter and Brody (1970) mentioned that it is better to have an index of sensitivity of dispersion for forward linkages, also as in Equation (7).

$$q_j = \frac{\frac{1}{n} i'(I-O)^{-1}}{\frac{1}{n^2} i'(I-O)^{-1}} \quad (6)$$

$$J_i = \sqrt{\frac{\left(\frac{1}{n-1}\sum_{j=1}^n (v_{ij} - \frac{1}{n}\sum_{j=1}^n v_{ij})\right)^2}{\frac{1}{n}\sum_{j=1}^n v_{ij}}} \quad (7)$$

OUTCOME OF ANALYSIS

Based on the objective of the current study, the main findings show the empirical results of linkages in the production process in the Hungarian economy. We can also observe various indicators such as technical change, distortions in the market, and welfare in the economy. The overall backward linkages results are summarized in the appendices (Table A2). These indices show the extent to which the output of a particular sector stimulates the production of its inputs, meaning that when an

industry increases its production, there is increased demand for inputs from other industries. In the case of the Hungarian economy, various sectors display high ranks based on total linkages indices, such as: computer, electronic, and optical equipment (1); electrical machinery and apparatuses (2); motor vehicles, trailers, and semi-trailers (3); hotels and restaurants (4); transportation and storage (5); wholesale and retail trade; repairs (6); and machinery and equipment (7). This justifies that various manufacturing industries play a vital role in a country's economy, but this also signifies an important point that sometimes exports, and offshoring can destabilize European economies. Thus, to boost manufacturing sector productivity there should be a focus on R&D because high value-added shares may lead to an overall higher R&D intensity (Coad and Vezzani, 2019). From the production input aspect, this also verifies various expansionary fiscal and monetary policies the Hungarian government can implement to boost economic growth. This point also justified by Bekhet (2010), who pointed out that sectors with high backward linkages have a high dependence on intermediate goods, which are typically capital-intensive. Therefore, these investments will generate further revenues in the long run.

On the other hand, an increase in production by other industries leads to additional output required from the supply industry to meet the increased demand for inputs. This supply function is referred to as forward linkage, as documented in Table A3. In this context, key sectors are: basic metals (1); R&D and other business activities (2); mining and quarrying (3); computer and related activities (4); financial intermediation (5); renting of machinery and equipment (6) and wholesale and retail trade; and repairs (7). These findings elaborate a significant indicator that various sectors in the Hungarian economy are effective and efficient because R&D ranks high and also because of financial intermediation. This means that planned allocation of resources and financial measures to enhance the productivity in the country are present.

Table 2 shows the summary of demand and supply side linkages as the sectors with high q_j

and q_j with lower J_j and J_i , meaning that these sectors would need a comparatively large production increase to cope with one unit increase in the final demand for the industry j . So, the economic application of $q_j > 1$ would be that the relevant industry would draw more heavily than compared to other industries. Furthermore, the coefficient of variation (J_j) has been measured to gain a more appropriate

result. Chenery and Watanabe (1958) explained that a low J_j means that investment in this sector will stimulate other sectors evenly. For all twelve sectors appearing in the backward side, considering them for investment on a priority basis is important. This is also vice versa applicable to the other twelve sectors as forward linkages (q_i) with low variation indices as (J_i).

Table 2. Backward & Forward Linkages and Coefficient of Variation

No.	Sectors	Backward Linkages $q_j > 1$	J_j
1	Food products, beverages and tobacco	1.8411	0.6440
2	Coke, refined petroleum products and nuclear fuel	1.7812	0.6746
3	Basic metals	2.1941	0.7172
4	Machinery and equipment	1.8773	0.6363
5	Electrical machinery and apparatus	2.2662	0.5587
6	Motor vehicles, trailers and semi-trailers	2.1428	0.6300
7	Manufacturing and recycling	1.7150	0.6074
8	Wholesale and retail trade; repairs	1.8904	0.6321
9	Post and telecommunications	1.6587	0.6479
10	Hotels and restaurants	2.0667	0.5231
11	Transport and storage	2.0005	0.6811
12	Other community, social and personal services	1.7790	0.7142
No.	Sectors	Forward Linkages $q_i > 1$	J_i
1	Mining and quarrying	2.7178	0.6672
2	Wood and products of wood and cork	1.7852	0.8088
3	Basic metals	2.9503	0.7132
4	Fabricated metal products	1.8192	0.8161
5	Electrical machinery and apparatus	2.2586	0.7951
6	Manufacturing and recycling	2.2928	0.6742
7	Wholesale and retail trade; repairs	2.3077	0.7167
8	Post and telecommunications	1.9031	0.7453
9	Financial intermediation	2.5253	0.7825
10	Renting of machinery and equipment	2.4506	0.6457
11	Computer and related activities	2.6427	0.6747
12	R&D and other business activities	2.8919	0.6784

Source: Table A2 & A3.

Overall, sectors with a high forward linkage effect and a high backward linkage effect could be regarded as key sectors of the Hungarian economy in the period under study (see Figure 3). Firstly, basic metals play a vital role aluminum profiles and sheets, manufacturing and assembling structures, designing and

manufacturing special prototypes, aluminum (MIG and WIG) welding, heat treatment, and tube drawing. Secondly, machinery is a key sector regarding the exports market in generating revenues. Thirdly, the manufacturing sector is another contributor to exports, led specifically by machinery, electric machinery,

vehicles, electronics, IT equipment, automotive components, industrial engines, and other manufacturing technologies and supplies. It is dominated mainly by large international companies, which accounts for a large proportion of Hungarian value added, and integration of domestic SMEs into this value chain remains weak. From the service sectors aspect, wholesale and retail trade and

telecommunication appear to be key sectors, namely due to changes in the composition of sectors' shares in GDP growth (see Bekhet, 2012, 2013; Yamashita, Matsuura and Nakajima 2014; Baldwin and Venables, 2015; Dungey and Volkov, 2018).

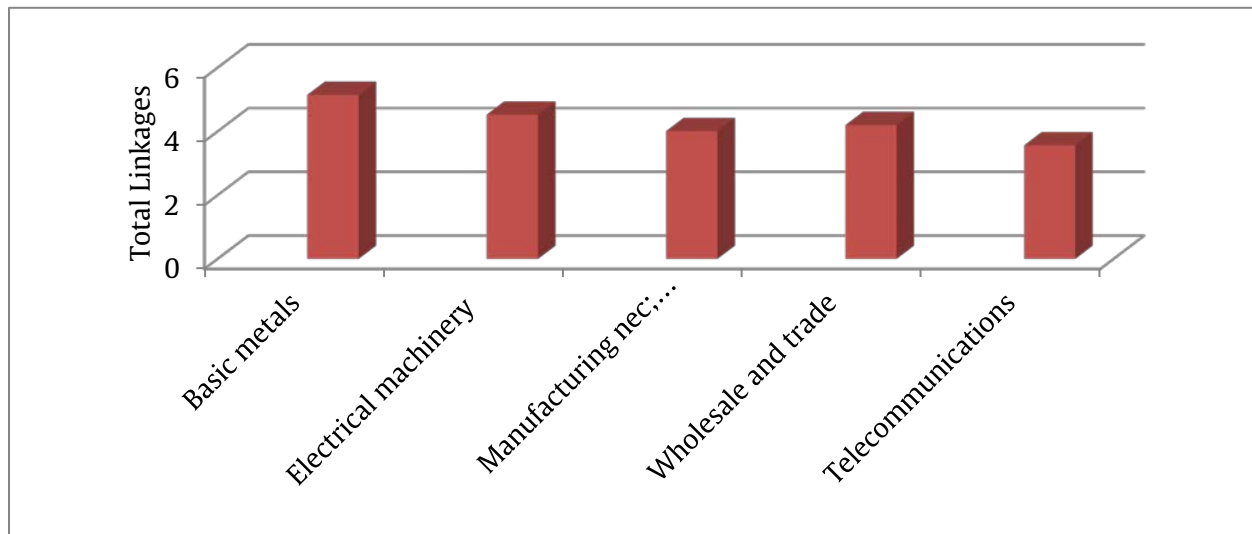


Figure 3: Key Sectors in Hungary.
Source: Table 1.

CONCLUSION AND POLICY IMPLICATIONS

The main findings drawn from the study show that there are various important sectors on the demand and supply sides. On the demand side, most sectors are manufacturing and service sectors, whereas on the supply side, most of the sectors are services. The prominent key sectors are basic metals, electrical machinery, manufacturing, wholesale and retail trade, and telecommunication. These sectors should be prioritized in the planning process in Hungary to reach long-term benefits. In summary, it is important for transition economies to develop effective strategies to achieve a growth path for high-potential sectors (see Nobuaki, Toshiyuki and Kentaro, 2014; Gurgul and Lach, 2015; Kichko, 2017). There are also ongoing changes in the structure of the Hungarian economy, and that also has an impact on the final demand.

Therefore, the findings about the production structure enlighten the potential of some export-oriented sectors, such as food, mining, and electronics to enhance GDP growth in the country. As such, Hungarian policy makers are introducing various strategies to enhance openness as free trade and mutual cooperation are crucial to securing multiregional trade.

The main results suggest various policies to implement in the Hungarian economy for long-term sustainable economic growth. Firstly, Hungary is widely considered to be the gateway to Central and Southeast Europe, which makes it an attractive market for foreign investment; however, maintaining various laws regarding credit institutions, financial enterprises, currency exchange, and money processing activities is highly important. In this context, the "New Hungarian legislation" on national

security screening of foreign investment is a remarkable step. Secondly, the innovation and R&D economy always fairly easily leads to diversified economy. The Hungarian economy already has a R&D sector with a high forward linkage index, which shows the country's strong innovation capacity. Ongoing policies to invest in innovation projects and human capital development will result in both local and global benefits. A comprehensive training system and consultation, including vocational training and covering skill gaps, will generate successful entrepreneurs and a positive business environment.

Thirdly, the conjunction of the demographic and economic transition in Hungary still has some effects on its economic performance, making the creation and implementation of initiatives to combat risk elements such as public expenditures, large pensions, an aging population, and healthcare facilities an important task. In particular, due to the aging population, a large share of public expenditures need to be allocated for health care, which also leads to labor shortages. To reduce this dependency ratio, there should also be some incentives to enhance family size.

Lastly, global competitiveness indices have shown that Hungary has taken the 60th position, and the economy's performance is enhancing due to an improvement in technological readiness. The macroeconomic environment and education are strong pillars that contribute to competitiveness (World Economic Forum (2018). Financial development is another aspect that will promote the business environment using the flexible regulatory framework in Hungary. Due to various new government policies, there are also three major initiatives that can boost economic growth as industry change, adaption strategies, and specialization progress. Future studies can compare various years to observe the sectoral changes on an annual basis. Structural decomposition analysis can be conducted to look in-depth at sector performance based on output and final demand changes during various years. Applying input-output multipliers can also broaden the research aspect by having employment and income multipliers to even further examine changes.

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