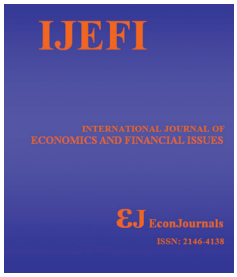

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Has EU Accession Caused Structural Change in New Entrants? Intersectoral Linkage Analyses on Bulgaria and Romania

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ABSTRACT

The European Union (EU) countries, especially the founders and earlier entrants (EU-15) are among the most-developed, post-industrial and innovation-driven economies in the world. Countries with different structures are expected to have progressive structural changes after their accessions to the EU by means of the intra-EU policies on socio-economic integration and monetary (Euro) adoption. Starting from this convergence premise, this study aims to explore whether the latest member states, Bulgaria and Romania, that joined the EU in 2007, have experienced significant changes in their economic structures. To this end, with a general equilibrium approach and using input-output data of the countries, we conduct intersectoral linkage analyses covering all economic activities aggregated to 34 sectors for the years of 1995, 2002, 2007 and 2011. Backward and forward linkage coefficients calculated from inverse matrices based on the Leontief model and the Ghosh model reveal that there is no strong evidence found supporting the structural change experiences in the 5th year of the EU accession for both countries.

Keywords: EU Accession, Input-output Model, Linkage Analysis, Structural Change
JEL Classifications: C67, D57, F15, L52

1. INTRODUCTION

Today, the European Union (EU) is the largest economy, the biggest exporter and importer, and the leading host and home region of the international investment flows, in the world. With just 7% of the world's population, it accounts for over one quarter of the world's wealth as measured by gross domestic product. The EU is the biggest trading partner for about 60 countries. Five EU countries (Germany, France, Netherlands, Italy and United Kingdom) are among the most exporting 10 countries. As affirmed by the European Commission (2014) the EU is one of the world's most outward-oriented economies and intends to remain so. Because the EU member countries have committed to pursue common policies there are economic interactions expected between the EU dynamics and new members.

From a core membership of six countries at the outset in 1957, the EU accessions reached 28 countries in 2013. Unlike the previous four ones, fifth enlargement, occurred in 2004, was the largest single expansion in terms of territory, number of states, and population (European Union, 2016). This enlargement also has another importance that it has brought formerly socialist countries into the EU. Even some problems were expected arising from the economic transformation to a free market economy in post-communist countries; these countries have had a relatively fast orientation. These transitions seem to have accelerated after the EU accession that now Croatia, Cyprus, Latvia and Poland are among the emerging industrial economies, not only in Europe, but also in the world as grouped by the United Nations Industrial Development Organization-UNIDO (Upadhyaya, 2013). This is true for Bulgaria and Romania that joined the EU in 2007. Moreover, Czech Republic, Hungary, Lithuania, Slovakia and Slovenia, the other countries that got accession to the EU in 2004 are usually with the developed, high-income and industrialized countries in most country classifications.

Even the relative success of the eight central and eastern European countries (Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, and Slovenia) that have joined the EU in 2004, the Balkan countries' accessions are considered

to be different in several aspects. Balkan countries are not only relatively under-developed compare to the other member countries but also economic, social-political, and institutional backwards characterize this region. Comparing the eight transition economies that have high human capital accumulation, political and economic stability, and better infrastructures, Balkan region is thought to have different impacts on the EU (Baourakis at al., 2008). However, because of the spillovers from the EU dynamics and the access to the international markets to Bulgaria and Romania, sizable overall integration gains are expected for these countries (Breuss, 2008). Even the currently large gaps in income levels between East and West Europe, this integration steps are projected to bring a convergence process in gross domestic products of the new entrants.

Many studies have examined actual and potential impacts of the EU accession on the new member countries with multidimensional aspects. They mainly focus on the EU policies, funds, migration, investment, foreign aid, the progress of market reforms and economic growth together with political, economic and legal stability, economic freedom and integration in the world economy (Balcerowicz, 2007; Baourakis et al., 2008; Breuss, 2008; Avery et al., 2009; Rapacki and Prochniak, 2009; Narula and Bellak, 2009; Feliciano and Doytch, 2016). The interest of studies seems to have restricted to the actual and potential impacts of EU cohesion policies. This interest has increased as the EU has enlarged gradually. After accession, new member countries face change pressures in their internal policies, legal systems, market regulations, etc., that starts before the accession, i.e., in the negotiation process. Even these interests, studies seem to be neglecting the structural changes that new member countries have experienced after the EU accession. This neglect seems to be caused by the unavailability of input-output data that can capture structural changes in term of domestic intersectoral relationships.

Starting from this neglect and pointing to the importance of input-output data, this study investigate the intersectoral linkages of Bulgaria and Romania that joined the EU in 2007, to explore whether they have experienced significant changes in their economic structures after the EU accession. In the next section, we present theoretical background and methodology, respectively, within the input-output theory and intersectoral linkage analysis. After demonstrating empirical results, the study concludes with a discussion on the evidence.

2. THEORETICAL BACKGROUND: INTERSECTORAL LINKAGES

After the Second World War, much attention was directed to the problem of development. Rosenstein-Rodan (1943; 1961) and Nurkse (1952) along with some others argued the persistent vicious circle that firms were not industrialized because there was no market for their goods, and there was no market for their goods because income was low, and income was low because firms were not industrialized. It was suggested that, this kind of low-income level cycle could be broken by the simultaneous industrialization of a large part of the economy. Failure in industrialization is seen in because of the coordination problem. All these suggestions are called the big push or balanced growth doctrine (Krishna and Perez, 2005).

Economic rationale for the intersectoral linkages theory is based on Hirschman's (1958) unbalanced growth hypothesis that point out the necessity of promoting economic growth by initially investing in leading (key) industries in developing countries. Even it was initially thought as an alternative of Nurkse's (1952) balanced-growth theory and big-push hypothesis of Rosenstein-Rodan (1943; 1961), later it was understood better that Hirschman (1958), while agreeing on the existence of a vicious circle, underlined the scarcity of the investment to push the all economy. Since the developing countries do not have enough investment, they need to be selective to subsidize the sectors that can stimulate the others spontaneously. To this end, governments attempted to determine the priorities of sectors in their economic structures, especially in 1950s and 1960s, the decades that many developing countries started to plan their economies. Accordingly, some seminal studies like those of Rasmussen (1956), Chenery and Watanabe (1958) ve Hirschman (1958) encouraged these efforts of the developing countries. At those times, governments started to compute input-output data that are required to determine leading sectors and to calculate reciprocal dependencies between sectors.

Input-output tables provide all aspects of the national accounts related to goods and services, including expenditure aggregates. The roots of input-out tables go back to Quesnay's economic table. This simple table pioneered to modern input-output tables especially with influential contribution of Leontief (1936; 1951; 1953; 1966) who combined Walras' general equilibrium approach, Quesnay's economic table and Keynesian multipliers in the same model.

The only data source to measure intersectoral linkages from is, for now, input-output tables. The input-output tables are also required to be arranged within the Leontief (1936; 1951; 1966) and Ghosh (1958) model, simultaneously. Related studies seem to be restricted to the developed countries depending on the availability of input-output data: Only a few developing countries provide input-output data, systematically. Beside this technical restriction, they do not have enough sources to inject into the leading sectors. Moreover, developing countries with a few exceptions have minimized government interventions on their economies according to the liberalization and international integration accelerated especially since the late 1970s. Consequently, some researchers believe that intersectoral linkage analysis used to be more appropriate for planned economies. In the study, we do not specifically attempt to identify the leading sectors; rather we determine the production structures related to the intersectoral linkages for Bulgaria and Romania, to assess whether there are significant changes before and after the EU accession.

Intersectoral linkage analysis is based on an economic rationale that no industry is independent from others. Within input-output framework, there are two kinds of economic linkages between sectors. On the one hand, if sector *i* increases its output, then also itself and other sectors producing contents used by the

sector *i*, have increased demand, as well. This is an intersectoral demand relationship. On the other hand, increased output in sector *i* also means that additional amounts of products that *i* produce are available to be used as inputs to production in the other sectors. This is an intersectoral supply relationship. These two linkages are referred backward linkage (BL) and forward linkage (FL), respectively (Reis and Rua, 2006). After Rasmussen (1956) suggested using intersectoral linkage coefficients as interdependences of the sectors, Hirschman (1958) defined the sectors with high linkage coefficients as leading sectors. Finally, Chenery and Watanabe (1958) ranked sectors in terms of their importance, i.e., by linkages coefficients.

In a static input-output structure, the column sums of the Leontief inverse matrix and the row sums of Ghosh inverse matrix give the total BL and FL, respectively. Rasmussen (1956) and Hirschman (1958) concluded that most crucial sectors are the ones that have high coefficients in both BL and FL. The sectors with high BL but low FL are still important, while the sectors with high FL but low BL are less crucial that they have limited linkage effects over the other sectors. The least important sectors are those that have both low BL and FL.

3. METHODOLOGY: INPUT-OUTPUT MODELS AND LINKAGE ANALYSIS

In a production structure of an economy, each sector depends, directly or indirectly, on the other sectors: If sector *i* uses input from sector *j* and sector *j* buys content from sector *k*, production of the sector *i* directly depends on the sector *j*, and indirectly on the sector *k*. These complex relationships can be tracked from the input-output tables. When an economy has *n* sectors, the simplified pattern of a domestic input-output table of this country is illustrated as in the Table 1.

In Table 1, x_{11} denotes intermediates flows from sector *i* to sector *j* (the inputs that flow from the first sector to first, second and n^{th} sector, respectively), d_i shows the final demand of sector *i* for its production and X_i is the total output of sector *i*. Finally, c_j shows how much content (input) the sector *j* uses in total. Input coefficients ($a_{ij}=x_{ij}/X_j$) can be expressed in the form of input coefficient matrix as in Equation 1:

$$|A| = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}_{3\times 3} \quad (1)$$

In the input-output framework, there are several approaches to follow while quantifying intersectoral interdependences using input-output tables. Most common ones are Leontief and Ghosh models (Lenzen, 2003; Temurshoev and Oosterhaven, 2010).

Alike the Keynesian multiplier model, Leontief's static quantity model is based on the total demand (AD) = Total supply (AS) identity and it shows the intersectoral transactions $(X=\{X_{ij}\}_{i,j=1,\ldots,N})$ in monetary terms. When we denote static Leontief model as $x=Ax+y$, where *x* is the *n*×1 endogenous vector

Table 1: Simple input-output table

???	Sectors (industries)	Final demand	Total
Sectors (industries)	$x_{11}\ x_{12}\ \cdots\ x_{1n}$ $x_{21}\ x_{22}\ \ldots\ x_{2n}$ $\vdots\ \vdots\ \vdots\ \vdots$ $x_{n1}\ x_{n2}\ \cdots\ x_{nn}$	d_1 d_2 $\vdots$ d_n	X_1 X_2 $\vdots$ X_n
Primary inputs	$C_1\ C_2\ \cdots\ C_n$		C
Totals	$X_1\ X_2\ \cdots\ X_n$	D	

of gross outputs of *n* sectors, *A* is the *n*×*n* direct input requirements matrix seen in the Equation 1, and *y* is the *n*×1 exogenous vector of final demands. When we denote the matrix of intermediate flows by *Z*, then z_{ij} is the values of deliveries from sector *i* to sector *j*. When $\hat{x}$ refer to the diagonal matrix with the elements of the vector *x*, the input coefficients matrix is derived as $A=Z\hat{x}^{-1}$ that its typical element a_{ij} shows the output of industry *i* directly required as input for one unit of output in industry *j*. Main equation of this model, that associates a relationship between exogenous final demand ($y(N\times 1)$) and total output as seen in Equation 2.

$$x=(I-A)^{-1}y=Ly\rightarrow x=Ly \quad (2)$$

Where *x* is production output by industry, *I* is an *N*×*N* identity matrix, *A* ($A=\{A_{ij}\}=\{X_{ij}/x_j\}$) the matrix of intermediate input coefficients, $L=(I-A)^{-1}$ is Leontief inverse matrix and *y* is final demand by industry. Here, an l_{ij} element of L_{ij} denotes the output in sector directly and indirectly required to satisfy one unit of final demand in sector *j*. When we define the row vector of output multipliers $m_o'=\imath' L$ as where $\imath$ is the summation vector of related sectors. Its i^{th} element $m_i^o=\sum_{k=1}^{n} l_{ki}$ indicates the increase of total output in all sectors per unit increase of final demand in sector *i*. It is called the total BL of sector *i*, which can be denoted by the Equation 3:

$$b_i=m_i^o=\sum_{k=1}^{n} l_{ki} \quad (3)$$

From the input side, the accounting identity that holds each period is $\imath' Z+v'=x'$ where *v* is the total primary input vector (i.e., payments to labor, capital and imports). Similarly, when we define the matrix of output coefficients by $B=\hat{x}^{-1}Z$, the accounting identity then can be written as $x'B+v'=x'$. This is the Ghosh model that main equation of the Ghosh model associates a relationship between exogenous primary inputs $v(1\times N)$ and total outputs as seen in the Equation 4.

$$x'=v(I-B)^{-1}=vG\rightarrow x'=v'G \quad (4)$$

Where $G=(I-B)^{-1}$ is the Ghosh inverse matrix and the typical element g_{ij} of *G* is interpreted as measuring the direct and indirect value increase of output in sector *j* due to a unit increase in price of the primary inputs in sector *i*., that is FL: The i^{th} row sum of *G* is accordingly gives the increase of the value

of total output in all sectors per unit price increase of primary inputs in sector *i*. Finally the total FL of sector *i* is defined as in Equation 5:

$$f_i = \sum_{k=1}^{n} g_{ik} \quad (5)$$

This gives the row sum of Ghosh inverse matrix, and so does FL (Lenzen, 2003; Miller and Blair, 2009; and Temurshoev and Oosterhaven, 2010, for further explanations).

4. RESULTS

We adopt augmented Leontief and Ghosh models to assess the BL and FL effects, respectively. Here we present the results for the two latest new EU-member countries, namely Bulgaria and Romania. These southeast Balkan countries joined the EU in 2007, so we present the results for 4 years: 1995, 2002, 2007, and 2011. In order to be able to capture possible structural changes we start from the 1995 that represents the period before the EU process. The results for the years 2002 and 2007 refer to accession negotiations and formal membership, respectively. Finally, results of the year 2011 are used to check possible structural changes after the EU accession.

We used harmonized input-output tables of these countries from OECD input-output database. Following OECD (2016), the results are reported in 34 sectors under the ISIC (Rev. 3) classification as seen in the Table 2.

Results from the intersectoral linkage analysis for Bulgaria are reported in the Table 3. When both high BL and FL affects are considered, 01-05 (agriculture, hunting, forestry and fishing) and 45 (construction) seem to be main leading sector aggregations for Bulgaria. These findings are true for all years that support no considerable differences between the structures before and after the EU accession. However, FL effect of the sector group 01-05 has decreased gradually over the years: The coefficient is 2.644 in 1995 and decreased to 1.953, 1.631 and 1.390 in 2002, 2007 and 2011, respectively. Hence, the outputs these sector produce are not used by the other sectors and by itself as much as they were used before.

However, there are not such variations in the sector group 45 over the years that construction seems to be a core sector stimulating the other sectors and itself. In manufacturing sectors (15-37), 21-22 (pulp, paper and paper products; printing and publishing) have relatively high BL and FL along with basic metals groups (27). For BL effects, 20 (wood and products of wood and cork), 24 (chemicals and chemical products), 26 (other non-metallic mineral products), 31 (not elsewhere classified electrical machinery and apparatus), 31 (not elsewhere classified electrical machinery and apparatus), 35 (other transport equipment) and 36-37 (not elsewhere classified manufacturing and recycling) have linkages affect over other sectors and themselves. However, there are not changes seen depending on the EU accession in manufacturing sectors.

On the services sectors (40-95), beside the construction's (45) relatively high importance, electricity, gas and water supply (40-41), wholesale and retail trade and repairs (50-52), transport and storage (60-63) together with the research and development and other business activities (73-74) have relatively strong contributions to the other sectors. Moreover, the sector of other community, social and personal services (90-93) has high BL while financial intermediation (65-67) has higher FL. One sectors group that has distinctive increases over the time is 60-63 (transport and storage). In these sectors, especially FL has increased that the FL value of 0.999 in 1995, increased to 1.859 in 2002 and to 1.861 in 2007. Its value reached 2.000 in 2011. This can be premised as the reflection of the EU funds on the infrastructure development in Bulgaria. Even, the sharp increase in 1995 and 2002, i.e., before the EU membership, has weakened this premise, the contribution of the pre-accession programs and financial assistance of the EU cannot be denied.

As it is shown in Table 4 Romania has a production structure that is not that different from that of Bulgaria. However, Romania's main leading sectors are 40-41 (electricity, gas and water supply), 01-05 (agriculture, hunting, forestry and fishing), 10-14 (mining and

Table 2: ISIC of all economic activities, Rev. 3

ISIC codes	Sector definitions
01-05	Agriculture, hunting, forestry and fishing
10-14	Mining and quarrying
15-16	Food products, beverages and tobacco
17-19	Textiles, textile products, leather and footwear
20	Wood and products of wood and cork
21-22	Pulp, paper, paper products, printing and publishing
23	Coke, refined petroleum products and nuclear fuel
24	Chemicals and chemical products
25	Rubber and plastics products
26	Other non-metallic mineral products
27	Basic metals
28	Fabricated metal products
29	Machinery and equipment, not elsewhere classified
30-33	Computer, Electronic and optical equipment
31	Electrical machinery and apparatus, not elsewhere classified
34	Motor vehicles, trailers and semi-trailers
35	Other transport equipment
36-37	Manufacturing, not elsewhere classified; recycling
40-41	Electricity, gas and water supply
45	Construction
50-52	Wholesale and retail trade; repairs
55	Hotels and restaurants
60-63	Transport and storage
64	Post and telecommunications
65-67	Financial intermediation
70	Real estate activities
71	Renting of machinery and equipment
72	Computer and related activities
73-74	Research and development and other business activities
75	Public administration and defense; compulsory social security
80	Education
85	Health and social work
90-93	Other community, social and personal services
95	Private households with employed persons

Source: Adapted from OECD (2016) input-output database. 01-14:Primary sectors, 15-37:Secondary (manufacturing) sectors, 40-95:Tertiary (service) sectors.. ISIC: International Standard Industrial Classification

Table 3: Sectoral linkages and leading sectors for Bulgaria

ISIC Rev. 3	1995		2002		2007*		2011	
codes	BL	FL	BL	FL	BL	FL	BL	FL
01-05	1.151	2.644	1.141	1.953	1.162	1.631	1.148	1.390
10-14	1.084	1.177	1.046	1.067	0.931	1.078	1.027	1.173
15-16	1.321	1.052	1.336	0.856	1.397	1.053	1.325	0.896
17-19	1.021	0.961	0.822	0.678	0.905	0.711	0.858	0.701
20	1.333	0.914	1.293	0.739	1.255	0.846	1.244	0.816
21-22	1.313	1.351	1.110	1.002	1.119	1.037	1.055	0.923
23	1.120	1.225	0.998	1.437	0.883	1.193	0.963	1.127
24	1.139	0.826	1.022	0.882	1.007	0.937	1.034	0.820
25	0.954	0.744	0.963	0.781	1.023	0.829	0.942	0.794
26	1.128	0.827	1.129	0.882	1.022	0.988	1.038	0.857
27	1.163	1.089	1.176	1.171	0.985	1.183	1.034	0.902
28	1.131	0.718	0.956	0.786	0.959	0.802	1.005	0.829
29	0.986	0.739	1.028	0.736	1.033	0.801	1.080	0.734
30-33	0.867	0.624	0.919	0.736	0.890	0.667	0.917	0.661
31	1.021	0.705	1.037	0.793	1.040	0.721	1.072	0.712
34	0.834	0.619	0.773	0.612	1.008	0.634	1.065	0.669
35	1.098	0.611	1.084	0.615	1.036	0.656	1.114	0.653
36-37	1.183	0.587	1.108	0.666	1.098	0.727	1.082	0.738
40-41	1.147	1.611	1.000	1.808	0.913	1.653	0.907	2.049
45	1.027	1.551	1.091	1.307	1.223	1.536	1.206	1.308
50-52	0.978	2.260	1.083	1.795	1.185	1.997	1.124	1.839
55	1.063	0.647	0.974	0.659	0.991	0.665	0.953	0.764
60-63	1.108	0.999	1.088	1.859	1.116	1.861	1.158	2.000
64	0.935	0.966	0.929	1.551	1.029	1.166	1.005	1.064
65-67	0.778	2.114	0.891	1.320	0.853	1.573	0.882	1.812
70	0.640	0.897	0.629	0.908	0.774	0.747	0.749	1.048
71	0.659	0.575	1.047	0.607	0.913	0.643	0.870	0.678
72	0.797	0.630	0.991	0.648	0.876	0.705	0.857	0.845
73-74	0.766	1.413	1.022	1.810	1.060	1.457	1.046	1.603
75	0.862	0.609	0.929	0.751	0.878	0.678	0.813	0.675
80	0.850	0.571	0.803	0.612	0.781	0.666	0.792	0.649
85	0.959	0.573	0.880	0.611	0.955	0.637	0.932	0.684
90-93	1.010	0.604	1.099	0.758	1.075	0.896	1.069	0.956
95	0.569	0.569	0.603	0.603	0.625	0.625	0.632	0.632

Source: Author's computations from OECD (2016) input-output database. Inverse matrices are domestic ones. Coefficients are adjusted by the averages of all sectoral linkages. *The year of EU accession. ISIC: International Standard Industrial Classification, BL: Backward linkages, FL: Forward linkages

quarrying) and 15-16 (food products, beverages and tobacco). The coefficients of the sector with the code of 71 (renting of machinery and equipment) have increased especially in FL, until 2011. Even this slight decline in 2011, this sector has strong linkages with the other sectors. Again, for Romania, like the case of Bulgaria, overall coefficients indicate no considerable time-variant changes directly related with the EU accession.

The coefficients in Tables 3 and 4 are adjusted by the averages of all sectoral linkages and so they embody intra-sector relations. For example, high coefficients linkages in both backward and forward can be derived from the effects on the subsectors in the same group, namely sectoral feedbacks. This is because of the characteristics of the input-output tables and frameworks of the Leontief and Ghosh models. Even this captures well the structural changes we aim; one can be interested in finding out which sectors are injected most from these linkage effects. For this aim, we also calculate raw linkages and refined coefficients together with most affected five sectors in both BL and FL. These complementary results are presented in the section of the Appendices. In order to save space we present the results only for the years, 2002 and 2011, that capture ex-post EU accessions. However, because there are not considerable changes over time, evaluating the results of Tables 3 and 4, the results reported in the Appendices can be extended for the other years. In this context for both countries, all the sectors, except 95 (private households with employed persons), use more or less content from other sectors. We can see that most of effects were in fact within industries as expected. However, some sectors demand great amount of contents from other sectors: The most linked sectors commonly belong to services sector for both countries and for both years, 2002 and 2011 (Appendices).

5. CONCLUSION

It was a distinct step of the EU to comprise the countries that were formerly socialist. Eight central and eastern European countries (Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, and Slovenia) that joined the EU in 2004 have made remarkable progress in their paths towards the EU adaptation, economic growth and macroeconomic stability. In addition to the existence of well-designed policy frameworks; better institutions, high human capital accumulations, successful privatization and product market deregulations have helped these countries in transforming their planned economies into market economies and adopting the EU dynamics. Now these countries have not only

Table 4: Sectoral linkages and leading sectors for Romania

ISIC Rev. 3	1995		2002		2007*		2011	
codes	BL	FL	BL	FL	BL	FL	BL	FL
01-05	0.994	1.956	1.018	1.629	1.060	1.392	1.029	1.330
10-14	1.018	1.627	1.084	1.525	1.064	1.507	1.152	1.421
15-16	1.216	1.399	1.158	1.408	1.148	1.308	1.151	1.074
17-19	1.000	0.906	0.971	0.800	1.032	0.743	0.830	0.699
20	1.059	0.805	1.106	0.881	1.126	0.895	1.028	0.814
21-22	1.074	0.976	1.032	0.988	1.056	1.017	1.052	0.847
23	1.077	1.020	1.165	0.867	1.083	0.693	1.240	0.788
24	1.171	1.219	1.212	1.000	1.140	0.927	1.182	0.732
25	1.087	0.920	1.003	0.912	1.047	0.978	1.101	0.813
26	1.107	0.891	1.124	0.890	1.110	0.934	1.209	0.765
27	1.260	1.566	1.316	1.129	1.150	0.982	1.056	0.982
28	1.091	0.894	1.018	0.875	0.951	0.967	1.140	0.946
29	1.110	0.774	1.032	0.662	1.006	0.710	1.052	0.591
30-33	1.017	0.761	0.931	0.613	0.981	0.659	0.818	0.636
31	1.046	0.825	0.898	0.685	0.905	0.760	0.954	0.675
34	1.112	0.676	0.973	0.618	0.936	0.662	0.931	0.800
35	1.113	0.667	1.077	0.668	1.042	0.684	1.023	0.642
36-37	1.048	0.655	1.021	0.637	1.031	0.658	0.910	0.721
40-41	1.140	2.390	1.390	3.095	1.244	2.267	1.133	2.404
45	1.064	0.882	1.037	0.819	1.043	0.877	1.122	1.416
50-52	0.827	1.421	0.882	1.695	0.914	1.939	1.184	2.269
55	1.032	0.859	1.062	0.901	1.078	0.821	1.021	0.834
60-63	1.104	1.257	0.982	1.365	0.966	1.451	1.042	1.710
64	0.788	0.824	0.862	1.274	0.861	1.201	0.939	0.841
65-67	0.723	1.871	0.772	0.968	0.991	1.043	0.883	1.104
70	0.852	0.707	0.870	0.801	0.873	0.950	0.826	0.874
71	0.925	0.761	1.090	1.441	1.201	2.067	0.934	1.872
72	0.795	0.582	0.829	0.712	0.845	0.694	0.982	0.816
73-74	0.929	0.796	0.922	0.724	0.856	0.630	1.024	0.977
75	0.918	0.564	0.817	0.586	0.782	0.611	0.817	0.588
80	0.853	0.564	0.805	0.595	0.844	0.625	0.748	0.726
85	0.954	0.564	0.937	0.602	0.966	0.640	0.940	0.632
90-93	0.933	0.859	1.017	1.047	1.059	1.098	0.959	1.072
95	0.564	0.564	0.586	0.586	0.611	0.611	0.588	0.588

Source: Author's computations from OECD (2016) input-output database. Inverse matrices are domestic ones. Coefficients are adjusted by the averages of all sectoral linkages. *The year of EU accession. ISIC: International Standard Industrial Classification, BL: Backward linkages. FL: Forward linkages

opened to the world but also they increased their competitive power in the world economy adopting technology and increasing overall productivity.

There has been a doubt about the Balkan countries' success since the EU accessions of Bulgaria and Romania in 2007. In terms of initial condition of the EU adaptation, Balkan countries are not only relatively low-income countries compare to the other member countries but also they have some economic, socio-political, and institutional backwards and worse infrastructures. However, because of the spillovers from the EU dynamics to Bulgaria and Romania, sizable overall integration gains are predicted for these countries. In the related literature, there is a further convergence process projected between these countries and mature EU members. In this process, Bulgaria and Romania are expected to have considerable structural changes especially as they have integrated in the world economy.

Starting from this convergence and structural change premises, this study intended to explore whether the latest member states, Bulgaria and Romania, have experienced significant changes in their economic structures. To this end, with a general equilibrium approach and using input-output data of the countries, we conducted intersectoral linkage analyses covering all economic activities aggregated to 34 sectors for the years 1995, 2002, 2007 and 2011. BL and FL coefficients, calculated from the inverse matrices based on the Leontief and the Ghosh models reveal that the leading sectors mainly belong to the agricultural activities and some service sectors have important injections over themselves (intra-sectoral linkage) and other sectors in both countries and for all years.

Findings affirm that there is no strong evidence supporting the structural changes experiences in the 5th year of the EU accession for the countries investigated. Overall results are in fact consistent with the argument that countries' production structures take time to change. When considered planned economy experiences together with the regional difficulties and disadvantages of these countries, it is not reasonable to expect to change that fast. It cannot be directly associated with the EU accession, but calculated coefficients illustrate that even the most crucial sectors are among agricultural and labor-intensive industries, some service sectors are becoming more important with respect to their linkages effect on the other sectors. We can conclude intersectoral linkages patterns are consistent with comparative advantages of these countries and overall specialization patterns within the EU.

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APPENDICES

Appendix 1: Total linkages and refined coefficients for Bulgaria, 2002

ISIC	Total linkages		Except itself		Most linked sectors	
codes	BL	FL	BL	FL	BL, top 5, except itself	FL, top 5, except itself
01-05	1.892	3.237	0.399	1.744	50-52; 60-63; 23; 15-16; 40-41	15-16; 20; 50-52; 36-37; 21-22
10-14	1.733	1.769	0.695	0.731	60-63; 40-41; 23; 50-52; 73-74	23; 27; 40-41; 26; 28
15-16	2.215	1.418	1.091	0.295	01-05; 50-52; 60-63; 40-41; 73-74	55; 01-05; 85; 50-52; 80
17-19	1.363	1.123	0.319	0.080	50-52; 40-41; 73-74; 60-63; 65-67	36-37; 55; 25; 85; 20
20	2.143	1.225	1.080	0.163	01-05; 60-63; 50-52; 23; 40-41	36-37; 45; 35; 27; 26
21-22	1.839	1.662	0.526	0.348	50-52; 01-05; 60-63; 73-74; 40-41	72; 26; 20; 15-16; 24
23	1.654	2.382	0.590	1.318	10-14; 60-63; 40-41; 50-52; 73-74	60-63; 10-14; 20; 26; 24
24	1.694	1.462	0.621	0.389	40-41; 50-52; 23; 60-63; 73-74	25; 85; 20; 21-22; 26
25	1.596	1.295	0.558	0.256	24; 50-52; 60-63; 23; 40-41	36-37; 45; 26; 35; 30-33
26	1.871	1.461	0.755	0.346	60-63; 40-41; 23; 50-52; 73-74	45; 35; 34; 27; 55
27	1.949	1.941	0.795	0.787	40-41; 60-63; 50-52; 10-14; 23	35; 29; 31; 28; 30-33
28	1.585	1.303	0.533	0.251	27; 50-52; 60-63; 10-14; 40-41	45; 27; 29; 34; 20
29	1.703	1.220	0.681	0.198	27; 40-41; 73-74; 60-63; 50-52	45; 27; 10-14; 75; 28
30-33	1.523	1.221	0.452	0.149	50-52; 31; 27; 40-41; 60-63	72; 31; 64; 90-93; 55
31	1.719	1.314	0.660	0.255	73-74; 27; 50-52; 40-41; 60-63	30-33; 34; 40-41; 35; 45
34	1.281	1.015	0.274	0.008	50-52; 40-41; 31; 26; 60-63	60-63; 27; 20; 45; 28
35	1.796	1.020	0.790	0.013	27; 50-52; 40-41; 60-63; 45	60-63; 27; 20; 29; 45
36-37	1.837	1.104	0.828	0.096	20; 01-05; 60-63; 50-52; 73-74	35; 27; 29; 31; 28
40-41	1.657	2.997	0.536	1.876	60-63; 23; 10-14; 64; 50-52	10-14; 27; 24; 26; 29
45	1.809	2.166	0.687	1.045	26; 73-74; 60-63; 50-52; 23	90-93; 55; 27; 73-74; 35
50-52	1.795	2.976	0.740	1.922	01-05; 60-63; 73-74; 64; 40-41	15-16; 71; 20; 21-22; 36-37
55	1.615	1.092	0.612	0.089	73-74; 45; 01-05; 64;40-41	60-63; 73-74; 30-33; 90-93; 29
60-63	1.803	3.082	0.626	1.905	23; 50-52; 73-74; 64; 40-41	26; 10-14; 20; 27; 50-52
64	1.540	2.571	0.334	1.366	73-74; 60-63; 40-41; 65-67; 50-52	71; 72; 90-93; 65-67; 73-74
65-67	1.477	2.187	0.290	1.000	64; 73-74; 40-41; 45; 70	71; 60-63; 36-37; 27; 20
70	1.043	1.505	0.043	0.505	45; 73-74; 40-41; 50-52; 64	71; 72; 73-74; 55; 50-52
71	1.735	1.006	0.735	0.006	64; 73-74; 50-52; 70; 65-67	60-63; 90-93; 50-52; 73-74; 55
72	1.643	1.074	0.632	0.062	64; 73-74; 40-41; 70; 50-52	73-74; 64; 60-63; 40-41; 75
73-74	1.695	3.000	0.445	1.750	64; 40-41; 45; 70; 50-52	71; 90-93; 31; 50-52; 72
75	1.541	1.245	0.453	0.157	64; 40-41; 60-63; 50-52; 73-74	90-93; 50-52; 73-74; 60-63; 45
80	1.330	1.015	0.328	0.013	40-41; 01-05; 65-67; 64; 45	75; 90-93; 85; 60-63; 65-67
85	1.459	1.013	0.458	0.012	01-05; 50-52; 24; 40-41; 73-74	01-05; 60-63; 15-16; 20; 75
90-93	1.822	1.256	0.724	0.158	73-74; 64; 45; 40-41; 23	73-74; 55; 85; 75; 64
95	1.000	1.000	0.000	0.000	-	-

Source: Author's computations from OECD (2016) input-output tables. Inverse matrices are domestic ones. ISIC: International Standard Industrial Classification, BL: Backward linkages, FL: Forward linkages

Appendix 2: Total linkages and refined coefficients for Bulgaria; 2011

ISIC	Total linkages		Except itself		Most linked sectors	
codes	BL	FL	BL	FL	BL, top 5, except itself	FL, top 5, except itself
01-05	1.816	2.199	0.529	0.912	50-52; 60-63; 73-74; 65-67; 23	15-16; 20; 36-37; 50-52; 21-22
10-14	1.624	1.855	0.595	0.826	40-41; 60-63; 65-67; 23; 50-52	23; 40-41; 27; 24; 26
15-16	2.096	1.417	0.945	0.266	01-05; 50-52; 60-63; 40-41; 73-74	55; 01-05; 50-52; 85; 20
17-19	1.357	1.108	0.319	0.071	50-52; 40-41; 01-05; 60-63; 65-67	36-37; 85; 55; 25; 50-52
20	1.968	1.290	0.884	0.207	01-05; 40-41; 60-63; 50-52; 65-67	36-37; 34; 45; 35; 30-33
21-22	1.669	1.460	0.483	0.274	40-41; 50-52; 65-67; 60-63; 01-05	20; 36-37; 50-52; 34; 15-16
23	1.523	1.782	0.504	0.763	10-14; 60-63; 50-52; 40-41; 65-67	60-63; 10-14; 01-05; 20; 15-16
24	1.635	1.297	0.612	0.274	40-41; 10-14; 50-52; 60-63; 65-67	25; 21-22; 20; 01-05; 26
25	1.491	1.256	0.455	0.221	40-41; 50-52; 24; 60-63; 65-67	35; 45; 29; 26; 31
26	1.641	1.355	0.576	0.289	40-41; 60-63; 50-52; 10-14; 65-67	45; 35; 34; 28; 27
27	1.636	1.426	0.571	0.361	40-41; 10-14; 50-52; 60-63; 65-67	29; 31; 28; 36-37; 35
28	1.590	1.311	0.562	0.284	40-41; 60-63; 50-52; 27; 65-67	29; 45; 27; 35; 36-37
29	1.709	1.161	0.688	0.139	40-41; 60-63; 50-52; 27; 65-67	45; 34; 28; 31; 35
30-33	1.451	1.045	0.448	0.043	50-52; 40-41; 60-63; 65-67; 45	35; 71; 20; 36-37; 34
31	1.696	1.126	0.677	0.107	60-63; 40-41; 50-52; 73-74; 65-67	34; 30-33; 35; 29; 45
34	1.685	1.058	0.661	0.034	65-67; 60-63; 50-52; 73-74; 40-41	35; 60-63; 71; 30-33; 31
35	1.762	1.034	0.739	0.011	45; 40-41; 50-52; 60-63; 65-67	60-63; 36-37; 29; 45; 75
36-37	1.712	1.168	0.690	0.146	20; 50-52; 40-41; 01-05; 65-67	27; 35; 15-16; 29; 45
40-41	1.434	3.242	0.383	2.191	10-14; 50-52; 60-63; 65-67; 45	24; 10-14; 26; 20; 27
45	1.908	2.069	0.787	0.949	60-63; 65-67; 73-74; 50-52; 26	35; 90-93; 70; 50-52; 55
50-52	1.778	2.910	0.717	1.849	60-63; 65-67; 73-74; 40-41; 45	15-16; 20; 01-05; 34; 36-37
55	1.507	1.209	0.503	0.205	40-41; 65-67; 45; 73-74; 50-52	90-93; 60-63; 50-52; 73-74; 35
60-63	1.832	3.164	0.614	1.945	23; 65-67; 50-52; 40-41; 73-74	50-52; 45; 15-16; 34; 31
64	1.589	1.683	0.428	0.522	70; 60-63; 65-67; 40-41; 50-52	90-93; 65-67; 60-63; 72; 50-52
65-67	1.396	2.866	0.238	1.708	73-74; 64; 45; 60-63; 72	45; 34; 50-52; 60-63; 31
70	1.185	1.658	0.175	0.647	65-67; 45; 40-41; 73-74; 60-63	72; 71; 64; 50-52; 90-93
71	1.377	1.072	0.362	0.058	70; 73-74; 65-67; 60-63; 50-52	60-63; 90-93; 01-05; 73-74; 45
72	1.356	1.336	0.335	0.316	70; 73-74; 65-67; 50-52; 64	64; 73-74; 30-33; 21-22; 65-67
73-74	1.655	2.536	0.413	1.295	65-67; 50-52; 60-63; 45; 70	85; 45; 50-52; 15-16; 72
75	1.287	1.068	0.277	0.058	60-63; 73-74; 85; 50-52; 45	50-52; 80; 45; 90-93; 73-74
80	1.253	1.027	0.248	0.021	65-67; 45; 50-52; 23; 40-41	75; 90-93; 85; 60-63; 73-74
85	1.474	1.082	0.458	0.067	73-74; 50-52; 40-41; 45; 60-63	75; 65-67; 60-63; 90-93; 73-74
90-93	1.691	1.513	0.536	0.358	60-63; 73-74; 50-52; 45; 65-67	55; 85; 35; 45; 10-14
95	1.000	1.000	0.000	0.000	-	-

Source: Author's computations from OECD (2016) input-output tables. Inverse matrices are domestic ones. ISIC: International Standard Industrial Classification, BL: Backward linkages, FL: Forward linkages

Appendix 3: Total linkages and refined coefficients for Romania, 2002

ISIC	Total linkages		Except itself		Most linked sectors	
codes	BL	FL	BL	FL	BL, top 5, except itself	FL, top 5, except itself
01-05	1.738	2.781	0.305	1.348	40-41; 15-16; 50-52; 24; 60-63	15-16; 20; 55; 36-37; 50-52
10-14	1.851	2.604	0.713	1.466	40-41; 50-52; 71; 60-63; 27	23; 40-41; 27; 26; 24
15-16	1.976	2.404	0.759	1.187	01-05; 40-41; 50-52; 60-63; 65-67	55; 50-52; 75; 85; 01-05
17-19	1.657	1.366	0.509	0.217	50-52; 40-41; 01-05; 71; 15-16	85; 90-93;34; 55; 25
20	1.888	1.504	0.722	0.339	01-05; 40-41; 50-52; 71; 60-63	36-37; 45; 70; 35; 21-22
21-22	1.761	1.687	0.512	0.438	40-41; 50-52; 71; 15-16; 01-05	80; 90-93; 85; 75; 36-37
23	1.989	1.481	0.962	0.454	10-14; 40-41; 50-52; 60-63; 71	27; 26; 10-14; 35; 90-93
24	2.069	1.707	0.940	0.578	40-41; 50-52; 10-14; 60-63; 15-16	85; 25; 34; 01-05; 36-37
25	1.712	1.556	0.520	0.364	40-41; 50-52; 24; 60-63; 71	30-33; 34; 29; 31; 60-63
26	1.919	1.520	0.812	0.413	40-41; 10-14; 50-52; 71; 60-63	45; 27; 70; 90-93; 31
27	2.246	1.927	1.079	0.760	40-41 10-14; 50-52; 23; 60-63	35; 29; 28; 34; 31
28	1.738	1.494	0.637	0.393	40-41; 27; 50-52; 60-63; 64	29; 35; 10-14; 31; 27
29	1.761	1.129	0.741	0.109	40-41; 27; 50-52; 60-63; 71	35; 28; 10-14; 71; 34
30-33	1.590	1.047	0.576	0.033	40-41; 60-63; 64; 50-52; 71	72; 85; 64; 71; 73-74
31	1.533	1.169	0.486	0.122	40-41; 27; 50-52; 71; 10-14	30-33; 35; 29; 40-41; 73-74
34	1.660	1.055	0.648	0.043	40-41; 27; 50-52; 60-63; 64	10-14; 29; 26; 60-63; 35
35	1.838	1.140	0.748	0.050	40-41; 27; 50-52; 60-63; 71	60-63; 24; 10-14; 27; 23
36-37	1.743	1.087	0.731	0.074	20; 40-41; 01-05; 50-52; 60-63	90-93; 85; 55; 27; 75
40-41	2.373	5.284	0.640	3.551	10-14; 50-52; 71; 60-63; 90-93	24; 27; 10-14; 26; 23
45	1.771	1.398	0.662	0.289	40-41; 71; 26; 50-52; 27	70; 40-41; 27; 55; 90-93
50-52	1.506	2.892	0.444	1.830	15-16; 01-05; 40-41; 64; 60-63	27; 23; 17-19; 15-16; 24
55	1.812	1.538	0.719	0.444	15-16; 01-05; 40-41; 50-52; 64	90-93; 30-33; 26; 60-63; 73-74
60-63	1.676	2.330	0.511	1.165	40-41; 71; 50-52; 64; 10-14	23; 24; 36-37; 35; 27
64	1.471	2.174	0.221	0.924	40-41; 60-63; 90-93; 50-52; 71	73-74; 30-33; 28; 72; 90-93
65-67	1.317	1.653	0.225	0.561	64; 90-93; 40-41; 15-16; 21-22	45; 23; 15-16; 70; 55
70	1.485	1.368	0.395	0.278	40-41; 65-67; 50-52; 64; 45	72; 90-93; 71; 64; 55
71	1.861	2.459	0.457	1.055	40-41; 50-52; 64; 15-16; 90-93	45; 10-14; 26; 21-22; 35
72	1.415	1.215	0.360	0.160	40-41; 64; 70; 71; 50-52	73-74; 45; 71; 50-52; 70
73-74	1.575	1.236	0.538	0.200	40-41; 64; 01-05; 72; 50-52	30-33; 29; 60-63; 27; 10-14
75	1.395	1.000	0.395	0.000	15-16; 90-93; 50-52; 40-41; 01-05	-
80	1.374	1.015	0.366	0.007	21-22; 40-41; 15-16; 50-52; 60-63	34; 71; 40-41; 29; 85
85	1.599	1.028	0.590	0.019	24; 50-52; 40-41; 15-16; 17-19	29; 28; 34; 73-74; 30-33
90-93	1.737	1.788	0.596	0.647	40-41; 50-52; 21-22; 15-16; 64	75; 65-67; 24; 10-14; 71
95	1.000	1.000	0.000	0.000	-	-

Source: Author's computations from OECD (2016) input-output tables. Inverse matrices are domestic ones. ISIC: International Standard Industrial Classification, BL: Backward linkages, FL: Forward linkages

Appendix 4: Total linkages and refined coefficients for Romania, 2011

ISIC	Total linkages		Except itself		Most linked sectors	
codes	BL	FL	BL	FL	BL, top 5, except itself	FL, top 5, except itself
01-05	1.749	2.261	0.387	0.899	50-52; 60-63; 40-41; 15-16; 71	15-16; 20; 55; 17-19; 21-22
10-14	1.958	2.417	0.782	1.240	50-52; 40-41; 60-63; 71; 45	23; 40-41; 27; 26; 24
15-16	1.957	1.826	0.848	0.717	01-05; 50-52; 60-63; 40-41; 71	55; 85; 50-52; 90-93; 24
17-19	1.412	1.189	0.360	0.137	50-52; 40-41; 71; 01-05; 60-63	25; 36-37; 85; 50-52; 34
20	1.748	1.384	0.641	0.277	40-41; 01-05; 50-52; 71; 60-63	36-37; 45; 26; 50-52; 35
21-22	1.789	1.440	0.688	0.339	71; 40-41; 90-93; 50-52; 60-63	80; 50-52; 75; 26; 65-67
23	2.108	1.339	1.097	0.328	10-14; 50-52; 60-63; 40-41; 71	24; 60-63; 50-52; 27; 26
24	2.010	1.244	0.961	0.195	40-41; 50-52; 60-63; 45; 71	25; 85; 01-05; 21-22; 26
25	1.871	1.382	0.783	0.294	40-41; 50-52; 71; 60-63; 24	34; 60-63; 29; 31; 28
26	2.056	1.300	1.007	0.252	40-41; 50-52; 10-14; 60-63; 45	45; 29; 60-63; 28; 24
27	1.795	1.670	0.719	0.594	50-52; 10-14; 40-41; 60-63; 71	28; 29; 35; 34; 31
28	1.939	1.609	0.831	0.502	40-41; 27; 50-52; 60-63; 71	29; 45; 26; 24; 31
29	1.788	1.005	0.788	0.005	40-41; 50-52; 27; 60-63; 28	60-63; 36-37; 35; 20; 45
30-33	1.391	1.081	0.381	0.072	40-41; 50-52; 60-63; 71; 27	72; 64; 50-52; 85; 31
31	1.621	1.148	0.603	0.130	40-41; 71; 50-52; 27; 60-63	29; 30-33; 64; 34; 72
34	1.583	1.360	0.508	0.286	40-41; 50-52; 27; 60-63; 71	60-63; 35; 26; 73-74; 36-37
35	1.739	1.091	0.710	0.062	40-41; 50-52; 71; 60-63; 27	60-63; 36-37; 45; 29; 50-52
36-37	1.547	1.226	0.539	0.218	40-41; 20; 50-52; 71; 60-63	60-63; 34; 65-67; 50-52; 35
40-41	1.926	4.087	0.711	2.872	10-14; 50-52; 60-63; 45; 71	24; 26; 28; 29; 25
45	1.907	2.407	0.794	1.293	40-41; 50-52; 26; 60-63; 90-93	60-63; 50-52; 24; 26; 70
50-52	2.013	3.858	0.913	2.758	60-63; 70; 40-41; 71; 45	23; 10-14; 40-41; 26; 27
55	1.735	1.419	0.726	0.410	15-16; 90-93; 50-52; 40-41; 01-05	75; 85; 50-52; 60-63; 45
60-63	1.772	2.907	0.711	1.846	50-52; 71; 45; 40-41; 34	23; 10-14; 50-52; 26; 24
64	1.597	1.430	0.561	0.394	71; 40-41; 50-52; 60-63; 45	50-52; 65-67; 60-63; 28; 70
65-67	1.500	1.877	0.413	0.789	40-41; 71; 72; 60-63; 45	50-52; 73-74; 71; 72; 60-63
70	1.403	1.486	0.393	0.476	45; 71; 40-41; 50-52; 60-63	50-52; 45; 23; 26;24
71	1.588	3.182	0.450	2.044	40-41; 73-74; 50-52; 45; 65-67	73-74; 72; 90-93; 21-22; 64
72	1.670	1.387	0.656	0.374	71; 40-41; 50-52; 73-74; 45	65-67; 21-22; 50-52; 35; 28
73-74	1.741	1.661	0.688	0.609	71; 40-41; 50-52; 45; 60-63	71; 72; 90-93; 21-22; 50-52
75	1.389	1.000	0.389	0.000	55; 45; 60-63; 50-52; 90-93	-
80	1.271	1.234	0.270	0.232	90-93; 21-22; 45; 50-52; 15-16	73-74; 72; 71; 90-93; 21-22
85	1.598	1.075	0.597	0.074	90-93; 50-52; 15-16; 45; 60-63	73-74; 72; 71; 90-93; 21-22
90-93	1.631	1.822	0.576	0.767	71; 40-41; 50-52; 15-16; 45	55; 85; 21-22; 45; 80
95	1.000	1.000	0.000	0.000	-	-

Source: Author's computations from OECD (2016) input-output tables. Inverse matrices are domestic ones. ISIC: International Standard Industrial Classification, BL: Backward linkages, FL: Forward linkages