COMPARATIVE DYNAMIC ANALYSIS OF VALUE ADDED CREATED BY INDUSTRY "MANUFACTURE OF WOOD AND OF PRODUCTS OF WOOD AND CORK, EXCEPT FURNITURE; MANUFACTURE OF ARTICLES OF STRAW AND PLAITING MATERIALS" IN BALTIC STATES AND FINLAND

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Abstract. The goal of the research is to carry out the comparative dynamic Input-Output analysis of economics of the industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" (C16) in the Baltic States and Finland. The information for the study is the National Input-Output Tables for the period 2000-2014 as part of the World Input-Output Database. The theoretical basis in the general sense is the Input-Output analysis and linear algebra as well. The investigation tool is the original version of the Input-Output model elaborated by the authors according to the structure of the National Input-Output Tables. The purpose of the work is the dynamic comparative Input-Output analysis of industry's C16 operating as an economic unit in the Baltic States and Finland in order to highlight the differences in the sales and purchases structures as factors for industry's value added creation and industry's influence to the national economy as a whole. The investigations concern the gross output sales structure, intermediate consumption structure, Leontief inverse, Ghosh inverse, direct and total backward linkages, direct and total forward linkages of the industry C16. Comparison the industry's C16 operating in Estonia, Finland, Latvia and Lithuania in the dynamic aspect allows us to discover the cost and revenue factors of the industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" value added creation efficiency in the referred countries. All indicators calculated with help of the Input-Output model contain the pithy information for the managers of the industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials". Our results are original because of the specific object of current research and the dynamic comparative Input-Output investigation method employed by us.

Keywords: industry C16, Input-Output, Leontief inverse, Ghosh inverse, backward linkages, forward linkages.

Introduction

According to the widespread opinion the basic ideas of Input-Output economics appear in the Economic table presented by Francois Quesnay in 1758 [1; 2]. The further contribution was made by Leon Walras's work "Elements of Pure Economics" [3; 4]. The Input-Output analysis was founded by the Soviet-American economist Wassily Leontief (Russian: *Василий Васильевич Леонтьев*; 1905-1999) in the thirties of the last century [5]. Wassily Leontief was the first to use a matrix representation of a national economy, to calculate and to interpret so called Leontief inverse matrix.

It seems that nowadays the socio-economic role of the Input-Output analysis has to be rethought. Many economists are speaking about terrible disproportionalities between unseen technological opportunities and rapidly breaking social harmony, they discuss the purposefulness of global planning in order to control the Earth resources' spending.

The signals about growing interest to the Input-Output economics already appears. Let us mention just three very interesting and easy available books richly highlighting the newest tendencies in the Input-Output economics [8-10].

The crucially important role for the Input-Output economics holistic implementation is played by the unified optimally structured mature and stable information. The mathematics of the Input-Output economics, the calculation tools and ideas of application nowadays are sufficiently developed, however, there still are serious problems with the data collection and preparation.

The current research is devoted to the Input-Output analysis of the industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" (C16). The empirical basis is the National Input-Output Tables for 2000-2014 as part of the World Input-Output Database (www.wiod.org). The theoretical basis is the Input-Output analysis (W. Leontief, A. Ghosh [6]). The easy available book of Ronald E. Miller and Peter D. Blair "Input-Output Analysis. Foundations and Extensions" [7] contains the modern exposition of the Input-Output theory.

The current paper contains original results about the Input-Output economics of the industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of

straw and plaiting materials" in Estonia, Finland, Latvia, Lithuania. The purpose of the work is to highlight the differences in the sales and purchases structures as factors for industry's value added creation and industry's influence to the national economy as a whole. The research concerns gross output sales structure, intermediate consumption structure, interindustry coefficients, Leontief inverse, allocation coefficients, Ghosh inverse, direct and total backward linkages, direct and total forward linkages of the industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" in Estonia, Finland, Latvia, Lithuania for the period 2000-2014. All economical and technological interpretations of indicators are based on the mathematical connections resulted from the Input-Output model. Comparison of the industry's C16 operating in Estonia, Finland, Latvia and Lithuania in the dynamic aspect allows us to discover the cost and revenue factors that influenced the industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" value added creation efficiency in the referred countries. All indicators calculated by help of the original Input-Output model contain pithy information useful for the decision making of the industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" managers. Behind of each indicator there are plenty of producers and consumers operating in the real political, technological, international, legal and bio environment. Our results are original because of the specific object of current research and the dynamic comparative Input-Output investigation method employed by us. As it was expected, we did not find any scientific work from other countries' scientists and authors dedicated to the the dynamic comparative Input-Output analysis of the industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" in Estonia, Finland, Latvia, Lithuania.

Even more, in the last decades we do not meet in Latvia the dynamic and comparative mathematical Input-Output researches in the area between macroeconomics and microeconomics, and one of our targets is to retain and to develop the mathematical methods in economics.

Note. All tables and all Figures in the current paper are created by the authors by applying NIOT data, mathematical models and Microsoft Excel tools.

Materials and methods

Input-Output analysis is the field for empirical research at the border between microeconomics and macroeconomics. We consider each industry of national economy as a separate economic unit, whose actions are the dialectic fusion of the internal firm owners' economic decisions and actions in the real time and under the real political, economical, social, technological, international, legal and bio-environmental (in abbreviator – PESTILB) factors. The industry as an economic agent in a definite period of time with help of purchased multiple (factor) input and owned current technologies produces output to sell. Economic equilibrium requires equality between the value of input and the value of output. The main questions are: what is the economic unit's domestic and imported purchases structure (bought resources for the intermediate consumption) and what is its gross sales structure (product sold for the intermediate consumption and for the final demand, including exports), how the final demand of industry product and value added of industry are related, what are the sources for value added formation. Therefore, we are detailing the assertion of Thijs ten Raa who offers the following interpretation of industry [19]: "All industries are machines transforming factor inputs into value added. In other words, industries have multiple (factor) inputs, but essentially a single "output", namely value added."

The authors have already provided systematic Input-Output comparative dynamic analysis of the line of industries as economic units in the Baltic States and Finland: Crop and animal production, hunting and related service activities (A01), Forestry and logging (A02), Fishing and aquaculture (A03), Manufacture of food products, beverages and tobacco products (C10-C12), Scientific research and development (M72), Education (P85) [11-18]. The results of the current paper are new.

Definition of the industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" according the NACE (*Nomenclature statistique des activités économiques dans la Communauté européenne*):

"The industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" includes the manufacture of wood products, such as lumber, plywood, veneers, wood containers, wood flooring, wood trusses, and prefabricated wood buildings.

The industry does not include the manufacture of furniture, or the installation of wooden fittings and the like. The production processes include sawing, planning, shaping, laminating, and assembling of wood products starting from logs that are cut into bolts, or lumber that may then be cut further, or shaped by lathes or other shaping tools."

The information for the current research is taken from the "World Input-Output Database" (WIOD) for the period 2000-2014 released in 2016 (www. wiod.org). WIOD contains the "National Input-Output tables" (NIOT)). As we already mentioned, the mathematics of the Input-Output economics, the calculation tools and ideas of application are sufficiently developed, but, obviously, the real situation with input-output data collection and preparation is in a contradiction with the modern statistic institutes and modern information technologies. The old established exoneration sounds that the data collection and preparation process for the input-output accounts is traditionally regarded as necessarily labour and computer intensive. For that reason, the Input-Output tables are often published a long time after the year in which the data were collected, typically 5-7 years after.

It is hard to believe that modern information technologies are not able to solve the problems with data collection and preparation. Therefore, we can expect that WIOD will be carried on also for the further time and WIOD will grow as a very fruitful empirical inventory for scientific and management needs.

Pity, but till nowadays the researchers have to base their studies on currently available data. Let us mention only two examples.

The important research of Håkan Nordström and Harry Flam (European University Institute Robert Schuman Centre for Advanced Studies) about production integration in the European Union based on the input-output data taken from the November 2016 edition of the World Input-Output Database[1].

Also, the paper "Ivanova, Olga; Kancs, D'Artis; Thissen, Mark (2019) : Regional Trade Flows and Input Output Data for Europe, EERI Research Paper Series, No. 06/2019, Economics and Econometrics Research Institute (EERI), Brussels" is based on the WIOD, 2016[2].

The detailed information about WIOD is available in the book "An Illustrated User Guide to the World Input–Output Database" by Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., de Vries, G. J. [20]. Let us shortly point the main features of the NIOT.

The National Input-Output tables cover 28 EU countries and 15 other major countries in the world.

According to the United Nations 3-letter codes are used, for example, EST (Estonia), FIN (Finland), LVA (Latvia), LTU (Lithuania).

Classification of products (goods and services) covers 56 product categories following the primary outputs from 56 sectors. Data for 56 sectors are classified according to the United Nations industry classification system "International Standard Industrial Classification of All Economic Activities (ISIC Rev. 4)". The products are classified according to the statistical classification of products by activity, abbreviated as CPA.

The different institutes of statistics prepare Input-Output tables in many different forms. In our opinion, NIOT is prepared in the almost optimal, handy and user friendly form. We must be grateful to the NIOT elaborators.

The structure of NIOT conditionally is showed in Table 0. We have presented a number of papers which examine in detail the theoretical methods used in Input-Output research, and in order to be reader friendly we have also illustrated the theoretical content with simple numerical examples. We kindly appeal to the readers to get acquainted with the chapter "Materials and methods" in the open access papers [11-18] which can be easily accessed.

See, for example, the Input-Output table for Latvia, 2014 (www.wiod.org). Each component of the table presents information-triple: (numerical value of component; sense of row; sense of column). Knowing "the kitchen" of statistics data collection and aggregation, we perceive the confidence

[1] https://cadmus.eui.eu/bitstream/handle/1814/55684/RSCAS_2018_23.pdf?sequence = 1.
[2] https://www.econstor.eu/bitstream/10419/213559/1/168645595X.pdf
https://www.econstor.eu/handle/10419/213559

vulnerability of the presented indicators. Nevertheless, the authors have accepted NIOT as a reliable source of information and NIOT are assumed in the current research as indisputable.

Table 0

Structure of NIOT table compiled in current prices, expressed in millions of US dollars

Code	Origin	Code1	Code2	Code3	CONS_h	CONS_np	CONS_g	GFCF	INVEN	EXP	GO
Code1	Domestic										go1
Code2	Domestic										go2
Code3	Domestic										go3
Code1	Imports										
Code2	Imports										
Code3	Imports										
II_fob	TOT										
TXSP	TOT										
others	TOT										
VA	TOT										
GO	TOT	go1	go2	go3							TGO

- There are standard notations used in NIOT.
- The industries in the International Standard Industrial Classification are strictly defined and internationally accepted[3].
- We are using the NIOT codes of industries and other notations in the text.
- The codes and descriptions used in NIOT are provided in the paper [12, Table 7].
- The National Input-Output table and models derived from it exposes the holistic logic of the definitions given by the ECB and Eurostat. For example, for the separate industry
- Value added (gross) = Output at basic prices − Total intermediate consumption: GVA = GO − II_fob.

Note. Our experience whitenesses that the indicators EXP_adj, PURR, PURNR, IntTTM in the economic analysis of gross value added GVA are used more uncommonly than the two others indicators: TXSP and VA. Especially often analysts are speaking about value added because this indicator accumulates most dramatically features of the national institutional order. Value added is equal to the income earned in production like surplus value and includes workers labour earnings and rentier capital earnings. The history shows how staggering is the suspicion of economic agents about unfair distribution of the income earned. Let us critically remark that WIOD does not explore the complete structure of value added ("compensation of employees + gross operating surplus + net taxes on production and imports") and it makes it impossible to investigate the distribution of created wealth between different economic agents.

In Latvia the slogan: "Create value added!" due to some reasons is in political fashion. The reasons of this funny social phenomena were investigated in the article [21]. The behaviour theory convinces: the owner of a firm first of all is interested to maximize his profit. The maximizing of value added can lead to the profit decreasing because of increasing the payments for capital rent. In our opinion the Latvian business slogan must be: "Create profit!"

The Input–Output model is fundamentally linear in nature. We consider the input-output balancing linear equation systems as the comparative statics models, which allow us to introduce a number of the pithy interpreted significant economic marginal indicators useful for the endogenous and exogenous economical and technological perturbances analysis: interindustry coefficients, elements of Leontief inverse matrix, allocation coefficients and elements of Ghosh inverse matrix. The models allow to estimate the intersectoral dependencies and marginal linkages of the industry C16 in the national

[3] https://inspire.ec.europa.eu/codelist/EconomicActivityNACEValue/C.16

economy and structure of required imports. All economical and technological interpretations of indicators are based on the mathematical connections resulting from the Input-Output model.

Our conclusions about the industry's C16 different efficiency in EST, FIN, LVA, LTU are obtained by help of indicators calculated and mostly have a descriptive character. Explaining of the causality of the economical indicators requires more detailed socio-economic causality analysis, namely, we have to study the firm owners' behaviour in the real time and under the real political, economical, social, technological, international, legal and bio-environmental factors.

Results and discussion

In order to get a complete holistic view on the industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" (C16) economics in EST, FIN, LVA, LTU an array of indicators according to the chapter "Materials and Methods" is calculated. The interpretations of indicators follow from the mathematical relationships resulting from the pivot transformations of the Input-Output model as a system of linear equations. Let us stress that the interpretations of indicators often have the marginal sense holding proper *ceteris paribus* condition. We are employing the NIOT codes on a regular basis for more unified and precise scientific understanding of the meaning of each industry.

1. The scale of the industry C16 operating in the referred countries.

In the Baltic States the industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" is one of the ten biggest (see [18, Table 1] and Table 1 below). In Latvia in 2014 the industry's C16 gross output equals 4.15% of the national economy total gross output 64725.66. In Finland industry's C16 gross output equals 1.49% of the national economy total gross output 513657.88.

Table 1

Ten biggest Latvian industries measured by the current industry's gross output as share of the national economy total gross output, 2014

C.	F	L68	H52	G46	D35	H49	O84	C16	C10-C12	G47	Total GO
EST	0.0756	0.0591	0.0563	0.0488	0.0358	0.0455	0.0432	0.0424	0.0420	0.0373	1
FIN	0.0742	0.0835	0.0174	0.0385	0.0222	0.0248	0.0522	0.0149	0.0290	0.0303	1
LVA	**0.1137**	**0.0765**	**0.0645**	**0.0642**	**0.0576**	**0.0535**	**0.0463**	**0.0415**	**0.0402**	**0.0388**	**1**
LTU	0.0697	0.0454	0.0388	0.0648	0.0311	0.0698	0.0432	0.0162	0.0672	0.0503	1

2. Excerpts from the NIOT 2014: the industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" expenditures and revenues in current prices, expressed in millions of US dollars, and as parts of industry's gross output.

Tables 2a and 2b contain the general indicators that describe C16 intermediate consumption and value added.

Table 2a

Industry "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" expenditures (in millions of US dollars) in EST, FIN, LVA, LTU

Code	Description	EST	FIN	LVA	LTU
	Intermediate consumption (domestic)	1243.81	5330.07	1577.17	341.04
	Intermediate consumption (imports)	457.09	688.33	369.66	413.70
II_fob	Total intermediate consumption	1700.89	6018.40	1946.83	754.74
GVA	Gross value added at basic prices	609.15	1632.43	740.16	632.58
VA	Net value added at basic prices	572.23	1567.63	701.39	580.61
GO	Output at basic prices	2310.04	7650.83	2686.99	1387.32

Tables 2a and 2b give us the signal about Finland's C16 expenditures in contrast with C16 in EST, LVA, LTU. Namely, in Finland the imported intermediate consumption equals only 9% from the

industry's monetary unit of gross output, when the corresponding indicators of EST, LVA, LTU are 20%, 14%, 30%. It is clear, that domestic industry A02 FIN is able to support C16 more completely than, for example, A02 LTU. But what are the differences in the industry's C16 other intermediate purchases? We will analyse Finland's industry C16 structure of input vector.

Table 2b

Industry C16 expenditures in EST, FIN, LVA, LTU as share of the current industry's gross output

Code	Description	EST	FIN	LVA	LTU
-	Intermediate consumption (domestic)	0.5384	0.6967	0.5870	0.2458
-	Intermediate consumption (imports)	0.1979	0.0900	0.1376	0.2982
II_fob	Total intermediate consumption	0.7363	0.7866	0.7245	0.5440
GVA	Gross value added at basic prices	0.2637	0.2134	0.2755	0.4560
VA	Net value added at basic prices	0.2477	0.2049	0.2610	0.4185
GO	Output at basic prices	1	1	1	1

Tables 3a and 3b contain the general indicators of C16 describing the gross output sales allocation.

Table 3a

Industry C16 intermediate sales and final demand (in millions of US dollars) in EST, FIN, LVA, LTU

Code	Intermediate sales	CONS_h	CONS_np	CONS_g	GFCF	INVEN	EXP	GO
EST	561.19	35.49	0.06	0.47	10.45	-16.90	1719.28	2310.04
FIN	4034.95	55.02	0.06	4.50	39.53	36.95	3479.82	7650.83
LVA	905.68	149.87	0.03	5.82	13.70	3.65	1608.23	2686.99
LTU	324.78	144.69	0.00	1.48	3.60	66.45	846.31	1387.32

Table 3b

Industry C16 intermediate sales and final demand in EST, FIN, LVA, LTU as share of the industry's gross output

Code	Intermediate sales	CONS_h	CONS_np	CONS_g	GFCF	INVEN	EXP	GO
EST	0.2429	0.0154	0.0000	0.0002	0.0045	-0.0073	0.7443	1
FIN	0.5274	0.0072	0.0000	0.0006	0.0052	0.0048	0.4548	1
LVA	0.3371	0.0558	0.0000	0.0022	0.0051	0.0014	0.5985	1
LTU	0.2341	0.1043	0.0000	0.0011	0.0026	0.0479	0.6100	1

Tables 3a and 3b give us the worthy of attention insight about the industry's C16 sales vector structure. The roles of the industry C16 in the domestic intermediate consumption in the referred countries are different. The intermediate domestic sales in FIN make 53% of gross output but in EST, LVA, LTU accordingly only 24%, 34%, 23%. We come to a conclusion that Finland's industry C16 significant domestic intermediate purchases (70% of GO) and significant domestic intermediate sales (53% of GO) enriched the Finland's economy as a whole. Let us note that a similar conclusion in the paper [18] we have received also for the industry C10_C12 (Manufacture of food products, beverages and tobacco products): the industry FIN C10_C12 domestic intermediate purchases equals 65% of GO and domestic intermediate sales equals 52% of GO.

In our opinion the Finland's C16 total intermediate sales 53% of gross output and final demand 47% is a positive indication and must be studied by the Latvian government (FIN C16 53% + 47% versus LVA C16 34% + 66%).

3. Excerpts from the NIOT 2014: the industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" revenues from exports and expenditures for imports as shares of gross output.

Fig. 1 presents the dynamics of the industry's C16 exports in the Baltic States and Finland. Let us note that since 2002 export of Finland's C16 is less than industry's C16 export in Estonia, Latvia and Lithuania. In the paper [18] we have observed a similar phenomena also for the industry "Manufacture of food products, beverages and tobacco products" (C10_C12). In 2014 industry's C10_C12 export is 16% from the industry's C10_C12 gross output what is sufficiently less compared to 43% (EST), 48% (LVA), 47% (LTU).

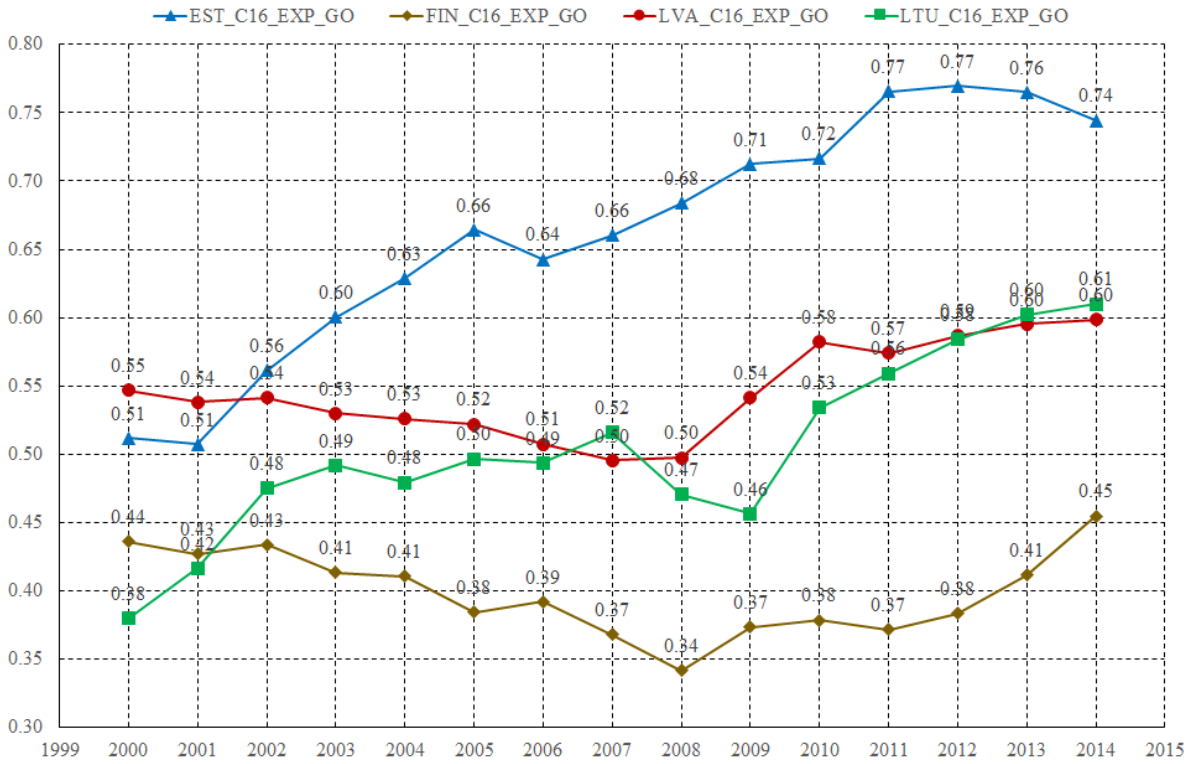

Fig. 1. **Dynamics of industry C16 exports as share of C16 gross output in EST, FIN, LVA, LTU in 2000-2014**

Table 6 in the paper [18] shows the trade balance of the line of industries in EST, FIN, LVA, LTU with respect to one unit of the proper industry's gross output, 2014. Ten industries are arranged by Latvian trade balance, from largest to smallest. As it was expected, the trade balance of C16 in the referred countries is sufficiently positive: EST 0.5464; FIN 0.3649; LVA 0.4610; LTU 0.3118.

4. Dynamics of the industry's C16 value added as part of industry's gross output in EST, FIN, LVA, LTU (2000-2014).

Fig. 2 depicts the time series of the industry's C16 net value added as part of gross output in EST, FIN, LVA, LTU for period 2000-2014. The Latvian C16 value added as part of industry's gross output dramatically falls in 2002-2003. The similar conclusion we have received also for the industry C10_C12 (Manufacture of food products, beverages and tobacco products) [18] and for the other industries investigated before [13], [14], [17]. The costs of electricity in Latvian economy raise because of the Latvian mandatory procurement public service obligation fee. The cause of electricity costs decreasing in 2012-2013 has to be investigated. For the economists a question arises about sufficient difference between the proper indicator for LTU and other referred countries.

5. Comparison and analysis of intermediate consumption.

Table 4 contains excerpts from the industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" total intermediate consumption matrix (2014): arrangement by LVA indicators and arrangement by FIN indicators.

Table 4 discovers sufficient differences in the structure of the average production costs towards the industry C16 in the referred countries. For example, the industry's LTA C16 purchases of the industry's G46 (Wholesale trade, except of motor vehicles and motorcycles) product is 0.0131; but at the same time the proper indicator in EST C16 is 0.0912, in FIN C16 it is 0.0781, in LVA C16 it is 0.0935. A

similar situation is about the industry H52 (Warehousing and support activities for transportation). The question arises: what are managers of C16 in LTU doing differently to have sufficiently smaller average costs of utilized C16, H52 products? It is worth to study Lithuanian C16 experience in the wholesale trade management.

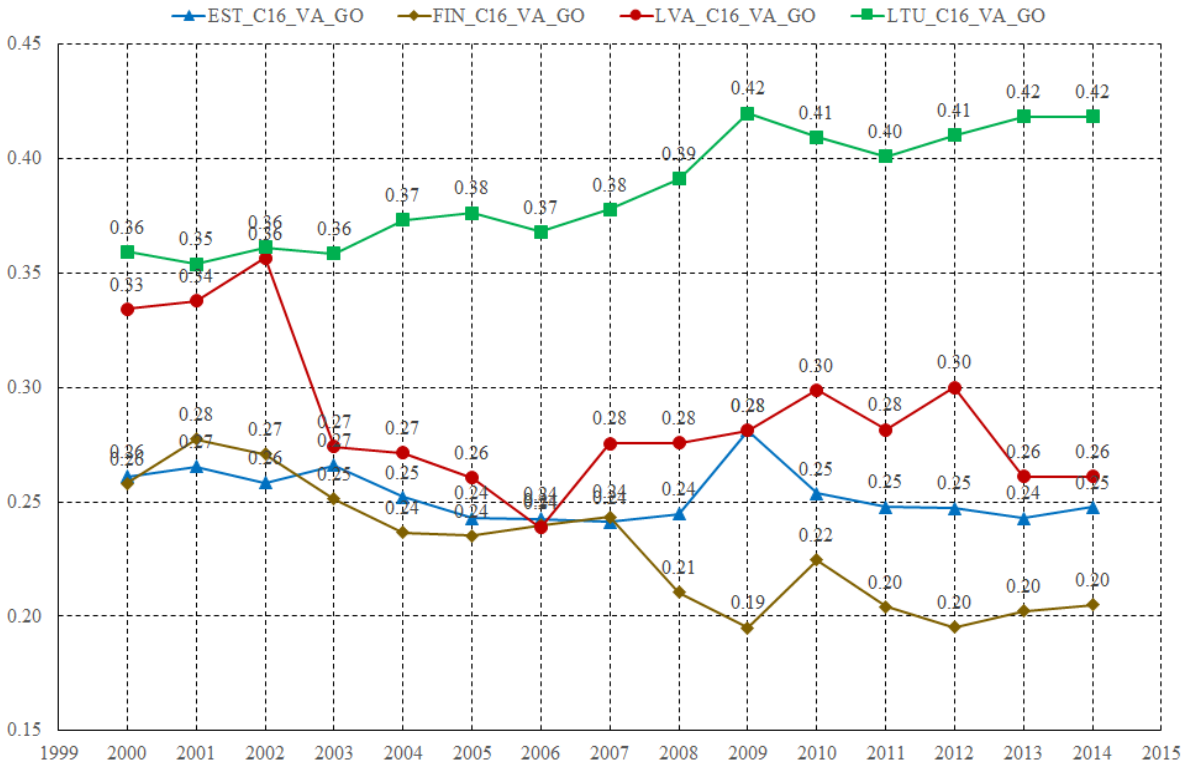

Fig. 2. **Dynamics of C16 net value added as part of the industry gross output in EST, FIN, LVA, LTU in 2000-2014**

Table 4

Industry C16 input (domestic plus imported) indicators in LVA and FIN, 2014

Code	EST	FIN	**LVA**	LTU
C16	0.2163	0.1168	**0.2067**	0.1104
A02	0.1582	0.2951	**0.2003**	0.0646
G46	0.0912	0.0781	**0.0935**	0.0131
H49	0.0527	0.0415	**0.0369**	0.0188
D35	0.0203	0.0299	**0.0366**	0.0159
C20	0.0192	0.0264	**0.0347**	0.0680
H52	0.0165	0.0402	**0.0225**	0.0061
C17	0.0063	0.0042	**0.0117**	0.0455
C19	0.0075	0.0023	**0.0113**	0.0079
G47	0.0109	0.0019	**0.0080**	0.0108
DBL_domestic	0.5384	0.6967	0.5870	0.2458
DBL_imports	0.1979	0.0900	0.1376	0.2982
DBL_total	0.7363	0.7866	0.7245	0.5440

Code	EST	**FIN**	LVA	LTU
A02	0.1582	**0.2951**	0.2003	0.0646
C16	0.2163	**0.1168**	0.2067	0.1104
G46	0.0912	**0.0781**	0.0935	0.0131
H49	0.0527	**0.0415**	0.0369	0.0188
H52	0.0165	**0.0402**	0.0225	0.0061
D35	0.0203	**0.0299**	0.0366	0.0159
C20	0.0192	**0.0264**	0.0347	0.0680
A01	0.0051	**0.0206**	0.0027	0.0005
C23	0.0092	**0.0119**	0.0012	0.0032
O84	0.0008	**0.0116**	0.0007	0.0004

Fig. 3 demonstrates dynamics of the intermediate expenses of C16 relating to D35.

High expenses for “Electricity, gas, steam and air conditioning supply” (D35) input in Latvia are well known as the consequence of the Latvian mandatory procurement public service obligation fee. As it was expected, we can observe that consequence also in the industry C16: LVA has 0.0366 against EST 0.0203, FIN 0.0299 and LTU 0.0159.

The direct backward linkages DBL_domestic, DBL_imports, DBL_total in Table 4 merge the system of intermediate average costs.

The direct backward linkage DBL_total shows that the total average costs with respect to one monetary unit of gross output in the industry C16 in the referred countries are approximately equal. Generally speaking, it signalizes about similar technological conditions in the C16 production process.

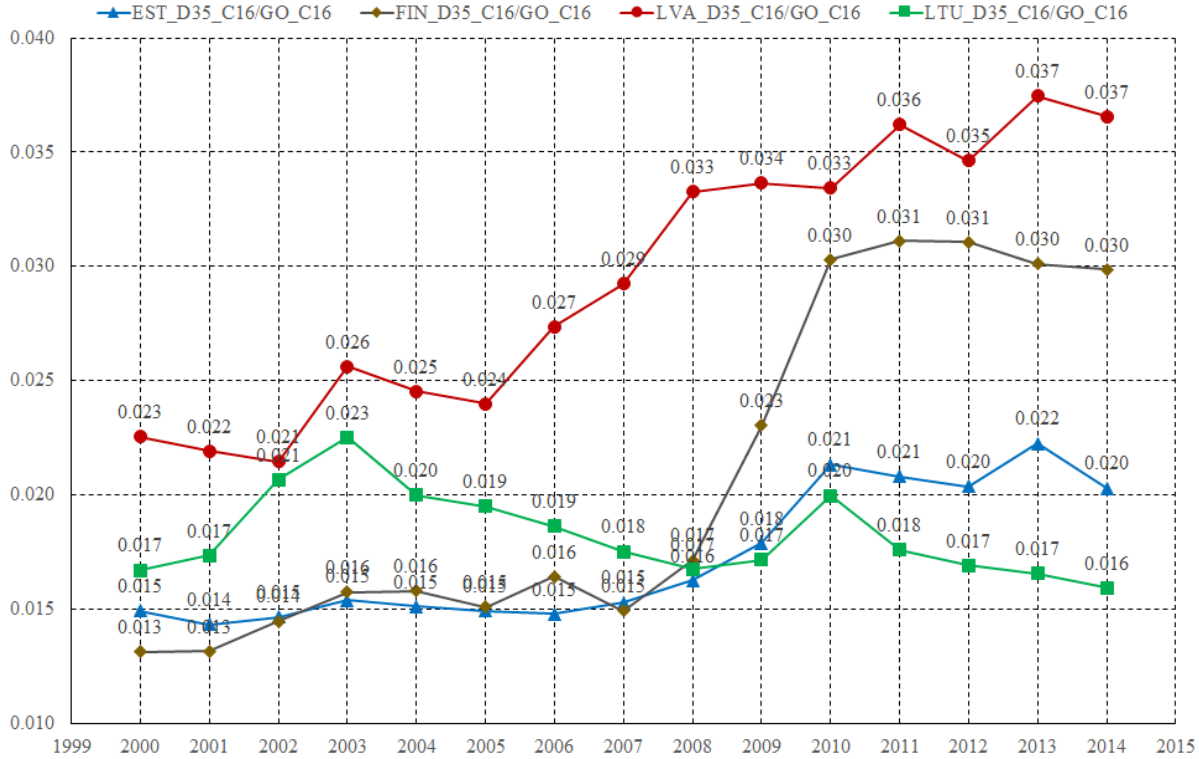

Fig. 3. **Dynamics of industry D35 (Electricity, gas, steam and air conditioning supply) product intermediate consumption as part of C16 one monetary unit gross output**

At the same time, sufficient differences are in the structure of equation "DBL_total = DBL_domestic + DBL_imports" what signalize about different PESTILB factors influencing the operating of the industry C16.

Equality 0.7866 = 0.6967 + 0.0900 allows us to confirm the fact that FIN C16 is oriented to the domestic intermediate consumption more than in other referred countries.

Fig. 4 depicts dynamics of the industry's C16 total intermediate consumption (II_fob) as part of C16 gross output. It shows the specific feature of the Lithuanian C16 intermediate consumption dynamics, namely, the value of the proper indicator is sufficiently less than in the other referred countries. That observation corresponds to the facts approved before. What are the deepest socio-economical reasons of that phenomenon? This phenomenon requires further investigation.

6. Comparison and analysis of allocation coefficients.

Table 5 contains excerpts from the allocation matrices: arrangement by Latvian indicators and arrangement by Finland indicators.

Due to the limited volume of the paper, we are not able to discuss the observed differences in details.

Let us discuss only two discovered phenomena.

The first. How to explain the sufficiently bigger direct forward domestic linkage of the C16 product in FIN (FIN DFL_domestic = 0.5274) comparing with the other referred countries?

From the matrix of domestic intermediate sales revenue allocation coefficients follows the balancing equation $s_{j1} + s_{j2} + ... + s_{jn} + z_j = 1$, what characterizes the j-th industry's revenue structure as domestic allocation coefficients and final demand by selling one monetary unit of the j-th industry's gross output. The sum $s_{j1} + s_{j2} + ... + s_{jn}$ is called the direct forward domestic linkage of j-th product and denoted as DFLj_domestic. The direct economical sense of the DFLj_domestic follows from definition,

namely, it equals the summary revenues of j-th industry (with respect to one monetary gross output) trough selling its product as production resource to the domestic industries.

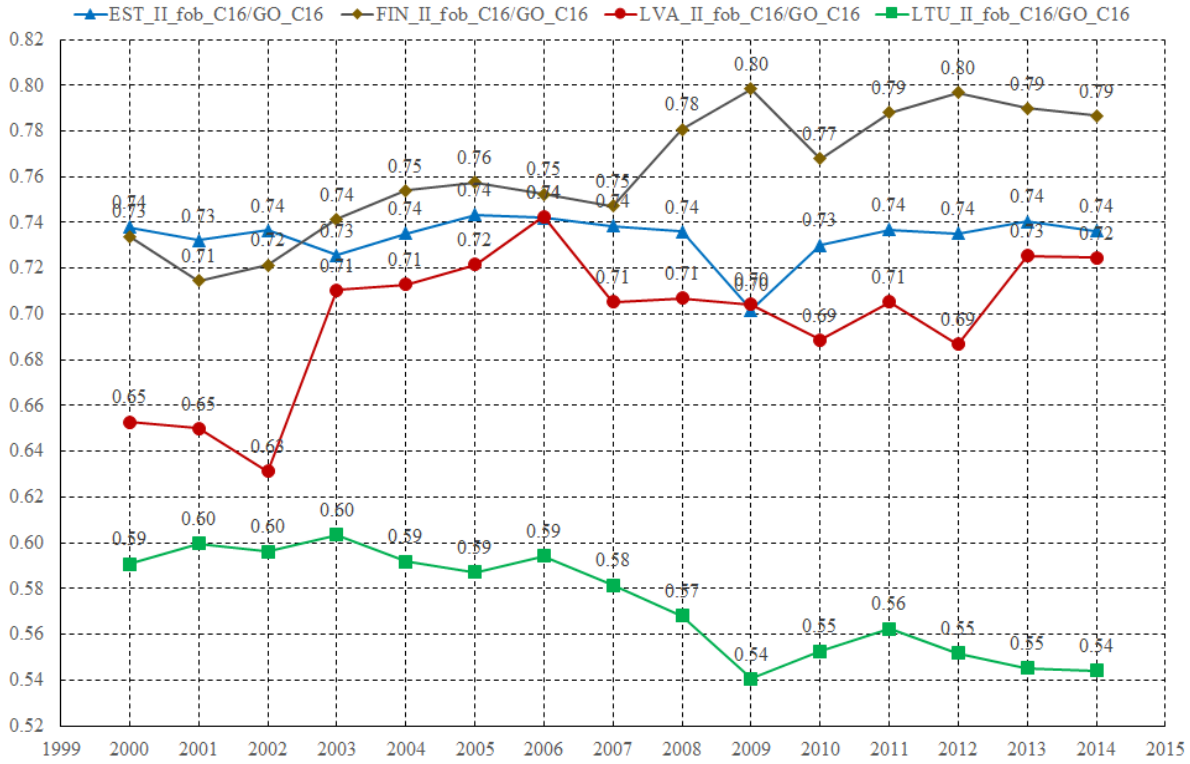

Fig. 4. **Dynamics of industry C16 total intermediate consumption (II_fob) as part of C16 gross output**

Table 5

Industry C16 ten biggest allocation coefficients for LVA and FIN (2014)

Code	C16	F	A02	C31_C32	D35	C24	L68	E37-E39	C23	C10-C12	DFL_domestic
EST	0.1265	0.0407	0.0045	0.0267	0.0110	0.0000	0.0029	0.0005	0.0023	0.0021	0.2429
FIN	0.1002	0.2979	0.0003	0.0107	0.0320	0.0020	0.0048	0.0003	0.0017	0.0019	0.5274
LVA	**0.1689**	**0.0767**	**0.0368**	**0.0179**	**0.0064**	**0.0059**	**0.0044**	**0.0022**	**0.0019**	**0.0014**	0.3371
LTU	0.0487	0.0061	0.0007	0.0702	0.0010	0.0001	0.0779	0.0000	0.0009	0.0038	0.2341

Code	F	C16	C17	D35	C31_C32	L68	R_S + T + U	G46	G47	M74_M75
EST	0.0407	0.1265	0.0016	0.0110	0.0267	0.0029	0.0005	0.0046	0.0013	0.0002
FIN	**0.2979**	**0.1002**	**0.0394**	**0.0320**	**0.0107**	**0.0048**	**0.0036**	**0.0036**	**0.0022**	**0.0021**
LVA	0.0767	0.1689	0.0007	0.0064	0.0179	0.0044	0.0006	0.0014	0.0003	0.0000
LTU	0.0061	0.0487	0.0014	0.0010	0.0702	0.0779	0.0016	0.0008	0.0011	0.0000

Therefore, the increasing the industry's FIN C16 gross output by one monetary unit leads to the increasing of summary intermediate consumption of this product by 0.5274.

The second phenomenon is more dramatical.

The most striking allocation coefficient in Table 6 is 0.0368, what means LVA C16 sales to the LVA A02 as part of one unit of LVA C16 gross output. Let us notice that for FIN the corresponding indicator equals 0.0003, namely, almost hundred times smaller!

In our opinion the two numbers "0.0368 and 0.0003" discover latent Latvian industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" managerial failure or even malice.

It is absolutely clear that industry C16 is a significant buyer of A02 product. But what does the Latvian industry A02 buy from C16? Let us stress that volumes of sales are significant. Table 6 shows the industry's C16 sales to the industry A02 (in millions of US dollars) in EST, FIN, LVA, LTU, 2000-2014. For instance, in 2014 Latvian C16 receives approximately 100 million of US dollars from the domestic industry A02. We require the Latvian government to explain that fact.

Table 6

Industry C16 sales to industry A02 (in millions of US dollars) in EST, FIN, LVA, LTU

Year	EST	FIN	LVA	LTU
2000	2.44	2.37	19.54	0.25
2001	2.97	2.20	22.18	0.29
2002	3.28	2.44	22.37	0.36
2003	4.30	3.56	30.03	0.48
2004	5.13	4.23	45.97	0.62
2005	5.04	4.25	47.88	0.69
2006	5.35	5.03	54.24	0.72
2007	6.08	5.77	72.51	0.89
2008	5.95	4.29	67.05	0.74
2009	3.99	2.62	47.91	0.47
2010	5.86	3.02	77.44	0.55
2011	9.51	3.01	100.77	0.88
2012	8.09	2.52	91.51	0.85
2013	8.92	2.47	101.16	0.97
2014	10.47	2.35	98.96	0.92

Table 7 shows the pair of indicators "C16 interindustry sales to the A02" and "A02 interindustry purchases of the domestic C16" for EST, FIN, LVA, LTU in 2000-2014.

Table 7

Industry C16 sales to industry A02 and industry A02 purchases from industry C16 (as parts of proper gross output) in EST, FIN, LVA, LTU

Year	EST		FIN		LVA		LTU	
	G	D	G	D	G	D	G	D
2000	0.0054	0.0113	0.0005	0.0009	0.0305	0.0810	0.0007	0.0024
2001	0.0056	0.0130	0.0005	0.0008	0.0343	0.0845	0.0007	0.0028
2002	0.0051	0.0125	0.0005	0.0009	0.0282	0.0718	0.0007	0.0030
2003	0.0049	0.0124	0.0005	0.0011	0.0270	0.0831	0.0006	0.0033
2004	0.0046	0.0131	0.0006	0.0011	0.0341	0.0877	0.0007	0.0035
2005	0.0040	0.0132	0.0006	0.0011	0.0310	0.0908	0.0007	0.0034
2006	0.0037	0.0146	0.0006	0.0012	0.0325	0.0810	0.0006	0.0032
2007	0.0034	0.0114	0.0006	0.0010	0.0306	0.0763	0.0006	0.0025
2008	0.0037	0.0105	0.0005	0.0007	0.0331	0.0660	0.0006	0.0020
2009	0.0036	0.0116	0.0004	0.0005	0.0321	0.0617	0.0005	0.0020
2010	0.0039	0.0115	0.0004	0.0006	0.0384	0.0697	0.0005	0.0017
2011	0.0051	0.0129	0.0004	0.0005	0.0396	0.0822	0.0007	0.0019
2012	0.0046	0.0119	0.0004	0.0005	0.0378	0.0824	0.0007	0.0021
2013	0.0043	0.0134	0.0003	0.0004	0.0376	0.0803	0.0007	0.0019
2014	0.0045	0.0154	0.0003	0.0004	0.0368	0.0793	0.0007	0.0020

Figures 5, 6 depict the industry's C16 sales to the industry A02 and industry's A02 purchases from the domestic industry C16 (as parts of proper gross output) in EST, FIN, LVA, LTU.

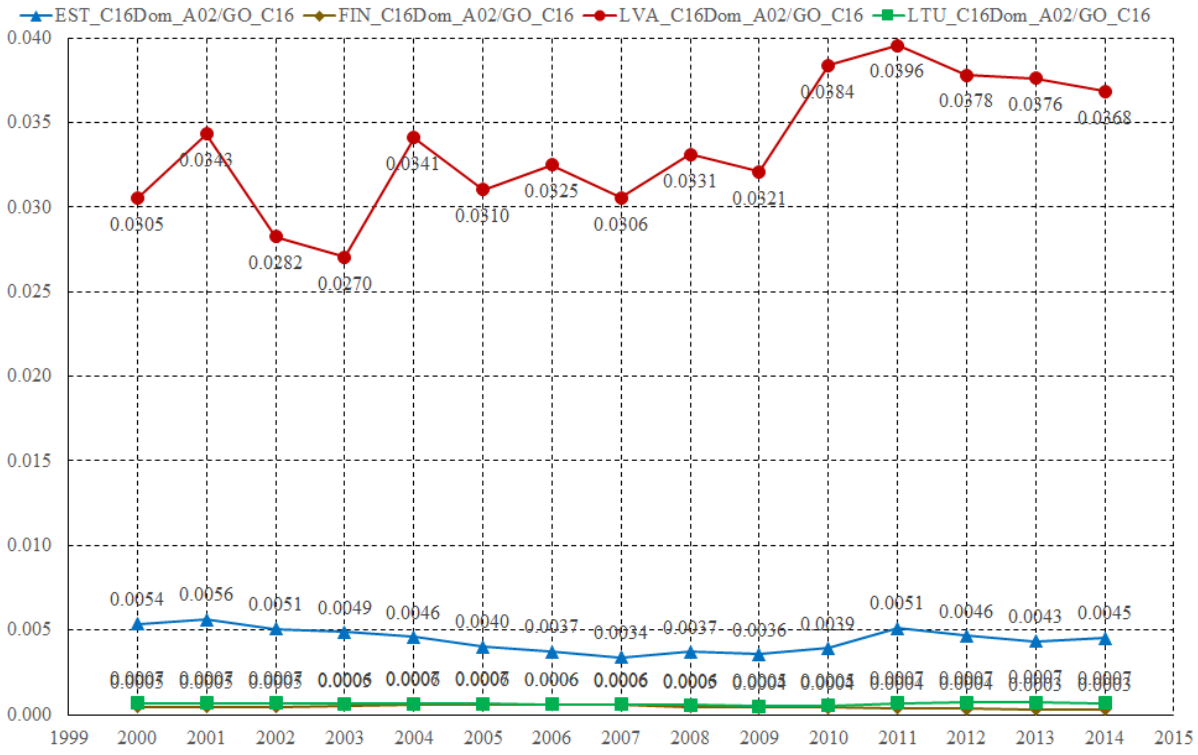

Fig. 5. **Industry C16 sales to industry A02 as parts of C16 gross output in EST, FIN, LVA, LTU**

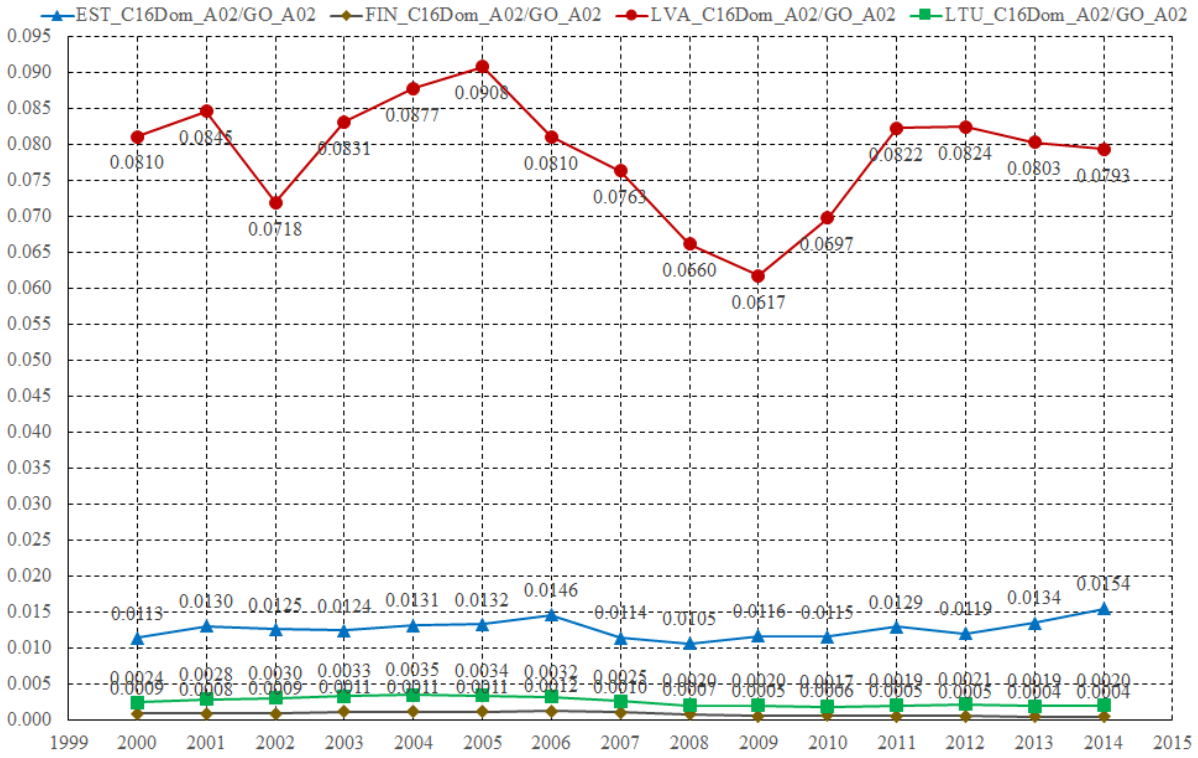

Fig. 6. **Industry A02 purchases from domestic industry C16 as parts of A02 gross output in EST, FIN, LVA, LTU**

Fig. 7 shows Latvian A02 anomalous big C16 foreign purchases comparing with EST, FIN, LTU.

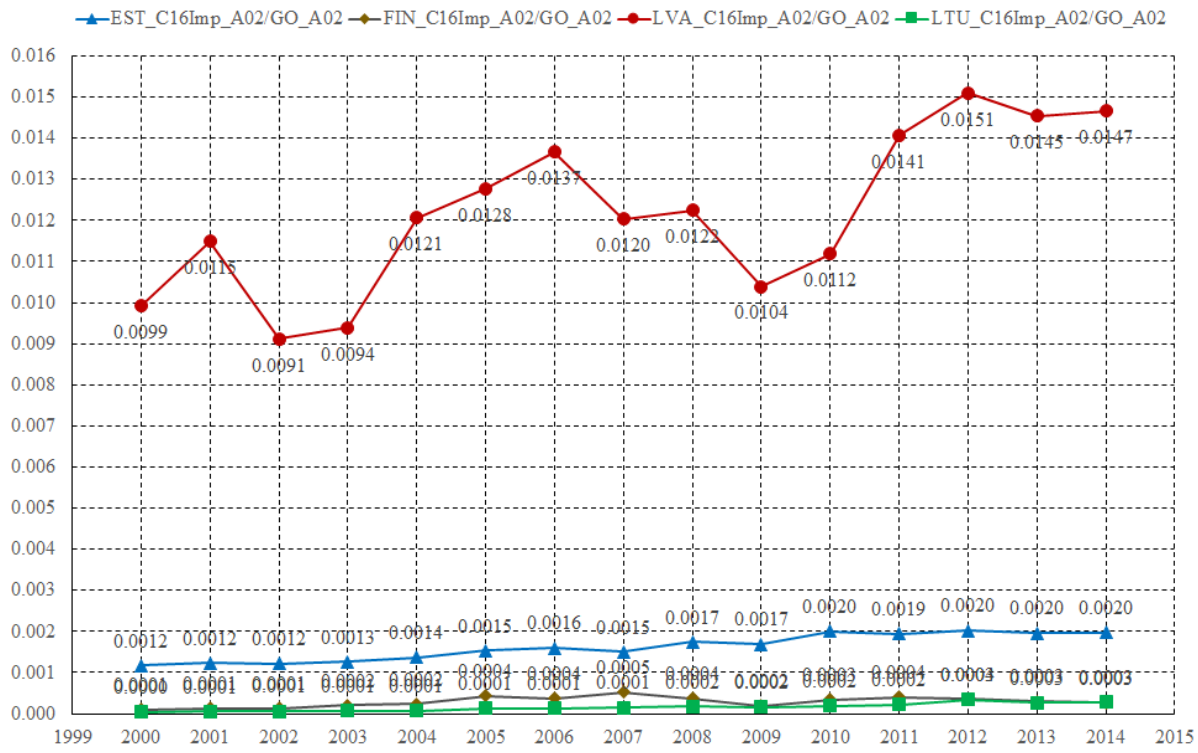

Fig. 7. **Industry A02 purchases from foreign C16 as parts of A02 gross output in EST, FIN, LVA, LTU**

7. The effects on the national economy total output as a result of the initial increase in C16 final demand.

The Leontief inverse matrix shows the marginal indicators (economic multipliers) what measure the impact of separate industry's final demand increase *ceteris paribus* on the industries' gross output required for equilibrium in the national economy. Table 8 contains the industry's C16 twelve biggest Leontief coefficients for LVA and FIN (2014) arranged from the largest to smallest: arrangement by Latvian indicators and arrangement by Finland indicators.

Table 8

Industry C16 twelve biggest Leontief coefficients for LVA and FIN (2014)

Code	EST	FIN	**LVA**	LTU
C16	1.1504	1.1147	**1.2348**	1.0520
A02	0.1860	0.3846	**0.3113**	0.0731
G46	0.1163	0.1003	**0.1300**	0.0031
H52	0.0569	0.0723	**0.0986**	0.0075
D35	0.0306	0.0405	**0.0816**	0.0190
H49	0.0893	0.0633	**0.0772**	0.0221
G47	0.0170	0.0066	**0.0259**	0.0103
N	0.0193	0.0188	**0.0227**	0.0058
L68	0.0298	0.0203	**0.0225**	0.0088
K64	0.0138	0.0121	**0.0209**	0.0068
M69_M70	0.0163	0.0129	**0.0203**	0.0055
F	0.0111	0.0220	**0.0180**	0.0089
TBL_domestic	1.8897	2.1191	2.1677	1.3447
TBL_imports	0.3539	0.1972	0.2864	0.3725

Code	EST	**FIN**	LVA	LTU
C16	1.1504	**1.1147**	1.2348	1.0520
A02	0.1860	**0.3846**	0.3113	0.0731
G46	0.1163	**0.1003**	0.1300	0.0031
H52	0.0569	**0.0723**	0.0986	0.0075
H49	0.0893	**0.0633**	0.0772	0.0221
D35	0.0306	**0.0405**	0.0816	0.0190
C20	0.0030	**0.0235**	0.0020	0.0110
F	0.0111	**0.0220**	0.0180	0.0089
O84	0.0019	**0.0212**	0.0018	0.0003
L68	0.0298	**0.0203**	0.0225	0.0088
N	0.0193	**0.0188**	0.0227	0.0058
G45	0.0206	**0.0150**	0.0092	0.0055

We can observe notable distinction in the national output necessary reaction to the C16 final demand increase in order to support the economic equilibrium in the national economy.

For example, FIN and LVA have significant Leontief coefficients for the industry A02: 0.3846 and 0.3113. At the same time, for EST and LTU these indicators are 0.1860 and 0.0731. These indicators can be easy interpreted taking into account the role of domestic A02 for C16 in the referred countries.

Let us remind, for example, the meaning of the coefficient 0.3113: the required balanced growth of A02 gross output in case if the final demand of C16 increases by one monetary unit when the final demand of all the other industries remains unchanged.

As it was expected, in LVA the big pressure is related to the pitifully famous Latvian industry D35 (Electricity, gas, steam and air conditioning supply): 0.0816 in LVA against 0.0306 in EST, 0.0405 in FIN, 0.0190 in LTU.

Tables 10 and 11 in the paper of the authors [12] show LVA and FIN industries with ten biggest and with ten smallest total backward linkages (TBL_domestic, TBL_imports).

For the industry LVA C16: TBL_domestic = 2.1677, TBL_imports = 0.2864.

For the industry FIN C16: TBL_domestic = 2.1191, TBL_imports = 0.1972.

It means that the total impact on the rest national industries caused by an increase in the final demand in C16 by one monetary unit when the final demand of all the other industries remains unchanged for LVA is 2.1667, but for FIN the proper impact is 2.1191. The total impact on imports for LVA is 0.2864, but for FIN the impact is 0.1972.

8. The effects on the national economy total output as a result of the initial increase in C16 value added.

The Ghosh inverse matrix shows the marginal indicators (economic multipliers) that measure the impact of separate industry's value added increase *ceteris paribus* on the industries' gross output required for equilibrium in the national economy. Table 9 contains the industry's C16 twelve biggest Ghosh coefficients for LVA and FIN (2014) arranged from the largest to smallest: arrangement by Latvian indicators and arrangement by Finland indicators.

Table 9

Industry C16 ten biggest Gosh inverse coefficients for LVA and FIN (2014)

Code	C16	F	A02	D35	C31 _C32	L68	C24	C10-C12	H52	G46	TFL
EST	1.2918	0.1195	0.0097	0.0350	0.0691	0.0160	0.0017	0.0152	0.0210	0.0181	1.7871
FIN	1.1382	0.4582	0.0017	0.0531	0.0173	0.0623	0.0173	0.0183	0.0103	0.0174	2.1349
LVA	**1.3085**	**0.2139**	**0.0778**	**0.0370**	**0.0310**	**0.0231**	**0.0135**	**0.0126**	**0.0115**	**0.0112**	1.8607
LTU	1.1310	0.0343	0.0033	0.0196	0.1888	0.2083	0.0010	0.0329	0.0149	0.0139	2.0219

Code	C16	F	C17	L68	D35	O84	C10-C12	G46	C24	C31 _C32
EST	1.2918	0.1195	0.0045	0.0160	0.0350	0.0091	0.0152	0.0181	0.0017	0.0691
FIN	**1.1382**	**0.4582**	**0.0813**	**0.0623**	**0.0531**	**0.0231**	**0.0183**	**0.0174**	**0.0173**	**0.0173**
LVA	1.3085	0.2139	0.0026	0.0231	0.0370	0.0087	0.0126	0.0112	0.0135	0.0310
LTU	1.1310	0.0343	0.0070	0.2083	0.0196	0.0132	0.0329	0.0139	0.0010	0.1888

The Ghosh coefficient indicates the impact on the industries' gross output caused (to support the economic equilibrium in the national economy) by an increase in the C16 value added by one monetary unit when value added of all other industries remains unchanged.

We can observe distinction in the industries' gross output necessary growing reacted to the C16 value added increase.

For example, LVA and FIN have significant Ghosh coefficients for the industry F (Construction): 0.2139 and 0.4582. At the same time for EST and LTU the proper indicators are 0.1195 and 0.0343. These indicators can be feasibly interpreted taken in account the different demand for wooden houses

in referred countries. It is well known that there is a low demand for wooden houses in Latvia. In comparison, in Finland wooden houses are very popular.

Let us consider the Ghosh coefficients for the industry A02. The LVA coefficient 0.0778 means the following: the required balanced growth of A02 gross output in case if the value added of C16 increases by one monetary unit when the value added of all the other industries remains unchanged in LVA is 0.0778. The corresponding indicators for EST, FIN, LTU are: 0.0097, 0.0017, 0.0033. Indeed, something is wrong in the relations between the two Latvian industries "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" and "Forestry and logging".

Conclusions

1. The comparative analysis of the industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" (C16) sales structure demonstrates that Finland's industry C16 is more oriented to the domestic intermediate sales and less to the exports, what sufficiently differs from EST, LVA, LTU.
2. The comparison of direct backward linkages (domestic and imports) confirms the conclusion one. The structure of equation "DBL_total = DBL_domestic + DBL_imports" concretizes as equality "0.7866 = 0.6967 + 0.0900" and confirms the fact that FIN C16 is oriented to the domestic intermediate consumption more than the other referred countries. That phenomenon signalizes about different PESTILB factors influencing the industry C16.
3. LVA C16 sales to LVA A02 as part of one unit of LVA C16 gross output in 2014 is 0.0368. For FIN the corresponding allocation coefficient equals 0.0003. In 2014 Latvian C16 receives approximately 100 million US dollars from the domestic industry A02. In our opinion these two numbers "0.0368 and 0.0003" discover latent Latvian industry's "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" managerial failure or even malice. We require the Latvian government to explain that fact.

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