Trade dynamics and adjustment costs in the Baltic States*

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The development of trade patterns, determined by structural changes and the reallocation of resources has been investigated. The different indicators of trade patterns and adjustment costs have been analysed. On the basis of calculated indicators conclusions about adjustment costs in the Baltic States have been presented.

Key words: trade patterns, intra-industry trade, adjustment costs.

1. Introduction

In recent decades increasing openness, trade liberalization, economic integration and other factors of globalization have essentially changed the structure of world trade and specialization. In developed countries, changes in specialization have been mainly determined by R&D development, relocation to developing countries to obtain cost advantages, and so on. In developing countries, these processes were determined, first of all, by the inflow of FDI. Emerging markets and transition economies gained a lot from regional integration. The development of trade patterns is a dynamic process, determined by structural changes and the reallocation of resources between economic sectors. This creates essential adjustment costs. The dynamic character of this process requires a special approach to its analysis and the selection of appropriate indicators for measurement. The aim of this mainly empirical paper is to apply this approach to the Baltic States in order to analyse the trade dynamics and adjustment costs induced by the development of foreign trade.

For this purpose we used an export and import data time series from the UNSTAD database for the years 1995-2012. This data is available in the format of the Standard International Trade Classification (SITC) Revision 3 structure and includes 255 commodity sectors in 3 digit level of aggregation.

Although the development of trade pattern is a long-term process, determined mainly by changes in the factor endowments, there are some exceptions, in which structural changes occurred quite quickly. The Baltic States belong to these exceptions.

Before its collapse, the Baltic countries were the part of the Soviet Union and their foreign trade for the greater part was focused on the USSR republics. After obtaining independence, over several years the Baltic countries dramatically reoriented their foreign trade towards the counties of the European Union. Further integration into and membership of the European Union, as well as a series of economic crises, made this reorientation even more profound. This was accompanied by deep structural changes in the economy of the Baltic countries, an inflow of foreign investment and institutional development.

The rest of the paper is structured as follows: in the second section problems involved in the measurement of trade dynamics are considered; in the third section, we define the trade adjustment cost; in the fourth section, we discuss problems with measuring adjustment costs; an empirical analysis is presented in the fifth section; and in the last section we conclude.

2. Measuring trade dynamics

There are well known indicators of trade patterns widely used in the scientific literature.

The most popular measure of the structure of trade flows determining by comparative advantage is the Balassa index of revealed comparative advantage (RCA), proposed by Balassa[1]. It is calculated as follows:

$$RCA_i = \frac{X_{ij} \Big/ \sum_i X_{ij}}{X_i^W \Big/ \sum_i M_i^W}, \quad (1)$$

where X_{ij} denotes the export of commodity i to country j;

X_i^W denotes a world export (or export in the reference group of countries) of commodity i.

A positive aspect of the Balassa index is that it has a direct and clear economic interpretation. It allows us to analyse the comparative advantages of different product groups in the same country as well as to compare the comparative advantages held by product groups across countries.

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Powerful though it is, the theory of comparative advantage cannot explain a significant part of foreign trade flows. Obviously, it cannot be attributed to the mutual trade flows within one commodity group (matched trade) - a relation defined as intra-industry trade.

The common measure of the level of intra-industry trade is the Grubel - Lloyd (GL) index[2]:

$$GL_i = 1 - \frac{|X_i - M_i|}{(X_i + M_i)}, \quad (2)$$

where M_i denotes countries' imports of commodity group *i*;

X_i denotes countries' exports of commodity group *i*.

The GL index is suitable for the analysis of intra-industry trade between different product groups in the same country as well as across countries.

Both indices vary between 0 and 1. In the case of the Balassa index, '0' means the absence of comparative advantage whereas '1' means complete specialization. In the case of the Grubel-Lloyd index, '1' means that trade is completely intra-industry while '0' indicates intra-industry (unmatched) trade.

As Balassa as GL indices analyse the trade pattern in the period of time. To analyse trade dynamics, we can compare the different time periods. This comparative static approach, however, gives us a little information about the structure of changes in trade patterns. To overcome this problem, Brülhard proposed a measure of marginal intra-industry trade (MIIT)[3]:

$$MIIT_i = 1 - \frac{|\Delta_t X_i - \Delta_t M_i|}{|\Delta_t X_i| + |\Delta_t M_i|}, \quad (3)$$

where $\Delta_t X_i = X_{ti} - X_{t-1,i}$,

$\Delta_t M_i = M_{ti} - M_{t-1,i}$.

MIIT index like GL can be aggregated across industries as a weighted average:

$$MIIT_{total} = \sum_{i=1}^{n} MIIT_i \cdot W_i, \quad (4)$$

where $W_i = \frac{|\Delta_t X_i| + |\Delta_t M_i|}{\sum_{i=1}^{n} (|\Delta_t X_i| + |\Delta_t M_i|)}$. (5)

The MIIT index, unlike the GL index, reveals the structure of change in trade flows. This index also ranges between 0 and 1. '0' means that marginal trade is entirely intra-industry and '1' indicates that trade expansion happen completely by intra-industry type. The disadvantage of the MIIT index is the inadequacy of the information it provides about the unmatched component of marginal trade.

Considering the inter-industry component of trade expansion, we can distinguish between two effects: the increasing amount of prior specialization and specialization shift. Statistically, the deepening of prior specialization can be reflected as an increase in net exports in an export-oriented sector or as a decrease in net imports in import-competing sectors of the economy. Correspondingly, specialization shift can be shown as a decrease in net exports in an export-oriented sector and as an increase in net imports in import-competing sectors.

Following Bastos et al.[4], we decompose the marginal inter-industry trade between two components, the increasing amount of previous specialization (IPS) and specialization shift (SS), as follows:

$$INTER_{it} = \begin{cases} IPS_{it} \text{ if } \operatorname{sign}(\Delta_t X_t - \Delta_t M_i) = \operatorname{sign}(X_{i0} - M_{i0}) \\ SS_{it} \text{ if } \operatorname{sign}(\Delta_t X_t - \Delta_t M_i) \neq \operatorname{sign}(X_{i0} - M_{i0}), \end{cases} \quad (6)$$

where X_{i0} export of sector *i* at the beginning of period *t*;

M_{i0} import of sector *i* at the beginning of period *t*.

As in the case of MIIT we can aggregate these measures across economic sector to the country level as a weighted average

$$IPS_{total} = \sum_{i=1}^{n} IPS_i \cdot W_i; \quad (7)$$

$$SS_{total} = \sum_{i=1}^{n} SS_i \cdot W_i. \quad (8)$$

We will apply these measures to the analysis of the Baltic States' trade expansion in section 6.

3. Definition of trade adjustment costs

In a broad sense, adjustment costs are defined as the cost of adjustment of resources between economic sectors because of changes occurring in the economy. In the contest of trade expansion or contraction, this cost is associated with the appropriate reallocation of production factors. Changes in trade patterns in their turn depend upon different factors, such as structural changes in production, changes in domestic and foreign demand and trade liberalization, etc. In Table 1, the components of adjustment costs are presented. A distinction is made between private and public adjustment costs. Public adjustment costs are mainly associated with losses of tax revenue because of trade liberalization and expansion.

Most papers devoted to adjustment costs in the private sector analyse the adjustment of the labour market because these costs are highest. Labour adjustment costs include temporary unemployment,

Table 1. **Adjustment Costs**

Private sector	Labour:	Opportunity costs of unemployed labour
		Obsolescence of skills and skill specificity
		Lower wage levels
		Re-training costs
		Personal costs such as psychological suffering
		Other costs: (e.g. rent seeking)
	Capital	Opportunity costs of underutilized or unemployed capital
		Cost of capital rendered obsolete (Capital write-offs)
		Transition costs of shifting capital from one activity to another
Public sector		Loss in tax revenue
		Social safety net spending (e.g., unemployment benefits)
		Erosion of benefits from preferential treatment
		Efforts to ensure macroeconomic stability
		Implementation costs of trade reforms
		Non Trade Concerns: food security, support to rural areas, environmental concerns

Source: *Azhar Abdul, Robert Elliott*. On the measurement of trade-induced adjustment // Review of World Economics (Weltwirtschaftliches Archiv). Springer, 2003. Vol. 139 (3). P. 419-439.

retraining, displacement, decreasing wage levels and personal costs, etc.

Capital adjustment costs may include the underutilization of capital, the redistribution of capital between economic sectors, moral depreciation and write-offs, etc.

The size of adjustment costs depends upon the possibility of reemploying production factors. This is determined by the flexibility of labour and capital markets, the availability of governmental support, the speed of structural changes and patterns of trade.

The relation between the dynamics of trade patterns and adjustment costs is formulated by the smooth adjustment hypothesis (SAH). According to this approach, mobility of labour and capital is higher within industries than between industries. The basic reason for that is the similarity of requirements for labour skills and technologies within economic sectors. Often, firms in the same industry are spatially concentrated, which also increase mobility.

Because changes in production and trade within industries are associated with intra-industry trade dynamics, changes in inter-industry trade lead to the reallocation of production factors between industries, while IIT expansion leads to significantly smaller adjustment costs.

4. Measuring trade adjustment cost

Based on SAH, the MIIT index can be used directly as a measure of adjustment costs. The higher the share of IIT in trade expansion, the lower the magnitude of any adjustment costs. However, this index does not take into account the direction of change in trade balance. This is important information, because adjustment costs could be different in the case of export expansion or import expansion. To overcome this problem, Brülhard[5] proposed another index:

$$B_i = \frac{\Delta_t X_i - \Delta_t M_i}{|\Delta_t X_i| + |\Delta_t M_i|}, \quad (9)$$

where $[\text{EMBER}] = 1 - MIIT_i$. (10)

This index ranges between -1 and 1. The closer that B_i is to 0, the higher the share of IIT. The closer the index is to 1 or -1, the higher the share of inter-industry trade. This index also provides information about change in exports and imports in relation to each other. When $B_i > 0$, $\Delta_t X_i > \Delta_t M_i$, and vice versa. In contrast to the MIIT index, this index cannot be aggregated across economic sectors and only provides information about sector performance.

Another measure of trade-induced adjustment costs was proposed by Azhar et al.[6], and is calculated as follows:

$$S_i = \frac{\Delta_t X_i - \Delta_t M_i}{2\left(max\{|\Delta_t X_i|, |\Delta_t M_i|\}\right)}. \quad (11)$$

This index also ranges from -1 to 1, though it differs from the previous scale by its scaling, which is the absolute maximum for the largest change in imports and exports for the period considered. Scaling by the largest value for a given time-scale allows us to observe the progress of adjustment pressure over time, because the magnitude of trade flows are taken into consideration in the generation of the index's value[7].

5. Analysis of trade pattern dynamics

In Table 2 the aggregated components of trade expansion for the Baltic States are submitted. We aggregated the calculated indicators for the three-digit commodity groups. To eliminate short-run fluctuations, we calculated the five-year average of these indicators.

Table 2. **Aggregated components of trade dynamic for the Baltic States, 1996-2012**

Component	1996-2000	2001-2005	2006-2010	2011-2012
ESTONIA				
IPS	0,33	0,35	0,27	0,33
SS	0,23	0,24	0,22	0,25
MIIT	0,44	0,40	0,51	0,42
LATVIA				
IPS	0,48	0,44	0,31	0,32
SS	0,28	0,14	0,24	0,22
MIIT	0,23	0,41	0,44	0,46
LITHUANIA				
IPS	0,41	0,49	0,36	0,33
SS	0,23	0,08	0,25	0,21
MIIT	0,36	0,43	0,39	0,46

As can be seen, the most important component in trade expansion in all the Baltic States is intra-industry trade, which is consistent with our previous results[8] and the findings of other authors for the OECD countries[9]. In particular, a large expansion of MIIT occurred in 2006-2010 in Estonia and Latvia. For Latvia and Lithuania, in the last two years of analysis, the share of MIIT was the highest.

Another obvious result is the increasing importance of specialization shift in trade expansion. We can observe this tendency while taking into account an increase in MIIT and a decrease in the level of previous specialization. The exclusions are Latvia and Lithuania, in 2001-2005, when the share of SS essentially decreases. This result is also consistent with our previous publication[10], concerning the diversification of specialization structures in the Baltic States, as well as with the findings of other authors for the OECD countries[11] regarding the same tendency. In particular, this tendency was obvious from 2006 onwards when trade expansion contributed to a decrease in the level of prior specialization.

In Tables 3-5, the calculated indicators are presented in terms of aggregated commodity sectors. The structure of the trade dynamics is quite different between countries and time-periods. Intra-industry trade contributes a lot to trade expansion in machinery and transport equipment in all the Baltic States, and in chemicals and manufacturing goods in Latvia and Lithuania. In Estonia, an essential sector for MIIT is animal and vegetable oils, while in Lithuania it is food and mineral fuels. In recent years, the importance of MIIT has increased in all the countries.

The importance of the inter-industry components of trade dynamics by sector also depends upon the country and time period in question. For food products, specialization shift dominated in the trade dynamics in Estonia and Latvia. In Lithuania, an essential shift of specialization was observed in the trade dynamics of these production sectors. In crude materials and mineral fuels, an increase in previous specialization also dominated in Estonia and Latvia, while in Lithuania change in specialization was the dominant tendency in the trade dynamics. For manufacturing goods and machinery, we observe strong specialization for Latvia and Lithuania for the first two five-year periods, followed by a specialization shift. For Estonia, in these production sectors, an increase in previous specialization was the dominant tendency for the entire period. The trade dynamics in chemical products were determined by a specialization shift in Estonia and strong specialization in Latvia and Lithuania.

Table 3. **Components of trade dynamic by aggregated commodity sectors in Estonia, 1996-2012**

Sector	1996-2000			2001-2005			2006-2010			2011-2012		
	IPS	*SS*	*MIIT*	*IPS*	*SS*	*MIIT*	*IPS*	*SS*	*MIIT*	*IPS*	*SS*	*MIIT*
Food and live animals	0,69	0,26	0,06	0,52	0,17	0,31	0,85	0,10	0,04	0,60	0,19	0,21
Beverages and tobacco	0,39	0,52	0,09	0,63	0,29	0,09	0,62	0,31	0,08	0,70	0,30	0,00
Crude materials, inedible, except fuels	0,57	0,19	0,24	0,69	0,16	0,15	0,42	0,48	0,10	0,27	0,30	0,43
Mineral fuels, lubricants and related materials	0,78	0,00	0,22	0,41	0,39	0,20	0,59	0,25	0,17	0,30	0,70	0,00
Animal and vegetable oils, fats and waxes	0,11	0,49	0,40	0,61	0,11	0,27	0,62	0,07	0,31	0,00	0,50	0,50
Chemicals and related products, n.e.s.	0,37	0,63	0,00	0,47	0,53	0,00	0,65	0,22	0,13	0,50	0,50	0,00
Manufactured goods	0,63	0,28	0,09	0,60	0,18	0,22	0,72	0,10	0,18	0,86	0,07	0,06
Machinery and transport equipment	0,55	0,29	0,16	0,53	0,46	0,01	0,56	0,16	0,28	0,47	0,03	0,50
Miscellaneous manufactured articles	0,51	0,15	0,33	0,45	0,38	0,17	0,82	0,12	0,07	0,42	0,18	0,40

Table 4. **Components of trade dynamic by aggregated commodity sectors in Latvia, 1996-2012**

Sector	1996-2000			2001-2005			2006-2010			2011-2012		
	IPS	SS	MIIT	IPS	SS	MIIT	IPS	SS	MIIT	IPS	SS	MIIT
Food and live animals	0,60	0,07	0,33	0,21	0,09	0,70	0,10	0,13	0,77	0,15	0,50	0,35
Beverages and tobacco	0,74	0,20	0,06	0,24	0,07	0,69	0,32	0,27	0,41	0,58	0,00	0,42
Crude materials, inedible, except fuels	0,59	0,20	0,21	0,36	0,14	0,50	0,15	0,10	0,75	0,28	0,50	0,22
Mineral fuels, lubricants and related materials	0,38	0,57	0,05	0,31	0,11	0,58	0,59	0,20	0,21	0,61	0,00	0,39
Animal and vegetable oils, fats and waxes	0,47	0,12	0,41	0,57	0,20	0,23	0,41	0,13	0,46	0,87	0,00	0,13
Chemicals and related products, n.e.s.	0,49	0,11	0,40	0,48	0,00	0,52	0,26	0,10	0,64	0,02	0,09	0,89
Manufactured goods	0,25	0,16	0,59	0,08	0,01	0,91	0,12	0,24	0,64	0,50	0,04	0,46
Machinery and transport equipment	0,60	0,07	0,33	0,57	0,00	0,43	0,34	0,36	0,30	0,19	0,23	0,58
Miscellaneous manufactured articles	0,13	0,14	0,73	0,30	0,04	0,65	0,26	0,34	0,40	0,60	0,00	0,40

Table 5. **Components of trade dynamic by aggregated commodity sectors in Lithuania, 1996-2012**

Sector	1996-2000			2001-2005			2006-2010			2011-2012		
	IPS	SS	MIIT	IPS	SS	MIIT	IPS	SS	MIIT	IPS	SS	MIIT
Food and live animals	0,20	0,37	0,43	0,10	0,12	0,78	0,09	0,01	0,91	0,26	0,00	0,74
Beverages and tobacco	0,29	0,42	0,30	0,16	0,40	0,44	0,00	0,43	0,57	0,07	0,21	0,72
Crude materials, inedible, except fuels	0,05	0,66	0,29	0,27	0,01	0,71	0,06	0,42	0,52	0,50	0,01	0,49
Mineral fuels, lubricants and related materials	0,10	0,27	0,62	0,06	0,17	0,77	0,31	0,04	0,65	0,29	0,00	0,71
Animal and vegetable oils, fats and waxes	0,72	0,20	0,08	0,48	0,20	0,32	0,21	0,06	0,73	0,43	0,00	0,57
Chemicals and related products, n.e.s.	0,49	0,00	0,51	0,36	0,00	0,64	0,08	0,09	0,83	0,00	0,20	0,80
Manufactured goods	0,36	0,15	0,49	0,38	0,00	0,62	0,13	0,29	0,58	0,08	0,50	0,42
Machinery and transport equipment	0,37	0,17	0,46	0,30	0,00	0,70	0,19	0,29	0,51	0,12	0,50	0,38
Miscellaneous manufactured articles	0,49	0,03	0,48	0,25	0,00	0,75	0,23	0,00	0,77	0,65	0,00	0,35

6. Conclusions about adjustment costs

According to the theoretical approach, we can analyse the trade adjustment costs using the MIIT index. We also analysed additional measure such as B index. The value of this index by economic sector is presented in Appendix 1. Taking into account these measures, we can draw the following conclusions about adjustment costs in the Baltic States:

1. The aggregated trade adjustment costs in the Baltic States are approximately the same level for each. The basic tendency is a decrease in adjustment pressure over time.

2. In Estonia, the highest adjustment costs due to trade dynamics occurred in such production sectors as beverages, tobacco products and chemical products. The lowest adjustment costs were for machinery, transport equipment and oils.

3. In Latvia, the lowest trade adjustment costs for the period in question occurred for chemical products, manufacturing goods, machinery and transport equipment. In the remaining sectors, the adjustment costs were moderate.

4. In Lithuania, the lowest trade adjustment costs for the period in question also occurred in chemical products, manufacturing goods, machinery and transport equipment.

Appendix
B index for the Baltic States, 1999-2012

Table 1-1. **B index. Estonia**

Sector	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Food and live animals	0,21	-0,12	0,41	0,14	-0,70	1,00	-0,14	-0,28	-0,01	-0,11	0,21	-0,12	0,42	-0,38
Beverages and tobacco	0,45	-1,00	-0,18	-0,17	-0,28	-0,82	0,43	0,04	-0,39	-0,76	0,34	-0,38	-0,59	-0,01
Crude materials, inedible, except fuels	0,18	-0,19	-0,01	0,42	0,36	-0,62	-0,13	0,25	0,53	1,00	-0,50	0,62	0,59	-0,86
Mineral fuels, lubricants and related materials	0,37	-0,27	-1,00	-0,68	-0,14	1,00	-0,15	-0,11	-0,13	-1,00	0,67	0,16	-0,40	-1,00
Animal and vegetable oils, fats and waxes	1,00	1,00	-0,03	-0,33	1,00	-0,37	0,20	0,33	-0,05	-0,28	0,24	1,00	-1,00	1,00
Chemicals and related products, n.e.s.	-0,23	-1,00	-0,54	-0,91	-0,33	-0,59	-0,27	-0,44	-0,44	0,38	0,27	-0,22	0,00	-1,00
Manufactured goods	0,43	-0,64	0,59	0,18	-0,26	-0,63	0,33	-0,28	-0,07	0,72	0,19	-0,13	-0,14	0,13
Machinery and transport equipment	0,57	0,23	-1,00	-1,00	-0,29	0,06	0,00	-0,65	-0,15	1,00	0,33	0,07	0,06	-1,00
Miscellaneous manufactured articles	0,72	-1,00	0,95	0,86	0,10	-0,66	-0,18	-0,33	0,11	0,12	0,02	0,33	0,36	-0,80

Table 1-2. **B index. Latvia, 1999-2012**

Sector	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Food and live animals	-0,35	-0,72	-1,00	-0,29	-1,00	0,34	-0,59	-0,32	-0,15	0,11	-0,13	-0,28	-0,07	0,49
Beverages and tobacco	-1,00	-0,70	-1,00	-1,00	1,00	0,07	0,25	-1,00	0,04	-0,20	-0,60	0,19	1,00	0,17
Crude materials, inedible, except fuels	-1,00	0,67	0,71	1,00	0,58	-0,72	0,26	0,47	0,06	1,00	-0,02	0,20	-0,41	-0,07
Mineral fuels, lubricants and related materials	-0,90	0,84	1,00	1,00	-1,00	0,01	0,52	-0,90	-0,40	-0,25	-1,00	-1,00	-0,92	1,00
Animal and vegetable oils, fats and waxes	-1,00	-0,93	0,61	-0,10	-0,33	-1,00	-0,84	-0,67	-0,35	1,00	-0,50	-0,89	-0,66	0,43
Chemicals and related products, n.e.s.	-0,77	-0,53	-1,00	-0,15	0,57	-0,59	-0,85	-0,52	-0,34	-0,11	-0,39	-0,23	-0,20	0,49
Manufactured goods	-0,30	-0,45	-0,21	0,78	-0,30	0,01	0,04	-0,25	0,01	-0,14	-0,46	-0,10	1,00	0,20
Machinery and transport equipment	-1,00	-1,00	-1,00	0,33	0,01	-0,64	-0,78	-0,67	-0,42	-0,36	-0,66	-0,51	1,00	0,79
Miscellaneous manufactured articles	0,25	-0,07	-0,25	0,44	-0,33	-0,02	-0,32	-0,18	0,22	-1,00	-0,74	-0,55	1,00	0,56

Table 1-3. **B index. Lithuania, 1999-2012**

Sector	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Food and live animals	-0,10	0,62	-0,46	-0,28	0,34	0,27	-0,19	0,16	0,08	0,19	0,05	0,18	-0,03	0,08
Beverages and tobacco	-0,56	-0,30	0,22	0,78	0,45	0,43	0,76	-0,37	-0,15	0,20	0,04	0,05	-0,49	0,38
Crude materials, inedible, except fuels	-0,24	-0,75	-0,83	0,64	0,19	0,89	0,03	0,18	0,10	-0,06	-0,33	0,23	-0,50	0,20
Mineral fuels, lubricants and related materials	0,21	0,09	0,60	-0,28	-0,12	0,30	-0,21	-0,01	0,14	-0,20	-0,40	-0,32	-0,12	0,17
Animal and vegetable oils, fats and waxes	-0,37	-0,98	-0,60	0,62	-0,57	-0,34	-0,25	-0,49	-0,37	0,89	-0,17	-0,12	-0,24	0,23
Chemicals and related products, n.e.s.	-0,28	-0,53	-0,44	-0,05	-0,18	-0,60	-0,22	-0,23	-0,17	-0,02	-0,24	0,08	0,26	-0,08
Manufactured goods	-0,29	-0,29	-0,67	0,22	0,32	-0,35	-0,30	-0,37	-0,26	0,00	-0,25	-0,25	0,64	0,31
Machinery and transport equipment	-0,22	-0,36	-0,90	0,31	0,28	-0,23	-0,18	-0,20	-0,40	-0,09	-0,30	-0,32	0,57	0,32
Miscellaneous manufactured articles	0,31	-0,06	-0,09	0,98	0,80	0,18	0,28	0,22	0,18	0,12	0,03	0,06	0,18	0,04

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