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THE IDENTIFICATION OF REGIONAL CLUSTERS IN THE REPUBLIC OF KAZAKHSTAN

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The identification of Regional Clusters in the Republic of Kazakhstan

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ABSTRACT

The purpose of this paper is to identify industrial clusters in the Eastern region of the Republic of Kazakhstan. Our research proceeds in two stages. In the first stage we discuss several of the methods available. These include input-output analysis, factor analysis, graph analysis, various spatial statistics, different specifications of location quotients and coefficients, and various combinations among all of them. In recent times, however, there is a considerable increase in the use of input-output tables in empirical analysis of cluster identification. The input-output table allows us to identify industries linked by supplier-buyer relationships and to estimate the strength of their forward and backward linkages. In the second stage we apply several methods to input-output data of the East Kazakhstan region and compare their results with those of the method developed in Fernandez and Fernandez-Grela (2003). We work with a regionalization of the Kazakhstan 2009 national input-output table through the use of semilogarithmic quotients based on employment data. The results obtained allow us to reach some conclusions about the cluster initiatives process launched in Kazakhstan in 2005 to increase competitiveness and diversify the economy of the country through gradual movement from the extracting of raw materials to high value-added production. The last stage is the application of factor analysis to the input-output table in order to improve credibility of results received from previous method.

Keywords: Regional input-output, Clusters, Kazakhstan
JEL Codes: C67, R15

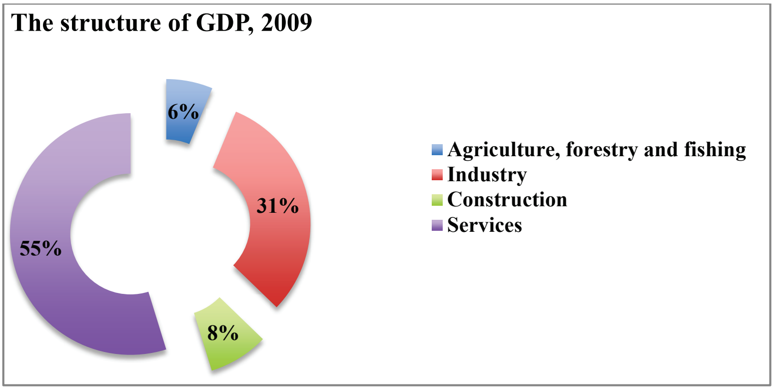
1. INTRODUCTION

Kazakhstan overview

The Republic of Kazakhstan lies between two worlds Europe and Asia. The territory of the country stretches on 2,717,300 square km, which is greater than Western Europe in its entirety. Kazakhstan is bordered with two great powers: Russia on the north, China on the east; and with Kyrgyzstan, Uzbekistan and Turkmenistan on the south. Despite its enormous size, the population density is less than six people per square km, for comparison Spain has 93 per square km (World Atlas, 2010).

Economy of Kazakhstan mainly is based on the extraction of natural resources such as crude oil and other metal products. Therefore, industry sector is occupied approximately 34 per cent of GDP, in 2010. On the other hand, agriculture and construction take only 5 and 8 per cent of GDP, respectively, and production of services – 53 per cent (Figure 1). However, the industry sector is characterized by the lack of high value-added production.

Figure 1: The Structure Of GDP, 2009

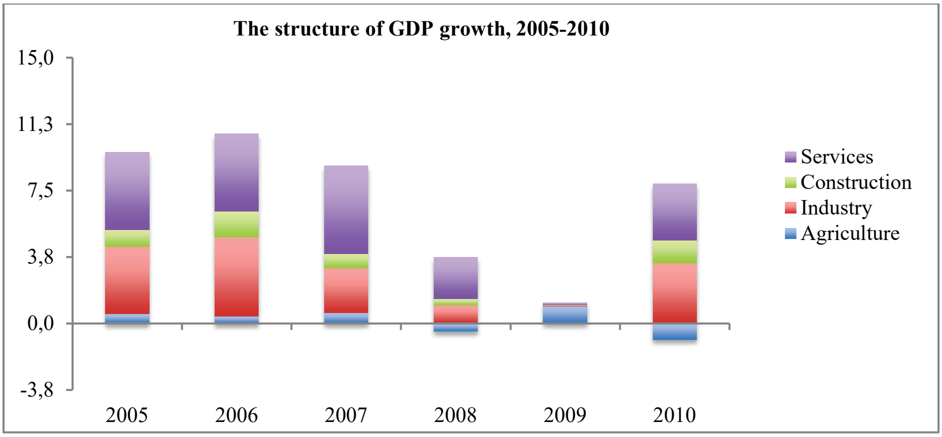


Source: Own elaboration based on the data of the Agency of Statistics of the Republic of Kazakhstan

As you can see on the Figure 2, GDP growth is not stable for the last 10 years. The economy of Kazakhstan had the pick of growth in 2006, as a result of price increase on crude oil in this year. The extracting of gas and crude oil is one of the main sources of state budget replenishment. Since the start of world financial crisis economy of Kazakhstan has endured hard time. Construction sector was the most affected sector. If in 2005 the growth in construction sector achieved almost 40 per cent, then in 2008 it hardly increased by 4 per cent.

The stable growth of 2010 year was solely driven by industry sector. It reached the point of 10 per cent. Since 2010, manufacturing has expanded by 18,4 per cent and mining and quarrying by 5,2 per cent. Due to damage from severe summer droughts, agriculture contracted by 11,6 per cent.

Figure 2: The Structure Of GDP Growth, 2000-2010



Source: Own elaboration based on the data of the Agency of Statistics of the Republic of Kazakhstan

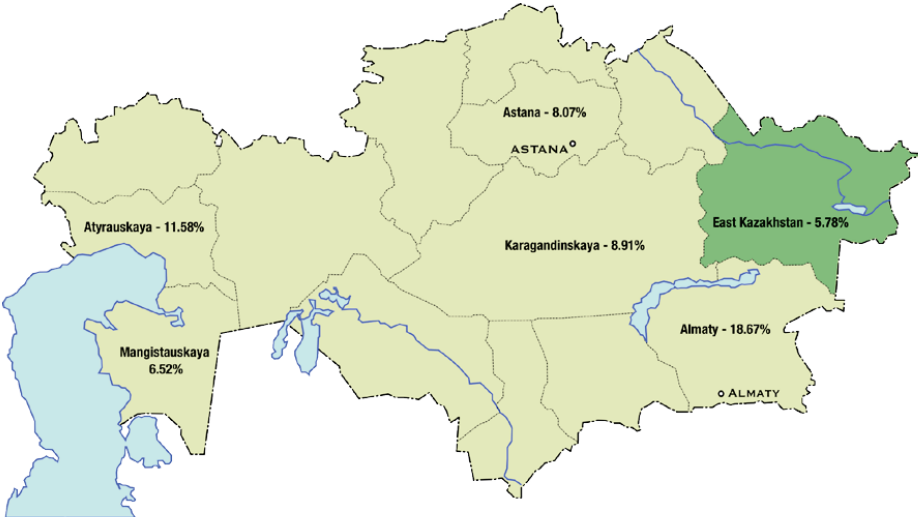
History and development of the Metallurgical Sector in the East Kazakhstan Region

Considerably large and relatively developed facilities of metallurgical complex originate from Soviet Union time. Since the beginning of Second World War, many factories with a specialized workforce were transferred deep into Soviet country, far away from fascists. The East region was an appropriate place with a rich resource deposits and acceptable remoteness. Therefore, the region inherited a good facility of extracting metallurgical raw materials as well as specialized infrastructure and local networking.

The metallurgical complex was formed on the basis of domestic strengths, since Kazakhstan has the largest world's reserves of zinc, tungsten, vanadium, and barite ore, the second largest world's reserves of chrome, phosphate and uranium ores, and the third largest world's reserves of copper, silver, lead and zinc. Kazakhstan ranks also the fourth in world's reserves of molybdenum, the sixth in gold reserves, and the eighth in world's reserves of iron ore. In the underground of the country are estimated to lie 50 percent of the world's tungsten, 23 percent of the world's chrome ore, 19 per cent of world's lead, 13 percent of world's zinc, and 10 percent of global reserves of copper and iron.

East Kazakhstan is one of the industrial developed regions of the Republic of Kazakhstan. In 2009, industrial output achieved 492.1 billion tenge, which is 5,4% of total country´s output. The East Kazakhstan region ranks sixth in regional Gross Domestic Product (GDP) after Almaty city (18,67%), Atyrau region (11,58%), Karaganda region (8,91%), and Mangistau (6,52%) (Figure 3).

Figure 3: GDP Shares of Kazakhstan's Regions, 2009



Source: Own elaboration based on the data of the Agency of Statistics of the Republic of Kazakhstan

As it is shown on the Table 1, region was significantly affected by World financial crisis in 2008. There is noticeable decline of all indicators in 2008 and 2009 was provoked by the world financial crisis. The indicator of industry sector responded faster on overall economical comedown than agricultural and foreign trade. However, since 2009 almost the indicators have had positive trend, except the number of existing small enterprises. Average monthly wage of the region is considerably lower than that of the country. But unemployment rate in the region is less than that in the country in average. As we can seen, there is big lag between the number of registered and existing small enterprises.

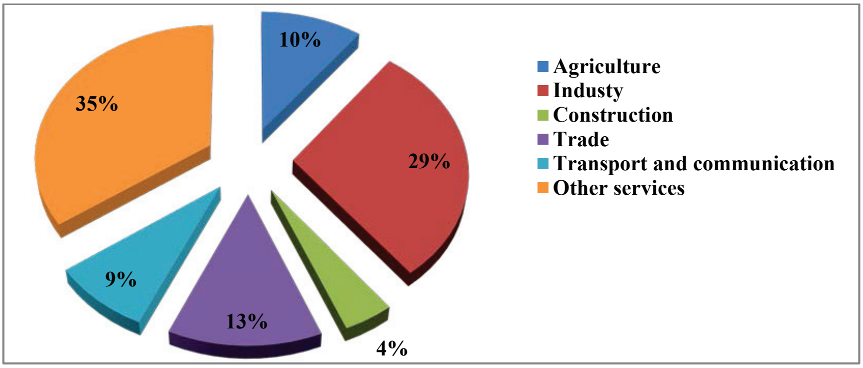
Table 1: The key indicators of the region, 2006-2011

Indicators	unit	2006	2007	2008	2009	2010	2011	% weight or +,- deviation
GDP	billion tenge	615,1	800,5	890	983,7	1244,1	1,624,3	5,9
Industrial output	billion tenge	410,1	481,1	469,5	492,1	641,2	822,9	5,3
Gross agriculture production	billion tenge	80,3	98,5	110,2	165	153,1	202,2	8,8
Foreign trade turnover	million dollars	2535,9	3385	3140	2700	2988,1		3,9
Fixed investments	billion tenge	116,1	126,5	161,4	139,2	144,6	241,6	4,8
The number of registered small enterprises	units	10668	11232	11786	12006	12096	12285	5,9
The number of existing small enterprises	units	7662	7891	6998	7482	7308	6421	5,8
Average monthly wage	tenge	33101	42138	48293	53496	61388	73677	-16351
Unemployment rate	%	6,9	6,6	6,4	6,4	5,7	5,2	-0,2
Consumer price index	%	107,5	116,1	110,5	105,7	108,1	107,1	0,3

* weight of 2011 year

Non-ferrous metallurgy is prevalent sector of the region, as well as machinery and metal processing, energy, forestry and woodworking, light and food industries. The Figure 4 confirms the industrial orientation of the East region. Industry with approximately 29 % share in region´s GDP, contributes considerably to the economy of region. Industrial specialization is highly promoted by local and central government.

Figure 4: Gross Regional Product by Types of Economic Activity, 2009



Source: Own elaboration based on the data of the Agency of Statistics of the Republic of Kazakhstan

The region has significant reserves of polymetal ores containing zinc, lead, copper, rare and precious metals. There are some deposits of coal in Semey and Zaysan regions. The region also has considerable reserves of gold, rare metals and raw materials to produce cement, slag glass, slate and zeolite.

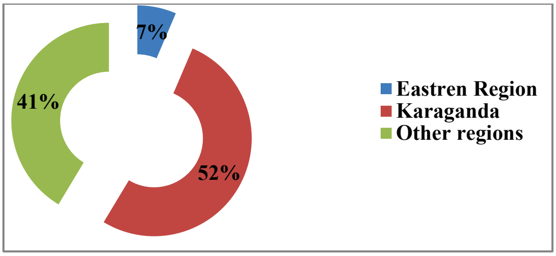
East Kazakhstan is one of the main producers of lead, zinc and copper in concentrates, refined gold and silver in the Republic, and the only one in production of titanium, magnesium, tantalum and fuel for nuclear power plants. The share of region´s manufactured lead in total Republic output is 88 %, copper-zinc ores - 95.4%, zinc – 89 %, and titanium - 100%. The firms of non-ferrous metallurgy produce more than a half of the total industrial output of the region. The largest industrial joint-stock companies are "Kazzinc", "Ust-Kamenogorsk Titanium Magnesium Plant", "UMP", Association "Vostokkazmed" as a branch of "Kazakhmys" corporation. Machinery sector is represented by large enterprises, such as: JSC "Asia Auto", JSC "Vostokmashzavod", JSC "Ust-Kamenogorsk Valve Plant", JSC "Ust-Kamenogorsk Condenser Plant", JSC "Semipalatinsk Engineering Plant", JSC "Irtyshtsvetmetremont", "Mashzavod" LLP, "Kazelektromash" LLP, "George plant pumping equipment." They produce the car "Niva», «Skoda», mining equipment, mineral processing equipment, oil and gas fittings, household electric motors and pumps with various modifications, capacitors and other electrical and cable products (Восточно-Казахстанская область : Экономика, 2007).

Background of cluster policy

Due to the strong dependence of the economy on extraction of natural resources, in 2005, the government of Kazakhstan approved the plan to create and develop seven pilot clusters. The Centre for Marketing and Analytical Research of the Republic of Kazakhstan developed the project together with foreign consulting firms JE Austin Associates, and Economic Competitiveness Group. The goal of the project is to increase the competitiveness of sectors that are not related to the extraction of natural resources. During the first phase of the clusterization, special groups studied fifty five thousand companies, in forty-six industries in twelve regions of the country. Because of resource and financial restrictions, the government determined a limited number of clusters, which are considered the most meaningful for economic development. Seven pilot clusters were selected, including transport and logistics services, tourism, oil and gas machinery, construction materials, food and textile industries, and metallurgy. Some of them were in a more developed stage, while others needed to start from scratch.

Geographical concentration was one of the criteria used in industry selection, as well as the critical mass of existing companies in the industry. The metallurgical cluster has been basically initiated in the central region of Kazakhstan, because a significant proportion of metallurgical output is located in that area. However, there are significant metallurgical complexes in the eastern part of Kazakhstan, which are also included in the cluster. Copper, zinc and lead concentrate are the main metallic products produced in the East Region. Despite the fact that the metallurgical cluster includes complexes in the Karaganda and Eastern regions, our research is focused only on the Eastern region metallurgical complex (Figure 5). Both complexes have a different specialization and different target markets, which gives us a possibility to consider these regions separately.

Figure 5: Share of Metallurgical Cluster in Country's Metallurgical output, 2009



The metallurgical cluster in Kazakhstan conforms to the concept of "vertical cluster" described in Blum (2008) as a spatial hub that dominates suppliers settled in the vicinity. It is structured through centralized networks that profit from agglomeration economies and economies of scale external to the firms, and from low transaction and physical transport costs upstream and downstream the value chain. In many cases, initially vertical integrated firms become more flexible by means of outsourcing activities. "Outsourcing of non-core activities has been chosen by Kazzinc as part of its streamlining strategy. The spin-off of auxiliary operations to create new entities encourages their development by means of turning them into stand-alone profit centres" (The specialized industrial complexes and subsidiaries, 2010). Usually, vertical clusters are based on "backward linkages", and innovations are concentrated in the head of cluster. Core competences mostly rest on the demand side and vertically oriented research is directed to the needs of the market.

Despite the fact that the mining and manufacturing of non-ferrous metals are concentrated in the East Region, other types of metals such as copper and aluminium are dispersed over the big territory of Kazakhstan. Because of this metallurgical cluster captures only approximately 6 per cent of total metallurgical output. Total metallurgical output accounts to 10 % and 13 % of total manufacturing and mining output, respectively. Cluster´s firms produce the half of them (Table 2).

Table 2: The Indexes Of Metallurgical Sector And Cluster, 2009

Indexes	Cluster	Sector
Share in Total Manufacturing Output	5,95%	10%
Share in Total Mining Output	6,61%	13%

Source: Own elaboration based on the data of the Agency of Statistics of the Republic of Kazakhstan

The majority of metallurgical production is unwrought and semi-manufactured outputs. Due to the lack of specialized facilities, almost all extracted metals and metal products are exported abroad for further processing. Moreover, existing production facilities have a high degree of environmental pollution and technological backwardness. The majority of them were commissioned in the Soviet Union period and since then have not had significant technological upgrade. In the region there is no facilities for utilisation of industrial residuals, it simply discharged to the sewer. For instance, the waste pond belonging to "Ust-Kamenogorsk

Capacitors Plant" is not fenced. Its protections arrangements are purely nominal and nobody monitor pollutant there. The country lacks laws and regulations on safe management and pollution restrictions. Therefore, companies do not utilise contaminated installations to meet environmental protection criteria. Industrial companies are not interested in provision of information on contamination to the public or in some cases they even hidden it.

According the manual developed by the Environmental Directorate of East Kazakhstan Oblast in the framework of a joint MoE-UNDP project, obsolete PCBs-containing equipment was found at facilities of "Kazzink" and "Kazakhmys" and it still used at Ust-Kamenogorsk Titanium and Magnesium Plant". The health effect of PCB exposure involves damage to the liver, thyroid, and immune system along with reduced birth weight, reproductive toxicity, alteration of neurodevelopment, and cancer. The PCBs level in soils reaches 7-4 mg/kg, compared to the relevant regulatory maximal acceptable concentration (MAC) of 0.06 mg/kg (Astanina, 2006).

In order to accomplish strategic goal to diversify the economy through the development of clusters, the government approved the Program of Industrial and Innovation Development 2004-2015 (Program of Industrial and Innovation Development 2004-2015). The program contains the plan of actions for a successful diversification. Due to the industrial specialization of the East Region, the program has been focused on the development of high-value production of metallurgical complex. The goal of program is to achieve the sustainable development of the region through diversification, which means gradual movement from extracting of raw materials to production of high-tech outputs.

Very optimistic aims are based on three main directions: the support of small private business; the expansion of manufacturing share in total industrial output and the development of scientific and innovation potential. However, only 8 % of industrial output is produced by small enterprises instead of 25%, tasked by the program, in 2009. Government planed to achieve 80% of manufacturing share in total industrial output. By now, its share grew from 71 % in 2009 to 76 % in 2011. The share of industrial output in regional GDP is supposed to be increased to 50 % (30% in 2009 year).

Joint Stock Company Sovereign Wealth "Samruk-Kazyna" holding is responsible institution for the financial support and practical realisation of program at national level (Informational and analytical portal of «Sovereign wealth fund "Samruk-Kazina" JSC, 2009). According to preliminary estimates, the ratio of public and private capital should be one to two. In 2009, government invested approximately 500 billion tenge in the development of metallurgical cluster (1 dollar is approximately 145 tenge, 2009). The own funds of enterprises stay the main source of capital investments, around 70 percent (103 million tenge) in 2010. The structure of capital investments of region is 20% (30308,7 million tenge) are coming from central government, 3,6% (5451,2 million tenge) - local government, 1,4% (2078,4 million tenge) – foreign capital and 6,5% (9769,3 million tenge) borrowed funds.

The biggest capital investments are observed in manufacturing (31,3%) and mining and quarrying (16.0%) sectors. In contrary, agriculture, forestry and fisheries and construction sectors insignificantly invest in capital. Manufacturing sector cut capital investment by 11% in 2010, whereas mining invested by 2% more than in previous year. Investments in mining sector come from own fund of firms (88 %) and insignificant part from borrowed funds and government (Statistics Department of East Kazakhstan region, 2009).

International experience has demonstrated that stock market is one of the justifiable ways to attract foreign investments. Since 2007, five companies located in East Kazakhstan have entered in the stock market, including “Ulba Metallurgical Plant” and “Ust-Kamenogorsk Titan-Magnesium Plant”. In addition, in the framework of the Industrial Innovative Program, 21 investment projects were approved and funded by the “Samruk-Kazyna” JSC. East Kazakhstan takes the fifth place among the regions by the number of implemented projects with the participation of public development institutions. In order to support competitive enterprises, local authorities established industrial zones with proper infrastructure and equipped facilities. Approximately 763 million were allocated to accomplish this purpose. Nevertheless, entrepreneurs complain about the opacity of procedures and the long duration of the timing to review projects. In practice, a project gets funded no earlier than one year from the date of filing an application to development institutions.

Metallurgical cluster is mainly represented by large enterprises with more than 250 employees. Three companies, "Kazzink" JSC, "Ust-Kamenogorsk titan and magnesium complex" JSC and "Ulba metallurgical plant" JSC produce more than a half of total industrial output. According to the Department of Statistics of East Kazakhstan Region, 123 private firms operate in this sector, including 111 small and medium enterprises and 12 large size firms (Table 3).

Table 3: The Number Of Metallurgical Firms By Size And Sectors, 2009

Sector	Small	Medium	Big
Mining sector Extraction of fuel and energy minerals	28	10	2
Manufacturing sector Metallurgy and production of metal products	64	9	10

Source: Own elaboration based on the data of the Department of Statistics of the East Kazakhstan Region

Third part of all employees is referred to industrial employment. The third highest nominal wage is in mining sector after financial and information & communication sectors. The majority of employees in the mining sector prefer to work in large size firms due to higher wages and social infrastructure (kindergarten, medical service and etc.). However, there is the high risk of adverse health from direct exposure of heavy metals.

The total output of the mining sector is approximately 18 million ton of metal ores (Table 4). Lead-zinc ores occupy the largest share of total production, being copper-zinc and gold-bearing ores the second and third largest, respectively.

Table 4: Output Of Metallurgical Cluster In Eastern Region, 2009

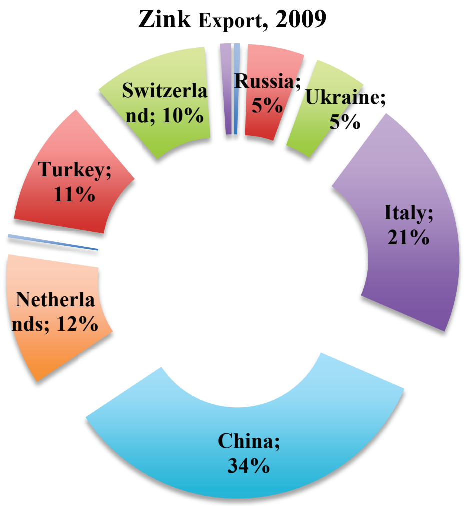
Output	
Mining, ton	
Copper ore	351000
Copper concentrate	888300
Copper in copper concentrate	172900
Copper-zinc ore	4853400
Gold-bearing ore	4878100
Gold-bearing concentrate	167700
Lead concentrate	61900
Lead in lead concentrate	35500
Lead-zinc ore	5734200
Zinc concentrate	698500

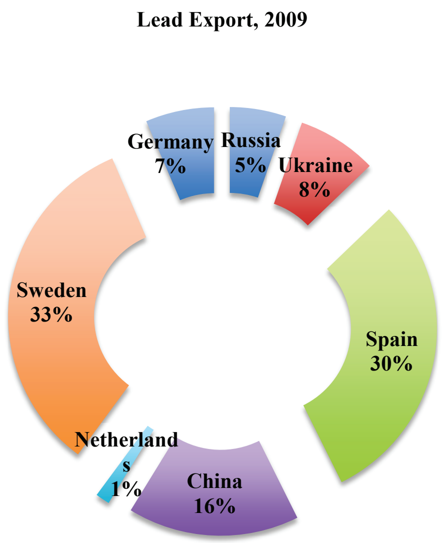
Zinc in zinc concentrate	374900
Manufacturing and production of metal products	
Ferrous metallurgy	
Crude steel, ton	9174
Stainless steel in ingots or other primary forms and semi-finished products of stainless steel, ton	10174
Electric carbon steel, ton	1772
Nonferrous metallurgy	
Silver, kg	100,173
Gold, kg	12,556
Lead, ton	320269
Other non-ferrous metals, ton	36914
Casting	
Casting of iron, ton	2671
Casting of steel, ton	13560
Casting of other non-ferrous metals, ton	92
Production of metal products	
Construction metal products, ton	7065
Other metal products, items	24

Source: Own elaboration based on the data of the Department of Statistics of the East Kazakhstan Region

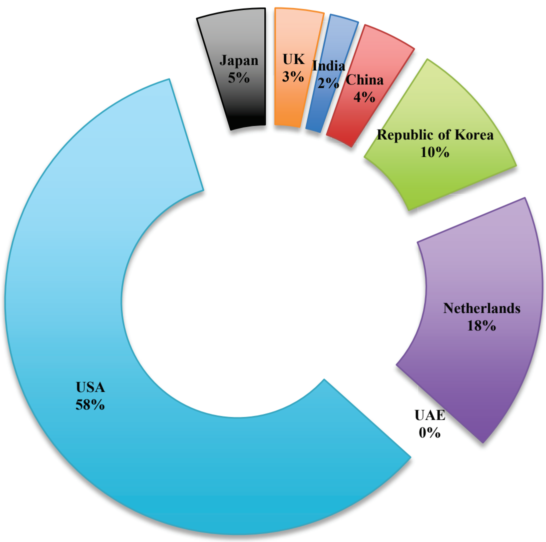
More than a half of produced zinc exports to Italy and China. Approximately equal percentage of zinc export is going to Netherlands, Turkey and Switzerland (Figure 6). The zinc sold domestically is used mainly to produce galvanized steel at Mittal Steel Temirtau (Karaganda). The main zinc-producer in Kazakhstan is “Kazzinc” company. Its share accounts to 87 per cent of all produced zinc in the country.

Figure 6: Export of Main Metals, 2010

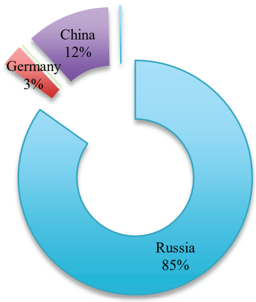




Titanium Export, 2010



Copper Export, 2009



Source: Own elaboration based on the data of the Customs Control Committee under the Ministry of Finance of the Republic of Kazakhstan

Kazakhstan's proven reserves of lead are estimated at 11.7 million tons (or 10,1% of world reserves) (Цветная металлургия Республики Казахстан, 2007). Kazakhstan ranks sixth place in lead reserves after Russia, Australia, Canada, USA and China. "Kazzinc" provides over 58 per cent of lead in lead concentrate produced in the country.

As well as other metals, the majority of production is exporting. The main buyers of lead are Sweden, Spain and China (Figure 6).
Produced titanium sponge is fully intended for export to USA, Netherlands, UK, Republic of Korea and other countries (Figure 6). The shipment is mainly accomplished by long-term contracts (in particular, by RMI Titanium Co.). It is estimated that "Ust-Kamenogorsk titan and magnesium complex" captures almost the half of the US market of titanium sponge and a 20 per cent of the global market. "Michael Levi, the representative of American company Timet, has declared, "deliveries from Kazakhstan accounts for more than half of national import ". As a result the American manufacturers of the titanium insist on imposition of 15% duty on production of Ust-Kamenogorsk titanium-magnesium factory" (Nikolaev, 2003).
Proven reserves of copper in Kazakhstan are estimated at 37 million tons (or 5,5 percent of world reserves) (Цветная металлургия Республики Казахстан, 2007). Kazakhstan is among the top countries of copper producers. Copper is mainly exported to Russia and China (Figure 6). Beryllium products are supplied mainly for export to the U.S., Europe, China, Japan and Russia (Metallurgy of Kazakhstan, 2007).
The purpose of this paper is to identify industrial clusters in the Eastern region of the Republic of Kazakhstan. Our research proceeds in two stages. Since only national input-output table is available, at the first stage we discuss several methods of regionalization available. As the second stage we apply methods of cluster identification at regional level, using regionalized input-output table.

2. REGIONALISATION OF NATIONAL INPUT-OUTPUT TABLE

For the empirical part of paper we use the Input-Output Table, which reflects the flow of goods and services on the economy of Kazakhstan in 2009. The table is available on the webpage of The Agency of Statistics of the Republic of Kazakhstan. The Input-Output Table of Kazakhstan is aggregated from extended matrix of 714×164 to the symmetric matrix of 58 sectors. The data is represented in national currency, tenge. In case of Kazakhstan as in majority of countries, only national input-output table is available. However, regional studies suggest several methods to regionalize the national table using some coefficients.

Let's denote the regional technical coefficient matrix by $A^{rr} = \left[a_{ij}^{rr}\right]$, where a_{ij}^{rr} is the amount of inputs from sector i in the region r per tenge's (national currency) worth of output of sector j in the region r.

Based on the assumption that local producers use the same production recipes as are shown in the national coefficient matrix, we consider that the technology of production in each sector in region r is the same as in the nation as a whole. However, in order to translate regional final demands into outputs of regional firms x^{rr}, the national coefficient matrix will be modified to A^{rr}.

Early studies of regional economics suggest using *regional supply percentage* in order to modify national matrix.

$$p_i^r = \frac{\left(x_i^r - e_i^r\right)}{\left(x_i^r - e_i^r - m_i^r\right)},$$

where x_i^r is the total regional output of each sector i, e_i^r is the export of the product of each sector i from the region r and m_i^r is the import of good i into region r. If we can estimate p_i^r for each sector in the economy, then each element in the i_{th} row of the national coefficient matrix multiply by p_i^r, we construct a row of locally produced direct input coefficient of good i to each local producer. The equation for two-sector model is:

$$A_{rr} = \hat{p}^r A = \begin{bmatrix} p_1^r & 0 \\ 0 & p_2^r \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = \begin{bmatrix} p_1^r a_{11} & p_1^r a_{12} \\ p_2^r a_{21} & p_2^r a_{22} \end{bmatrix}$$

However, the assumption made is quite strong. *It means, for example, that if the aircraft, kitchen equipment, and pleasure boat sectors in Washington all use aluminum (sector i) as an input, all three sectors buy the same percentage, p_i^r, of their total aluminum needs from firms located within the state* (Miller & Blair, 2009). Another problem is the availability intra- and interregional data that is needed to adjust national matrix to regional input-output model.

There are several methods of regionalization through adjustments based on employment data, income or output by industry. Nevertheless, than more speculations are made and more comprehensive method than more regional data you need.

Simple Location Quotients

If the x_i^r is the gross output of sector i in region r and x^r is a total output of all sector in the region r, and x_i^n and x^n are these totals at the national level, then the simple location quotient for sector i in region r is defined as

$$LQ_i^r = \frac{(x_i^r / x_i^n)}{(x_r / x_n)}$$

or

$$LQ_i^r = \left(\frac{x_i^r / x^r}{x_i^n / x^n} \right)$$

The numerator represents the proportion of sector i in total output of region r. The denominator shows us the national proportion of the same sector i in total output of the country. From this it follows that if $LQ^r > 1$ sector i is more localized in the region r than in the country as whole. Conversely, if $LQ^r < 1$ sector i is less concentrated in the region r than in the country as whole. In case if a national sector is not present in the region, i.e. $LQ^r = 0$, that column and row are simply deleted from regional matrix.

The same quotients are derived from other measures of regional and national economic activity such as employment, personal income earned, valued added and so on.

Beside the product-mix issue that was discussed before, this approach has a cross-hauling problem, where region export and import the same goods. According to LQ approach the region can either net exporter or net importer of a particular good. However, region can export one product and import another within the same sector, which is understand by approach as the same good since in the same sector. *It leads to a tendency for underestimation of interregional trade and thus for overestimation of intraregional economic activity, and therefore it also tends to generate regional multipliers that are too large* (Miller & Blair, 2009).

The simple modification are made to eliminate those sectors that not use good of sector i as input.

$$PLQ_i^r = (\frac{x_i^r / x^{*r}}{x_i^n / x^{*n}})$$

where x_i^r is regional output of sector i and x^{*r} is a total regional output of only those sectors that use good of sector i as input. x_i^n and x^{*n} are national output of sector i and total output of those sectors that use i as input, respectively.

Cross-Industry Quotients

If previous approach modifies national coefficients by rows, the cross-industry approach makes cell-by-cell adjustments within A^n.

$$CIQ_{ij}^r = (\frac{x_i^r / x_i^n}{x_j^r / x_j^n})$$

and

$$a_{ij}^{rr} = \begin{cases} (CIQ_{ij}^r) a_{ij}^n & \text{if } CIQ_{ij}^r < 1 \\ a_{ij}^n & \text{if } CIQ_{ij}^r \geq 1 \end{cases}$$

If the output of regional sector i relative to the national output of sector i is larger than output of regional sector j relative to the national output of sector j, i.e. when $CIQ_{ij}^r > 1$, then all need's of sector j in input i can be supplied from within the region. Conversely, if $CIQ_{ij}^r < 1$ then some of need's of sector j has to be imported. Two features are valid for this approach $CIQ_{ij}^r = LQ_i^r / LQ_j^r$ and $CIQ_{ij}^r = 1$ along the main diagonal.

The Semilogarithmic Quotient and its Variants

The Cross-Industry Quotients approach includes relative sizes of both selling (x_i^r / x_i^n) and buying (x_j^r / x_j^n) sectors but not contains relative size of region (x^r / x^n). Flegg & Webber (1997) proposed to modify the Semilogarithmic Quotient approach that takes into account all three measures, where

$$FLQ_{ij}^r = (\lambda) CIQ_{ij}^r$$

where $\lambda = \{\log_2 [1 + (x_E^r / x_E^n)]\}^\delta, \ 0 \le \delta < 1$ (empirical work suggested that $\delta = 0,3$) (Flegg & Webber, 1997)

so,

$$a_{ij}^{rr} = \begin{Bmatrix} (FLQ_{ij}^r) a_{ij}^n & \text{if } FLQ_{ij}^r < 1 \\ a_{ij}^n & \text{if } FLQ_{ij}^r \ge 1 \end{Bmatrix}$$

Flegg and Webber (1997) use employment as a measure of relative size of region (x_E^r / x_E^n).

Above-mentioned approaches are most frequently used and applied methods in regional economics (Miller & Blair, 2009). However, there are more methods slightly modified or methods using the value added, export-import information and so on.
Since the Semilogarithmic Quotient approach has relative advantages among other methods and due to data constraints we decided to apply this approach.

Application of Semilogarithmic Quotient approach and results

National Input-Output Table of Kazakhstan includes 58 sectors (The Agency of Statistics of the Republic of Kazakhstan, 2010). By multiplying each coefficient of national matrix by obtained Semilogarithmic Quotient's matrix, we reduced matrix to 39 sectors. In case when sector is not presented in the region, FLQ = 0, column and row were simply deleted.

At the second stage, we applied two methods of cluster identification. One of them is based on the estimation of strength of forward and backward linkages and other one includes factor analysis. However, both of them use the input-output tables in empirical analysis of cluster identification.

Interregional model

Regional IOT incorporate information about inter-industry relationships within a particular region. It is useful tools to measure the total effect that an initial change in economic activity has on a local economy. However, the regional model is limited to show the interconnections between regions and spillover effects (Bess & Ambargis, 2011). As a result, intraregional model might miss those cluster that cross regional boundaries. Hofe & Dev Bhatta (2007) argue that is impossible to study clusters isolated from surrounding national economy. On the other side, multiregional model is data intensive. It requires a lot of detailed intra- and interregional information. For example, two-region model (the region and the rest of the country) involves two matrices estimating the transaction between two regions; three-region model has 6 matrixes and 12 matrixes are needed for four-region model. This information is not always available.
Two-region model allows to measure the spillover effect and to which extent the East Region is interconnected with the rest of country. Let´s denote r to the East Region and$s$ to the rest of the country. In our case, complete coefficient matrix of two-region model consists of the four submatrices. Each of four matrixes have $n \times n$ the dimension, where n the number of industries.

$$A = \begin{bmatrix} A^{rr} & A^{rs} \\ A^{sr} & A^{ss} \end{bmatrix}$$

where
A^{rr} is the intraregional input coefficient matrix for region r, the East Region;
A^{ss} is the intraregional input coefficient matrix for the rest of country;
A^{rs} is the interregional trade coefficient matrix which represent “export” from region r and in the same time “import” to the rest of county. It is common practice in regional input-output

work to use the terms export and import as a trade that crosses regional boundaries (Miller & Blair, 1985).

A^{sr} is the interregional trade coefficient matrix which represent interregional trade flows from the rest of country to region r.

It is important to bear in mind the stability of intraregional ($A^{rr} A^{ss}$) and interregional (A^{rs} A^{sr}) input coefficients when using the interregional model. Although interregional model reflects trade relationship between regions, the constancy of these relationships is not easy to accept. Data availability allows us to construct only ($A^{rr} A^{ss}$) matrixes, deriving them from national IOT. (A^{rs} A^{sr}) are the most problematic in terms of data intensity. In Kazakhstan, there is no trade flows registration between regions. The territory of the country is considered as whole entity. Products are going to and from abroad only way to register trade flows. Therefore, the reliable construction of interregional model for Kazakhstan is not possible.

3. IDENTIFICATION OF CLUSTERS

Rasmussen's method

There is a large number of cluster identification methodologies, for example industry-based input-output relationships, industry growth forecasts, case studies, shift-share analysis and location quotients. However, one of the well-known and applied methods is the estimation of forward and backward linkages based on the Leontief input-output table. The idea of linkages was introduced by Rasmussen in 1956 and subsequently suggested as a tool of key sector identification by Hirschman (1958). Input-output analysis is a method to identify relationships between different actors within regional or national economies. It helps to determine the financial impacts for a certain policy change and its effects on the whole economy. Comparison of forward and backward linkages determines "greater than average impact upon an economy", so a relatively small number of industries, amplifying initially small changes, eventually affect the whole economy (Hewings, 1982). The idea of inter-industry linkages was further elaborated and applied by several authors such as Sonis and Hewings (1999), Rimbler et al (2000), Aroca (2001), Hazari (1970), and others.

The backward linkages indicate the interconnection of a particular sector to those sectors from which it purchases inputs (Miller & Blair, 1985). If a sector j increases its output, there will be increased demands from sector j, as a purchaser, on the sectors whose products are used as inputs to production in j (Cristobal & Biezma, 2006). The backward linkages include the direct and indirect effect of all industries that provide the intermediate inputs necessary for the production of a particular industry being invested (Kim, Sohn, & Whang, 2002). It is a measure that is expressed in terms of a sector's use of inputs from other sectors in the economy.

The forward linkages indicate the interconnection of a particular sector to those sectors to which it sells its output (Miller & Blair, 1985). If a sector j increases its output, it means additional amounts of product j that are available to be used as inputs to other sectors for their own production (Cristobal & Biezma, 2006). So, will be increased supplies from the sector j, as a seller, for the sectors, which use goods j in their production.

The output level X's required to satisfy a given vector of final demand F in the input-output model are determined by the following equation:

$$X = (A - I)^{-1} F$$

where $(A - I)^{-1} = L$ is the Leontief inverse matrix.

Let us denote the typical element of the $(A - I)^{-1}$ matrix by b_{ij}. Then $B_{.j}$ and $B_{i.}$ are the sum of the column and row elements.

$$B_{.J} = \sum_{i=1}^{n} b_{ij}$$

indicates the total input requirements for a unit increase in the final demand for the j^{th} sector.

Similarly,

$$B_{i.} = \sum_{j=1}^{n} b_{ij}$$

indicates the increase of the output of sector number i needed to cope with a unit increase in the final demand of all industries.

If the $\bar{B}$ as an average, unweighted value of an element in the inverse matrix, then the indices will be developed as follows:

Power of dispersion: $U_j = \left[B_{.j}/n\right]/\bar{B}_J$

Sensitivity of dispersion: $U_i = [B_{i.}/n]/\bar{B}_i$

U_J and U_i can be also interpreted as Hirschman's backward and forward linkages.

Since the averages $\bar{B}_J$ have been interpreted earlier showing the requirements of inputs if the final demand of industry number j increases by 1 unit, a unit change in final demand in a sector where $U_j > 1$ will thus generate an above average increase in activity in whole economy (Hewings, 1982). In the same way, $U_i > 1$ indicates that the industry number i will have to increase its output more than others for a unit increase in the final demand from the whole system (Hazari, 1970).

However, many authors complained that averaging method is sensitive to extreme values and may give false results. Therefore, Hazari (1970) one of the first, proposed to use the indices of coefficient of variation.

$$V_J = \sigma_J/\bar{b}_j$$

And

$$V_j = \sigma_j/\bar{b}_i$$

where the σ_j and σ_i are the standard deviation of the j column elements and i row elements. The denominators, $\bar{b}_j$ and $\bar{b}_i$ are the column and row means.

The high indices of coefficient of variation show that a particular industry draws heavily on one or few sectors. On the other hand, low indices can interpreted as industry drawing evenly from the other sectors.

Consequently, key sectors can be defined as

a. Where both $U_J > 1$ and $U_i > 1$;

b. Where both V_J and V_i are relatively low.

Rasmussen approach takes into account both direct and indirect effects. However, Jones (1976) argued that the forward linkages show the impacts when the final demand of each single sector increases by one unit. While not all sectors provide the same equal part of their output to other sectors. It can lead to a large Leontief inverse row sums and to the overestimated impacts of some sectors on the final demand. In order to solve this problem, Jones proposed to use the row sum of output inverse matrix derived from the output coefficient matrix as a better indicator of forward linkages (Munday, Jones, & Malcolm, 2009).

Hazari method

According to Rasmussen method, all sectors or industries are of equal importance in the economy and have an equal share in the estimation of forward and backward linkages. However, Hazari insists that some weights procedure has to be applied for bringing out the relative importance of the various sectors in the economy (Hazari, 1970). There are different measures of weighting industries according to their relative importance; its selection depends on the objective function of the planner. Hazari called this "policy´s makers preference function". Foe example, in the identification of key sectors in Indian economy, he used final demand of particular sector as a proportion of the total final demand.

Backward linkage is determined by the following equation:

$$Z_j = \sum_{i=1}^{n} K_{ij} F_j$$

and forward linkage is

$$Z_i = \sum_{j=1}^{n} K_{ij} F_i$$

where K_{ij} is the elements of the inverse of $(I - A)$ and F is the final demand.

Then, in order to discriminate against sectors that are too small, let weight the backward and forward linkages according to final demand shares of sectors.

$\lambda_j = Z_j W_i$ where $$W_i = \frac{F_i}{\sum_{i=1}^{n} F_i}$$

and

$\lambda_i = Z_i W_i$ where $$W_i = \frac{F_i}{\sum_{i=1}^{n} F_i}$$

By the Hazari approach sectors in which both Z_j and Z_i are high relative to others and both λ_j and λ_i are high can be defined as a *key sectors from the point of view of the importance of each sector in the economy as a contributor to final demand* (Hazari, 1970).

However, final demand is not a homogeneous aggregate therefore a simple relative share of sector to final demand could not measure its impact on the economy. In addition, *final demand comprised of different components; it is highly unlikely that the impact of each component be equal to that of another component* (Pirasteh & Karimi, 2005).

Later, Jones (1976) Laumas (1976) proposed to use the primary inputs as the weight for forward linkage and the share of sectors in the final demand as the weight of backward linkage.

So, the backward linkage is defined as

$$BL_j^w = \sum_{i=1}^{n} k_{ij}^w = B_{.j}^w$$

where,

$$k_{ij}^{w} = k_{ij} \frac{F_i}{\sum_{i=1}^{n} F_i}$$

k_{ij} is the ij^{th} element of Leontief inverse matrix

k_{ij}^{w} is the weighted ij^{th} element of Leontief inverse matrix

F_i is the final demand

and the forward linkage is defined as

$$FL_i^{w} = \sum_{i=1}^{n} g_{ij}^{w} = B_{i.}^{w}$$

where,

$$g_{ij}^{w} = g_{ij} \frac{V_j}{\sum_{j=1}^{n} V_j}$$

g_{ij} is the ij^{th} element of Gosh inverse matrix

g_{ij}^{w} is the ij^{th} element of Gosh inverse matrix

V_j is the value added

Chenery-Watanabe Method

The Chenery-Watanable (1958) model uses the input coefficient matrix A = [a_{ij}].
The backward and forward linkages are defined as column and row sum of input and output coefficients matrix **A**, respectively.

So, the backward linkage is

$$BL_j^{CW} = \sum_{i=1}^{n} \frac{X_{ij}}{x_j} = \sum_{i=1}^{n} a_{ij}$$

and forward linkage is

$$FL_i^{CW} = \sum_{j=1}^{n} \frac{X_{ij}}{x_i} = \sum_{j=1}^{n} b_{ij}$$

The main disadvantage of the Chenery-Watanable method is that it neglects the indirect effects. The method measures only the first round of effects generated by the inter relationships between sectors.

Application of Rasmussen´s method

Taking into account the disadvantages of Chenery-Watanable method and the dependence of Hazari method on the objective function of the planner, we applied the Rasmussen's method to national IOT and to regionalized input-output table of the East Region.

Regional level

As you can see on the Table 1, nine sectors were selected as key sectors based on Rasmussen's method. The high forward and backward linkages and low coefficient of variation were detected in the following sectors. If we eliminate local-serving sectors such as Production and distribution of electricity, gas and water, Construction and Manufacture of food products, including beverages "metalworking" cluster has greater than average impact on the economy of the East region, in supporting other industries as well as boosting other industries.

Table 1. Key Sectors in The East Region by Rasmussen's Method

	Key sectors	Backward linkage	Forward linkage
1	Agriculture, hunting and related service activities	1.12	1.17
2	Forestry	1.06	1.04
3	Manufacture of food products, including beverages	1.02	1.03
4	Manufacture of paper and paper products	1.13	1.06
5	Chemical industry	1.32	1.36
6	Metallurgical industry	1.09	1.79
7	Manufacture of electrical machinery and apparatus	1.04	1.01
8	Production and distribution of electricity, gas and water	1.04	1.37
9	Construction	1.2	1.2

Source: Own elaboration

However, not always strong both backward and forward linkages are the indicators of importance of sector in a region. Therefore, usually input-output analysis is usually supplemented by other methods and various combinations among all of them, including employment data of sectors.

The Table 2 shows sectors in which the backward linkages are high and coefficient of variation is relatively low, excluding local-serving sectors. These sectors are called the backward-linkage-oriented sectors (BLOS) (Figure 3). The backward linkage is a measure, which is expressed in terms of sector's use of inputs from other sectors in the economy (Cristobal & Biezma, 2006). The high backward linkage means the high sectors dependence on others in the economy for its inputs, and therefore a high effect on the economy might be expected by the stimulating an increase in this sectors' output.

Table 2. Strong Backward Linkages Sectors with Low Coefficient of Variation

	Sectors	Backward linkage	Coeff. Of variation
1	Mining the production of coal dropped, brown coal mining of coal and lignite	1.03	4.77
2	Other mining and quarrying	1.05	4.62
3	Production of textile products	1.03	5.19
4	Publishing, printing and reproduction of recorded media	1.02	4.94
5	Manufacture of rubber and plastic products	1.05	4.69
6	Manufacture of fabricated metal products, except machinery and equipment	1.26	4.09

Source: Own elaboration

The Table 3 shows us the sectors with high forward linkages and relatively low coefficient of variation, excluding local-serving sectors. They are named by abbreviation FLOS on the Figure 3, which means forward-linkage-oriented sectors. The forward linkages indicate the proportion of sector output that serves as inputs to other sectors of economy. The high forward linkage means the more its output is used as an input to production in the regional economy therefore the more an increase in the regional economy's production would stimulate this sector (Aroca, 2001).

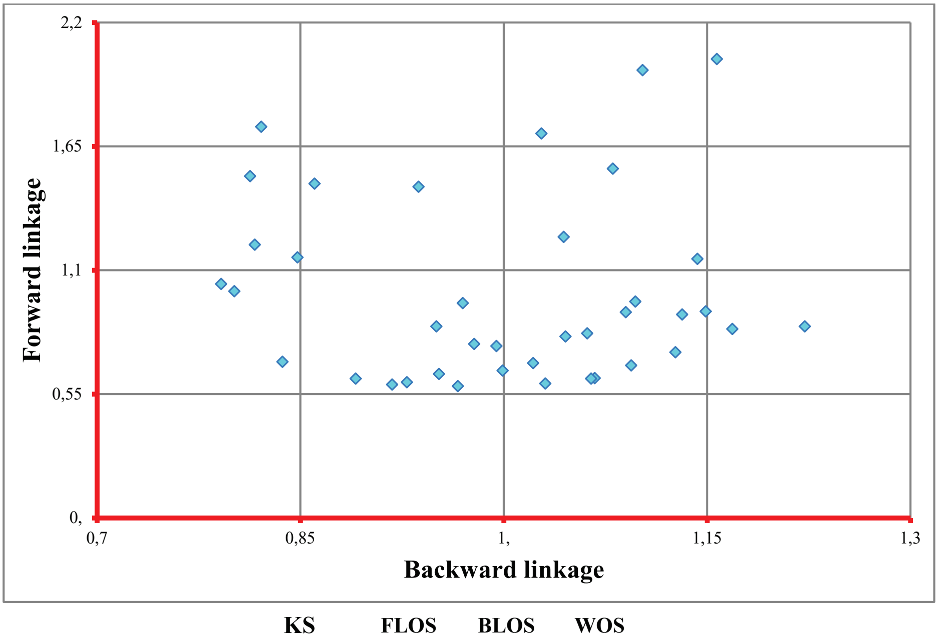
Table 3. Strong Forward Linkages Sectors with Low Coefficient of Variation

	Sectors	Forward linkage	Coeff. Of variation
1	Mining of metal ores	1.19	4.52
2	Production of wood and cork, except furniture, manufacture of articles of straw and plaiting materials	1.0	5.7
3	Manufacture of other non-metallic mineral products	1.06	5.22
4	Machinery and equipment	1.32	4.51

Source: Own elaboration

As you can see on the Figure 3, in red dots are all sectors that have strong forward and backward linkages. In the upper left-hand corner there are forward linkage- oriented sectors (FLOS), which are have strong forward linkages. In the lower left corner there are weak oriented sectors (WOS) which are have weak or less than one both forward and backward linkages. And in the lower right corner sectors that have strong backward linkages (BLOS).

Figure 3: The key sectors of the East Region



Source: Own elaboration

National level

National IOT includes 58 aggregated sectors. The table 4 shows us the key sectors by the Rasmussen's method of cluster identification. As you can see there are only few sectors which have strong both forward and backward linkages. However, sectors with well established forward linkages rather than backward linkages predominate considerably (Table 5).

Table 4: Key Sectors in The Republic of Kazakhstan by Rasmussen's Method

	Key sectors	Backward linkage	Forward linkage
1	Manufacture of coke and petroleum refining goods	1.03	1.34
2	Manufacture of goods of chemical industry	1.09	2.41
3	Manufacture of other non-metallic mineral products	1.14	1.06

Source: Own elaboration

There are only two backward-linkage-oriented sectors, excluding primary and local serving sectors (Table 6). Kazakhstan is vast and unevenly populated country. The most of regions are well connected with the capital than with each other. The dispersed localization of industrial complexes is aggravated by poor connection between regions. The country faces a lot of difficulties caused by transportation and infrastructure constraints. In some cases import inputs from neighbour country is less costly than the same inputs from other region of the country in terms of logistics and time-consuming. It leads to the low level of local content in input proportions.

Table 5: Strong Forward Linkages Sectors with Low Coefficient of Variation

	Sectors	Forward linkage	Coeff. Of variation
1	Production of rude oil and natural gas, providing services in these areas	2.16	2.59
2	Mining of metal ores	1.52	2.71
3	Manufacture of textile goods	1.04	3.63
4	Manufacture of wood and wood products, except furniture; manufacture of goods made of straw and braiding	1.02	3.81
5	Manufacture of paper and paper productions	1.18	3.47
6	Manufacture of rubber and plastic products	1.04	3.28
7	Metallurgy	2.79	2.02
8	Manufacture of fabricated metal products	1.17	2.95
9	Production of machinery and equipment	1.30	2.82

Source: Own elaboration

Despite the connectivity problems between industrial complexes, sectors with strong forward linkages are considerably prevailing. We assume that outputs of Kazakhstan´s industries are uncompetitive to sell to international market. Therefore, the most of production are targeted to local market. As well, there is domestic market protection policy in terms of import´s barriers, local-content subsidies and etc. For example, the government increased customs duties on used imported vehicles in order to stimulate growth of domestic car production.

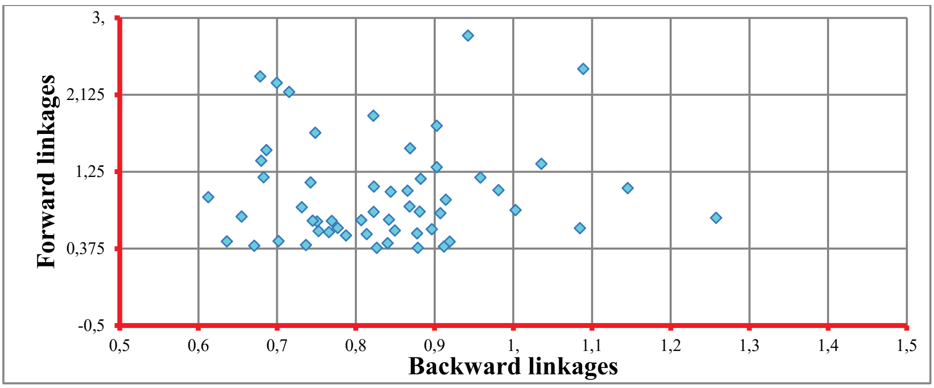
Table 6: Strong Backward Linkages Sectors with Low Coefficient of Variation

	Sectors	Backward linkage	Coeff. Of variation
1	Mining of coal and lignite	9.77	0.43
2	Production of other motor vehicles	1.0	3.97

Source: Own elaboration

The upper right corner of the figure represents those sectors with strong backward and forward linkages (Figure 7). Chemical industry, the production of petroleum products and non-metallic mineral products are the sectors with more than average impact on the economy of the country. The most of the sectors have weak backward linkages, which is well seen on the figure. The majority of sectors are located on the left side of picture. Only few of them have a strong interconnection of those sectors from which they purchases inputs.

Figure 7: The key sectors of the Republic Kazakhstan



KS FLOS WOS BLOS

*Factor analysis*Factor analysis is method to identify linkages via buyer-supplier relationship based on input-output table. The measures of direct and indirect linkages calculated from input-output table for each sector were treated as variables for factor analysis. The number of factors was defined by the size of eigenvalues and by scree plots. We applied factor analysis to both national and regionalized input-output tables in order to adhere the consistency and interpretability.

Factor analyses were run on the both 58 x 58 national transaction matrix and 39 x 39 regionalized transaction matrix. For each matrix, two matrixes, X and Y were derived (Feser, Sweeney, & Renski, 2005):

$$x_{ij} = \frac{a_{ij}}{a_{+j}}, y_{ij} = \frac{a_{ij}}{a_{i+}}$$

where a_{ij} is the tenge (national currency) value of goods and services sold by industry i in some period to industry j. a_{+j} and a_{i+} are total intermediate good purchases and sales of industries i and j, respectively.

x_{ij} (y_{ij}) captures intermediate good purchases (sales) by sector j from sector i as a proportion of $j's$ ($i's$) total intermediate good purchases (sales). Therefore, the large value of x_{ij} (y_{ij}) means that j (i) industry significantly depends on industry i (j) as a source of its total intermediate purchases (sales).

Four correlations describe the selling and buying patterns of two industries A and B, with the column vector of X matrix and the row vectors of Y matrix.

$r(x_A x_B)$ measures the degree to which industries A and B have similar input purchasing patterns;

$r(y_A y_B)$ measures the degree to which industries A and B have similar output selling patterns;

$r(x_A y_B)$ measures the degree to which the buying pattern of industry A is similar to the selling pattern of industry B;

$r(x_B y_A)$ measures the degree to which the selling pattern of industry A is similar to the buying pattern of industry B.

Based on the largest value of the four correlations for each pair of sectors, linkage L matrix was derived. Performing factor analysis, Kaiser criterion suggests to retain those factors with eigenvalues equal or higher than 1. After running factor analysis we rotate the factor loadings to get a clearer pattern.

Factor analysis of L matrix identified 14 value chains at national level and 8 at regional level, which have eigenvalues greater than 1. For each factor, the analysis generates loadings. In our context, the loading provides a measure of the relative strength of the linkage between a given industry and the derived factors. The higher the absolute value of loading, the more factor contribute to the variable. A negative value indicates an inverse impact on the factor. It is standard procedure, to define loadings greater than 0.5 as significant and worthy of interpretation. Before label each factor we eliminated primary locally-serving sectors from results.

Table 4: "Metalworking" cluster

	Industry	Factor loading
1	Mining of non-ferrous metals	0.5113
2	Other mining and quarrying	0.8629
3	Production of wood and cork, except furniture, manufacture of articles of straw and plaiting materials	0.9404
4	Manufacture of rubber and plastic products	0.8112
5	Other non-metallic mineral products	0.9362
6	Metallurgical industry	0.5741
7	Manufacture of fabricated metal products, except machinery and equipment	0.7603
8	Manufacture of electrical machinery and apparatus	0.6755

Source: Own elaboration

National level

At national level, 14 factors were defined. They explain 87 per cent of the total variance. Based on the content of the variables with high factor loadings, the first factor is labeled as "metalworking". The eigenvalue of "metalworking" cluster is 13,75 and it explains 23.71 per cent of the total variance. 8 industries with high factor loading were included in this cluster (Table 4).

Other well-defined factor is the fourth factor. The majority of industries included in the factor are connected with oil processing. The eigenvalues of "oil processing" cluster is 4.87 and it explains 8 per cent of the total variance. Extraction of crude petroleum and oil-well gas, Manufacture of coke and refined petroleum products and Machinery and equipment were included in the cluster (Table 5).

Table 5: "Oil processing" cluster

	Industry	Factor loading
1	Extraction of crude petroleum and oil-well gas	0.9026
2	Manufacture of coke and refined petroleum products	0.6363
3	Machinery and equipment	0.5829

Source: Own elaboration

Regional level

Based on the content of the variables with high factor loadings, we defined and named factors. We selected only one factor from 8 defined by factor analysis for further examination. Despite the fact that other factors have eigenvalues greater than one, they are not well defined in terms of content of the variables with high factor loadings. "Metalworking" cluster has the highest eigenvalue (13,08) and explains 34 per cent of total variance. It includes following sectors represented in the Table 6, with factor loading greater than 0.5.

Table 6: Results of Factor Analysis

	Industry	Factor Loading
1	Other mining and quarrying	0.9357
2	Production of wood and cork, except furniture	0.9432
3	Manufacture of rubber and plastic products	0.8298
4	Other non-metallic mineral products	0.9591
5	Metallurgical industry	0.7210
6	Manufacture of fabricated metal products, except machinery and equipment	0.9339
7	Machinery and equipment	0.7460
8	Manufacture of electrical machinery and apparatus	0.7949

Source: Own elaboration

CONCLUSION

The implementation of cluster policy promoted by government raises the question about adequateness of selected sectors. Among the abundant methods of cluster identification, the study applied the combination of two methodologies. At first, we evaluated backward and forward linkages between aggregated sectors at national and regional level. To be able work with input-output table for the region, we regionalize it, using regional employment data of sectors. Returning to the question posed at the beginning of the study, it is now possible to stat that metallurgical cluster takes place in the East Region of Kazakhstan. That is, there is strongly marked metallurgical specialisation of the region. However, it was also shown that industrial complexes are very dispersed all over the country and poorly interconnected. Usually input-output analysis is supplemented by other methods. Therefore, factor analysis was included to consolidate the results of input-output analysis. For the most part, the results were similar for each methodology.

The study has gone some way towards enhancing our understanding of interconnection between industries. The important finding is that clusters in Kazakhstan are very dependent on physical proximity between sectors. The big size of the country, poor infrastructure and remoteness of regions make difficult to form clusters at the country level. Sectors are more interconnected, from regional point of view. The results of this research support idea that clusters spread apart from territorial boundaries.

Beside the substantial evidence of the study, it can only form the basis for more in depth analyses that should involve business infrastructure, internal innovation process and possible market and technological barriers of cluster developments. Examining the government institutions and mechanism to foster interidustry networking is a valuable next step to more in-depth cluster research.

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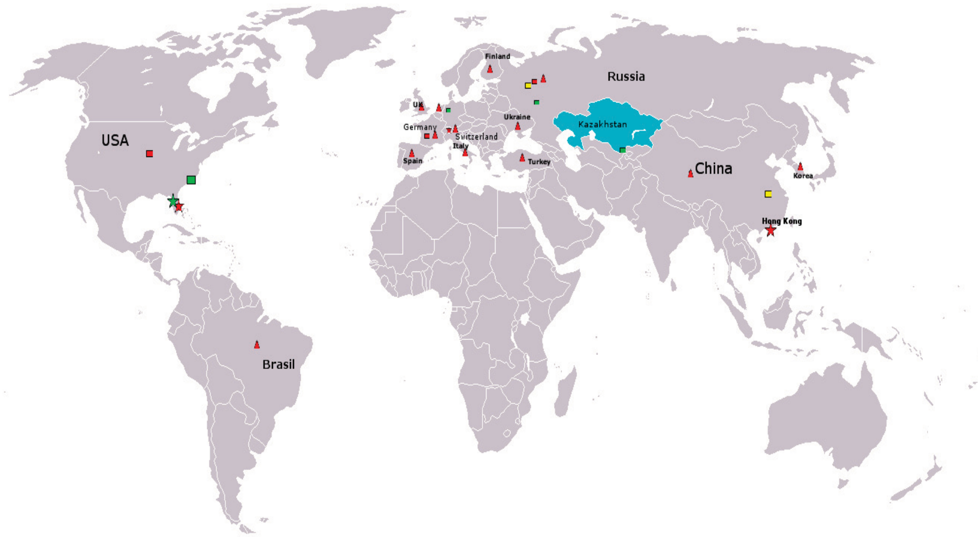
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