The Impact of Immigration on Polish Export Trade after Membership in the European Union

December 2014

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Abstract

This paper investigates how immigration impacts on Polish export trade in the period of Poland's membership in the European Union. We employ a data set of emigration recipient country pairs and conduct a multiple regression analysis. Using a model based on gravity model of trade, we examined exports of 4 commodities to 8 countries, which are divided into two regions i.e. Western European region and Central-Eastern European region. Our results indicate that in general, the effect of migrant stock on trade amount between host-country and recipient country is positive, while a negative impact was observed between the number of Poland's emigrants to Western Europe countries and the amount of vehicle export to the Western European countries. This relation between migration and trade seems to be peculiar to export of vehicle to Western European countries from Poland.

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Introduction

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Introduction

Since Poland's accession to the European Union in 2004, the Polish economy has made a 'civilisational leap forward'[1]. Despite disadvantageous external economic conditions of Poland's accession to the EU – such as low dynamics of EU states' development or a significant rise in world prices of raw materials and the resulting increase in production costs and prices – Polish economy copes exceptionally well with merging into EU structures and smooth transition into the Internal Market. [2] According to the investigation implemented by the Ministry of Foreign Affairs in Poland, if Poland had not joined the EU, in 2013 Poland's GDP per capita in purchasing power standards would have been at the 2009 level, i.e. it would have been lower by 11% relative to the EU-27 average. In 2013, the value of Polish exports would have been lower by PLN 164 billion (i.e. by 25%). The capital expenditures, in turn, would have been lower by PLN 36 billion (i.e. by 12%) in 2013, and throughout the 2004–2013 period — by PLN 200 billion (i.e. by 7.8%).[1]

Although it is difficult to provide an unambiguous and precise answer to a question what part of changes observed in the Polish economy after 2004 can be ascribed directly and clearly to the process of Poland's integration with the EU and what part needs to be ascribed to membership-independent factors, one can assume that the "Union effect" has been an element advantageously affecting the development of Poland's economic situation. [2]

One of the important element of the "Union effect" is accessibility to the open European market and the 'open door migration system' guaranteed by the Schengen Agreement[3] with which the simplifications introduced in the rules concerning employment of Poles on labor markets of other Member States, including their full opening, accompanied. The liberalization of

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[1] Ministry of Foreign Affairs in Republic of Poland: "Poland's 10 years, Report"

[2] Ministry of Foreign Affairs in Republic of Poland: "Poland in the European Union – Experiences of the first year of membership"

[3] The Schengen Agreement is an agreement led to the creation of Europe's borderless Schengen Area in 1995. The treaty was signed on 14 June 1985 between five of the then ten member states of the European Economic Community near the town of Schengen in Luxembourg. It proposed the gradual abolition of border checks at the signatories' common borders. (Respectively Articles 2, 6 and 7 of the Schengen Agreement)

movement of persons in the EU area has expedited inflows and outflows of migration to and from Poland, so as trade activities between Poland and EU countries.

In this paper, we investigate the relationship between the amount of Poland's export trade and the number of Poland-originated migration flowing to countries in Western Europe and Central-Eastern Europe (hereinafter referred to as Central Europe), after Poland's accession to the EU. As in Western Europe we select countries to which relatively large numbers of migrants from Poland have been flowing, i.e. Germany, Italy, Spain, and Norway. As in Central Europe we select countries with the same criteria as in Western Europe i.e. Czech Republic, Hungary, Slovak Republic, and Slovenia. In order to see the relation between export and migration, we employ a data set of migration-recipient country pairs and conduct a multiple regression analysis. By separating Poland's export in commodities, the analysis enables us to examine the effect of migrants on exports by each industry.

To address the issue, this paper would be divided in five sections. Previous studies on linkages on migration and trade are reviewed in Section 1. Methodology and Data set used for the empirical analysis are explained, respectively in Section 2 and 3. Statistical outcomes of our analysis and investigation of the impact of migration on exports are shown in Section 4. Finally, we will conclude the analysis on Section 5.

1 Current Trends, Issue and Previous Studies

Before we analyze the relationship between migration and export, it is necessary to show that there is a theoretical predicts mentioning a positive relation between migration and trade between two countries.

In this Section, we will examine recent economic trends in Poland's trade balance and migration. In addition, we will review previous studies addressing the issues above. As a result, previous studies have proven that generally migration has a positive impact on promoting trade between host countries and home countries.

Based on the studies, through Section 2 to Section 6, we will investigate the relationship between Poland-originated migrants and Poland's export trade with the countries in Europe i.e. Czech Republic, Hungary, Slovak Republic, Slovenia, Germany, Italy, Spain, and Norway.

1-1 Economic trends in Poland and trade

Since Poland's accession to the European Union, the Polish economy has made a 'civilisational leap forward'. Progress of this magnitude was not easily foreseeable, especially that prior to integration with the EU, projections as to the anticipated prospective benefits were rather cautious, while specific advantages for the economy and for the country were expected to appear in the long term. The last decade clearly shows that Poland has taken very good advantage of EU membership. Poland's most important successes comprise: significant economic progress and increased wealth of society, as well as enhanced competitiveness of Polish companies, which today are capable of effectively marketing their products and services in foreign countries.1

After joining the EU, Poland was perceived by foreign investors as a more attractive and reliable country. In the years 2004–2008 investments reached a high level and their share in GDP growth was significant, exceeding 17% in 20071. Growing public investments – the effect of implementing the EU

cohesion policy – also contributed to a higher investment rate[4]. According to estimates, EU funds were responsible for 1% of the growth rate in Poland's GDP[5].

Foreign trade has played a significant role in the generation of GDP growth since 2003. Immediately after EU enlargement, the dynamics of export exceeded 10%[1], thanks to the opportunities offered by the EU's common market and its four pillars: the free movement of goods, persons, services and capital. The slowdown in the Eurozone checked this trend, but at the same time resulted in higher exports to countries of Central and Eastern Europe and third countries (especially in Eastern Europe). Poland has become part of the world's biggest free trade area, which is home to 500 million consumers and 20 million firms[1]. In 2013, Poland exported to the EU almost three times as many goods as before joining the EU. Poland has consolidated its leadership position as the biggest exporter of all the EU Member States that joined the EU in 2004 and in 2007: almost 27% of goods exported from Central and Eastern Europe originated in Poland[1].

Assessing Poland's achievements, in particular those resulting from Poland's presence on the internal market note should be taken of the following facts:

- Thanks to the free movement of goods, we have seen an unprecedented success of Polish companies, which have exported goods worth almost PLN 3.5 trillion to the EU in 10 years. This is twice the value of Poland's GDP. Moreover, Poland has become one of the leading European producers and exporters in key industrial sectors (such as the automotive industry, the electronic and home appliances sectors or the furniture sector), and an important service provider on the EU market. [1]

- Since Poland's EU accession in 2012, Polish firms have made a

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[4] P. Żuber, S. Sudak, Raport Polska 2011. Gospodarka-Społeczeństwo-Regiony, Ministry of Regional Development, 2011, p. 8.

[5] Wpływ polityki spójności na rozwój społeczno-gospodarczy Polski w latach 2004–2015 w świetle wyników badań makroekonomicznych, Ministry of Regional Development, Warszawa 2013, p. 3.

profit of almost PLN 550 billion (EUR 135 billion) on exports of services to the EU (the positive balance exceeds PLN 37 billion (over EUR 9 billion)). Thus, Poland has become the leader among countries that joined the EU in 2004; almost 30 per cent of services delivered to the EU by Central and Eastern European countries in 2012 came from Poland. After 2004, Poland saw the most rapid growth in the export of its services (an increase in value by 160 per cent) of all the countries in the region. This trend was especially visible in the transport, business support and tourism sectors.1

- Poland has seen an export boom and an increase in productivity: right after accession, the number of firms exporting their products and services grew twice as fast as the total number of companies. As a result, in 2013, Polish companies earned one fifth of their revenues from exports. Since 80 per cent of these exports were to the EU, most of the revenues were generated thanks to our presence on the internal market. However, after ten years of EU membership, many Polish companies are still not present on the EU's common market. This means that they have not yet tapped into the significant development potential offered by this market.1

1-2 Poland's migration issues

The situation of migration related to Poland's people is also one of the elements on which significant influences was made by the opportunities offered by the EU's common market and its four pillars: the free movement of goods, persons, services and capital.

Poland's Central Statistics Office estimates that 2.1 million Polish people are living abroad, most within Europe. That figure peaked at 2.3 million in 2007, after which some people started to move back. Yet predictions of a mass return of emigrants as Western Europe slid into recession (whereas Poland did not) proved wrong. For the past four years, the number of

emigrants has been rising steadily again.[6]

As for immigration to Poland, in turn, in 2010 a total of 97,080 foreigners had valid residence cards, with 43,766 holding short-term residence cards (for 1 to 2 years) and 53,292 long-term residence cards. The largest groups of nationals holding permanent residence cards in Poland in 2010 included Ukrainians (28,450), Russians (12,550), Belarusians (8,995), Vietnamese (8,567), and Armenians (3,858).[7]

In 2010 and 2011, around 50 to 60 thousand foreigners worked in the Polish territory. In 2010 a total of 37 121 residence permits were issues, with 29 340 issued in 2009. Most of those permits were granted to Ukrainian nationals (13,150). Other leading countries of nationalities include China (2,252), Nepal (2,158), and Belarus (1958). Since 2008 around 150 thousand seasonal immigrants a year have been visiting Poland for work on the basis of an employment certificate registered by their employers. This simplified procedure applies to nationals of Belarus, Georgia, Moldova, Russia, and Ukraine.[7]

Migration plays, mentioned in IOM report on migration trends in the EU, an important role at both the micro level (of the individual or household) and the macro level (e.g. of local communities and regions). The most important economic effects of the present migration include: an easing of the impact of high unemployment (especially in the case of those whose long-term unemployed status resulted in their losing the right to unemployment benefit), as well as remittances transferred to the country (estimated at c. $900 million annually from legal employment alone). The supply of cheap labor due to economic migrants from the former USSR raises the competitiveness of certain sectors of the economy (construction, agriculture), as well as making it possible for a greater number of households to purchase services (domestic work, care of children and elderly persons), that would not be accessible to the average family were it not for the participation of the migrant labor force.[8]

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[6] The economist: "Poland's emigration headache"

[7] Ministry of the Interior in Poland: "New migration policy in Poland"

[8] International Organization for Migratioin, "Sharing Experience: Migration Trends in Selected Applicant Countries and Lessons Learned from the 'New Countries of

1-3 Previous Studies on the linkages on migration and trade

- James A. Dunlevy and William K. Hutchinson [1999]

  Applying a gravity model to U.S. imports, they found a positive relation between trade and migration. The survey supported for a broad pro-import immigrant effect, especially for more finished and more differentiated goods.

- Assaf Razin and Efraim Sadka [1992]

  In this paper, it is mentioned that when there is difference of productivity between two countries, physical capital has weak incentives to flow from developed to developing countries while pressures for international migration from developing to developed countries are strong.

- Endreas Hatzigeorgiou [2010]

  His study provides an empirical investigation of the link between migration and trade flows for Sweden. Trade and migration data for Sweden and 180 partner countries between 2002 and 2007 are used to estimate an augmented gravity model. The results show <u>a statistically strong, positive and robust link between migration and increased trade flows</u>. The analysis derives the effect from the ability of foreign-born people to improve the flow of information between Sweden and their former home countries. This study argues, in light of the findings, that immigration can be used as an instrument for increased foreign trade and that the issue of migration thus deserves increased focus in trade policy and economic policy.

- Murat Genc, Masood Gheasi, Peter Nijkamp and Jaques Poot [2010]

  They compile and analyze in this paper the distribution of immigration elasticity of imports and exports across 48 studies that yielded 300 estimates. The results confirm that immigration boosts trade, but its impact is lower on trade in homogeneous goods. An increase in the number of immigrants by 10 percent increases the volume of trade by about 1-2 percent.

Immigration' in the EU and Austria"

- Charles B. Keely [2002]

  He mentioned the importance of closer coordination of trade and migration policies by governments and international bodies, firms in the long run.

- Gabriel Felbermayr, Volker Grossmann and Wilhelm Kohler [2012]

  It is reviewed that the empirical literature exploring the link between migration and trade. Using the gravity model of trade, the analysis revisited the identification of the overall trade-creating effect of migration and its break-down into the trade channel and the preference channel. Finally it clarified the role of product differentiation for the size of estimated effects, discuss the role of immigrants' education and occupation, and emphasize direct and indirect networks and their trade-enhancing potential.

- Giorgio Fagiolo and Marina Mastrorillo [2014]

  They explored the relationships between international human migration and merchandise trade, using a complex network approach. Investigating whether the position of any pair of countries in the migration network affects their bilateral trade flows, some facts were found as below: (i) both weighted and binary versions of the networks of international migration and trade are strongly correlated; (ii) such correlations can be mostly explained by country economic/demographic size and geographical distance; and (iii) pairs of countries that are more central in the international-migration network trade more. These findings suggest that bilateral trade between any two countries is not only affected by the presence of migrants from either countries but also by their relative embeddedness in the complex web of corridors making up the network of international human migration.

2   Hypothesis and Methodology

The paper's hypothesis is as below.

H1: As in the case of Poland within the EU membership, the relation between migration to Poland and Poland's export trade differs according to the importing countries and commodities.

Explaining the relationship between immigration and exports from Poland requires a model that controls for factors that are generally considered to explain exports. Following James A. Dunlevy, William K. Hutchinson and others working in the empirical sphere of international economics, we employ a variation of the gravity model in the empirical work that follows.[9]

The basic gravity model related the volume of trade, imports or exports, between two countries as a function of the size of the two countries and the distance between them. Size is measured variously in different studies as some combination of population and gross domestic product; we use per capita income and population. Control variables are then generally added, in a somewhat *ad hoc* fashion, to reflect factors specific to the case under investigation; this is a practice we also employ.[10]

The representation of the model is:

$$Exports_{ijkt} = f\ (Per\ Capita\ Income_{it},\ Population_{it}$$

$$Pl\ Per\ Capita\ Income_{jt},\ Pl\ Population_{jt}$$

$$Distance_{ij},\ Relative\ Income_{ijt},\ Relative\ Price_{ijt}$$

$$Migrant\ Stock_{it},\ Year_t)\ \dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

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[9] See, also, Hummels and Levinsohn, "Monopolistic Competition."

[10] See Frankel, "Regional Trading Blocks", especially chapter 4, for a discussion of these issues. The theoretical foundations of the gravity approach have been developed by Anderson, "Theoretical Foundation", by Bergstrand, "Gravity Equation,""Generalized Gravity Equation," and "Heckscher-Ohlin-Samuelson Model", and by Deardroff, "Determinants." See also Haveman and Hummels, "What Can We Learn." (James A. Dunlevy and William K. Hutchinson [1999])

The basic gravity equation for our regression analysis takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \text{Ln}[Per\ Capita\ Income]_{it} +$$

$$\beta_2 \text{Ln}[Population]_{it} + \beta_3 \text{Ln}[Pl\ Per\ Capita\ Income]_{jt} +$$

$$\beta_4 \text{Ln}[Pl\ Population]_{jt} + \beta_5 \text{Ln}[Distance]_{ij} + \varepsilon_{ijkt} \ \dots(2)$$

NOTE1:

[*Exports*]ijkt = the value of exports of commodity k from Poland (j) to country i in year t

[*Per Capita Income*]it = income per capita of country i in year t

[*Population*]it = population in country i in year t

[*Pl Per Capita Income*]jt = income per capita of Poland(j) in year t

[*Pl Population*]jt = population in country i in year t

[*Distance*]ij = distance between Poland (j) and its trading partner (j)

The motivation for variables in equation (2) is as follows: *Per Capita Income* and *Population* of the Poland's trading partner, *Pl Per Capita Income* and *Pl Population* are standard gravity variables intended to measure the size of the trading partners.[11] Distance between the trading partners, likewise, is a standard element of the gravity model.

Based on the standard gravity equation (2), we included four variables i.e. *Relative Income, Relative Price, Migrant Stock and Year* variables as other explanatory variables in order to see the significance of factors under investigation. The detail of these variables are in NOTE2 in this Section.

The resulting equation (3) takes the following form:

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[11] The definitions of these variables and the sources of the data are more fully explained in Section 3.

$$\text{Ln}[\textit{Exports}]_{ijkt} = \alpha + \beta_1 \text{Ln}[\textit{Per Capita Income}]_{it} +$$

$$\beta_2 \text{Ln}[\textit{Population}]_{it} + \beta_3 \text{Ln}[\textit{Pl Per Capita Income}]_{jt} +$$

$$\beta_4 \text{Ln}[\textit{Pl Population}]_{jt} + \beta_5 \text{Ln}[\textit{Distance}]_{ij} +$$

$$\beta_6 [\textit{Relative Income}]_{ijt} + \beta_7 [\textit{Relative Price}]_{ijt} +$$

$$\beta_8 [\textit{Migrant Stock}]_{it} + \beta_9 [\textit{Year}]_t + \varepsilon_{ijkt} \,...(3)$$

NOTE2:

[*Relative Income*]ijt = the percentage difference of relative per capita income between Poland (j) and country i in year t[12]

[*Relative Price*]ijt = the relative delivered price of exports in year t[13]

[*Migrant Stock*]it = the number of persons born in Poland residing in country i in year t

[*Year*]t = a trend variable that ranges from zero to eight

Relative Income is designed to capture Linder taste effects. Staffan Linder argues that countries with similar per capita incomes produce similar, but differentiated, products that constitute the basis of intra-industry trade among them.[14] The *Relative Price* variable is the ratio of the Poland's unit value of aggregate exports relative to the importers' consumer price index, adjusted for tariff and transport costs. Unlike other gravity model studies of trade, we are also working at the level of the individual commodity; the ideal relative price measures are unobtainable and we are forced to use this aggregated rough measure as a proxy. *Migrant Stock* is the key variable in this study; it denotes the number of immigrants originated in Poland which

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[12] The detail of data is described in Section 3.
[13] The detail of data is described in Section 3
[14] Linder, Essays; and Frankel, Regional Trading Blocks, p.60.

are living in country i in year t.[15]Finally, the *Year* variable serves as a catch-all trend variable and is intended to control for unobserved effects.

The data cover exports of 4 types of commodities[16] to a maximum of 8 countries[17]. The set of commodities was selected so as to include the major export items of Poland after the accession in the EU. Note that we do not hypothesize that all exports are subject to an "immigrant pull" effect. Our purpose here is to detect such a pull if it existed, not to generalize it to all commodities.

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[15] Alternative measures of immigration were considered, including the five-year change in the measured migrant stock and the five-year flow of nationality-specific immigrants over the $t-50$ to $t-1$ interval, both independently and in conjunction with migrant stock. These measures were an attempt to capture cohort effects that would exist if newer immigrants had different effects on trade volume than did longer- settled immigrants. In general, these measures were inferior to *Migrant Stock* in their performance, and, hence, were dropped from further consideration. (James A. Dunlevy and William K. Hutchinson [1999])

[16] "Vehicles other than railway, tramway," "Electrical, electronic equipment,""Edible vegetables and curtain roots, cut flowers etc," and "Oil seed, oleagic fruits, grain, seed, fruit, etc, ne."

[17] Czech Republic, Hungary, Slovak Republic, Slovenia, Germany, Italy, Spain, and Norway

3　Data

3.1　[*Exports*]ijkt is the value of exports of commodity k from country j (Poland) to country i in year t. It is available in OECD StatExtracts. For export amounts by commodity groups, we use the data of commodity groups listed on Harmonised System 1988 of OECD ITCS statistics. (Data are in current U.S. dollars.)

3.2　[*Migrant Stock*]it is the number of stock of emigrants from Poland residing in country i in year t. These data are available in OECD StatExtracts. Some countries' latest data was not available, so the same number as in previous year. (Unit of measure used; Thousands)

3.3　[*Pl Population*]jt is the amount of population in country j (Poland) in year t, which is available for all years in OECD StatExtracts. Data are presented in thousands of persons. (Unit of measure used; Thousands)

3.4　[Population]it is the amount of population in country i in year t, which is available for most nationalities in OECD StatExtracts. For Spanish latest population, the number of previous year is used. Data are presented in thousands of persons. (Unit of measure used; Thousands)

3.5　[*Per Capita* Income]it is the ratio of real gross domestic product to population in country i in year t. It is measured in thousands of dollars per person. It is available for covered years and countries in World Development Indicators, World Bank. (Data are in current U.S. dollars.)

3.6　[Distance]ij is measured in kilometers between the capital city of the host country i and the capital city of country j (Poland), Warsaw.

3.7　[*Relative* Income]ijt is the percentage difference of relative per capita income between country j (Poland) and country i in year t. It is the absolute value of the difference between Poland per capita income and the per capita income of country i relative to the per capita income of i.

3.8 [*Relative* Price]ijt is the relative delivered price of exports in year t. It is the absolute value of the host country's import value index for aggregate imports relative to host country's consumer price index. Data for import value index and consumer price index come from the website of World Bank, "Import value index (2000=100)" and "Consumer price index (2010=100)".

3.9 [Year]t is a trend variable that ranges from zero to eight, corresponding to the years 2005, 2006, … , through 2013.

4   Estimation Results

To examine the effect of migration on export trade, we first conducted a multiple regression analysis with overall export trade amount in each year as explained variable. After that, regression analyses are made for each commodity group of export trade.

For data of exported commodities, we apply four category of commodity which is listed in the Harmonised System 1998 of OECD StatExtracts, i.e. category which includes oil seed[18], edible fruits and vegetables[19], vehicles[20] and electronic equipment[21]. As process of selection, we first select two major divisions in Standard Industrial Classification (SIC) [22], Division A (Agriculture, Forestry And Fishing), which includes the most exported commodities of Primary industrial sector of, and Division D (Manufacturing), which includes the most exported commodities in Secondary industrial sector. Since oil seeds, fruits and vegetables are major exported commodities as well as vehicles and electronic equipments in primary sector of Poland in recent years, from Division A we selected Major Group 01 (Agricultural Production Crops) and from Division D we selected Major Group 36 (Electrical Equipment) and 37 (Transportation Equipment).[23] As for Data, we apply the commodity categories listed on OECD StatExtracts' Harmonised System 1998, which include the commodities described above.

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[18] 12: Oil seed, organic fruits, grain, seed, fruit, etc, ne (OECD StatExtracts)
[19] 08: Edible fruits, nuts, peal of citrus fruits, melons (OECD StatExtracts)
[20] 87: Vehicles other than railway, tramway (OECD StatExtracts)
[21] 85: Electrical, electronic equipment (OECD StatExtracts)
[22] UNITED STATES DEPARTMENT OF LABOR
[23] Ministry of Treasury Republic of Poland

【Major Divisions of SIC】

Major Division in Standard Industrial Classification
Division A: Agriculture, Forestry, And Fishing
Division B: Mining
Division C: Construction
Division D: Manufacturing
Division E: Transportation, Communications, Electric, Gas, And Sanitary Services
Division F: Wholesale Trade
Division G: Retail Trade
Division H: Finance, Insurance, And Real Estate
Division I: Services
Division J: Public Administration

【Major Groups in Division A and D of SIC】

Division A: Agriculture, Forestry, And Fishing
Major Group 01: Agricultural Production Crops
Major Group 02: Agriculture production livestock and animal specialties
Major Group 07: Agricultural Services
Major Group 08: Forestry
Major Group 09: Fishing, hunting, and trapping
Division D: Manufacturing
Major Group 20: Food And Kindred Products
Major Group 21: Tobacco Products
Major Group 22: Textile Mill Products
Major Group 23: Apparel And Other Finished Products Made From Fabric
Major Group 24: Lumber And Wood Products, Except Furniture
Major Group 25: Furniture And Fixtures
Major Group 26: Paper And Allied Products
Major Group 27: Printing, Publishing, And Allied Industries
Major Group 28: Chemicals And Allied Products
Major Group 29: Petroleum Refining And Related Industries
Major Group 30: Rubber And Miscellaneous Plastics Products
Major Group 31: Leather And Leather Products
Major Group 32: Stone, Clay, Glass, And Concrete Products
Major Group 33: Primary Metal Industries
Major Group 34: Fabricated Metal Products, Except Machinery And Transportation Equipment
Major Group 35: Industrial And Commercial Machinery And Computer Equipment
Major Group 36: Electronic And Other Electrical Equipment And Components, Except Computer Equipment
Major Group 37: Transportation Equipment
Major Group 38: Measuring, Analyzing, And Controlling Instruments; Photographic, Medical And Optical Goods; Watches And Clocks
Major Group 39: Miscellaneous Manufacturing Industries

Further on, we tried 2 types of regions i.e. Western Europe countries and Central Europe countries to see how the emigration effects on export differ depending on the region. As in Western Europe we select Germany, Italy, Spain, and Norway, and in Central Europe Czech Republic, Hungary, Slovak Republic, and Slovenia. These countries are, among countries that data are available in OECD StatExtracts, top 4 countries in each region, Western Europe and Central Europe, which have accepted large amount of immigrants from Poland.

In total, 2 analyses are made for each of the 4 commodity groups. In order to improve accuracy of the models, we apply backward elimination method for each of the regression analyses.

In summary, the results suggest that immigration stock originated in Poland has a positive effect on export trade to the host countries, mostly consistent with the theoretical prediction. However, a negative effect was seen in result of Vehicle export to Western European countries. The reason is discussed in Section 4.11, Summary and discussion of overall results.
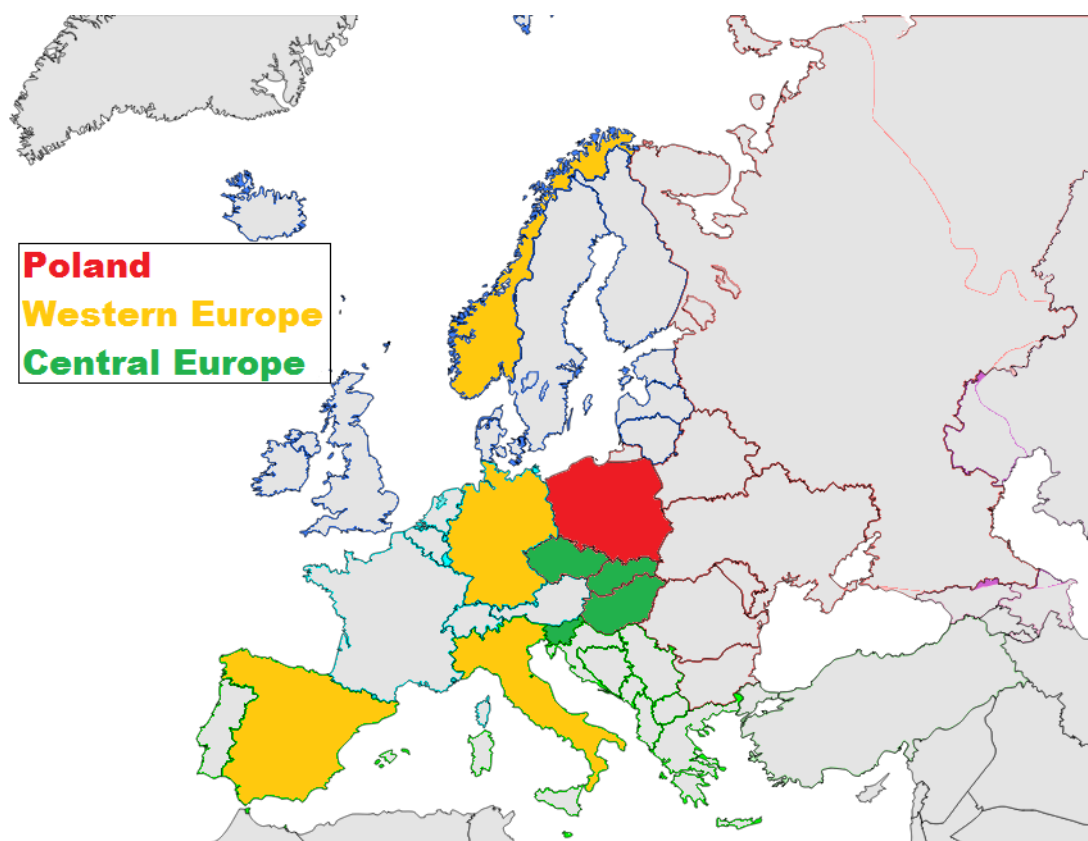
4.1 Results: Export of Overall Commodity to Western Europe

We start with the estimation of the impact of Poland's emigration on overall export trade to host countries in Western Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 4 variables. The analyses detail is described below.

4.1.1 Table 1-1

According to the result described in Table 1-1, the t-ratio absolute value of PL population variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.1.2

Summary 1-1

Regression Statistics	
Multiple R	0.99092352
R Square	0.98192942
Adjusted R Square	0.97567422
Standard Error	2277028898
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	7.32518E+21	8.1E+20	156.978	2.44143E-20
Residual	26	1.34806E+20	5.2E+18		
Total	35	7.45999E+21			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	5.2268E+10	2.06273E+11	0.25339	0.80196	-3.71733E+11	4.7627E+11
population	-12.791576	90.04327736	-0.1421	0.88813	-197.8781819	172.295029
PL population	-193.79039	4805.248674	-0.0403	0.96814	-10071.1204	9683.53963
per capita income	-529170.82	451189.2514	-1.1728	0.2515	-1456603.597	398261.963
PL per capita income	1549828.69	2564580.34	0.60432	0.55087	-3721741.641	6821399.03
distance	-6030730.6	2325852.752	-2.5929	0.01542	-10811589.35	-1249871.8
migrant stock	73390141.9	7491953.405	9.79586	3.3E-10	57990211.25	88790072.5
Relative Income	193395727	13022101633	0.01485	0.98826	-26573917271	2.6961E+10
year variable	-1.118E+09	2866341217	-0.3899	0.6998	-7009379148	4774318241
Relative Price	4905509652	3528937507	1.39008	0.17629	-2348325210	1.2159E+10

4.1.2 Table 1-2

Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 1-2, the t-ratio absolute value of population variable is lower than 2 and is the closest to 0 among all the variables. So we drop this variable and sequentially conducted three analyses in the same manner, dropping Relative Income and year variables. The final result is described in the next Section.

Summary 1-2

Regression Statistics	
Multiple R	0.99092295
R Square	0.98192829
Adjusted R Square	0.97657371
Standard Error	2234533744
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	8	7.32518E+21	9.2E+20	183.381	1.73148E-21
Residual	27	1.34815E+20	5E+18		
Total	35	7.45999E+21			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	4.4208E+10	50169064752	0.88119	0.38599	-58729992474	1.4715E+11
population	-11.927835	85.82684003	-0.139	0.8905	-188.0299621	164.174293
per capita income	-521882.27	405696.4366	-1.2864	0.20923	-1354302.592	310538.047
PL per capita income	1584149.84	2374110.341	0.66726	0.51027	-3287122.151	6455421.83
distance	-6003186.5	2181820.29	-2.7515	0.01047	-10479911.91	-1526461.1
migrant stock	73388878.8	7352070.248	9.98207	1.5E-10	58303676.91	88474080.8
Relative Income	29171020.4	12138190327	0.0024	0.9981	-24876338023	2.4935E+10
year variable	-1.178E+09	2400276323	-0.4907	0.62761	-6102759987	3747160317
Relative Price	4836757861	3032179383	1.59514	0.12232	-1384760258	1.1058E+10

4.1.3 Table 1-3

  According to the result of regression analysis described in Table 1-5, the t-ratio absolute value of every variable is higher than 2. So we finalize this elimination procedure and determine a final model for analyzing Export of Overall Commodity to Western Europe. The resulting equation (4) takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \text{Ln}[Per\ Capita\ Income]_{it} +$$

$$\beta_2 \text{Ln}[Pl\ Per\ Capita\ Income]_{jt} + \beta_3 \text{Ln}[Distance]_{ij} +$$

$$\beta_4 [Relative\ Price]_{ijt} + \beta_5 [Migrant\ Stock]_{it} + \varepsilon_{ijkt} \dots (4)$$

  As for migrant stock the t-value is higher than 2, which means it has a significant effect to Poland's overall export trade to the host countries in Western Europe. Moreover, the coefficient is above 0, which indicates a positive impact of this element.

Summary 1-3

Regression Statistics	
Multiple R	0.99080559
R Square	0.98169572
Adjusted R Square	0.97864501
Standard Error	2133461597
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	5	7.32344E+21	1.5E+21	321.792	4.16417E-25
Residual	30	1.3655E+20	4.6E+18		
Total	35	7.45999E+21			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	5.8899E+10	13465842245	4.37395	0.00014	31398067480	8.64E+10
per capita income	-528747.83	111265.9749	-4.7521	4.7E-05	-755983.2606	-301512.39
PL per capita income	540609.511	179911.5718	3.00486	0.00532	173181.065	908037.958
distance	-6252079	1342688.779	-4.6564	6.1E-05	-8994215.341	-3509942.7
migrant stock	71436705.3	3934069.613	18.1585	9.9E-18	63402263.36	79471147.3
Relative Price	5751303345	1703540114	3.37609	0.00205	2272210303	9230396387

4.2 Results: Export of Overall Commodity to Central Europe

In this Section, we start with the estimation of the impact of Poland's emigration on overall export trade to host countries in Central Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 6 variables. The analyses detail is described below.

4.2.1 Table 2-1

According to the result described in Table 2-1, the t-ratio absolute value of distance variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.2.2

Summary 2-1

Regression Statistics	
Multiple R	0.95214382
R Square	0.90657786
Adjusted R Square	0.87423942
Standard Error	1035163854
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	2.70363E+20	3E+19	28.0341	3.55409E-11
Residual	26	2.78607E+19	1.1E+18		
Total	35	2.98223E+20			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-5.194E+10	79062848359	-0.6569	0.51701	-2.14453E+11	1.106E+11
per capita income	74231.4207	302297.5334	0.24556	0.80795	-547150.0523	695612.89
PL per capita income	534941.663	1478665.815	0.36177	0.72045	-2504499.42	3574382.7
distance	-1467132.7	6977888.922	-0.2103	0.83511	-15810388.69	12876123
migrant stock	285597120	83622763.56	3.4153	0.0021	113708069.6	457486171
Relative Price	66447597.2	441672618.3	0.15045	0.88157	-841423463.2	974318658
PL population	1236.35321	2024.404551	0.61072	0.54668	-2924.869898	5397.5763
population	-56.102331	29.96438873	-1.8723	0.07245	-117.6950131	5.490352
Relative Income	1993670935	5958161124	0.33461	0.7406	-10253504535	1.424E+10
year variable	-347833093	1513431870	-0.2298	0.82002	-3458736825	2.763E+09

4.2.2 Table 2-2

　Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 2-2, the t-ratio absolute value of per capita income variable is lower than 2 and is the closest to 0 among all the variables. So we drop this variable and sequentially conducted five analyses in the same manner, dropping Relative Price, PL population, year, and Relative Income variables. The final result is described in the next Section.

Summary 2-2

Regression Statistics	
Multiple R	0.9520604

Summary 2-6

Regression Statistics	
Multiple R	0.95011849
R Square	0.90272514
Adjusted R Square	0.89017355
Standard Error	967364871
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	4	2.69214E+20	6.7E+19	71.9212	3.08941E-15
Residual	31	2.90096E+19	9.4E+17		
Total	35	2.98223E+20			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-2.054E+09	1221173174	-1.6819	0.10263	-4544515179	436683019
PL per capita income	298756.213	63239.99675	4.72417	4.7E-05	169777.3894	427735.036
migrant stock	305940938	21657109.67	14.1266	4.7E-15	261770971.8	350110904
population	-44.264852	11.33360216	-3.9056	0.00047	-67.37988629	-21.149818
Relative Income	1087873840	1551759310	0.70106	0.4885	-2076960127	4252707807

4.2.3 Table 2-3

According to the result of regression analysis described in Table 2-7, the t-ratio absolute value of every variable is higher than 2. So we finalize this elimination procedure and determine a final model for analyzing Export of Overall Commodity to Central Europe. The resulting equation (5) takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \text{Ln}[Pl\ Per\ Capita\ Income]_{jt} +$$

$$\beta_2 [Migrant\ Stock]_{it} + \beta_3 [Population]_{it} + \varepsilon_{ijkt} \quad ...(5)$$

As for migrant stock the t-value is higher than 2, which means it has a significant effect on Poland's overall export trade to the host countries in Central Europe. Moreover, the coefficient is above 0, which indicates the impact of this element is positive.

Summary 2-3

Regression Statistics	
Multiple R	0.94930655
R Square	0.90118292
Adjusted R Square	0.89191882
Standard Error	959647815
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	3	2.68754E+20	9E+19	97.2769	3.6358E-16
Residual	32	2.94696E+19	9.2E+17		
Total	35	2.98223E+20			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-1.646E+09	1065118800	-1.5454	0.13208	-3815631176	523520802
PL per capita income	278184.987	55573.45407	5.00572	2E-05	164985.5663	391384.409
migrant stock	304576033	21397352.52	14.2343	2.2E-15	260991052.1	348161013
population	-37.431748	5.737426507	-6.5241	2.4E-07	-49.11850286	-25.744992

4.3 Results: Export of Grains and Fruits to Western Europe

In this Section, we start with the estimation of the impact of Poland's emigration on export of grains and fruits to host countries in Western Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 8 variables. The analyses detail is described below.

4.3.1 Table 3-1

According to the result described in Table 3-1, the t-ratio absolute value of Relative Income variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.3.2

Summary 3-1

Regression Statistics	
Multiple R	0.943835246
R Square	0.890824971
Adjusted R Square	0.853033615
Standard Error	36953060.69
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	2.89696E+17	3.22E+16	23.57219	2.54669E-10
Residual	26	3.55037E+16	1.37E+15		
Total	35	3.252E+17			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	7455077286	3347535128	2.227035	0.034817	574120350.9	14336034221
population	-3.085810153	1.46127908	-2.11172	0.044476	-6.089512291	-0.082108015
PL population	-158.7760166	77.98260535	-2.03604	0.052053	-319.071556	1.519522849
per capita income	-8002.872546	7322.183661	-1.09296	0.284434	-23053.83647	7048.091377
PL per capita income	-57569.91793	41619.62681	-1.38324	0.178355	-143120.2852	27980.44936
distance	-42758.22778	37745.40498	-1.13281	0.267634	-120345.0181	34828.56256
migrant stock	779539.601	121584.1438	6.411524	8.59E-07	529619.8166	1029459.385
Relative Price	61682537.05	57269822.98	1.077051	0.29135	-56037268.87	179402343
Relative Income	9978519.228	211330876.2	0.047218	0.962701	-424418313.7	444375352.2
year variable	80105168.71	46516792.59	1.72207	0.096935	-15511466.91	175721804.3

4.3.2 Table 3-2

Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 3-2, the t-ratio absolute value of distance variable is lower than 2 and is the closest to 0 among all the variables. So we drop this variable and sequentially conducted seven analyses in the same manner, dropping Relative Price, PL per capita income, PL population, year, per capita income, and population variables. The final result is described in the next Section.

Summary 3-2

Regression Statistics	
Multiple R	0.943830286
R Square	0.890815609
Adjusted R Square	0.858464679
Standard Error	36263843.07
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	8	2.89693E+17	3.62E+16	27.53601189	4.64099E-11
Residual	27	3.55068E+16	1.32E+15		
Total	35	3.252E+17			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	7427155840	3233438302	2.296984	0.029603255	792688533.9	14061623146
population	-3.05887308	1.320225657	-2.31693	0.028332819	-5.767752342	-0.349993819
PL population	-157.6245749	72.69016244	-2.16844	0.039104024	-306.7724668	-8.476683081
per capita income	-7739.354923	4651.593672	-1.66381	0.107716562	-17283.63666	1804.926814
PL per capita income	-58471.24697	36294.10082	-1.61104	0.118801326	-132940.5897	15998.09581
distance	-42665.61456	36991.36401	-1.15339	0.258857316	-118565.6232	33234.39409
migrant stock	778537.4533	117484.4786	6.626726	4.13E-07	537479.2177	1019595.689
Relative Price	60402313.4	49504166.05	1.220146	0.232959892	-41171844.03	161976470.8
year variable	80550630.75	44700486.3	1.802008	0.082720659	-11167190.1	172268451.6

4.3.3 Table 3-3

According to the result of regression analysis described in Table 3-9, the t-ratio absolute value of every variable is higher than 2. So we finalize this elimination procedure and determine a final model for analyzing Export of Grains and Fruits to Western Europe. The resulting equation (6) takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_2[Migrant\ Stock]_{it} + \varepsilon_{ijkt} \qquad \ldots(6)$$

As for migrant stock the t-value is higher than 2, which means it has a significant effect on Poland's export of grains and fruits to the host countries in Western Europe. Moreover, the coefficient is above 0, which indicates the impact of this element is positive.

Summary 3-3

Regression Statistics	
Multiple R	0.916336584
R Square	0.839672736
Adjusted R Square	0.834957228
Standard Error	39159727.77
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	1	2.73062E+17	2.73E+17	178.0662	4.50612E-15
Residual	34	5.21385E+16	1.53E+15		
Total	35	3.252E+17			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-37209365.51	9192957	-4.04759	0.000282	-55891701.79	-18527029.23
migrant stock	532547.4465	39908.69378	13.34415	4.51E-15	451443.2232	613651.6699

4.4 Results: Export of Grains and Fruits to Central Europe

In this Section, we start with the estimation of the impact of Poland's emigration on export of grains and fruits to host countries in Central Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 7 variables. The analyses detail is described below.

4.4.1 Table 4-1

According to the result described in Table 4-1, the t-ratio absolute value of population variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.4.2

Summary 4-1

Regression Statistics	
Multiple R	0.863172623
R Square	0.745066977
Adjusted R Square	0.65682093
Standard Error	2950854.751
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	6.61665E+14	7.35E+13	8.443063517	8.84312E-06
Residual	26	2.26396E+14	8.71E+12		
Total	35	8.88061E+14			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-162543003.7	225377828.6	-0.7212	0.477220681	-625813760.6	300727753.2
population	0.012332822	0.085416969	0.144384	0.886310814	-0.163244271	0.187909915
PL population	5.500910195	5.770800208	0.953232	0.349251391	-6.3611394	17.36295979
per capita income	679.2318587	861.7342161	0.788215	0.437698845	-1092.088173	2450.551891
PL per capita income	-4054.760848	4215.108581	-0.96196	0.344932082	-12719.04054	4609.518842
distance	5226.72459	19891.28252	0.262765	0.794803023	-35660.39179	46113.84097
migrant stock	605347.2794	238376.3963	2.53946	0.017424262	115357.5842	1095336.975
year variable	4348617.768	4314213.257	1.007975	0.322755874	-4519374.499	13216610.03
Relative Price	-340664.349	1259039.077	-0.27057	0.788854383	-2928656.212	2247327.514
Relative Income	-13827092.73	16984430.03	-0.8141	0.422979237	-48739088.32	21084902.86

4.4.2 Table 4-2

Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 4-2, the t-ratio absolute value of Relative Price variable is lower than 2 and is the closest to 0 among all the variables. So we drop this variable and sequentially conducted six analyses in the same manner, dropping PL population, per capita income, Relative Income, PL per capita income and distance variables. The final result is described in the next Section.

Summary 4-2

Regression Statistics	
Multiple R	0.863054212
R Square	0.744862573
Adjusted R Square	0.669266298
Standard Error	2896854.368
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	8	6.61484E+14	8.27E+13	9.853165045	2.68994E-06
Residual	27	2.26578E+14	8.39E+12		
Total	35	8.88061E+14			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-159371021.7	220199780.6	-0.72376	0.475439727	-611183646	292441602.6
PL population	5.435153988	5.647525438	0.962396	0.344391486	-6.152610914	17.02291889
per capita income	709.0501703	821.3109888	0.863315	0.395568602	-976.1407608	2394.241101
PL per capita income	-4001.056691	4121.830097	-0.9707	0.340314314	-12458.35337	4456.239989
distance	3137.092939	13395.88216	0.234183	0.816609324	-24348.98655	30623.17243
migrant stock	578872.6157	149532.1277	3.871226	0.000621599	272058.0365	885687.195
year variable	4324785.528	4232162.549	1.021885	0.315904459	-4358894.64	13008465.7
Relative Price	-353274.4987	1233021.374	-0.28651	0.776673649	-2883225.353	2176676.356
Relative Income	-12020805.25	11277279.65	-1.06593	0.295894163	-35159871.51	11118261.01

4.4.3 Table 4-3

According to the result of regression analysis described in Table 2-8, the t-ratio absolute value of every variable is higher than 2. So we finalize this elimination procedure and determine a final model for analyzing Export of Grains and Fruits to Central Europe. The resulting equation (7) takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \text{Ln}[Year]_t + \beta_2 [Migrant\ Stock]_{it} + \varepsilon_{ijkt}$$

...(7)

As for migrant stock the t-value is higher than 2, which means it has a significant effect on Poland's overall export of grains and fruits to the host countries in Central Europe. Moreover, the coefficient is above 0, which indicates the impact of this element is positive.

Summary 4-3

Regression Statistics	
Multiple R	0.844964969
R Square	0.713965799
Adjusted R Square	0.696630393
Standard Error	2774428.079
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	2	6.34045E+14	3.17E+14	41.18540941	1.07373E-09
Residual	33	2.54016E+14	7.7E+12		
Total	35	8.88061E+14			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-1990818.926	938283.444	-2.12177	0.04145299	-3899770.937	-81866.91556
year variable	627607.8906	179208.3919	3.502112	0.001347659	263005.6777	992210.1034
migrant stock	508037.6983	61660.39586	8.239287	1.62874E-09	382588.6803	633486.7163

4.5 Results: Export of Edible Vegetables to Western Europe

In this Section, we start with the estimation of the impact of Poland's emigration on export of edible vegetables to host countries in Western Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 6 variables. The analyses detail is described below.

4.5.1 Table 5-1

According to the result described in Table 5-1, the t-ratio absolute value of population variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.5.2

Summary 5-1

Regression Statistics	
Multiple R	0.994439462
R Square	0.988909844
Adjusted R Square	0.985070944
Standard Error	8621112.869
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	1.72313E+17	1.91E+16	257.6024	4.37706E-23
Residual	26	1.93241E+15	7.43E+13		
Total	35	1.74246E+17			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	573088874.4	780976666.9	0.73381	0.46963	-1032231640	2178409388
PL population	-3.254161459	18.19326545	-0.17887	0.859429	-40.65095382	34.1426309
per capita income	-1856.474389	1708.258277	-1.08676	0.287114	-5367.849532	1654.900754
PL per capita income	-5722.784402	9709.818173	-0.58938	0.560693	-25681.6013	14236.0325
distance	-33105.41459	8805.966015	-3.75943	0.000873	-51206.33679	-15004.49238
migrant stock	354216.8183	28365.46167	12.48761	1.72E-12	295910.7774	412522.8592
year variable	7532788.871	10852322.15	0.694118	0.493764	-14774478.57	29840056.32
Relative Price	14150788.4	13360993.61	1.059112	0.29929	-13313127.03	41614703.83
Relative Income	-17279867.6	49303286.44	-0.35048	0.728801	-118624223.3	84064488.1
population	-0.040156233	0.340914978	-0.11779	0.90714	-0.740917	0.660604534

4.5.2 Table 5-2

　Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 5-2, the t-ratio absolute value of PL population variable is lower than 2 and is the closest to 0 among all the variables. So we drop this variable and sequentially conducted five analyses in the same manner, dropping Relative Income, PL per capita, Relative Price and year variables. The final result is described in the next Section.

Summary 5-2

Regression Statistics	
Multiple R	0.994436487
R Square	0.988903926
Adjusted R Square	0.9856162
Standard Error	8462213.305
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	8	1.72312E+17	2.15E+16	300.7866	2.43944E-24
Residual	27	1.93344E+15	7.16E+13		
Total	35	1.74246E+17			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	545969732.3	732513878.6	0.745337	0.462507	-957024580.4	2048964045
PL population	-2.744439014	17.3454171	-0.15822	0.875459	-38.33429473	32.8454167
per capita income	-1693.191674	979.8640958	-1.72799	0.095414	-3703.706705	317.3233571
PL per capita income	-5832.60276	9486.81495	-0.61481	0.543826	-25297.93896	13632.73344
distance	-32444.10331	6659.070948	-4.87217	4.29E-05	-46107.38813	-18780.81848
migrant stock	351687.2291	18189.57171	19.33455	2.4E-17	314365.3113	389009.147
year variable	7429983.911	10617792.84	0.699767	0.490058	-14355927.21	29215895.03
Relative Price	13356628.74	11322512.76	1.179652	0.248429	-9875248.207	36588505.68
Relative Income	-19547104.14	44554143.25	-0.43873	0.66435	-110964653.9	71870445.57

4.5.3 Table 5-3

According to the result of regression analysis described in Table 5-7, the t-ratio absolute value of every variable is higher than 2. So we finalize this elimination procedure and determine a final model for analyzing Export of Edible Vegetables to Western Europe. The resulting equation (8) takes the following form:

$$\mathrm{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \mathrm{Ln}[Per\ Capita\ Income]_{it} +$$

$$\beta_2[Distance]_{ij} + \beta_3[Migrant\ Stock]_{it} + \varepsilon_{ijkt} \qquad ...(8)$$

As for migrant stock the t-value is higher than 2, which means it has a significant effect on Poland's export of edible vegetables to the host countries in Western Europe. Moreover, the coefficient is above 0, which indicates the impact of this element is positive.

Summary 5-3

Regression Statistics	
Multiple R	0.993490953
R Square	0.987024274
Adjusted R Square	0.985807799
Standard Error	8405664.083
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	3	1.71985E+17	5.73283E+16	811.3811	2.96432E-30
Residual	32	2.26097E+15	7.06552E+13		
Total	35	1.74246E+17			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	237126909.7	41335929.43	5.736581056	2.33E-06	152928377.1	321325442.3
per capita income	-1117.264225	245.5228376	-4.55055112	7.3E-05	-1617.377877	-617.1505722
distance	-21111.56118	3297.325124	-6.40263255	3.4E-07	-27827.99263	-14395.12972
migrant stock	377387.3063	10945.8981	34.47750955	7.05E-27	355091.2416	399683.371

4.6 Results: Export of Edible Vegetables to Central Europe

In this Section, we start with the estimation of the impact of Poland's emigration on export of edible vegetables to host countries in Central Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 7 variables. The analyses detail is described below.

4.6.1 Table 6-1

According to the result described in Table 6-1, the t-ratio absolute value of per capita income variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.6.2

Summary 6-1

Regression Statistics	
Multiple R	0.989026016
R Square	0.978172459
Adjusted R Square	0.970616772
Standard Error	3615571.413
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	1.52313E+16	1.69E+15	129.4617476	2.80975E-19
Residual	26	3.39881E+14	1.31E+13		
Total	35	1.55712E+16			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	213916267.5	276146982	0.774646	0.44553665	-353711977.9	781544512.9
population	0.034773977	0.104658202	0.332262	0.742355101	-0.180354036	0.249901989
PL population	-5.217045218	7.070744587	-0.73784	0.467222136	-19.75116873	9.317078291
per capita income	-118.8680664	1055.850545	-0.11258	0.911227956	-2289.199923	2051.46379
PL per capita income	-1188.508506	5164.61411	-0.23013	0.819795374	-11804.52475	9427.507733
distance	-3426.050889	24372.04081	-0.14057	0.889290697	-53523.49776	46671.39598
migrant stock	2545488.204	292073.6384	8.715227	3.4227E-09	1945122.247	3145854.16
year variable	1628853.636	5286043.344	0.308142	0.760429257	-9236763.966	12494471.24
Relative Price	2396250.587	1542653.258	1.553331	0.132433308	-774718.5675	5567219.741
Relative Income	-4544148.535	20810383.73	-0.21836	0.828853756	-47320504.49	38232207.42

4.6.2 Table 6-2

Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 6-2, the t-ratio absolute value of Relative Income variable is lower than 2 and is the closest to 0 among all the variables. So we drop this variable and sequentially conducted six analyses in the same manner, dropping population, PL per capita income, PL population, year and distance variables. The final result is described in the next Section.

Summary 6-2

Regression Statistics	
Multiple R	0.989020636
R Square	0.978161819
Adjusted R Square	0.971691247
Standard Error	3548849.35
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	8	1.52312E+16	1.9E+15	151.1708391	2.20645E-20
Residual	27	3.40047E+14	1.26E+13		
Total	35	1.55712E+16			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	212157290.7	270616748.9	0.783977	0.439877592	-343102406.7	767416988
population	0.031950219	0.099733108	0.320357	0.751163755	-0.172685213	0.236585651
PL population	-4.997340828	6.670682115	-0.74915	0.460244345	-18.6844498	8.689768145
PL per capita income	-1618.871892	3408.671058	-0.47493	0.638657872	-8612.887109	5375.143324
distance	-4882.793754	20272.27785	-0.24086	0.811482765	-46478.0716	36712.48409
migrant stock	2531657.495	260090.1016	9.733771	2.52504E-10	1997996.694	3065318.297
year variable	2049779.263	3667747.009	0.558866	0.580859267	-5475815.89	9575374.416
Relative Price	2299697.545	1258615.495	1.827164	0.07874919	-282768.1071	4882163.197
Relative Income	-5540726.618	18486227.84	-0.29972	0.766684635	-43471332.61	32389879.37

4.6.3 Table 6-3

According to the result of regression analysis described in Table 6-8, the t-ratio absolute value of every variable is higher than 2. So we finalize this elimination procedure and determine a final model for analyzing Export of Edible Vegetables to Central Europe. The resulting equation (9) takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \text{Ln}[Relative\ Price]_{ijt}$$

$$+ \beta_2 [Migrant\ Stock]_{it} + \varepsilon_{ijkt} \qquad \dots(9)$$

As for migrant stock the t-value is higher than 2, which means it has a significant effect on Poland's export of edible vegetables to the host countries in Central Europe. Moreover, the coefficient is above 0, which indicates the impact of this element is positive.

Summary 6-3

Regression Statistics	
Multiple R	0.987818996
R Square	0.975786369
Adjusted R Square	0.974318876
Standard Error	3380136.226
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	2	1.51942E+16	7.6E+15	664.9343611	2.17264E-27
Residual	33	3.77036E+14	1.14E+13		
Total	35	1.55712E+16			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-7558270.891	2104535.896	-3.59142	0.001055147	-11839981.34	-3276560.438
migrant stock	2583703.201	78714.71202	32.82364	8.92671E-27	2423556.916	2743849.486
Relative Price	2970062.718	562068.4077	5.284166	7.97653E-06	1826525.95	4113599.486

4.7　Results: Export of Electronic Equipment to Western Europe

In this Section, we start with the estimation of the impact of Poland's emigration on export of electronic equipment to host countries in Western Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 4 variables. The analyses detail is described below.

4.7.1　Table 7-1

According to the result described in Table 7-1, the t-ratio absolute value of Relative Income variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.7.2

Summary 7-1

Regression Statistics	
Multiple R	0.98801121
R Square	0.976166151
Adjusted R Square	0.967915972
Standard Error	213949667.1
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	4.87446E+19	5.42E+18	118.3206	8.75463E-19
Residual	26	1.19014E+18	4.58E+16		
Total	35	4.99347E+19			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	17465039476	19381453465	0.901121	0.375796	-22374108294	57304187245
population	-7.781514803	8.4604676	-0.91975	0.366158	-25.17225485	9.609225243
PL population	-375.4182707	451.5012326	-0.83149	0.413269	-1303.492337	552.6557954
per capita income	-60320.89892	42393.74837	-1.42287	0.166662	-147462.4959	26820.69802
PL per capita income	255525.9158	240968.0046	1.060414	0.298708	-239790.9065	750842.7382
distance	-515592.0354	218537.1571	-2.35929	0.026101	-964801.5908	-66382.48002
migrant stock	6470319.533	703944.0467	9.191525	1.19E-09	5023341.836	7917297.23
year variable	-171482093.8	269321460.8	-0.63672	0.529874	-725080279.6	382116091.9
Relative Price	411218560.1	331579017.5	1.240183	0.225984	-270351865	1092788985
Relative Income	-135804081.6	1223556852	-0.11099	0.912476	-2650861185	2379253022

4.7.2 Table 7-2

  Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 7-2, the t-ratio absolute value of year variable is lower than 2 and is the closest to 0 among all the variables. So we drop this variable and sequentially conducted three analyses in the same manner, dropping population and PL population variables. The final result is described in the next Section.

Summary 7-2

Regression Statistics	
Multiple R	0.988005495
R Square	0.976154858
Adjusted R Square	0.969089631
Standard Error	209999987.6
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	8	4.8744E+19	6.09E+18	138.1633	7.18925E-20
Residual	27	1.1907E+18	4.41E+16		
Total	35	4.99347E+19			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	17845040381	18724491001	0.953032	0.349029	-20574441220	56264521983
population	-8.148118735	7.645283791	-1.06577	0.295965	-23.83494514	7.538707675
PL population	-391.0889802	420.9408578	-0.92908	0.361078	-1254.788268	472.6103075
per capita income	-63907.27963	26936.87515	-2.37248	0.025052	-119177.1814	-8637.377816
PL per capita income	267792.682	210175.2069	1.27414	0.213472	-163451.2163	699036.5804
distance	-516852.4682	214212.9825	-2.4128	0.022893	-956381.1978	-77323.73871
migrant stock	6483958.405	680339.8908	9.530469	3.94E-10	5088016.272	7879900.539
year variable	-177544673	258855674.7	-0.68588	0.498635	-708672639.7	353583293.8
Relative Price	428641946.6	286673263.9	1.495228	0.146452	-159562997.7	1016846891

4.7.3 Table 7-3

According to the result of regression analysis described in Table 7-5, the t-ratio absolute value of every variable is higher than 2. So we finalize this elimination procedure and determine a final model for analyzing Export of Electronic Equipment to Western Europe. The resulting equation (10), which is similar to the equation (4), takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \text{Ln}[Per\ Capita\ Income]_{it} +$$

$$\beta_2 \text{Ln}[Pl\ Per\ Capita\ Income]_{jt} + \beta_3 \text{Ln}[Distance]_{ij} +$$

$$\beta_4 [Relative\ Price]_{ijt} + \beta_5 [Migrant\ Stock]_{it} + \varepsilon_{ijkt} \quad \dots(10)$$

As for migrant stock the t-value is higher than 2, which means it has a significant effect on Poland's export of electronic equipment to the host countries in Western Europe. Moreover, the coefficient is above 0, which indicates the impact of this element is positive.

Summary 7-3

Regression Statistics	
Multiple R	0.985825231
R Square	0.971851386
Adjusted R Square	0.967159951
Standard Error	216455724
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	5	4.85291E+19	9.71E+18	207.1544	2.61185E-22
Residual	30	1.40559E+18	4.69E+16		
Total	35	4.99347E+19			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	3963084309	1366210967	2.900785	0.006906	1172909290	6753259327
per capita income	-48323.95005	11288.76994	-4.28071	0.000176	-71378.69388	-25269.20622
PL per capita income	78884.11803	18253.38201	4.321617	0.000157	41605.73885	116162.4972
distance	-462806.4762	136225.8745	-3.39735	0.001937	-741016.8267	-184596.1258
migrant stock	5690810.85	399140.9489	14.25765	6.7E-15	4875656.286	6505965.413
Relative Price	539039095	172836956.3	3.118772	0.003989	186058940.9	892019249.1

4.8 Results: Export of Electronic Equipment to Central Europe

In this Section, we start with the estimation of the impact of Poland's emigration on export of electronic equipment to host countries in Central Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 4 variables. The analyses detail is described below.

4.8.1 Table 8-1

According to the result described in Table 8-1, the t-ratio absolute value of distance variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.8.2

Summary 8-1

Regression Statistics	
Multiple R	0.862713852
R Square	0.74427519
Adjusted R Square	0.655755064
Standard Error	212189107.5
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	3.40706E+18	3.79E+17	8.407977034	9.17607E-06
Residual	26	1.17063E+18	4.5E+16		
Total	35	4.57769E+18			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-10969155112	16206395881	-0.67684	0.504484576	-44281878613	22343568390
population	-5.780634435	6.142135733	-0.94114	0.355293838	-18.40597513	6.844706257
PL population	75.11650182	414.9648318	0.181019	0.857756409	-777.8559176	928.0889212
per capita income	-70936.98587	61965.30484	-1.14479	0.262727414	-198308.4929	56434.52116
PL per capita income	688675.2442	303098.6623	2.272116	0.031586642	65647.02722	1311703.461
distance	-175569.0371	1430335.899	-0.12275	0.903251568	-3115666.556	2764528.482
migrant stock	10644684.28	17141092.68	0.621004	0.540003638	-24589335.98	45878704.54
year variable	-662612857.7	310225049.2	-2.13591	0.042270868	-1300289573	-24936142.72
Relative Price	-107042060.7	90534574.09	-1.18233	0.247773705	-293138541.1	79054419.73
Relative Income	868509191.7	1221310892	0.711129	0.483335992	-1641931277	3378949660

4.8.2 Table 8-2

　Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 8-2, the t-ratio absolute value of PL population variable is lower than 2 and is the closest to 0 among all the variables. So we drop this variable and sequentially conducted three analyses in the same manner, dropping Relative Income and population variables. The final result is described in the next Section.

Summary 8-2

Regression Statistics	
Multiple R	0.862627962
R Square	0.744127
Adjusted R Square	0.668312778
Standard Error	208282929
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	8	3.40638E+18	4.26E+17	9.8151373	2.78905E-06
Residual	27	1.17131E+18	4.34E+16		
Total	35	4.57769E+18			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-10884402145	15893608699	-0.68483	0.499289157	-43495393117	21726588828
population	-5.232082261	4.135992121	-1.26501	0.216676342	-13.71843701	3.254272491
PL population	69.33754479	404.6956617	0.171333	0.86523989	-761.0293543	899.7044439
per capita income	-74975.17571	51544.13005	-1.45458	0.157312673	-180734.9935	30784.64206
PL per capita income	689017.986	297506.3091	2.315978	0.028392447	78585.46901	1299450.503
migrant stock	12637565.2	5395945.154	2.342048	0.026803828	1566000.392	23709130
year variable	-663798651.6	304366450	-2.18092	0.038074536	-1288307015	-39290288.55
Relative Price	-99688589.53	66629565.44	-1.49616	0.146210313	-236401163.6	37023984.57
Relative Income	802443737.5	1076135980	0.745671	0.462308816	-1405604880	3010492355

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4.8.3 Table 8-3

According to the result of regression analysis described in Table 8-5, the t-ratio absolute value of every variable is higher than 2. So we finalize this elimination procedure and determine a final model for analyzing Export of Electronic Equipment to Central Europe. The resulting equation (11) takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \text{Ln}[Per\ Capita\ Income]_{it} +$$

$$\beta_2 \text{Ln}[Pl\ Per\ Capita\ Income]_{jt} + \beta_3 \text{Ln}[Year]_t +$$

$$\beta_4 [Relative\ Price]_{ijt} + \beta_5 [Migrant\ Stock]_{it} + \varepsilon_{ijkt} \quad \dots(11)$$

As for migrant stock the t-value is higher than 2, which means it has a significant effect on Poland's export of electronic equipment to the host countries in Central Europe. Moreover, the coefficient is above 0, which indicates the impact of this element is positive.

Summary 8-3

Regression Statistics	
Multiple R	0.85247517
R Square	0.726713916
Adjusted R Square	0.681166235
Standard Error	204207392.4
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	5	3.32667E+18	6.65E+17	15.9550147	1.11952E-07
Residual	30	1.25102E+18	4.17E+16		
Total	35	4.57769E+18			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	-7464593158	1808704731	-4.12704	0.000269013	-11158460999	-3770725317
per capita income	-65782.21547	10665.40459	-6.16781	8.73056E-07	-87563.87743	-44000.55351
PL per capita income	643930.4154	137287.4331	4.690381	5.57719E-05	363552.073	924308.7577
migrant stock	14867003.17	4807929.176	3.092184	0.004268589	5047901.878	24686104.47
year variable	-621916802.1	150364898	-4.13605	0.00026239	-929002890.7	-314830713.5
Relative Price	-164090665.2	37827184.13	-4.3379	0.000149766	-241344081.2	-86837249.23

4.9 Results: Export of Vehicles to Western Europe

In this Section, we start with the estimation of the impact of Poland's emigration on export of vehicles to host countries in Western Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 5 variables. The analyses detail is described below.

4.9.1 Table 9-1

According to the result described in Table 9-1, the t-ratio absolute value of year variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.9.2

Summary 9-1

Regression Statistics	
Multiple R	0.904799773
R Square	0.818662629
Adjusted R Square	0.755892001
Standard Error	826143040
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	8.01127E+19	8.9E+18	13.0421	1.42297E-07
Residual	26	1.77453E+19	6.8E+17		
Total	35	9.7858E+19			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	63846909419	74839344712	0.85312	0.40138	-89987565296	2.17681E+11
population	46.46818588	32.66916242	1.42239	0.1668	-20.68423855	113.6206103
PL population	-1814.682882	1743.422208	-1.0409	0.30752	-5398.338519	1768.972754
per capita income	-206713.8994	163698.7832	-1.2628	0.21788	-543201.5639	129773.7652
PL per capita income	750963.1934	930471.3701	0.80708	0.42694	-1161648.081	2663574.468
distance	-1086268.195	843857.1266	-1.2873	0.20934	-2820841.344	648304.9538
migrant stock	-2108652.163	2718202.289	-0.7758	0.44489	-7695996.933	3478692.607
Relative Price	1716655173	1280355802	1.34076	0.19159	-915153844.3	4348464190
Relative Income	6927560033	4724629820	1.46627	0.15457	-2784055553	16639175619
year variable	-257782328	1039955114	-0.2479	0.80618	-2395440658	1879876002

4.9.2 Table 9-2

   Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 9-2, the t-ratio absolute value of migrant stock variable is lower than 2 and is the closest to 0 among all the variables. Since the amount of emigrants is the very key element of this paper, we retain migrant stock variable and drop the one that absolute value of t-ratio is the second closest to 0, which is here per capita income variable. Sequentially we conducted four analyses in the same manner, dropping Relative Income, PL population and Relative Price variables. The final result is described in the next Section.

Summary 9-2

Regression Statistics	
Multiple R	0.904562927
R Square	0.81823409
Adjusted R Square	0.764377524
Standard Error	811657117
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	8	8.00708E+19	1E+19	15.19284	3.57398E-08
Residual	27	1.77873E+19	6.59E+17		
Total	35	9.7858E+19			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	76576582096	53484768533	1.431746	0.163692	-33165096890	1.86318E+11
population	45.8169159	31.99236056	1.432121	0.163585	-19.82598504	111.4598168
PL population	-2039.999695	1461.621437	-1.39571	0.174175	-5038.999128	958.9997375
per capita income	-211928.3117	159494.964	-1.32875	0.195053	-539184.9424	115328.319
PL per capita income	530664.7166	270712.7843	1.96025	0.060361	-24792.02909	1086121.462
distance	-1190162.607	719565.2994	-1.654	0.109708	-2666588.63	286263.4165
migrant stock	-2243457.62	2616544.905	-0.85741	0.398764	-7612164.241	3125249.002
Relative Price	1894082918	1042970360	1.816047	0.080484	-245915469.2	4034081305
Relative Income	6690037879	4545317386	1.471853	0.152622	-2636182935	16016258692

4.9.3 Table 9-3

According to the result of regression analysis described in Table 9-6, the t-ratio absolute value of every variable except migrant stock variable is higher than 2. Since the amount of emigrants is the very key element of this paper, we retain migrant stock variable and finalize this elimination procedure to determine a final model for analyzing Export of Vehicles to Western Europe. The resulting equation (12) takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \text{Ln}[Population]_{it} +$$

$$\beta_2 \text{Ln}[Pl\ Per\ Capita\ Income]_{jt} + \beta_3 \text{Ln}[Distance]_{ij} +$$

$$\beta_4 [Migrant\ Stock]_{it} + \varepsilon_{ijkt} \dots (12)$$

As for migrant stock the coefficient is below 0, which indicates a negative impact of this element. Since our purpose here is to detect an "immigrant pull" effect if it existed, not to generalize it to all commodities, we take this migrant stock variable as significant to some extent.

Summary 9-3

Regression Statistics	
Multiple R	0.886857855
R Square	0.786516855
Adjusted R Square	0.758970643
Standard Error	820916933.7
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	4	7.6967E+19	1.92E+19	28.55263	5.3139E-10
Residual	31	2.0891E+19	6.74E+17		
Total	35	9.7858E+19			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	4534489393	2165308704	2.094154	0.044517	118313192.6	8950665593
population	64.34965904	11.96616379	5.377635	7.27E-06	39.94450717	88.7548109
PL per capita income	105198.9786	52069.10939	2.020372	0.052057	-996.6697361	211394.6269
distance	-763675.283	255978.0947	-2.98336	0.005516	-1285746.047	-241604.5189
migrant stock	-2132298.186	2087730.196	-1.02135	0.314995	-6390251.976	2125655.604

4.10 Results: Export of Vehicles to Central Europe

In this Section, we start with the estimation of the impact of Poland's emigration on export of vehicles to host countries in Central Europe, using the equation (3) described in Section 2, which includes migrant stock as a key independent variable. Applying backward elimination method, we finally dropped 3 variables. The analyses detail is described below.

4.10.1 Table 10-1

According to the result described in Table 10-1, the t-ratio absolute value of Relative Income variable is lower than 2. So we drop this variable and conduct an analysis with same data in the next Section 4.10.2

Summary 10-1

Regression Statistics	
Multiple R	0.915060884
R Square	0.837336421
Adjusted R Square	0.781029797
Standard Error	114934814.9
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	9	1.76802E+18	1.96446E+17	14.871011	3.72314E-08
Residual	26	3.4346E+17	1.321E+16		
Total	35	2.11148E+18			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	9387426145	8778391748	1.069378813	0.294727	-8656816341	27431668631
population	-7.193591829	3.326962641	-2.16220998	0.03998464	-14.03226141	-0.35492225
PL population	-162.847384	224.7707561	-0.72450432	0.47522593	-624.8702855	299.1755175
per capita income	38101.53073	33564.2622	1.135181536	0.26665619	-30890.79764	107093.8591
PL per capita income	-296172.9385	164177.0826	-1.80398466	0.08283272	-633643.7617	41297.88469
distance	532045.0951	774758.8634	0.68672347	0.4983366	-1060494.541	2124584.731
migrant stock	28009624.84	9284681.653	3.01675662	0.00565061	8924688.564	47094561.12
year variable	324546128.8	168037176.9	1.931394794	0.06440389	-20859231.8	669951489.3
Relative Price	125502122.3	49039154.91	2.559222779	0.01665599	24700696.73	226303547.9
Relative Income	-108543352.6	661537922.4	-0.16407729	0.87093916	-1468354014	1251267308

4.10.2 Table 10-2

Hereafter, we eliminate the variables one by one on the basis of backward elimination method. If any variable shows t-ratio that the absolute value is lower than 2, we drop that variable. In case more than one variables show lower absolute value of t-ratio, we drop the one which has closer value to 0. According to the result of regression analysis described in Table 10-2, the t-ratio absolute value of PL population variable is lower than 2 and is the closest to 0 among all the variables. So we drop this variable and sequentially conducted two analyses in the same manner, dropping distance variable. The final result is described in the next Section.

Summary 10-2

Regression Statistics	
Multiple R	0.914968848
R Square	0.837167993
Adjusted R Square	0.788921472
Standard Error	112844687.6
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	8	1.76766E+18	2.20958E+17	17.35188	8.62021E-09
Residual	27	3.43816E+17	1.27339E+16		
Total	35	2.11148E+18			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	9521111332	8581549568	1.10948626	0.277005	-8086773748	27128996413
population	-7.595673241	2.209286226	-3.438066627	0.001915	-12.12875409	-3.062592395
PL population	-171.2370434	214.8971733	-0.79683246	0.4325	-612.1696165	269.6955298
per capita income	35758.95259	29823.88501	1.199003838	0.240944	-25434.60409	96952.50927
PL per capita income	-278975.6713	124068.7542	-2.248557044	0.032905	-533543.7245	-24407.61814
distance	476023.7739	682820.266	0.697143594	0.491673	-925007.669	1877055.217
migrant stock	27201080	7725940.453	3.520746783	0.001549	11348759.79	43053400.2
year variable	308815810.3	135494584.1	2.279174569	0.030781	30803891.05	586827729.6
Relative Price	126644858.7	47659318.46	2.657294791	0.013068	28856015.81	224433701.6

4.10.3 Table 10-3

According to the result of regression analysis described in Table 10-4, the t-ratio absolute value of every variable is higher than 2. So we finalize this elimination procedure and determine a final model for analyzing Export of Vehicles to Central Europe. The resulting equation (13) takes the following form:

$$\text{Ln}[Exports]_{ijkt} = \alpha + \beta_1 \text{Ln}[Per\ Capita\ Income]_{it} +$$

$$\beta_2 \text{Ln}[Pl\ Per\ Capita\ Income]_{jt} + \beta_3 \text{Ln}[Population]_{it} + \beta_4 [Relative\ Price]_{ijt}$$

$$+ \beta_5 \text{Ln}[Population]_{it} + \beta_6 [Migrant\ Stock]_{it} + \varepsilon_{ijkt} \qquad \dots (13)$$

As for migrant stock the t-value is higher than 2, which means it has a significant effect to Poland's export of vehicles to the host countries in Central Europe. Moreover, the coefficient is above 0, which indicates a positive impact of this element.

Summary 10-3

Regression Statistics	
Multiple R	0.911986972
R Square	0.831720237
Adjusted R Square	0.796903735
Standard Error	110690426
Observations	36

ANOVA

	DF	SS	MS	F	Significance F
Regression	6	1.75616E+18	2.93E+17	23.8886785	5.43914E-10
Residual	29	3.55319E+17	1.23E+16		
Total	35	2.11148E+18			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
intercept	3510605367	1310128566	2.679588	0.012021725	831091628.4	6190119105
population	-8.577224561	1.619710758	-5.29553	1.11574E-05	-11.88990496	-5.264544158
per capita income	53889.72593	13655.65689	3.94633	0.000462742	25960.77209	81818.67977
PL per capita income	-290868.5925	103970.6623	-2.7976	0.00905089	-503512.4697	-78224.71537
migrant stock	22232322.82	2633203.203	8.443071	2.64486E-09	16846817.65	27617827.98
year variable	310188200.7	110777736.2	2.800095	0.008996294	83622294.28	536754107
Relative Price	97798146.19	26947603.42	3.629196	0.001083606	42684109.73	152912182.6

4.11 Summary and discussion of overall results

【Summary 11】

impact of migration by commodities and regions	Western Europe				Central Europe			
	Grains and fruits	Edible vegetables	Electronic equipments	Vehicles	Grains and fruits	Edible vegetables	Electronic equipments	Vehicles
Positive	✓	✓	✓		✓	✓	✓	✓
Negative				✓				

【Summary 12】

○・・・POSITIVE / X・・・NEGATIVE	OVERALL		GRAINS		VEGETABLES		ELECTRONICS		VEHICLES	
	WESTERN	CENTRAL	WESTERN	CENTRAL	WESTERN	CENTRAL	WESTERN	CENTRAL	WESTERN	CENTRAL
per capita inicome	X				X		X	X		○
PL per capita income	○	○					○	○	○	X
population		X							○	X
PL population										
distance	X				X		X		X	
Relative Income						○				
Relative Price	○						○	X		○
Migrant Stock	○	○	○	○	○	○	○	○	X	○
Year				○				X		○

In order to examine the effect of migration on export trade, we conducted 2 regression analyses by region, Western Europe and Central Europe, for each of the 4 commodity groups. The results show a statistically strong, positive and robust link between migration and increased trade flows, as discussed in previous studies, mostly consistent with the theoretical prediction. We may assume that it derives the effect from the ability of emigrants from Poland to improve the flow of information between Poland and the host countries. However, a negative effect was seen in result of Vehicle export to Western European countries.

W assume that there are two reasons why a negative correlation is observed between migrant stock and Poland's vehicle export; high percentage of Poland's export of automotive related products bound for Western Europe, and inflation of wages in Poland. Since 1990s, the industrial structure of Central Europe had changed drastically due to the FDI bound from European and US developed countries. The predominant foreign enterprises constructed manufacturing base, and it transformed Central Europe to a huge production base of vehicle, which has been developed as a leading

manufacturing base playing a role as a part of division of labor of major automakers in the world.

According to World Investment Report of Poland (JETRO), in 2008 the percentage of vehicle export reached 39.8% of overall export, which noted large increases of export amount, expanding by 22.6% compared to previous year. Of overall export, 78.9% was bound for the EU countries and 26.1% was bound for Germany, which is the biggest part of overall export. Most of the manufactured automotive in Poland is for export market, which noted 98% in 2009.[24] In 2014, in turn, the percentage of vehicle export reached 37.5% of overall export, with high export rate, which noted large decreases of product amount declining by 11.5 %. Of overall export, 74.6% was bound for the EU countries.

As for wages in Poland, the average annual wages was 30,690 PLN in 2005, while it noted 43,557 PLN in 2014, which noted about 40% increases compared to 2005. By the factors described above, Poland has been losing attraction to automakers. Moreover, the immigrants, who had been flowing to the countries in Western Europe for better wages or job, played a role to reduce the production cost in the host countries. This also made an incentive to set a manufacturing base in Western European countries. We can say that it is one of the proof of Poland's loss of attractiveness that the manufacturing base of "Panda", which is famous as one of the FIAT Products, was transferred from Poland to Italy in 2014, which is one of the reasons why Poland's product amount of automotive declined in 2014. We assume, for the reasons above, that migration had a negative impact to Poland's vehicle export.

According to Assaf Razin and Efraim Sadka [1992], it is mentioned that when there is difference of productivity between two countries, physical capital has incentives to flow from developed to developing countries while pressures for international migration from developing to developed countries are strong. There had been incentives for physical capital to flow from Western Europe to Poland, while a strong pressure of migration from Poland to Western Europe was seen. If emigrants from Poland continue to outflow to

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[24] Institute of Eurasian Studies

Western Europe, Poland might confront labor shortage in the long run and see the time of diversion of the flow direction of physical capital to other countries, which cause a significant decrease of automotive production amount. As we know the case of FIAT, this outflow of physical capital, particularly automotive manufacturing base, might have already started.

As results for grain and fruit export, described in Summary 12, the amount of export to Western Europe is explained by only migrant stock variables, which has a positive influence to the export amount, while grain and fruit export to the countries in Central Europe is explained also by year variables in addition to migrant stock variables. Year variable serves as a catch-all trend variable and is intended to control for unobserved effects. We assume it is due to the percentage increase in oil seed exports for the 5-year period ending in 2013 was shown. It is mentioned as one of the Fastest-Growing Polish Export Products, which noted 131.2% up in 5 years ($550,563,000).[25] In addition, as a factor for this, we can consider the elimination of EU tariffs against grains was announced in 2007, which was associated with the grain production decrease due to unexpected climate change in EU, and was conducted in 2011.

As for vegetables, exports to the countries in Central Europe was explained by migrant stock and Relative Income variables, which have both positive influence to export amount, while exports to the countries in Western Europe was explained by, in addition to migrant stock with positive effect, per capita income (PCI) and distance, which have both negative effect to export amount. It means the higher PCI and the longer the distance between two countries is, the less vegetables are exported to Western European countries. We assume it is because the more population in Poland, the more vegetables is consumed in Poland. Since historically Poland has exported farm products, which include vegetables, it caused a significant decrease in export of vegetables to Western Europe. On the other hand, the export bound for Central Europe was not influenced by the increase of domestic consumption of vegetables because of the less dependence on export trade to Central Europe.

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[25] The World Factbook, Field Listing: Exports, Central Intelligence Agency. Accessed on November 27, 2014

5   Concluding Remarks

  This paper investigates whether Poland's emigrants has a positive effect on export trade to countries after Poland's accession to the EU. We employ a data set of host country pairs and conduct a multiple regression analysis. Our empirical methodology enables us to examine the effect of emigrants to exports by each commodity group. According to our empirical analysis, a relation can be seen between Poland's emigrations and export trades to host countries, following the theoretical prediction and previous studies done by James A. Dunlevy and William K. Hutchinson [1999]. Further on, our results show a statistically strong, positive and robust link between migration and increased trade flows, as discussed in previous studies, mostly consistent with the theoretical prediction, while a negative impact was observed between the number of Poland's emigrants to the countries in Western Europe and the amount of Poland's vehicle export to the same countries. We may assume that it derives the positive effect from the ability of emigrants from Poland to improve the flow of information between Poland and the host countries.

  The relation between migration and trade seems to be peculiar to export of vehicle to Western European countries from Poland. We assume that the negative effect of migration to vehicle exports to Western Europe derives from high percentage of Poland's export of automotive related products bound for Western Europe, and inflation of wages in Poland. Since automotive industry is one of the biggest part of Poland's export-intensive industry and its exportation occupy a large part of Poland's overall export, we cannot overlook the factor which has a negative influence over the export of vehicles. Therefore, we suggest that Poland's government takes some actions, especially employment creation, to control the acceleration of outflow of emigrants who expected to have job and better wages, which was associated with Poland's EU accession.

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