ESTIMATING EXCHANGE RATE ELASTICITIES OF TOP TRADED GOODS OF UKRAINE'S TOP TRADING PARTNERS

by

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Abstract

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In this work, import and export elasticities of exchange rate are estimated by two-digit HS code of Ukraine's top three trading partners of both import and export using data from UN Comtrade. Real exchange rates are calculated using data from the National Bank of Ukraine's archives and CPI data for Ukraine and each respective partner nation. A log-log OLS model with a lag for exchange rate is used to account for the trailing adjustment of trade decisions in response to changes in purchasing power.

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GLOSSARY

HS Harmonized System (international classification of goods)

NEX Nominal exchange rate

OLS Ordinary least squares

REX Real exchange rate

Chapter 1

INTRODUCTION

Ever since the break-up of the Soviet Union, the purchasing power of the Ukrainian Hryvnia has been falling. This is characterized not by a steady linear decline, but rather by jumps caused by international economic and political factors as well as policies set in place by the National Bank of Ukraine. The two most recent UAH devaluations occurred in 2008 and 2014.

Figure 1. The nominal exchange rate of UAH/USD

As a result of the global recession in 2008, the exchange rate dropped from about 4.5 UAH/USD to about 8 UAH/USD, and policy implementations as a result of the 2013 revolution have lowered the exchange rate from around 8.33 to what we have today, around 27 UAH/USD. In 2015, NBU adopted a floating exchange rate regime, as is the case for the majority of developed nations.

Since its independence, Ukraine has been more of an importer than an exporter, posting a trade deficit for most of the past years. In fact, according to the State Statistics Service of Ukraine, there has only been one trade surplus in recent years – a $1.54B surplus in 2015. According to the State Statistics Service of Ukraine, the average trade deficit over the last 20 years has been about half a billion dollars (see Figures 2 and 3).

Figure 2. Imports into Ukraine, value in USD mlns

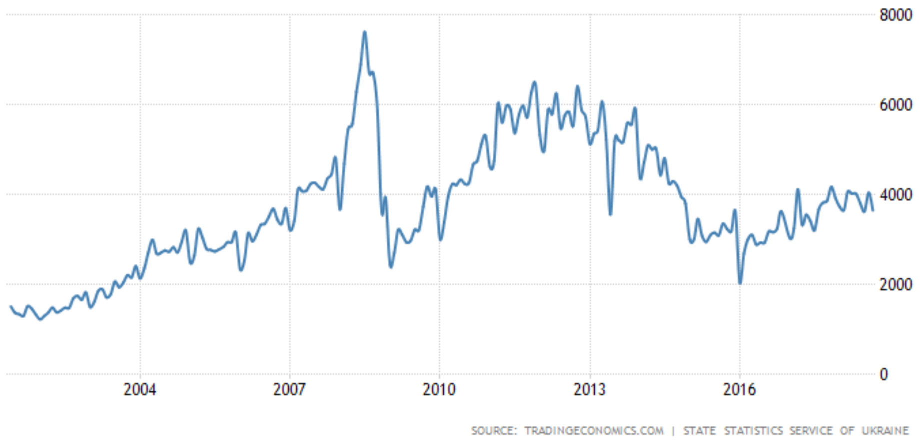

Figure 3. Exports from Ukraine, value in USD mlns

From a theoretical standpoint, the devaluation of a domestic currency stimulates exports while simultaneously making imports more expensive for the nation. Changes in the valuation of currency cause uncertainty and possible profit loss for firms with export contracts as it causes risk-averse agents to decrease foreign activity, thereby decreasing exports. On the contrary, a decrease in value of domestic currency can be considered a precursor for potential profits and could cause an increase in trade as domestic products become cheaper and more appealing to foreign buyers.

Classical open economy models assume that international markets are in perfect competition, meaning that agents will take advantage of different prices in different markets and will equalize the prices of tradable goods. Therefore, differences in exchange rates should be reflected in prices (Faryna 2016).

Exchange rate pass-through is an important concept to consider when analyzing import and export flows in this context. Exchange rate pass-through is the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries (Goldberg and Knetter 1997). In other words, it's the elasticity of import prices in terms of the local currency. A higher pass-through means greater vulnerability of the local economy to external shocks to international prices.

The effects of economic globalization have continued to amplify fluctuations of local currencies, and Ukraine is not excluded. The recent political and economic climate have caused the speed of transmission of exchange rate shocks to domestic prices in Ukraine to be faster than in the countries with historically low inflation (Tseliuk 2002).

It is well known that currency conversion costs and exchange rate uncertainty add to trade costs (Obstfeld and Rogoff 2000). In my research, I would like to examine how the changes of the real exchange rate of the hryvnia relative to other currencies affects both the imports to, and exports from Ukraine and to find a relationship between how a percentage change in the exchange rate affects the percentage change of imports and exports.

I will examine the case of Ukraine's top three trading partners for both import and export, and for each of those partners analyze the top five most traded commodity groups by HS code. Knowing these elasticities would be of importance for the major players in these industries as it would allow them to better predict their sales for upcoming periods after changes in the exchange rate.

The theoretical framework of this paper is based on Goldstein and Kahn (1985), using a two-country economy with imperfect substitutes for imported goods. The completed theoretical model predicts that the depreciation of domestic currency leads to an increase in imports and, consequently, an appreciation of domestic currency leads to an increase in imports.

The data is taken from UN Comtrade for Ukraine as the reporter and The Russian Federation, Poland, Italy, China, and Germany as the partner nations. Data for exchange rates is taken from the archives of the National Bank of Ukraine, and the data for respective CPI, GDP, and population statistics is taken from various sources such as the World Bank database and the St. Louis Fed.

It is found that not all results are in line with theory. Some of the signs of the coefficients of interest in models (2.4) and (2.5) have the opposite sign, however intuitive trends can be seen in some cases which match expected results.

The structure of this work is as follows: first a review of the relevant literature is presented, with both theoretical and empirical papers analyzing the effects of exchange rates on trade. Then a theoretical framework is presented which predicts the effects of exchange rates and GDP of both the importer and exporter on the trade balance, followed by an empirical log-log model. The results with an explanation are presented along with a conclusion.

Chapter 2

LITERATURE REVIEW

As a result of the "Great Recession", global trade has slowed down and has not fully recovered to pre-2008 volumes. In 2010, the first year of analysis for this research, global trade increased by 13%, but the next few years haven't shown as much growth (Constantinescu et al 2015). Trade volumes increased by 6.2% and only 2.8% in 2012, well below the 7.1% average prior to 2008. This so-called global trade slowdown has been linked to changes in world GDP, to the Euro crisis, and to other cyclical factors affecting the global economy.

Whether the cause of changes in policy or exogenous shocks, exchange rates have a very significant effect on international trade (Nicita 2013). It is well established that the exchange rate volatility has negative effects on trade due to the risks and transaction costs involved (Clark 1973). The author claims that the relationship between exchange rate volatility and trade flows could be subject to reverse causality, in which case real exchange rates would help stabilize international trade. Another important relationship between trade and exchange rates has to do with currency misalignment – when a nation has a persistent overall trade surplus or benefit, the former being true for Ukraine. Trade is impacted by currency misalignment by way of relative import prices, if a currency is undervalued the competitiveness of the nation's exports is increased while imports become more restricted.

Both macroeconomic theory and empirical results show that real exchange rate affects trade balance. Effects can differ based on the changes to the exchange rate – a devaluation of domestic currency will lead to a reduction of foreign currency price for domestic goods, hence increasing exports. The opposite is true for an appreciation of domestic currency, which will lead to an increase in foreign prices for domestic goods, decreasing exports. Combining these effects, it is clear that an appreciation of domestic currency leads to a decrease in trade balance, whereas a depreciation leads to an increase in trade balance (Allen 2006).

The effects of currency valuation changes have been studied in the framework of the so-called Marshall-Lerner condition, which states that a depreciation of a nation's currency will cause an improvement in the trade balance, given that demand elasticity of the nation's exports is greater than one (Matesanz, Fugarolas 2009. The authors suggest that the Marshall-Lerner condition is met when the nation has a fixed exchange rate, but not always in the case of a floating exchange rate policy.

Prior to 2015, the National Bank of Ukraine set the exchange rate daily, after selling a limited amount of its USD reserves to commercial banks. This created a large black market for foreign currencies. By 2015, the National Bank shifted its policy to a floating exchange rate, with the goal of properly reflecting the value of the hryvnia on the international market. There are mixed opinions on a floating exchange rate regime (Tenreyro 2007). Those who oppose a floating exchange rate argue that the risks associated with the variability will discourage agents from international trading, while those who support it claim that there are solid financial and policy instruments available to hedge against the variability, and therefore the effects should be negligible. The author used a gravity model augmented by the pseudo-maximum likelihood method to account for measurement error of exchange rate variability to show that fluctuations in the exchange rate do not have negative effects on trade.

In the analysis of the effect of Chinese exchange rate on processed and non-processed exports, Ahmed (2009) used a classical CES utility function as well as standard demand functions. Using quarterly data from 1996:1 to 2009:2 and building AR and ARCH regression models, it was found that a one percentage point increase in the real appreciation of the Chinese Renminbi caused a decrease in non-processed exports by 1.9 percentage points and a 1.5 percentage point decrease in the processed exports in the short-term. These results indicate that the appreciation of the real exchange rate has lagged negative effects on the growth of exports, and that an increase in consumption of foreign markets has positive effects. A percentage point increase in foreign consumption of the domestic goods increased export growth by 5.9 percentage points – according to the author a "strangely large effect" that is also statistically significant.

An analysis of the 1980's U.S. dollar exchange rate shocks by Baldwin and Kruger (1989) led to a development of a partial-equilibrium model in which large exchange rate fluctuations do not influence the market entry and exit decisions once the exchange rate stabilizes. They used a system of recursive equations to show that there is a hysteresis between significant exchange rate shocks and a structural change in the exchange rate-import relationship. They also show that a large capital flow which leads to an initial appreciation can lead to a reduction in the exchange rate.

The theoretical framework of Dornbusch (1986) and Goldstein and Kahn (1985) predicted that the appreciation of local currency is a cause of a decline in the price of imports, which matched the empirical results from an analysis of 87 industries in the United States by Yang (1997). He found that short-run pass through elasticities are positive but less than one, meaning that when domestic currency appreciates, the prices of imported goods become cheaper but not proportionally.

Chapter 3

METHODOLOGY

3.1. Theoretical framework

The theoretical framework is based on the work of Goldstein and Kahn (1985). The key assumption of this imperfect substitutes model is that imports are not perfect substitutes for domestic goods. This assumption is supported by the fact that if imports were a perfect substitute, then we should observe certain goods taking over the market when they are produced at constant or decreasing costs. Furthermore, it has been shown by multiple studies (Kreinen and Officer (1978), Isard (1977b), Kravis and Lipsey (1978)) that the law of one price does not hold across multiple countries, and between domestic prices and import prices of a certain good in one country. Therefore, it's possible to estimate supply and demand elasticities for most internationally traded products. We consider a simple system with two regions, in which the following equations describe the trade with imperfect substitutes the country *i*'s imports from and exports to the outside market, denoted by (‘):

$$I_i^d = f(Y_i, PI_i, P_i) \quad (1.1)$$

$$X_i^d = g(Y'e, PX_i, P'e) \quad (1.2)$$

$$I_i^s = h(PI'(1 + S'), P') \quad (1.3)$$

$$X_i^s = j(PX_i(1 + S_i), P_i) \quad (1.4)$$

$$PI_i = PX'(1 + T_i)e \quad (1.5)$$

$$PI' = PX_i(1 + T')/e \quad (1.6)$$

$$I_i^d = I_i^s e \quad (1.7)$$

$$X_i^d = X_i^s \quad (1.8)$$

These equations determine the quantity of imports demanded in country *i* (I_i^d), the quantity of that country's exports demanded on the international market (X_i^d), the quantity of imports supplied to this country (I_i^s), the quantity of exports supplied from this country to the global market (X_i^s), the price in domestic currency paid by importers in the two regions (PI_i and PI'), and the price in domestic currency received by exporters of in the two regions (PX_i and PX'). Nominal income (Y_i and Y') of the two regions are the exogenous variables, and (P_i and P') are the prices of domestically produced goods. Tariff and subsidy rates (T_i and T') and (S_i and S') respectively are applied to imports and exports in the two regions, and *e* is the exchange rate linking the two currencies.

The model assumes that each agent, in our case each firm, maximizes their utility subject to individual budget constraints. The resulting functions represent quantities of imports demanded as a function of the price of the goods, the price of domestic substitutes, and of the income. So, we have that the demand for exported goods from country *i* in the outside market depends on the level of income in that country and the price level of similar domestic goods within that country. We can also conclude that domestic elasticity of income is greater than zero, because of another key assumption that there are no inferior goods within these markets.

In this model, the income elasticities of both imports and exports are assumed to be positive, own-price elasticities are assumed to be negative and cross-price elasticities of imports and exports are also positive:

$$\frac{\partial I_i^d}{\partial Y_i} > 0,\ \frac{\partial I_i^d}{\partial PI_i} < 0,\ \frac{\partial I_i^d}{\partial P_i} > 0 \tag{1.9}$$

$$\frac{\partial X_i^d}{\partial Y'e} > 0,\ \frac{\partial X_i^d}{\partial PX_i} < 0,\ \frac{\partial X_i^d}{\partial P'e} > 0 \tag{1.10}$$

The additional assumption

$$\frac{\partial I_i^d}{\partial Y_i} + \frac{\partial I_i^d}{\partial PI_i} + \frac{\partial I_i^d}{\partial P_i} = \frac{\partial X_i^d}{\partial Y\prime e} + \frac{\partial X_i^d}{\partial PX_i} + \frac{\partial X_i^d}{\partial P\prime e} = 0 \qquad (1.11)$$

can be made to account for the effect of a consumer "money illusion", so that multiplying all variables by some constant leaves the import and export demands constant. Since the functions are homogeneous of degree zero, we can divide all variables by a constant price level and rewrite (1.1) – (1.6) as:

$$I_i^d = f(Y_r, PI_r) \qquad (1.12)$$

$$X_i^d = g(Y_r', PX_r) \qquad (1.13)$$

$$I_i^s = h(PI_r'(1 + S')) \qquad (1.14)$$

$$X_i^s = j(PX_r'(1 + S_i)) \qquad (1.15)$$

$$PI_r = PX_r'(1 + T_i)e \qquad (1.16)$$

$$PI_r' = PX_r(1 + T')/e \qquad (1.17)$$

Where $Y_r = \frac{Y_i}{P_i}$, $PI_r = \frac{PI_i}{P_i}$, $Y_r' = \frac{Y\prime e}{P\prime e}$, $PX_r = \frac{PI_i}{P\prime e}$, and the index *r* denotes real price levels. We can now define the exchange rate as

$$PI_r = \frac{P\prime e}{P_i} * \frac{PX'}{P'} = REX * pX' \qquad (1.18)$$

Where pX' is export price in the foreign currency and REX is the real exchange rate. In this context the exchange rate is defined as units of foreign currency per unit of domestic currency.

To complete the model, we must introduce the auxiliary functions of the supply of import and export:

$$I_i^s = f(PI', P') \tag{1.19}$$

$$X_i^s = g(PX', P) \tag{1.20}$$

Where I_i^s and X_i^s are the supply of import and export of country *i* in foreign currency, with PI' denoting the foreign price deflator of export. In this case, the equilibrium conditions of the import and export markets are:

$$I_i^s e = I_i^d = I \tag{1.21}$$

$$X_i^s = X_i^d = X \tag{1.22}$$

The trade balance can then be defined as:

$$TB = X * PX_i - I * REX * pX' \tag{1.23}$$

Or the difference between total export volume multiplied by export prices and total import volume multiplied by adjusted import prices. Substituting (1.12) and (1.13) into (1.23) we obtain the equation for real trade balance:

$$TB_r = f(Y_r, Y_r', REX) \tag{1.23}$$

With the following properties:

$$\frac{\partial TB_r}{\partial Y_r} < 0,\ \frac{\partial TB_r}{\partial Y_r'} > 0,\ \frac{\partial TB_r}{\partial REX} < 0 \tag{1.24}$$

We obtain the intuitive result that trade balance negatively depends on domestic income – as the agents of the domestic economy earn more, they are likely to purchase more foreign goods, thus lowering the trade balance. However, foreign income has a positive income on the trade balance for the same reason, as foreign agents earn more they are more likely to import more goods. And finally, the trade balance is negatively influenced by an increased real exchange rate – as domestic currency appreciates, exports decrease and imports increase.

3.2. Empirical framework

The empirical model is based on the work of Li at al. (2012), who connected exchange rate changes with trade flows in the following OLS model:

$$\ln(X_{pct}) = \alpha_0 + \alpha_1 \ln(REX_{ct}) + \alpha_2 M_{ct} + \alpha_3 \lambda_t + \mu_{pc} + \varepsilon_{pct} \quad (2.1)$$

$$\ln(I_{pct}) = \beta_0 + \beta_1 \ln(REX_{ct}) + \beta_2 M_{ct} + \beta_3 \lambda_t + \mu_{pc} + \varepsilon_{pct} \quad (2.2)$$

Where the indexes *p*, *c,* and *t* represent products by HS code, partner country, and time respectively. Here X_{pct} are exports from Ukraine and I_{pct} imports into Ukraine, and M_{ct} are macroeconomic variables. The most important explanatory variable in this model is REX_{ct}, the real exchange rate of the Ukrainian hryvnia relative to the currency of the destination country of exports or the origin country of imports – an increase in REX_{ct} means a depreciation of the hryvnia against the foreign currency, the formula for which is given by:

$$REX_{ct} = \frac{NEX_{ct} * CPI_{foreign,t}}{CPI_{UA,t}} \quad (2.3)$$

Where the nominal exchange rate NEX_{ct} is defined as UAH per unit of foreign currency. Note that this is the inverse of the definition given in the theoretical portion in (1.18). The notation used in the theoretical part is the so-called American notation, whereas in the empirical part we use the European notation. This will not influence the result except for the sign, because in the case of American notation an increase in the variable REX means an appreciation of domestic currency, and in the European notation an increase in REX means a depreciation of domestic currency against a foreign one.

The log-log specification of the model will yield results in the same fashion as Ahmed (2005), with a certain percentage point change in price and quantity of exports relative to a percentage point change in the exchange rate.

The variable M_{ct} is the used to control for market-specific factors, such as the GDP of a corresponding country to control for the size effect and GDP per capita to control for the income effect. The variable μ_{fpc} is used to control for trade shocks such as tariffs or quotas, and λ_t is the year dummy which will control for yearly fixed effects like business cycles or the introduction of new technologies.

Taking the lags of the exchange rate to account for the fact that imports and exports in period t are dependent on the exchange rate in period $t-1$ and writing out the macroeconomic factors – the change in the trading partner's GDP as well as Ukraine's GDP and adding the populations of Ukraine and the respective trade partner to account for the size effect, we can rewrite equations (2.1) and (2.2). Note that in this model the year 2010 is used as the base, meaning coefficients are estimated for years 2011-2018:

$$\ln\left(X_{pct}\right) = \alpha_0 + \alpha_1 \ln(REX_{t-1}) + \alpha_2 \ln(ParGDP_t) + \alpha_3 \ln(UAGDP_t) + \alpha_4 PARPOP_t + \alpha_5 UAPOP_t + \alpha_6 \lambda_t + \mu_{pct} + \varepsilon_{pct} \quad (2.4)$$

$$\ln\left(I_{pct}\right) = \beta_0 + \beta_1 \ln(REX_{t-1}) + \beta_2 \ln(ParGDP_t) + \beta_3 \ln(UAGDP_t) + \beta_4 PARPOP_t + \beta_5 UAPOP_t + \beta_6 \lambda_t + \mu_{pct} + \varepsilon_{pct} \quad (2.5)$$

Consequently, α_1 and β_1 are the most important coefficients which are to be estimated. They are, respectively, the export and import elasticities of exchange rate. The coefficient α_1 is expected to be positive, which is intuitive because as the hryvnia depreciates – more UAH is needed per unit of foreign currency, meaning an increase in REX – export volumes will increase. The coefficient β_1 is expected to be negative, as the depreciation of the UAH should lead to a decrease in imported goods. It also expected, based on (1.24), that α_2 and β_3 will be positive, because as a partner nation's income increases they are able to import more goods, and as Ukraine's income increases they are able to import more goods.

Four tests are performed in the postestimation of this model. The Breusch–Godfrey test for serial correlation, the Shapiro –Wilk test for normality of residuals, the Breusch–Pagan test for heteroskedasticity, and Ramsey RESET test for omitted variables. The results of these tests along with the null hypothesis of each one can be found in Appendixes A through F.

Chapter 4

DATA DESCRIPTION

The key data for this research is monthly import and export flow data given by HS code and partner nation, taken from the UN Comtrade website. Monthly values are given in USD of that period, which have been deflated to 2010 USD, which is used as the base year for all value deflations. Nominal exchange rate information is taken from the official NBU archives and converted to real exchange rates according to formula (2.3). The NBU exchange rate data is daily, the data for this model was obtained by averaging the values by month (see Figure 4).

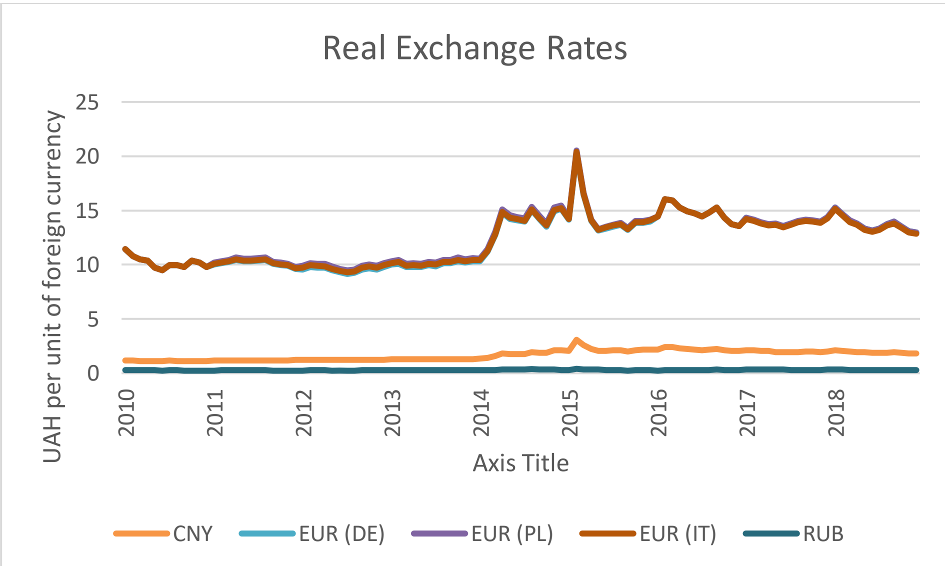

Figure 4. Real exchange rates

Despite having different levels of CPI, the currencies of the three European nations are almost identical in terms of UAH/EUR. Their lowest value relative to the hryvnia was in mid-2012 and highest in early 2015, with an increase of about 120% for all three. The Chinese Renminbi showed the biggest change compared to the hryvnia, with a 176% difference between its lowest point in mid-2010 and its highest in early 2015. The real exchange rate of the Russian Ruble against the hryvnia showed the smallest amount of change in the provided time period, with a difference of 56% between the lowest point in late 2011 and highest in mid-2014.

Data for GDP and CPI is taken from either the NBU website or official statistics sources of corresponding nations, as well as the World Bank website and the St. Louis Fed. Since some data is only provided quarterly, a linear interpolation was done to obtain monthly values used in the regressions.

Each benchmark regression uses 90-96 observations which range from January 2010 to September 2018. There are a few instances of missing monthly data, but it's a rare occurrence and shouldn't affect the overall picture. For 2015 only two months of data are available – January and February. Ukraine did not report its imports and exports for the rest of the year.

This research considers the top three trading partners of Ukraine for imports and exports, selected by total trade value of traded goods. They are Russia, China, and Germany for imports and Russia, Poland, and Italy for exports. The Russian Federation remains Ukraine's top trading partner despite the recent conflicts. The top traded goods by HS code for each country are as follows:

The top exports To the Russian Federation are once again HS72 with overall trade value of $12.02B over the 8 year period; HS84 in a close second with an overall value of exported goods at $11.84B; HS86 - Railway, tramway locomotives, rolling-stock and parts thereof, railway or tramway track fixtures and fittings and parts thereof, mechanical (including electro-mechanical) traffic signaling equipment of all kinds with total exports to Russia valued at $10.48B; HS73 - Iron or steel articles with $5.55B; and HS27 with $5.42B worth of exported goods to Russia between 2010 and 2018.

The top exported goods to Poland include HS72 with total exports over the 8-year period valued at $3.99B; HS26 - Ores, slag and ash with exports totaling $2.47B; HS85 with $2.11B in exports; HS44 - Wood and articles of wood, wood charcoal with $1.3B in exported goods; and HS12 - Oil seeds and oleaginous fruits, miscellaneous grains, seeds and fruit, industrial or medicinal plants, straw and fodder, with exports totaling $838M.

The top exported goods to Italy are HS72, which is the clear leader among exports to Italy with a total value of $9.73B over the 8-year period; HS10 – Cereals with $1.66B in exports; HS15 - Animal or vegetable fats and oils and their cleavage products, prepared animal fats; animal or vegetable waxes with $1.13B; HS12 with $867M; and HS44 with $458M in exports from 2010 to 2018.

For Russia, the top imports are once again HS27 - Mineral fuels, mineral oils and products of their distillation, bituminous substances, mineral waxes; HS39 - Plastics and articles thereof; HS84 - Nuclear reactors, boilers, machinery and mechanical appliances, parts thereof; HS31 - Fertilizers; HS72 - Iron and steel. HS27 is clearly the most traded good of any country over the whole time period, with a maximum traded value of $2.12B imported by Ukraine in September of 2013, and a minimum of $91.45M imported in January of 2016. The second largest good imported from Russia by volume is HS84, followed by HS72, HS31 and HS39, with a total trade value of $7.53B, $5.39B, $4.01B, and $2.77B respectively over the given time period.

Top imports from China include HS85 - Electrical machinery and equipment and parts thereof, sound recorders and reproducers, television image and sound recorders and reproducers, parts and accessories of such articles, which is the top imported good from China with a total value of $10.9B for the time period for which data was used; HS84 with a total imported value of $6.49B; HS39 with $2.68B of imported value; HS64 – Footwear, gaiters and the like, parts of such articles with $2.19B of imports; and HS72 with a total imported value of $1.76B (see Figure 10).

And finally, the most imported German goods are HS84 with the value of imports over the given time period totaling $7.99B; HS87 - Vehicles other than railway or tramway rolling stock, and parts and accessories thereof with total imports of $5.67B; HS27 with $4.07B; HS85 with $3.71B; and HS30 - Pharmaceutical products valuing at $3.32B over the 8-year time period.

It is clear to see how intertwined the economies are, especially between Russia and Ukraine. The most traded good is HS72 (Iron and Steel), which is both imported and exported to and from every nation in the sample except Germany, followed by HS84 (Nuclear reactors and related machinery), which Ukraine imports from all three partners but exports only to Russia. By total value, HS27 is the most imported good with $85.17B, while HS72 is the most exported, with a total value of $25.74B over the 8-year time period.

C h a p t e r 5

RESULTS

So far, the hypotheses stated in the Methodology have been confirmed. The estimate of α_1 of the top exporting good by HS72 (Steel and Iron) to Ukraine's top exporting trade partner, Russia, is 1.142 in the augmented log-log model (2.4). Meaning a percentage point decrease in the value of the UAH against the RUB has led to a 1.142 percentage point increase in Russia's purchases of Ukrainian steel for the years available in the data. The hypothesis is also confirmed for exports of the second and third most exported Ukrainian goods to Russia – HS84 (Nuclear reactors and related machinery) with an elasticity of 0.189, although not significant, as well as HS86 (Railway related goods) with an elasticity of 1.532, also significant at the 1% level.

As far as macroeconomic factors are concerned, the change in Russia's GDP is significant in all five regressions, however, Ukraine's GDP is not. This is a reasonable outcome since these are exports, in which case the partner nation's income is a much better indicator of their ability to purchase outside goods. Another interesting result is the sign and magnitude of the year dummies in the regressions – for HS72 and HS86 they are all positive and increasing with time, meaning that Russia has been purchasing more of these goods as time went on. However, HS27, HS73, and HS84 are all negative and decreasing with time, meaning the opposite is true. In the case of HS72 and HS73, which means that Russia has been importing more raw Ukrainian Iron and Steel, such as blocks and wire, but has been importing less raw metal products, such as pipes, containers, and general iron structures (see Table 1).

Table 1. Exports to Russia

VARIABLES	(1) HS27	(2) HS72	(3) HS73	(4) HS84	(5) HS86
L.logREX	0.0468	1.142***	0.789**	0.189	1.532***
	(0.847)	(0.333)	(0.382)	(0.387)	(0.482)
logParGDP	4.522**	1.515*	3.451***	3.020***	3.883***
	(2.201)	(0.866)	(0.992)	(1.007)	(1.253)
logUAGDP	-0.987	0.912	-0.673	-1.377	0.455
	(1.991)	(0.783)	(0.897)	(0.910)	(1.133)
PARPOP	1.13e-05**	0.000	0.000	0.000	0.000
	(5.04e-06)	(1.99e-06)	(2.27e-06)	(2.31e-06)	(2.87e-06)
UAPOP	4.13e-06*	0.000	0.000	0.000	0.000
	(2.46e-06)	(9.68e-07)	(1.11e-06)	(1.12e-06)	(1.40e-06)
2011.Year	-0.262	0.0953	-0.244	-0.497	0.201
	(0.736)	(0.290)	(0.332)	(0.337)	(0.419)
2012.Year	-2.641*	0.0365	-0.734	-0.899	0.198
	(1.338)	(0.526)	(0.603)	(0.612)	(0.761)
2013.Year	-6.546**	0.656	-1.166	-1.588	0.703
	(2.771)	(1.090)	(1.249)	(1.267)	(1.577)
2014.Year	-10.43**	1.511	-1.231	-2.516	1.450
	(4.822)	(1.897)	(2.173)	(2.205)	(2.744)
2015.Year	-30.02	4.820	-3.663	-10.32	10.65
	(19.28)	(7.586)	(8.687)	(8.816)	(10.97)
2016.Year	-31.37	5.340	-3.840	-10.76	10.83
	(20.35)	(8.007)	(9.169)	(9.305)	(11.58)
2017.Year	-34.48	5.778	-4.369	-11.78	11.68
	(22.33)	(8.787)	(10.06)	(10.21)	(12.71)
2018.Year	-35.49	5.727	-4.637	-12.39	11.82
	(23.00)	(9.049)	(10.36)	(10.52)	(13.09)
Constant	-1,883**	327.2	-93.97	-205.3	209.0
	(727.5)	(286.3)	(327.8)	(332.7)	(414.0)
Observations	94	94	94	94	94
R-squared	0.911	0.914	0.937	0.895	0.969

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Estimations of α_1 for Poland are in line with the hypothesis for again three of the five goods, however, the top traded good HS72 (Steel and iron) has a negative elasticity of -0.071, meaning that Italy has been importing less Ukrainian steel as the UAH has been depreciating against the EUR. The second and third most traded goods, HS26 (Ores, slag and ash) and HS85 (Electrical machinery and similar parts) have an estimated elasticity of 1.830 and 0.136 respectively, which matches the hypothesis. As noted in the description of results for Italy, the estimated elasticity of HS12 also has a negative sign for Poland, although not as large in magnitude. However, contrary to Italy, the estimated coefficient of interest of HS44 (Wood and charcoal) is positive, however not very large in magnitude and not very significant.

As before, the coefficients of the change in Poland's GDP has a positive effect on exports which is also in four out of the five cases statistically significant and surprisingly large in magnitude, 41.01 for HS12 (Fruits, grains, and plants) and 37.33 for HS26 (Oil seeds, plants, etc). Another interesting result is the estimated coefficients of the year dummies, which are negative for four out of the five regressions and for the most part seem to be decreasing with time. The only positive increasing trend of year dummy coefficients is for HS85, despite its elasticity not being very large in magnitude (see Table 2).

Table 2. Exports to Poland

VARIABLES	(1) HS12	(2) HS26	(3) HS44	(4) HS72	(5) HS85
L.logREX	-1.172	1.830	0.334	-0.0710	0.136
	(1.522)	(3.951)	(0.283)	(1.257)	(0.423)
logParGDP	41.01***	37.33**	1.157	15.28***	5.746***
	(5.158)	(15.45)	(0.960)	(4.262)	(1.434)
logUAGDP	1.944	-3.443	-0.236	3.255**	0.0710
	(1.727)	(4.483)	(0.321)	(1.427)	(0.480)
PARPOP	-5.16e-06***	0.000	0.000	-3.02e-06**	0.000
	(1.55e-06)	(4.15e-06)	(2.89e-07)	(1.28e-06)	(4.31e-07)
UAPOP	0.000	0.000	0.000	0.000	0.000
	(4.41e-06)	(1.12e-05)	(8.21e-07)	(3.64e-06)	(1.23e-06)
2011.Year	-0.539	2.491	0.180	1.053	0.569**
	(0.903)	(2.321)	(0.168)	(0.746)	(0.251)
2012.Year	-0.646	1.398	-0.0622	0.222	0.435
	(1.541)	(3.938)	(0.287)	(1.273)	(0.428)
2013.Year	-2.530	-0.217	-0.355	0.0951	0.691
	(1.900)	(4.854)	(0.354)	(1.569)	(0.528)
2014.Year	-3.619	-5.107	-0.123	0.524	0.611
	(2.499)	(6.378)	(0.465)	(2.064)	(0.695)
2015.Year	-6.867	-11.23	-1.064	-3.689	2.350
	(13.41)	(34.20)	(2.496)	(11.08)	(3.728)
2016.Year	-8.994	-14.14	-0.932	-4.882	1.890
	(14.20)	(36.22)	(2.643)	(11.73)	(3.947)
2017.Year	-10.89	-15.13	-0.868	-6.232	1.934
	(14.98)	(38.22)	(2.787)	(12.37)	(4.163)
2018.Year	-11.09	-14.73	-0.639	-6.133	2.188
	(15.49)	(39.52)	(2.882)	(12.79)	(4.305)
Constant	-931.7***	-635.6	5.595	-305.5	-151.2**
	(253.3)	(672.2)	(47.14)	(209.2)	(70.41)
Observations	94	89	94	94	94
R-squared	0.601	0.258	0.829	0.599	0.730

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The estimations for Italy are in line with the hypothesis as far as the sign is concerned for the top three exported goods, with α_1 being 0.696 for HS72 (Iron and Steel), 3.345 for HS10 (Cereals), and 7.638 for HS15 (Animal and vegetable fats). An interesting result is obtained for HS12 (Fruits, grains, and plants), for which the estimated elasticity is -7.014. Not only is the sign opposite from the predicted value, but the coefficient is also very large in magnitude and is the only one significant at the 10% level. This could be explained by Italy switching to other sources of fruits such as Poland, despite increasing imports of Ukrainian cereals. Also, as will be presented below, the elasticity of HS12 exported to Poland is also negative and greater than unity.

An interesting result is also obtained for the effects of the changes in Italy's GDP. For four out of the five regressions the coefficient is surprisingly high, with the largest being 39.75 for HS72, which is also significant at the 5% level. Also it's worth noting that the change in Ukraine's GDP is significant at the 5% level for HS72 and has a large negative effect. A similar effect for the year dummies is observed as with the regressions for Russian exports – four out of the five regressions show positive coefficients which are increasing with time. The only negative coefficients are for HS44 (Wood and charcoal), which also has a negative elasticity. What is strange is the very high and increasing estimated coefficients of the year dummies for HS12, despite the large negative estimated elasticity (see Table 3).

Table 3. Exports to Italy

VARIABLES	(1) HS10	(2) HS12	(3) HS15	(4) HS44	(5) HS72
L.logREX	3.345	-7.014*	7.638	-0.173	0.696
	(3.918)	(3.624)	(4.609)	(0.481)	(2.389)
logParGDP	26.44	18.61	-31.26	5.051	39.75**
	(24.46)	(23.83)	(28.46)	(3.161)	(15.55)
logUAGDP	-1.065	-5.484	8.256	-0.150	-7.510**
	(5.220)	(5.021)	(7.471)	(0.666)	(3.302)
PARPOP	0.000	0.000	-9.34e-06**	0.000	-4.79e-06***
	(2.65e-06)	(2.66e-06)	(4.26e-06)	(3.53e-07)	(1.80e-06)
UAPOP	0.000	0.000	0.000	0.000	0.000
	(9.28e-06)	(9.29e-06)	(1.03e-05)	(1.23e-06)	(6.06e-06)
2011.Year	5.867***	4.394**	-0.242	0.163	2.219*
	(1.914)	(1.965)	(2.310)	(0.259)	(1.276)
2012.Year	8.890**	7.615**	2.054	-0.157	3.856
	(3.464)	(3.674)	(4.406)	(0.486)	(2.395)
2013.Year	11.09**	6.963	6.283	-0.231	6.990**
	(4.593)	(5.056)	(6.559)	(0.670)	(3.347)
2014.Year	11.64**	7.551	15.95**	-0.666	5.164
	(5.785)	(6.233)	(7.886)	(0.826)	(4.139)
2015.Year	38.40	31.95	21.37	-5.515	6.436
	(28.07)	(28.54)	(31.98)	(3.787)	(18.67)
2016.Year	37.34	30.32	27.08	-5.923	3.744
	(29.60)	(29.90)	(33.39)	(3.968)	(19.55)
2017.Year	38.68	32.91	27.64	-6.290	3.570
	(31.24)	(31.49)	(35.13)	(4.179)	(20.58)
2018.Year	40.22	34.65	26.42	-6.393	3.707
	(32.93)	(33.18)	(36.96)	(4.403)	(21.68)
Constant	-1,061	-685.2	1,051	-47.57	-674.1
	(789.5)	(765.6)	(904.1)	(101.6)	(500.0)
Observations	90	93	74	94	93
R-squared	0.430	0.338	0.522	0.473	0.251

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results for imports from the Russian Federation are in line with theory for four out of the five cases. The elasticities for all the goods except HS39 (Plastics) are negative, meaning that as the Ukrainian hryvnia depreciates against the Russian ruble, the imports of these goods decline. An interesting result is the estimated positive β_1 for HS39, which is both positive and statistically significant at the 5% level.

The year dummy estimations for three out of the five regressions are negative and decreasing with time, meaning Ukrainians have been importing less and less of those specific goods. This makes sense because of the political conflicts between Ukraine and Russia have led to, among other things, boycotts of Russian imports among Ukrainians. The two goods which have positive year coefficients are HS31 and HS84, which both show an increasing trend, meaning more of those goods have been imported despite the boycotts of Russian made goods. A note should be made of HS39, which despite having a statistically significant elasticity has all negative and decreasing estimated year coefficients, all of which are also statistically significant at the 1% level. Four out of the five regressions show an large jump in the year coefficients from 2014 to 2015, something that is observed in results for other countries but not as strongly as for the regressions using Russian data (see Table 4).

Table 4. Imports from Russia

VARIABLES	(1) HS27	(2) HS31	(3) HS39	(4) HS72	(5) HS84
L.logREX	-0.550	-0.305	0.519*	-0.231	-0.200
	(0.502)	(0.842)	(0.270)	(0.310)	(0.969)
logParGDP	5.351***	-1.238	3.339***	1.265	6.060**
	(1.304)	(2.188)	(0.701)	(0.805)	(2.517)
logUAGDP	-2.427**	1.105	-2.325***	0.0384	-2.688
	(1.179)	(1.979)	(0.634)	(0.729)	(2.276)
PARPOP	0.000	0.000	3.36e-06**	0.000	0.000
	(2.99e-06)	(5.01e-06)	(1.61e-06)	(1.85e-06)	(5.77e-06)
UAPOP	0.000	4.98e-06**	-1.47e-06*	0.000	0.000
	(1.46e-06)	(2.44e-06)	(7.83e-07)	(9.00e-07)	(2.81e-06)
2011.Year	-0.330	1.399*	-0.621***	-0.0241	0.364
	(0.436)	(0.731)	(0.234)	(0.269)	(0.841)
2012.Year	-0.687	2.274*	-1.307***	-0.434	1.320
	(0.793)	(1.330)	(0.426)	(0.490)	(1.530)
2013.Year	-1.410	2.852	-2.448***	-1.431	3.315
	(1.642)	(2.754)	(0.882)	(1.014)	(3.168)
2014.Year	-2.212	3.219	-4.375***	-2.673	6.513
	(2.856)	(4.793)	(1.535)	(1.765)	(5.513)
2015.Year	-4.660	15.61	-17.12***	-8.411	28.89
	(11.42)	(19.16)	(6.137)	(7.055)	(22.04)
2016.Year	-5.112	16.47	-17.66***	-8.458	32.04
	(12.05)	(20.22)	(6.477)	(7.446)	(23.26)
2017.Year	-5.270	17.67	-19.14***	-9.218	34.84
	(13.23)	(22.20)	(7.109)	(8.172)	(25.53)
2018.Year	-5.176	17.71	-19.71***	-9.330	35.97
	(13.62)	(22.86)	(7.321)	(8.416)	(26.29)
Constant	-261.4	-213.0	-426.6*	-424.6	801.8
	(431.0)	(723.1)	(231.6)	(266.2)	(831.8)
Observations	94	94	94	94	94
R-squared	0.916	0.299	0.770	0.933	0.530

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results for Chinese imports are for the most part not in line with predicted results, with only one coefficient having the predicted negative sign instead - HS64 (Footwear), meaning that the demand for Chinese made shoes and footwear has decreased with the devaluation of the hryvnia with an elasticity of -1.874. All the other coefficients have positive signs, meaning that despite the devaluation of the UAH against the CNY, Ukraine has still been importing Chinese goods, plastics having the highest elasticity of 1.149. Unsurprisingly, the estimated coefficients of the change in Ukraine's GDP are almost all positive and greater than unity, except for again HS64. What's interesting is that this is the first country for which population results are significant in almost all cases, with three out of the five even being significant at the 1% level.

The year dummy estimations for Chinese data do not follow clear trends as in the regressions above. They are negative in three out of the five regressions, but neither of those show a clear decreasing trend, meaning that despite having positive elasticities, Ukraine has nevertheless been importing less of these goods in the recent years. As observed before, there is a small jump in the coefficients between 2014 and 2015, although it is not anywhere near as large in magnitude as for the previously estimated nations. Another interesting observation is that the year coefficients for HS72 (Iron and steel) are all negative, something that is also true for imports of Russian goods of the same category. This could be an indicator that Ukraine's metallurgic industry is developing and relying increasingly less on foreign imports of these goods (see Table 5).

Table 5. Imports from China

VARIABLES	(1) HS39	(2) HS64	(3) HS72	(4) HS84	(5) HS85
L.logREX	1.149	-1.874	0.829	0.656	1.082
	(0.822)	(1.703)	(0.878)	(0.779)	(1.155)
logParGDP	-1.242	0.474	-3.823***	0.120	0.502
	(0.973)	(2.017)	(1.039)	(0.922)	(1.367)
logUAGDP	2.492***	-0.784	1.282	1.117	2.061
	(0.938)	(1.943)	(1.001)	(0.888)	(1.317)
PARPOP	1.41e-07***	0.000	2.29e-07***	1.04e-07***	1.31e-07**
	(4.11e-08)	(8.51e-08)	(4.38e-08)	(3.89e-08)	(5.77e-08)
UAPOP	0.000	0.000	0.000	0.000	0.000
	(2.09e-06)	(4.33e-06)	(2.23e-06)	(1.98e-06)	(2.93e-06)
2011.Year	0.252	0.301	-0.412	0.385	0.519
	(0.426)	(0.883)	(0.455)	(0.404)	(0.599)
2012.Year	-0.695	1.267	-1.781**	-0.385	-0.540
	(0.761)	(1.576)	(0.812)	(0.720)	(1.069)
2013.Year	-1.202	1.229	-2.268**	-0.870	-1.480
	(0.977)	(2.023)	(1.042)	(0.925)	(1.372)
2014.Year	-1.686	0.401	-3.893***	-1.616	-2.510
	(1.280)	(2.652)	(1.367)	(1.212)	(1.798)
2015.Year	2.629	2.338	-1.046	-0.0228	-1.463
	(6.143)	(12.73)	(6.558)	(5.817)	(8.630)
2016.Year	1.574	2.069	-2.326	-0.742	-2.554
	(6.447)	(13.36)	(6.882)	(6.105)	(9.057)
2017.Year	0.993	1.911	-2.903	-1.025	-3.176
	(6.789)	(14.07)	(7.248)	(6.429)	(9.537)
2018.Year	0.752	2.262	-3.517	-1.278	-3.646
	(7.153)	(14.82)	(7.636)	(6.773)	(10.05)
Constant	-288.2**	-28.65	-287.1**	-190.8*	-252.1
	(113.9)	(235.9)	(121.5)	(107.8)	(159.9)
Observations	94	94	94	94	94
R-squared	0.563	0.303	0.572	0.687	0.614

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The estimation results for German imports are in line with the hypothesis in four out of the five cases. An interesting result for German imports is the high positive elasticity of HS27 (Mineral oils and Fuel), estimated at 4.099, which is also significant at the 1% level. Despite contradicting expected results, it makes sense in the context of Ukraine's relationship with Russia over the past few years. In late 2015, the Ukrainian government announced that it would stop its purchases from Gazprom due to cheaper sources of natural gas and fuel, Germany being one of them. The other estimates β_1 all have the sign predicted by theory, although their magnitude is less than unity. An interesting result in this case is that all the estimations for the changes in German GDP are significant at the 1% level, while Ukraine's GDP is not significant at all and has alternating signs – one would expect all positive signs for changes in Ukrainian GDP, since it is the importer in this case.

With German results, the estimated year dummy coefficients once again show a decreasing trend in four out of the five cases. The only goods which has been increasingly imported in the last few years is HS30 (Pharmaceutical products), which is reasonable because Germany is one of the leading pharmaceutical manufacturers in the world, and their medical products are considered high quality among the Ukrainian population. As observed in previous estimations, there is a jump in magnitude for year estimations between 2014 and 2015, with the HS30 being the only good to show an increase in this period (see Table 6).

Table 6. Imports from Germany

VARIABLES	(1) HS27	(2) HS30	(3) HS84	(4) HS85	(5) HS87
L.logREX	4.099***	-0.122	-0.670	-0.229	-0.399
	(1.553)	(0.548)	(0.528)	(0.480)	(0.551)
logParGDP	24.48***	13.73***	5.839**	8.575***	7.993***
	(6.642)	(2.346)	(2.254)	(2.047)	(2.351)
logUGDP	1.205	-0.635	-0.560	0.448	0.574
	(1.858)	(0.656)	(0.631)	(0.573)	(0.658)
PARPOP	0.000	-3.56e-07**	-2.91e-07*	0.000	-5.44e-07***
	(4.41e-07)	(1.56e-07)	(1.50e-07)	(1.36e-07)	(1.56e-07)
UAPOP	0.000	0.000	-2.96e-06**	0.000	0.000
	(3.97e-06)	(1.40e-06)	(1.35e-06)	(1.23e-06)	(1.41e-06)
2011.Year	-0.550	-0.217	-0.315	-0.0984	-0.161
	(0.920)	(0.325)	(0.313)	(0.284)	(0.327)
2012.Year	-0.558	0.0585	-0.901*	-0.566	-0.102
	(1.401)	(0.495)	(0.477)	(0.433)	(0.498)
2013.Year	0.0108	-0.237	-1.398**	-0.533	-0.292
	(1.696)	(0.599)	(0.577)	(0.524)	(0.602)
2014.Year	-1.650	-0.960	-2.326***	-1.195*	-0.807
	(2.260)	(0.798)	(0.769)	(0.699)	(0.803)
2015.Year	-4.416	0.845	-10.58**	-4.062	-1.564
	(12.05)	(4.257)	(4.103)	(3.727)	(4.281)
2016.Year	-8.248	1.138	-10.10**	-4.325	-0.559
	(12.70)	(4.486)	(4.324)	(3.928)	(4.512)
2017.Year	-8.447	1.022	-10.55**	-4.707	-0.840
	(13.40)	(4.734)	(4.563)	(4.145)	(4.762)
2018.Year	-9.003	1.148	-11.05**	-4.805	-0.870
	(14.13)	(4.991)	(4.811)	(4.370)	(5.020)
Constant	-723.5**	-380.9***	25.01	-187.0**	-178.5*
	(293.7)	(103.8)	(99.67)	(90.54)	(104.0)
Observations	93	93	94	94	94
R-squared	0.692	0.594	0.650	0.637	0.744

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

C h a p t e r 6

CONCLUSIONS

We have analyzed trade data from 2010 to 2018 for Ukraine's top trading partners and the top traded goods with those partners. The estimation from models (2.4) and (2.5) have shown mixed results relative to the hypothesis (1.24) presented in the theoretical framework, with only a few goods by HS code having the expected sign along with the expected sign and effects of Ukraine's and partner nation's GDP levels. According to this theory, an increase in the partner nation's GDP should lead to an increase in exports from Ukraine, an increase in Ukrainian GDP should lead to an increase in imports, a depreciation of Ukrainian currency against a partner nation's should lead to an increase of Ukrainian exports, and finally an appreciation of Ukrainian currency against a partner's should lead to more imports from the corresponding nation.

An expected result is the negative coefficients of the year dummy variables for most of the regressions, which are negative. Ukraine has been importing less since the 2014 devaluation of its currency and is only now beginning to recover from the shock to its economy. The fact that not all α_1 and β_1 estimates are significant suggests that other factors play a role in the determination of the trade quantities and that different goods could have their own different model specifications.

Further research on this topic could be done using augmented industry specific models which would take into account the specific nuances unique to each industry such as lag structure or additional variables, which could be responsible for some of the unexpected results in this work.

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APPENDIX A

Table 7. Postestimation for exports to Russia

	HS27	HS72	HS73	HS84	HS86
Test for serial correlation H_0: no serial correlation	0.000	0.003	0.016	0.551	0.279
Test for normality of residuals H_0: residuals are normal	0.000	0.000	0.340	0.055	0.103
Heteroskedasticity test H_0: Constant variance	0.021	0.003	0.002	0.215	0.006
Ramsey RESET test for omitted variables H_0: no omitted variables	0.011	0.869	0.087	0.671	0.395

Notes: p-value of test provided

APPENDIX B

Table 8. Postestimation for exports to Poland

	HS12	HS26	HS44	HS72	HS85
Test for serial correlation H_0: no serial correlation	0.002	0.002	0.057	0.000	0.000
Test for normality of residuals H_0: residuals are normal	0.081	0.000	0.000	0.002	0.005
Heteroskedasticity test H_0: Constant variance	0.422	0.000	0.043	0.000	0.000
Ramsey RESET test for omitted variables H_0: no omitted variables	0.097	0.008	0.021	0.000	0.000

Notes: p-value of test provided

APPENDIX C

Table 9. Postestimation for exports to Italy

	HS10	HS12	HS15	HS44	HS72
Test for serial correlation H_0: no serial correlation	0.006	0.000	0.195	0.136	0.064
Test for normality of residuals H_0: residuals are normal	0.000	0.742	0.000	0.006	0.000
Heteroskedasticity test H_0: Constant variance	0.000	0.108	0.000	0.033	0.000
Ramsey RESET test for omitted variables H_0: no omitted variables	0.095	0.619	0.000	0.204	0.000

Notes: p-value of test provided

APPENDIX D

Table 10. Postestimation for imports from Russia

	HS27	HS31	HS39	HS72	HS84
Test for serial correlation H_0: no serial correlation	0.000	0.000	0.557	0.013	0.289
Test for normality of residuals H_0: residuals are normal	0.000	0.000	0.636	0.023	0.000
Heteroskedasticity test H_0: Constant variance	0.373	0.003	0.049	0.019	0.002
Ramsey RESET test for omitted variables H_0: no omitted variables	0.567	0.448	0.086	0.213	0.065

Notes: p-value of test provided

APPENDIX E

Table 11. Postestimation for imports from China

	HS39	HS64	HS72	HS84	HS85
Test for serial correlation H_0: no serial correlation	0.000	0.000	0.000	0.000	0.000
Test for normality of residuals H_0: residuals are normal	0.130	0.011	0.058	0.000	0.000
Heteroskedasticity test H_0: Constant variance	0.027	0.055	0.000	0.000	0.000
Ramsey RESET test for omitted variables H_0: no omitted variables	0.000	0.141	0.046	0.000	0.000

Notes: p-value of test provided

APPENDIX F

Table 12. Postestimation for imports from Germany

	HS27	HS30	HS84	HS85	HS87
Test for serial correlation H_0: no serial correlation	0.000	0.065	0.299	0.064	0.010
Test for normality of residuals H_0: residuals are normal	0.040	0.007	0.189	0.000	0.005
Heteroskedasticity test H_0: Constant variance	0.129	0.512	0.399	0.000	0.331
Ramsey RESET test for omitted variables H_0: no omitted variables	0.170	0.229	0.600	0.094	0.872

Notes: p-value of test provided