

Master Thesis

Gravity model of Agriculture.  
In case of Uzbekistan

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The Graduate School of Hansung University

Major in International Market Analysis

Dept. of International Trade and Economics

Mamadaliev Bekzod



Master Thesis

Advisor Professor Roh Jaewhak

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- 농업의 중력 모델. 우즈베키스탄의 경우 -

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Approved Mamadaliev Bekzod Master Thesis in  
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Judge Chair 조윤교 (Sign)

Judge 이동환 (Sign)

Judge 노재확 (Sign)

# Abstract

## Gravity model of Agriculture. In case of Uzbekistan

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Purpose of my dissertation is analyzing Uzbekistan's bilateral trade relationships on agriculture part, trade flow with Uzbekistan's main 11 trade partner countries (Belarus, China, Germany, Japan Kazakhstan, South Korea, Kyrgyzstan, Russia, Tajikistan, Turkey, Ukraine) using gravity model. In order to get most alternative positive effects on bilateral trade flow in agriculture section of trading, different estimation test are conducted by using gravity model regressions: OLS (ordinary least squares, fixed model, random effect and comparing them by taking another tests fixed&ols and fixed&random. As a final result that fixed model estimation was most effective result among them. That is fact that Uzbek agricultural exports to CIS (commonwealth of independent states) countries are more effective and correlated with size of countries, population or sharing common borders, cultural similarity or common language, less transportation time or cost.

For this purpose, data is collected from 2000 to 2020 in panel data form

(based on secondary data with time series). Main purpose of my dissertation is indicating and estimating market size and trade volume of Uzbekistan in agricultural section with its allies based on collected data. After finalizing results, working on trade suggestions if there is more room for trade growth.

【Keyword】 gravity model of trade, Uzbekistan agriculture exports and imports, free trade agreements

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# I . Introduction

We are living in extremely fast growing and developing technological era where trade has become one of main source of economic growth which exchanging goods and services over borders and filling missing parts of domestic demands and gaining wealth during process. Country's economy grows based on internal and external effects. Trading is one of key factors of economic growth in country economy. Uzbekistan has become one of trading center in central Asia with 4th ranking among central and south east Asia.

It is fact that, agriculture is one of main sectors of Uzbekistan economy. According to statistics roughly 28% of total GDP comes from agriculture sector and also it plays important in total employment with 27% of total labor force in country. Cotton and grain are basically main principal crops of country but it is shifted to higher value vegetables and fruits cultivation since it is becoming more contribute to economy. In 2020, overall contribution of agricultural products reached to almost 9% of overall external earnings. Uzbekistan is in process of improving productivity of agricultural products with adoption of new modern technologies in order improving product quality and balance with world standards. Furthermore, it helps to develop packaging capabilities to improve domestic and external products. In order to upgrade quality and increase agricultural products export Uzbekistan need to focus to involving more foreign investments for modernization of existing agricultural stations. In order to gather more profits from agricultural

products, country need to focus more manufacturing from agricultural raw to ready goods to use. For example, developing and owning more textile companies to process cotton and make fabrics, materials and export. It should be the same for other gricultural products as well.

Government has been focusing more production of wheat and increase channels of poultry and extend animal farmings in last a few years. And also export amount of fresh fruits and vegetables as increased significantly. As fallowing, we can see changes during last three years between 2018 to 2020:

Table 1. Total market size and exchange rate

	2018	2019	2020
Total Local Production	14,086	14,775	15,041
Total Exports	1,319	1,436	1,336
Total Imports	1,259	1,609	1,851
Imports from the US	2.3	1.07	10.4
Total Market Size*	14,026	14,948	15,556
Exchange Rates**	8,069	8,839	10,056

\*Total market size = (total local production + imports) – exports

\*\* Exchange Rates = Uzbek soums per \$1.

Units: \$ millions

Source: The State Statistics committee of Uzbekistan

In addition, Uzbekistan economy has increased significantly in last two decades throughout in every sector of economy and increasing trade volume year by year. Developing manufacture and changing economy from agriculture to producing has made huge improvement in economy and pushed nation GPD to next level from 13.76 billion USD in 2000 to 57.71 billion in 2020. And trading, export and import have become one of key factor of economic growth in country. In the meantime, agriculture goods and products have contributed to GDP growth of Uzbekistan by exporting to other countries, mostly CIS(commonwealth of independent states) neighbor countries.

## II. Literature review

### 2.1 General background and Economic growth

Uzbekistan became on 80th economic increased country in the world ranking in terms of GDP and 81th in terms of export in total and 75<sup>th</sup> in import level. Uzbekistan economy has been developing and increasing since country became independent from Soviet Union in 1991. Uzbekistan is rich with natural resources and highly productive land with world standard agricultural products. At earlier years of independence, economy was focused on more agriculture rather and industry, manufacturing. Country economy changed step by step during years toward industrialized economy and showed significant growth and improvement GDP and life of expectancy. It was beginning of industrial era and improvement quality of manufacturing products and extend its market to globally. But world standard is very high when it comes to quality and it takes time and challenge to enter world markets. That is why, yet, Uzbekistan import percentage are higher than export percentage. Country economy, GDP increases more when import and export are balanced or higher export and import, not one way flow and attract more investors to country. Here is data of export and import amount in 2019 and contribution to GDP in 2020.

Table 2. Uzbekistan's total trade volume

Total Exports (2019)	\$14,929,506,690
Total Imports (2019)	\$21,867,269,545
Trade Balance (2019)	(\$6,937,762,855)
Exports of goods and services (% of GDP) (2020)	26.31%
Imports of goods and services (% of GDP) (2020)	36.73%

During last two decades Uzbekistan economy has increased significantly and expanding its trade channels and making new strategic business with oversea countries in order making new opportunities to increase economy and demonstrating more FDI and increasing export volume.

Figure 1. Uzbekistan's economic status



source: worldbank.org

## 2.2 FTA and its effects to agricultural trade volume

Free trading agreements (FTA) are next level of trading between countries. Free trade agreements are mutual agreements among two or more countries in order to reduce trade barriers and ease them to imports and export products and open borders with more opportunities with smooth flow of goods and services. Under free trade agreements, good and services can be imported or exported across national borders with no government tariffs or quotas, or prohibitions which can be beneficial for all sides.

FTA demonstrate and encourages great trade channels and Foreign Direct Investment (FDI) doors between nations. It creates supportive atmosphere for foreign investments as they help to build new incoming source and creating employment opportunities in host country.

FDI is one of important recourse of developing Uzbek economy and way to liberalization on a global level in every field of economy, agriculture products or manufacture goods and so on. One of main advantages of FTA is they are easier and faster way to conclude.

## **2.3 Free economic zone**

At the same time, Uzbekistan's trading strategies are being expanded and opening lot of opportunities to increase trade volume in every section of economy manufacture products or services or agriculture products. In the purpose, President of Uzbekistan signed and declared whole Navoi region as free economic zone in 2019, May 15. Navoi region is one of largest region of Uzbekistan with 110,800 sq. km area. Navoi region is full of natural resource and rich with raw materials like different kind of metals, gold, basalt, phosphorates, cement raw materials, and so on. Navoi region had become already main mining and energy industry center of Uzbekistan. And now it opened door wide for foreign investors, traders with more unlimited opportunities. In 2008, only one part of Navoi region, Karaman district was opened as free economic zone for whole world until 2019. This strategic economy decision showed economic growth and changed whole area as free economic zone.

Main purpose from this decision is to attract more investors from whole world and make area one of industrial center in Asia and logistic center with high standardized innovative techniques.

In this economic free zone, all tax, customs, visa process are different than other regions and they are under special care and protected by government. Special rules and opportunities as follow for area:

All Economic free zone member is tax free from land, income, property and son taxes and also tax free for small enterprise or micro-firms in area.

And also no costume duties for import products or construction materials for all things which are brought as a purpose of area projects. And list of for those products are approved by Ministry of economy and industry of Uzbekistan

And for those who is investing or bringing business to area, there are special business visas for them and their family members called investment visa. These visas are allowed to stay 3 years of period and possibility to extend their visa without leaving country.

And those special discounts apply under Uzbek law for certain period of time based on amount of investments or project size.

## **2.4 Geographic location and it's effect to trade**

When it comes to trade, geographic location of country and it's surroundings play important role. In international trade, delivering time and cost are important factors. In the case of Uzbekistan, country is

located in central Asia where country is surrounded with 5 border countries which are Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Afghanistan which are mostly main trade partners. As Uzbekistan agricultural fruits and vegetables are famous in Central Asia, and main export allies of Uzbekistan neighbor countries, Uzbekistan's location is suitable for especially agricultural supply.

And as matter of fact, as far Uzbekistan's trade volume and economic relationship gets better, neighbor countries can be bridge for Uzbekistan market to connect with more far countries

Figure 2. Uzbekistan's border countries



source: google map

Geographic features includes deserts, mountains or water, land which are tied to economic outcomes of trade and linked directly movements of trade and also movements of people as well. Based on location of Uzbekistan, we can say it is located in center of Asia which brings benefits to trade easily with Asian countries by delivering goods by land through rails or trucks which are considered profitable way in trade world. But there is more cheaper way with more advantages which is by sea way which is used most in international trade and sea shipping gives advantages of delivering large amount of goods at lower cost.

Uzbekistan's main trade transports are by rails, or air force and truck, in some case for long distance like South Korea or Japan, it can involve different transportation land to sea and land transportation again like a few at the same time which cost more and takes more time to get goods to destination. Not having sea delivering chance in country effects significantly to country economy and reduce volume of trade as ocean or sea are powerful economic resource not only delivering or shipment of goods but natural resources they can offer.

## **2.5 Distribution channels**

Uzbekistan's main trade partners have reached to 52 countries and 5 of them are not in force yet, still ongoing process. Uzbekistan's first strategic framework agreement was signed with Russia in 2004 which opened all doors for trading and took out all trade barriers, tariffs as it includes free trade agreements. And next free trade agreement was signed with

Ukraine in order to remove all trade mutual trade barriers in order to smooth products or services flow.

Trading agreements and tariffs are negotiated between countries under WTO regulations (but Uzbekistan is not member of WTO) based on their interest and capability of what they are capable of offering or receiving.

Uzbekistan currently became 9th member of “Liberal countries union” (MDA, Mustaqil davlatlar hamdo’stligi) in 2011, October 18 and had free trade agreements with all countries which are mostly Soviet Union countries and one of them out of circle and still in process of negotiation, South Korea. Other eight main free trade partners are Russia, Ukraine, Belarus, Kazakhstan, Kyrgyzstan, Armanistan, Moldova, Tajikistan.

Uzbekistan’s largest trade partners are Russia and China in dominant so far. Now South Korea is dominating as a third biggest partner of Uzbekistan.

Main export and import distribution channels of Uzbekistan in 2019 as follow and amount of export and import in USD \$:

Table 3. Top 10 export countries of Uzbekistan

Country	Export USD\$
Russia	\$2,034,723,460
China	\$1,762,654,355
Kazakhstan	\$1,205,703,958
Turkey	\$1,122,701,798
Kyrgyzstan	\$634,433,775
Afghanistan	\$455,262,655
Iran	\$208,512,589
Tajikistan	\$190,180,651
Ukraine	\$113,627,658
Pakistan	\$93,752,68

Top 10 Export Countries

Source [World Bank Open Data | Data](#)

Table 4. Top 10 import countries of Uzbekistan

Country	Import USD\$
China	\$5,052,436,029
Russia	\$3,974,192,820
South Korea	\$2,524,586,334
Kazakhstan	\$1,897,813,583
Turkey	\$1,296,307,847
Germany	\$884,163,793
United States	\$498,020,796
Lithuania	\$441,930,892
Turkmenistan	\$401,272,032
Japan	\$381,283,098

Top 10 Import Countries

Source [World Bank Open Data](#) | [Data](#)

### III. Trade relationships of Uzbekistan's with main countries

#### 3.1 Bilateral trade relationship of Uzbekistan and Russia

It is true to mention that Uzbekistan is one of main exporter country in Central Asia in terms of raw materials, natural resources, and famous for its agricultural products. Country has been always open and interested in for new opportunities and market in Asia and in the world. Since Asian has limited both in measure of area and economic indicators like income of countries or Uzbekistan is in place of need new alternative markets opportunities in close and far marketplaces to extend its trade volume and increase GDP. Comparing of Uzbekistan Market place , Russ has been and remained one of important partner of country from the past till nowadays. we can see bilateral relations of two countries has improved lot in last decades. In 2018, after President Vladimir Putin visited to Uzbekistan country parties had meetings and had paper signed economic deals which was worth to 27 Billion \$ (Eurasianet, 2020) which brings huge distribution to country's industrial development as well as countries trade partners as well as more trade flow between Russia and Uzbekistan. Moreover, Uzbekistan has become an observer state in the Eurasian Economic Union (EAEU), which allows it to participate in open meetings of the union and receive non-confidential documents [Hashimova, 2020]. The EAEU promises both benefits and costs. If the

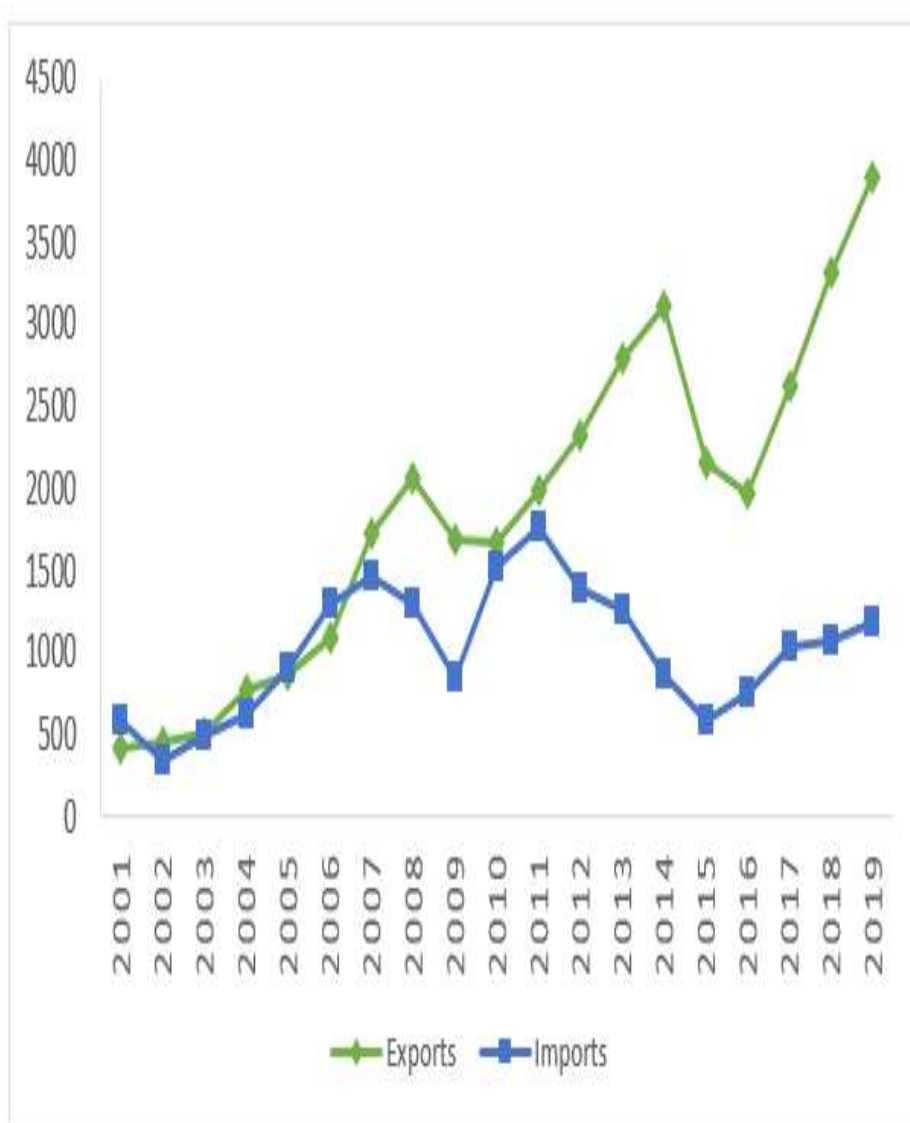
former is associated mainly with better conditions for Uzbekistan's migrants and new export opportunities, the latter is mainly linked to independence of the country's trade policy and intense competition from companies of Russia [Bhutia, 2020] .

To analysis future bilateral trade relationships, we should look back trade volume and mutual trade flow size. According to International trade center (ITC, 2020) trade volume has increased significantly during last 20 years. As trade volume was \$ 1 Billion overall in 2001 this amount reached to more than \$ 5 Billion until 2019 and this volume. It is important to mention that Uzbekistan's export volume exceeded than its imports in 2001. Statistically speaking, Uzbekistan's total supply towards Russia was more than \$584 mln worth of goods and imports from Russia was quite less with \$ 409 mln amount. But this dominance situation did not last more than 2011 and Uzbekistan's export volume decreased according to reasons which Russia created new Custom Union with other neighbor countries like Kazakhstan and Belarus. This economic event effected to Uzbekistan's export towards Russia and it leads Uzbekistan's export flow towards Kazakhstan. We can see this decrease of supply in numbers. For example, total amount of exports of vegetables and fruits in 2010 reached to \$ 139.3 MLN and \$288.6 but after this event it decreased from \$139.3 MLN to \$ 26.2 MLN and from \$ 288.6 MLN to \$ 104.1 MLN in 2012 which was big step down on trading volume of agricultural products and it had countunied to reduce newt a few years. But Uzbekistan increased supply volume of vegetables and fruits towards Kazakhstan which was worth of 42.2 MNL \$ of vegetables and 30.6 MLN \$ worth of fruits.

Russia's exports to and imports from Uzbekistan, million \$, based on this date, we can see Russia's export volume increased continuously during last years and in 2019 it reached to maximum volume of export which was \$4 Billion worth of supply to Uzbekistan. At the same time,

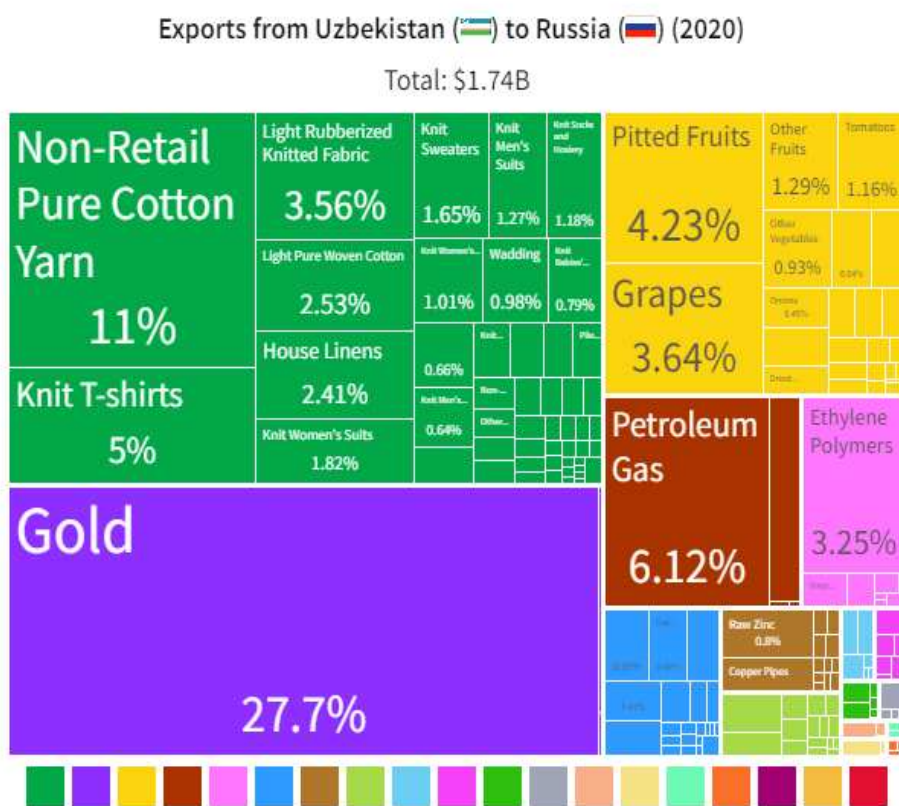
Uzbekistan's export level up and down during 2006 till 2019 but in general slightly increased during those years and it is expected to grow next years.

Figure 3. Russia's trade volume to Uzbekistan



Relationship of Uzbekistan and Russia on trade are performed and conducted on free trade agreements. Based on agreements parties are excluded from paying taxes, custom duties, and other fees for equivalent movement for commodity import or export and so on fees which give both parties equal benefits to trade freely and smooth. based on free trade agreements, there are few detailed articles are made based on different categories of products.

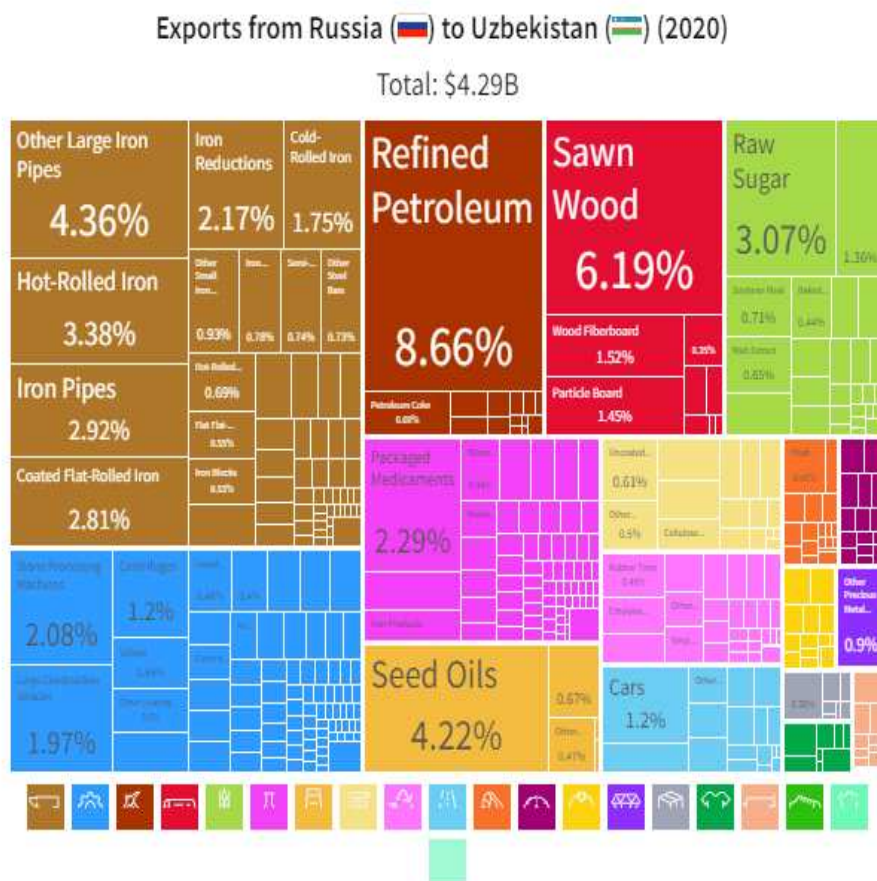
Figure 4. Export volume of Uzbekistan to Russia



[ec.world/en/profile/bilateral-country/rus/partner/uzb](https://ec.world/en/profile/bilateral-country/rus/partner/uzb)

Uzbekistan's main export products to Russia are Gold with worth of 483MLN \$, Non-Retail pure cotton yarn in amount of 191MLN \$ and Petroleum gas worth of 107MLN \$ and other products with total amount of \$ 1.74 Billion worth of products in 2020.

Figure 5. Export volume of Russia to Uzbekistan



[per.world/en/profile/bilateral-country/rus/partner/uzb](https://per.world/en/profile/bilateral-country/rus/partner/uzb)

At the same time during 2020, Uzbekistan's import from Russia reached to overall \$ 4.28 Billion with main import products: Refined petroleum worth of \$371MLN, Sawn wood worth of \$266MLN, other large iron pipes with amount of \$187MLN.

As we see statistics, Uzbekistan export level is way lower than its import level to Russia but in general, comparing trade volume of Uzbekistan in 1996 and in 2020, export volume increased 4.45% from \$613MLN to \$1.74 Billion. At the same time, Russia's export volume increased as well from \$1.08 Billion in 1996 to \$4.29 Billion in 2020 which was increased to 5.93% overall.

Uzbekistan and Russia economic relationships are tied with long term strategic plans and makes way to continuous growth for both parties in different sectors of economy. However, Russia's market place in Uzbekistan significantly increased with manufacturing products rather than Uzbekistan's marketplace in Russia which turned more import to Uzbekistan rather than export size of country.

### **3.2 Uzbekistan and China's economic relationships**

Uzbekistan and China relationships, economic and diplomatic, started right after Uzbekistan's independence from Soviet Union and this relationship had been improved throughout next following years. One of biggest event of trading strategic relationship upgraded and lead to signing "China-Uzbek Treaty Friendship and Cooperation" in 2005 while Uzbekistan first President Islom Karimov and Chinese Leader Hu Jintao's

meeting where it took place in Beijing.

Uzbekistan is China's one of "closest partner" Uzbekistan economist say. China is Uzbekistan's important leading trading partner with massive amount export and import sources for country. And the same time China has been increasing investments toward Uzbekitans at the same time development loans since Uzbekistan is one of main parts of Belt and Road Initiative (BRI) project. Belt and Road Initiative is one of biggest strategic trading channel project by China. Belt and Road Initiative is new upgraded version of One belt one road (OBOR). This project started in 2013 with investing more than 70 countries includes international organizations. It was Chinese masterpiece economic foreign policy project by leader Xi and it serves to connect many countries and makes easier trade flow among countries. According to last statistics, 146 countries got interested in China's project and signed for BRI in 2022 March. China regards Uzbekistan one of important partner in this project.

This project can lead Uzbekistan and China's export and import flow to next level. This project links main Cities of member countries and helps to connect all countries in one trade channel and all members can get mutual benefits during trading operations.

This chain is long-term project and it is expected to connect whole work in terms of trade and supply channel and bring world one step closer. Since China is one of biggest world's supply country, it serves more to China and makes their export products easier and cheaper way to its destinations

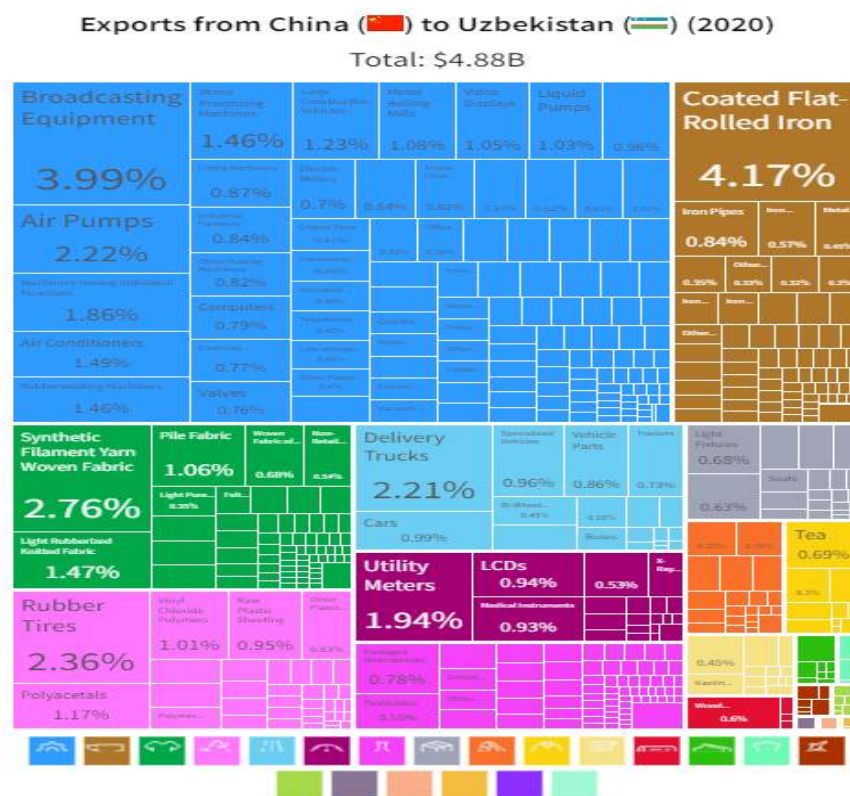
Figure 6. China's Belt and Road Initiative



Lets look at latest numbers of bilateral relations of Uzbekistan and China. According to oec.world information, China export to Uzbekistan reached to \$4.88 Billion worth of goods in 2020. As main import

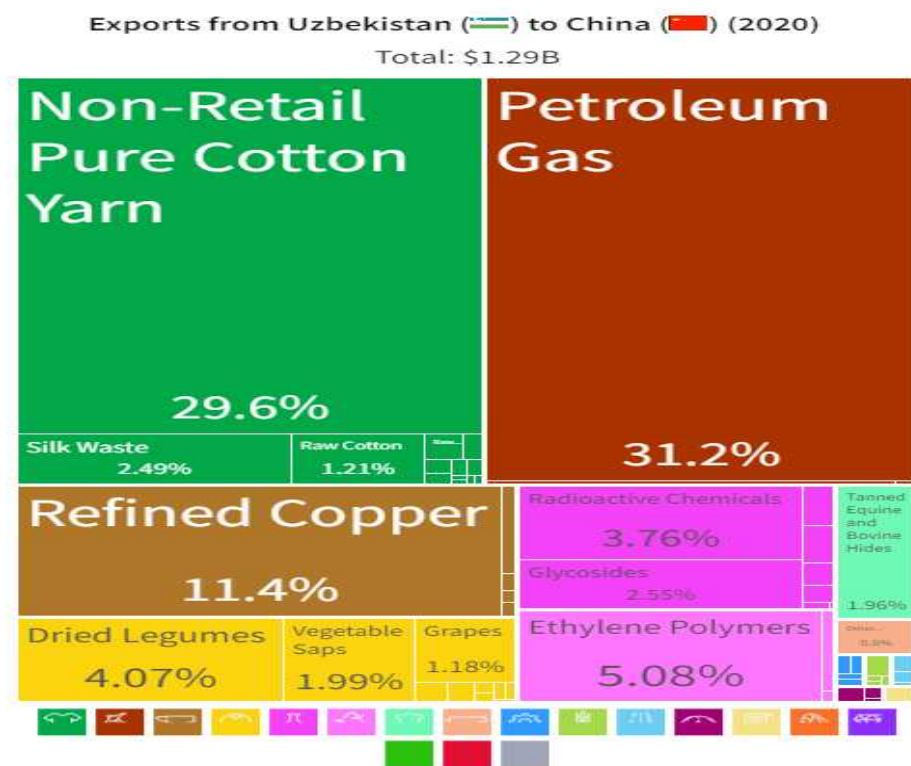
products from China to Uzbekistan are coated flat-rolled Iron worth to \$203MLN and Broadcasting equipment with \$195MLN and Synthetic Filamnet yarn woven fabric worth to \$135MLN and so on other small imports. China's annual export rate increased to 20.4% fro1995 untill 2020 from \$47.5MLN to \$4.88Billion.

Figure 7. Export volume of China to Uzbekistan

[cec.world/en/profile/bilateral-country/chn/partner/uzb](http://cec.world/en/profile/bilateral-country/chn/partner/uzb)

In comparing export and import volume of countries obviously China's market place in Uzbekistan is bigger than Uzbekistan's marketplace in China. By 2020, Uzbekistan's export to China had been increasing significantly. For example, Uzbekistan's export volume was only \$64MLN in 1995 and this supply reached to \$1.29 Billion in 2020 which with annually 12.8% increasing rate which is good improvement on trade scale. Uzbekistan's main supplies to China are included Petroleum gas, Non-retail pure cotton yarn and refined copper and so on other small amount of other export products like vegetables and so on.

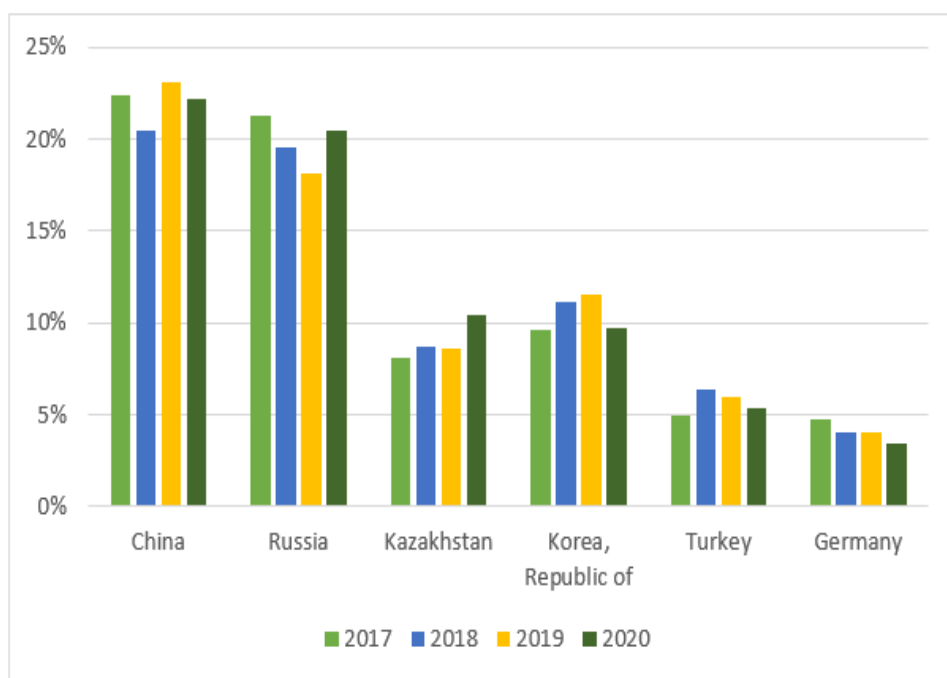
Figure 8. Export volume of Uzbekistan to China



<https://tradingeconomics.com/uzbekistan/exports-to/china/>

In order to increase export volume of goods and products, country need improve their quality of goods or services include logistics services, transportation. Uzbekistan's logistics and transportation's system need be improved as well as payment systems in order to increase volume and improve trade connections with other partners. In last few years, there is positive improvements done by government and keeps upgrading transplantation system and that is one more step to improve logistics services in country. So far Country's main biggest parnters are Russia and China, Kazakhstan, South Korea and so on. There is we can see transportation developments towards main partner countries and it effects significant to trade volume:

Figure 9. Transport strategy of Uzbekistan



source: eurasian-research.org

### 3.3 Uzbekistan and South Korea free trade agreements

Uzbekistan and South Korea diplomatic and economic relationships started from 1992 in January. Since then Uzbekistan and South Korea connections has began to strength and started cooperating in different section of economy with lot of investing interest of South Korea in Uzbekistan and establishing trading opportunities between parties.

During last 20 years, Uzbekistan and South Korea's economic relationships has grown throughout and expanding it allies to next levels.

Trade volume between countries increased significantly during last decade and reached from \$1,070.4MLN in 2016 to \$ 2,767.7MLN in 2019. But next following years this size decreased in 2020 and slightly drop ted to \$2,150.7MLN. Growth rate from 2016 to 2019 was more higher with 258.6% than rate in 2020 with 200% which was a bit step down on trade scale.

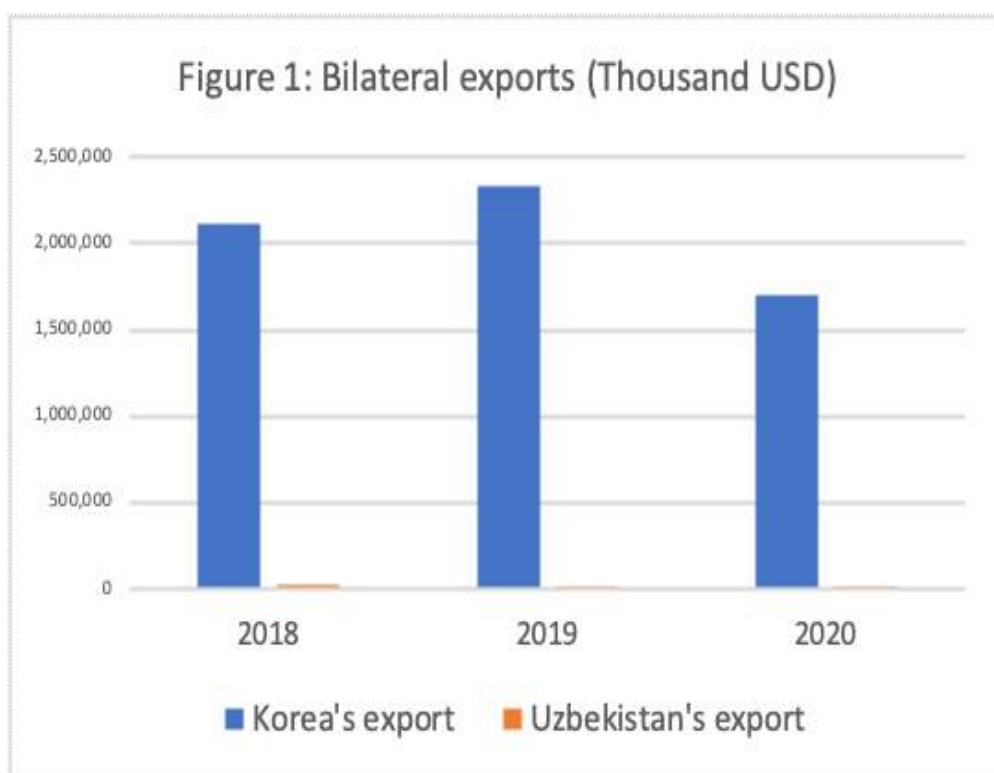
Uzbekistan has free trade agreements with mostly CIS countries and pursuing to have free trade agreements as well with far east countries as well like South Korea. Country leaders have had meetings based on expanding trade opportunities between countries and making free trade agreements. It is ongoing process since 2018 and it has been delayed because of Covid-19 Pandemics. This agreements are included free trade agreements on agricultural sections as well.

If agreement reaches to FTA deal, Uzbekistan would be first country from Soviet countries which has FTA with South Korea.

South Korea's total investment to Uzbekistan has reached more than \$7

billion by 2021. South Korea is pushing more stronger than Uzbekistan for free trade agreement even though it bring mutual benefits to Uzbekistan experts say. Korea-Uzbekistan agreements bring both countries benefits. Comparing of export volume of both countries Korea is lot dominant than Uzbekistan with huge amount different. In fact, Korea export's level in 2019 reached to \$2.3 billion while Uzbekistan's export amount was \$19.7 million.

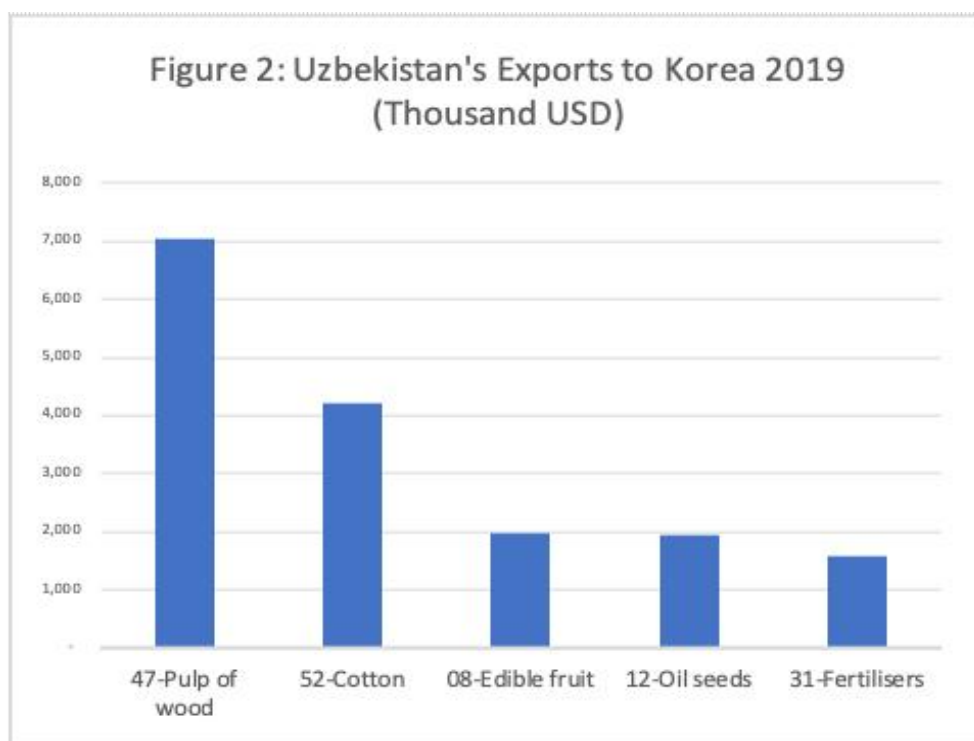
Figure 10. Bilateral export volume of Uzbekistan and South Korea



source: [tradingeconomics.com](http://tradingeconomics.com)

Based on these statistics, one this is clear that export and import different between both countries are so unbalanced. Uzbekistan should take advantages as opportunity to increasing exporting volume to Korea with more agricultural products since South Korea is one of third larges food market in Asia and Uzbekistan is rich with its delicious, organic agricultural products and other resources. Lower taxes, tariffs are open window to flow market which was not available before. It is time to move on and make exporting process.

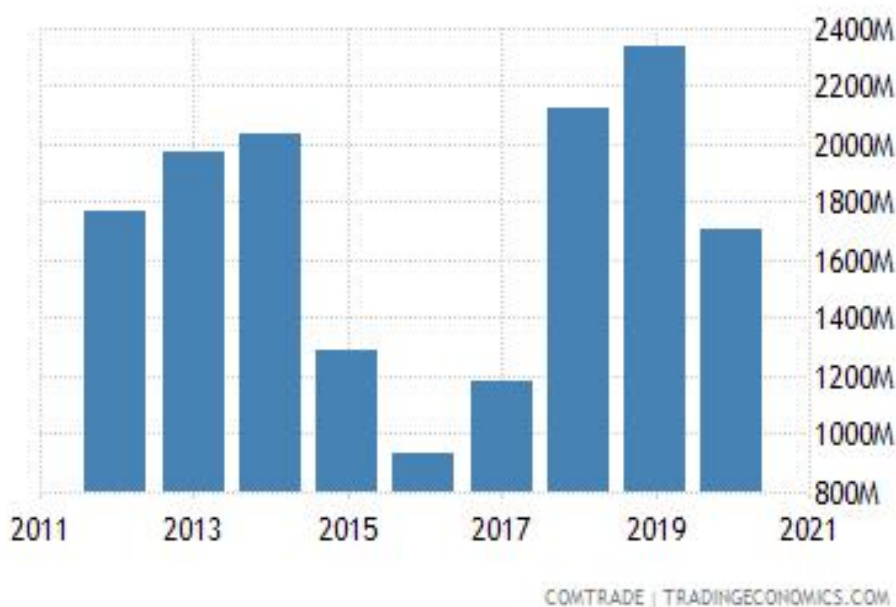
Figure 11. Uzbekistan's export volume to South Korea



source; [tradingeconomics.com](http://tradingeconomics.com)

FTA opens more opportunities for farmers as well. Let's have a look and compare tariffs without FTA. For example, melons or pomegranates were charged with 45% tariff rate for Uzbek products where USA farmers paid only 4.5% tariff rates for the same products. It opens way and gives better promises to Korean investors in Uzbekistan. There are more than 461 enterprises in Uzbekistan with South Korea investments and 386 joint venture companies and 75 out of 461 enterprises are built fully with South Korea capital which provided employment for many and increase GPA. Uzbekistan is seeking more investment to Uzbekistan from South Korea and in return providing labor forces to Korea and ease unemployment level in country. South Korea's export volume to Uzbekistan has increased during recent years:

Figure 12. South Korea's export flow to Uzbekistan



source; tradingeconomics.com

As we see here, volume of export of South Korea's to Uzbekistan reached to maximal level with worth of almost \$2400MLN in 2019. And this size decreased following years because of world Pandemic Covid-19.

### **3.4 Uzbekistan and Central Asia trade relations.**

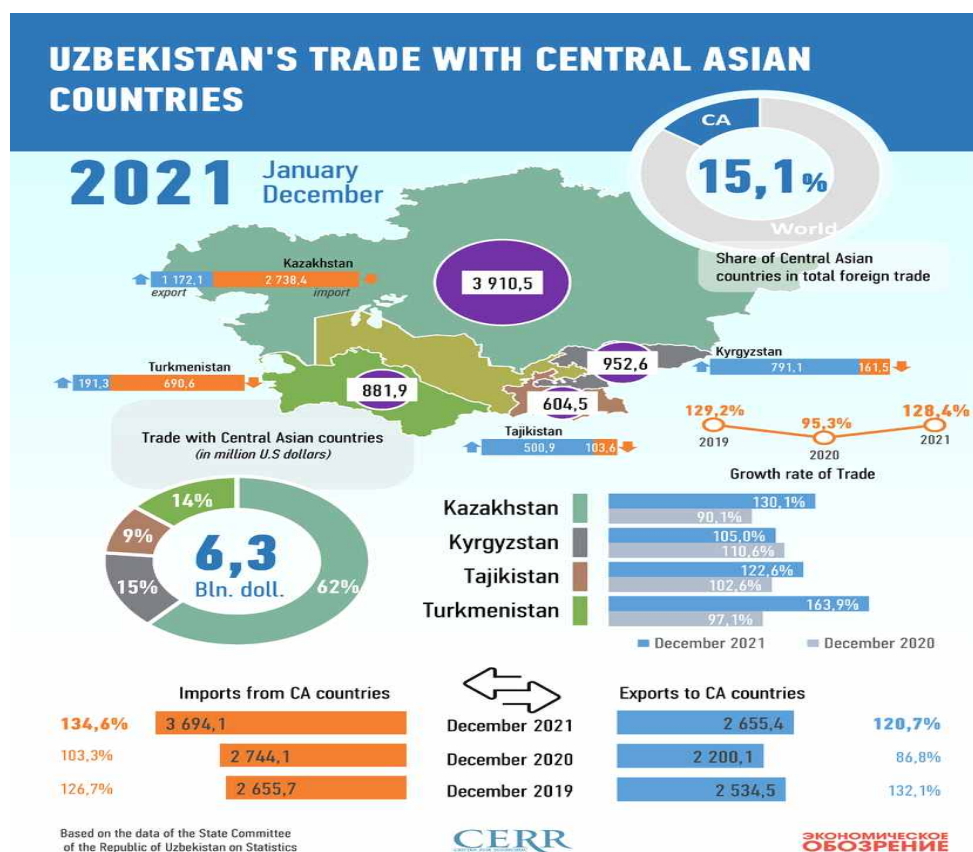
Central Asian are composed of five neighbor countries which are Uzbekistan, Kazakhstan, Kirghistan, Turkmenistan and Tajikistan. These 5 countries share the same border and similar culture and common language and related to each other in every sector of social activities, economic relationships for years. Years by years countries economic ties have been expanding and increasing exchange volumes.

Not far, in last 5 years from 2016 to 2021 Uzbekistan's trade volume with Central Asian countries increased significantly and reached \$6.3 Billion in 2021. This number was \$2.5 Billion in 2016 which ended up growth of 2.6 times in 5 years. Uzbekistan's import value in total reached \$3.7 Billion in 2021 which is 3.2 times more than import volume in 2016 which was \$1.2 Billion. At the same time export volume has increased towards Asian countries from \$1.3 Billion worth of supply to \$2.7 Billion worth of supply. Data shows export rate increased 2 times than before which is huge economic growth of country.

It is fact that trade is more efficient and easier when distance is close and transportation cost is low. Uzbekistan and Central Asian countries have all these benefits to use and have mutual benefits from it. According to statistics, overall trade volume of Uzbekistan with rest of Central Asian Countries have been growing faster than Uzbekistan's other trade

with rest of the world which is related facts to distance and common interests. In fact that, that export volume shows that export rate is 1.4 times more to Asian countries than rest of the world and import rate is 2 times.

Figure 13. Uzbekistan and Central Asia bilateral trade

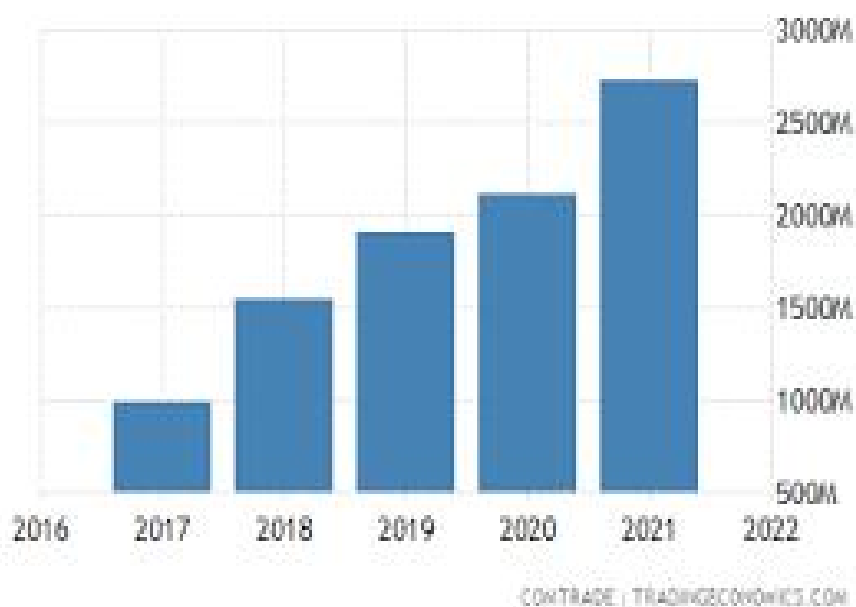


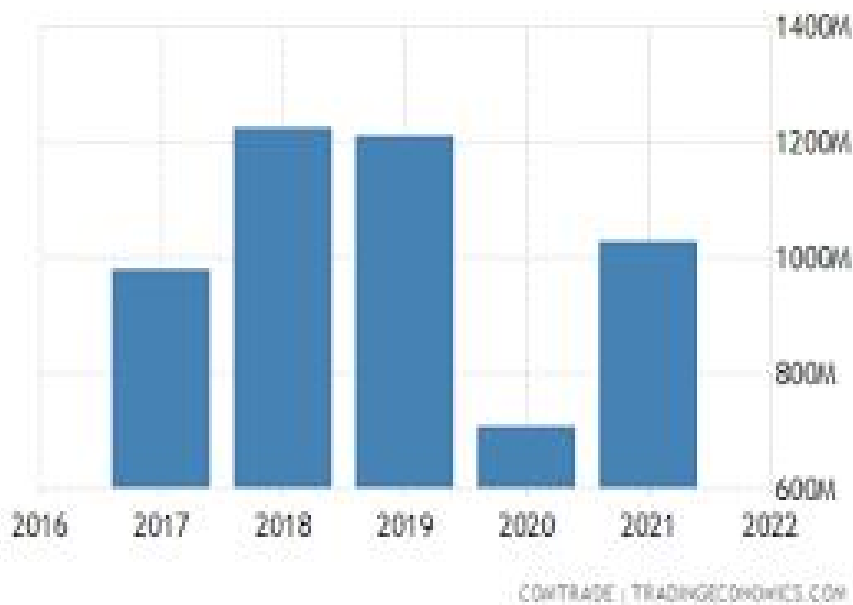
Among other central Asian countries Kazakhstan has remained as main trading allies of Uzbekistan. Kazakhstan and Uzbekistan economic relationships have become stronger than ever and became Uzbekistan's largest economic and trading partner in Central Asia. Countries signed

important Strategic contract in 2017 for next two years and this economic cooperation became one more reason for economic mutual growth for both countries.

After this even, trade volume started growing more and reached \$2Billion by end of that year and increased by 31% more growth than 2016 which is huge effect of Economic Cooperation. In 2020, Uzbekistan's biggest trade partners China shared 17.7% of foreign trade rate and Russia 17.4% share of foreign trade volume and as third biggest overall but biggest trading partner in central Asia, Kazakhstan shared 9.3% of external trade volume. It show how two countries are important and related to each other.

Figure 14. Export and Import relationship of Uzbekistan and Kazakhstan





Main imports from Kazakhstan to Uzbekistan are as follow: Wheat which is one main agricultural supply with worth of \$593MLN and second import product is Crude Petroleum with worth of \$129MLN and last main import is Semi-finished Iron products which is worth to \$121MLN and other small products.

And Supplies from Uzbekistan to Kazakhstan as follow: main export is cars with amount of \$136MLN and second main export is Pitted Fruits and last main supply is Petroleum gas and other different export supplies.

Kyrgyzstan is second biggest trade partner of Uzbekistan after Kazakhstan in Central Asia. Uzbekistan and Kyrgyzstan's trading volume I agriculture and other raw material supplies have increased significantly during last a

few years and reached \$951 MLN in 2021 and both parties are planning to reach this number to \$2Billion by end of 2022. Kyrgyzstan share 2.3% of Uzbekistan's foreign share and it makes country 6<sup>th</sup> biggest trade partner of Uzbekistan after China, Russia, Kazakhstan, Turkey and South Korea.

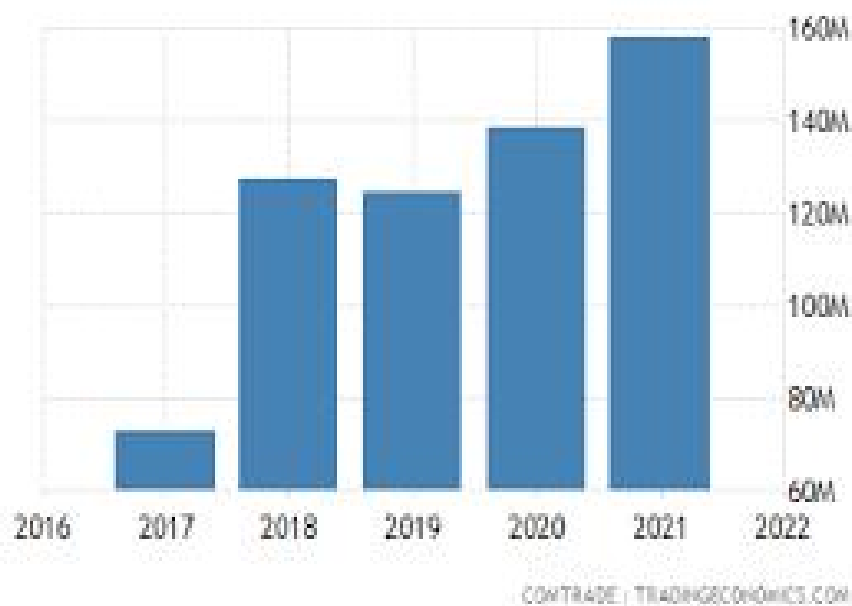
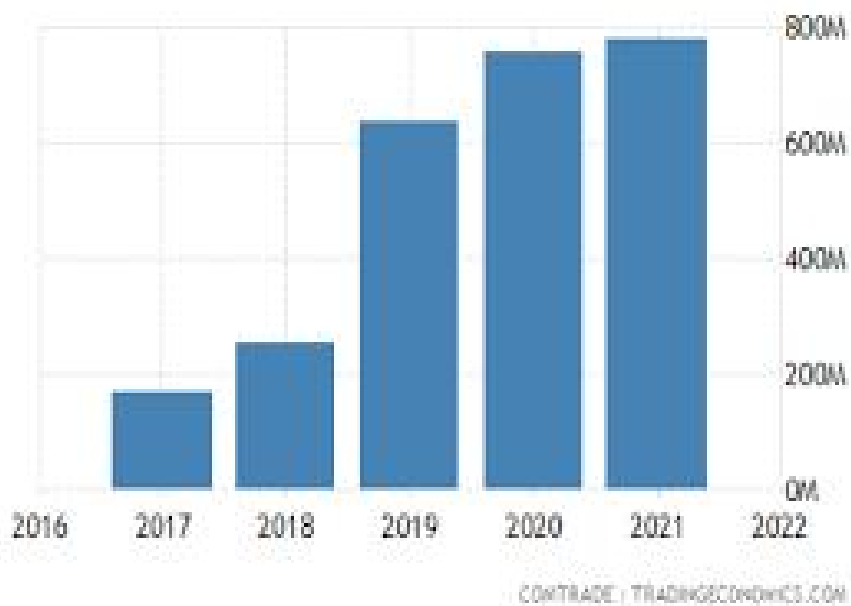
Uzbek and Kyrgyz relationship in economic terms are moving forward and lot of strategic planes, meeting are conducting between to countries in order to increase supply and demand rate. To improve joint projects of logistics and transportation or energy wise projects are launched and overall \$200 MLN amount of Uzbekistan and Kyrgyzstan Development fund has been invested in order to financially support joint projects. Kyrgyzstan actives are offering rising amount of coal , cement , quartz sand or agricultural product like potatoes or milk stuff or diary products towards Uzbekistan which an lead increase of Kyrgyzstan supply to Uzbekistan.

Uzbekistan's export level than import from Kyrgyzstan are much higher than other way around which leaves room for both countries to grow their export and import amount in next years. Main export products of Uzbekistan to Kyrgyzstan are Knit T-shirts with value of \$65.6MLN and Other live Plants with value of \$62.2MLN worth of goods and also Pitted Fruits (agricultural products) with amount of \$59.6 MLN and so on small products. Comparing to 1995 year amount of export increased significantly in 2020 from \$81.3MNL to \$757MLN which is 9.34% annual growth rate. But there was any export services from Uzbekistan

to Kyrgyzstan in 2020.

And main import products from Kyrgyzstan to Uzbekistan increased quite enough from 1995 till 2020. According to statistics, value of export products from Kyrgyzstan reached from \$70MLN to \$155MLN in 25 years with 3.23% annually. Main import products are included Cementworth of \$22.3MLN supply and Scrap Iron with amount of \$15.4 MLN, and Coal Briquettes \$15.3MLN and also small service which are Insurance services and computer and information services in small amount.

Figure 15. Export and import status of Uzbekistan and Kyrgyzstan



## IV. Basics of Gravity model

### 4.1 Method of study

There is no doubt that gravity model of trade is one of most popular method in international trade in term of analyzing, estimating or giving economic diagnosis of trade flow between countries based on their GDP, distance or trade volume and so on variables. Originally gravity model was introduced to the economy world by Walter Isard in 1954 and later on in 1962 model was more established and proposed by Tinbergen by utilizing the gravitational force idea as an comparing to state the volume of bilateral trade flows among trading allies. After this explore of economic event so many, thousands of papers were published based on gravity model. As it was said that “Some of the clearest and most robust findings in empirical economics.” (Leamer & Levinsohn, 1995) .

### 4.2 Foundation of Gravity model

Gravity model's main advantages are as it's ability using real data to assess sensitivity of trade flow and predicts overall trade flow based on countries GDP, distance or economic size of countries.

According to Walter Isard, model was basic model for bilateral trade flow among countries :

$$F_{ij} = G \cdot \frac{M_i M_j}{D_{ij}}.$$

F = trade flow

D = distance

M<sub>i</sub> and M<sub>j</sub> = economic dimensions

G= constant

According to Tinbergen's model, model builds upon two primary assumptions. The first assumption is that larger countries will attract more trade, just as a Newton's law of gravity states that an object with a larger mass will attract objects with smaller mass. The second assumption is that location, and the geographic distance between two countries, will have an impact on the level of trade between those nations.

Tinbergen's main equation can be written as follows:

$$T_{ij} = \frac{GDP_i^\alpha GDP_j^\beta}{D_{ij}^\theta}$$

In the equation above,

$T_{ij}$  represents the bilateral trade between country I and country j

GDP represents the domestic production for both countries I and j

$D_{ij}$  represents the geographical distance between the two countries.

Instead of assuming that trade is directly proportional to the GDP of both countries and inversely proportional to the distance between trading partners, the alpha, beta, and theta variables show that the weight (or size) of the GDPs and distance must be considered in the final equation.

The economists Krugman, Obstfeld, and Melitz simplified the gravity model to appear as follows:

$$T_{ij} = A \times Y_i \times Y_j / D_{ij}$$

In this model,  $A$  is a constant term

$T_{ij}$  is the value of trade between country  $i$  and country  $j$

$Y_i$  is country  $i$ 's GDP

$Y_j$  is country  $j$ 's GDP

$D_{ij}$  is the distance between the two countries.

This presents a simplified view of Tinbergen's earlier model, but both models yield virtually identical results.

The gravity model is still widely accepted by economists as a valid analysis of international trade. As University of Chicago economist Thomas Chaney wrote, "The so called 'gravity equation' in international trade has proven surprisingly stable over time and across different samples of countries and methodologies. It stands among the most stable and robust empirical regularities in economics.

## V. Data and results

### 5.1 Data

To analysis Uzbekistan's agriculture export and import products between 2000 to 2020, I have selected Uzbekistan's main 11 trade allies during these years: Belarus, China, Germany, Japan, Kazakhstan, South Korea, Kyrgyzstan, Russia, Tajikistan, Turkey, Ukraine. Those countries are selected for not only agricultural trade countries, they are partner countries on many categories.

Data is collected from different sources for years between 2000 to 2020. Mostly data related to trade flow is collected data.worldbank.org or data.imf.org in US\$ and other data are collected from different data bases like stat.uz or google or data.gov.uz and so on sources. And data is organized as panel data in different time series and all tests are run and analyzed by Rstudio.

### 5.2 Used variables

In my model, Uzbekistan agriculture trade volume is selected as dependent variable and rest of variable like GDP per capital of Uzbekistan and partner countries, distance, exchange rate, CIS (commonwealth of independent states ) and transportation time. These variables are selected because they are main indicators of measuring

countries economic stance as well as market size. Overall trade volume of agriculture is calculated by subtracting all other trading categories from total trade volume of Uzbekistan during 2000 to 2020 year period. Agricultural trade volume is effected by different variables and some of them leads to positive growth while other variables do opposite depends on distance or exchange rates, or GDP levels, their trade relationships.

Uzbekistan GDP per capital and Partner country GDP per capital variables

GDP indicates host country (Uzbekistan) and other partner countries overall wealth and market size or economic condition. So countries with higher GDP are assumed to have more trade each other and more trade flow among them compare to countries with lower GDP. So It is expected to have positive effect on trade volume of bilateral trade flow. GDP data is collected from World bank database and IMF database.

Distance

When it comes to trading among countries, distance is very important and play very significant role. Distance remains almost always the same since it is time invariant variable. In gravity model, distance is used to estimate transportation cost for trading countries. It is fact that distance is big influence to trade volume between countries as longer distance should reduce total amount of trade as total cost of transportation increases. More important factor of distance when it comes to

agricultural products is delivering products in short time and with more freshness quality. In the case, since Uzbekistan's main export and import allies are CIS countries it should effect positively to our estimation results.

There are different ways to measure distance based on main interest area of country for trade or it can be measured between capitals of countries or main trade area or most populated areas and so on. It is hard to measure each country distance based on interest of trade or close border area. To keep it simple, in my research, I took roughly distance center locations as well as closest boundaries of countries in Km measurement as some countries are big and some of them are small and it is not easy to keep actual trading area.

#### Exchange rate

In my research, exchange rate is a time variant variable which influence to export and import amount like other economic factors like inflation or interest rate. Once country exports increases country money (Uzbek Sum) appreciates more, its import cost becomes less expensive and their product become more expensive in abroad countries and should effect positive to country GDP. For calculation of exchange rate, from overall amount of trade in sum to other country currencies yearly basics between 2000 to 2020 years by dividing total amount to exchange rate level during different years based on each country rates.

CIS members dummy variable

I used CIS as dummy variable. Former Soviet Union countries have still free access with each other in different categories as well as free trade agreements. And another important factor is they are located close to each other which should effect positive results to our estimation since it reduces transportation cost and time. CIS variable should effect positive on our model but not much as we expected since we are using it as dummy variable (1 and 0), not actual trade volume.

Transportation time (in hours)

Transportation time is one of crucial elements in trading business and has massive effect on trade volume. Delivering products in short time and better quality increase export volume and increase demand level as well from other countries. As Uzbekistan is located in Central Asia where sea shipping chances are limited and makes available mostly railway or air delivering, or truck options which can work for many main trade partners in Asia area. That is why I took measure in hours and selected delivering transportation based on country locations like for CIS countries railway and far countries like Japan, South Korea airway as main transport of exporting and importing.

### 5.3 Test results

This section contains all different test results and discussion about my model of agriculture export and import in Uzbekistan. To get final alternative best statistical estimation and reliable results, different regression tests are conducted which are OLS (ordinary least square) regression test, fixed model test, random effect test and comparing all results by taking another tests fixed&ols and fixed&random test which helps to pick most positive results among them. In my model, I take Agriculture trade volume as dependent variable (Y) and other independent variables which are Uzbekistan's gross domestic products per capital (uz\_gdp\_per\_cap) partner countries gross domestic products per capital (p\_gdp\_per\_cap), distance (distance), exchange rate (ex\_rate), Commonwealth of independent states (CIS\_mem), and transportation time (trans\_time) variables. Lets run test and see how agriculture trade flow are effected by those variables. Model:The method of Ordinary Least Squares(OLS) is most widely used model due to its efficiency. This model gives best approximate of true population regression line. The principle of OLS is to minimize the square of errors ( $\sum e_i^2$ )

OLS test.

```
> ols<-lm(basemodel,data=Book1)
> summary(ols)
```

Call:

```
lm(formula = basemodel, data = Book1)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-839621903	-104077668	44940787	187530386	425211139

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )	
(Intercept)	-580670163	88904818	-6.531	4.32e-10	***
uz_gdp_per_cap	1503905	26882	55.945	< 2e-16	***
p_gdp_per_cap	-2718	2139	-1.271	0.205	
distance	12760	18069	0.706	0.481	
ex_rate	52794	7233	7.299	4.99e-12	***
CIS_mem	-21231453	55965075	-0.379	0.705	
trans_time	-48744	525613	-0.093	0.926	

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 285100000 on 224 degrees of freedom

Multiple R-squared: 0.9484, Adjusted R-squared: 0.947

F-statistic: 686.6 on 6 and 224 DF, p-value: < 2.2e-16

According to OLS test results, we can see Uzbekistan's GPD per capital and exchange rate has positive effects on bilateral trade flow, unfortunately other variables like distance, CIS members or transpiration time have slightly negative effects. CIS member should have positive effects on trade volume in this case, but unfortunately it has negative sign since I took it as dummy variable (0,1) not actual trade volume. Distance and time variables have negative effects because main partners of Uzbekistan are not all neighbor countries like Russia or China and located not close. As a result, R-squared 0.9484 and adjusted R-squared 0.947 which are positive results. In our ols test, overall results came out less positive than we expected. We move on with next test and lets see if we have more positive results.

## FIXED effect test results

```
> summary(grun.fe)
Oneway (individual) effect within Model

Call:
plm(formula = basemodel, data = Bookp, model = "within")

Balanced Panel: n = 11, T = 21, N = 231

Residuals:
      Min.      1st Qu.      Median      Mean      3rd Qu.      Max.
-8.86e+08 -9.72e+07  4.19e+07  0.00e+00  1.77e+08  5.11e+08

Coefficients:
              Estimate Std. Error t-value Pr(>|t|)
uz_gdp_per_cap 1561879.7    31395.6  49.7483 < 2.2e-16 ***
p_gdp_per_cap  -22550.5     6092.7  -3.7012 0.0002721 ***
ex_rate         59246.7     7390.5   8.0166 6.669e-14 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total sum of Squares:    3.5308e+20
Residual sum of Squares: 1.7252e+19
R-Squared:              0.95114
Adj. R-Squared:         0.94821
F-statistic: 1408.07 on 3 and 217 DF, p-value: < 2.22e-16
```

According to Fixed Effect results, Uzbekistan and partner country GDP per capital and exchange rate have positive effects on bilateral trade. Overall P-value which is  $2.22e-16$  is also showing significantly positive results. It is clearly shown than fixed effect model has most positive results comparing to OLS results. And R-squared points are also quite positive with 0.95114. Estimation standards on partner country GDP per capital quite negative. But overall p-value is significant,  $2.22e-16$ .

## Random effect

```
> summary(grun.re)
Oneway (individual) effect Random Effect Model
(Swamy-Arora's transformation)

Call:
plm(formula = basemodel, data = Bookp, model = "random")

Balanced Panel: n = 11, T = 21, N = 231

Effects:
              var std.dev share
idiosyncratic 7.95e+16 2.82e+08    1
individual    0.00e+00 0.00e+00    0
theta: 0

Residuals:
      Min.      1st Qu.      Median      Mean      3rd Qu.      Max.
-8.40e+08 -1.04e+08  4.49e+07  0.00e+00  1.88e+08  4.25e+08

Coefficients:
              Estimate Std. Error z-value Pr(>|z|)
(Intercept) -5.8067e+08  8.8905e+07 -6.5314 6.517e-11 ***
uz_gdp_per_cap 1.5039e+06  2.6882e+04 55.9450 < 2.2e-16 ***
p_gdp_per_cap -2.7179e+03  2.1389e+03 -1.2707  0.2038
distance      1.2760e+04  1.8069e+04  0.7062  0.4801
ex_rate       5.2794e+04  7.2331e+03  7.2990 2.898e-13 ***
CIS_mem      -2.1231e+07  5.5965e+07 -0.3794  0.7044
trans_time   -4.8744e+04  5.2561e+05 -0.0927  0.9261
---
signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 3.5308e+20
Residual Sum of Squares: 1.821e+19
R-Squared: 0.94843
Adj. R-Squared: 0.94705
chisq: 4119.34 on 6 DF, p-value: < 2.22e-16
```

Random effect test shows that only Uzbekistan GDP per capital and exchange rate has positive effect on trade flow and other variables have slightly negative signs in this case. Estimation results are quite negative on mostly variables and also intercept result shows minus result which they have negative influence on trade flow.

Fixed and OLS test

```
> pFtest(grun.fe,ols)

      F test for individual effects

data:  basemodel
F = 1.7211, df1 = 7, df2 = 217, p-value = 0.1053
alternative hypothesis: significant effects
```

Fixed and random test

```
> phtest(grun.fe,grun.re)
```

Hausman Test

```
data: basemodel  
chisq = 12.085, df = 3, p-value = 0.007097  
alternative hypothesis: one model is inconsistent
```

After running all test OLS, Fixed effect and Random effect regressions, results came out different since all variable effect different to agriculture trade estimations with positive and some negative influence in bilateral trade flow, but in general p-value shows positive results on pretty much all test results. When it comes to trade, Countries GDP, Population, distance are big influencers to trade volume and they effect directly future strategic relationships of countries.

To have clear picture of agricultural trade flow assumption and more reliable statistical results, a few more comparing regression tests are conducted which are fixed against ols first. Test results shows that fixed effect model has more positive results on bilateral trade flow between countries based on Uzbekistan and partner countries GPD per capital and exchange rate variables. Results shows that is effective with less than 0.05. Furthermore for comparing fixed effect and random effect results (hausman test), one more comparing test between fixed and random test is conducted. As a results, fixed model has most effective results overall with p-value 0.007097 on Hausman test.

## VI. Conclusion

Uzbekistan's economy has been developing and growing fast on every section of economic field in more than last two decades. After Country became independent in 1991 from Soviet Union, all diplomatic and economic relationships with other close and far countries started. Russia, China and neighbor countries Kazakhstan, Kyrgyzstan were first countries who started trading, investing and expanding ties on different section with Uzbekistan. During last 20 years Uzbekistan's GDP level increased significantly and extended trade allies with more countries and improved export and import channels. Uzbekistan's export volume in agriculture and other export supplies have increased in size. Annual growth rate increased 6.80 percent from 2002 until 2022 which is significant growth rate for country. Country's economy grows based on internal and external effects. Trading is one of key factors of economic growth in country economy. Uzbekistan has become one of trading center in central Asia with 4th ranking among central and south east Asia. Uzbekistan's economy is changing from agriculture to more industrial sector and increase export flow with ready manufactured goods and products which is good term in economy. But still agricultural section remains as one of main export sources of country.

In my paper, I have conducted a few test using Gravity model regressions to figure out what are main effects to trade volume of agriculture products supplies and how they are effected by different variables. Uzbekistan and its main 11 partner countries have different export and import channels and have developed strategic relationships in different

fields of exchanging. Agricultural products of Uzbekistan are more exported to near or neighbor countries rather than far allies. That is why some of countries are effected negative on our statistic estimations. Due to regression test results, I can say GDP of Uzbekistan and GDP of partner country and exchange rate have positive effects and plays significant role in increasing and promoting bilateral trade flow with partner countries. But at the same time Transplantation time and distance have slightly negative effect than we expected.

Country's GDP level play important role when it comes to trade and other economic relationships among countries. It is fact that economic developed countries with high GPD rates effect more to developing countries and they trade in bigger volume than other countries. Uzbekistan's GPD level increased significantly last 10 years and economic relationships with other countries keep increasing and leading country's external trade increase.

Uzbekistan's industrial and agricultural section developing at the same time year by year and creating more opportunities to enter world market. To attract more trading partners and increasing external trade volume, Uzbekistan is improving logistics services, payment systems which are one main factors in international trade.

It is important to understand that distance, population and transportation is also important when it comes to trade. Better logistics services and low transportation cost can attract more countries to trade with and involves more investments to country. Since Uzbekistan is located in the center of

Asia it makes it harder to improve trade relationships with overseas since transportation cost leads decline of trade flow, country need improve with neighbor countries and make a way trough them until reaching to sea ports which can cut transportation costs significantly.

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3.7%20billion.

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# 국 문 초 록

## -농업의 중력 모델, 우즈베키스탄의 경우-

한 성 대 학 교 대 학 원  
국 제 무 역 경 제 학 과  
국 제 무 역 시 장 전 공  
백 조 드

필자의 논문의 목적은 우즈베키스탄의 주요 11개 무역 상대국(벨라루스, 중국, 독일, 일본 카자흐스탄, 한국, 키르기스스탄, 러시아, 타지키스탄, 터키, 우크라이나)과의 농업 부분, 무역 흐름에 대한 우즈베키스탄의 양자 무역 관계를 중력 모델을 이용하여 분석하는 것입니다. 농업 부분의 양자 무역 흐름에 대한 대부분의 대안적 긍정적 효과를 얻기 위해 중력 모델 회귀 분석(OLS, 일반 최소 제곱, 고정 모델, 랜덤 효과)을 사용하여 다른 추정 테스트를 수행하고 고정 & 롤과 고정 & 랜덤 테스트를 통해 비교합니다. 최종 결과, 그 중에서도 고정 모델 추정이 가장 효과적인 결과였습니다. 우즈베키스탄의 농업 수출은 CIS(독립국가연합) 국가로 가는 것이 더 효과적이고 국가 규모, 인구 또는 공통 국경 공유, 문화적 유사성 또는 공통 언어, 운송 시간이나 비용 절감과 상관관계가 있다는 사실입니다.

이를 위해 2000년부터 2020년까지 패널 데이터 형태로 데이터를 수집합니다(시계열이 있는 2차 데이터 기반). 제 논문의 주요 목적은 수집된 데이터를 바탕으로 우즈베키스탄의 농업 분야 시장 규모와 교역량을 표시하고 추정하는 것입니다. 결과 확정 후 무역 성장 여력이 더 있다면 무역 제안서를 작성합니다.

[키워드] 무역의 중력모델, 우즈베키스탄 농업 수출입, 자유무역협정