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MASTER'S THESIS

Economic impact of protectionist measures

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, April 28, 2020

Signature

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Abstract

Protectionism has become a hot topic in these years. Based on the data of China-U.S. trade war, this thesis explores the economic impact of protectionism on United States. The effect of U.S. protectionist measures on imports value, welfare change and employment has been estimated and the result shows although trade protection could bring benefits to the U.S. in the short term, it will cause substantial welfare losses to U.S. residents.

JEL Classification	F1
Keywords	protectionism, imports, welfare, employment

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Abstrakt

Protekcionismus se v těchto letech stal horkým tématem. Na základě údajů China-U.S. Tato diplomová práce zkoumá ekonomický dopad protekcionismu na Spojené státy americké. Dopad amerických protekcionistických opatření na hodnotu dovozu, změnu blahobytu a zaměstnanost byl odhadnut a výsledek ukazuje, že ačkoli ochrana obchodu může v krátkodobém horizontu přinést výhody pro USA, způsobí rezidentům USA značné ztráty v blahobytu.

Klasifikace	F1
Klíčová slova	protekcionismus, dovoz, blahobyt, zaměstnanost

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Master's Thesis Proposal

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Defense Planned:	June 2020

Proposed Topic:

Economic impact of protectionist measures

Motivtion:

Trade protection is the deliberate attempt to limit imports or promote exports by putting up barriers to trade. Governments want to use protectionist policies shield the producers, businesses, and workers of the import-competing sector in the country from foreign competitors. But the barriers reduce trade and adversely affect consumers in general (by raising the cost of imported goods), and competitors may retaliate which is harmful for the development. The protectionism may be the cause of some economic crises, most notably the Great Depression (Douglas, 2017). So, researching the economic impact of protectionist measures is meaningful for developing trade policy and economic growth.

The principle of comparative advantage shows that countries can specialize in the production of goods and services in free trade, and it will create more jobs for citizens and reduce the cost of goods, which is the main criticism for protectionism (Krugman Paul, 1997). But some researches find economic protection was positively correlated with economic growth (Bairoch Paul 1993). Many economists attribute this phenomenon to factors unrelated to the tariff and a prominent 1999 study by Jeffrey A. Frankel and David H. Romer found, while controlling for relevant factors, that trade does indeed have a positive impact on growth and incomes. So, the benefits of trade protectionism may be an illusion and controlling relevant variables is essential for a reliable outcome.

The recent US-China trade war makes the topic “protectionism” be hot. Both countries have developed some protection measures, including increasing tariffs on imports and creating barriers for foreign companies to entry. But some examples of the past show that many protection measures may be harmful for the economy, like US increased tariff on Chinese steel in 2002 (Robert 2005) and on Chinese tires in 2009 (Thomas 2016).

Hypotheses:

1. Hypothesis #1: Protectionism will influence the trade significantly in short run.

2. Hypothesis #2: Protectionism will reduce the welfare of U.S. consumers.
3. Hypothesis #3: Protectionism will influence U.S. employment.

Methodology:

Because the tariffs will increase the cost of exporter which may lead to an increase in the price of imported goods and a decrease in the quantity, research if increasing tariffs have a significant influence on trade is important for researching the impact of protectionism. Gravity equation (Tinbergen 1962) will be used to find whether increasing tariffs has an significant impact on imports. Regressing the equation $\ln X_{si} = a\ln Y_i + b\ln D_i + c\ln I_i + \lambda\ln\tau_{si} + \varepsilon$ where X is the import, Y is the real GDP, D is the distance between trading countries and United States, I is the real GDP per capita, τ is tariffs, s is the different sectors. I can find whether the tariffs has a significant influence on trade. The data will include US, China, Japan and other countries and it is free for finding in different countries database and word bank database.

To measure the change of welfare, I need to compare the gain from more tariffs and higher domestic price with the loss from less consumption and less foreign supply. A special case is that imports are supplied perfectly elastically which means higher tariff will not affect the price of foreign exporters and the distortion of domestic production and consumption decisions leads to the loss of welfare. This effect will be estimated by regressing the change in the log import unit value of different sectors over a period ($\ln\frac{p_t}{p_{t-t'}}$) on the change in one plus the applied tariff on imports ($\ln\frac{1+\tau_t}{1+\tau_{t-t'}}$) over the same period and the coefficient will reflect whether the tariff will affect the prices received by foreign exporters. To calculate the welfare loss (assuming the imports are supplied perfectly elastically in short run which has been proved by Fajgelbaum, et al.,(2018)), I use the equation $WL = \frac{1}{2}p_1\tau(m_0 - m_1) = \frac{1}{2}\tau p_1 m_1\frac{(m_0 - m_1)}{m_1}$, in time 1, government increase tariff rate τ on imports and the quantity of imports is m (equation has been explained by Amiti，at al, 2018). $p_1 m_1$ is the value of imports after increasing tariffs, which can be estimated by replacing the dependent variable with import values ($\ln\frac{p_{st}m_{st}}{p_{s,t-t'}m_{s,t-t'}}$, i is the different countries and s is the different sectors). Tariff rate τ is observable.

$\frac{(m_0 - m_1)}{m_1}$ is the change in quantity of imports which can be estimated by the change in tariff multiplied by the import demand elasticity β, β is the coefficient of the regression $\ln\frac{m_t}{m_{t-t'}}$ on $\ln\frac{1+\tau_t}{1+\tau_{t-t'}}$, because the quantity of imports has a negative relation with increasing tariffs, it needs to time negative one to keep positive. So the welfare loss can be estimated by the equation $-\frac{1}{2}p_1 m_1 \tau\beta \ln\frac{1+\tau_t}{1+\tau_{t-t'}}$. And through comparing it with the revenue of increasing tariffs, I can conclude whether trade war can bring benefits to consumers.

Based on the comparative advantage theory, free trade can create more jobs for citizens because of specification. And the employment rate is an important index for a government. To measure the effect of protectionism on employment, I will regress the U.S. employment rate ($\ln ER$) on the U.S. custom revenue ($\ln TR$) and the coefficient will reflect whether the tariff will affect the employment rate.

Expected Contribution:

I want to explore the economic impact of protectionism not only in theory, but also in practice. I'd like to analyze the advantage and disadvantage of protectionism and through empiric analysis to estimate the effect of protectionism on United States economic. This paper will be a reference for developing trade policies and be helpful in analyzing the effect of trade war on U.S. economic.

Outline:

1. Motivation: I will explain the importance of researching protectionism.
2. Studies on protectionism: I will describe relevant theory and motivation of trade protection.
3. Analysis: I will analyze the relation between trade protection and economic growth with studies and newest data. I will measure the welfare loss of U.S. consumers from trade protection as an example to validate the theory.
4. Conclusion: I will discuss the result of empiric analysis and theory to find the economic impact of protectionism and find whether the benefit is enough a country can get from trade protection measures.

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Author **Supervisor**

1 Introduction

The recent US-China trade war makes the topic “protectionism” be hot. Both countries have developed some protection measures, including tariffs increases in imports and creating barriers for foreign companies to entry. Trade protection is the deliberate attempt to limit imports or promote exports by putting up barriers to trade. Governments want to use protectionist policies shield the producers, businesses, and workers of the import-competing sectors in the country from foreign competitors. But some examples of the past show that many protection measure may be harmful to the economy, like US increased tariff on Chinese steel in 2002 (Read 2005) and on Chinese tires in 2009 (Chung at al 2016). Whether trade protection can bring benefit to countries is the core issue for policy makers. Most of the measures can bring direct benefit to government and producers (more tariffs and less imports) which is recognized as the evidence that protectionist is beneficial. The principle of comparative advantage shows that countries can specialize in the production of goods and services in free trade, and it will create more jobs for citizens and reduce the cost of goods, which is the main criticism for protectionism (Krugman 1997). The barriers reduce trade and adversely affect consumers in general (by raising the cost of imported goods), and competitors may retaliate which is harmful for the development. Based on this idea, researching the economic impact of protectionist measures is meaningful for developing trade policy and economic growth.

The objective of this thesis is to analyze the possible consequences of protectionism in economy. This paper will find the motivations for protectionism and compare the typical protectionism that has ever appeared, like Japan-US in 1980s, United States steel safeguards in 2002. Through comparing reasons and outcomes of these typical protectionism, this paper will verify the theory about the economic impact of protectionism. The examples studied in this thesis show that increasing tariffs could

not improve U.S. current account in long run, although imports quantity decreased significantly after applying new tariffs. And how these trade disputes settled in history will be a good reference on current China-U.S. trade war. The difficulties in negotiations between the two sides may be the development of high-tech industries and the exchange rate. And the resolute intervention of World Trade Organization or other international organizations will be an important factor in resolving China-U.S. trade disputes. The US-China Phase One trade deal has been signed in January 2020, the two sides have reached agreement in various fields and agreed to further negotiations. Agreeing on high-tech fields and exchange rate issues will promote a complete end to the trade war. And how much the welfare change of U.S. citizens is in this period must be considered.

Some main variables influenced by the trade war will be observed in this paper, including the decrease of imports value, imports price change and employment level, to verify whether increasing tariffs on imports could achieve U.S. intended purpose. In empirical part, this paper will try to find out whether tariffs will influence imports significantly and estimate the U.S. welfare and employment rate change from increasing tariffs on Chinese exports. The relation between tariffs and U.S. imports value will be tested firstly. Because trade protectionism may have the opposite effect on different sectors, for example, if tariffs increase the price of steel, the industry of car producing will face a higher producing cost, sector-level data will be used to make regression which can show the effect of tariffs better. Based on related research, the trade between two countries can be affected by many factors, like language, population and so on, in this paper, the knowledge of gravity equation (Tinbergen 1962) will be considered which can release the influence of other factors on bilateral trade. And due to the trade war may influence the third countries through global value chain, which has been proved by Haiou and Holger (2019), the data used in estimating the effect of tariffs on imports will not only include the main trade countries, but also some third countries who maybe affected indirectly by trade protectionism. Through regressing imports value on tariff rate, the effect of changing tariffs on imports could

be estimated. The result shows that although tariffs will influence U.S. imports value significantly, this effect will be decreasing with the rise of tariff rate, increasing 10%-25% tariff rate will reduce 5.9% to 14.8% of U.S. imports value in 2018 but only 1%-2.5% in 2019.

Focus on China-U.S. trade war, to measure the welfare, conventional trade models will be used in this paper and it can predict the effect of tariffs on demand and supply framework effectively in short run. Changes in the welfare of American residents come from two main sources in this model. Through regressing imports price change on tariff rate change, the effect of tariff on imports price could not be ignored, which is different with some other researches focusing on multi-country data (Amiti et al 2019). Part of tariffs revenue was transferred from decreasing imports price. After regressing imports quantity on tariff change, the effect of tariffs on imports quantity could be estimated and deadweight welfare loss will be measured, 30 billion dollars in 2018 and 23 billion dollars in 2019. After calculating the tariff revenue in this years, the welfare loss of U.S. citizens could be measured, 51 billion dollars in 2018 and 62 dollars in 2019. And tariff revenue was increasing significantly in 2019, U.S. government revenue exceeds deadweight welfare loss. Although welfare loss of U.S. citizens was large since the trade war, the sharp increase in tariff revenue could make U.S. government be not aggressive in trade negotiations with China.

The effect of China-U.S. trade war on U.S. domestic employment rate will be tested in the last part. Because the effect of increasing tariffs on employment rate could not be decided, decreasing imports will increase the domestic employment, lower resource allocation efficiency will reduce domestic employment, this article has tested the relation between tariffs revenue and employment rate based on the U.S. data over the past two decades. The result shows that there is a positive relation between employment rate and tariffs revenue in United States, increasing 1% tariff revenue will make a 0.033% rise in employment rate. Based on the calculation of U.S. tariff revenue increased from trade war, this article has estimated the effect of increasing tariffs on U.S. employment rate. The final result shows that about 28% of U.S.

employment rate growth in 2019 are due to increased tariffs on Chinese exports.

Section 2 will review related literature, including basic theory about protectionism and some of the latest research on the China-U.S. trade war. Section 3 will introduce two typical protection examples in history and make comparison with on going trade war. Section 4 will introduce the method and data used in this article. Section 5 will show the calculation details, empirical results and make some interpretations about the process and result. Section 6 will make conclusions.

2. Literature review

2.1 Basic theory

One of the most important theories about researching protectionism is the principle of comparative advantage which was created by David Ricardo in 1817. In this theory, Ricardo holds that the basic of international trade are the relative difference in production of different countries and he believes that one country should still engage in international trade while other countries can produce every single good more efficiently. This theory provides strong evidence for free trade for the first time and successfully explained an important cause of international trade from the perspective of productivity differences, which has a profound impact on the formulation of trade policy.

In his book, the Ricardo model is a general equilibrium mathematical model of international trade. He made nine assumptions to make his analysis reliable, including there are only two countries and two goods in this model, the productivity of same good is different between this two countries, no economic of scale, no transport cost, elements can flow freely within a country but not internationally, factors and products market is perfect competitive, no change in wage, two countries will only produce and trade two same goods, no technology development. In this model, a country may produce this two goods more efficiently than another country, but every country can still increase their consumption by specializing in the production with comparative advantages and trading. A country has comparative advantages in producing a product means this country can spend less factors to generate more value through specializing in producing this product, compared with producing the other product. This model shows that blindly producing and exporting a product can not increase overall consumption. Only by spending more inputs on comparative advantage products and actively conducting trade, the total consumption of a country can increase

significantly.

The principle of comparative advantage is the basic of international trade theory. It shows that different countries can get benefit through exploring the comparative advantage goods and importing the other goods, and two countries with very different production capacities can still benefit from free trade. Free trade will encourage a country to specialize in producing comparative advantage products and the overall consumption will increase from exchanging goods in the world market. Meanwhile, more consumption implies more demand for commodities and services, which will create more jobs for citizens, and specialization will improve the efficiency of production, which will decrease the cost of production. Based on this theory, protectionism will increase the cost of production and decrease overall consumption and employment rate, which will decrease the welfare of a country. The principle of comparative advantage is often used by economists as a weapon against protectionism. Krugman, who awarded the Nobel Memorial Prize in Economic Sciences, often uses the principle of comparative advantage to support free trade. He holds that if a country can specialize in producing the comparative advantage products, economies of scale will exist in this industry which can drive technological progress and reduce production costs. Based on this, he analyzes the relation between the development of developing countries and of developed countries in the article “Pop internationalism” in 1997. He believes that because of cheap labor force, developing countries can produce some goods with low cost which will reduce some profits for developed countries, but the purchasing power of residents in developed countries has also increased relatively and the core industries with high technology in developed countries will not be affected significantly. His article shocked the protectionist policies of developed countries at the time and shows the benefit of free trade.

However, the assumptions this theory based on is far from reality and it is more like to show the benefits that free trade would bring rather than predicting the behavior of a country. In reality, many countries choose to protect their sectors until it has comparative advantage in production (Chang 2007). In the article “Kicking away the

ladder: the “real” history of free trade”, through introducing the history of trade and industrial policies in developed countries, Chang concludes that almost all developed countries used some protection polices to promote their infant industries when they were in catching-up positions, including United Kingdom and the United States, the supposed hometowns of free trade policy. He holds that compared with the past protection polices of developed countries, the tariffs rate of present developing countries may be low, and he believes that developed countries can get benefit from the development of developing countries in the long run with the increase of trade and investment opportunities. The view of Galbraith (2008) is similar to Chang, that potential competitors have to protect their own industries if they wish them to survive long enough to achieve competitive scale. In the book “The predator state: How conservatives abandoned the free market and why liberals should too”, he analyzes the reason for United State choose to protect some industries. He argues that there is a strong case for protection policies because the original argument for trade according to comparative advantage assumed static conditions (i.e. factor and technology immobility). A country should respond to the change of factors or production technologies on the international market by instituting protection policies. And some researchers argue that a certain degree of economic protection is necessary for the realization of industrialization. Shafaeddin (1998) holds that government intervention is important for industrialization and economic protection is conducive to capital accumulation. In his article “ How did developed countries industrialize? The history of trade and industrial policy: The cases of Great Britain and the USA”, he finds that the late industrial country has shown many common features with the early ones and the history of United kingdom and United State suggests the protection for infant industry is essential for their industrialization. All of these scholars have concluded that protectionism is essential for development by analyzing the history of developed country trade policies.

Above articles shows that the application of comparative advantage in reality is difficult, but they only analyze the important role of protectionism in short run. Many

economists believe the benefit of protectionist polices exists in the short term, but this effect is temporary and is bad for resources allocation effectively (Baldwin 1969). In the article “The case against infant-industry tariff protection”, Baldwin analyzed four cases in which the country might adopt protectionism, including the acquisition of knowledge involves costs, costs associated with on-the-job training cannot be recouped by the training firm, the risk from static and reversible externalities and imperfect information in the market. He found that although protectionism can cover part of cost and risky, do infant-industry duties will distort consumption and may fail to achieve a socially efficient allocation of productive resources in new industries. Other researchers holds that some countries may become protectionist when sudden shifts in comparative advantage happened (Feenstra and Taylor 2014). The first chapter of the book “Globalization in an age of crisis: Multilateral economic cooperation in the twenty-first century” shows that the trade system of a country should be multilateral and stable. They hold that a country can trade in the world market with some limits and the barriers should be predictable and well controlled. If sudden shifts in comparative advantage happened, a country often chooses protectionism in order to promote its dominant position in trade and other countries tend to make more barriers to reduce losses. Therefore, when the shifts in comparative advantage happen, open trade and good adjustment mechanisms often lead to protectionist policies. In reality, there are also examples of protectionism that can cause economic losses. For example, US increased tariffs on Chinese steels in 2002 to protected its steel industry, but it has been proved harmful for U.S. economy (Robert 2005). He analyzes the motivation of steel safeguards and measure the gains and losses from this policy in GDP and employment. He found that the steel safeguards owed more to political expediency than justification for protection under the WTO rules and measures outweighed their benefits in terms of aggregate GDP and employment as well as having an important redistribution impact.

Samuelson (2004) analyzed what will happen if the productivity of a country has changed. Because the Ricardo model assumes that there is no technology

development and no permanent loss of jobs, the relation between inventions and real wage rate was not observed. Inventions will increase the productivity and real wage of labor, which will make a change in comparative advantage. In the article " Where Ricardo and Mill rebut and confirm arguments of mainstream economists supporting globalization", Samuelson found that the result is very different when the improvement of productivity happens in comparative advantage products or disadvantage products. Based on Ricardo model, if the productivity of export goods is improved, the other country can spend less and consume more which means free trade can increase the overall consumption and then increase welfare in both countries. But if the productivity of disadvantage products is improved, country can reduce inputs and expand production which will decrease the demand for import. Because this change will not affect the demand of another country for another good, another country will face a decline in exports and welfare, free trade will reduce overall consumption and generate a permanent loss in another country. Although this article did not make a comparison between free trade and protectionism, it analyzes the relation between inventions and protectionism which is meaningful for researching trade war. In recent years, the rapid development of technology has caused huge changes in the comparative advantage of products among countries, which may be the important reasons for the adoption of protectionism in the United States. Gottfried developed the theory of comparative advantage and provided a modern opportunity-cost formulation which uses the forgone units of production to measure the value of the other good and he introduced the concept of a production possibility curve into international trade theory. Technology development will be reflected by the expansion of the production possibility curve which releases the assumption of Richard model. The benefits of trade mentioned in this theory have been recognized by the majority of economists and encourages countries to trade in the world market. It also provides theoretical support for that trade affects welfare by affecting prices of factors and employment rates, which is helpful for the empirical test part of this article.

Based on different assumptions, there are different representations of international trade. Armington (1969) assumes different products face a constant returns to scale and perfect competitive market and the goods in different region will be heterogeneous. Armington model differentiates products by country of region and has many empirical advantages, including the empirical observation of cross-hauling goods, explanation of over-specialization of homogeneous products and consistent outcomes with trade in geographically differentiated products. However, the heterogeneity of product implies the market power in perfect competitive market, which means the demand elasticities for the traded goods by trading partners will decrease as the increase of trade flows (Melo and Robinson 1989). Because Armington model can not explain the pro-competitive effects from trade liberalization (imperfect competitive market), Krugman (1979) develops the assumptions of internal scale economies and imperfect competition to create a monopolistic competition model of international trade. Krugman believes that specialized production within industries will reduce the unit cost of production and generate scale economies effect. In imperfectly competitive markets, monopolistic firms have a higher level of specialization and can profit from trade, so the bilateral trade can still occur even if the two countries have the same factor endowment and technologies. Melitz (2003) introduced the competitive selections of heterogeneous firms in a monopolistic competition model with fixed cost associated with supplying external markets. This model shows that international trade forces high productivity companies enter the exports market and low productivity companies exit the domestic market, because companies with lower unit cost of products will have stronger competitiveness and more demand. Melitz model also shows that as trade in the industry further increases, an endogenous reallocation toward more productive firms can be found, which will improve the overall productivity of industries. In this way, this model can explain how to gain benefits from international trade. When performing general equilibrium analysis, a good analysis of market characteristics is essential to the validity of the hypothetical model. Different assumptions will produce different demand functions and then affect the final equilibrium result.

2.2 protectionism and welfare

Economic welfare is the utility gained through the achievement of material goods and services. It refers to that part of social welfare that can be fulfilled through economic activity (Samuelson 2004). In the article “The future of the Environmentally sustainable national income”, Hueting (2011) holds that welfare is dependent on factors like employment, income distribution, labour conditions, production and so on. Based on comparative advantage theory, protectionism can affect the employment rate, consumption, production and other factors which can influence the welfare of a country. Measuring welfare will be an important measure of the effectiveness of protectionism. Although free trade makes some loss in welfare, like less demand in some sectors, most economists believe that free trade has benefit on economic welfare.

The author of “The Wealth of Nations”, Adam Smith(1776), is the first person to support free trade theory. In his book, Smith finds that division of labor can increase output, “it is the maxim of every prudent master of a family never to attempt to make at home what it will cost him more to make than to buy.” Smith holds that a nation should import goods because its opportunities for consumption can be expanded and exporting goods can create jobs due to the increase in productivity. And David Ricardo developed this theory into the principle of comparative advantage. It shows that through trading with others , every nation can consume more and spend less even though it has disadvantage in production. Based on this theory, it has been a consensus that free trade can reduce the cost of consumption through importing low price goods and increase the purchasing power of citizens. Heckscher-Ohlin theorem is a development of comparative advantage which shows that countries export products that use their abundant and cheap factors of production, and import products that use the scarce factors. It provides a way to find which production the country has comparative advantage in. According to this theory, a country can make full use of its resources for production and alleviate the constraints on resource scarcity of

consumption. Free trade will make resource allocation more reasonable, which can improve the efficiency of production, and increase the diversity of commodities in market. Both of this will increase the welfare of citizens. And international competition reduces monopoly power by domestic producers and compels them to design and achieve higher production efficiency.

But trade with other countries can make to lose in import-competing sectors. More imports means lower price of domestic products and fewer demand of production, domestic producer will make lower profit and the employment rate will decrease in short term. All of this can be observed directly, which is the main reason for protectionism, and it will reduce overall welfare. William (2004) analyzed the relation between worker and trade in the article “Free trade: why are economists and noneconomists so far apart?”. Through introducing some related reports, William finds that workers are not seen as benefiting from trade and the benefits of trade flow to industry, rather than to workers, and to those abroad rather than to those in domestic. Hopefully, many papers have proved that the size of the winnings from free trade is larger than the losses. In the chapter eight of the book “Price Theory and Applications”, Landsburg (2013) explains how the welfare will change if a country trades with others and he finds that although protectionism can increase the surplus of producer in the short term, free trade will make the social welfare be maximal. Some researchers use the real economic data to compare the gains from free trade with from restricted trade. In the article “Trade protectionism: reasons and outcomes”, Abboushi(2010) compared the average annual growth in real per capita income of countries with free trade and countries with restricted trade between the early 1960s and late 1980s and he concluded that resource is more productive in a free trade environment, output is higher and productivity is more efficiently.

In import-competing sectors, restricted trade can save some jobs and reduce imports, which is the main goal of protectionism. But sectors that depend on import will loss from trade protection directly, like trade related service industries or reprocessing industry whose cost will be higher. Some articles proved that in the long term,

protectionism will reduce overall employment rate of the country because less exports reduces jobs of export industries. Luttrel (1978) compared the employment gains from reduced imports with the losses from reduced exports and found the net employment effect near zero which means the increase effect of protectionism in employment only exists in the short term. Because the saved jobs are publicized and loss jobs are not, the effect of protectionism on increasing employment may be just a public illusion. In the long term, the impact of protectionism on employment does not ultimately translate into impacts on welfare. Another goal of protectionism is to reduce trade deficit which is popular in politicians, especially in Trump government. The trade deficit is seen as the evidence that a country loss from trade, but no evidence can prove trade deficit is harmful to economy. Because protections that reduce imports invariably reduce exports, the deficit situation may not be improved. Kaempfer and Willett (1987) analyzed the effect of import surcharge on reducing trade deficit and they find that import surcharge would distort resource allocations and fail to reduce the deficit. Correcting government budget deficit to reduce trade deficit may be more efficient than restrict trade. And in the world market, governments tend to impose protection measures against foreign businesses if their another government develop protections for their domestic industries. Although these protections will bring benefits to protected industry, they always result in an escalation of reciprocal trade restrictions that hurt both economies. Researches have proved that costs of trade tar exceed the benefits to the protected industry (Coughlin et al., 1988). It shows that protections often cause another country to develop retaliatory measures and ultimately harm the welfare of both parties.

The results of these and other studies shows that although protectionism is benefit for domestic producers and workers for a while, the cost of trade protections is bigger: domestic price of the imported goods will increase, the purchasing power of citizens will decrease and then the overall consumption will decrease, the diversity of commodities will reduce, the efficiency of resource allocation will decline, employment and trade deficit will not be improved significantly in long term. There

are many evidences that protectionism will harm social welfare, it is meaningful to measure the effect of protections through measuring welfare losses.

2.3 method review

Based on the theory review, protectionism should have a big influence on imports. Tariffs is the most widely used instruments of protectionism to restrict trade. The thesis will analyse the effect of tariffs on international trade with gravity equation at first. Through regressing the imports on tariffs with controlling other related variables, the result will show whether tariffs can reduce imports significantly.

Because there are many external factors that can interfere with regression results, building a reliable equation is essential. Tinbergen (1962) first used gravity equation to analyze international trade flows and he finds that the scale of bilateral trade between two countries is proportional to their economic aggregates and inversely proportional to the geographic distance between them. Based on Heckscher-Ohlin model, when two countries have similar resource, the reason for the difference in prices is border effect, and gravity equation is a useful instrument to explain these items. Many researches have proved that involving geographic distance variable in regression is significant for analyzing bilateral trade and some explanation has been made (chaney 2018). The theoretical foundation for the gravity equation was built based on constant elasticity of substitution preferences and goods that are differentiated by region of origin (Anderson 1979). Anderson helped to explain the presence of income variables in the gravity equation, as well as their multiplicative (or log linear) form. It shows that multiplicative gravity equation has a great power to interpret trade flows and the results is reliable. Linnemann (1966) added demographic variables to the gravity equation, arguing that the scale of trade between the two countries is positively related to the scale of population. In his article “An econometric study of international trade flows”, he treats comparative advantage as an endogenous factor and try to find other factors related to bilateral trade flow. He

found that demographic variables can increase the interpretation of the gravity equation for bilateral trade and population is significantly related to trade. Income per capita is a better indicator than population when analyze the trade between large and small countries (Bergstrand 1989). After that, gravity equation has been developed into gravity model which uses many different variables to analyze bilateral trade, like population, gross production, distance and so on. Because the data required by the gravity model has the characteristics of high availability and high credibility, the application of the trade gravity model is becoming more and more popular. Based on these theories, the model in this thesis will include the influence of distance, economic size and population (data can be found in World Bank database). Every variable will take log to reduce the effect of heteroscedasticity on regression and the result will be reliable (Anderson 1979). To avoid multicollinearity problems, control variable only be related to U.S. trade partner not include U.S. data. The regression equation in this article will be $\ln X_s = a\ln Y_i + b\ln D + c\ln I_i + \lambda_i \ln \tau_i + \varepsilon$, where X is the import, Y is the real GDP, D is the distance between the trading country and the United States, I is the real GDP per capita, τ is tariffs, s is the different sectors, i is U.S. trade partner. Through regressing imports on these variables, whether the tariffs has a significant influence on U.S. imports can be found in the result of regression.

After finding the relation between tariffs and imports, this article will create a model to analysis the changes of welfare level due to tariff increases. Based on the theory reviews, increasing tariffs could increase the living cost of citizens and reduce overall consumption. The effect of tariffs on welfare depends on the comparison between consumer surplus and producer surplus plus tariffs income.

A popular method to measure the effect of tariffs on welfare is the computable general-equilibrium (CGE) model. The general-equilibrium approach on international trade is particularly useful because it considers all impacts of the new tariffs, provides a consistent assessment of the winners and losers, and measures the net loss in income (Balistreri 2019). In his article “International Trade Policy: Insights from a

General-equilibrium Approach", Balistreri believes that the benefits from international trade outweigh the costs after evaluating all markets. Although protectionism is benefit for steel and aluminum workers, other sectors may face loss which will offset the beneficial effects of protectionism and eventually lead to inefficient allocation of resources. Based on general equilibrium model, Balistreri holds that because both countries have their own currency, every country need to sell products or bonds to get another currency which can be used in international trade. Trade deficits can be separable from tariffs and other trade policy distortions, which can be seen as borrowing from or lending to the rest of the world. Improving the welfare of residents by eliminating the trade deficit is not feasible. A detailed general-equilibrium simulation model has been made to measure the economic impacts of the trade war (Balistreri et al. 2018). The article "Quantifying Disruptive Trade Policies" describes quantitative analysis about the economic impacts of tariffs implemented by the United States in 2018. This article develops a flexible modeling framework to reveal the inherent structural sensitivity of quantitative trade policy, concerning three alternative representations of international trade: Armington model, Krugman model and Bilateral Representative Firms model. Through comparing the difference of the models, this article can measure the impact of possible endogenous factors, like monopoly power or the differences in productivity between companies. The model follows the basic microeconomic optimization framework: (i) Consumers maximize utility by adjusting personal consumption within budget constraints. (ii) Producers minimize costs by adjusting factor inputs within technological constraints. labor and capital are mobile across sectors within a region. Nested constant-elasticity-of-substitution function is used to describe the preferences and technological constraints, which capture the reaction of demand and supply to changes in relative prices. In order to better study the effects of the trade war, the article uses sector-level data to distinguish between winners and losers. The article also compares the impact of trade war in different countries to observe whether trade war will benefit third parties. This article got some intuitive results: (i) Across regions, damages from the trade war are concentrated on the US and China. (ii) Trade war has

different effects on different sectors, and cross-sectoral analysis is useful to increase credibility. (iii) Third parties benefit from the bilateral dispute between the US and China through trade diversion along the intensive margin, but suffers from the overall loss of varieties. Through comparing three alternative trade models, this article analyzes the structural sensitivity on trade assumptions and the result reveals that scale economies and variety effects have an important impact on quantifying the magnitude and distribution of economic impacts at the level of countries and sectors. This article uses the general equilibrium approach to analyze the impact of trade wars on welfare and considers the endogenous disturbances from different trade assumptions. Applying sector-level data is better for reflecting the impact of the trade war and spillover effects of trade wars could affect results when comparing the change of welfare among different countries.

Another example is from Dong and Whalley (2011). In the article “Gains and Losses from Potential Bilateral US-China Trade Retaliation”, they applied general equilibrium method to measure the effect of bilateral US-China trade retaliation. The basic model assumption built in this article is Armington assumption and nested constant-elasticity-of-substitution function is used to describe the production function. They believe that trade retaliation between US and China has a welfare effect by affecting the terms of trade and thus the relative prices of goods. Compared with the previous article, the model in this article involves currency non-neutral effects and treat trade surplus as an endogenous factor. Country-level data has been used in this article and the different reaction of sectors is captured by the chosen substitution elasticities. On the supply side, this model assumes the reserve currency can be affected by central bank policy, bank will absorb excess supply of foreign currency at a given exchange rate, which will make the trade surplus be determined endogenously. Given a large trade surplus in China, if this is endogenously determined in the model, the effects of bilateral trade retaliation can appear as quite different. On demand side, a simple monetized extension to a pure barter trade model with a transactions demand for money and unitary velocity of circulation has been built in this article. The result

from traditional Armington model shows that US will gain in welfare and terms of trade under bilateral retaliation and other regions will face loss. But after treating trade imbalance as endogenous variable, the result suggests that the trade deficit regions, US and EU, will face welfare loss while the trade surplus regions, China and other regions, have welfare gains. This article shows that elasticity values in both models will affect the results and currency neutrality has implications for studying welfare changes.

Although applying general equilibrium analysis to quantify the impact of tariffs on welfare has complete mathematical inferences, the assumptions the model required are far from reality and many endogenous variables may affect model results. Many scholars want to use a basic theoretical analysis framework to measure welfare costs. Unlike derivation through mathematical formulas, some scholars hope to obtain welfare costs through geometric analysis and then regress the cost on the change of tariffs to measure the effect of protectionism. If the graph has a good fit, this method can build model with empirical data instead of based on theoretical assumptions. Tullock (1967) applied this method to measure the welfare cost of tariffs and provided basic theoretical analysis for his model. The article analyzes the welfare loss triangle in the framework of international trade and assumes the supply elasticity of the imports is infinite. A part of goods is imported and part produced domestically, which is close to the reality. Infinite supply elasticity of foreign producer means the foreign price of goods is constant and will not be influenced by tariffs. When domestic excise tax is not considered, increasing tariffs will increase domestic commodity prices, which will increase domestic production while domestic demands declines and the imports will decrease. Welfare cost of tariffs can be measured by the loss in consumer surplus and the gain in producer surplus and government income. This method can be used in analyzing the welfare loss of trade war between US and China (Amiti et al 2019). Based on the standard model of import tariffs, this article holds that after increasing the tariffs, the price of goods will rise and the consumption will reduce, which will influence welfare. In their model, the change of welfare can be measured

by the change of domestic commodity price and consumption ($WL = \frac{1}{2}\Delta p * \Delta m$). Through regressing the change of welfare loss on the change of tariffs rate, this article can find whether there is a significant relation between tariffs and welfare. And the effect of tariffs on employment rate can also be measured by replacing the dependent variable into the change of employment rate. Through regressing the change of imports price on the change of tariffs rate, this article finds that the elasticity of foreign exporters is infinite, which is similar to the result of another study using fixed effect model (Fajgelbaum et al 2019). Their article provides empirical support for the point that there are real income losses from import protection and by distinguishing between changes in import prices and domestic prices, they believe that the entire incidence of the tariffs fell on domestic consumers and importers. However, some potential welfare costs may be ignored by the model, such as transfer costs, trade policy uncertainty cost and so on. However, this method is based on direct observation of the data, it does not require too many theoretical assumptions and the conclusions obtained are more general. As social welfare is mainly affected by prices, consumption and employment levels, the second method could be better for analyzing the economic impact of protectionism.

2.4 Research on the US-China trade war

Protectionism in recent years has seriously affected the international trade environment. In order to maintain the mainstream status of free trade in economic region, many economists try to find out the economic impact of protectionism. Before the recent US-China trade war, some economists have predicted the effect of increasing tariffs on national welfare with theoretical assumptions and past data (Dong and Whalley 2011). Due to the lack of empirical data, these research conclusions are easily affected by other factors, such as trade retaliation and technology development. In the past two years, many scholars studied the impact of protectionism on the economy with the data of US-China trade war and get some intuitive and robust conclusions. Because welfare is an important indicator for trade

effect, many researchers studied the economic significance of protectionism by analyzing how the trade war affects welfare and what is the consequence.

Because the China-US trade war has gone through multiple rounds of negotiations, many scholars have established models to study the impact of initial rounds. Balistreri et al. (2018) analyzed the impact of the 2018 trade disruptions on the Iowa economy through combining a global CGE model and a regional CGE model of United States. This article analyzes what is the effect of the first round on Iowa welfare level, the tariff increases up to the $50 billion in August 2018. Because the retaliatory taxation of China is focused on U.S. agricultural exports and Iowa is a major agricultural state in the United States (about 1% of Gross State Agricultural Product), the impact of the trade war on this state could be more significant. In their article, a partial-equilibrium model was used to analyze the impacts on the four main agricultural sectors of the Iowa economy without linkages among the markets and industries across the state of Iowa, and a general equilibrium model was used to examine the trade disruptions across 20 distinct industries in Iowa after considering that the different effects of trade war on sectors. There are two assumptions about price was made in this article, the price changes are based upon supply and demand elasticities or the price changes are based upon observations in the futures market. The price in futures market reflects crop production projections for the upcoming crops which can influence the effect of trade war. Both models and their two sets of assumptions result in four estimates of the trade impacts and all of the results are similar. Overall losses in Iowa's gross product are calculated to be $1 to $2 billion and the revenue losses in main agricultural sectors translate into additional lost labor income across the state range from $245 to $364 million with federal offsetting. Comparing the results from using different price data, the crop production projections will not influence the result significantly. Comparing the results from different models, even after accounting for industries that may benefit from greater protectionism, the overall impact has not changed much. Their article shows a good framework to analyze the effect of trade

war, but due to the complexity of industries within the states, this method is difficult to analyze the nationwide impact.

Bollen (2018) uses WorldScan model, a special computational general equilibrium model of the world economy, to assess the impact of tariff increases and the general equilibrium effects to other countries indirectly affected by the policies. This article provides a broad view of the national economic impacts of the tariff increases and predict changes in overall welfare of the countries. Three trade policy scenarios have been constructed in this article, including the tariff increases in steel and aluminum, the unilateral increasing tariffs to imports from China and the possible retaliatory responses by trading partners. Based on these scenarios, some hypothetical tariff increases on imports have been used to simulate the effect of trade war. Through comparing the results from different scenarios, this article draws the following conclusions: (i) the unilateral imposition of steel and aluminum tariffs by the US has a very low impact on the US and its trading partners. (ii) when several countries retaliate against the US at the same time, some countries will gain from trade conflicts (trade diversion effects). (iii) After adding the US-China trade conflict, the GDP loss for China is significant to 1.2%, while US faces a limited GDP loss (about 0.3%). Although this article predicts the impact of trade war from global perspective, the chosen countries are only developed (European Union) or close to US (Canada and Mexico). The target sectors are steel and aluminium, the crop sectors which can be influenced directly by trade war are not involved in his article.

Carvalho et al.(2019) use GTAP model to analyze the effect of the US-China trade war first round on the overall welfare. The emerging countries have been involved in their model and the effect of trade war on different sectors can be estimated. Compare with the method of Balistreri et al. (2018), GTAP model can directly capture the input-output relationship between different sectors in the global market and thus its result of estimate is more robust. This article made hypothetical tariff rates based on two trade scenarios: one corresponds to the unilateral imposition of US import tariffs on products from China and other countries, and another considers the Chinese

retaliation against the US. When analyze the effect of trade war on welfare, this article measures three factors affecting welfare, allocate distortion effects, terms of trade effect and investment-saving effect. The result shows that the welfare losses of US are mainly from distorted allocation and China welfare losses would be related mainly to terms of trade effect. After analyzing the estimation of GTAP model in two scenarios, this article made following conclusions: (i) the trade deficit of US will decrease significantly and the domestic production of steel and aluminium will increase. (ii) The world would face welfare loss, due to the significant allocation distortion, especially in the US ($23.598 billion), and the loss of terms of trade, especially in the China ($43.063 billion). (iii) the emerging countries have gains from US-China trade war, which are concentrated in terms of trade improvements. About measuring the welfare loss of US and China, this article made a similar estimation to the result of Bollen (2018) and it further studied the impact of different effects on welfare. However, these studies use hypothetical tariffs increases on all exports, so their results cannot fully and accurately capture the impacts of the trade war.

Amiti et al. (2019) use the empirical data to analyze the effect of 2018 trade war on U.S. prices and welfare with the standard economic method. They argue that conventional trade model is an effective framework for understanding what has happened to prices, quantities, and welfare and the impacts of tariff increase can be predicted based on a simple supply and demand framework. The data is from U.S.. customs in 10-digit level of harmonized tariff system. Based on their model, the welfare loss can be measured by the change of domestic commodity price and consumption ($WL = \frac{1}{2}\Delta p * \Delta m$). They use the data from 12 months ago as benchmark and take the logarithm to measure how the data changed during the trade war (ie, the change of price can be measured by $\frac{\ln p_t}{\ln p_{t-12}}$). Through regressing the change of price and the change of welfare on the change of tariffs, this article can make some conclusions about their relation. The results from their model suggest: (i) The welfare cost from the U.S. tariffs is around $6.9 billion during the first 11 months of 2018,

with an additional cost of $12.3 billion to domestic consumers and importers in the form of tariff revenue transferred to the government. (ii) The U.S. tariffs were almost completely passed through into U.S. domestic prices, so that the entire incidence of the tariffs fell on domestic consumers and importers. (iii) The trade war affects the international supply chains significantly, as approximately $165 billion dollars of trade is lost or redirected in order to avoid the tariffs. This article provides the empirical support for the point that welfare will loss from tariff increases and the measure of welfare loss is more reliable. However, because of policy uncertainty and short time spans of the data, this model cannot predict the long-term impact of the trade war.

Minghao et al. (2019) quantify the impacts of US-China trade war using the GTAPinGAMS model, a computable general Equilibrium (CGE) model which calibrated to the recently released GTAP 10 database. This article is the first comprehensive evaluation of the US-China trade war using CGE method and all of the cumulative tariff increases in different rounds of trade disputes have been used in the analysis. In their article, three scenarios are constructed with different tariff increases: (i) Steel-aluminum Tariff increases due to the U.S. steel and aluminum tariffs and retaliatory tariffs from China, the EU, India, and Turkey. U.S. (ii) The current tariffs imposed by China and U.S. (iii) All implemented tariff increases and announced threats between the United States and China. Compared with previous articles, this article involves all the rounds of tariffs increase and analyzes the importance of the trade dispute to the individual sector. The article draws the following conclusions: (i) The implemented tariff increases decrease welfare in China by 1.9% and welfare in United State by 0.3%. (ii) the tariffs have substantial effects on the output of targeted sectors as well as related sectors. (iii) China's export to and import from the U.S. will be reduced by 58.3% and 50.7% respectively under the accumulated tariffs as of September 2019. (iv) Most other countries and regions, especially major exporters of manufactured goods to the United States, gain from the trade dispute between the United States and China. This article not only analyzes the

impact of trade war on global market, but also considering its effect on individual sector. All existing US-China trade war data have been used in their model, which makes their estimation of welfare cost be more reliable. However, this model faces the parametric and structural uncertainty, parametric sensitivities analysis is too simple to prove the robustness of the model. Whether the model can be supported by empirical data needs further research.

3. Typical protectionism examples

After the second world war, some countries have adopted significant protectionist measures to reverse trade deficits or protect own industries, including increasing tariffs, applying import quotas, limit on technology and patents, restrictions on foreign investments and so on. These measures always reduce imports and increase jobs in some industries, but based on literature review, decreasing exports and increasing cost of product tend to make a significant loss for the whole economy. In some cases, these measures improved their trade accounts in short run, however, the results will be unpredictable if the other party retaliates. Even if the other side adopts a compromise policy, the trade situation has not changed fundamentally with the implementation of protectionist policies. Historical data indicate that protectionist policies in bilateral trade will cause significant losses to at least one party. In this section, two typical protectionist incidents will be introduced (Japan-U.S. trade dispute and U.S. steel safeguards in 2002), including event background, causes, processes, results and so on. Through analyzing these two typical protectionist events, this article will find whether protectionist has achieved its goal and which factors will influence the results. Through comparing the difference between the events and present China-U.S. trade war, this article will identify possible effects of the present trade war on U.S. economic.

3.1 Japan-U.S. trade dispute during 1960-1990

The first protectionist example is Japan-U.S. trade dispute. There are many similar features between this trade dispute and the present trade war, which makes it be reasonable to compare them. During 1960s-1990s, United States and Japan engaged in decades-long trade disputes. It related to many industries, including the textile, steel, color TV, automotive, semiconductor, and telecommunications industries. After

a long period of trade negotiations, two countries have signed a series of agreements to gradually reduce the U.S.-Japan trade deficit. It is different from the present China-U.S. trade war that Japan did not take retaliation measures, but Japan used state support to ensure the competitive advantage of enterprises and hoped to obtain U.S. tariff exemption.

After 1950s, the rapid economic development of Japan (the average growth rate is around 10%) and the continuous expansion of exports to the United States (the trade surplus of Japan with U.S. reached $ 148.5 billion in 1985) have resulted in a significant trade imbalance between United States and Japan. Based on this, in order to improve trade account, United States implemented protection policies for some industries in which Japan has comparative advantages, including tariffs, quotas and other typical protectionist measures. With the upgrading of Japanese industrial structure, the protection scope of U.S. industry has expanded from labor-intensive industry (textile) to the capital-intensive industry (automotive, color TV) and high-technology industry (semiconductor, telecommunications). As Japanese goods were mainly exported to the United States, to protect other industries, Japan has not retaliated against U.S. protectionist policies and implemented voluntary export restrictions on related industries to calm trade frictions. However, such a compromise has not prevented the United States from imposing punitive measures on other industries. During three decades, Japan made compromise in many industries, including setting voluntary export restrictions in three industries (textile, steel and automotive), paying settlement money to stop U.S. anti-dumping duties on Japanese TV exports, opening domestic telecommunications market to the U.S. and promised to purchase American equipment, setting the lowest share of imported semiconductor products in the Japanese market and so on. All of these decisions are to reduce exports to American and imports more products from American, which is similar to the current requirements of the United States on China. However, these compromises did not stop Japan-U.S. trade dispute, U.S. government asked to change the exchange rate to improve the competitive advantage of U.S. products. In 1985, the Plaza Accord

depreciated significantly the U.S. dollar in relation to the Japanese yen by intervening in currency markets, which led to a decline in the international competitiveness of Japanese products and the Japanese asset price bubble of the late 1980s. Throughout Japan-US trade dispute, United States used some typical protectionist methods, such as imposing punitive tariffs on Japanese cars and imposing import quotas on Japanese textiles, which is similar to China-U.S. trade war. The difference is that China-U.S. trade war involves almost all trade products, tariffs generally rise across industries and no initial consultations within the industry, which makes it more difficult for China and United States to reach consensus. In Japan-U.S. trade dispute, U.S. restrictions on Japanese high-tech industries are particularly obvious. Since the high-tech industry is of great significance to the development of the country, most countries spend a lot in developing technology and supporting high-tech companies. Before Japan-U.S. trade dispute, high-quality labors and efficient production lines make Japanese companies have obvious production advantages in high-tech fields, and with the strong support of the state, Japanese companies hold a lot of core technologies lead in the production of high-tech equipment parts. To protect own high-tech industries, U.S. government made a series of measures, such as patent restrictions, dumping duties and so on, to make Japan open its market and reduce production. All of these measures are similar with present U.S. policies, patent disputes and imports restrictions has been more and more serious. Based on this, it is reasonable that the difficulties in the trade negotiations between China and the United States will focus on high-tech industries. Due to Japan always take compromise in years of trade disputes, which is completely different from China, and the number of industries involved in Japan-U.S. trade dispute is far less than the China-U.S. trade war, it is reasonable that China-U.S. trade negotiations will be more difficult to bring the two sides to a settlement. Considering that the Plaza Accord played an important role in eliminating the U.S. trade deficit, the appreciation of the yuan (Chinese currency) may be one of the main goals of the United States. Some researches believe that the undervalue of Chinese currency is one of the main reasons for the deficit of American current account (Bergsten 2010). Through increasing the value of yuan,

Chinese exports will loss price advantage and United States will therefore improve its trade situation. Through researching the process of Japan-U.S. trade dispute, this article found that if China and the United States reach agreement on high-tech industries and exchange rates, it will be an important part of the end of the trade war.

The results of the Japan-U.S. trade dispute also provide references for the prediction of China-U.S. trade war. Based on historical data (Figure 3.1), U.S. tariffs on Japanese exports are only effective in the short term, U.S. trade account with Japan has not improved much in the long run, which means increasing tariffs did not meet U.S. main goal. What is more, with the support of Japanese government, U.S. protection policies prompted Japan to adjust its industrial structure (transformation of labor-intensive industries to technology-intensive industries), and the average added value of its exports has continued to rise, which makes Japan keep its stage in international market. Japanese voluntary export restrictions have improved the quality of Japanese export products, prompting U.S. import demand to shift to high-quality products. The appreciation of the Japanese yen has increased the competitiveness of the Japanese industry, promoted changes in the structure of import and export commodities, and promoted the development of tertiary industry. Based on this, it is difficult for the U.S. trade deficit with Japan to improve significantly. Although Japan still maintained a large trade surplus with the United States, this trade dispute still has a significant negative impact on Japanese economic development. Based on the historical data, after the trade dispute, the real GDP growth rate of Japan has fallen from 9% to 4% and now only about 1% (Figure 3.2). Based on real GDP and GDP per capita data (Figure 3.3), relative to United States, Japan has experienced an obvious inflection point and has never surpassed it. Japanese economic development has been slowed significantly, and its economic dependence on the United States has further increased. In the years following the Plaza Accord, the yen has appreciated 64% relative to the US dollar and Japanese government adopted positive fiscal policy to ensure domestic market demand, which caused the Japanese economy to rapidly bubble and eventually cause a severe recession. Blind changes in exchange rate have

brought a painful price to Japan. The rise of currency values made a lot of Japanese capital were used in purchasing foreign assets, which made Japanese companies lack capital in long-term competition. In the high-tech industries, the U.S. restrictions on Japanese related companies also played a significant role in the decline of Japanese economic. Patent restrictions and loss of price advantage have led to the rapid decline of the Japanese semiconductor industry (market share in the world dropped by 80%), and many Japanese high-tech companies have gone bankrupt. After this, Japan gradually lost its leading position in high-tech industry and many of the core components of high-tech products rely on imports. The opening of domestic market makes Japanese high-tech companies lose the environment for redevelopment and the increasing cost of labour force makes Japan lose production advantage. Judging from the results of Japan-U.S, trade dispute, although Japan took compromise policies for trade frictions, U.S. trade deficit with Japan has not significantly improved through protectionist policies in long run. Compared with the present China-U.S. trade war, it is reasonable that protectionist policies may be less effective at improving trade deficits due to Chinese retaliation. Japanese economic recession triggered by changes in exchange rate will make China more cautious in negotiating exchange rate issues. The economic bubble will seriously endanger the Chinese economy, which will prevent the value of the yuan from rising significantly in a short period of time. U.S. goal of reducing trade deficit by changing exchange rate is difficult to achieve. In the high-tech industries, the development of Chinese company technology has put pressure on U.S. companies. A large amount of R & D investment has made Chinese companies lead in some areas. Although some core parts and components of Chinese high-tech products still depend on imports, the strong production capacity enables China to quickly become self-sufficient after mastering related technologies, which will cause related U.S. companies to lose some markets and leading positions. Patent issues and the market share in China of U.S. high-tech companies will be an important part of China-U.S. trade negotiations. Lessons from Japanese exchange rate compromise and the decline of high-tech companies will make China be more cautious on this two issues, which means that agreement on this two issues between

the two countries will be very important for the end of trade war. As for the motivation, United States launched this trade war to improve its trade deficit, however, the result of Japan-U.S. trade dispute shows that protectionist measures are difficult to reverse the trade deficit, which is consistent with mainstream economic theory, but Japan was plunged into a severe recession. Based on this, compared with simply studying the improvement of trade account, studying the changes in the welfare level of residents is more convincing in judging the effects of the trade war on U.S. economic. Transient changes in the trade deficit may be accompanied by a large loss of consumer welfare.

3.2 U.S. steel safeguards in 2002

Another example is U.S. steel safeguards in 2002. Before this safeguard, there were more than 30 U.S. steel makers declared bankruptcy and the international competitiveness of U.S. steel has declined significantly. In order to reduce the impact of the surge in imported steel on the domestic steel industry, the United States imposed tariffs of 8% - 30% on imported steel from the European Union, Japan, China and other countries. Unlike the Japan-U.S. Trade dispute, many countries have quickly taken retaliatory measures in response to U.S. protection policies. The World Trade Organization played an important role in ending this dispute. Due to the huge impact of this protectionism measure on the world steel market, the U.S. government faces huge external pressure from other countries and eventually cancels this safeguard. The trade dispute lasted only a few years from the beginning to the end, studying how this trade dispute was resolved is helpful for the settlement of trade war.

The steel industry has always been one of the major industries in United States, however, since 1970s, the United States has a serious shortage of technology investment in steel production, which has made the cost of steel production too high and lost its production advantage in the international market. European steel companies reduce production costs and improve quality by upgrading production

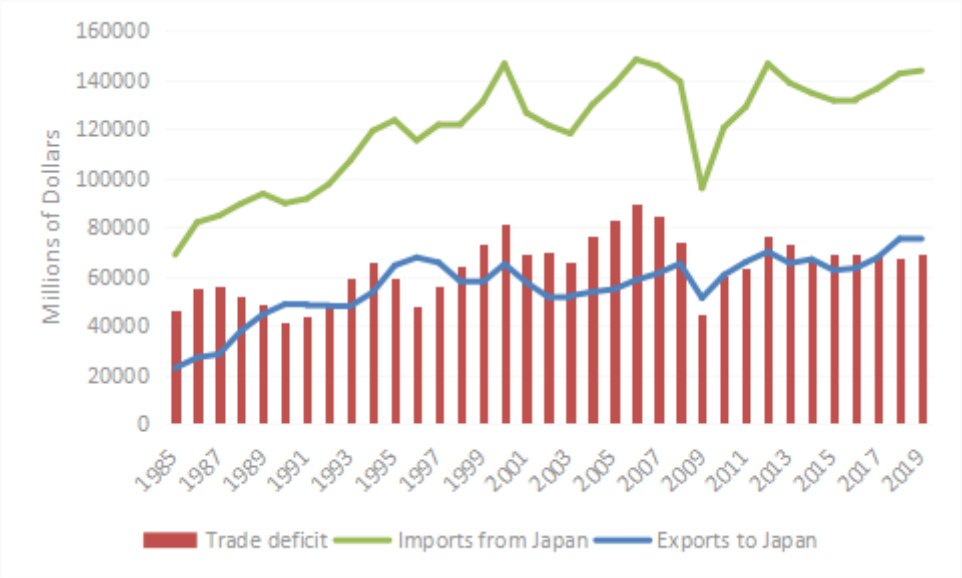
processes, and then, many American companies imported steels from Europe to make products. In 2000, United States imported 34 million tonnes steel with import penetration of 30%, which is the peak of imported steel. The impact of imported steel on the U.S. domestic market made the steel industry face profit margins fall and the unemployment rate rises. Many steel companies required the U.S. government to develop policies to protect domestic steel markets. In 2002, after comparing the foreign and domestic steel production, U.S. government believes that subsidies to the steel industry in other countries are an important factor causing the decline in U.S. steel competitiveness and government should take measures to reduce imported steel (Zoellick, 2002b). To protect domestic steel industry, U.S. government imposed many anti-dumping duties and countervailing measures, which made imported steel no longer have a price advantage in the U.S. market. Compared with Japan-U.S. dispute, this measure involves the major industrial producers in the world and caused a significant decline in international steel trade volume in that year. Many countries have retaliated against U.S. protectionist policies, including rising imported steel tariffs and implied other restrictions on imported U.S. steel, which is similar to the present China-U.S. trade war. This dispute shows the effect of tariffs on trade transfers, other countries expanded steel exports to China by about 40% in the following months according to the report of U.S. department of commerce, which is consistent with the increase in trade volume of third-party countries after present trade war. Based on this, trade transfers effect should be considered in researching China-U.S. trade war. Because too many countries are involved in this trade friction, it is difficult for the negotiation between countries to play a significant role. During 2002, the World Trade Organization played an important role in ending this trade dispute. Many countries turned to WTO for trade arbitration due to unsuccessful negotiations with the United States. After investigating, the World Trade Organization found that U.S. protection measures violates trade principles and urged the U.S. to eliminate tariffs, otherwise huge fines will be imposed. This eventually caused the US government to cancel steel imports tariffs, and world steel trade returned to normal.

Considering present trade war, it is reasonable that arbitration results of World Trade Organization will make an important impact on China-U.S. negotiations.

The results of this trade dispute show the adverse effects of protectionism on economic development. Although this steel safeguard has reduced the total amount of U.S. imported steel, the rise in the average domestic steel price has significantly increased the cost of the steel consumer industry, which has reduced the welfare of residents. According to the report of U.S. International Trade Commission in September 2003, the impact of the tariffs on the U.S. welfare loss is about $41.6 million. The rising production costs have reduced the steel consumer sector by nearly 200,000 jobs, which is even larger than the total employment (187,500) of the steel production sector at that time (Francois and Baughman, 2003). In 2005, the research of Read used empirical data further confirmed that the steel safeguards is harmful for GDP and employment and has significant redistributive impact (Read, 2005). All the researches about the U.S. steel safeguards in 2002 show that the protectionist measures may cause loss of welfare when other countries choose to take retaliatory trade measures. Based on this, researching the welfare effect of China-U.S. trade war on U.S. residents is meaningful, and the improvements of U.S. trade deficit may be accompanied by a huge loss of welfare. Due to the huge external pressure and the obvious decline in domestic welfare, the United States terminated this steel safeguard in 2003. Compared with Japan-U.S. trade dispute, this trade protection was settled very fast. Just involving one industry may be one of the important reasons for the quick resolution. The trade war between China and the United States involves almost all industries, making negotiation between the two countries extremely difficult, and it is difficult for the World Trade Organization to make arbitration in a short time. However, the huge effect of this steel safeguard on U.S. welfare loss shows that the welfare loss from trade war will exceed imagination. It is reasonable to measure the U.S. welfare change during trade war and to research whether protectionism has improved U.S. employment.

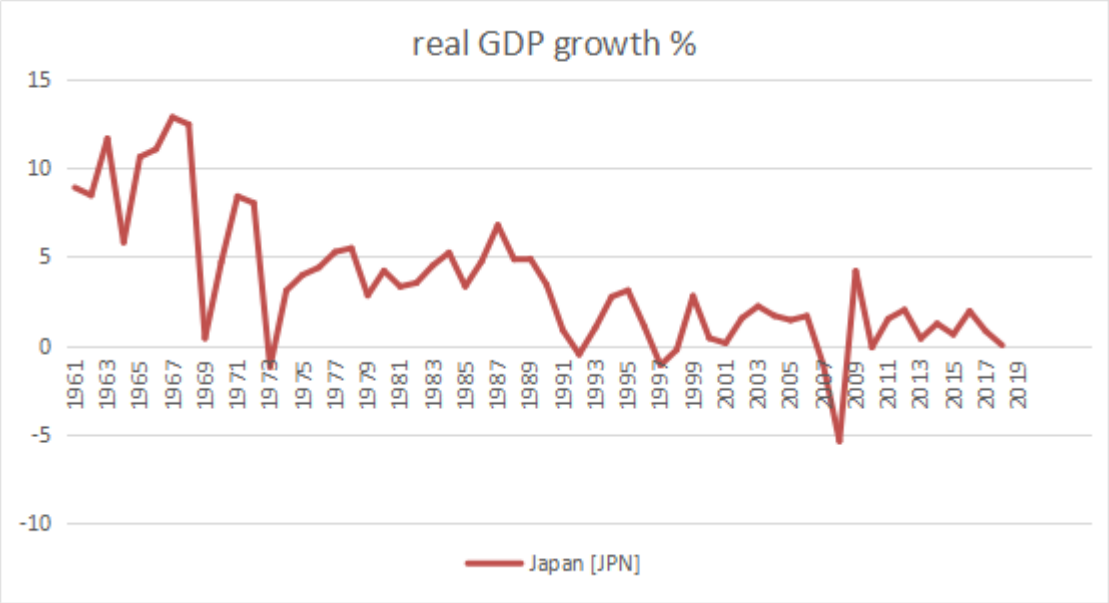
3.3 Figures

Figure 3.1： U.S. trade account with Japan



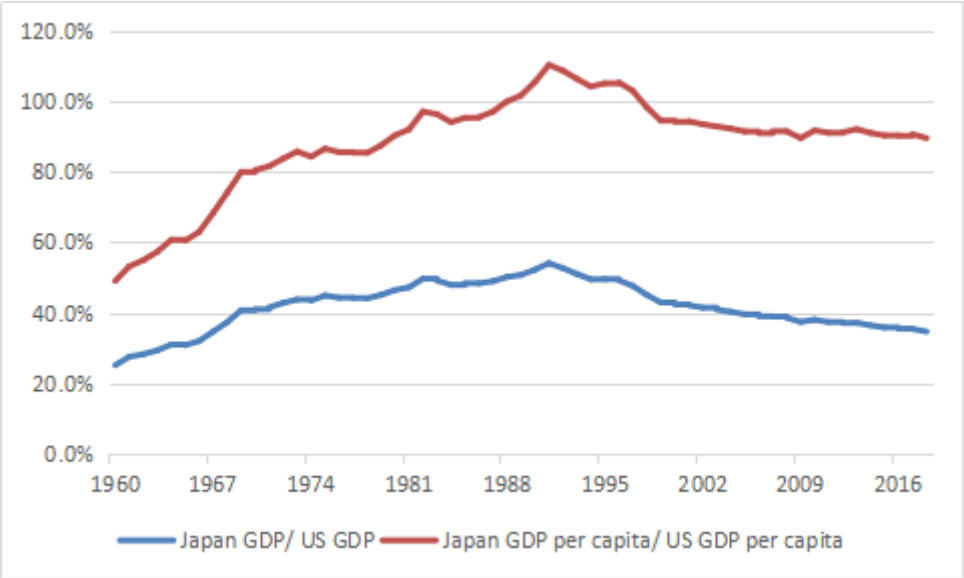
Source: Federal Reserve bank of ST.Louis

Figure 3.2: real GDP growth rate of Japan



Source: world bank database

Figure 3.3: Comparison about real GDP and real GDP per capita (Japan/US)



Source: world bank database

4. Method

4.1 the effect on imports value

As the direct reason for protectionist measures is the unbalance of U.S. trade account, whether increasing tariffs have a significant effect on US imports and how much of this effect will be an important factors in measuring the effectiveness of protectionist policies. The first part will test the relation between U.S. tariffs and imports. The data used in this part will include many countries, countries directly affected by U.S. tariff increases (like China) and other important U.S. trading partners (like Mexico). Based on literature review, gravity equation will be useful to study bilateral trade. Gross national product and the distance between countries will have a big influence on bilateral trade. Beyond that, language and common boundaries should also be considered to make the result be more reliable.

The basic equation used in this article is $X_{si} = Y_i^{a} Y_{US}^{\ b} D_i^{c} A_i^{\ d} \tau_{si}^{\ \lambda} \varepsilon$, where X_s is the value of U.S. imports value from s sector, Y is the real GDP in dollars, D is the distance between country i and US, A is any other factor(s) that may affect the trade, τ is the U.S. import tariffs rate, ε is a log-normally distributed error term with $E(\ln \varepsilon) = 0$. This specification is from Tinbergen (1962) with adding the tariffs as independent variable. To test the relation between imports and tariffs in different time, panel data will be applied in regression. Because the target country is United States, to avoid multicollinearity problems (all of U.S. data are same in one year, like U.S. GDP) , controlling variable only be related to U.S. trade partner and not include U.S. data. And then, the equation changes into $X_{si} = Y_i^{a} D_i^{b} A_i^{c} \tau_{si}^{\ \lambda} \varepsilon$. Because different countries have different scale of market and different types of imports and exports (elasticity is low or high) which may influence the reaction for the change of imports and exports price, income per capita will be used in this equation to reduce this effect

(the level of income per capita can to some extent reflect the demand of residents for imported goods). As different countries have large differences in many aspects, this equation may be influenced by heteroscedasticity, taking log will be a good way to reduce the effect of heteroscedasticity (Anderson 1979). The final equation will be $\ln X_{si} = a\ln Y_i + b\ln D_i + c\ln I_i + \lambda\ln\tau_{si} + \varepsilon$, where I is the real GDP per capita in different countries. Total real GDP and real GDP per capita can be found in the World Bank database and International Monetary Fund, imports value and tariffs rate data is from the U.S. International Trade Commission. And because many imports may be exempt from tariffs after negotiation, to avoid this influence, the tariff rate will be calculated through dividing U.S. calculated duties by custom value of imports and the result will be multiplied by 100 to make tariffs rate valuable be in percent level (100* Calculated Duties / Custom value of imports). After taking log of all variables, the coefficient of the equation means the elastic between dependent variables and others. To test the effect of tariffs, three data groups will be used (no tariff rate change in 2017, announced the increasing tariff rate in 2018, applied additional tariff in 2019), the empirical group is from 2018 and the prediction about the effect of tariff on imports will be based on it. Through comparing the results from different groups, more predictions about increasing tariffs could be made. Based on the difference of different years on tariffs, this article could measure the effect of tariff in normal years (if the results from 2017 and 2018 are similar) and find whether this effect still persist when high tariff rate has been applied (the difference between 2018 and 2019 will reflects whether tariffs have diminishing effects on import restrictions). Based on literature review, some other factors also have effects on U.S. imports. Three factors will be considered in the equation. Whether the trading country has the same language with the United States will be used as one dummy variable to test the effect of common language on U.S. imports. The effect of Economic freedom level on trade will be tested through adding a dummy variable, whether the score of freedom measured by Heritage Function has been over 60 (this number represents moderately free level and higher number represents higher free level). Whether the trading

country has common border with U.S will also be added as one dummy variable. After adding this three dummy variables, the equation will be changed into $\ln X_{si} = a\ln Y_i + b\ln D_i + c\ln I_i + \lambda_i \ln \tau_i + border + language + freelevel + \varepsilon$. Because the dummy variables in this equation may have direct effect on trade in theory which could influence the measure of other variables (common border could be related to the distance between countries or the GDP per capital could be related to the economic free level), the terms with interactions will be added into the equation (border*lnD, freelevel*lnI). After regressing the equation, stepwise regression method will be used to test the optimal form of the equation (through performing multiple regressions on different combinations of variables, unsuitable variables will be removed and the effect of collinearity on regression results will be reduced). White test will be used to test the heteroscedasticity problem in the equation. If the heteroscedasticity exists in the regression, Weight Least Squares regression will be applied to improve the accuracy of the estimate.

4.2 the effect on welfare change

Based on the third section, protectionist measures may not improve U.S. trade deficit significantly, especially when others choose to retaliatory. However, trade frictions will definitely affect the welfare of U.S. residents, which will be an important indicator of researching the outcome of China-U.S. trade war. The second part will focus on China-U.S. trade war in this two years and to measure the change of welfare in United States due to increasing tariffs on Chinese exports. After applying additional tariffs, the change of welfare will be the difference between the gain from the decrease of imports price and the loss from domestic consume distortion (Figure 4.1). There is a special case needs to be considered that additional tariffs will not influence imports price. Based on literature review, the price elastic of foreign producers maybe infinite in short run (the foreign supply curve is horizontal and p'=p), which means no changes in imports price (Fajgelbaum et al 2019). So the welfare loss is only from the distortion of domestic consumption (region B). As the data used in

this article is U.S. imports from China and not include other countries, which is different from other researches, the elasticity of imports price on tariffs need to be tested at first. After regressing the change of imports price on the change of tariffs rate, the price elasticity could be reflected by the coefficient of the result. Assuming the imports price could not be influenced by the change of tariffs rate (region C is 0), which is consistent with some other researches, to measure the welfare loss, another assumption needs to be made that the slope of demand is constant and then the region B will be a triangle. So the change of U.S. welfare can be measured by half of the change of domestic commodity price multiplied by the change of consumption ($WL = \frac{1}{2}\Delta p * \Delta m$). In this article, three period will be used: the data from year 2017 which did not be affected by China-U.S. trade war, the data from year 2018 in which some related information was announced and the data from year 2019 in which the additional tariffs has been applied for some time. The result from testing this three group will show whether the trade war has reduced U.S. welfare significantly and the reaction of U.S. domestic market. To measure the change of different variables during the same period, the 12-month relative change rate in variables will be used and all of variables will be taken log (ie, the change of price can be measured by $\ln\frac{p_t}{p_{t-12}}$). To make the data be available to test the effect of increasing tariffs rate, the equation need to be changed: $WL = \frac{1}{2}\Delta p * \Delta m = \frac{1}{2}\tau_t pm' \frac{m - m'}{m'}$ (Amiti et al 2019). pm' is the value of imports after applying tariffs, $\frac{m-m'}{m}$ is the percentage change of imports quantity in one year which can be estimated by regressing the $\ln\frac{m'}{m}$ on $\ln\frac{1+\tau_t}{1+\tau_{t-12}}$ (assume the coefficient is β), $\frac{m - m'}{m}$ can be measured by $-\beta\ln\frac{1+\tau_t}{1+\tau_{t-12}}$, the final equation will be $WL = \frac{1}{2}\Delta p * \Delta m = -\frac{1}{2}\tau_t pm'\beta\ln\frac{1+\tau_t}{1+\tau_{t-12}}$

（assuming increasing tariffs will not influence imports price p=p’）and all of the variables can be used to measure the effect of increasing tariffs on U.S. welfare change. Because the tariffs rate is different across sectors, HTS-8 digital level data will be used in this article, which is available in U.S. International Trade Commission, and the value of imports can be found from U.S. national database. To test the price elasticity of foreign supply, the regression $\ln\frac{p_t}{p_{t-12}}$ on $\ln\frac{1+\tau_t}{1+\tau_{t-12}}$ will be used, if the coefficient is very small, the elastic will be infinite (p=p’). The price data will be measured by unit value of imports ($\frac{pm}{m}$), which can be found from U.S. International Trade Commission. The final welfare loss of U.S. citizens will be the welfare loss from domestic consume distortion (region B) plus the part which has been transferred into tariffs revenue ($m'p'\tau_t$). If the imports price has been influenced by increasing tariffs, part of tariff revenue was from the decrease of imports price (region C) and then the final welfare loss of U.S. citizens will be region B plus total tariff revenue minus region C.

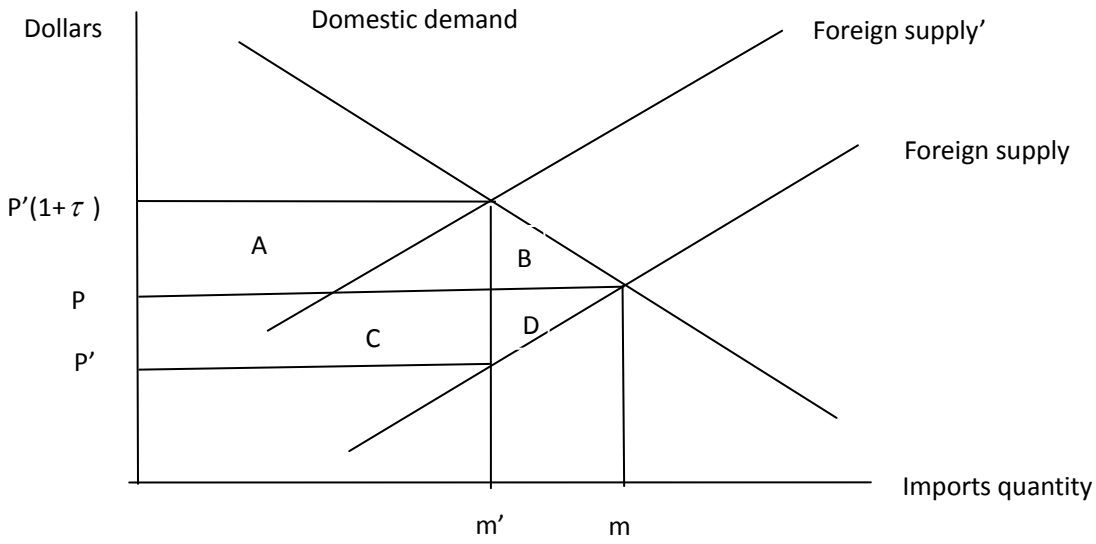
4.3 the effect on employment rate

The last part will test the relation between custom duties and U.S. employment rate. Based on the literature review, increasing tariffs will reduce the imports and increase domestic production, which will increase the demand of labour. However, based on the principle of comparative advantage, more domestic production will make a decrease in the efficiency of market resource allocation, which will increase the cost of production and then reduce the employment (David, 1817). In this part, the relation between tariffs and employment rate will be tested through regressing the domestic employment rate on U.S. tariffs revenue with a simple log-linear regression model (all of the data could be found in St. Louis Fed). Because the cost of production could be influenced by many other factors, Producer Price Index will be used as controlling variable to release this effect. As the gross domestic production and population will

influence employment rate directly, this two variables will also be tested in the regression. Ordinary Least Square regression will be applied to measure the relation between tariff revenue and employment rate. After taking log for every variable to reduce the effect of heteroscedasticity in the regression, the final equation will be $\ln ER = a_0 + a_1 \ln TR + a_2 \ln PPI + a_3 \ln GDP + a_4 \ln Population + \varepsilon$, where ER is the U.S. domestic employment rate, TR is U.S. tariffs revenue measured by U.S. custom duties, PPI is the domestic Producer Price Index, ε is a log-normally distributed error term with $E(\ln \varepsilon) = 0$. The data used in this article starts from 1999 to 2019 and Quarterly data will be applied in the regression. The coefficient of the variable TR will show the effect of tariffs revenue on U.S. domestic employment rate. Because the total effect of tariffs on employment could not be determined, the sign of the coefficient could be positive or negative, negative coefficient means the decreasing employment from lower resource allocation efficiency is bigger, positive coefficient means the increasing employment from more domestic production demand is bigger. Through multiplying the coefficient of the variable TR with the change of tariff revenue from increasing tariffs on imports from China, this article could measure how much percent change of U.S. employment rate was from China-U.S. trade war.

4.4 Figure

Figure 4.1: the effect of tariffs



Source: author's computations.

After applying tariffs rate τ , the price of foreign supply will decrease to p' (based on the elastic of price, foreign producer need to bear part of tariffs) and the domestic price will increase into $p'(1+\tau)$. Rising prices will reduce domestic demand, imports quantity will decrease to m'. Region A is a transfer from consumer surplus into government tariff income, Region D is the loss of foreign producer from production distortion. The change of welfare will be (C-B), welfare gain from the decrease of imports price minus welfare loss from domestic consume distortion. If the price elastic of foreign producers is infinite in short run, the foreign supply curve is horizontal and p'=p. In this case, the change of welfare will be the region B, the region will not decrease but domestic consume distortion still make welfare loss.

5. Empirical result

5.1 the effect of tariff rate on imports value

$\ln X_{si} = a\ln Y_i + b\ln D_i + c\ln I_i + \lambda_i \ln \tau_{si} + language + freescore + border + \varepsilon$ has been regressed on the data from 2018 (Table 5.1). Although all of variables are significant, signs of some variables are not consistent with expectations. Common border and high economic freedom level should attract U.S. to import more, because of low transportation costs and convenient capital conversion, but the sign of these variables are negative, which means the equation may have collinearity problem. The White Heteroskedasticity test shows Ordinary least squares regression method could not estimate the coefficient of variables effectively. Through adding the terms with interaction (border*lnD, freelevel*lnI), the collinearity problem has not been improved, there are useless variables in the equation. After reducing variables based on stepwise regression, collinearity problem can be effectively eliminated and only dummy variable "language" still keep in the equation. For reducing the heteroskedasticity in the equation, Weight least squares regression will be used. After making an auxiliary regression to generate an estimate of the error variance, the reciprocal of the estimated variance could be used as weight to reduce heteroskedasticity in the original regression. The result of Weight least squares regression could be found in Table 5.2. All of variables are significant and the p-value of F test is very low, which means the regression is meaningful. Low standard error shows the coefficients in the regression are precisely estimated. Positive relation between Y and Xs is meaningful, higher GDP level means more production which will attract United States to import more. Negative relation between I and X_S could be accepted, higher GDP per capita in trading countries means more domestic demand which will reduce local commodity exports. Although expected relation between Language and X_S should be positive (same language could make the business

negations be easier), the reason for negative sign may be the United States increased tariff rate on most English-speaking countries (like UK, Germany and so on), the tariff rate on many non-English-speaking countries did not change in 2018 (like India, Mexico). The target explaining variable of this regression is tariff rate, which is significant and has a very low standard error (0.007). Negative relation between tariff rate and imports value is expected, higher tariff rate lead to more cost of imports which will reduce the value of imports. The tariff data is calculated through dividing duties by custom value of goods, which will avoid the impact of possible tax deductions on imports value, and the data will be multiplied by 100 to change into percent level. The result shows increasing tariff rate has a significant effect on imports value, increasing 1% tariff rate will decrease 0.59% of U.S. imports value. Based on the announcement of U.S. government, most of the increasing tariff rate on other countries is in the range from 10% to 25%, which means the imports value may fall 5.9% to 14.8% (multiply the announced tariff rate with 0.59). Considering the total U.S. imports value on 2018 is 254.2 billion (data from the United States Department of Commerce), the increasing tariff rate will make United States reduce imports significantly.

Compared with the regression on the data from 2017 (Table 5.3), the effect of tariff rate on imports value in 2018 is a little smaller than 2017 (from 0.68% to 0.59%) and the sign of language variable in 2017 is positive which is expected (because no increased tariffs on English-speaking countries in this year, common language should promote imports). The difference of tariff rate effect between 2017 and 2018 is not big (just 0.1%), which means the effect of increasing tariff rate on imports value will not change too much in different time and the prediction in this article (U.S. imports value will reduce 5.9% to 14.8% because of increasing tariffs rate) is reliable. Because many announced additional tariffs in 2018 has been applied for some time in 2019, the difference between 2018 and 2019 regression results could reflect the change of tariff effect in different tariff rate level. The regression result of the data from 2019 (Table 5.4) shows that the effect of increasing tariff rate on imports has

been very small (increasing 1% tariff rate will decrease imports value only 0.1%). The difference between 2018 and 2019 means the effect of this protecting measure is limited and further increasing the tariff rate could not improve the imports too much. All of the results show that the tariff rate has significant effect on imports value but this effect will decrease as the tariffs rate increasing. Increasing tariff rate may make U.S. reduce 5.9% to 14.8% imports from related country, however, the effect of this protecting measure may be very small when the tariff rate has been very high.

5.2 the U.S. welfare change after trade war

Because the imports price elasticity will influence the calculation of welfare loss (if the imports price will not change after applying additional tariffs, the cost of new tariffs will be taken by U.S. domestic consumers and no gains from imports price changing), the relation between imports price and tariffs rate will be tested firstly. This effect could be tested through regressing the change of log imports price over twelve-month period ($\ln \frac{p_t}{p_{t-12}}$) on the change of one plus tariff rate ($\ln \frac{1+\tau_t}{1+\tau_{t-12}}$) over the same period. The coefficient in this regression captures the impact of increasing tariffs on U.S. imports price and infinite elasticity means the coefficient should be very small. The regression in this article relates two periods, 2018-2017 and 2019-2018, if the result have no big change in different period, the elasticity may not have big change in short run.

The regression results of imports price elasticity could be found in table five. Fixed effect has been included in the regression based on HTS-8 products. And to avoid the impact of extreme data on regression results, any observations with a ratio of unit values in t relative to t-12 greater than 3 and less than 0.3 has been dropped. The effect of tariffs on imports price is bigger in 2019, but both of results show the coefficient is less than 0.1 and the standard errors are very small (Table 5.5). The coefficient of this two regressions show that increasing 1% tariff rate will reduce

about 0.1%-0.05% imports price, which could not be ignored. Although other articles found the U.S. imports price will not change as increasing tariffs in short run, like Fajgelbaum et al (2019) and Amiti et al (2019), all of these articles use multi-country trade data rather than only focus on China-U.S. trade and the related period is only 2018 (no enough time for foreign producer to change price), which may be the reason for the different result in this article. To measure the effect of decreasing imports price on U.S. welfare, the equation will be $WL = \Delta p * m' = m' p' \frac{p - p'}{p'}$ (based on graph four). The percentage change in imports price due to the imposition of the tariffs could be estimated through negative one times the coefficient in the regression multiplied by the change of tariffs ($-\beta_1 \ln \frac{1+\tau_t}{1+\tau_{t-12}} = \ln \frac{p'}{p} \approx \frac{p - p'}{p'}$). And the final equation could be changed into $WL = \Delta p * m' = -\beta_1 m' p' \ln \frac{\tau_t}{\tau_{t-12}}$, the result of this two years will be showed in table six and table seven, the welfare change in 2018 was 0.4 billion and in 2019 was 2 billion dollars, all of these welfare has been transferred into U.S. tariffs revenue (region C in Figure 4.1).

Because increasing tariffs will influence the imports price significantly, the assumption p=p' could not be hold. The equation measuring the welfare change from consumption distortion need to be changed, $WL = \frac{1}{2} \Delta p * \Delta m = -\frac{1}{2} m' \beta \ln \frac{1+\tau_t}{1+\tau_{t-12}} \Delta p.$

Based on graph four, Δp will be measured through $p'(1+\tau_t) - p = p'(\frac{p'-p}{p'}) + p'\tau_t$.

Based on the imports price regression, $\frac{p'-p}{p'} \approx -\ln \frac{p'}{p} = \beta_1 \ln \frac{1+\tau_t}{1+\tau_{t-12}}$. The final equation will be $WL = \frac{1}{2} \Delta p * \Delta m = -\frac{1}{2} m' \beta_2 \ln \frac{1+\tau_t}{1+\tau_{t-12}} p' \tau_t - \frac{1}{2} m' \beta_2 p' \beta_1 (\ln \frac{1+\tau_t}{1+\tau_{t-12}})^2.$

β_1 is the coefficient of imports price regression and β_2 is the coefficient of imports quantity regression.

After increasing tariffs, U.S. domestic demand will decrease and higher price of domestic goods will distort the consumption of U.S. citizens. Through regressing the change of imports quantity ($\ln\frac{m_t}{m_{t-12}}$) on the change of tariffs ($\ln\frac{1+\tau_t}{1+\tau_{t-12}}$), the demand elasticity of imports could be estimated and the result could be found in table five. The effect of increasing tariffs on imports quantity is bigger in 2018 than in 2019, which is consistent with previous estimates of price elasticity (higher imports price elasticity means more cost will be taken by foreign producer when the tariffs increase and then the domestic demand elasticity will be lower). All of variables are negative and significant, which is expected, and fixed effect has been included in the regression based on HTS-8 products. Increasing tariffs will significantly reduce domestic consumption and the consumption distortion will generate a big welfare loss for U.S. citizens.

After getting the coefficient of imports quantity regression, the welfare loss from consumption distortion could be measured (region B in Figure 4.1) based on the equation $WL = \frac{1}{2}\Delta p * \Delta m = -\frac{1}{2} m' p' \beta_2 \ln\frac{1+\tau_t}{1+\tau_{t-12}} \tau_t - \frac{1}{2} m' p' \beta_2 \beta_1 (\ln\frac{1+\tau_t}{1+\tau_{t-12}})^2$. The result of different years could be found in Table 5.6 and Table 5.7. Because of increasing tariffs, the welfare loss from domestic consumption distortion in 2018 was about 29.6 billion and in 2019 was about 23.5 billion dollars. Tariff revenue could be estimated through the equation $m' p' \tau_t$ (region A + region C in Figure 4.1), and the result has been showed in the Table 5.6 and Table 5.7. In 2019, U.S. tariff revenue from Chinese imports was estimated to be above 40 billion dollars, compared with the revenue in 2018 (23 billion dollars), increasing tariff rate on Chinese exports has made a significant revenue to U.S. government. Because part of tariff revenue was transferred from foreign producer (reduced the price to keep the quantity of exports), the final welfare loss for U.S. citizens will be calculated through the welfare loss from consumption distortion plus total U.S. tariff revenue and minus the welfare gain from imports price decreasing (region B + region A in Figure 4.1). The result has been

shown in the Table 5.6 and Table 5.7, the welfare loss for U.S. citizens was about 51 billion dollars in 2018 and 62 billion dollars in 2019.

5.3 the effect of trade war on U.S. unemployment rate

The equation $\ln ER = a_0 + a_1 \ln TR + a_2 \ln PPI + a_3 \ln GDP + a_4 \ln Population + \varepsilon$ has been regressed and the result has been shown in the Table 5.8. Because the regression includes only 84 observations (small sample data set), Breusch-Pagan test will be used to test the heteroskedasticity of the result and its result shows that the null hypothesis, heteroskedasticity not present, could not be rejected. In the result of regression, all of variables are significant in 0.01 level and the result of F-test shows this equation has a good explaining power. The coefficient of result shows that there is a positive relation between U.S. custom duties and employment rate during this twenty years, which means the decreasing imports will increase U.S. employment rate. The coefficient of variable lnTR is 0.033, which means increasing 1% custom duties will make a 0.033% rise in employment rate.

Increasing tariffs on imports from China will increase U.S. domestic employment, but the number is difficult to measure. This article will predict the percent change of employment rate due to increasing tariffs on imports from China in 2019 and compared it with the total percent change of U.S. employment rate. Based on the calculation of section 5.2, the change of tariffs revenue from Chinese imports could be measured ($\Delta TR = TR_{2019} - TR_{2018}$). After dividing it by the total tariffs revenue in 2018, the percent change of tariffs revenue from trade war could be measured ($\ln TR = \frac{\Delta TR}{TR_{totalin2018}}$). After multiplying it with 0.033, the percent change of employment rate from trade war could be estimated ($\ln ER = 0.033 \ln TR$). The total change of U.S. employment rate in 2019 has also been calculated and all of results could be found in Table 5.9. Based on the result, the tariffs from trade war in 2019 will make a rise in U.S. employment rate, which is about 0.25% of employment rate

in 2018. Compared with the total change of U.S. employment rate in 2019 (about 0.89% of 2018), 28% of U.S. employment rate growth is due to increased tariffs on Chinese exports. The result shows that although increasing tariffs will reduce some employment in some sectors, there is a significantly positive relation between tariffs and employment growth.

5.4 Tables

Table 5.1: the result of gravity equation regression using the data from 2018

OLS, using observations 1-32090

Dependent variable: l_XS

	Coefficient	Std. Error	t-ratio	p-value	
const	29.795	6.91424	4.3092	<0.0001	***
Language	1.38616	0.195096	7.1050	<0.0001	***
Score	−0.45612	0.0567325	−8.0398	<0.0001	***
Border	−2.24983	0.290404	−7.7472	<0.0001	***
l_Y	0.10286	0.212095	0.4850	0.6277	
l_I	2.59845	0.372586	6.9741	<0.0001	***
l_D	−1.53352	0.0996923	−15.3825	<0.0001	***
l_t	−0.600294	0.0104684	−57.3436	<0.0001	***

Mean dependent var	13.00482	S.D. dependent var	3.167480
Sum squared resid	258676.3	S.E. of regression	2.839537
R-squared	0.196525	Adjusted R-squared	0.196349
F(7, 32082)	1121.006	P-value(F)	0.000000
Log-likelihood	−79020.18	Akaike criterion	158056.4
Schwarz criterion	158123.4	Hannan-Quinn	158077.8

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 1147.96
with p-value = P(Chi-square(15) > 1147.96) = 2.45564e-235

Xs is the custom value of different imports (in HTS-8 digital level). Y and I is the real GDP and GDP per capita of U.S. trade partner. D is the distance between the

capitals of trading countries and US (in kilometers). t is the real tariffs rate in percent (100* Calculated Duties / Custom value of imports). All of the variable has been taken log to reduce the effect of heteroscedasticity. Language, openness and border are dummy variables, whether the trading country has the same language with the United States, whether the economic freedom of the trading country has been viewed as free (the score of freedom measured by Heritage Function has been over 60), whether the country has common border with United State. Although all of variables are significant with very low p-value, the collinearity test shows the collinearity problem is serious in this equation. And White test shows Heteroskedasticity problem exists in the regression.

Table 5.2: the result of adjusted regression using the data from 2018

WLS, using observations 1-32090

Dependent variable: l_XS

	Coefficient	Std. Error	t-ratio	p-value	
const	−25.1155	0.822078	−30.5513	<0.0001	***
l_t	−0.595754	0.00796165	−74.8280	<0.0001	***
l_Y	1.7115	0.0301521	56.7622	<0.0001	***
l_I	−0.328606	0.0174941	−18.7839	<0.0001	***
l_D	−0.856415	0.0273071	−31.3624	<0.0001	***
Language	−0.146266	0.0482162	−3.0335	0.0024	***

Statistics based on the weighted data:

Sum squared resid	99058.88	S.E. of regression	1.757124
R-squared	0.252156	Adjusted R-squared	0.252040
F(5, 32084)	2163.600	P-value(F)	0.000000
Log-likelihood	−63619.18	Akaike criterion	127250.4
Schwarz criterion	127300.6	Hannan-Quinn	127266.4

Statistics based on the original data:

Mean dependent var	13.00482	S.D. dependent var	3.167480
Sum squared resid	259394.2	S.E. of regression	2.843386

To reduce the effect of heteroskedasticity, weighted least squared regression method has been used, the using weight in this regression is the reciprocal of the estimated variance. And the interaction terms could not reduce the collinearity, there may be useless variables in the equation. After removing the dummy variable “score” and “border”, collinearity has been eliminated. The result shows that all of the variables are significant (p-value is very low).

Table 5.3: the result of gravity equation regression using the data from 2017

WLS, using observations 1-28682

Dependent variable: l_XS

	Coefficient	Std. Error	t-ratio	p-value	
const	−28.2386	0.859615	−32.8503	<0.0001	***
l_t	−0.680347	0.00847154	−80.3096	<0.0001	***
l_Y	1.76849	0.0328146	53.8933	<0.0001	***
l_I	−0.350242	0.0211883	−16.5300	<0.0001	***
l_D	−0.682713	0.0278936	−24.4756	<0.0001	***
Language	0.105908	0.0549606	1.9270	0.0540	*

Statistics based on the weighted data:

Sum squared resid	89098.13	S.E. of regression	1.762686
R-squared	0.271773	Adjusted R-squared	0.271646
F(5, 28676)	2140.368	P-value(F)	0.000000
Log-likelihood	−56953.07	Akaike criterion	113918.1
Schwarz criterion	113967.7	Hannan-Quinn	113934.1

Statistics based on the original data:

Mean dependent var	12.84473	S.D. dependent var	3.129195
Sum squared resid	221674.0	S.E. of regression	2.780341

All of variables are significant and P-value of F test is very low, which means the result is meaningful to be compared with the result from 2018.

Table 5.4: the result of gravity equation regression using the data from 2019

WLS, using observations 1-32913

Dependent variable: l_Xs

	Coefficient	Std. Error	t-ratio	p-value	
const	−10.972	0.749339	−14.6422	<0.0001	***
l_t	−0.107765	0.00951656	−11.3239	<0.0001	***
l_Y	1.29488	0.0280077	46.2330	<0.0001	***
l_I	−0.349874	0.0181774	−19.2477	<0.0001	***
l_D	−1.13329	0.0300921	−37.6607	<0.0001	***
language	−0.197438	0.0497054	−3.9722	<0.0001	***

Statistics based on the weighted data:

Sum squared resid	98831.50	S.E. of regression	1.733020
R-squared	0.115766	Adjusted R-squared	0.115631
F(5, 32907)	861.6505	P-value(F)	0.000000
Log-likelihood	−64796.25	Akaike criterion	129604.5
Schwarz criterion	129654.9	Hannan-Quinn	129620.6

Statistics based on the original data:

Mean dependent var	12.92914	S.D. dependent var	3.139830
Sum squared resid	295410.1	S.E. of regression	2.996184

The data GDP and GDP per capita in 2019 is predicted by International Money Fund. All of the variables are significant in 0.01 level and p-value of F test is very small, which means the model is meaningful. Adjusted R-squared is lower than other regression, the reason may be many country applied retaliatory measures which will influence the U.S. imports. As a control group, because the tariff rate is difficult to be related to retaliatory measures taken by other countries, the result still have reference value for the prediction.

Table 5.5: regression result about U.S. welfare change

	$l\_p_{2019/2018}$	$l\_p_{2018/2017}$	$l\_m_{2019/2018}$	$l\_m_{2018/2017}$
l_t	−0.0974505***	−0.0557004	−2.40088***	−8.91688***
	（0.0221）	（0.0374）	(0.0770216)	(0.413960)
N	54542	56362	62751	52500
R^2	0.0024	0.0011	0.019225	0.0089

There are two period has been tested, 2019-2018 and 2018-2017. Dependent variable p means the price change of unit imports (p_t / p_{t-12}), dependent variable m means the quantity change of unit imports (m_t / m_{t-12}), exploring variable t means the change of tariffs rate (τ_t / τ_{t-12}) and all of them have been taken log. Panel data in month-level has been applied. The regression includes the HTS-8 product fixed effect and drops any observations with a ratio of unit values in t relative to t-12 greater than 3 and less than 0.3 in the first two regressions. Standard errors are reported in parentheses. P-value<0.01 ***

Table 5.6: U.S. welfare change in 2018 (Dollars)

Month	Welfare change from imports price change	Welfare change from consumption distortion	Tariff revenue	Welfare loss for U.S. citizens
Jan	-259465.574	-20844483.52	1185568715	1164983697
Feb	-165067.2439	-13845054.71	1072360385	1058680398
Mar	-63304.94993	-5118621.156	854125208	849069891.8
Apr	-145339.4104	-11684193.86	883812823	872273968.6
May	584820.8929	45914196.16	1087418466	1132747841
Jun	634686.5859	49687460.39	1186644992	1235697766
Jul	18135508.74	1386421510	1659101504	3027387505
Aug	24357163.46	1851287826	1820453420	3647384083
Sep	39682772.56	3054158378	2127857707	5142333312
Oct	98215143.15	7611434172	3329456463	10842675492
Nov	93214845.53	7219062768	2937499771	10063347693
Dec	109376903.4	8484912871	3294722404	11670258372
Total	383568667.14	29651386828.3	21439021858	50706840019

Table 5.7: U.S. welfare change in 2019

Month	Welfare change from imports price change	Welfare change from consumption distortion	Tariff revenue	Welfare loss for U.S. citizens
Jan	153673249.2	1838358520	2969066899	4653752170
Feb	124477619.9	1497845791	2405087575	3778455746
Mar	114036163.8	1365334692	2034805924	3286104452
Apr	126161158.6	1510879729	2305018611	3689737181
May	155916525.8	1864536803	2808861957	4517482234
Jun	209218061.7	2491414374	3514937855	5797134167
Jul	214721389.8	2564664540	4075160128	6425103278
Aug	196171366.9	2347242518	3975196801	6126267952
Sep	236085435.8	2833894236	4521846085	7119654885
Oct	163644112.9	1974654489	4312812748	6123823124
Nov	134905279.5	1623067228	3677061696	5165223645
Dec	132437746	1594359066	3715351858	5177273178
Total	1961448109.9	23506251986	40315208137	61860012013

Table 5.8: the relation between tariffs and U.S. employment rate

OLS, using observations 1999:1-2019:4 (T = 84)

Dependent variable: lnER

	Coefficient	Std. Error	t-ratio	p-value	
const	21.0388	1.35409	15.5373	<0.0001	***
lnTR	0.0331105	0.00928987	3.5642	0.0006	***
lnPPI	−0.128608	0.0192289	−6.6883	<0.0001	***
lnGDP	0.705961	0.0663905	10.6335	<0.0001	***
lnPopulation	−1.82539	0.151152	−12.0765	<0.0001	***

Mean dependent var	4.251729	S.D. dependent var	0.032937
Sum squared resid	0.009036	S.E. of regression	0.010695
R-squared	0.899651	Adjusted R-squared	0.894570
F(4, 79)	177.0635	P-value(F)	1.33e-38
Log-likelihood	264.5791	Akaike criterion	−519.1581
Schwarz criterion	−507.0041	Hannan-Quinn	−514.2723
rho	0.866697	Durbin-Watson	0.240819

Breusch-Pagan test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 5.36236
with p-value = P(Chi-square(4) > 5.36236) = 0.252095

The variable UR is the domestic unemployment rate, TR is the tariff revenue measured by custom duties, PPI is the producer product price. The data start from 1999 to 2019 and in quarterly level. All of variables are significant in 0.01 level and the result of F-test shows this equation has a good explaining power. Because there are only 84 observations (small sample data set), BP-test will be used to test the heteroskedasticity of the result. The result shows that the null hypothesis, heteroskedasticity not present, could not be rejected.

Table 5.9 the effect of tariff revenue on U.S. employment in 2019

Season	The change of U.S. tariff revenue from Chinese exports % (2018-2019)	Estimated employment rate change due to trade war (2018-2019)	Total employment rate change in United States % (2018-2019)
Q1	9.46392549	0.312309541	0.785812189
Q2	10.42560817	0.34404507	0.706932344
Q3	9.476936786	0.312738914	1.031051619
Q4	2.871617587	0.09476338	1.05228718
Total	7.672716227	0.253199635	0.894070326

The change of tariff revenue is measured through $\frac{TR_{2019} - TR_{2018}}{totalTR_{2018}}$

6. Conclusion

Because different countries have different development histories and stay at different stages of economic development, it is difficult for a country to find and maintain the best trade strategy before making trade policies. Although free trade is still the mainstream of economics today, more and more trade frictions and protectionist measures make it be meaningful to study the economic impact of protectionism. Through introducing some typical protectionism examples in the history, this thesis studies the possible impact of protectionism on economic development in theory. And based on the data of China-U.S. trade war, this thesis estimated the effect of protectionist policies on U.S. economic, including imports value, resident welfare, and employment rate changes.

In the third section, this thesis introduces two typical protectionism events in history, Japan-U.S. trade dispute and U.S. steel safeguard in 2002. The result of the first event shows that U.S. trade protection measures did not improve its trade deficit with Japan in long run, which means that the main objectives of the protection measures have not been achieved. But after this trade dispute, the economic development of Japan has fallen into a long period of stagnation or even a recession, the gap of GDP and income per capita between this two countries continues to widen. Based on this, it may not be sufficient to consider the impact of protectionism on imports, this article will also estimate the change of other factors in U.S. to evaluate the effect of U.S. protectionist measures. Through researching the process of Japan-U.S. trade dispute, this thesis finds that the main contradictions in the Japan-U.S. negotiations are concentrated on the development of high-tech industries and currency exchange rate. The US-China Phase One trade deal has been signed in January 2020, the two sides have reached agreement in various fields and agreed to further negotiations. However, the current situation with coronavirus may affect the performance of the agreement between the

two parties, there is still uncertainty about the complete end of the trade war. The second event is the U.S. steel safeguards in 2002. Unlike the Japan-U.S. trade dispute, many countries have retaliated against US steel protection measures. The huge pressure from the outside caused the U.S. government to cancel the steel protection measures in a short time. The World Trade Organization played an important role in the settlement of this trade dispute, the direct reason for the U.S. cancellation of protection measures is the WTO judgment on U.S. violation of free trade principles. Therefore, this article believes that the active mediation of World Trade Organization will help the end of China-U.S. trade war. Based on some researches, this steel safeguards caused a huge welfare loss to the United States and the rising production costs have reduced the steel consumer sector by nearly 200,000 jobs. This thesis believes that welfare changes will be an important indicator for evaluating trade protection policies and it is meaningful to estimate the impact of U.S. protectionist measures on welfare and employment for researching the economic impact of protectionism.

In the empirical part, this article focuses on three possible economic effects of protectionism, including the effect on imports value, welfare change and employment rate. Through regressing the U.S. imports value on tariff rate, this article will test whether U.S. tariff increases can effectively improve the trade deficit. According to the year the data is from, three groups have been used to make regression (no tariff rate change in 2017, many increasing tariff just be announced in 2018, all of additional tariff has been applied in 2019). Because the U.S. tariff rate level is different in these three years, it is similar in 2017 and 2018 but increased significantly in 2019, comparing the regression results from different groups is helpful for researching the effect of increasing tariffs. To reduce the influence of other factors, this article applied trade gravity equation and considered other possible factors. The term with interactions has also been considered. Stepwise regression method is used to avoid the effect of collinearity on regression results and Weighted Least Square method is used to reduce the heteroskedasticity in the regression. The result of

regressions show that the effect of tariffs on imports value could be estimated precisely. Through comparing the regression results of different groups, this article could make some conclusions about the economic impact of U.S. protectionism measures. All of the results show that there is a significant negative relation between tariffs and imports value, but the effect of increasing tariffs on reducing imports will be significantly reduced when tariffs are at high levels. In 2018, the result shows that increasing 1% tariff rate will decrease 0.59% of U.S. imports value, which is similar to the result from 2017, but in 2019, the regression result shows the effect of increasing tariffs has been very small, increasing 1% tariff rate will decrease imports value only 0.1%. Based on the result, this article believes that although increasing tariffs on imports could improve U.S. trade deficit significantly in the short run, but this effect will decline with the rise of tariff rate level and could not improve the U.S. trade situation in the long run. This conclusion is consist with the result of Japan-U.S. trade dispute, which makes it be more reliable that protectionism could not improve the trade account of a country in long run.

Because trade frictions will definitely affect the welfare of U.S. residents, which is an important indicator of researching the outcome of protectionism measures, this article has focused on the trade data of China-U.S. trade war in this two years and estimated the change of welfare in United States due to increasing tariffs on Chinese exports. Two sources of U.S. welfare changes has been estimated in this article, the gain from the decrease of imports price and the loss from domestic consume distortion. Through regressing the change of imports price on the change of tariff rate, this article found that increasing tariffs will reduce the price of imports significantly. After assuming the slope of production function and demand function is constant, the welfare gains from decreasing imports price could be estimated, about 0.4 billion dollars in 2018 and 2 billion dollars in 2019, which has been transferred into U.S. tariff revenues. The welfare loss from U.S. domestic consume distortion will be calculated as half of the change of price multiplied by the change of quantities ($WL = 0.5 * \Delta p * \Delta m$). To measure the effect of China-U.S. trade war on U.S. domestic consume distortion, this

article has estimated the effect of increasing tariffs on the change of domestic demand and the final equation has been changed into $WL = \frac{1}{2}\Delta p * \Delta m = -\frac{1}{2} m' p' \beta_2 \ln\frac{1+\tau_t}{1+\tau_{t-12}} \tau_t - \frac{1}{2} m' p' \beta_2 \beta_1 (\ln\frac{1+\tau_t}{1+\tau_{t-12}})^2$, where β_1 is the effect of increasing tariffs on the change of imports price and β_2 is the effect on the change of domestic demand. After calculation, the result shows that consumption distortion due to increased tariffs on Chines exports will cause massive welfare losses to the U.S, about 29.6 billion dollars in 2018 and 23.5 billion dollars in 2019. Through multiplying the imports value by tariff rate, this article also measured the total U.S. tariff revenue on Chinese exports. And the result shows increasing tariff rate on Chinese exports has made a significant revenue to U.S. government (from 23 billion dollars in 2018 to 40 billion dollars in 2019). The welfare loss of U.S. citizens will be calculated as the welfare loss from consumption distortion plus total U.S. tariff revenue from Chinese exports and minus the welfare gains from falling imports price. The result of calculation shows that the welfare loss for U.S. citizens was about 51 billion dollars in 2018 and 62 billion dollars in 2019. China-U.S. trade war will cause massive welfare losses to U.S. consumers, but there is a significant increase in U.S. tariff revenue.

Based on literature review, protectionism may have different effects on employment, reduced imports could increase domestic production and then increase employment but reduced resource allocation efficiency will increase production costs and then reduce employment. This article also tested the relation between U.S. employment rate and tariffs revenue with the data from 1999 to 2019. Custom duties has been used to measure U.S. tariff revenue. Production Price Index, GDP and population have been included in the regression to reduce the effect of other factors on U.S. employment rate. After regressing employment rate on tariff revenue, the coefficient in the regression result shows that there is a positive relation between U.S. custom duties and employment rate during this twenty years, increasing 1% custom duties will make a 0.033% rise in employment rate. Because the tariff revenue from Chinese

exports has been estimated in last part, the increased tariff revenue due to the trade war as a percentage of total U.S. tariff revenue could be calculated. After further calculation, the tariffs from China-U.S. trade war in 2019 will make a rise in U.S. employment rate, which is about 0.25% of the employment rate in 2018. Compared with the total change of U.S. employment rate in 2019 (about 0.89% of 2018), 28% of U.S. employment rate growth is due to increasing tariffs on Chinese exports. Although the increase in tariffs may promote an increase in overall U.S. employment, some sectors still face a significant decrease in employment and income, like Corn and soybean producer. The commitment of China to expand the purchase of products from these sectors is an important factor in the China-US phase one trade deal.

Through researching the effect of U.S. protectionist measures in this two years, this article makes an empirical analysis for the economic impact of protectionism on the largest world economy. Although protectionism may bring benefits to the United States in the short term, American residents was facing huge welfare losses. The US-China Phase One trade deal shows that no one will further increase tariffs and the existing tariffs will be gradually reduced. Based on this trade deal, China promised to expand the purchase of US exports, which is the core requirement of the United States, but the emergence of coronaviruses may reduce the purchasing power of China. There is still uncertainty about the end of the China-U.S. trade war. Although this thesis has made some reliable estimations based on the U.S. data, studying different sectors separately may better reflect the economic impact of protectionism. Because protectionism has different impacts on different sectors, by statistically classifying different affected sectors, it may be better for studying the specific economic impact of protectionism. And the estimation about U.S. welfare change is based on constant slope of production and demand in short run, but in practice, there might be some further effect that are not covered by the methodological framework.

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