# US-Singapore Free Trade Agreement and Trade in Pharmaceuticals

Bocheng Zhang[a]
[a]Department of Economics, University of Minnesota

## Abstract

As the first free trade agreement between the United States and its Asian trade partners, the US-Singapore Free Trade Agreement (USSFTA) that came into force in 2004 has played a critical role in the bilateral pharmaceutical trade between the US and Singapore. This paper investigates the effects of USSFTA on trade volume between the US and Singapore, domestic employment in the US pharmaceutical industry, and the price of US pharmaceutical goods. The paper also tests how well the estimates match classical and neoclassical trade theories. The effects on trade volume are estimated by Difference-in-Differences (DID) and Ordinary Least Square (OLS), and the effects on employment and price are estimated by OLS. USSFTA increased the US pharmaceutical imports from Singapore but did not meaningfully impact the exports. Although the USSFTA did not lead to a statistically significant reduction in pharmaceuticals' price in the US, it is associated with higher employment in the US pharmaceutical industry. The estimates on trade volume, especially imports from Singapore, are consistent with the theory of comparative advantage, but the estimate of employment contradicts trade theories. The violation of trade theories implies that demand-side factors may be more important for the employment variable. This paper evaluated the effects of USSFTA on several important economic variables. Further research may be required to fix potential endogeneity threats and to present both the short-term and long-term effects.

Keywords: US-Singapore Free Trade Agreement, pharmaceuticals, trade volume, price level and employment, trade theories

## 1. Introduction

The US-Singapore Free Trade Agreement (USSFTA) that came into force on January 1st, 2004, has had remarkable impacts on the bilateral trade and two-way investments between the United States and Singapore, as well as the overall economy of these two countries. According to the Office of the United States Trade Representative (n.d.), Singapore was the 13th largest export market of goods for the United States in 2018 and the 18th largest supplier of goods imports at the same time. The USSFTA increased the trade volume between the US and Singapore dramatically, and the large trade flow between these two countries potentially created hundreds of thousands of jobs.

This paper focuses on the trade of
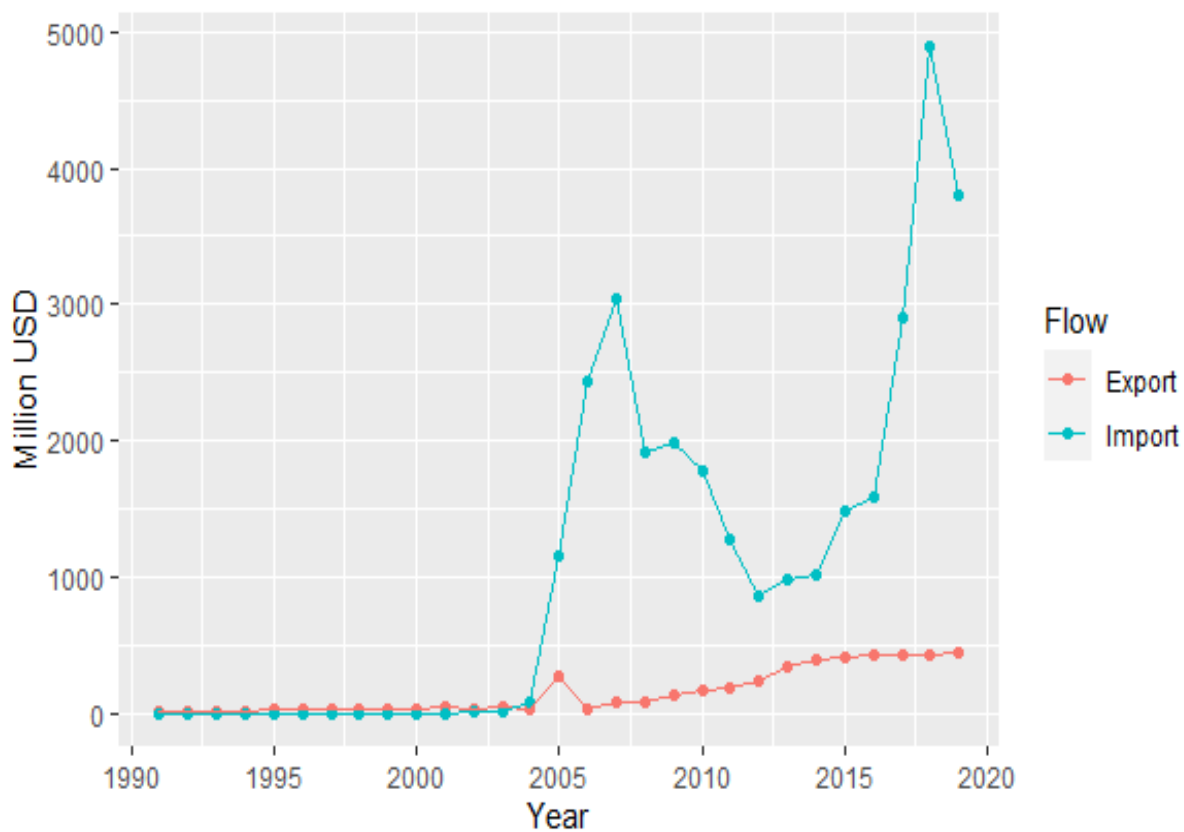
*Figure 1*. Trade Flow of Pharmaceuticals (US as the Reporter)

pharmaceutical products, one of the top US import categories from Singapore, under the USSFTA. In this study, I will examine the effects of the USSFTA on trade flow in pharmaceuticals between the US and Singapore. This topic is worth studying because of the uniqueness of Singapore as a trading country in the world economy and the role of the pharmaceutical industry in Singapore. Different from most countries, Singapore has a very high trade-to-GDP ratio. According to data from the World Bank, Singapore's trade was 326.2% of its GDP in 2018, and the ratio has never fallen below 300% since 1987. This implies Singapore has a very high willingness to trade. As a country of small size with limited natural resources, Singapore imports goods of different varieties to satisfy its domestic consumption. It in turn specializes in and exports several profitable goods, such as pharmaceuticals, to maintain its trade balance and support the overall economy. Singapore's pharmaceutical

industry has grown very rapidly in recent decades and has become one of the most influential components of its manufacturing sector (Ribbink, 2014). Nowadays, Singapore is recognized as the Pharma Hub of Asia, where pharmaceutical industry plays a leading role (Ribbink, 2014). While there must be many engines behind the prosperity of Singapore's pharmaceutical industry, I believe the USSFTA has played a significant role. In order to intuitively observe if the USSFTA impacted trade in pharmaceuticals between the United States and Singapore, I retrieved the bilateral trade data from the UN Comtrade Database and graphed the time series of trade volume, where the US is the reporter (see figure 1).

According to Figure 1, the volume of exports to and imports from Singapore was tiny before 2004, and there was no significant difference between them. In fact, the value of exports to Singapore in pharmaceuticals is even slightly greater than the value of imports.
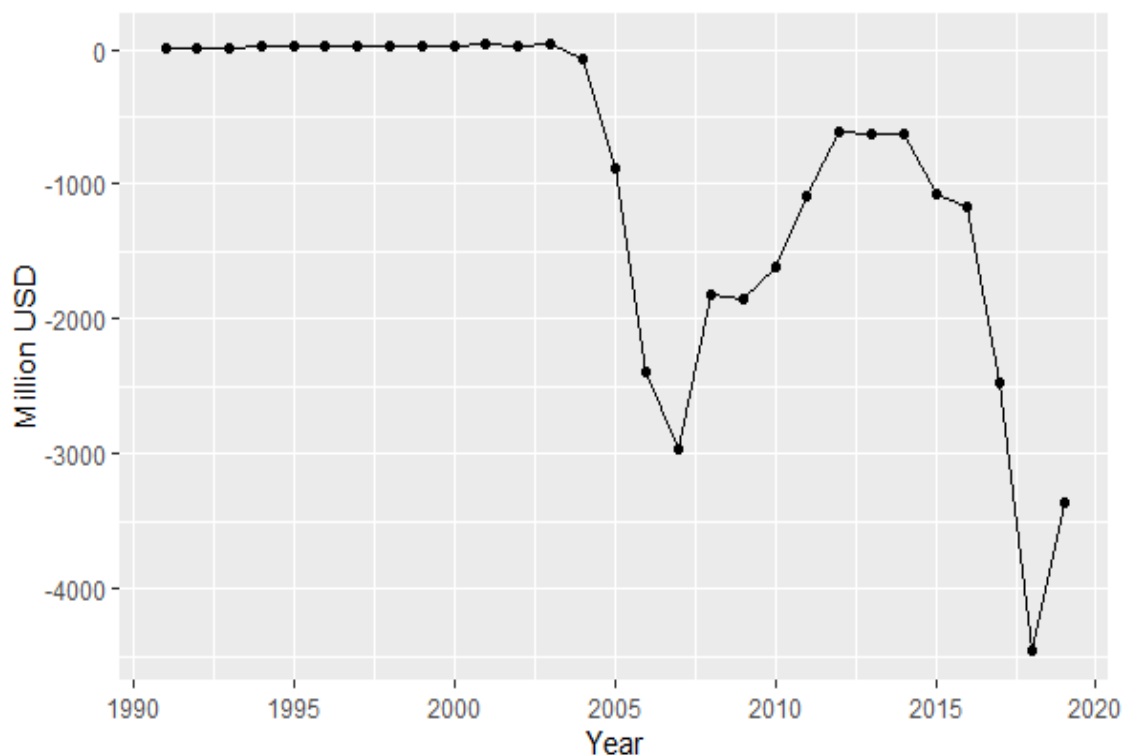
*Figure 2.* US-Singapore Trade Surplus in Pharmaceuticals (US as the Reporter)

However, the value of imports from Singapore in pharmaceutical products has skyrocketed since 2004, which was the year that the USSFTA came into force. Notably, US imports of pharmaceuticals from Singapore rose from $9.4 million in 2003 to $91.8 million in 2004 and to $1.1618 billion in 2005; by 2007, it had reached $3.0433 billion. The import of pharmaceuticals from Singapore decreased dramatically in 2008, and Figure 1 also shows a further decrease in later years, which can be ascribed to the global financial crisis. Similar to imports, Pharmaceutical exports from the United States to Singapore also increased from 2004 to 2005 but it fell again in 2006. Overall, it can be easily observed that the change of trade volume after the implementation of the USSFTA is significant, and its potential stimulation to Singapore's pharmaceutical industry is evident. It is therefore essential to estimate more precisely the effects of the USSFTA on Singapore as a trading country and on its leading pharmaceutical industry.

Another reason to study the USSFTA is its potential policy implications to the United States. The USSFTA, signed by President Bush, is America's first free trade agreement (FTA) with its Asian trade partners, according to the Office of the United States Trade Representative (n.d.). By focusing on this landmark, one can have a clearer picture of the consequences to the United States trading with Asian countries, especially with members of the Association of Southeast Asian Nations (ASEAN). Variables studied in this paper involving the effects of USSFTA on the United States are employment in the US pharmaceutical industry and the price level of pharmaceuticals for US consumers. Below is the graph of trade surplus that the US has run with Singapore in pharmaceutical products (see Figure 2). As can be seen in Figure 2, the US began to run a huge trade deficit with Singapore in pharmaceuticals after the implementation of the USSFTA. If trade theories apply to this case, the price level of

pharmaceuticals and employment in the pharmaceutical industry should have decreased.

In brief, this paper investigates the effects of the USSFTA on the value of trade in pharmaceuticals, its effects on the price of pharmaceutical products in the US, as well as the way that USSFTA has influenced employment in the pharmaceutical industry in the United States. Another goal of my research is to test which effects of the USSFTA on these indicators match the classical and neoclassical trade theories, and which ones do not.

Section 2 of this paper reviews previous research on this topic and similar topics. Section 3 characterizes the theoretical foundation of my paper, and Section 4 analyzes the effects of the USSFTA empirically. Section 4 contains a detailed description of data, econometric models, and results of analyses. Section 5, the conclusion section, emphasizes the limitations of the study and how it can be improved, in addition to the summary of major findings from this paper.

## 2. Literature Review

Many current works of literature either focus on the theoretical explanation of the gravity model of trade (Chaney, 2013) or use it as a foundation to conduct empirical analyses on international trade between countries (Batra, 2004; Renjini et al., 2017). Economist and Nobel Prize winner Jan Tinbergen developed a model to describe the bilateral trade flow between two countries, where he stated that the trade flow between two countries is proportional to countries' GDPs and inversely proportional to the distance between countries. This model is named as the gravity model of trade since it is similar to Newton's law of universal gravitation. Numerically, the equation can be written as

$F_{1,2} = \frac{(GDP_1)^{\alpha}(GDP_2)^{\beta}}{Distance_{1,2}^{\delta}}$ , where $F_{1,2}$ represents the trade flow between country 1 and country 2. Then in the sense of econometrics, the model can be transformed into a log-log model by taking the natural logarithm of both sides of the equation. The transformed model has the form:

$log(F_{1,2}) = \alpha log(GDP_1) + \beta log(GDP_2) - \delta log(Distance_{1,2})$

Chaney (2013) offered a detailed theoretical explanation for the gravity equation and pointed out that the impact of distance on trade should not be changed by exogenous factors. Meanwhile, Batra (2004) and Renjini et al. (2017) made use of the gravity model to analyze the trade potential of India with other countries, and they also found historical and cultural similarities also impact bilateral trade positively, besides the traditional effects of countries' sizes and distances. Similar to Batra and Renjini et al., I propose to take advantage of the gravity model of trade to examine the trade flow of pharmaceuticals between the US and Singapore. However, since I am only focusing on the trade between the US and Singapore and the distance between these two countries is fixed, I will drop the distance variable in my statistical analyses. In the case that the trade flows of the US or Singapore with multiple other countries are to be examined, the distance variable is helpful.

Dick Nanto, a specialist in Industry and Trade at Congressional Research Service, has written two reports on the effects of the USSFTA on the United States. His reports, which were written in 2008 and 2010, discussed the effects of this trade policy after three years and five years, respectively. In his reports, Nanto (2008, 2010) summarizes some of the key statistics on the bilateral trade between the United States and Singapore after the trade deal was implemented, and the trade in pharmaceuticals between the two countries is

particularly highlighted. Similar to almost all bilateral or multilateral free trade agreements, the USSFTA also includes provisions on lowering tariffs and removing restrictions on trade. However, the story is different when it comes to pharmaceutical trade between the US and Singapore. Before the USSFTA came into force, pharmaceutical products could already enter the United States without duty; instead, the growth of Singapore's pharmaceutical industry and the increased exports of pharmaceuticals from Singapore to the US were triggered by provisions that require Singapore to reinforce the protection on intellectual property rights (IPRs), which then attracted many multinational biotechnology corporations to Singapore (Nanto, 2008, 2010). As the USSFTA and provisions of IPRs protection attracted more and more transnational corporations to Singapore, the country developed a biomedical industrial park with many pharmaceutical R&D and production centers (Tuas Medical Park), became the Asian Pharma Hub, and began to export more pharmaceuticals worldwide. Some other scholars (Ng-Loy, 2004) consider the Intellectual Property chapter in the USSFTA as a gold standard that all other FTAs should learn from. As a result, the US experienced a rapid increase in pharmaceutical imports from Singapore and the pharmaceutical products sector became one of the only two sectors which the US ran a sectoral trade deficit in with Singapore. The major difference between works of Nanto (2008, 2010) and this paper is the focus of commodity. While Nanto (2008, 2010) focuses on the products of all categories briefly and elucidates the trading environment, this paper focuses explicitly on the trade of pharmaceuticals. Nonetheless, I can study the USSFTA and conduct my empirical analysis

more efficiently based on the important background provided by Nanto (2008, 2010).

While some researchers write about the US-Singapore Free Trade Agreement, most of them focus on the IP chapter of the USSFTA and the provision that promotes labor rights and labor environment. This is not surprising because the protection of IPRs that the FTA brings to Singapore has successfully attracted FDI and capital investment. Some other researchers, such as Tongzon (2003), focus differently on the implication of USSFTA on other countries, such as other ASEAN nations and Australia. However, none of the literature focuses on a particular or a few categories of commodity, and none of them have tested the effects of the USSFTA either on Singapore or the United States empirically. In addition, most literature about USSFTA was written in the 2000s, especially between 2003 and 2004, when the FTA was under negotiations and firstly came into effect. Another problem with the existing literature is that the statistics presented in them are not up-to-date. For example, Nanto (2010) says the trade deficit that the US runs with Singapore in pharmaceuticals is $1.9 billion, but I found that the trade deficit has further enlarged in recent years and has reached a peak of more the $4.5 billion in 2018, and the cumulative trade deficit until 2019 was approximately $26.8 billion.

### 3. Theory

Singapore is considered a capital abundant country as opposed to its neighboring countries that are labor abundant, such as Malaysia and Thailand. As I have already mentioned, Singapore has received enormous FDI and experienced a growth in capital because of the IPRs protection under the USSFTA and establishment of the biomedical industrial park. The pharmaceutical industry is

highly capital-intensive because of R&D and marketing requirements. The US might have a comparative advantage in pharmaceuticals relative to Singapore, but the implementation of the USSFTA has helped Singapore to capture this comparative advantage. The trade pattern should suggest that Singapore has obtained a comparative advantage in pharmaceuticals after the USSFTA came into effect.

If the trade pattern reflects the comparative advantage of the US and Singapore on pharmaceutical products, then according to neoclassical trade theories that describe the movements of commodity and factor prices, implementation of the USSFTA should lead the United States to experience a decrease in the price of pharmaceuticals and a decrease in employment in the pharmaceutical sector.

In addition, according to the classical theory of trade, the export condition of a country is influenced by its currency exchange rate. In this paper's settings, a strong exchange rate of the US Dollar (USD) to the Singapore Dollar (SGD) stimulates imports and weakens exports. I will include the USD to SGD exchange rate in my OLS regression to examine whether the currency exchange rate plays its classical role.

### 4. Empirical Analysis

#### a. Data

As aforementioned in the introduction section, variables I plan to use include the trade volumes in pharmaceuticals between the US and Singapore, the price of pharmaceutical products in the US, and employment in the US pharmaceutical industry. Data on the exports and imports of pharmaceuticals is available from 1991 to 2019 at the UN Comtrade Database, and the reporter is the US. Data on employment is retrieved from the US Bureau of Labor Statistics (BLS), which also covers from

1991 to 2019. The employment indicator "All Employees, Thousands" on the BLS is available in the monthly form, so I calculated the annual average to represent the annual employment. I also included employment from the following two industries to represent the total employment in the entire pharmaceutical industry: the pharmaceutical and medicines industry and the pharmaceutical preparation industry. While the pharmaceutical and medicines industry focuses more on manufacturing, the pharmaceutical preparation industry needs to process drugs for final consumption. Data for employment is seasonally adjusted. Finally, data on the price level, which is available from 2000 to 2017, was retrieved from the Federal Reserve Bank and the price indicator is the personal consumption expenditures price index in the pharmaceutical industry — Pharmaceutical and Other Medical Products Expenditures Price Index.

Other variables in my empirical analysis include US exports of pharmaceuticals to the world from Comtrade, US imports of pharmaceuticals from the world from Comtrade, annual GDP for the US and Singapore from the World Bank, the USD to the SGD exchange rate from the Federal Reserve Bank, and the producer price index (PPI) in pharmaceuticals from the Federal Reserve Bank. As I will explain in the analysis subsection later, I will employ two different strategies to examine the effects of the USSFTA on the volumes of trade for this study—Ordinary Least Square (OLS) and Difference-in-Differences (DID). The OLS strategy is related to the gravity model of trade and it is commonly used. However, it may be vulnerable to endogeneity. I therefore employ the DID method, a quasi-experimental design, as a complement to elaborate the casual effects of the USSFTA. For DID, I will use Hong

Kong as a counterfactual case to see what would take place if the USSFTA did not exist. Thus, data on the trade flows between the United States and Hong Kong in pharmaceutical products, as well as Hong Kong's annual GDP, was retrieved. Data on Hong Kong has been obtained from the same sources as that for the US and Singapore. That is, the trade flows between the US and Hong Kong are retrieved from the Comtrade database, and Hong Kong's annual GDP is retrieved from the World Bank.

Some of the most crucial variables for the analysis are trade flows of pharmaceuticals between the US and Singapore (US as the reporter), annual GDPs of the US and Singapore, annual employment in the pharmaceutical industry, expenditure price index of pharmaceuticals and the USD to SGD currency exchange rate. Table 1 below is the descriptive statistics table for these key variables. In Table 1, we can see the mean, range, and standard deviation of each variable. It is found that data on imports, exports, and the GDP are slightly right-skewed, with different levels of skewness. Thus, I will employ logarithmic transformations in my regression model to normalize the data associated with these variables. The units of the value of imports/exports of pharmaceuticals and GDP are 1 USD in Table 1 but 1 million USD in

regression equations.

**b. Analyses**

**i. Estimate the Effects on Trade Volume**

For this study, as mentioned above, I will employ DID and OLS to estimate the effects of the USSFTA on trade volumes. For the Difference-in-Differences strategy, Hong Kong is used as a counterfactual scenario. Hong Kong and Singapore have similar levels of development, economic environment, and trade environment. They are both small geographically with very high trade-to-GDP ratios, and they are both considered as one of four Asian tigers. For example, the trade-to-GDP ratio was 376.5% for Hong Kong and 326.2% for Singapore in 2008. I did not use Korea and Taiwan, the other two Asian tigers, as the counterparts because they have lower trade-to-GDP ratios and they are more geographically expansive. The DID estimation of the effects of the USSFTA is based on the parallel trend assumption, which means the difference between the treatment and control group is constant over time if a policy was not introduced. In this case, if the USSFTA was never implemented, the difference between Singapore-US trade and Hong Kong-US trade in pharmaceuticals should be relatively constant over time. To present the relationship between trade volumes and the USSFTA in DID, I

*Table 1.* Descriptive Statistics Table

| Statistic | N | Mean | St. Dev. | Min | Pctl(25) | Pctl(75) | Max |
|---|---|---|---|---|---|---|---|
| US Import from Singapore ($) | 29 | 1,078,766,512 | 1,330,054,857 | 1,707,534 | 4,896,396 | 1,781,056,714 | 4,892,471,691 |
| US Export to Singapore ($) | 29 | 155,557,450 | 163,999,120 | 9,789,695 | 28,874,335 | 280,052,076 | 452,188,604 |
| Singapore GDP ($) | 29 | 178,484,938,830 | 109,333,678,506 | 45,466,164,978 | 89,794,943,350 | 295,000,000,000 | 373,000,000,000 |
| US GDP ($) | 29 | 12,934,827,586,207 | 4,518,920,241,361 | 6,160,000,000,000 | 9,060,000,000,000 | 16,200,000,000,000 | 21,400,000,000,000 |
| Employment (Thousands) | 29 | 476 | 41 | 395 | 441 | 514 | 522 |
| Expenditure Price Index | 18 | 97.21 | 2.63 | 92.80 | 94.80 | 99.20 | 101.00 |
| USD to SGD Exchange Rate | 29 | 1.51 | 0.18 | 1.25 | 1.37 | 1.67 | 1.79 |

I construct the following reduced-form models:

$$log(Flow_{it}) = \beta_0 + \beta_1 Country_i + \beta_2 Year_t + \beta_3 USSFTA_{it} + \epsilon_{it}$$

$$log(Flow_{it}) = \beta_0 + \beta_1 Country_i + \beta_2 Year_t + \beta_3 USSFTA_{it} + \beta_4 log(GDP_{it}) + \epsilon_{it}$$

$Flow_{it}$ is the trade flow between the United States and country $i$ in year $t$. The $Flow_{it}$ can either be imports or exports of pharmaceuticals, where the US is always the reporter. $Country_i$ is a dummy variable for Singapore and Hong Kong, $i \in (Singapore, HongKong)$. In my analysis, $Country_{Singapore}=1$ and $Country_{Hong Kong}=0$. $Year_t$ is a dummy variable to indicate whether a year is before or after the year that the USSFTA came into force. The USSFTA came into effect on January 1st, 2004: therefore $Year_t$ has value 0 before 2004 and 1 for 2004 and after. $USSFTA_{it}$ is a dummy variable that determines if the USSFTA affects country i at year t, which can simply be found by taking the product of $Country_i$ and $Year_t$. Among regression coefficients β's, $\beta_3$ is the estimation of the effect of the USSFTA on exports or imports of pharmaceuticals. If $\beta_3$ is positive and statistically significant, then there is evidence that the USSFTA stimulated trade. $\in_{it}$ is the error term. For the second reduced-form models, I add GDP as a control variable, so $GDP_{it}$ is the annual GDP for country $i$ in year $t$. I take natural logarithms of variable $Flow_{it}$ and $GDP_{it}$ to normalize my data.

To estimate the effects of USSFTA by OLS, I construct the following regression model:

$$log(Flow_t) = \beta_0 + \beta_2 USSFTA_t + \beta_3 log(GDP_{Singapore,t}) + \beta_4 log(GDP_{US,t})$$
$$+ \beta_5 Exchange_t + \epsilon_t$$

The OLS estimation is inspired by the gravity model of trade and classical trade theories, where the variable USD to SGD exchange rate is embedded in log-log form regression. $Flow_t$ is the trade flow between the US and Singapore at year t. $Flow_t$ can either be exports or imports of pharmaceuticals, and the US is always the reporter $USSFTA_t$ is a dummy

variable that represents whether the USSFTA has come into force in year t. $GDP_t$ represents countries' gross domestic product in year t and $Exchange_t$ is the USD to SGD annual average exchange rate in year $t$.

### ii. Estimate the Effects on Employment

As it is stated in the theory section, the domestic employment of a country in a product is influenced by the imports and exports of that product. Here I assume that the effect of the USSFTA is independent of the US trade of pharmaceuticals with the world, and if an economy runs a trade surplus with its trade partners, then trade stimulates domestic employment. On the other hand, if the country runs a trade deficit in a good, then trade discourages domestic employment in the production of that good. Based on these assumptions, I propose to use the following regression model to find out how the USSFTA has affected employment in the US:

$$E_t = \alpha_0 + \alpha_1 USSFTA_t + \alpha_2 Surplus_t + \alpha_3 PPI_t + \eta_t$$

In this model, $E_t$ is the employment in the US pharmaceutical industry in year $t$, $USSFTA_t$ indicates if the USSFTA has come into force in year t, and $PPI_t$ is the producer price index in pharmaceuticals in year $t$. PPI is a variable that can influence employers' hiring decisions. If the PPI is high, producers may receive higher profit and may hire more workers. $Surplus_t$ is the trade surplus in pharmaceuticals that the United States runs with all its trade partners, or the world, in year $t$.

### iii. Estimate the Effects on Price

Similar to employment, the domestic price of pharmaceuticals is influenced by the sizes of pharmaceutical imports and exports, as well as their international prices. To estimate the effects of the USSFTA on the price level, the following model is used, where the assumptions

for the employment model also hold for this model:

$$P_t = \alpha_0 + \alpha_1 USSFTA_t + \alpha_2 log(import_t) + \alpha_3 log(Export_t) + \eta_t$$

$P_t$ is the expenditure price index of pharmaceuticals in year t, $USSFTA_t$ indicates if the USSFTA has come into force in year t, $import_t$ is the US imports of pharmaceuticals from the world in year t, and $Export_t$ is the exports of pharmaceuticals from the US to the rest of the world in year t. Different from the model for employment, I do not use the trade surplus in this model because I anticipate that imports and exports drive domestic prices more independently.

### c. Results

I used the R software to run the regression models above, and the regression results are summarized into 4 tables by the package "stargazer".

#### i. Effects on Trade Volume

Table 2 below represents the estimates from the DID method. In the DID regression results (see Table 2), the first two columns excluded GDP as an independent variable. While all columns suggest positive effects of the USSFTA on exports and imports, the estimated effects on exports are statistically insignificant, according to β3's of column 1 and column 3.

*Table 2.* Trade Flow DID Regression Results

| | Dependent variable: | | | |
|---|---|---|---|---|
| | Natural Logarithm of Exports of Pharmaceuticals (Million USD) | Natural Logarithm of Imports of Pharmaceuticals (Million USD) | Natural Logarithm of Exports of Pharmaceuticals (Million USD) | Natural Logarithm of Imports of Pharmaceuticals (Million USD) |
| | (1) | (2) | (3) | (4) |
| Country | -1.014 | -0.468 | 0.279 | 1.850 |
| | (0.738) | (1.621) | (0.293) | (1.107) |
| Year | 1.003* | 0.011 | -0.366 | -2.444*** |
| | (0.551) | (1.210) | (0.225) | (0.852) |
| USSFTA | 0.981 | 4.342** | 0.176 | 2.897** |
| | (0.780) | (1.712) | (0.303) | (1.145) |
| Natural Logarithm of GDP (Million USD) | | | 1.892*** | 3.392*** |
| | | | (0.107) | (0.404) |
| Constant | 3.603*** | 1.265 | -18.247*** | -37.913*** |
| | (0.522) | (1.146) | (1.251) | (4.727) |
| Observations | 58 | 58 | 58 | 58 |
| $R^2$ | 0.235 | 0.509 | 0.889 | 0.789 |
| Adjusted $R^2$ | 0.192 | 0.482 | 0.881 | 0.774 |
| Residual Std. Error | 0.904 (df = 54) | 1.985 (df = 54) | 0.347 (df = 53) | 1.313 (df = 53) |
| F Statistic | 5.524*** (df = 3; 54) | 18.695*** (df = 3; 54) | 106.352*** (df = 4; 53) | 49.688*** (df = 4; 53) |
| *Note:* | | | | *p**p***p<0.01 |

The estimates of the effects of USSFTA on imports are greater than 0 and statistically significant. This means that the USSFTA stimulated the US imports of pharmaceuticals from Singapore. With this information, one may estimate the potential effects of IPRs protection on trade volume. Coefficients of GDP implies that trade volume is positively correlated with Singapore's GDP, which implicitly reflects the gravity model of trade. Besides, according to the adjusted R-square values from the DID strategy, the model that included the control variable

seems to be a better estimation of the overall effects.

Table 3 below summarizes the OLS

estimates. Similar to the DID estimation, the effect of the USSFTA on US exports of pharmaceuticals to Singapore is not statistically significant, but the effect on imports is positive and significant. Large R-squared values suggest the OLS model can mostly explain the variation in the dependent variable.

The estimates of the effects of USSFTA on trade volumes through DID and OLS are not precise but reflect classical and neoclassical trade theories. After the FTA was implemented, Singapore received a lot of FDI and capital investments, which helped it to develop a comparative advantage in pharmaceuticals, a capital-intensive good. With the capability of producing pharmaceutical products at lower

*Table 3.* Trade Flow OLS Regression Results

|  | Dependent variable: | |
| --- | --- | --- |
|  | Natural Logarithm of Exports of Pharmaceuticals (Million USD) | Natural Logarithm of Imports of Pharmaceuticals (Million USD) |
|  | (1) | (2) |
| USSFTA | -0.073 | 3.852*** |
|  | (0.387) | (0.559) |
| Natural Logarithm of Singapore's GDP (Million USD) | 2.049 | -3.112 |
|  | (2.367) | (3.420) |
| Natural Logarithm of US GDP (Million USD) | 0.084 | 7.055 |
|  | (3.387) | (4.894) |
| USD to SGD Exchange Rate | 1.011 | -4.199 |
|  | (3.092) | (4.468) |
| Constant | -22.853 | -69.149** |
|  | (23.048) | (33.306) |
| Observations | 29 | 29 |
| $R^2$ | 0.908 | 0.967 |
| Adjusted $R^2$ | 0.892 | 0.962 |
| Residual Std. Error (df = 24) | 0.411 | 0.595 |
| F Statistic (df = 4; 24) | 58.924*** | 178.419*** |
| Note: | | *p**p***p<0.01 |

relative prices, Singapore exported more pharmaceuticals to the US and gradually became the Pharma Hub of Asia.

## ii. Effects on Employment

Table 4 below summarizes the estimates of the effects of trade surplus and the USSFTA on US employment in the pharmaceutical industry. Straightforwardly, the regression results show a statistically significant positive effect of the USSFTA on employment and statistically insignificant effects of PPI and trade surplus.

The estimate of the USSFTA coefficient violates trade theories stated in the theory section, and there should be mainly two reasons for this. First, the model is actually an inaccurate model to estimate the effect of a trade policy since it allows potential endogeneity. There may be many other variables in the real world that influence domestic employment, such as the demand from domestic consumers and the trade between the US and other nations. For instance, if the United States itself is a large exporter of pharmaceuticals, the demand for labor in the pharmaceutical products sector should be high. Second, free trade does not necessarily decrease employment; trade is also able to create new jobs. As was mentioned at the beginning of this paper, the large trade flow between these two countries has in fact potentially created many jobs. How the USSFTA and other trading activities influence employment in the US pharmaceutical sector is uncertain, but according to the time series, the employment in the US pharmaceutical industry has an upward trend. I believe one of the main driving forces is the huge demand from the consumer side. The employment in the domestic pharmaceutical industry should be high if the domestic market is profitable.

## iii. Effects on Price

*Table 4.* Employment Regression Results

|  | Employment (Thousands) |
| --- | --- |
|  | Employment |
| USSFTA | 46.088** |
|  | (21.018) |
| Trade Surplus (Million USD) | -0.001 |
|  | (0.001) |
| Producer Production Index | -0.105 |
|  | (0.260) |
| Constant | 467.371*** |
|  | (49.251) |
| Observations | 29 |
| $R^2$ | 0.396 |
| Adjusted $R^2$ | 0.323 |
| Residual Std. Error | 33.842 (df = 25) |
| F Statistic | 5.460*** (df = 3; 25) |
| *Note:* | *p**p***p<0.01 |

Table 5 below is the summary of the effects of the USSFTA, imports, and exports on the expenditure price index of pharmaceutical products. The regression estimates show a statistically insignificant effect of the USSFTA on the prices of pharmaceuticals in the US, but significant effects of imports and exports. If the coefficient of the USSFTA is statistically significant, it can be concluded that the pharmaceutical trade between the US and Singapore lowers the price of pharmaceuticals in the US, which satisfies trade theories stated in the theory section. According to Table 5, while the regression coefficient of imports from the rest of the world is negative, exports variable's estimate is positive. The coefficients can suggest a positive. and negative

correlation, but they not necessarily estimate the precise causal relationship. However, these estimates still meet the trade theories that the international price of an imported product is lower than the price of the same product that is domestically produced. In other words, as trade commences or expands between the US and other countries after trade agreements, it is reasonable to observe a rise in the domestic price of the good that the US exports and a price fall in the good that it imports.

## 5. Conclusion

In this paper, I focused on the effects of the USSFTA on trade volume in pharmaceuticals between the US and Singapore, its effects on employment in the US pharmaceutical industry, and its effects on the price of US pharmaceutical products. I found

*Table 5.* Price Level Regression Results

|  | Pharmaceutical Products Expenditure Price Index |
| --- | --- |
|  | Price |
| USSFTA | -1.244 |
|  | (0.957) |
| Natural Logarithm of Exports of Pharmaceuticals (Million USD) | 13.069*** |
|  | (2.231) |
| Natural Logarithm of Imports of Pharmaceuticals (Million USD) | -6.419*** |
|  | (1.769) |
| Constant | 33.162*** |
|  | (7.997) |
| Observations | 18 |
| $R^2$ | 0.910 |
| Adjusted $R^2$ | 0.891 |
| Residual Std. Error | 0.875 (df = 14) |
| F Statistic | 47.335*** (df = 3; 14) |
| *Note:* | *p**p***p<0.01 |

that the effect of the USSFTA on the US imports of pharmaceuticals from Singapore and its effect on the employment in the US pharmaceutical industry is statistically significant. The primary reason that the USSFTA expanded the trade volume in pharmaceuticals, especially US imports from Singapore, is the protection of IPRs. Despite statistical significance, the estimated effects on employment may not be precise because of endogeneity and other considerations. How well the trade of pharmaceuticals between the US and Singapore matches trade theories was also discussed in this paper. The trade flow of pharmaceuticals between the US and Singapore matches the theory of comparative advantage, and how overall imports and exports influence domestic price is also consistent with neoclassical trade theories. However, the effects of trade on employment contradict the classical and neoclassical theories.

There are some limitations to this research project. Firstly, the effects of the USSFTA in different years cannot be evaluated through the regression models used in the paper. Depending on the year, the USSFTA might have different magnitudes of effects on the trade flow, employment, and price level. Also, the models for employment and price level are not robust since the exogeneity assumption may have not been perfectly satisfied. There is therefore a necessity to extend current research on this topic and remedy those weaknesses. To present different levels of effects within different years, the interaction terms between the USSFTA and years of interest should be added to the regression models. If more data is available, applying instrumental variables and Two-Staged Least Square would be helpful in solving the issue of endogeneity.

# References

Batra, A. (2006). India's Global Trade Potential: The Gravity Model Approach. *Global Economic Review, 35*(3), 327-361. doi:10.1080/12265080600888090

Chaney, T. (2013). The Gravity Equation in International Trade: An Explanation. doi:10.3386/w19285

Nanto, D. (2008, January). The U.S.-Singapore Free Trade Agreement: Effects After Three Years. Retrieved from https://digitalcommons.ilr.cornell.edu/key_workplace/481/

Nanto, D. (2010, March 26). The U.S.-Singapore Free Trade Agreement: Effects After Five Years. Retrieved from https://digitalcommons.ilr.cornell.edu/key_workplace/726/

Quick Facts: U.S.-Singapore Free Trade Agreement. (n.d.). Retrieved from https://ustr.gov/about-us/policy-offices/press-office/fact-sheets/archives/2003/may/quick-facts-us-singapore-free-trade-agreement

Renjini, V., Kar, A., Jha, G., Kumar, P., Burman, R., & Praveen, K. (2017). Agricultural trade potential between India and ASEAN: An application of gravity model. *Agricultural Economics Research Review, 30*(1), 105. doi:10.5958/0974-0279.2017.00009.x

Ribbink, K. (2014, February). Singapore a Pharma Hub for Asia. Retrieved from https://www.pharmavoice.com/article/singapore-pharma-hub/

Singapore. (n.d.). Retrieved from https://ustr.gov/countries-regions/southeast-asia-pacific/singapore

Tongzon, J. L. (2003). U.S.–Singapore Free Trade Agreement:: Implications for ASEAN. *Asean Economic Bulletin, 20*(2), 174-178. doi:10.1355/ae20-2f

Ng-Loy, Wee Loon. The IP Chapter in the US-Singapore Free Trade Agreement. *Singapore Academy of Law Journal*, Vol. 16, No. 1, Mar 2004: 41-73. Retrieved from https://search.informit.com.au/documentSummary;dn=889599039717881;res=IELHSS. ISSN: 0218-2009.