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Welfare gains of China's WTO access: A note

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Abstract: The measurement of welfare brought about by trade environment change has long been a heated topic in international trade analysis. By utilizing compensating variation as in Grinols and Wong (1991) and Irwin (2005) and equivalent variation methodology, we separately measure the direction and the magnitude of the welfare change in China after the entrance into the World Trade Organization (WTO) in 2001. The result shows that China gained up to 4.8% of GDP in welfare in the short run thanks to the WTO access.

JEL classification: F00; F53; F62
Keywords: Trade welfare; WTO access; China

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1 Introduction

International trade has long been considered beneficial to economies compared to autarky. However, the welfare gains brought by international trade are still not well understood by scholars. To estimate the welfare change, the most common method is to compare the welfare of an economy's autarky equilibrium with that earned with international trade. Comparative advantage theory like Ricardian or Hecksher-Ohlin models suggests that when an economy opens to international trade, it will gain through exporting goods from its most productive industries and importing goods that it is not as keen to produce.[1]

Along with identifying the direction of welfare change, it is important to measure the value of welfare increase in order to offer sound policy implications. This issue has been popular in the trade literature since Grinols and Wong (1991) that introduced one of the most valuable methodologies for estimating the magnitude of welfare change. In this stream of studies, Bernhofen and Brown (2005) analyze the transformation from autarky to free trade in Japan between 1868 and 1875. Irwin (2005) estimates the welfare costs for the US of the Jeffersonian Trade Embargo from 1807 to 1809. Carrasco-Gallego (2012) quantifies the welfare change of the exclusion of Spain from the Marshall plan and the Madrid Treaty with the US. Etkes and Zimring (2015) focus on the blockade of Gaza from 2007 to 2010.

In the last two decades, the global trade setting has experienced a sharp change with the access of China to the World Trade Organization (WTO) in 2001. This event has been investigated from several perspectives. For example, Brandt et al. (2017) show that this event has spurred Chinese manufacturing firms' productivity. However, Yeung and Mok (2004) document that the abolition of restriction on exports (export quota) has reduced the competitive advantage for foreign-financed firms with investments in southern China. Teng (2004) illustrates that the entry mode of foreign firms into the Chinese market has changed from Joint Venture into wholly-owned subsidiaries, and acquisitions. Ng and Tuan (2003) show that China's access to WTO has affected the geographical agglomeration of FDI firms, favoring knowledge spillover from multinational enterprises to local firms.

[1] See Jones (1965) for Hecksher-Ohlin model.

Only few studies have also sought to quantify the welfare effects of international trade in China. One pioneering work is Bach et al. (1996) that estimate the welfare effects of trade liberalization in 1990s, i.e. before the WTO access. More recently, Ianchovichina and Walmsley (2003) have used CGE model to estimate the welfare effects of WTO joining on Chinese economy.

The present paper contributes to this infant literature by quantifying the welfare effects of China's entrance into the World Trade Organization (WTO) using a more flexible framework than those exploited in earlier papers (Bernhofen and Brown, 2005; p. 209). The work follows the widely utilized methodology proposed Grinols and Wong (1991) and adopts unique trade data by commodities in order to measure the value of welfare change induced by the WTO access. As one of the first attempts to utilize China price data in welfare change analysis, this paper aims to bring a new vision on developing countries' welfare gains associated with changes in trade environments. Our analysis considers only the short-run (not long-run) effects of trade liberalization, focusing on the 2002-2004 period, on the presumption that technology does not change before and after trade liberalization (Jones 1965). The result shows that China has gained up to 4.8% of GDP in welfare after joining the WTO.

The paper is organized into 6 sections. Section 2 presents the background and history as a basis for understanding the research motivation. Section 3 introduces the methodologies and components of welfare. Data resources are presented in Section 4. In Section 5, the calculation will be shown and interpreted. Section 6 interprets and discusses the empirical results. Section 7 concludes.

2 Background

This section introduces the historical background concerning the period of analysis, offering reference to the related histories of the shocks that have encouraged or discouraged the international trade of the countries discussed.

2.1 China's Participation in the WTO, 2001

China has been keeping its distance from Western society since the 1950s. After China's Reform and Opening-up in 1978, China was eager for foreign currency and sought a market for its drastically growing production.

Currently, 90% of China's commodity and service trades are conducted with GATT economies. However, as China is not a qualified a member of the GATT, these economies tend to place anti-dumping acts on Chinese products to protect their domestic enterprises. Moreover, if China has a dispute with a GATT country, it can only resolve the dispute with instruments of diplomacy instead of conducting multilateral negotiations under the GATT framework.

Until 2002, there were more than 500 anti-dumping acts being enforced against Chinese products (Ministry of Commerce, 2003). The US government has been continuously investigating Chinese enterprises under Section 301 of the US Trade Act, which allows the US government to initiate dispute settlement with trade proceedings at the WTO. China has been eager to release itself from a restricted trade environment and to find a way to resolve trade disputes within the international framework.

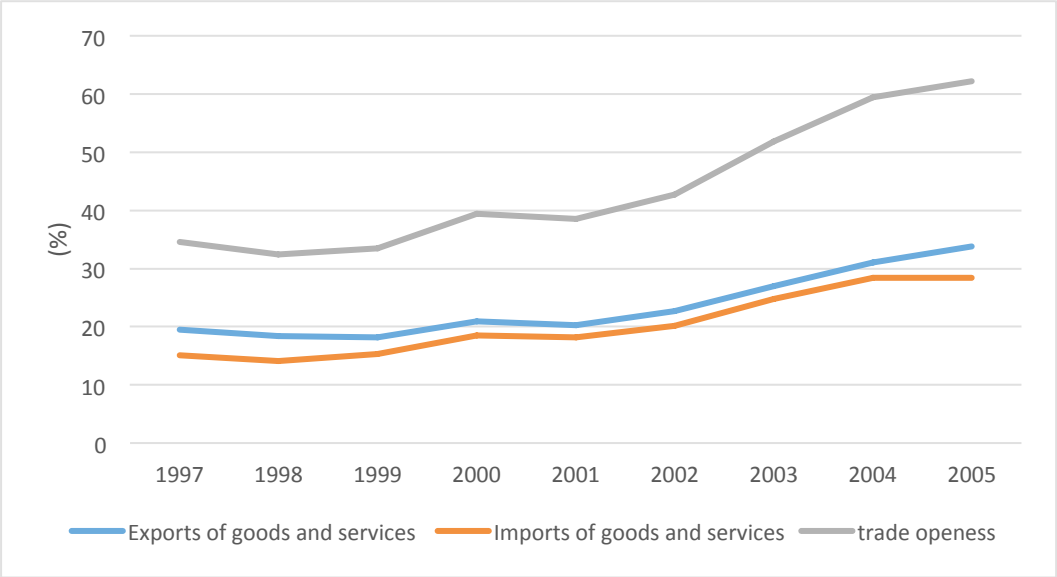
In 1986, China applied to reinstate its membership in the GATT. Much effort was made by China to realize this reinstitution, including a decrease in the import tariffs for 225 commodities in 1992 and the cancellation of import control of 283 commodities in 1994. After the Uruguay Round Final Agreement Document was signed by GATT members, the WTO replaced the GATT as the authorized international trade administration. After 15 years of negotiation with the GATT and then the WTO, China signed an agreement to join the WTO in December 2001.

Joining the WTO has brought great change to China's international trade relationships. In 2002, China achieved trade amounting to 628 billion US dollars. This was the first time China's trade amount exceeded 600 billion USD, and it was a 22% increase compared to that of 2001, as shown in Figure 1.

According to statistics from the Statistics Bureau of China, the trade value of China reached 38 billion US dollars in 1980, and it increased to 474 billion US dollars in 2000 before China entered the WTO. However, the growth rate of the trade value has lowered since the late 1990s. The lowered pace of trade growth is mainly due to two reasons. First, trade limitations are applied to the export market of China because the country is not qualified for a lowered tariff rate in most countries in the world. Second, though China enjoyed a long period of GDP growth of more than 10% in 1980, local enterprises are not abundantly capable of competitiveness in the world market, which requires commodities with high originality and

quality. As these factors could be lowering the further growth of GDP, causing China to fall behind its Asian neighbors, the Chinese government has turned its focus to the "quality" of economic development rather than the "quantity" of the development.

Figure 1. Export, Import and Trade Openness Ratio of China



Source: Calculation based on data from the World Bank

Therefore, the government seeks to encourage enterprises in China to enhance their competitiveness in the world market. Joining the WTO could be as one point of this policy shift, as open trade policy may impact local society in China given the increasing rate of unemployment and bankrupted enterprises. On the other hand, joining the WTO lowers tariffs and other trade barriers between China and other countries.

The agreement between China and the WTO set a number of conditions for reinstating China's membership. First, China lowered its tariff and nontariff barriers for foreign countries to gain support from Western countries for its membership reinstatement. Second, the service sectors in China that have long been controlled by government capital were opened to foreign enterprises quickly. Third, local enterprises with less originality found it more difficult to survive with the government application of intellectual property right laws. These conditions greatly opened the Chinese market to foreign enterprises, which was a risk China had to bear.

Regardless of these limitations, joining the WTO has had even more of an impact on various fields than China expected. By lowering trade barriers between China and the 164 WTO countries, China has gained access to most of the world market. According to the State Council of China, the average growth rate of trade between 1995 and 2005 turned out to be 9.1%, which is larger than the average trade growth rate of 6.1% between 1996 and 1999.

On the other hand, the risks China predicted it would confront before its entrance into the WTO turned out to be limited. Though the impact from the world market on local enterprises in China has been large, it appears that the country has overcome the obstacles facing its overall enterprise competitiveness and has started to increase its share of commodities and services worldwide. In the short run, the impact of a lowered import tariff rate had made it less costly for foreign commodities to enter China, but the situation has been beneficial for China when viewed in the long-term.

The positive impact on the export value of China brought by its participation in world trade has impact on China's GDP. In 2002, China presented a 9.1% growth in GDP. The growth rate of GDP has been increasing constantly since 2001. The GDP and trade data imply that China has gained welfare by joining the WTO, but the detailed magnitude of the gain is still to be measured.

3 Methodology

Following Grinols and Wong (1991), we estimate the compensated variation (ΔW_{CV}) as follows:

$$\Delta W_{CV} = e(p_1, u_1) - e(p_1, u_0) \tag{1}$$

where $p_1(p_0)$ is the price vector after (before) joining WTO, $u_1(u_0)$ is the associated utility level, and ΔW_{CV} represents the CV which is the difference between the two expenditure functions. The expenditure functions can be explained as follows:

$$\begin{aligned} e(p_1, u_1) &\equiv p_1 \cdot x_1 = p_1 \cdot y_1 + (p_1 - p_1^*) \cdot m_1 + B_1 \\ e(p_1, u_0) &\equiv p_1 \cdot x_0 = p_1 \cdot y_0 + (p_1 - p_1^*) \cdot m_0 + B_0 \end{aligned} \tag{2}$$

where x represents consumption, y represents production, p^* stands for the international price, $m(=x-y)$ is the net import good quantity and B is the international transfer.[2] Above three terms represent the value of domestic production, tariff revenue, and international transfer, respectively. By rearranging the formulas, we have:

$$\Delta W_{CV} \equiv e(p_1, u_1) - e(p_1, u_0) = R + F + E + S_c + S_p \tag{3}$$

where

$$R \equiv (p_1 - p_1^*) \cdot (m_1 - m_0)$$
$$F \equiv B_1 - B_0 = p_1^* \cdot (x_1 - y_1) - p_0^* \cdot (x_0 - y_0)$$
$$E \equiv (p_1^* - p_0^*) \cdot (-m_0)$$
$$S_c \equiv p_1 \cdot x_0 - e(p_1, u_0)$$
$$S_p \equiv p_1 \cdot (y_1 - y_0)$$

Here, the welfare change is divided into five terms. R is the tariff revenue effect of governments' through changes in volume of import; F, the transfer effect, represents the difference in net transfer between two periods; E, the term-of-trade effect, presents the value of excess export through difference in international price between two periods; S_c is the substitution effect of consumption; S_P is the substitution effect of production.

Following Irwin (2005), we assume following two assumptions to estimate above five terms to avoid unavailability of data.[3]

First, we suppose that an economy can replace all its imports with domestic production in an autarky situation, as the production possibility frontier does not change during the trade environment shift. In this case, the substitution effect of production (S_p) equals the difference between the total import values of the two referenced years:

$$S_p \equiv p_1 \cdot (y_1 - y_0) = p_1 \cdot (m_1 - m_0) \tag{4}$$

[2] Rewriting budget constraint yields $B_i = (p_i^*) \cdot (x_i - y_i), i = 1,2$.

[3] We have no data for production for each commodity and we have no information for expenditure function.

Finally, as we cannot estimate the expenditure to achieve the initial utility level with the new price, the substitution effect of consumption (S_c) is assumed not to exceed the substitution effect of production (S_p). In this case, the most secure way for us is to assume that $S_c = S_p$, in order not to overestimate the effect caused by import value increase as in Irwin (2005). Therefore,

$$S_c = S_p = p_1 \cdot (m_1 - m_0) \tag{5}$$

Moreover, we estimate the equivalent variation. The concept of EV can be expressed as follows:

$$\text{EV: } \Delta W_{EV} = e(p_0, u_1) - e(p_0, u_0) \tag{6}$$

Similarly, we decompose the equivalent variation into five terms as follows:

$$\begin{aligned} \Delta W_{EV} &= R + F + E + (S_c + S_p) \\ &= (p_0 - p_0^*) \cdot (m_1 - m_0) + p_1^* m_1 - p_0^* m_0 \\ &\quad + (p_1^* - p_0^*) \cdot (-m_1) + 2 \cdot p_0 \cdot (m_1 - m_0) \end{aligned} \tag{7}$$

where

$$\begin{gathered} R \equiv (p_0 - p_0^*) \cdot (m_1 - m_0) \\ F \equiv B_1 - B_0 = p_1^* \cdot (x_1 - y_1) - p_0^* \cdot (x_0 - y_0) \\ E \equiv (p_1^* - p_0^*) \cdot (-m_0) \\ S_c \equiv p_1 \cdot x_0 - e(p_0, u_0) \\ S_p \equiv p_0 \cdot (y_1 - y_0) \end{gathered}$$

Equations (3) and (7) are used separately in the calculation to reach a total value of welfare change in Section 5. The direction and magnitude of China's welfare change after it became a WTO member in 2001 is estimated in both CV and EV measurements.

4 Data

This section introduces the data source of our estimation. Import and export quantity and value data by commodities for China are available in the China Statistics Yearbook that has been published annually since 1980; the data after 1997 are offered online at the website of the National Bureau of Statistics of China. Tariff rates and general GDP data are taken from the World Bank database. As the study focuses on limited periods where shocks to the trade environment occurred, the data we use are also rather compact. The dataset from the National Bureau of Statistics of China contains information on the quantity and value of 144 exported commodities and 63 imported commodities.

As our research focuses on the comparison of economies' welfares before and after China's WTO joining, our reference years is 2001 because China entered the WTO in December of 2001 is preferable as a base year that has a relatively closed trade policy for comparison. The reference years are three years after the base year which is between 2002 and 2004. The calculation of the welfare between the base years and these reference periods is presented in Section 5.

5 Estimation and Results

Based on Equations (3) and (7), the calculation is conducted separately. The result is presented by means of calculation in this section.

5.1. China's Welfare Change after Entrance into the WTO, 2001

Table 2 shows the numerical results by components of welfare based on the CV and EV. The price and GDP data are normalized to the 2001 price of US dollars. To focus our analysis on the welfare resulting from the open policy of China after joining the WTO, only three reference years are included in this analysis, as other shocks and factors may exhibit influences on our results in the following years.

In the CV results, component R in Equation (3): $(p_1 - p_1^*)(m_1 - m_0)$ shows the tariff revenue effect. During the years included in our analysis, the tariff revenue was growing at a rapid pace in China after its entrance into the WTO; Component F in Equation (3): $p_1^* m_1 - p_0^* m_0$ presents the estimated transfer effect based on budget constraint $(B = p^* m)$; the terms-of-trade effect E: $(p_1^* - p_0^*) \cdot (-m_0)$; Component S_c: $p_1(m_1 - m_0)$ is

estimated following Irwin (2005); Finally, component $S_p: p_1(m_1 - m_0)$ is estimated following Irwin (2005). The EV results show a similar story, with the welfare gain in 2002 being higher than the CV measurement. The numerical results show that China gained 2.5% to 5% of GDP in welfare in the 3 years after joining the WTO, with 0.63% of GDP in welfare gain in the first year. China's welfare gains from entering into the WTO grew every year, as China's trade openness grew every year.

Table 2. This Is a Table Components of China's Welfare Gain after Joining the WTO in December 2001 (2001 price, 10000 US dollars)*

CV Estimation

Components	**2002**	**2003**	**2004**
R: Tariff Revenue Effect $(\boldsymbol{p_1 - p_1^*})(\boldsymbol{m_1 - m_0})$	194,675.93	515,692.02	800,282.73
F: Transfer Effect $\boldsymbol{p_1^* m_1 - p_0^* m_0}$	524,651.30	1,984,162.14	4,024,225.19
E: Terms-of-trade Effect $(\boldsymbol{p_1^* - p_0^*}) \cdot (-\boldsymbol{m_0})$	-413,709.29	-911,867.82	-1,872,522.11
$\boldsymbol{S_c}$: Consumption Effect $\approx \boldsymbol{p_1(m_1 - m_0)}$	305,617.94	1,587,986.34	2,951,985.81
$\boldsymbol{S_p}$: Production Effect $= \boldsymbol{p_1(m_1 - m_0)}$	305,617.94	1,587,986.34	2,951,985.81
Total Welfare Change	916,853.81	4,763,959.01	8,855,957.44
****Total Welfare Gained as percent of GDP**	**0.63%**	**2.97%**	**4.82%**

EV Estimation

Components	**2002**	**2003**	**2004**
R: Tariff Revenue Effect $(\boldsymbol{p_0 - p_0^*}) \cdot (\boldsymbol{m_1 - m_0})$	268,131.82	700,465.94	948,326.86
F: Transfer Effect $\boldsymbol{p_1^* m_1 - p_0^* m_0}$	524,651.30	1,984,162.14	4,024,225.19
E: Terms-of-trade Effect $(\boldsymbol{p_1^* - p_0^*}) \cdot (-\boldsymbol{m_1})$	-468,385.69	-1,386,288.97	-3,437,323.18
$\boldsymbol{S_c}$: Consumption Effect $\approx \boldsymbol{p_0} \cdot (\boldsymbol{m_1 - m_0})$	324,397.42	1,298,339.10	1,535,228.87
$\boldsymbol{S_p}$: Production Effect $= \boldsymbol{p_0} \cdot (\boldsymbol{m_1 - m_0})$	324,397.42	1,298,339.10	1,535,228.87
Total Welfare Change	973,192.27	3,895,017.31	4,605,686.60
****Total Welfare Gained as percent of GDP**	**0.67%**	**2.43%**	**2.51%**

* Compared with the base year of 2001; ** Compared with the GDP of later years of reference

The welfare effect caused by China's entrance into the WTO is observed to have a larger magnitude in the long run than in the short run. The total welfare gained in 2002-2004 was 94,739 million (by the CV measurement)

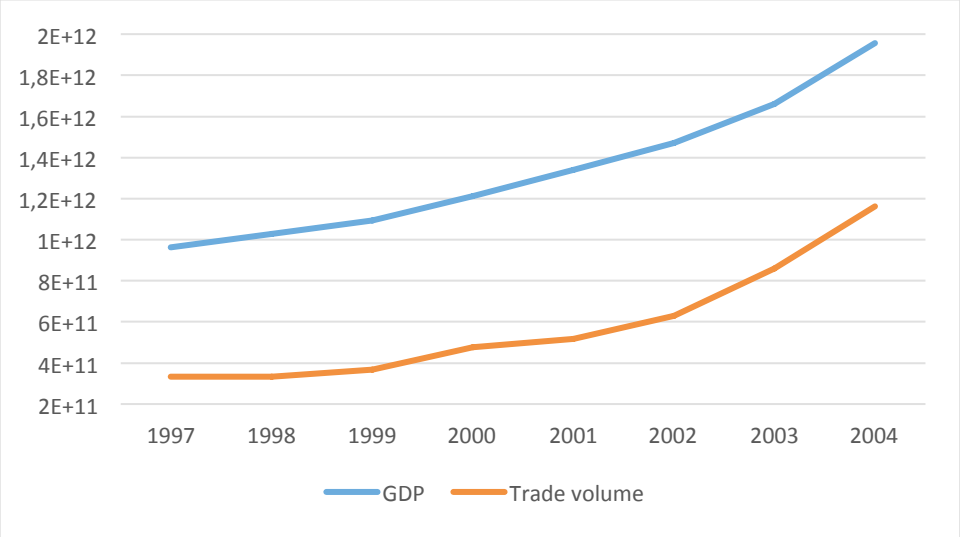
compared to 152,738 million (by the EV measurement) in 2001 as priced in US dollars.

6. Implications

We observed a great effect of international trade policy on economies' welfare change. China's cases show welfare changes after joining the WTO in 2001.

Before joining the WTO in 2001, China had to bear a high tariff for exports and a high price for imports, suffering from being banned entrance into the markets of Western economies. The high barrier for international trade had been setting a limit on exports and imports for China (refer to Figure 1). The lack of instruments by which China could increase income and the number of reasonably priced commodities from outside the country limited China from releasing its power of production. After 15 years of negotiation with the United States to become a member of the WTO, China succeeded in lowering the barriers of international trade. Components of welfare show that China has gained most of its welfare as a result of the increase of net imports and its value because tariff revenue effect, transfer effect, consumption effect, and production effect are positive.

Figure 2. Annual GDP and Trade of China between 1997 and 2004 (Current Price, Millions of US Dollars)



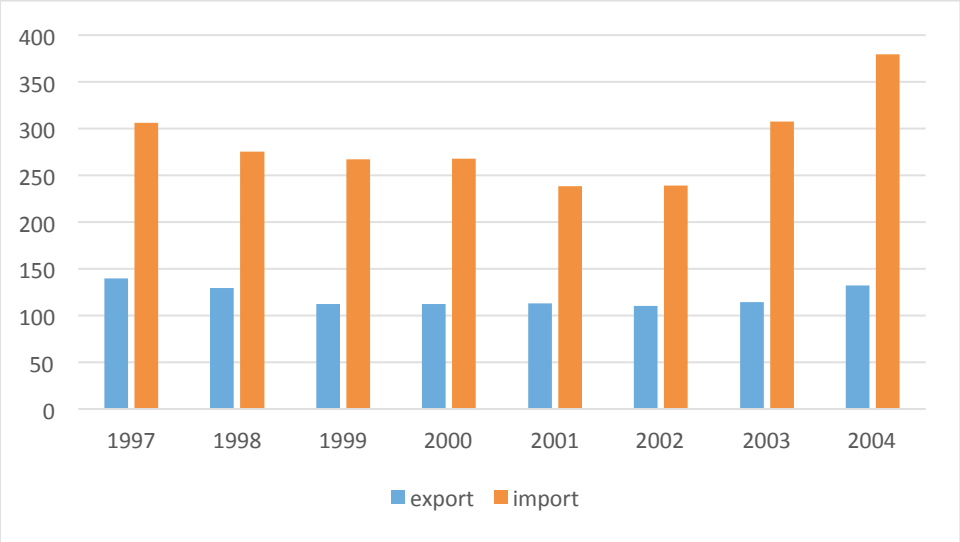
Source: The World Bank Open Data

The measurements of welfare gain by CV are generally higher than the EV measurements, except for the results that compare 2001 with 2002 and 2007 with 2009. Following Grinols and Wong (1991), as we are unable to access the foreign transfer data and the real utility function, the model is based on the assumption of the balance of trade being equal to the balance of payment and the assumption that China can substitute all its production with imports, as mentioned in Section 3. In this case, by simplifying Equations (3) and (7), we found that our estimation is based on the difference between the import values of the first and last reference years; thus:

$$\begin{aligned} &\text{CV: } \Delta W_{CV} = 3 \cdot p_1(m_1 - m_0) \\ &\text{EV: } \Delta W_{EV} = 3 \cdot p_0(m_1 - m_0) \end{aligned} \tag{8}$$

Equation (8) can be considered a simplified form of welfare change calculation through CV and EV methods. The CV measurement is estimated by the product of the new price and the differences between the net import quantities, while the EV is estimated similarly with the old price. Therefore, both the CV and EV results are sensitive to price changes. As the EV is measured at lower price, the result is usually less than the CV measurement as the price increases and is usually more than the CV measurement as the price decreases. Figure 3 shows the average price change of all the observed commodities, confirming that the average price of importing and exporting commodities decreased in 2002.

Figure 3. Average Price Change Rate of Export and Import Commodities in China between 1998 and 2015



Source: Calculation based on data from the China Statistics Yearbook

7 Conclusions

This research presents the welfare change measurement of China before and after joining WTO in 2001 December. Following Grinols and Wong (1991) and Irwin (2005), we estimate the compensated variation. Additionally, the EV approach was also applied to acquire a more accurate measurement of welfare change.

The results show that China has gained up to 4.8% of GDP in welfare after joining the WTO due to increased imports and exports. The substitution effects of consumption and production enlarged the welfare gain of China after these events.

The consequence of China entering the WTO is obvious. The trade openness of China dramatically grew during the years examined (refer to Figure 1). In the last fifteen years, China achieved an average GDP growth rate of 9.4%. As the comparative advantage theory like Ricardian and Hecksher-Ohlin models suggests, economies tend to involve themselves more in the production fields with the lowest opportunity costs. By importing more raw materials and exporting more secondary products, China has earned itself more productivity and income.

However, this research is still limited in terms of data sources as well as methodology. Production data for each commodity that was observed

would also be a better index to replace our assumptions regarding the substitution effect on consumption and production. The datasets also do not contain very detailed classifications for the commodities that would enable us to trace the price changes of certain goods. We hope that there are future chances for us to establish more detailed welfare measurement trials for China and other developing countries with abundant data sources. Moreover, we used the interindustry trade model for estimating welfare effects but intra-industry trade model is more consistent with real world. Thus, we need estimate welfare effects using monopolistically competitive model and firm heterogeneity as in Dhingra et al (2017).

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