Analysis of Economic Effects of the Korea-U.S. FTA using a Dynamic CGE Model

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I. Introduction

- **Since the first round of negotiation talks over a free trade agreement (FTA) between Korea and the U.S. in June 2006, there had been 8 official rounds of negotiation talks, a high-level negotiation talk and a trade-minister talk between them.**

- **The Korea-U.S. FTA (KORUS FTA) was signed by both sides on 30 June 2007.**

- **It should be ratified by the National Assembly of Korea and the Congress of the US to come into force.**

I. Introduction

- **As of 2005, the U.S. is Korea's 3rd largest trading partner, 2nd largest export market, and its largest supplier of foreign direct investment (FDI).**

- **Korea is the 7th largest trading partner of the U.S. and 7th largest export market.**

- **Therefore, the Korea-U.S. FTA is expected to affect Korean economy as a whole to a large extent, which will be an important exogenous factor for Korea's growth in years to come.**

I. Introduction

- **It is necessary and important to estimate potential economic effects of the Korea-U.S. FTA which was signed on 30 June 2007.**

- **Some studies of its economic effects have been carried out by the Korea Institute for International Economic Policy (KIEP), in which a static Computable General Equilibrium (CGE) model was used.**

I. Introduction

- **Against this backdrop, the objective of this study is:**
  - **To conduct a quantitative assessment of potential economic effects of the K-US FTA signed on 30 June 2007**
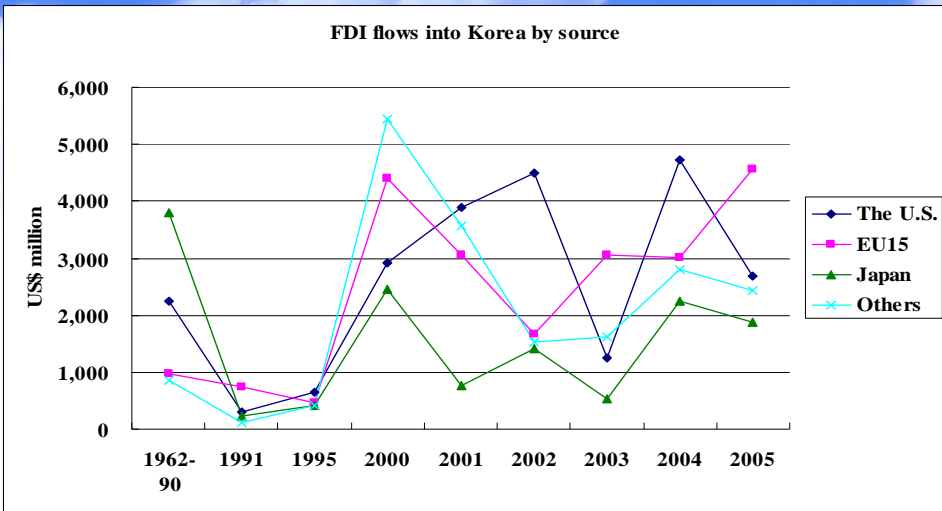 - **Using a dynamic multi-region, multi-sector CGE model.**

II. Economic Relations between China and Korea

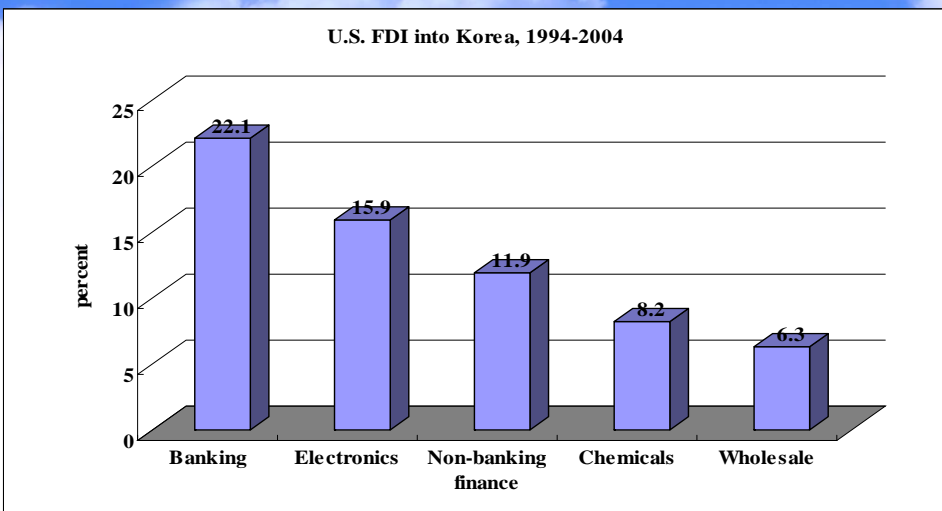# Figure 1: Korea's Bilateral Trade with the U.S.

Korea' Bilateral Trade with the U.S.
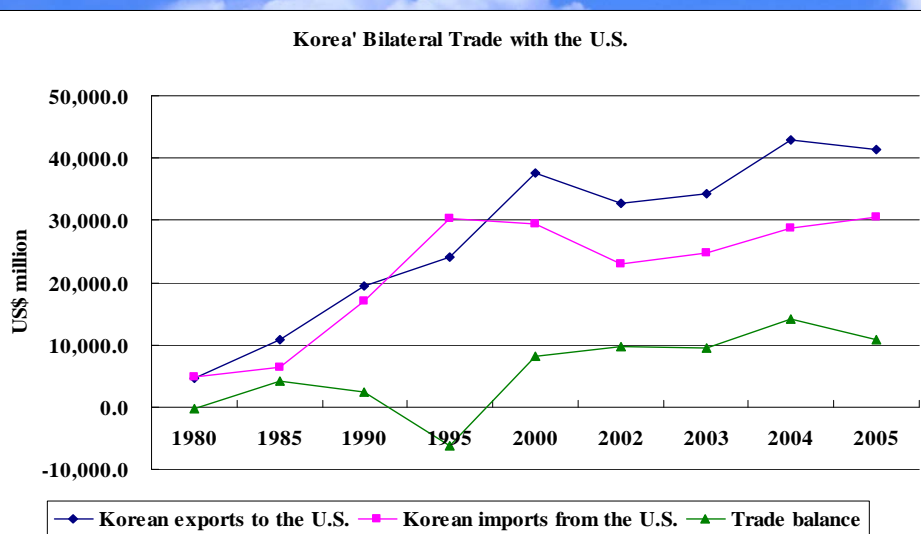
Source: Korea International Trade Association

Figure 2: FDI into Korea by Country (US$ million)

FDI flows into Korea by source

Figure 3: U.S. FDI into Korea by Industry (percent)

U.S. FDI into Korea, 1994-2004

Banking	Electronics	Non-banking finance	Chemicals	Wholesale
22.1	15.9	11.9	8.2	6.3

Data used in this study

- **The CGE model is applied to a 3-region by 21-sector aggregation of GTAP DB pre-release version 6.2, which was released in May 2006.**
- **3 regions include Korea, the U.S.A. and ROW.**
- **The GTAP data base is supplemented with foreign income data from the IMF Balances of Payments statistics to track international capital mobility and foreign wealth.**

List of 21 Sectors

Name	Description
1. Rice	Rice
2. OthCrops	Other crops except for rice
3. VgtFrt	Vegetable and fruits
4. LvstkMtDry	Livestock, meat and dairy products
5. Fishery	Fishery
6. Extract	Extract
7. PrcFood	Processed food
8. TextApp	Textile and apparel
9. WoodPaper	Wood, paper and publishing
10. PCheMineral	Petroleum, chemicals and other minerals

List of 21 Sectors

Name	Description
11. Metals	Metal and metal products
12. Autos	Automobiles and parts
13. OthTransp	Other transport equipment
14. Electronics	Electronics
15. Machinery	Machinery
16. OthMnf	Other manufactured goods
17. Construction	Construction
18. TradeTrans	Trade and transport services
19. Telecom	Telecommunications
20. FinanceBus	Finance and business services
21. OthServices	Other services

Table 1: Bilateral Trade by Sector in 2001 (US$ million)

	Korea's exports to the U.S.	U.S.'s exports to Korea
1 Rice	4	4
2 OthCrops	21	1,035
3 VgtFrt	23	88
4 LvstkMtDry	13	1,217
5 Fishery	2	5
6 Extract	2	200
7 PrcFood	212	622
8 TextApp	3,438	295
9 WoodPaper	476	560
10 PCheMineral	2,435	3,280
11 Metals	1,991	1,013

Source: GTAP DB pre-release version 6.2 (May 2006)

Table 1 (cont'd): Bilateral Trade by Sector in 2001 (US$ million)

	Korea's exports to U.S.	*U.S.'s exports to Korea*
12 Autos	6,969	324
13 OthTransp	282	2,706
14 Electronics	13,188	6,795
15 Machinery	4,172	5,336
16 OthMnf	926	245
17 Construction	3	4
18 TradeTrans	1,333	2,057
19 Telecom	112	187
20 FinanceBus	1,000	2,258
21 OthServices	935	1,137
Total	37,537	29,368

Source: GTAP DB pre-release version 6.2 (May 2006)

Table 2 : Bilateral Tariff Rates by Sector in 2001 (percent)

	Korea's tariffs on import from US	*US tariffs on imports from Korea*
1 Rice	1000.0	7.5
2 OthCrops	239.2	1.0
3 VgtFrt	52.5	0.7
4 LvstkMtDry	17.6	9.4
5 Fishery	19.6	0.0
6 Extract	1.7	0.1
7 PrcFood	21.8	4.3
8 TextApp	7.6	13.0
9 WoodPaper	2.8	0.4
10 PCheMineral	6.8	2.8
11 Metals	4.0	1.9
12 Autos	7.9	2.4
13 OthTransp	0.9	0.1
14 Electronics	0.6	0.2
15 Machinery	5.5	1.5
16 OthMnf	15.7	4.1
17 Construction	0.0	0.0
18 TradeTrans	0.0	0.0
19 Telecom	0.0	0.0
20 FinanceBus	0.0	0.0
21 OthServices	0.0	0.0

III. Overview of the Model

- **A Computable General Equilibrium (CGE) Model can be defined as a system of non-linear simultaneous equations describing the constrained optimization of behaviors of economic agents, such as producers, consumers, exporters, importers, savers, investors, and the government.**

III. Overview of the Model

- **This study uses a multi-region, multi-sector recursively dynamic CGE model, which provides a comprehensive assessment of the Korea-U.S. FTA in a global context.**
- **The dynamic CGE model is a recursive-dynamic extension of the static CGE model, which was used for the analysis of several FTAs of Korea (Ko, 1995, 1998, 2000, 2002).**
- **The model preserves all the features of the static CGE model, while enhancing the investment theory to incorporate international capital mobility and ownership (Ianchovichina and McDougall, 2000).**

III. Overview of the Model

- The static aspects of the CGE model is neoclassical in spirit and is part of a long tradition of models that have been widely used to analyze the impact of global trade liberalization and structural adjustment programs.
- The earliest world CGE models were developed by Whalley (1985) and Deardorff and Stern (1990) to analyze the impact of the Tokyo Round of GATT negotiations.
- The model used in this study applies Whalley (1985) to endogenize all regions including the rest of the world and incorporates the macroeconomic specifications from Devarajan, Lewis and Robinson (1990) and Ko (1992).

III. Overview of the Model

- **The CGE model has solid micro-foundations that are theoretically transparent.**
  - Firms supply commodities to domestic and export markets via a CET (Constant Elasticity of Transformation) function, while minimizing production costs.
  - Production structures are represented by a nested production functions consisting of Cobb-Douglas and CES functions.

III. Overview of the Model

- The model includes 5 primary factors of production: unskilled labor, skilled labor, capital, land and natural resources; and intermediate inputs.
- Labor and capital are employed by all sectors, but land is used only in agricultural sectors, and natural resources are utilized in specific sectors.
- It is assumed that intermediate inputs and capital are traded between regions, whereas labor, land and natural resources are not traded.

III. Overview of the Model

- Private consumption is represented via a Cobb-Douglas functional form.
- Product differentiation between domestic goods and imports, and imports by region of origin allows for two-way trade in each product category, depending on the ease of substitution between products from different regions (Armington approach).

III. Overview of the Model

- Within each region, the model solves for commodity and factor prices that equate demand and supply in all commodity and factor markets.
- The model also solves for world prices, equating demand and supply for sectoral exports and imports across the world economy.
- In addition, for each region, the model specifies an equilibrium relationship between the balance of trade and the real exchange rate that measures the average price of traded goods relative to the average price of domestically produced goods sold on the domestic market.

III. Overview of the Model

- Some of the main features of the dynamic CGE model are as follows:
  - In each region, a single regional household collects income from primary factors of production such as labor, capital, land, and natural resources as well as all kinds of taxes and financial assets, and allocates them across private consumption, government expenditure, and savings according to a Cobb-Douglas utility function.
  - Financial assets represent claims on earnings from regional physical capital, which is owned by both domestic and foreign households via a global trust.

III. Overview of the Model

– The global trust collects all the regional savings, and allocates them across regions to foreign investment.
– In the absence of policy reforms, the share of each regional household's wealth in domestic and foreign firms and the share of each region's capital stocks owned by domestic and foreign firms are held as close as possible to their initial values, subject to adding-up constraints, which means that their shares are likely to change, but the change is minimized.

III. Overview of the Model

– Explicit modeling of the ownership of regional investment makes it possible to track the accumulation of wealth by foreigners, thereby ascertaining how the Korea-U.S. FTA might affect foreign investment and ownership in each region.
– The income accruing from the domestic and foreign ownership of assets can be appropriately incorporated into regional income, and hence the calculation of welfare, both for Korea, the U.S. and for all other regions.

III. Overview of the Model

– **The investment theory in the model makes it possible to link economic activity over time, while keeping track of endogenous regional capital stocks and financial wealth, international investment and income flows.**

– **Investment funds are used for the purchase of physical investment goods, which are then added to the existing stock of physical capital.**

III. Overview of the Model

- **A disequilibrium approach for allocating investment across regions:**
  - **Investors respond to expected rates of return and act so as to eliminate errors in their expectations gradually over time.**
  - **In the process of adjustment, investors gradually eliminate any differences in the rates of return across regions that might exist in the short run by allocating capital from regions with lower rates of return to regions with higher rates of return, leading to equalization of rates of return across regions in the long run.**

How is investment determined?

- **Investment in a particular year is determined by three mechanisms.**
  - **The first one is the desire to eliminate errors in expectations (the second part of *Eq 1*). The expected rate of return falls by a portion (μ^r) of the error in expectations ($log(R^r_E/R^r_A)$) during the period (*dY*). Over time as the expected and actual rates of return converge, this error will be eliminated.**

Investment theory of the Dynamic CGE Model

$$\hat{R}^r_E = -\phi^r(\hat{K}^r - \Omega^r dY) - \mu^r \log\left(\frac{R^r_E}{R^r_A}\right) dY$$

where

R^r_E	: Expected rate of return in region r
$\hat{R}^r_E$	: Proportionate change in the expected rate of return in region r
R^r_A	: Actual rate of return in region r
K^r	: Quantity of capital stock in region r
ϕ^r	: Elasticity of the rate of return with respect to capital stock in region r
Ω^r	: Normal growth rate of capital in region r
μ^r	: Rate at which errors in expectations are eliminated in region r
dY^r	: Change in years in region r

How is investment determined?

– **The second one is the gradual equalization across regions of rates of return, which is reflected in *Eq 2*. This requires the movement of the expected rate of return in all regions towards the temporary equilibrium global rate of return (R_T), common to all regions. Differences between the target (R_T) and expected rates of return (R^r_E) determine the expected rate of growth in the gross rate of return (Γ^r_E). These differences are gradually eliminated at a rate determined by Λ^r.**

Investment theory of
the Dynamic CGE Model

$$Eq\,2 : \Gamma^{r}_{E} = \Lambda^{r}\left[\hat{R}_T - \hat{R}^{r}_{E}\right]$$

where

Γ^{r}_{E} : **Expected rate of growth in the expected rate of return in region r**

Λ^{r} : **Rate at which differences in the target and expected rate of return are eliminated in region r**

$\hat{R}_{T}$: **Proportionate change in the target rate of return**

How is investment determined?

– **3) The third one is the equalization of all three rates of return. In the long run, the target and expected rates of return will have converged, leading to an expected rate of growth in the rate of return of zero (*Eq 2*). Errors will also have been eliminated ($R^r_E/R^r_A = 1$) and there will be no tendency for the expected rate of return to change ($\check{R}^r_E = 0$). For this to happen, the growth rate of capital must equal the normal growth rate of capital (first part of *Eq 1*) and investment and capital must be changing at the same rate (*Eq 3*). Additionally, there should be no tendency for the normal growth rate of capital to change ($\omega^r = 0$ in *Eq 4*).**

Investment theory of the Dynamic CGE Model

$$Eq3:\Gamma^r_E = \phi^r \frac{I^r}{K^r}\left[\hat{I}^r - \hat{K}^r\right] + \phi^r d\Omega^r$$

where

I^r : Investment in region r

$\hat{I}^r$: Proportionate change in the investment in region r

K^r : Quantity of capital stock in region r

ϕ^r : Elasticity of the rate of return with respect to capital stock in region r

$d\Omega^r$: Proportionate change in the normal growth rate of capital in region r

Investment theory of the Dynamic CGE Model

$$Eq4: \omega^r = \Pi^r \left[\hat{K}^r + \frac{\hat{R}_A^r}{\phi^r} - \Omega^r dY \right]$$

$$Eq5: \hat{K}^r = I^r dY$$

where

ω^r : Change in the normal rate of capital in region r

Π^r : Coefficient of adjustment for the normal growth rate of capital (Ω^r) in region r

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IV. Baseline and Policy Scenarios for the Korea-U.S. FTA

- **Two simulations are undertaken, one baseline scenario (without the Korea-U.S. FTA) and a policy scenario (with the Korea-U.S. FTA).**
- **The baseline scenario provides a picture of what the global economy is expected to look like without the Korea-U.S. FTA, while the policy scenario is used to examine the impact of the Korea-U.S. FTA.**
- **The difference between the baseline scenario and the policy scenario shows the effect of the Korea-U.S. FTA.**
- **The effects of the Korea-U.S. FTA are examined over the period of 2008 to 2021 in order to take into account of its long-run effects.**

IV. Baseline and Policy Shocks for the Korea-U.S. FTA

- **1) The Baseline Scenario**
  - **To obtain the baseline scenario, forecasts of key macroeconomic variables and any anticipated policy changes are required, e.g. forecasts of the growth rates of GDP, gross domestic investment, skilled labor, unskilled labor and population for each region.**
  - **The baseline scenario also includes some policy shocks which have occurred, or which are expected to occur during the period of 2001 (base year) to 2021.**
  - **These policy shocks include implementation of the Uruguay Round.**
  - **ASEAN-China FTA, ASEAN-Japan FTA, and ASEAN-Korea FTA could be considered for preciser estimation.**

IV. Baseline and Policy Shocks for the Korea-U.S. FTA

- **Two policy shocks (scenarios) are assumed:**
  - **SC1: Tariffs are reduced, according to tariff schedules of Korea and the U.S.**
  - **SC2: SC1 + Total Factor Productivity (TFP), where TFP is taken into account on the premise that a 0.1 percent TFP is caused by a 1-percent increase in imports.**

V. Simulation Results

Figure 4.1: Effects on real GDP (cumulative % change from the baseline)

Impact on real GDP
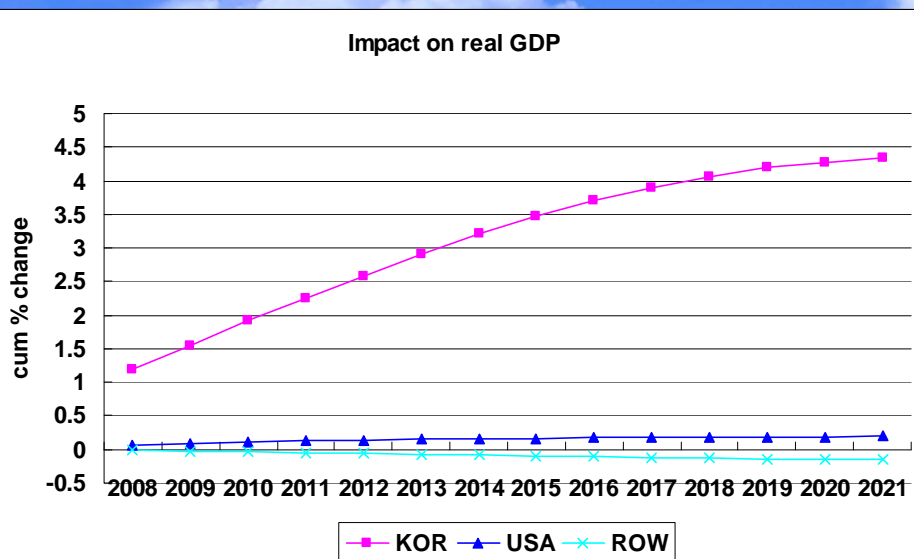
Figure 4.2: Effects on real GDP in Korea

Impact on real GDP

Legend: Tariff reduction
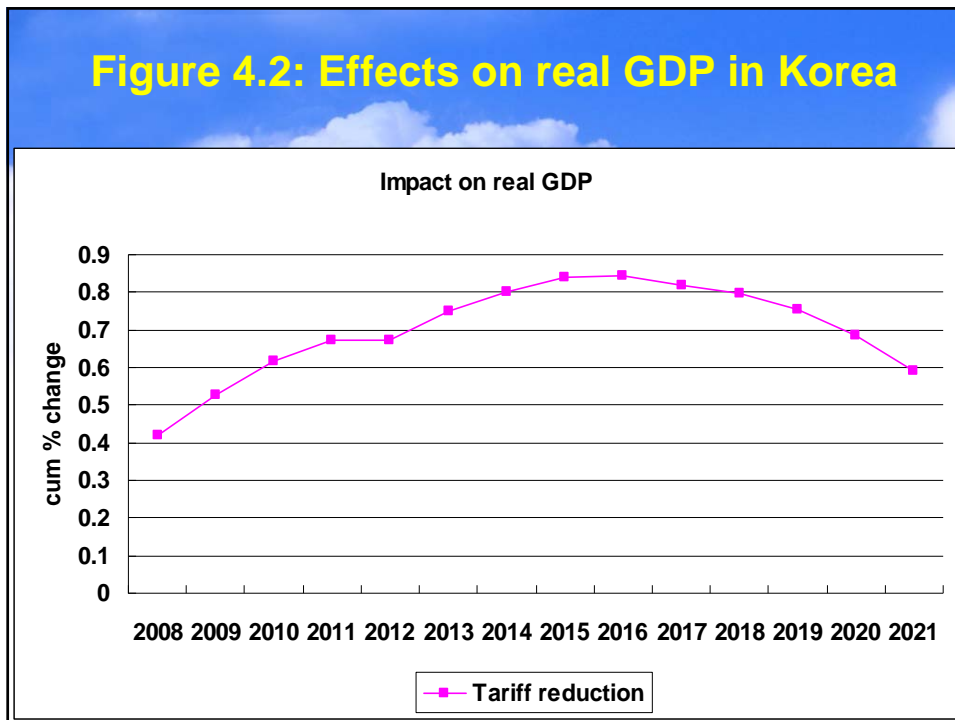
Figure 4.3: Effects on Welfare

Impact on welfare

Legend: KOR — USA — ROW
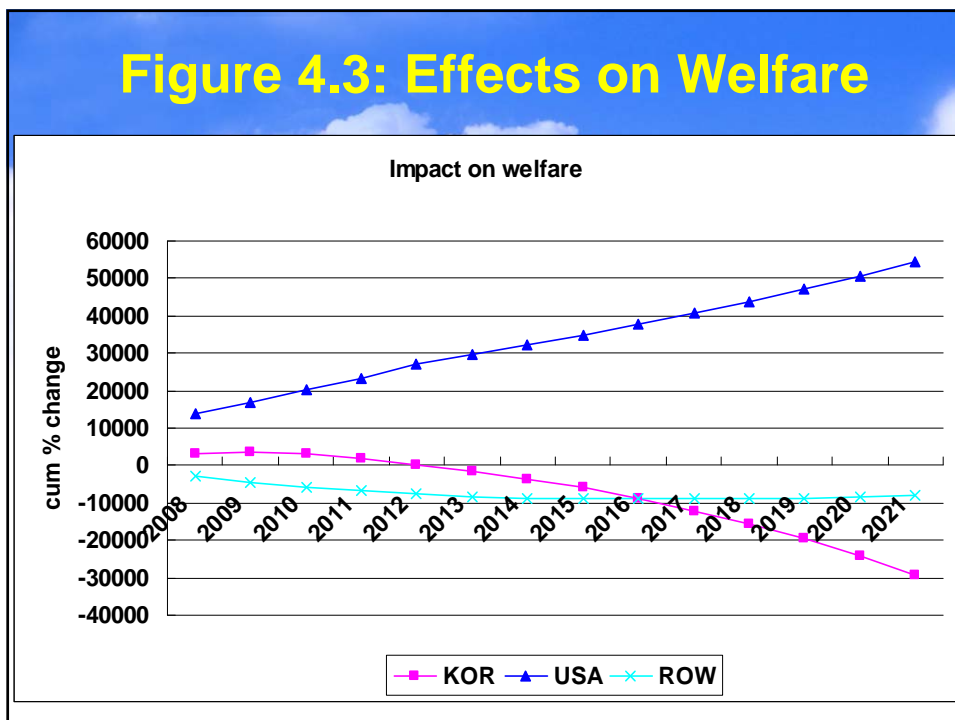
Figure 4.4: Effects on Total Exports

Impact on export volumes
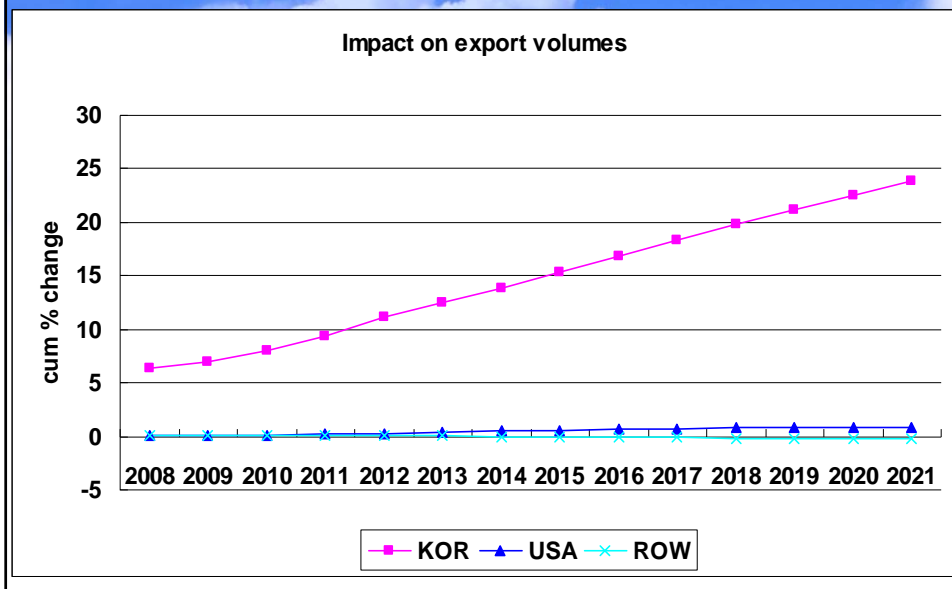
Figure 4.5: Effects on Total Imports

Impact on import volumes
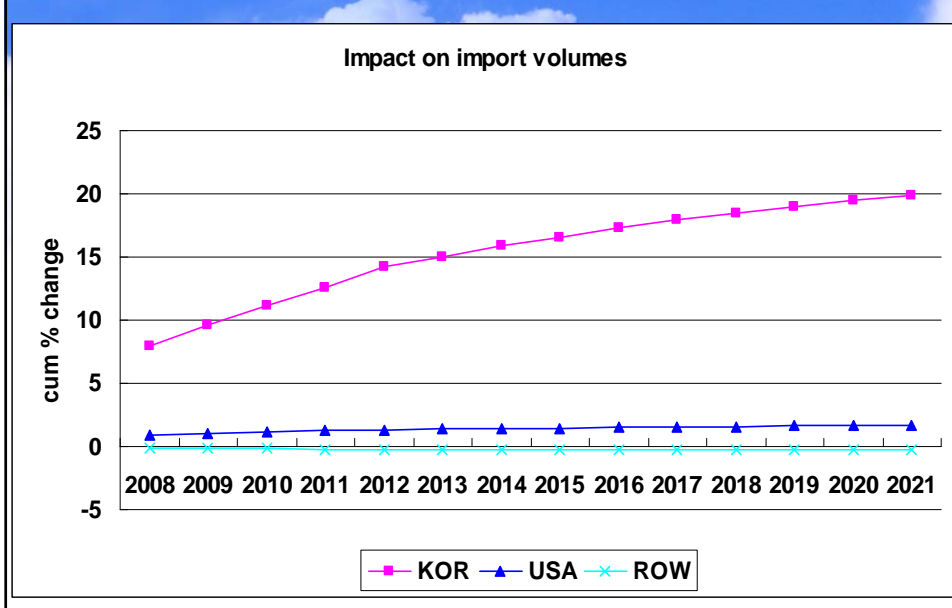
Figure 4.6: Effects on Trade Balance

Impact on trade balance

KOR — USA — ROW
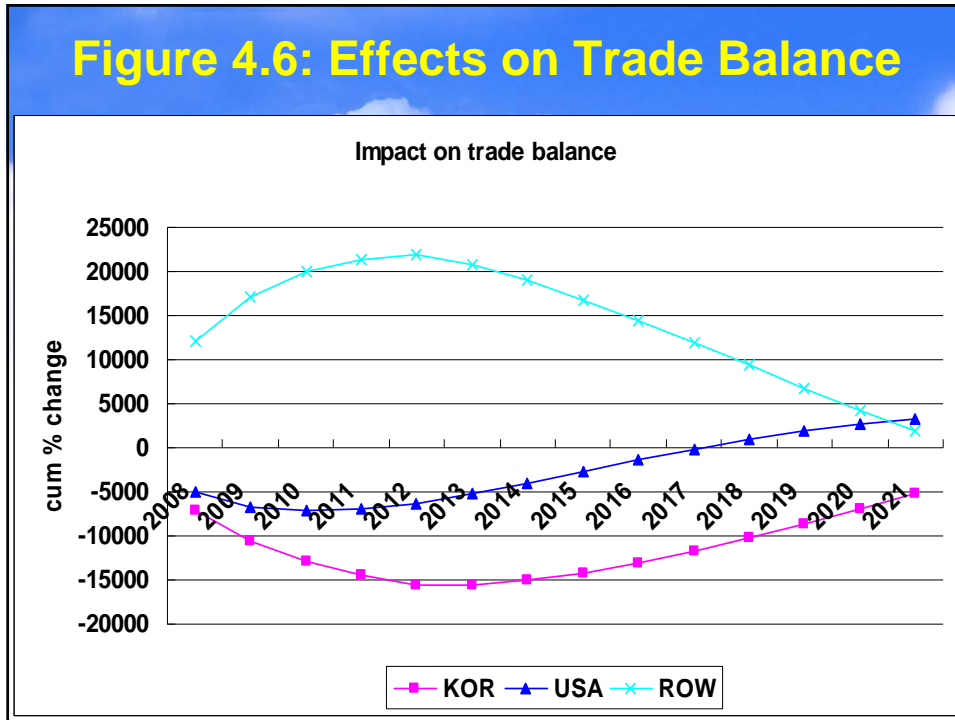
Figure 4.7: Effects on Ratio of Trade Balance to National Income

Impact on ratio of trade balance to national income

KOR — USA — ROW
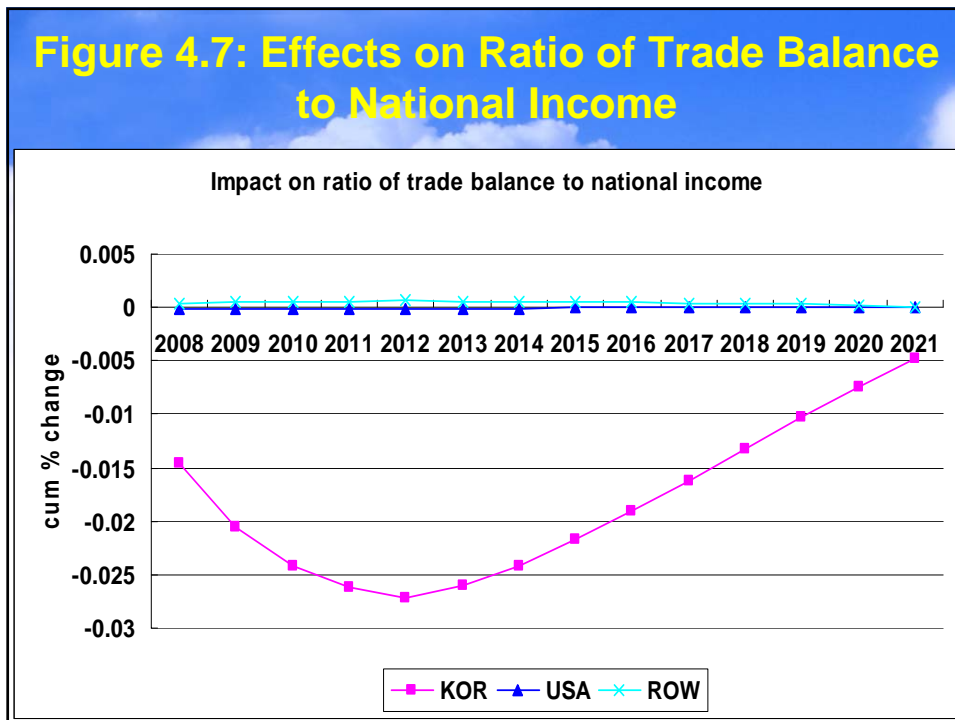
Figure 4.8: Effects on the Terms of Trade
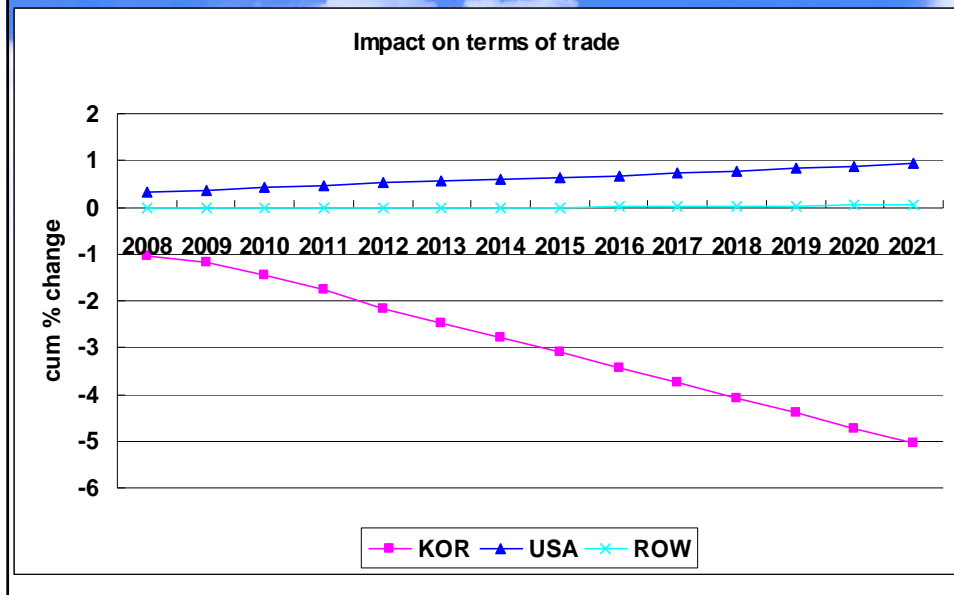
Impact on terms of trade

Fig. 4.9: Impact of Industry Output in Korea of SC2

Impact on industry output
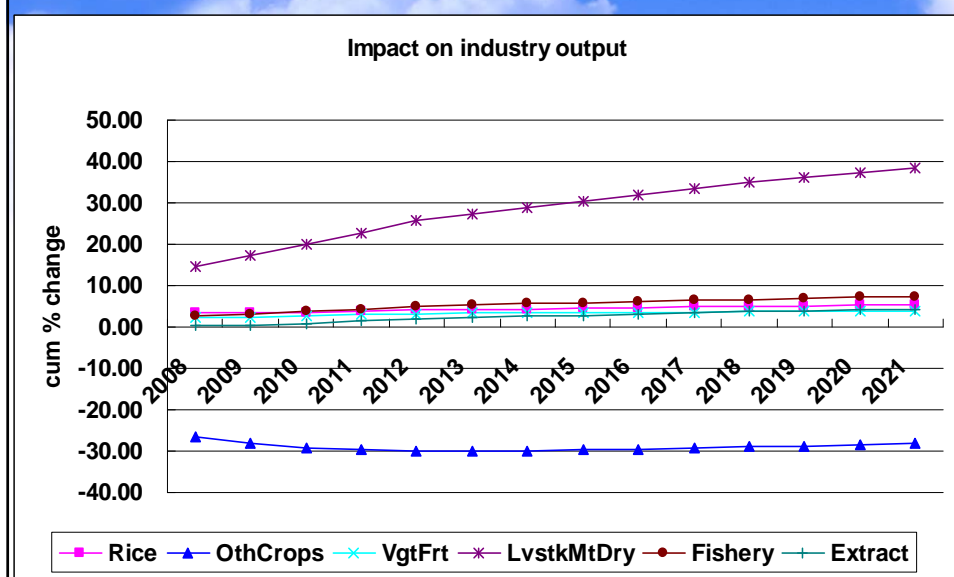
Fig. 4.9: Impact of Industry Output in the USA of SC2
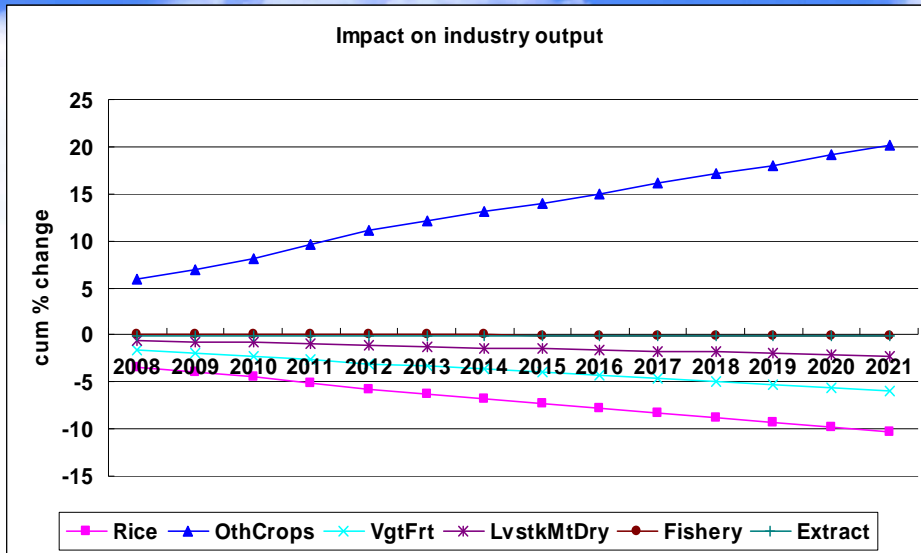
Fig. 4.10: Impact of Industry Output in Korea of SC2
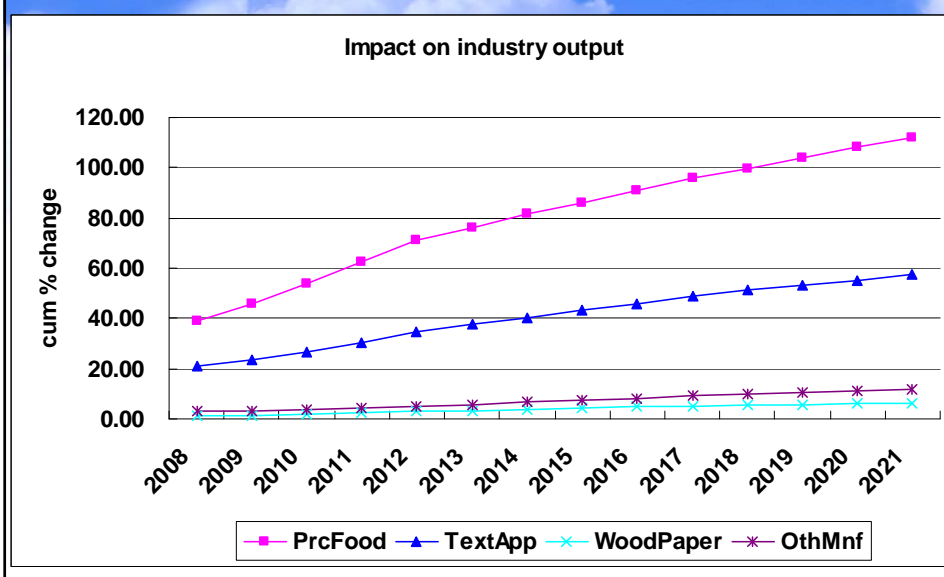
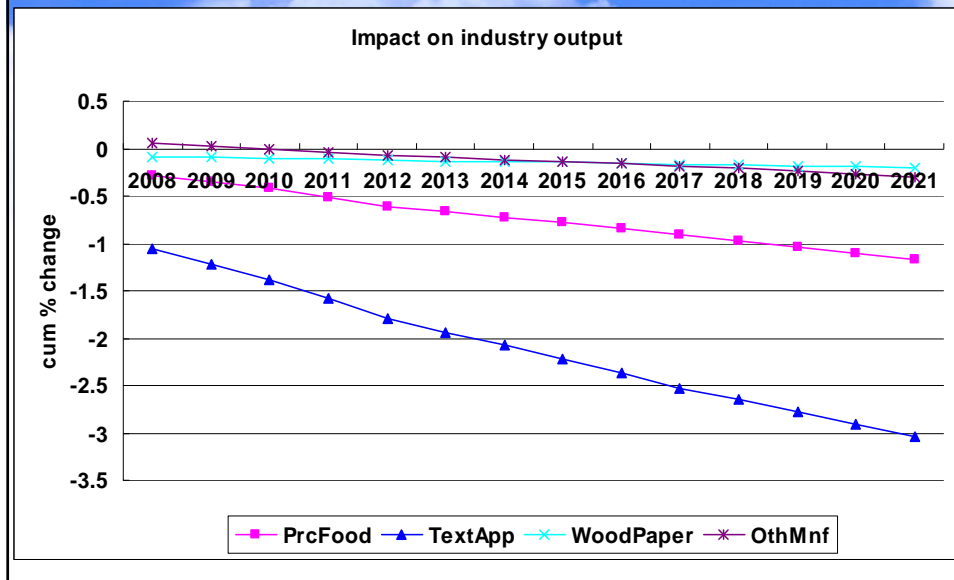Fig. 4.10: Impact of Industry Output in the USA of SC2

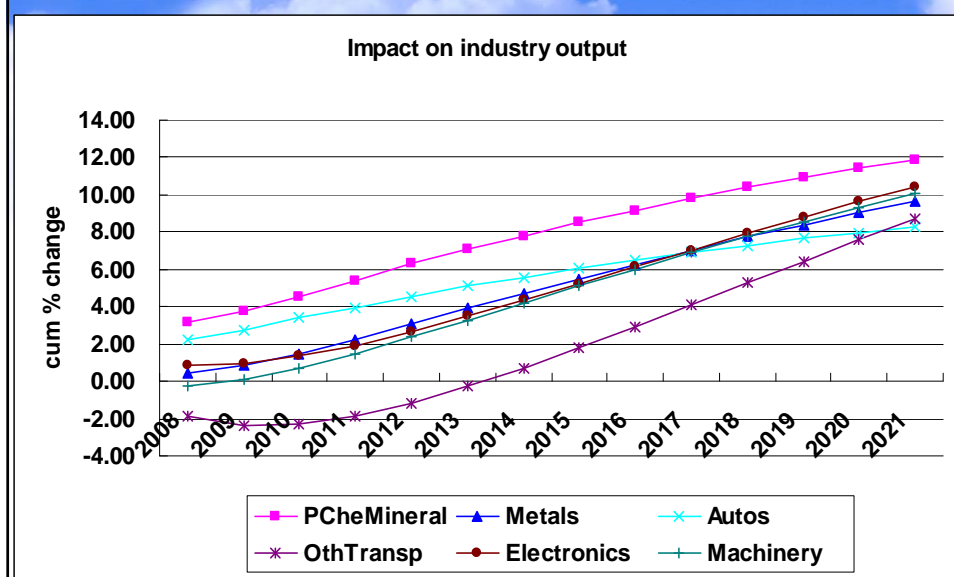Fig. 4.11: Impact on Industry Output in Korea of SC2

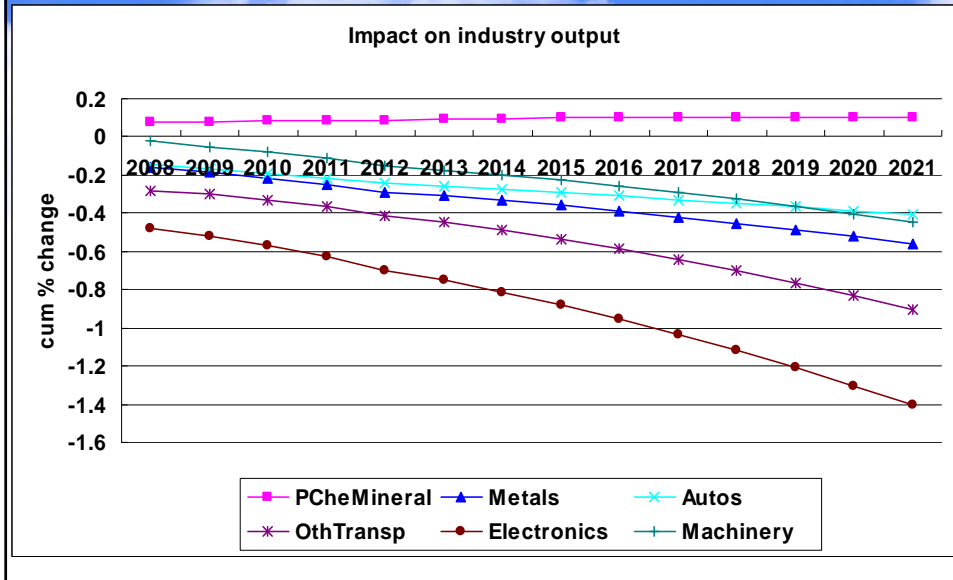# Fig. 4.11: Impact on Industry Output in the USA of SC2

Impact on industry output

Legend: PCheMineral, Metals, Autos, OthTransp, Electronics, Machinery

Fig. 4.12: Impact on Industry Output in Korea of SC2

Impact on industry output

Legend: Construction, TradeTrans, Communc, FinanceBus, OthServices
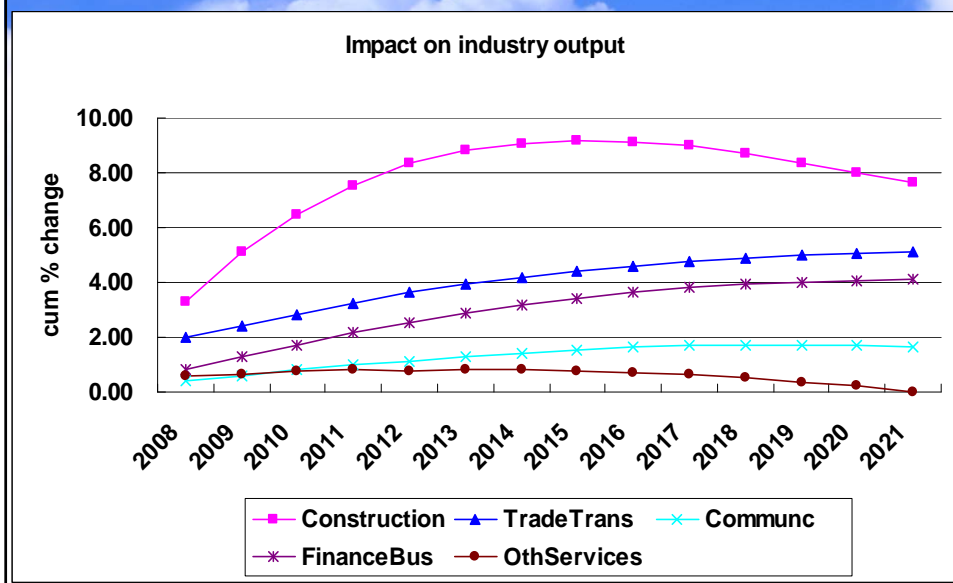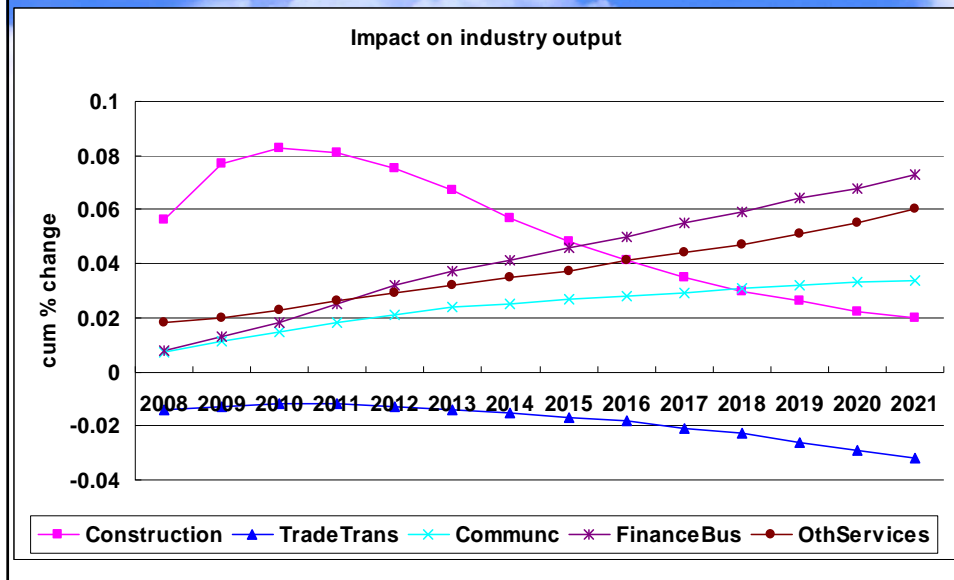
Fig. 4.12: Impact on Industry Output in the USA of SC2

VI. Conclusion

- **The Korea-U.S. FTA is to contribute to economic growth of Korea.**
    - **Tariff elimination (SC1) as a result of the Korea-U.S. FTA leads to a higher real GDP in Korea of up to 0.85 % in 2016, and up to 0.6 % in 2021,**
    - **while additional TFP (SC2) results in its continuous rise of up to 4.37% in 2021.**

VI. Conclusion

- **The Korea-U.S. FTA is to lead to trade deficit with its level declining to $ 4-5 billions in the long-run, in 2021.**
  - **Even though export volumes of Korea rise by 21-24% in 2021 and**
  - **import volumes of Korea increase by 17-20% in 2021, Korea runs trade deficits, because terms of trade in Korea deteriorate by 4.6-5.1% in 2021.**
  - **But the trade deficits are trivial compared to Korea's national income.**

VI. Conclusion

- **The effects of the Korea-U.S. FTA, in terms of industry output vary, depending on its comparative advantage.**
  - **Domestic production of livestock, meat and dairy products in Korea rises by 39% in 2021, whereas that of other crops drops by 28% in 2021.**
  - **Output of processed food and textiles and apparel in Korea increases by 112% and 57%, respectively, in 2021.**

VI. Conclusion

- **Output of all heavy industries rises.**
  - **Petroleum and chemicals by 12% in 2021.**
  - **Metal products by 9.7%**
  - **Automobile and parts by 8.3%**
  - **Other transport equipment by 8.8%**
  - **Electronics by 10.4%**
  - **Machinery by 10%**

VI. Conclusion

- **Output of service sectors is boosted, although service sectors were not simulated due to a lack of protection data.**
  - **Construction by 7.6% in 2021.**
  - **Trade and transport by 5.1%**
  - **Finance and business services by 4.1%**

VI. Conclusion

- **The effects of the Korea-U.S. FTA on employment by sector (i.e. demand for labor) reflects its impacts on industry output.**

- **Investment and capital stocks increase.**

- **Moreover, the Korea-U.S. FTA raises the extent of foreign ownership of domestic assets in Korea, which is driven by the opening-up of domestic markets to foreign investment as a result of the Korea-U.S. FTA.**