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An Economy-wide Analysis of Trade Liberalization Impacts on Rural Household Income in Taiwan

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I. Introduction

Agriculture is a relatively weak industry in the process of economic development. The way of economic development is different in each country. Due to limited natural resource, Taiwan depends on free trade to increase national income.

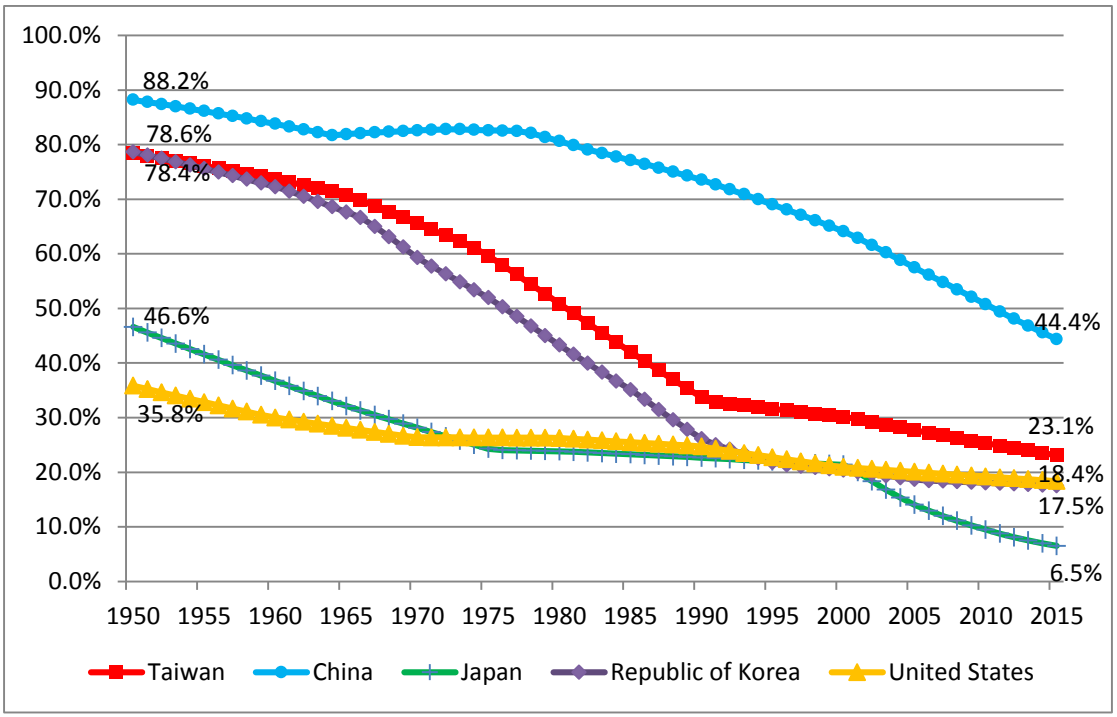
Irwin et al. (2010) studied about rural development and local economy of United States and Canada. They argured that "The rural economy is no longer a farm economy", "Rural vs. Urban is more than a simple dichotomy. There is a strong interdependence that produces a continuum from dense urban places to remote rural places", "Since World War II, migration flows have been explained increasingly by amenities and quality-of-life differences across regions", "Consumptions of natural amenities has become one of the primary determination of rural growth, Sector-based policies are neither efficient nor effective rural development policies", "Rural development is a general equilibrium problem that requires general equilibrium tools. These and other quantitative tools provide a necessary foundation for community economic analysis."

In recent decades, the major trends of commercialization, globalization, science and technology are all ongoing and interrelated. The impacts of trade liberalization (e.g., WTO, FTA, or TPP) on Taiwan's agriculture sector has been an important issue in policy debates. Most of the debates focus on decreases in major indicators, e.g., total output value in production agriculture sector, food security, food self-sufficiency rate and on-farm income of farm household. Almost all of them neglect or ignore those potential increases in off-farm employment and income from local economic growth with trade liberalization.

According to the Food and Agriculture Organization of the United Nations (FAO) statistics, the proportion of rural population over national population is shown in Figure 1. Taiwan is 78.4% in 1950 and 23.1% in 2015. Korea decreases from 78.6% to 17.5%. Japan decreases from 46.6% to 6.5%. US decreases from 35.8% to 18.4%. This displayed that the reduction in the proportion of rural population is a normal trend in worldwide urbanization development. The few amount in rural population implied that aging problem is more serious than the city.

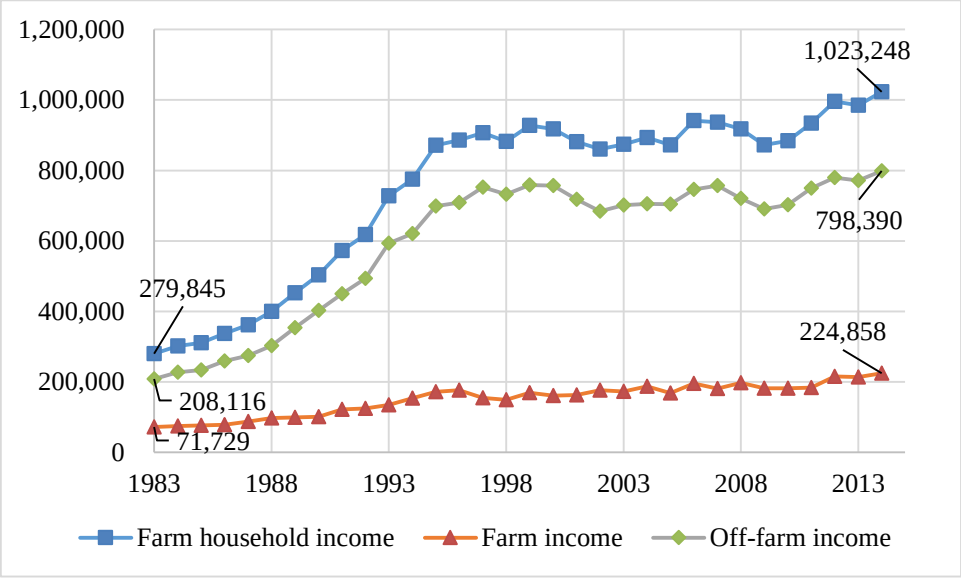
Moreover, according to the data from the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Taiwan's farm household income has been increased from 280 thousand dollars to 1.02 million dollars since 1983. In which farm income increase from 70 thousand dollars to 220 thousand dollars, off-farm income

increase from 200 thousand dollars to nearly 800 thousand dollars. It is obvious that a large part of increasing in farm household income is derived from off-farm income, the result as shown in Figure 2.



Source: FAOSTAT

Figure 1: Proportion of rural population over national population



Source: Directorate-General of Budget, Accounting and Statistics, Executive Yuan

Figure 2: Composition farm household income

Also, according to USDA investigation in 2006, 89% of farm household income

is from non-agricultural activities. USDA research highlighted that the reliance of agriculture sector on local economy is much higher than the reliance of local economy on agriculture. Thus in what way to activate local economy under urbanization to create more non-agricultural jobs opportunities and increase farm household income is a noteworthy issues. The data above showed that the most important reason of a substantial change in rural employment, rural population structure, and farm household income is that the proportion of off-farm income in farm household income has been increased.

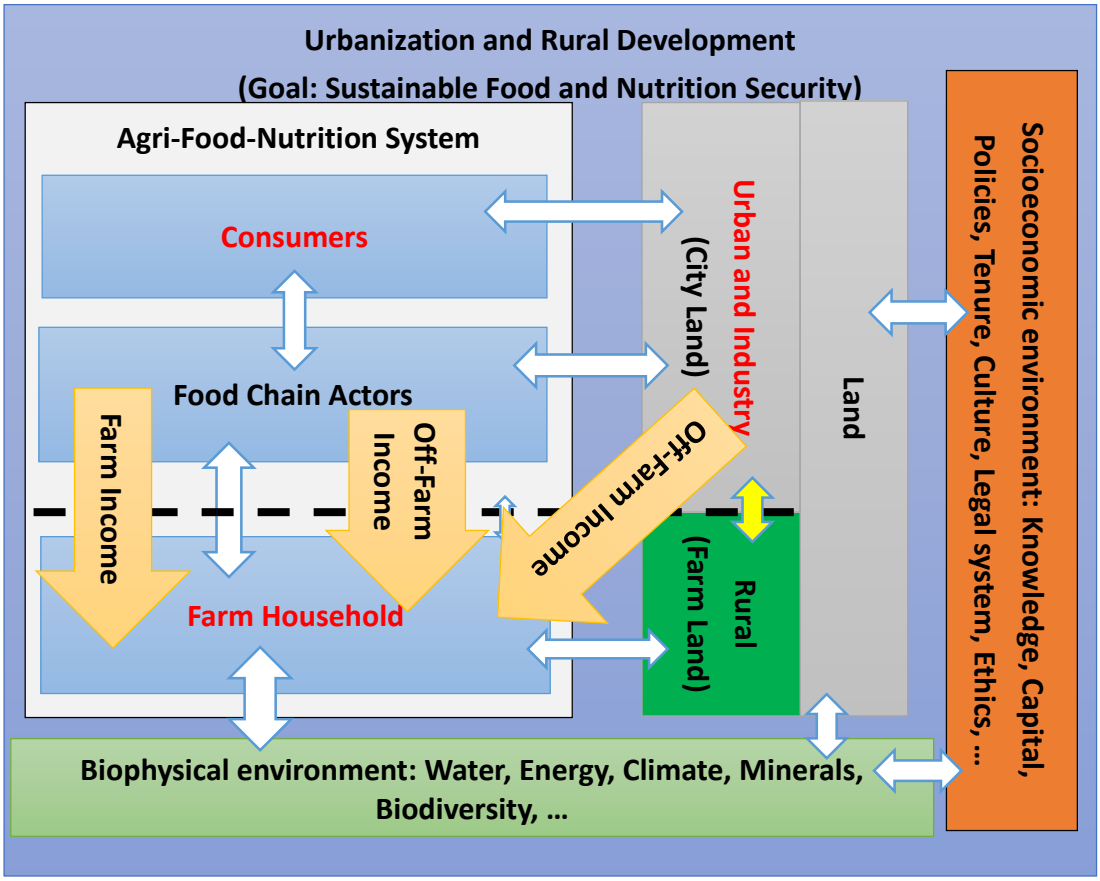


Figure 3: Urbanization and rural development

Trade liberalization may increase GDP and jobs and income in non-agricultural sectors, but agricultural sector may incur a loss in jobs and on-farm income. Sources of rural household income: On-farm income and off-farm income. Off-farm jobs and income are closely related to local economy. In this study, we built the SAM-based GEMTEE (General Equilibrium Model for Taiwanese Economy and Environment) model—a recursive dynamic computable general equilibrium (CGE) model that depicts the economy of Taiwan and its demographic structure through time—a flexible mechanism to reflect how fertility respond to income and demographic policies, as well

as demographers' perspectives. The GEMTEE model is a CGE model derived from the Monash-type CGE model (Dixon and Rimmer 2002) and is calibrated to the 2011 Social Accounting Matrix of Taiwan as the benchmark.

II. Literature review of the relationship between trade liberalization and agricultural development, employment of farmers, farm income, etc.

In the face of regionalization of the world economy, every country has engaged in bilateral, regional and multilateral trade agreements actively. Signings of trade agreements are certainly able to benefit from the preferential of tariff reduction. However, the way to respond to country's vulnerable industries (such as agriculture) should be considering.

Irwin et al. (2010) studied about rural development and local economy of United States and Canada. They believed that agricultural development had been an issue of cross-sectoral general equilibrium over past century. It should be considered in macroscopic perspective such as the relationship of industries. The "Input-output models" published by Leontief won the Nobel Prize in 1973. He provided a model that can quantify the magnitude of interrelated among industries. The model allow a more comprehensive framework to analysis the change of industry structure. The input-output table that most widely used in United States is the Impact Analysis for Planning (IMPLAN). IMPLAN not only has the country's information and even includes state and provincial input-output table for the preparation and evaluation of local economic development policy. Since there is no price component in the input-output table, therefore the labor and wages are fixed and assumed that supply of resources are unlimited in the absence of pricing mechanism. This is the biggest drawback of input-output model, that "unlimited resources". Thus the input-output model is more suitable for developing countries. For developed countries, since its resources are limited and the development has encountered a bottleneck, there is problem on efficiency and fairness of resources allocation. Computable General Equilibrium (CGE) models is an applied microeconomics model that extended Leontief model. It brings prices and the theory of limited resources into input-output model which can expands the scope of applications in order to formulate and evaluate economic development policies more comprehensive.

The variation of farm household income apart from the effect of swaps of domestic industry that arising from the comparison of advantages and disadvantages in trade which directly affect the value of agricultural product thereby making additional loss to farm households. Farm household income will also arising uncertainties as the fluctuation of domestic price, seasonality, and disaster losses. Thus the non-agricultural

part of the farm household income is even more important. Reardon *et al.* (2001) observed Latin American countries and suggested that the agricultural sector's policy has to base on arising off-farm income under the context of regional trade liberalization. They proposed be avoided that only been developing the agricultural economy in rural area and there should be a multifaceted development in order to reduce the risk of agricultural economy effectively. Sheu (2007) proposed that government should encourage uncompetitive farmers off from agricultural sector in response to free trade.

Mishra and Sandretto (2002) used the US farm household income data from 1933 to 1999 demonstrated that off-farm income will be able to reduce variation in farm household income effectively. Haggblade *et al.* (2010) recommended that besides to reduce the risk in agricultural production behavior, development of non-agricultural economy in rural area will also contribute to rural economy development and rise out of poverty and inequality. Development of non-agricultural economy in rural area and enhance the non-agricultural portion of farm household income will be able to stimulate agricultural productivity indirectly. Berdegué *et al.* (2001) found that off-farm income will be able to provide investment in equipment to improve agricultural productivity.

Ruttan (1955) believed that to increase farm household income, improve job opportunities in non-agricultural sector and activate local economy would be more important. In the 1970s, Agricultural Economics scholars in US had believed that "Rural was not agricultural alone". Edwards (1981) considered that most of the rural economy or the local economy is not the agricultural economy in US, the growth of rural area and agricultural growth can not equate. Furthermore, because of the improvement in agricultural technology, agricultural labor force has been released to non-agricultural sector, association between agricultural and non-agricultural will be more closely. Korea accept the theory above because they used this method to accelerate the economic recovery during bankruptcy in 1997.

Agricultural economy is now emphasize the economic diversity. Not only agricultural production will appear in rural development but also lots of services section. Rural economic diversity is also associated with the value chain. Stabler and Olfert (2009) stated that agriculture inputs (fertilizers, materials) come from around the world, the development of rural and urban are going more rapidly. Many residents live in rural area can drive to work or shopping in the city and there are a lot of medical care in the city. Thus the integration of urban and rural areas are getting closer.

Rural policies and agricultural policies should be differentiated. The idea of development of rural economy "only" depends on agriculture or "major" relies on agriculture as the main driver should be amended. Interdependence between rural

policies and agricultural policies should be taken seriously. One of the important means to increase farm household income is to increase off-farm job opportunities, which need to have support by a robust rural economy. The main instruments to promote rural development including investment in education, transportation, health, housing, and other construction in order to increase the attractiveness of rural areas (OECD, 2008).

(a) Taiwan's agricultural output

The current situation of Taiwanese agricultural development, described the main indicators of agriculture,like Taiwan's agricultural total output value, total export value of agriculture, agriculture's contribution to GDP, the agricultural employment and farm income respectively.

According to the Council of Agriculture and the Directorate-General of Budget, Accounting and Statistics show that in 2014 Taiwan's overall output value of 375,491 billion Taiwan dollars, agricultural output is 5,210 billion Taiwan dollars, accounting for the overall agricultural output value ratio is 1.39%, as detailed in Table 1. We further analyse Taiwan's agricultural output value during 1995-2014, while the share in total output value is showing a downward trend.

Table 1: Taiwan's agricultural output（1995-2014）

Units: One hundred million N.T. dollars

Year	Agricultural output	Total output	%
1995	4,111	159,686	2.57
1996	4,200	168,790	2.49
1997	3,790	182,466	2.08
1998	3,753	192,702	1.95
1999	3,915	199,954	1.96
2000	3,638	216,403	1.68
2001	3,527	205,523	1.72
2002	3,505	217,394	1.61
2003	3,579	229,886	1.56
2004	3,868	258,790	1.49
2005	3,827	270,491	1.41
2006	3,770	290,131	1.30
2007	3,891	311,567	1.25
2008	4,175	315,412	1.32
2009	4,067	285,869	1.42
2010	4,269	339,312	1.26
2011	4,757	354,036	1.34
2012	4,776	354,000	1.35

Year	Agricultural output	Total output	%
2013	4,825	359,815	1.34
2014	5,210	375,491	1.39

Source: Directorate-General of Budget, Accounting and Statistics, Executive Yuan; Council of Agriculture, Executive Yuan, R.O.C.(Taiwan)

(b) Taiwan's agricultural exports

According to the Council of Agriculture and the Customs Administration data, Taiwan's total exports value is 3,137 million US dollars, and the value of agricultural exports is 5.265 billion US dollars in 2014, which is accounting for 1.68% to the total exports value, as detailed in Table 2. We can know that the value of agricultural exports upward trend from 2003 to 2014, and its share in total is stabilizing after 2006.

Table 2: Taiwan's agricultural exports（2003-2014）

Units: One hundred million U.S. dollars

Year	agricultural exports	Total exports	%
2003	32.43	1,506.00	2.15
2004	35.54	1,823.70	1.95
2005	35.82	1,984.32	1.81
2006	32.99	2,240.17	1.47
2007	34.34	2,466.77	1.39
2008	38.51	2,556.29	1.51
2009	32.08	2,036.75	1.58
2010	40.22	2,746.01	1.46
2011	46.69	3,082.57	1.51
2012	50.88	3,011.81	1.69
2013	50.79	3,054.41	1.66
2014	52.65	3,136.96	1.68

Source: Council of Agriculture, Executive Yuan, R.O.C.(Taiwan); Customs Administration, Republic of China.

(c) Taiwan's agricultural GDP

As showed in Table 3, we can see Taiwan’s gross domestic product (GDP) and the contribution of agriculture to GDP during 1995-2014. As can be seen from the above chart from 1995 to 2001, Taiwan's agricultural contribution to GDP showed a substantial downward trend, fell from 3.33% in 1995 to 1.90% in 2001. In 2002, after

joining the WTO, agriculture's contribution to GDP is getting stable, maintained at an average level of about 1.7 percent in recent years (2012-2014) and even a slight upward trend.

Table 3: Taiwan's agricultural GDP

Units: million N.T. dollars

Year	GDP	GDP from agricultural	share
1995	7,396,650	243,467	3.33%
1996	8,036,590	242,266	3.06%
1997	8,717,241	210,710	2.46%
1998	9,381,141	219,118	2.38%
1999	9,815,595	236,720	2.45%
2000	10,351,260	205,434	2.02%
2001	10,158,209	188,593	1.90%
2002	10,680,883	188,436	1.82%
2003	10,965,866	183,581	1.71%
2004	11,649,645	190,733	1.68%
2005	12,092,254	195,833	1.67%
2006	12,640,803	197,589	1.61%
2007	13,407,062	191,886	1.45%
2008	13,150,950	201,656	1.55%
2009	12,961,656	215,109	1.68%
2010	14,119,213	224,828	1.60%
2011	14,312,200	245,783	1.72%
2012	14,686,917	242,400	1.67%
2013	15,221,201	255,782	1.70%
2014	16,084,003	296,110	1.88%

Source: Directorate-General of Budget, Accounting and Statistics, Executive Yuan.

(d) Taiwan agricultural employment

Table 4 shows the proportion between grand total employment and agricultural employment data in Taiwan from 1995 to 2014. Change in the proportion of Taiwanese agricultural employment is similar to the agricultural contribution to GDP. Before the accession to WTO (1995-2001), the proportion of agricultural employment continued to decrease from 1995 of 10.55% to 2001 down to 7.52%. After 2002, the proportion of agricultural employment declines slowly, and maintain a ratio about 5.0%.

Table 4: Agricultural employment

Units: thousand people

Year	employment	Agricultural employment	share
1995	9,045	954	10.55%
1996	9,068	918	10.12%
1997	9,176	878	9.57%
1998	9,289	822	8.85%
1999	9,385	776	8.27%
2000	9,491	740	7.79%
2001	9,383	706	7.52%
2002	9,454	709	7.50%
2003	9,573	696	7.27%
2004	9,786	642	6.56%
2005	9,942	590	5.93%
2006	10,111	554	5.48%
2007	10,294	543	5.27%
2008	10,403	535	5.14%
2009	10,279	543	5.28%
2010	10,493	550	5.24%
2011	10,709	542	5.06%
2012	10,860	544	5.01%
2013	10,967	544	4.96%
2014	11,079	548	4.95%

Source: Directorate-General of Budget, Accounting and Statistics, Executive Yuan.

(e)Farm household income

Table 5 shows the data of the farm and non-farm average income per family and the number of households from 1995 to 2014. Before 2000, the number of farm households and the average farm household income are showing a downward trend; in 2002 after joining the WTO, in addition to a slight decrease during the 2008 financial crisis, both are showing a slight increase. Besides, the average farm household income accounts for average non-farm household income per household remains at about 80 percent, and we can know that the growth trend of farmers is similar to non-farmers.

Table 5: Farm and non-farm average income per family and the number of households from 1995 to 2014

Year	Farm households	Total households	Average		Average farm household income accounts for average non-farm household income per household (%)
			Farm household income (N.T. dollars)	Household income (N.T. dollars)	
1995	792,120	5,819,155	871,082	1,052,834	82.74%
1996	779,427	6,021,783	885,469	1,072,461	82.56%
1997	780,246	6,204,343	907,221	1,123,112	80.78%
1998	782,136	6,369,768	881,853	1,144,969	77.02%
1999	787,407	6,532,466	927,663	1,162,602	79.79%
2000	721,161	6,681,685	917,623	1,166,870	78.64%
2001	745,812	6,802,281	881,298	1,136,274	77.56%
2002	748,317	6,925,019	860,771	1,140,075	75.50%
2003	755,454	7,047,168	873,901	1,136,206	76.91%
2004	759,716	7,179,943	893,124	1,143,826	78.08%
2005	767,316	7,292,879	872,677	1,156,935	75.43%
2006	756,366	7,394,758	941,160	1,170,133	80.43%
2007	751,338	7,512,449	937,053	1,181,490	79.31%
2008	748,276	7,655,772	917,705	1,168,447	78.54%
2009	744,147	7,805,834	872,668	1,146,797	76.10%
2010	780,388	7,937,024	884,547	1,152,330	76.76%
2011	777,473	8,057,761	933,785	1,182,905	78.94%
2012	779,375	8,186,432	995,645	1,198,917	83.05%
2013	780,307	8,286,260	985,343	1,219,610	80.79%
2014	784,490	8,382,699	1,023,248	1,233,327	82.97%

Source: Council of Agriculture, Executive Yuan, R.O.C.(Taiwan); Customs Administration, Republic of China.

III. SAM-based GEMTEE model and database

(a)SAM-based GEMTEE model

In this study, we built the SAM-based GEMTEE (General Equilibrium Model for Taiwanese Economy and Environment) model—a recursive dynamic computable general equilibrium (CGE) model that depicts the economy of Taiwan and its demographic structure through time—a flexible mechanism to reflect how fertility respond to income and demographic policies, as well as demographers' perspectives. The GEMTEE model is a CGE model derived from the Monash-type CGE model (Dixon and Rimmer 2002) and is calibrated to the 2006 Social Accounting Matrix of Taiwan as the benchmark.

With the funding support from the 2012-2014 sustainable research project, our team has cooperated with the Australian Bureau of Agricultural, Resource and Sciences (ABARES) and established a dynamic CGE model and database. This new model is called GEMTEE (General Equilibrium Model for Taiwan Economy and Environment) where the process of population ageing and physical capital investment are treated endogenously.

The main purpose of this project is to construct a dynamic computable general equilibrium (CGE) model and its database to address policy-related issues related to sustainable development including realignment of natural resources (e.g., water, land, energy) and human resource, environmental regulation, and green tax reform.

The sub-projects include (1) Towards an environment-economy integrated inter-regional computable general equilibrium model and database; (2) Computable general equilibrium analysis emphasizing on population growth and employment projection; (3) Social-economic impact assessment of environmental fiscal reform; (4) A dynamic CGE model for baseline forecasting and policy simulations with emphasis on renewable energies; and (5) Evaluating the effects of climate change on water markets and potential adaptation strategies. In this paper, GEMPACK software programs to solve, indicating that the software programs, see the Harrison and Pearson (1996).

(b)Structure of 2011 Input-Output table

The Input-Output Table made by the DBAS, Executive Yuan demonstrates the industries structure and the co-exist relationship of departments, it also shows the flows of currency and human capital in domestic economy system. The rows are the distribution of goods and the columns are the structure of industry departments or terminal demands (as shown in Figure 4).

		Absorption Matrix					
		1	2	3	4	5	6
		Producers	Investors	Household	Export	Other	Change in Inventories
	Size	I	I	1	1	1	1
Basic Flows	C x S	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Taxes	C x S	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	V6TAX
Capital	1	V1CAP					
Labour	O	V1LAB					
Land	1	V1LND					
Other Cost	1	V1OCT					

I＝Number of Industries,
C＝Number of Commodities,
O＝Number of Occupation Types,
S＝1.Domestic 2.Imported.

	Joint Production Matrix
Size	I
C	MAKE

	Import Duty
Size	1
C	V0TAR

Figure 4: The CGE core input-output database

(c)Establishment of farm household income database

This study established a basic database by using Input-Output Table that published by the Directorate-General of Budget, Accounting and Statistics, Executive Yuan. We divided income into farm household income and non-farm household income. The establishment of farm household income database was referred to the data of total farm household income published by the Council of Agriculture. According to the Agricultural Statistical Yearbook, sources of farm household income are divided into six categories:

1. Compensation of employees
   It refers to the total income from service units of household members (including full time and part time).
   i. Full time payroll
      It refers to gross cash receipts including basic pay, professional allowance, work subsidies, physical voucher, imputed rent of dormitory, wage, etc. (the amount before the deduction of public premium, labor premium and income tax).

ii. Part time payroll

It refers to gross cash receipts from engaging in part time jobs and pensions.

iii. Other receipts or subsidies

Including overtime, duty fees, travel expenses remaining, transportation fees, year-end bonuses, performance evaluation result bonuses, retired civil servants holiday benefits, work remuneration, no vacation bonuses, welfare funds, employers paid premiums or union fees, consolation payments, severance payments, education subsidies, marriage, death, maternity allowances, and other subsidy fees.

2. Entrepreneurial income

It refers to net income earned by household members by operating household unincorporated business. Entrepreneurial income includes net primary a farm income, net agricultural self-production income, and net non-agricultural business income.

i. Net primary farm income

Net income from agricultural production revenue (including own consumption or sale) deducts the cost of production (including production inputs fees, taxes, depreciation and repair costs).

ii. Net agricultural self-production income

Including net income of agro-processing, rural houses, catering and sold of self-grown product after deducting the costs.

iii. Net non-agricultural business income

It refers to operating income other than agricultural related business, such as net earnings from operating shops, factories, mines, and service industries or distribution of net earnings from partnership enterprise (net earnings refers to total income deducts operating expenses, such as commercial earnings, factory earnings, taxi income, self-employed mason income, self-operated pharmacy income, etc. Family living expenses provided by operators from the total income need to incorporate computing before business final accounts), and net operating income of own practitioners after the deduction of business expenses (such as lawyers' defense income, accountants' audit revenue, midwives' midwifery income, doctors' treatment income, scrivener income, architects' drawing fee income, etc.).

3. Property income

i. Interest income

Including interest income from fixed deposits, savings deposits, bonds, lending money, saving deposited life insurance, etc.

ii. Investment income

It includes dividends from stock securities and dividend income from investments, excludes the price difference from trading of stock and funds.

iii. Other property income

Including net rent (subject to deductions for tax and land reclamation fee) of land (excluding ground buildings), net royalty income (such as income from rent or sell of trademarks, copyrights, patents or professional licenses, deduct amortization costs), other rent income (such as actual rental income from housing, factories, vehicles, and other property, deduct taxes, depreciation and repair expenses).

4. Imputed rent income

The balance of imputed rent income after deducts depreciation.

5. Current transfer receipts

i. From individuals

Including private grants income, gifts income, relief funds, condolence payments, bride price, imputed rent income from private houses, scholarship from civil society, etc. The income is used for current consumption, rather than for investment of fixed assets or financial assets.

ii. From government

Including living allowance for low-income households, living allowance for elderly welfare, national insurance guarantee pension, work grant, farmer pension, lottery winnings, and other (disaster, emergency relief, disability living allowance, emergency relief for unemployment and immediately care, etc.).

- **Agricultural transfer receipts**

  Including fallow payment, transferred subsidies, natural disaster subsidies, old farmer subsidies, afforestation subsidies, farmers and fishermen children scholarships, and other unpaid regular transfer. For the case of claims for death of the insured pigs belongs to social insurance benefits.

- **Social insurance benefits**

  Including insurance benefits from public, labor, agriculture, fishery, military, and health insurance, employment insurance benefits and the payment after attending the national pension insurance contributions.

iii. From enterprises

Including insurance benefit from personal accident insurance and others (such as other insurance cash benefit, winning, relief funds, birthday cash gifts from life insurance companies, scholarships, etc.).

iv. From abroad

Grants or cash gifts from abroad and the income is used for current consumption, rather than for investment of fixed assets or financial assets.

6. Miscellaneous receipts

   Such as income from sales of waste, selling old newspapers, occasionally forestry and fishery income, and income from sales of scrapped household equipment that less than NTD 20,000, etc.

According to categories of the Agricultural Statistical Yearbook, "farm income" refers to "net primary farm income" and "net agricultural self-production income" in owners' total income, others are "Off-farm income". This study subdivided "Off-farm income" into "industrial income" and "non-industrial income". "Industrial income" includes "compensation of employees" and "net non-agricultural business income". "Non-industrial income" includes "property income", "imputed rent income", "current transfer receipts", "miscellaneous receipts", etc. "Non-industrial income" is not included in the scope of this study. To sum up, the composition of farm and off-farm income in farm household income as shown in Figure 5.

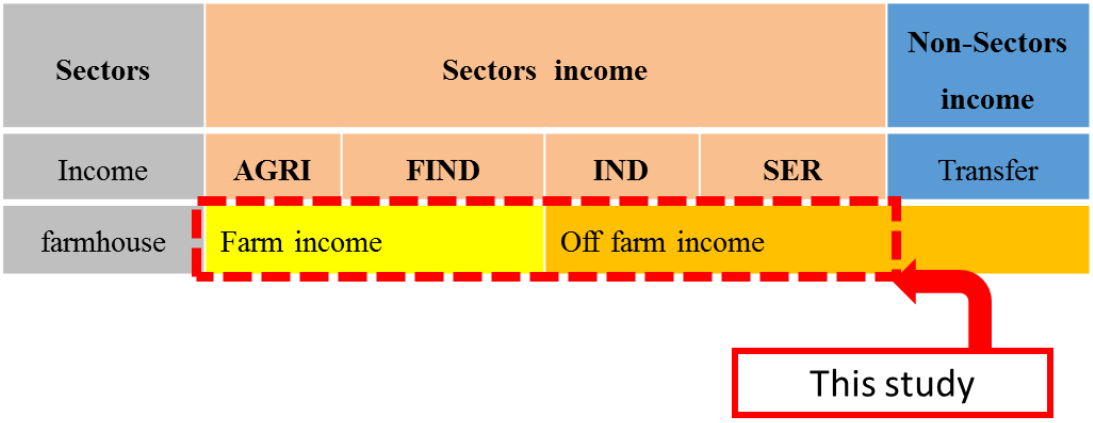


Figure 5: Structure of the farm household income

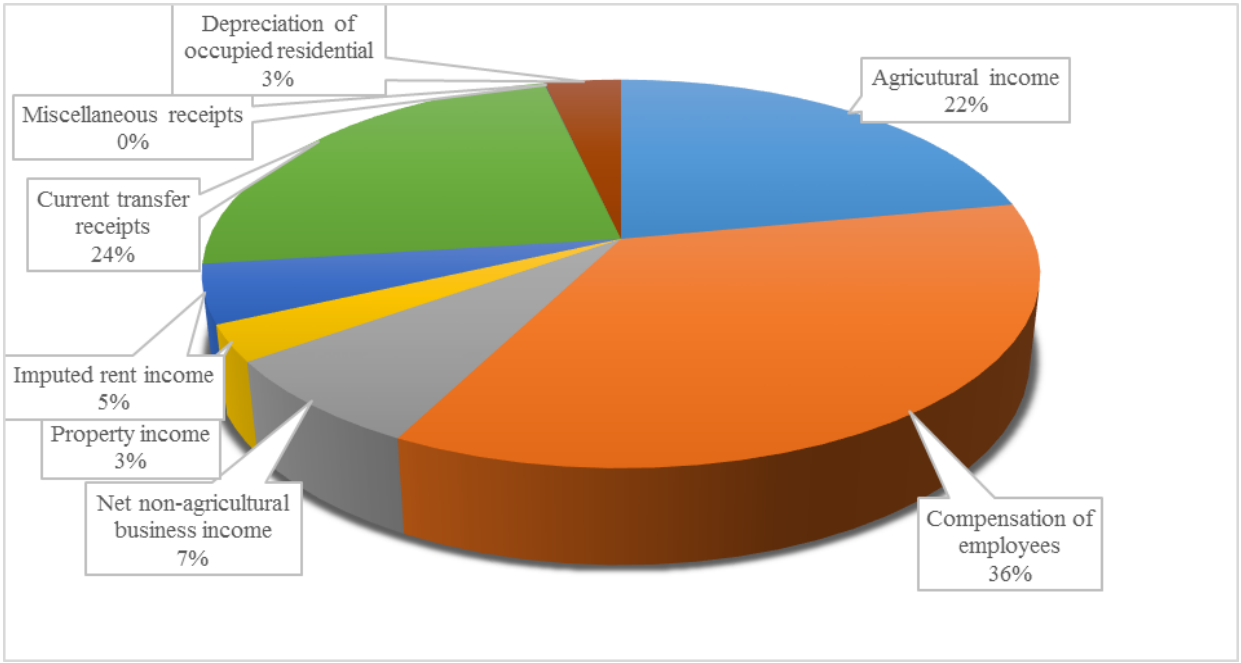
Taiwan's average farm household total income was NTD 985,000 in 2013, where farm income was NTD 213,000, industrial income was NTD 419,000 and non-industrial income was NTD 352,000. The proportions of the three were about 20%, 45%, and 35% over the past decade, as shown in Table 6. The share of the composition of farm household income in 2013 is shown in the following Figure 6.

Table 6: Composition of average farm household total income

Units：NTD

Year	Average farm household total income	Farm income	Off-farm income		Average farm household total income	Farm income	Off-farm income	
			Industrial income	Non-industrial income			Industrial income	Non-industrial income
2003	873,901	172,414	407,117	294,370	100%	20%	47%	34%
2004	893,124	187,758	404,754	300,612	100%	21%	45%	34%
2005	872,677	168,694	393,835	310,148	100%	19%	45%	36%
2006	941,160	195,137	426,043	319,980	100%	21%	45%	34%
2007	937,053	180,562	407,704	348,787	100%	19%	44%	37%
2008	917,705	196,919	376,590	344,196	100%	21%	41%	38%
2009	872,668	182,102	349,131	341,436	100%	21%	40%	39%
2010	884,546	182,160	392,921	309,465	100%	21%	44%	35%
2011	933,785	183,948	432,052	317,785	100%	20%	46%	34%
2012	995,645	215,795	434,504	345,346	100%	22%	44%	35%
2013	985,344	213,801	419,224	352,319	100%	22%	43%	36%

Source: Agricultural Statistical Yearbook



Source: Agricultural Statistical Yearbook

Figure 6: Share of the composition of farm household income 2013

The estimation of total farm household income in model base year (2011) refers to average farm household income in 2011 (NTD 930,000) and total number of farm

households (777,000 households). The estimated Taiwan's total farm household income was 7,259 hundred million dollars, where farm income was 1,430 hundred million dollars, industrial income was 3,359 hundred million dollars, and non-industrial income was 2,470 hundred million dollars.

This study analyzed the effect of cross-strait trade liberalization on farm household income. We progress by a mechanism of effect on price and production of import and export commodities by decreasing tariffs of each industry to zero. We divided industry sector into agriculture, agro-industry, industry and service sector. In farm household income, the income from industry sectors are "farm income" and "industrial income". We assumed that farm income was from "agriculture" and "agro-industry" sectors, industrial income was from "industry" and "service" sectors. In addition, we used SAM-based GEMTEE model which including transfer income and expenditure of the social accounting accounts. Therefore the "non-industrial income" in farm household income including "property income", "imputed rent income", "current transfer receipts", "miscellaneous receipts" will be solved in the model endogenously.

According to categories in our study, total national income is 7 trillion 2,958 hundred million dollars, where income from agriculture sector is 1,360 hundred million dollars, from agro-industry sector is 951 hundred million dollars, from industry sector is 1 trillion 3,526 hundred million dollars, and 5 trillion and 7,120 hundred million dollars is from service sector. We assume that all income from agriculture sector is under farm household's farm income, and the remaining 69 hundred million dollars is assumed from agro-industry sector. Whereas the farm household's off-farm income is estimated from sector salary and number of households of industry and service sector according to the household income and expenditure survey. Estimated results are shown in Table 7.

Table 7: Composition of total national income 2011

Units: million dollars

Sectors	Agriculture	Agro-industry	Industry	Service	Total
Total income	136,068	95,146	1,352,609	5,712,053	7,295,876
Farm income	136,068	6,947	64,314	271,595	478,923
Off-farm income	-	88,199	1,288,295	5,440,458	6,816,953

IV. Assessment of the impact of cross-strait trade liberalization on agriculture development and farm household income

Considering the current process of development of domestic and foreign economic environment and cross-strait relationship, cross-strait trade liberalization is absolutely necessary and important.

(a) Operation of GTAP and GEMTEE Model

This study formed an integrated model of empirical simulation operation by combining multi-national and single country CGE model using soft link method. In the setting of policy simulation scenarios, this study referred to the "ex ante" analytical methods which mentioned by Dixon and Rimmer (2002), Hsu *et al.* (2007) and Lin *et al.* (2013). First, we set cross-strait trade liberalization as basic scenario, tariffs of all commodities between Taiwan and China mainland are reduced to zero. We calculated the price change between international import and export using GTAP model. Thus we simulated the effect under the framework of cross-strait trade liberalization on Taiwan's agricultural sector and farm household income by combining single country GEMTEE model. The operating model diagram show in Figure 7.

According to the ninth edition GTAP database, the calculated level of trade distortion between Taiwan and China is shown in Table 8. We used GTAP model to estimate the impact on import and export price of Taiwan's current commodities under the condition of fully tariff concessions between Taiwan and China as well as excluding non-tariff barriers, the estimated result as show in Table 9.

The results show that import prices of domestic agricultural products decrease by 1.77%, while export prices of domestic agricultural products will reduce 1.65%. Import prices of agro-processing industry decrease by 1.64% and a reduction of 0.97% in export prices. For the industrial products, import prices decrease by 1.98% while export prices increase 10.67%. There are 1.30% decrease in import prices and 0.68% increase in export prices for service sector.

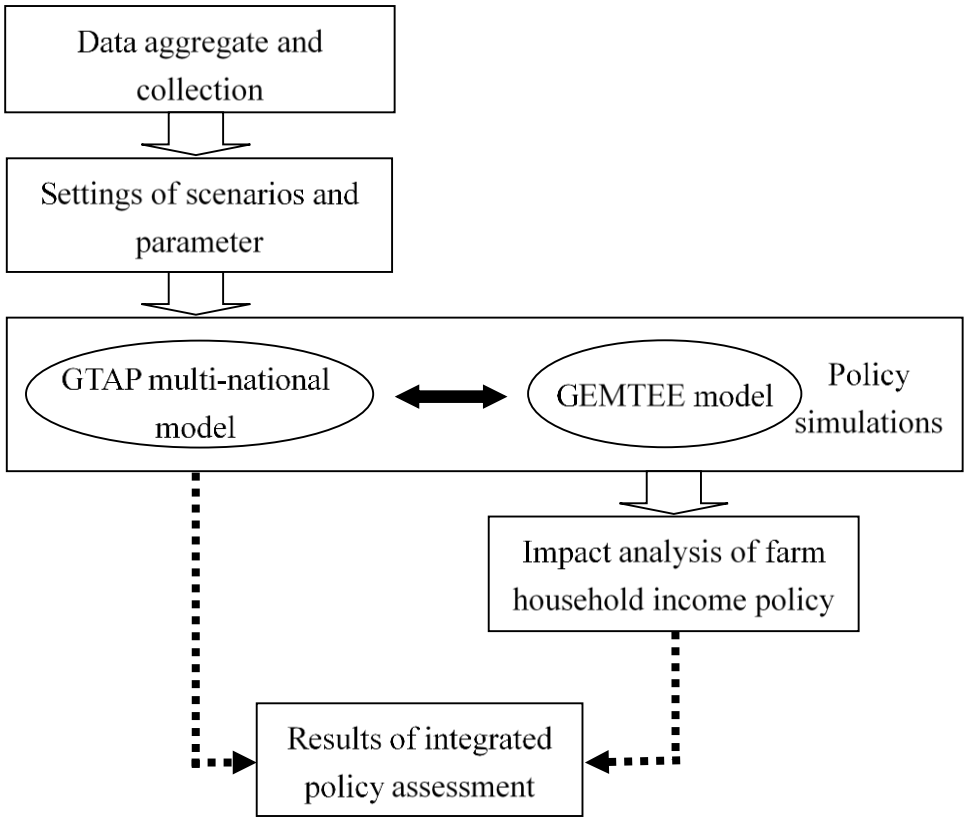


Figure 7: Functions and connection between GTAP model and GEMTEE model

Table 8: Level of trade distortion between Taiwan and China

Sectors	Level of trade distortion in Taiwan	Level of trade distortion in China
Agriculture	3.47%	15.60%
Agro-industry	7.66%	11.34%
Industry	3.03%	4.72%
Service	0.00%	0.00%

Table 9: Estimated results of the impact on import and export price of Taiwan's current commodities

Sectors	Import prices of domestic products	Export prices of domestic products
Agriculture	-1.77%	-1.65%
Agro-industry	-1.64%	-0.97%
Industry	-1.98%	10.67%
Service	-1.30%	0.68%

(b) Results of the impact of cross-strait trade liberalization on Taiwan's agriculture development and farm household income

In general, signings of RTAs can enhance the connection between domestic and international markets through trade liberalization. The removal of trade barriers between two regions can improve the fluidity of commodities. By the arising in the scale of economy and the increasing in the efficiency of resource used, the national economic welfare will be enhanced.

There are three scenarios in this study. Scenario 1 calibrate the model to 2016 and keep the current situation of trade relationship between cross-strait. Scenario 1 does not consider the elimination of trade distortions and changes in technology. All of simulation results are calibrated by model. There is no policy shock in scenario 1. Scenario 2 is a full liberalization in industrial and services but with some trade restriction in agriculture. Scenario 3 is a simulation to 2016 that both countries reduce tariffs of all commodities to zero. The simulation scenarios design as show in Table 10.

Table 10: Simulation scenarios design

Scenarios	Scenario 1	Scenario 2	Scenario 3
Trade relationship	Keep current situation	Full liberalization in industrial and services but with some trade restriction in agriculture	Reduce tariffs of all commodities to zero

For the agriculture sector, since the removal of tariff barriers between cross-strait except 830 kinds of agricultural products, import and export prices of agricultural product are both reduced. Because of lower prices of China's agricultural products, domestic agricultural production value will decreases from 5,209 hundred million dollars to 5,165 hundred million dollars, with a decline of 0.84%. Yet a complete removal of tariff barriers between cross-strait will reduce domestic agricultural production value to 5,118 hundred million dollars, with a reduction of 0.91%. Result are shown in Table 11.

Table 11: Impact of cross-strait trade liberalization on Taiwan's agricultural production value

Units: million dollars

Scenarios	Agricultural production value	Percentage change (%)
Scenario 1	520,957	
Scenario 2	516,575	-0.84%
Scenario 3	511,874	-0.91%

*The production value in scenario 1 refers to the total value of agricultural production in 2014.

For the impact on farm household income, results calibrated by model in scenario 1 as shown in Table 5-5. Total national farm household income is 4,789 hundred million dollars, farm household income from agriculture sector is 1,361 hundred million dollars, from agro-industry sector is 69 hundred million dollars. 643 hundred million dollars of off-farm income is from industry sector and 2,716 hundred million dollars is from service sector.

In scenario 2, farm household income from agriculture sector is 1,350 hundred million dollars. There is a reduction of 0.76% compared with scenario 1. While income from agro-industry sector is 71 hundred million dollars, increases by 2.19%. Off-farm income from industry and service sectors are 675 hundred million dollars and 2,752 hundred million dollars, increase by 4.9% and 1.36% respectively. The total farm household income in scenario 2 is 4,849 hundred million dollars, increases by 1.36% compared with scenario 1.

For the scenario 3, farm household income from agriculture sector is 1,348 hundred million dollars, with a decline of 0.9% compared with scenario 1. While income from agro-industry sector is 71 hundred million dollars, increases by 2.21%. Off-farm income from industry and service sectors are 675 hundred million dollars and 2,753 hundred million dollars, increase by 4.91% and 1.37% respectively. The total farm household income in scenario 3 is 4,847 hundred million dollars, increases by 1.21% compared with scenario 1. In addition, the overall impact on GDP increases by 1.779% in scenario 2 compared with scenario 1, while increases by 1.776% in scenario 3. Details of results are shown in Table 12.

Table 12: Impact of cross-strait trade liberalization on the composition change in farm household income and rates of change

Units: million N.T. dollars, %

Scenarios	Sectors				Total	Rates of change
	Agriculture	Agro-industry	Industry	Service		
Scenario 1 (Based scenario)	136,068	6,947	64,314	271,595	478,923	
Scenario 2	135,036	7,099	67,462	275,290	484,886	1.779%
Scenario 3	134,841	7,100	67,471	275,326	484,738	1.776%
Scenario 2/ Scenario 1	99.24%	102.19%	104.90%	101.36%	101.25%	
Scenario 3/ Scenario 1	99.10%	102.21%	104.91%	101.37%	101.21%	

From the perspective of the composition of farm household income (as shown in table 13), proportions of agriculture, agro-industry, industry, and service sectors in

scenario 1 are 28.41%, 1.45%, 13.43%, and 56.71% respectively. Moreover, proportions of each sector are 27.85%, 1.46%, 13.91%, and 56.77% in scenario 2 and 27.82%, 1.46%, 13.92%, and 56.80% in scenario 3. According to the trend in results, the proportion of farm household income from agriculture sector reduces by 0.56 percentage points, from agro-industry sector increases by 0.01 percentage points, from industry sector increases by 0.48 percentage points, and from service sector increases by 0.06 percentage points in scenario 2. In scenario 3, although the proportion of farm household income from agriculture sector reduces by 0.59 percentage points, but proportions from agro-industry, industry, and service sectors increase by 0.01, 0.49, and 0.09 percentage points respectively.

In the condition of an increase in the total farm household income in scenario 2 and scenario 3, this illustrates that the proportion of farm household income has transferred from agriculture sector to agro-industry sector, as well as industry and service sectors. By comparing results in scenario 2 and scenario 3, we can find that fully liberalization would decreases the proportion of farm household income from agriculture sector and increases proportions from agro-industry, industry, and service sectors.

Table 13: Impact of cross-strait trade liberalization on the composition of farm household income

Units: %

Scenarios	Agriculture	Agro-industry	Industry	Service	Total
Scenario 1	28.41%	1.45%	13.43%	56.71%	100.00%
Scenario 2	27.85%	1.46%	13.91%	56.77%	100.00%
Scenario 3	27.82%	1.46%	13.92%	56.80%	100.00%
Scenario 2- Scenario 1	-0.56 percentage points	+0.01 percentage points	+0.48 percentage points	+0.06 percentage Points	
Scenario 3- Scenario 1	-0.59 percentage points	+0.01 percentage points	+0.49 percentage points	+0.09 percentage Points	

Results of the impact of cross-strait liberalization on domestic employees is shown in Table 14. In scenario 1, the calibrated number of agricultural employees is 542,001 in 2016. Numbers of agricultural employees in scenario 2 and scenario 3 are 522,551 and 517,962 respectively. Scenario 1 has the highest agricultural employment proportion which is 4.95% whereas scenario 3 has the lowest proportion (4.67%).

Table 14: Impact of cross-strait trade liberalization on domestic employees

Units: people, %

Scenarios	Agricultural employees	Total employees	Agricultural employment proportion
Scenario 1	542,001	10,946,108	4.95%
Scenario 2	522,551	11,100,635	4.71%
Scenario 3	517,962	11,097,430	4.67%

To estimate Taiwan's average farm household income, we firstly assume that the number of farm households and the amount of off-farm income from non-industrial sector in 2016 as same with 2013, which are 780,307 households and NTD 352,319 respectively. Furthermore, we classified the estimated result into agricultural and off-farm income according to the definition of the Council of Agriculture. Estimated results of average farm household income in three scenarios are 1.08 million dollars, 1.09 million dollars, and 1.09 million dollars respectively. We found that farm household income is higher in the case of trade liberalization.

In addition, we found that the farm income proportion is the highest in scenario 1 (20.19%) and the lowest in scenario 3 (19.88%). Whereas the off-farm income proportion is the highest in scenario 3 (80.12%) and the lowest in scenario 1 (79.81%). This showed that higher level of agricultural products liberalization will causes a lower level in farm income proportion. But off-farm income will benefits from trade liberalization, the detail as shown in Table 15.

Table 15: Impact of cross-strait trade liberalization on Taiwan's average farm household income

Units: NTD, %

Sources of income	Farm income	Off-farm income		Total
		Industrial income	Non-industrial income	
Scenario 1	219,670	515,956		1,087,945
Scenario 2	218,855	526,467	352,319	1,097,641
Scenario 3	218,022	526,536		1,096,876
Proportion of income	Farm income	Off-farm income		
Scenario 1	20.19%	79.81%		100.00%
Scenario 2	19.90%	80.10%		100.00%
Scenario 3	19.88%	80.12%		100.00%

V. Conclusions and Suggestions

Taiwan is an export-oriented economy, and the exports accounts for over 70% of gross domestic product (GDP). The trade surplus has become the main export momentum of Taiwan's economic growth. With the unmistakable global trend of regional economic integration, many countries actively participate in regional trade agreements (RTAs) and bilateral free trade agreement (FTA), which helps reduce tariff and non-tariff barriers to the free flow of goods, services, and factors of production between each other. Since 2010, as the successive establishment of free trade zones, like the ASEAN, TPP, ASEAN, etc., has brought a lot more impact on Taiwan’s industrial competitiveness. With the free trade agreements signed, as a country lacking advantages of natural resources, we must gradually open up agricultural broders which will inevitably affect Farmers' livelihoods. The main points in this article including:(1) In recent years, Taiwan's overall conditions of agricultural workers (population distribution, average revenue, industrial scale and related development); (2) The impact of the Economic Cooperation Framework Agreement (ECFA) signed between Taiwan & China and the promotion of Taiwan's Free Economic Pilot Zones (FEPZs) (agriculture population, average revenue, scale of Taiwan agriculture); (3) Evaluation of the impact on agricultural development, agricultural employment and farm household income owing to trade liberalization across the Taiwan Strait; and (4) Policy recommendations.

This article uses Computable General Equilibrium analysis and the method of soft link. Combine multinational model (Global Trade Analysis Project, GTAP), single national model (SAM-based GEMTEE) and its database to construct the aggregate model of empirical simulation. Do a research about the relationship between the economic-trade liberalization across Taiwan Strait and Taiwan's agricultural development and farm household income.

(a)Conclusions and major findings

From the literature about the relationship between trade liberalization and agricultural development, agricultural employment, farm household income, etc., we can find where the sources of variability in farm household income come from. Besides the direct impact on the value of agricultural products, which is caused by the effect of

trade offset from the comparative advantages among domestic industry, making an income loss of farm household. The farm income of the farm household income itself will also arise uncertainties owing to the domestic price fluctuations, seasonality and disaster losses. Therefore the "off-farm income" of the farm household income is obviously important.

This article from the perspective of industrial association analyze the impact of Taiwan's agricultural development owing to cross-strait trade liberalization. Through the simulation analysis, we realize under the cross-strait exchanges and cooperation in trade, the agriculture will have positive benefits driven by the other industries. In addition, from the point of view of farm household income, we analyze the impact on farm and off-farm income owing to cross-strait trade liberalization, and through the database creation and simulation analysis to understand the importance of free trade for off-farm income. Povide the information of the impact of Taiwan's agricultural development and farm household income owing to cross-strait trade liberalization for government, as a reference to planning policy of the cross-strait economic and trade.

There are three scenarios in this article, including baseline scenario, cross-strait zero-tariff policy on all goods except for Taiwan's 830 agricultural products and cross-strait zero-tariff policy on all goods.

Under the state of reserving 830 agricultural products to be non-open, total output value of agriculture will be reduced from 520.9 billion to 516.5 billion, 0.84 percent decline. If the cross-strait tariff barriers is completely removed, then the total output value will be reduced to 511.8 billion, 0.91 percent decline.

From the perspective of the impact of farm household income, under the baseline scenario, the nation farm household income totaled NT$ 478.9 billion, the farm household income coming from agriculture is NT$ 136.1 billion, the farm household income coming from agro-processing industry is NT$ 6.9 billion off-farm income coming from industrial sector is NT$ 64.3 billion yuan, off-farm income coming from service industry is NT$ 271.6 billion. After limiting the degree of free trade of cross-strait, the two sides remove all trade barriers but retains 830 produce to be non-open. The farm household income coming from agriculture is NT$ 135 billion, 0.76 percent decline; farm household income coming from agro-processing industry is NT$ 7.1

billion, 2.19 percent increase, off-farm income coming from industrial sector is NT$ 67.5 billion, 4.90 percent increase, off-farm income coming from service industry is NT$ 275.3 billion, 1.36 percent increase, the nation farm household income totaled NT$ 484.9 billion, 1.25 percent increase ; Under the state of complete trade liberalization of cross-strait, the farm household income coming from agriculture is NT$ 134.8 billion, 0.90 percent decline; farm household income coming from agro-processing industry is NT$ 7.1 billion, 2.21 percent increase, off-farm income coming from industrial sector is NT$ 67.5 billion, 4.91 percent increase, off-farm income coming from service industry is NT$ 275.3 billion, 1.37 percent increase, the nation farm household income totaled NT$ 484.7 billion, shows an increasing state.

Consider the composition of the farm household income, the result of retaining 830 non-open produce is the farm household income coming from agriculture decreased 0.56 percent, from agro-processing industry increased 0.01 percent, from industrial sector increased 0.48 percent , from service industry increased 0.06 percent ; after the cross-strait trade liberalization, the farm household income coming from agriculture decreased 0.59 percent, from agro-processing industry increased 0.01 percent, from industrial sector increased 0.49 percent , from service industry increased 0.09 percent. It shows the proportion of farm income transfer to the proportion of agro-processing industry, industrial sector and service industry. Meanwhile, the complete trade liberalization will lower the proportion of farm income, and raise the proportion of off-farm income which is composed of agro-processing industry, industrial sector and service industry.

Concerned with the estimation of the impact on agricultural employment owing to cross-strait trade liberalization, the baseline scenario estimated 542 thousands persons are employed in agriculture, representing 4.95% of total employed. In the scenario of limited cross-strait trade liberalization, it's estimated that 522 thousands persons are employed in agriculture. In the scenario of complete cross-strait trade liberalization, it's estimated that 517 thousands persons are employed in agriculture, representing 4.67% of total employed, which is the lowest proportion among three scenarios.

Finally, we estimated the farm household income (per household) in 2016 according the data of 780,000 farm households and NT$ 350,000 non-industrial income. The scenario of limited cross-strait trade liberalization got the highest farm household

income. If we consider each scenario's sources of income proportion, we can find that allowing more produce to be traded will lower the proportion of farm household income, but the off-farm income will increase owing to the benefit from the free trade, which contributes to the increase of Taiwan's farm household income.

(b) Recommendations

According to the empirical simulation analysis, we propose the following recommendations:

(a) This article found that although trade liberalization makes total output value of agriculture decrease and farm income of farm household income decrease, off-farm income increase, thereby increasing the farm household income. It is recommended that let farm household income as an important governance indicators and use it to do the inter-departmental studies.

(b) Related complementary measures, such as develop the produce having comparative advantage and differentiation, strengthen the integration of industrial value chain such as whether coffee is good or bad depends on the quality of the coffee beans and roasting technology, so Taiwan can increase the comparative advantage of production through roasting technology. Other countries have developed the similar agricultural products such as Korean kimchi, United Kingdom Lipton tea and so on.

(c) The resource negotiation and integration of inter-departmental. Recently Taiwan government is pursuing "Productivity 4.0", including the agricultural part which is dominated by Council of Agriculture (COA). Agro-Productivity 4.0 focuses on boosting the agricultural productivity, and if the cross-strait trade liberalization go with technological progress, it will cause farm household income to increase more.

An ass in Germany is a professor in Rome. In 1997, as the Asian financial crisis happened, South Korea government was on the verge of bankruptcy. Under the IMF's demand of strong reformation, Korea make every possible effort to make Korea a prosperous nation. According to OECD's evaluation of agricultural policy reforms in Korea in 2008, it showed that Korea fully realize one of the important means of increasing the farm household income is to increase the opportunities of off-farm employment, which needs to be supported by vibrant countryside or local economy.

Korea use trade liberalization and free trade agreements as an engine of economic development to actively perk up local economy.

In addition, to increase the attractiveness of rural areas, the main ways of South Korea used to promote countryside or local development, including the construction investment of education, transportation, health and residence, etc. In some cases, appropriately releasing farmland to other new uses helps the countryside or local economy, such as developing industrial parks, or developing recreational sports facility to make rural areas as an important recreational resort. But the development direction of rural or local areas should be decided by the locals.

References

Anderson, K., J. Giesecke, and E. Valenzuela. 2010. How would global trade liberalization affect rural and regional incomes in Australia? *Australian Journal of Agricultural and Resource Economics*, *54*(4), 389-406.

Berdegué, J. A., E. Ramírez, T. Reardon, and G. Escobar. 2001. Rural nonfarm employment and incomes in Chile. *World Development*, *29*(3), 411-425.

Blank, S. C. 2008. *The Economics of American Agriculture: Evolution and Global Development*. M.E. Sharpe Inc.: Armonk, New York.

Dixon, P. B., and B.R. Parmenter. 1996. Chapter 1: Computable General Equilibrium Modelling for Policy Analysis and Forecasting. in H.M. Amman, D.A. Kendrick and J. Rust (eds.), *Handbook of Computable Economics,* Vol. I, Elsevier Science B.V.

Dixon, P.B., B. R. Parmenter, A.A. Powell and P.J. Wilcoxen, *Notes and Problems in Applied General Equilibrium Economics,* North-Holland Publishing Company, 1992, pp. xvi +392.

Dixon, P. B. and M. T. Rimmer. 2002. *Dynamic, General Equilibrium Modelling for Forecasting and Policy: A Practical Guide and Documentation of Monash.* Amsterdam: North-Holland.

Edwards, C. 1981. The Bases for Regional Growth: A Review. In: Martin L. R., editor. A Survey of Agricultural Economics Literature. Minneapolis: University of Minnesota Press, pp. 159–282; vol. 3.

Gardner, B. L. 2005. Causes of rural economic development. *Agricultural Economics*, *32*(s1), 21-41.

Harrison, W. J. and K. R. Pearson. 1996. Computing Solutions for Large General Equilibrium Models Using GEMPACK. *Computational Economics.* 9(2), 83-127.

Haggblade, S., P. Hazell, and T. Reardon. 2010. The rural non-farm economy: Prospects for growth and poverty reduction. *World Development*, *38*(10), 1429-1441.

Hsu, S. H. and B. R. Wu. 2002. An Economy-wide Analysis of Impacts of Liberalizing Taiwan's Investment in China under the WTO framework. *Taiwan Economic Forecast and Policy*. 33(1), 75-110.

Irwin, E. G., A. M. Isserman, M. Kilkenny, and M. D. Partridge. 2010. A century of research on rural development and regional issues. *American Journal of Agricultural Economics*, *92*(2), 522-553.

Lin, H. C., H. L. Lee, S. M. Hsu, K. J. Lin, D. H. Lee, C. C. Chang, and S. H. Hsu. 2015. Baseline Forecasting for Taiwan's Population in the Face of Low Fertility Rate and Ageing Problems. *Taiwan Economic Forecast and Policy*. 46(1), 113-156.

Lin, K. J., S. M. Hsu, and S. H. Hsu. An Economy-wide Analysis of Impacts on Taiwan's Labor Market and Income Distribution of Taiwan-China Economic Cooperation Framework Agreement (ECFA). *Taiwan Economic Forecast and Policy*. 44(1), 27-80.

Mishra, A. K., and C. L. Sandretto, 2002. Stability of farm income and the role of nonfarm income in US agriculture. *Review of Agricultural Economics*, *24*(1), 208-221.

Pant, H.M. 2002. *GTEM: The Global Trade and Environment Model.* Canberra: ABARES, Australia.

Reardon, T., J. Berdegué, and G. Escobar, 2001. Rural nonfarm employment and incomes in Latin America: overview and policy implications. *World development*, 29(3), 395-409.

Ruttan, V. W. 1955. The Impact of Urban-Industrial Development on Agriculture in the Tennessee Valley and the Southeast. *Journal of Farm Economics*. 37(1): 38-56.

Sheu, S. J. 2007 .Trade Liberalization and Income Distribution of Farm Households in Taiwan. *Journal of Agricultural Economics*. 81, 93-119.

Stabler, J. C., and R. Olfert. 2009. One Hundred Years of Evolution in the Rural Economy. *Perspectives of Saskatchewan*, 125-147.

U.S. Bureau of Economic Analysis, Regional Economic Information System. Available at www.bea.gov, accessed October 15, 2009.

U.S. Census Bureau; Census 2000, Summary File 3: generated using American Fact Finder; <http://factfinder.census.gov>; U.S. Census Bureau, 1976; USDA-NASS, “Trends in U.S. Agriculture.”