Key Indicators for Asia and the Pacific 2016 Conference
Asian Development Bank, Manila

Impacts of GVC Participation on Productivity and Wage: The Case of Thailand

Nattapong Puttanapong, Ph.D.

Faculty of Economics
Thammasat University
Bangkok, Thailand

Outline

(1) Introduction

(2) Empirical evidences

- GVC participation and local firms' productivity
- GVC participation and local workers' wage

(3) Dynamic CGE simulation

- Static simulation (increasing wage and labor productivity)
- Monte Carlo simulation (increasing wage and labor productivity)

(4) Conclusion and policy recommendation

(1) Introduction

- Along with the rise of globalization, the national development policy has been shifted from ISI (Import Substitute Industrialization) to the **export-led growth strategy** since 1980s.
- This transformation has caused the **international trade** to become the **biggest part** of **Thai economy**.

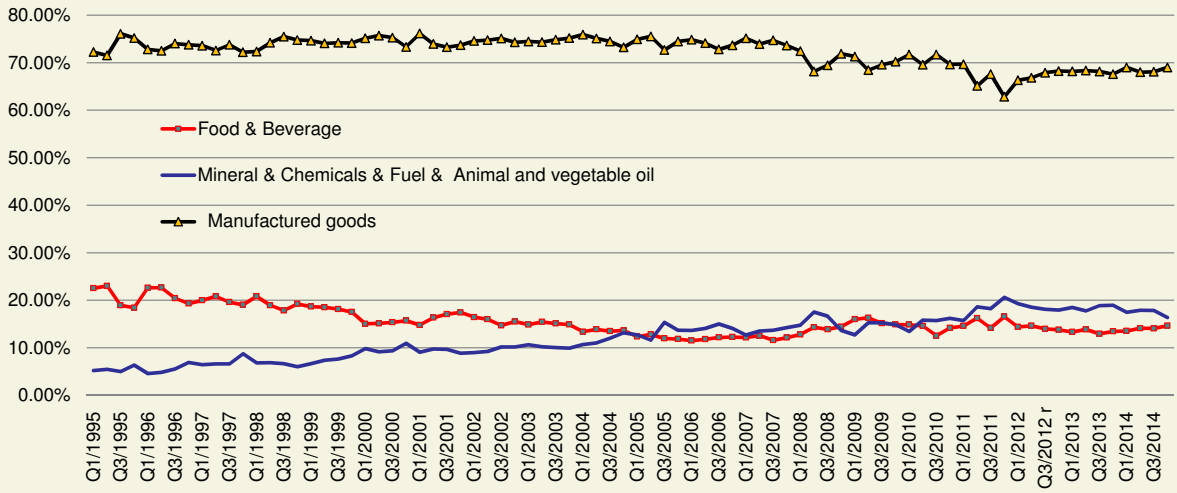
(1) Introduction

Figure 1: Percentage share as of GDP of export and import

Source: Bank of Thailand and author's calculation

(1) Introduction

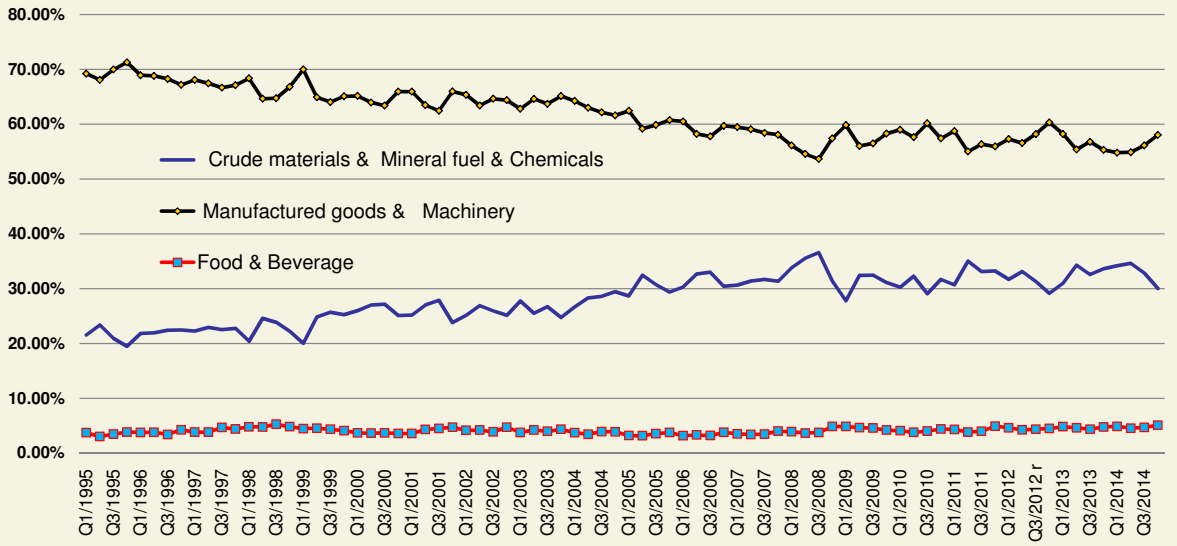
Figure 2: The main structure of exports



Source: Bank of Thailand and author's calculation

(1) Introduction

Figure 3: The main structure of imports



Source: Bank of Thailand and author's calculation

(1) Introduction

- Both figures indicate the **main feature** of Thai economy, whose **main import** and **export** are **manufactured products**.
- Intermediate goods of **electronic**, **machinery** and **automotive** industries are main components of export and import goods.
- This structure of trade implies the **deepened integration** of Thai economy to the **GVC network**, especially in these three industries.

(1) Introduction

There are **three** main **research questions** for this study, which are:

Q1: Does the GVC participation affect firms' productivity?

Q2: Does the GVC participation influence the wage?

Q3: What are the economy-wide impacts of the increment of productivity and wage of sectors that are highly involved in GVC?

(2) Empirical evidences

(2.1) GVC participation and local firms' productivity

- **Kohpaiboon (2006)** shows that the presence and involvement of international firms influences the local ones to **familiarize and absorb the new technology**.
- **Crespo and Fontoura (2004), Pfeiffer et al. (2014) and Winkler (2013**) identify that participation of international companies creates the **spillover of technology and knowledge** to local producers.
- **Paus & Gallagher (2008)** also show that the **spillover of technological improvement** propagates **through the supply chain network**.
- This study uses the **econometrical technique** introduced **by Javorcik (2004)**, and those of **Kohpaiboon & Jongwanich (2013)** and **Tantratananuwat (2015)**.

(2) Empirical evidences

- This study introduces the new variable which is the **index of GVC participation** (i.e. ***VSIndex***).
- The mathematic representation of the model is:

$$lnY_{ij} = \gamma_0 + \gamma_1 lnK_{ij} + \gamma_2 lnL_{ij} + \gamma_3 lnK_{ij} lnL_{ij} + \gamma_4 (lnL_{ij})^2 + \gamma_5 (lnK_{ij})^2 + \gamma_6 EXP_{ij} + \gamma_7 IMP_{ij} + \gamma_8 FRGNPRSNC_j + \gamma_9 FRGNPRSNC_j * \text{TRADPLCY}_j + \gamma_{10} BACK_j + \gamma_{11} FORW_j + \gamma_{12} VSIndex_j + \phi_{j\_LabInt} + \mu_{ij}$$

(2) Empirical evidences

- The main source of data is the Industrial Census collected in 2012 by National Statistical Office of Thailand (NSO), Ministry of Information and Communication Technology.
- The original data set contains 98,842 observations (i.e. number of firms). After the exclusion of outliners, the remaining observations are 22,677.
- The samples having the zero record of paid worker and micro firms (i.e. less than or equal to 10 paid workers) are excluded.

Variable	Source
lnY_{ij}	NSO's Industrial Survey (2012)
lnK_{ij}	NSO's Industrial Survey (2012)
lnL_{ij}	NSO's Industrial Survey (2012)
EXP_{ij}	NSO's Industrial Survey (2012)
IMP_{ij}	NSO's Industrial Survey (2012)
$TRADPLCY_j$	This study uses the computed obtained from Jongwanich & Kohpaiboon (2007)
$FRGNPRSNC_j$	NSO's Industrial Survey (2012)
$BACK_j$	Thailand's 2010 IO table
$FORW_j$	Thailand's 2010 IO table
$VSIndex_j$	Author's calculation based on Wang et al. (2013)

(2) Empirical evidences

Regression results

	2SLS	OLS
lnL	0.661	0.767
	(0.079)**	(0.078)**
lnK	1.500	1.162
	(0.046)**	(0.046)**
lnL·lnK	0.0163	0.002
	(0.006)*	(0.006)
lnL^2	-0.032	-0.019
	(0.008)**	(0.008)**
lnK^2	-0.031	-0.019
	(0.002)**	(0.002)**
EXP	0.508	0.565
	(0.071)**	(0.074)**
IMP	0.536	0.341
	(0.080)**	(0.082)**
FRGNPRSNC	-0.0533	0.127
	(0.223)	(0.089)

(2) Empirical evidences

Regression results

	2SLS	OLS
BACK_MLTPL	-0.545	-0.221
	(0.181)**	(0.140)
FOR_MLTPL	-1.49	-0.281
	(0.201)**	(0.166)+
FRGNPRSNC$_j$*TRADPLCY$_j$	-2.373	-1.567
	(0.328)**	(0.288)**
VS_INDEX	3.051	2.183
	(0.268)**	(0.160)**
CONSTNT	-0.255	-1.051
	(0.215)	(0.337)**
A dummy variable for labor intensive sectors (*j_LabInt*)	Yes	Yes
Number of obs	**18,445**	**19,467**
Wald chi2(22)	52,759.14	
Prob > chi2	0.0000	
F(22, 19,444)		2,143.91
Prob > F		0.0000
Adj R-squared	0.7404	0.7078
Root MSE	1.157	1.2682

(2) Empirical evidences

(2.2) GVC participation and wage

- **Lindsey (1986)**, **Filer et al.(1995)**, **Djankov and Hoekman (2000)** and **Sousa (2001)** demonstrate empirical evidences showing that foreign companies undertake **trainings on local workers** which substantially **improve their skills**.
- **Blomstrom and Kokko (1998)** also show that the improved skills induce the **spillover impacts** on local economy **through labor mobility**.
- Furthermore, to prevent the high rate of turnover which eventually benefit competitors, **Javorcik (2013)** indicates that the foreign affiliates usually pay **the premium wage** to local workers (i.e. efficiency wage).

(2) Empirical evidences

- Following the econometrical tests introduced in these literatures, the study uses both OLS and 2SLS.
- The mathematic representation of the model is:

$$lnWage_{ij} = \gamma_0 + \gamma_1 lnEXP_{ij} + \gamma_2 lnTOTAL\_HR_{ij} + \gamma_3 D\_EXEC_i + \gamma_4 D\_PROFSS_i + \gamma_5 D\_SKILLED_i + \gamma_6 InEDU_i + \gamma_7 lnSIZE_i + \gamma_8 RCA_j + \gamma_9 NRCA_j + \gamma_{10} VSIndex_j + \gamma_{11} IBACK_j + \gamma_{12} IFORW_j + \phi_{j\_LabInt} + \mu_{ij}$$

(2) Empirical evidences

- The main source of data is Labor Force Survey (LFS) gathered by National Statistics Office (NSO).
- The data of LFS of 2000, 2005, 2008, 2009, 2010 and 2011 are used in this study as to match the availability of GVC index.

Variable	Source
$lnWage_{ij}$	NSO's Labor Force Survey (2000, 2005, 2008-10)
$lnEXP_{ij}$	NSO's Labor Force Survey (2000, 2005, 2008-10)
$lnTOTAL\_HR_{ij}$	NSO's Labor Force Survey (2000, 2005, 2008-10)
D_EXEC_i	NSO's Labor Force Survey (2000, 2005, 2008-10)
D_PROFSS_i	NSO's Labor Force Survey (2000, 2005, 2008-10)
$D\_SKILLED_i$	NSO's Labor Force Survey (2000, 2005, 2008-10)
$InEDU_{ij}$	NSO's Labor Force Survey (2000, 2005, 2008-10)
$lnSIZE_{ij}$	NSO's Labor Force Survey (2000, 2005, 2008-10)
RCA_j	Author's calculation based on data obtained from TradeMap
$NRCA_j$	Author's calculation based on Wang et al. (2013)
$VSIndex_j$	Author's calculation based on Wang et al. (2013)
$IBACK_j$	Author's calculation based on data obtained from WIOD
$IFORW_j$	Author's calculation based on data obtained from WIOD

(2) Empirical evidences

Results from 2SLS

	2011	2010	2009	2008	2005	2000
lnEXP	0.1020	0.1124	0.1120	0.1163	0.1201	0.1042
	(0.003)**	(0.004)**	(0.003)**	(0.004)**	(0.004)**	(0.004)**
lnTOTAL_HR	0.2193	0.2751	0.2768	0.2534	0.3701	0.5438
	(0.010)**	(0.011)**	(0.009)**	(0.011)**	(0.010)**	(0.012)**
D_EXEC	0.9975	0.9851	1.0276	1.014	1.2003	0.6386
	(0.019)	(0.024)**	(0.020)**	(0.023)**	(0.022)**	(0.017)**
D_PROFSS	0.6665	0.5371	0.5035	0.5103	0.6434	0.2800
	(0.017)*	(0.021)**	(0.016)**	(0.019)**	(0.019)**	(0.017)**
D_SKILLED	0.1871	0.1624	0.1376	0.1736	0.1369	0.1778
	(0.006)**	(0.007)**	(0.006)**	(0.007)**	(0.007)**	(0.008)**
lnEDU	0.4344	0.4512	0.4976	0.5447	0.2631	0.1457
	(0.008)**	(0.009)**	(0.008)**	(0.009)**	(0.005)**	(0.004)**
lnSIZE	0.0550	0.0583	0.0640	0.0611	0.0719	0.0892
	(0.001)**	(0.001)**	(0.001)**	(0.001)**	(0.002)**	(0.001)**
VS_INDEX	2.4482	7.6899	9.0320	-2.0099	35.7943	2.0533
	(0.687)**	(2.678)**	(4.382)*	(0.469)**	(19.322)+	(1.004)*
IFORW	-0.5891	-2.5509	-3.2779	0.9757	-12.4406	-0.9247
	(0.237)*	(0.985)*	(1.752)+	(0.139)**	(7.382)+	(0.414)*
IBACK	0.1211	-0.0852	-0.3005	0.7117	0.5189	0.0825
	(0.033)**	(0.082)	(0.162)+	(0.044)**	(0.137)**	(0.092)
RCA	-0.7220	-0.9223	-0.0551	-1.2828	-1.9036	-0.0304
	(0.111)**	(0.185)**	(0.031)+	(0.194)**	(0.424)**	(0.076)
NRCA	0.6746	0.7446	-0.0083	1.0489	0.4278	0.1399
	(0.112)**	(0.185)**	(0.036)	(0.138)**	(0.042)**	(0.079)+
CONSTNT	4.5306	4.1457	3.9234	1.7048	4.6315	5.1611
	(0.098)**	(0.154)**	(0.133)**	(0.108)**	(0.460)**	(0.068)**
Dummy for labor intensive sector *(j_LabInt)*	Yes	Yes	Yes	Yes	Yes	Yes
Number of obs	33,035	22,590	33,503	34,568	33,240	19,189
Wald chi2	22897.45	16496.69	29625.42	21899.73	27492.21	14657.39
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.4091	0.4223	0.4694	0.3878	0.4512	0.4331
Root MSE	0.4781	0.4898	0.4844	0.5854	0.5398	0.4220

(2) Empirical evidences

Results from OLS

	2011	2010	2009	2008	2005	2000
lnEXP	0.1018	0.1124	0.1119	0.1162	0.1204	0.1042
	(0.003)**	(0.004)**	(0.003)**	(0.004)**	(0.004)**	(0.004)**
lnTOTAL_HR	0.2192	0.2753	0.2772	0.2535	0.3698	0.5438
	(0.010)**	(0.011)**	(0.009)**	(0.011)**	(0.010)**	(0.012)**
D_EXEC	0.9975	0.9854	1.0276	1.0142	1.1997	0.6386
	(0.019)**	(0.024)**	(0.020)**	(0.023)**	(0.022)**	(0.017)**
D_PROFSS	0.6663	0.5374	0.5042	0.5106	0.6439	0.2800
	(0.017)**	(0.021)**	(0.016)**	(0.019)**	(0.019)**	(0.017)**
D_SKILLED	0.1881	0.1625	0.1382	0.1737	0.1366	0.1778
	(0.006)**	(0.007)**	(0.006)**	(0.007)**	(0.006)**	(0.008)**
lnEDU	0.4352	0.4511	0.4969	0.5447	0.2628	0.1457
	(0.008)**	(0.009)**	(0.008)**	(0.009)**	(0.005)**	(0.004)**
lnSIZE	0.0549	0.0582	0.0639	0.0611	0.0703	0.0892
	(0.001)**	(0.001)**	(0.001)**	(0.001)**	(0.001)**	(0.001)**
VS_INDEX	0.7139	11.2167	18.2507	-1.5444	10.6959	2.0544
	(0.454)	(2.239)**	(4.134)**	(0.379)**	(1.762)**	(0.863)*
IFORW	-0.0016	-3.8421	-6.9615	0.8517	-2.8523	-0.9252
	(0.160)	(0.825)**	(1.653)**	(0.118)**	(0.679)**	(0.357)*
IBACK	0.0803	-0.0848	-0.0619	0.7023	0.3455	0.0825
	(0.031)*	(0.082)**	(0.158)	(0.044)**	(0.033)**	(0.092)
RCA	-0.6051	-1.0474	-0.1043	-1.4002	-1.3736	-0.0304
	(0.106)**	(0.178)**	(0.030)**	(0.182)**	(0.122)**	(0.076)
NRCA	0.5587	0.8913	0.0583	1.1326	0.4397	0.1399
	(0.107)**	(0.175)**	(0.034)+	(0.129)**	(0.041)**	(0.079)+
CONSTNT	4.6488	3.9881	3.6828	1.6538	5.2250	5.1611
	(0.091)**	(0.139)**	(0.127)**	(0.103)**	(0.072)**	(0.067)**
Dummy for labor intensive sector *(j_LabInt)*	Yes	Yes	Yes	Yes	Yes	Yes
Number of obs	33,035	22,590	33,503	34,568	33,240	19,189
Wald chi2	508.12	412.14	740.22	546.82	691.48	395.40
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.4086	0.4213	0.4688	0.3871	0.4538	0.4320

(3) Dynamic CGE simulation

- The CGE model structure follows the dynamic CGE model developed by Decaluwé et al. (2013), which enables adjustment of price and quantity of most goods and input factors.
- In this study, the main assumptions of the CGE model include:
  - Producers have the main purpose to maximize profit and production behavior under the constant-return-to-scale condition.
  - Consumers aim at maximizing utility under budget constraints, and deciding about consuming a combination of domestic and imported goods.
  - All markets of goods and services are in equilibrium and prices are equilibrating variables.

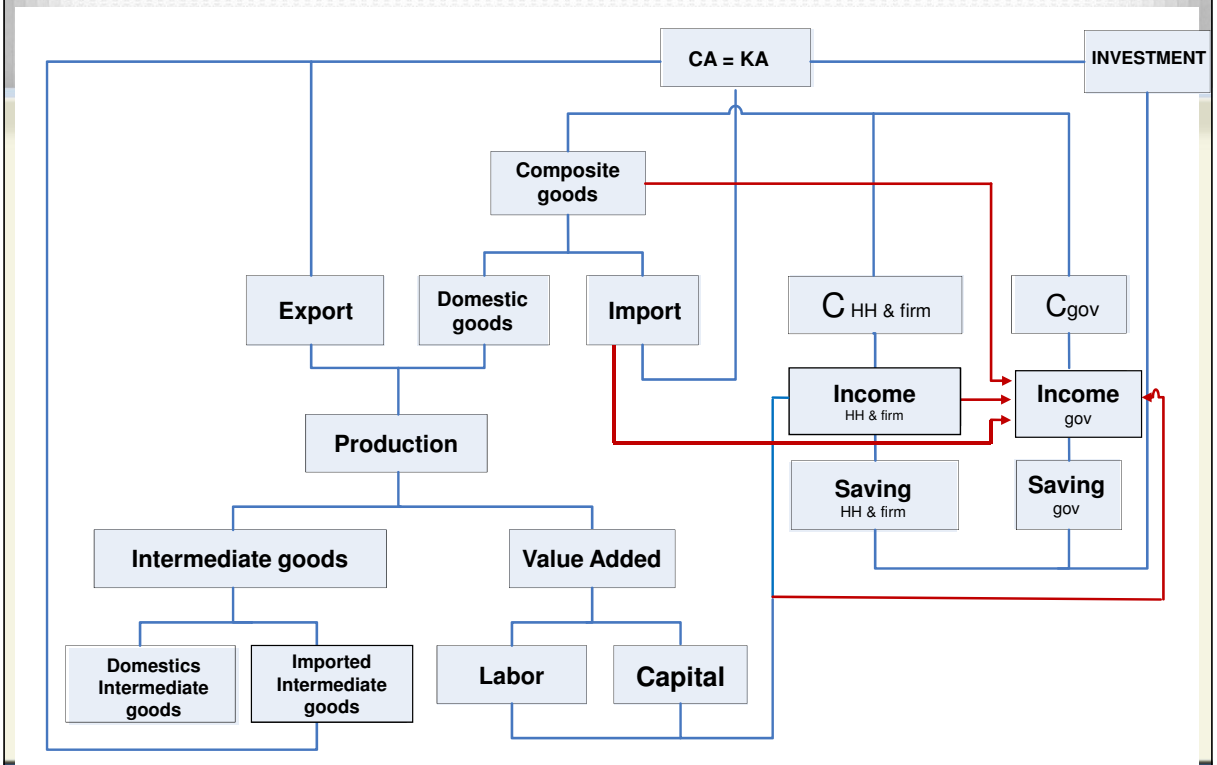
(3) Dynamic CGE simulation

- The CGE model has been calibrated to replicate the initial output identical to actual data of Social Accounting Matrix of 2010.
- Also the model has been set to generate the dynamic adjustment of Thai economy based on the average of potential growth path during 2001-2010.

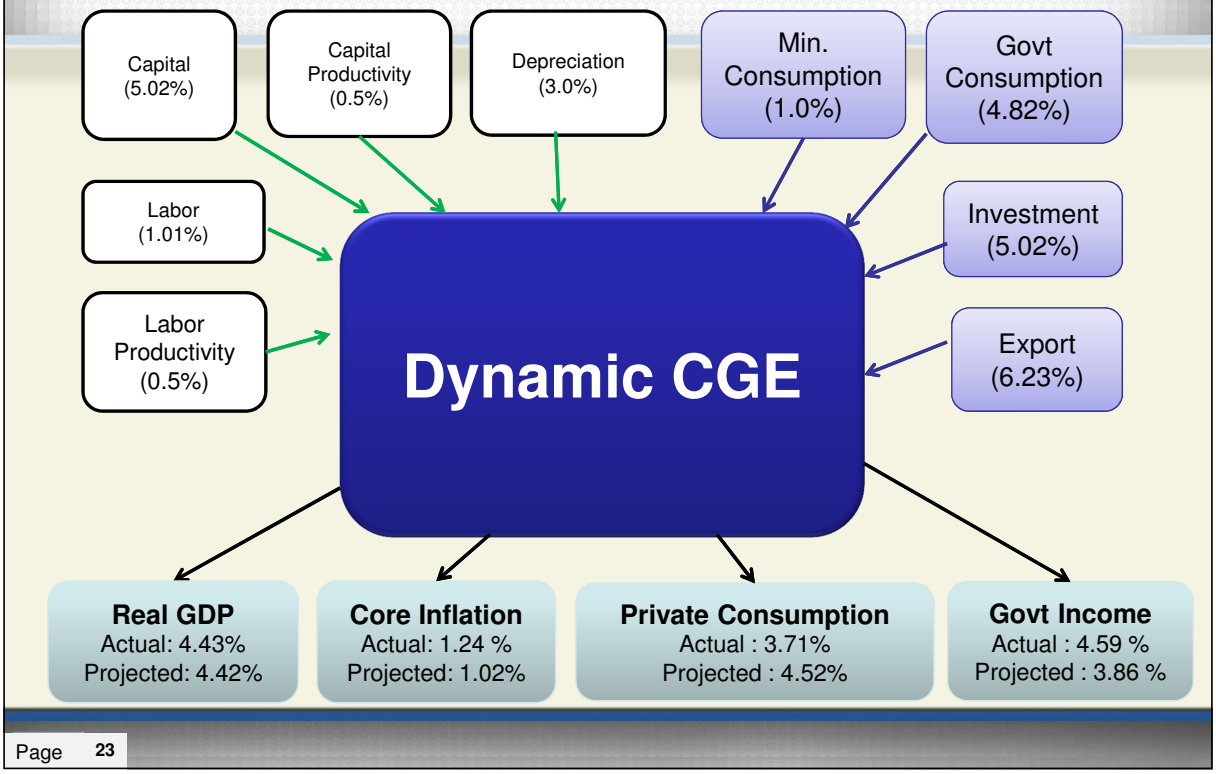
(3) Dynamic CGE simulation

- The Social Accounting Matrix (SAM) of Thailand in 2010 is the main source of data, including 40 production activities, 49 commodities, the aggregate household, the government, and the rest of the world.
- The model contains 5 categories of taxes (income tax, value-added tax, excise tax, tariff, and other indirect tax) and the government's consumption expenditure is set as an exogenous variable.
- Institutions in the model include the household, the government and the rest of the world.
- There is one type of labor and also one type of capital.

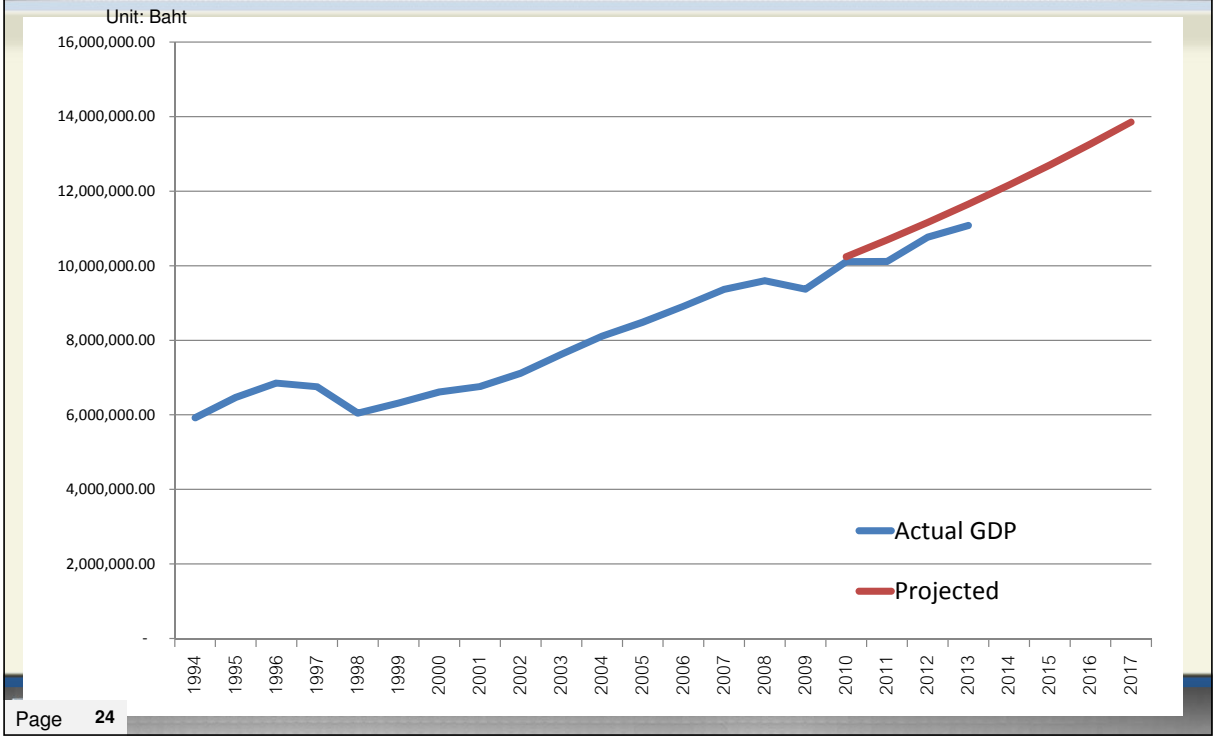
Main Structure of CGE Model



Main assumptions (average of % annual growth)



Model's Simulation Results: Real GDP



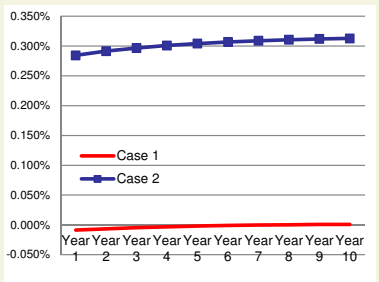
(3) Dynamic CGE simulation

- Results obtained from econometrical tests discussed indicate that the degree of GVC participation has the impacts on both Thai firm's productivity and wage of local worker.
- With these findings, there are two scenarios that have been simulated, which are:
  - **Case 1:** The 1% increment of both wage and labor productivity of automobile, electronics and other manufacturing sectors.
  - **Case 2:** Applying the same set of shock as Case 1 and also increasing the export of automobile, electronics and other manufacturing sectors by 1%.

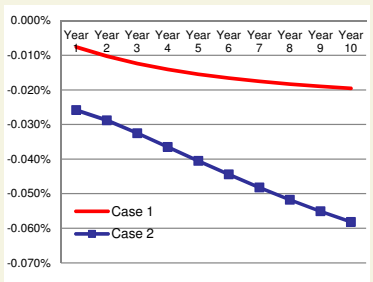
(3) Dynamic CGE simulation

(3.1) Simulation results of static – dynamic case

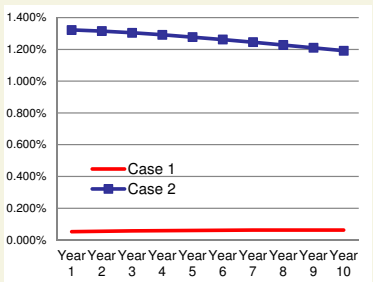
Real GDP



Consumer Price Index



Government's budget balance

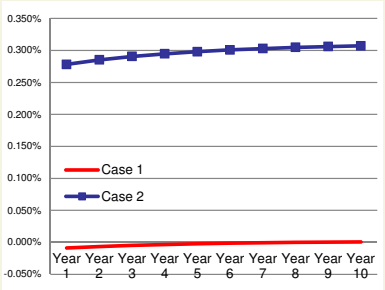


- In both cases, the inflation is decreased and the government's budget balance is improved.
- Interestingly the results of Case 1 indicate that the increasing wage and productivity of three sectors yield the slightly negative effect on real GDP in the first 5 years, and the impacts become positive after then.
- In Case 2, the real GDP continuously increases for all years.

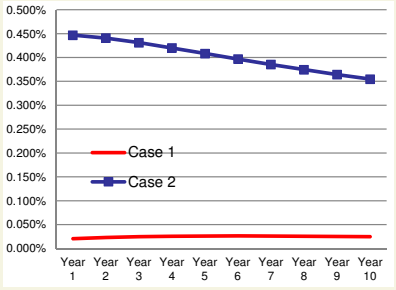
(3) Dynamic CGE simulation

(3.1) Simulation results of static – dynamic case

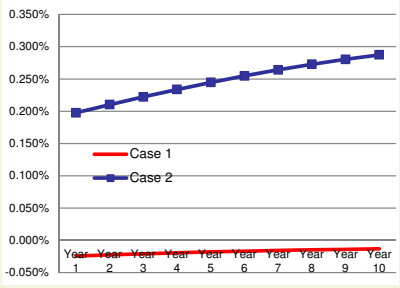
Household's total income



Household's income from wage

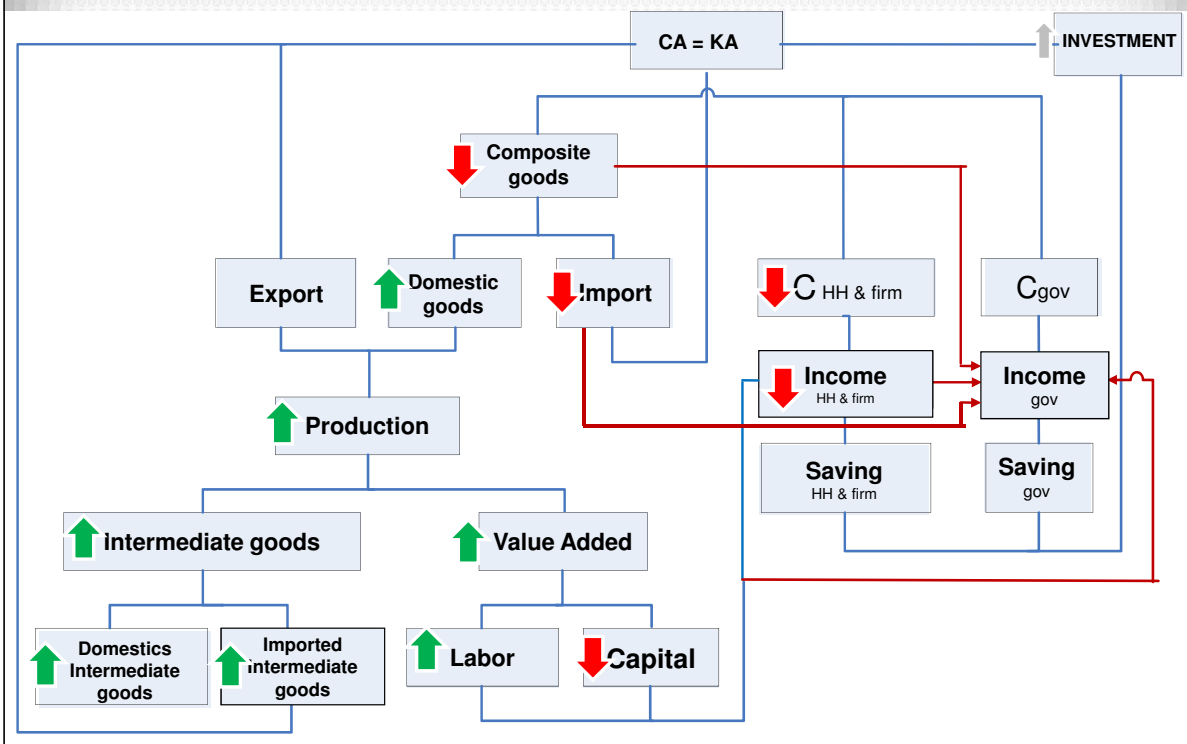


Household's income from capital return

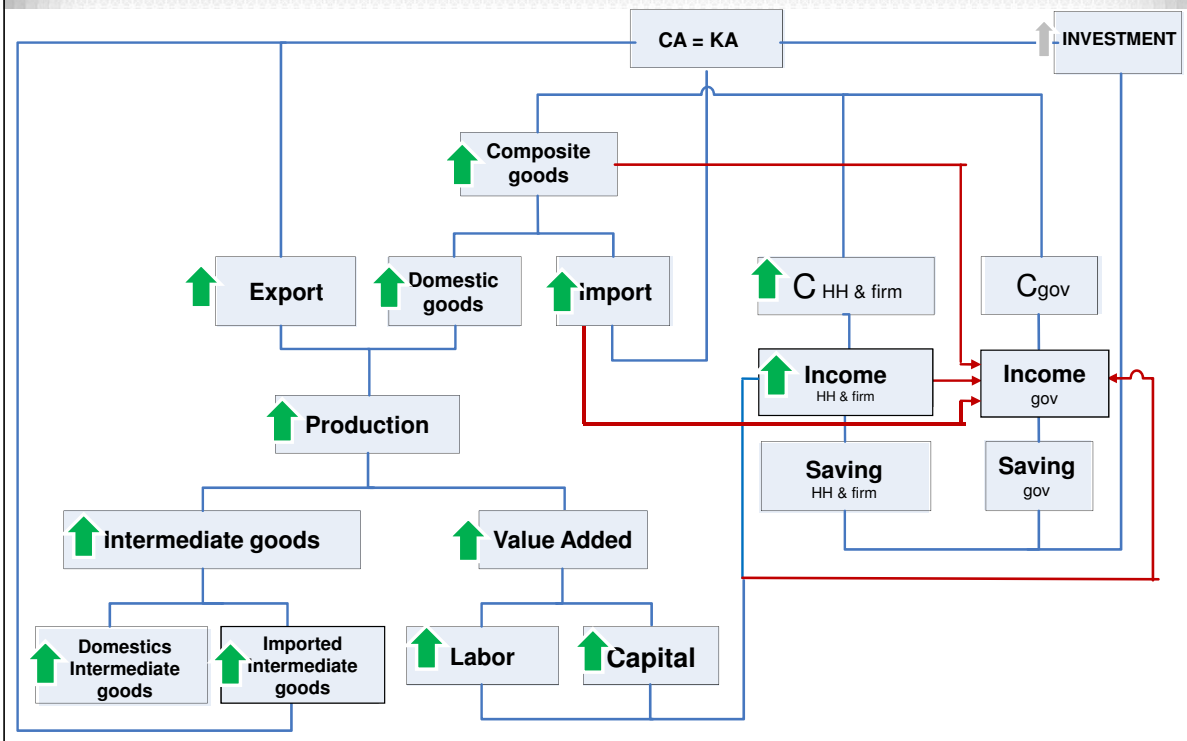


- In Case 1, The substitution between labor and capital in production sectors causes the lower income of household in the first 5 years.
- Without the substantial expansion of exports, the increasing labor productivity can lower demand for capital input, and subsequently decreases the income of household from capital return.

Impact propagation of Case 1



Impact propagation of Case 2



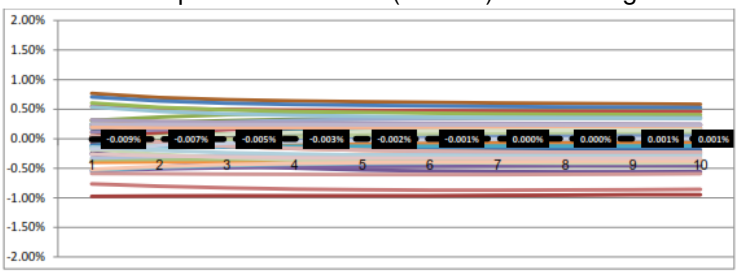
(3) Dynamic CGE simulation

(3.2) Simulation results of stochastic– dynamic case

- Monte-Carlo simulation is applied to the dynamic CGE model in order to examine the robustness of simulation results when varying key parameters governing substitution mechanism of the model.
- The values of elasticity parameters of CES functions were randomized based on the given distribution property.

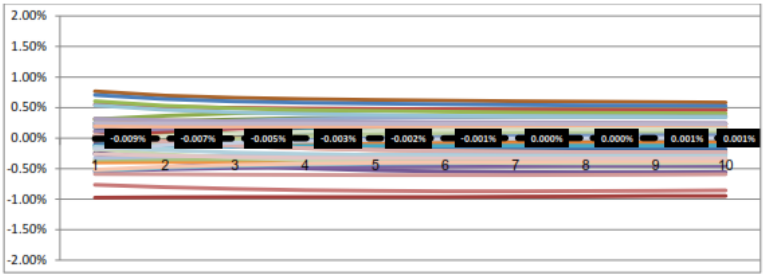
(3) Dynamic CGE simulation

The variation of impact on real GDP (Case 1) when using Monte-Carlo simulation



Note: The dash line and annual values shown in the graph are results obtained from static shock.

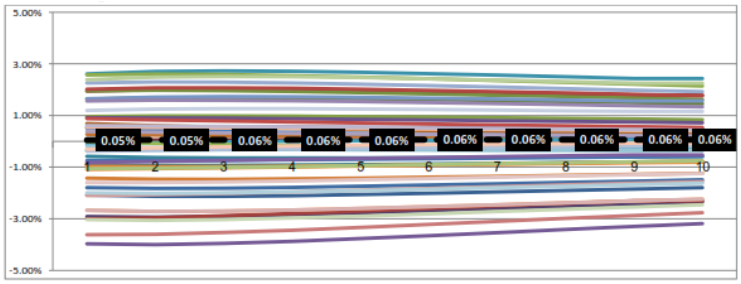
The variation of impacts on CPI (Case 1) when using Monte-Carlo simulation



Note: The dash line and annual values shown in the graph are results obtained from static shock.

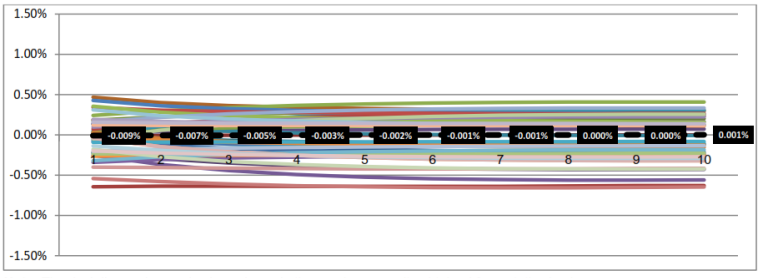
(3) Dynamic CGE simulation

The variation of impact on government's budget balance (Case 1) when using Monte-Carlo simulation



Note: The dash line and annual values shown in the graph are results obtained from static shock.

The variation of impact on household's saving (Case 1) when using Monte-Carlo simulation



Note: The dash line and annual values shown in the graph are results obtained from static shock.

(3) Dynamic CGE simulation

The combination of elasticity of substitution between labor and capital (i.e. *Sigma_VA* in PEP's standard CGE model) and that of substitution among commodities to supply local demand (i.e. *Sigma_XT*) significantly governs the variation of simulation outcomes.

Values of elasticity parameters		Simulation results (main variables)	
Sigma_VA	**Sigma_XT**	**Real GDP**	**Consumer Price Index**
Low	High	Higher real GDP	Lower inflation
High	Low	Lower real GDP	Higher inflation

Main findings

The simulation result is highly sensitive to:

(1) Elasticity of substitution between labor and capital

(2) Absorption capability of domestic demand on electronics, automobile, and other manufactured products.

(4) Conclusion and policy recommendation

(1) The results obtained from econometrical analyses show that the higher degree of GVC involvement influences the higher productivity of domestic firms, and also positively affects wage of local workers.

(2) The increasing labor productivity and wage can benefit the economy. However, the degree of substitution between labor and capital and the low expansion of demand for outputs of GVC-connected sectors are main factors that significantly alters the ultimate economy-wide outcomes.

(4) Conclusion and policy recommendation

Recommendation 1: Support the GVC participation and facilitate spillover on productivity

- The empirical studies conducted in this paper show that the GVC-connected sectors gain the benefit through both increasing productivity and higher wage. Therefore the related government agencies should support the expansion and also provide enabling factors to promote the spillover which finally gains productivity of domestic firms and local workers.

(4) Conclusion and policy recommendation

Recommendation 2: Balance the combination of rising productivity, increasing wage and expanding demand for outputs

- The CGE simulation results indicate that the rising productivity and increasing wage of GVC-connected industries might not benefit the economy as conventionally expected. The crucial factor is the expansion of demand for outputs of these sectors, which should be proportionately responded to the increment in productivity wage. Since a substantial portion of outputs of GVC-connected manufacturers are intermediate goods, the expansion of domestic demand is limited. Therefore the increasing international demand should be matched with the changes in productivity and wage in order to maximize the economy-wide benefits.

Thank you

Credit: PowerPoint's template is obtained from fppt.com.