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Benjasak, Chonlakan and Bhattarai, Keshab

University of Hull, UK

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General Equilibrium Impacts VAT and Corporate Tax in Thailand

Chonlakan Benjasak[1] and Keshab Bhattarai[2]
Business School, Hull University. HU 6 7RX

Abstract

We construct a CGE model of Thailand in order to assess economy wide impacts of reforms in the value added tax (VAT) and corporate income tax (CIT) on welfare and reallocation of resources across production sectors in the Thai economy. Our model was calibrated to the micro consistent benchmark data set contained in the Input-Output Table published in 2010 by the Office of National Economics and Social Development Board (NESD) with some restructuring into 18 sectors. The general algebraic modelling system (GAMS) was used to estimate the parameters of the model. The findings reveal that aggregate net changes in welfare of 10 percent VAT are better than zero percent VAT. Thus, increasing VAT from 7 to 10 percent becomes desirable policy action on the basis of economy wide welfare analysis because utility from the public services for the households more than compensates their loss of utility due to higher taxes. On the net welfare basis, the decreasing CIT rate from 30 to 20 percent is more preferable policy than 23 percent CIT. This model based analysis is a unique contribution to the current literature on impacts of VAT and corporate income tax in the Thai economy though further scope remains for full impact analysis of comprehensive reforms such as the GST with dynamic model and multi households.

Keywords: Tax Policy, VAT, Thailand's CGE model
JEL Classification: D58, H20, H30, O53

[1] Chonlakan Benjasak, PhD Scholar, University of Hull Business School, C.Benjasak@2014.hull.ac.uk
[2] Keshab Bhattarai, PhD, University of Hull Business School, HU6 7 RX, UK; K.R.Bhattarai@hull.ac.uk
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1 Introduction

Over the last four decades, Thailand has made remarkable progress in social and economic development, moving from a low-income country to an upper-middle income country in less than a generation. Thailand is now the second largest economy in the ASEAN following Indonesia and has the fourth highest GDP per capita as shown in Table 1. As such, Thailand has been one of the widely cited development success stories, with sustained strong growth and impressive poverty reduction, particularly in the 1980s. However, the high growth was interrupted by the Asian financial crisis of 1997-1998, followed by the effect of the global financial crisis of 2008-2009, the massive flooding in 2011 and the coup in 2006 and 2014. These all resulted to a slowdown of average real GDP growth rate to 2.5 percent over 2011-2014 (ADB, 2015).

Table 1: GDP per capita (constant 2010 US$)

Country	1990	1995	2000	2005	2010	2015
Cambodia	n/a	342.159	426.906	610.983	782.693	1,020.91
Laos	463.158	546.701	670.46	843.89	1,138.53	1,531.22
Vietnam	446.228	606.931	787.654	1,035.92	1,333.58	1,684.87
Philippines	1,525.81	1,506.58	1,608.43	1,821.12	2,145.24	2,639.87
Indonesia	1,652.93	2,223.43	2,143.39	2,524.61	3,125.22	3,834.06
Thailand	**2,502.74**	**3,543.78**	**3,472.69**	**4,308.43**	**5,111.91**	**5,775.14**
Malaysia	4,491.77	6,205.55	6,939.23	7,941.57	9,069.03	10,878.39
Brunei Darussalam	37,430.89	37,982.66	36,215.42	36,653.25	34,852.02	32,226.10
Singapore	22,178.49	29,008.50	33,390.06	40,020.26	46,569.68	51,855.08

Source: World Bank, 2017

Over several decades, Thai economy was growing at a very satisfactory rate (Pholphirul, 2009). The average annual GDP growth rate between 1960 and 2014 was 6.2 percent (World Development Indicators, 2016). This is because of continuous transformation process from agriculture to manufacturing and industrial sectors in the economy. As shown in Table 2 the agriculture sector's share of GDP has decreased to 11.6 percent in 2012 from 36 percent in 1960, whereas the contribution of manufacturing and industry sectors has increased rapidly from 12.5 percent and 18.5 percent to 28.2 percent and 37.5 percent, respectively. This led to substantial improvements in the welfare of the Thai population. As Thailand's per capita GDP rose more than 9.6 times to US$ 3,664.7 at 2005 constant prices in 2012 and GDP rocketed to

US$ 246,139 million[3]. However, growth and structural transformation have also largely concentrated in and around Bangkok. The North, Northeast, and the South still lag behind Bangkok and the Central region[4] in economic growth and social development (ADB, 2015). Thailand has population of approximately 67.9 million in 2015 (World Bank, 2016).

Table 2: Overview of Thai Economy and Energy Use

	Unit	**1960**	**1980**	**2000**	**2012**
Population	Million	27.40	47.38	62.69	67.16
Annual GDP growth rate	Percent	5.30	5.17	4.45	7.32
GDP at market price (constant 2005)	Million US$	10,434	44,375	145,249	246,139
GDP per capita (constant 2005)	US$	380.85	936.48	2,316.82	3,664.74
GDP per capita, PPP (constant 2011)	US$	n/a	n/a	9,228.21	14,597.17
Agriculture, value added	% of GDP	36.44	23.24	8.50	11.57
Manufacturing, value added	% of GDP	12.54	21.51	28.59	28.16
Industry, value added	% of GDP	18.51	28.68	36.84	37.46
Energy use per capita	ktonne	n/a	464.32	1,152.98	1,884.30

Source: World Development Indicators, World Bank

In 2011, the World Bank has upgraded Thailand's income categorization from a lower-middle income economy to an upper-middle income economy as Thailand's GNI per capita is currently at US$ 4,210 (World Bank, 2011).

Public sector plays a crucial role in Thai economy as government spending accounted for 22 percent of GDP in 2015 (IMF, 2016); The share of government in Thai economy has been

[3] In 1960, Thailand's GDP was only US$ 10,434 million at 2005 constant prices and GDP per capita was US$ 380.85. At that time, Thai economy was mainly based on the agriculture sector which accounted for 36.44 percent of GDP while manufacturing and industry sectors contributed only 12.54 percent and 18.51 percent, respectively.

[4] Thailand is an upper middle-income country located in the middle of mainland Southeast Asia. The diversification of population, basic resources, location, and level of social and economic development divides Thailand into 77 provinces that are grouped into six geographical regions namely; the North Region, the Northeast Region, the Central Region, the East Region, the West Region and the South Region.

slowly rising since 2003 as presented in Figure 1. Fiscal policy, which includes both government spending and taxation, is one of the key instruments that the government uses in order to achieve stability and growth in the economy. The Thai Government derives revenue predominantly from taxes, the most important of which are; income tax, value added tax, excise tax, and import duties (Sujjapongse, 2005). The vulnerability in the world economy and economic potentials in Thailand motivated the Thai government to embark on an ambitious reform programs to raise its long-term growth and achieve high-income status (World Bank, 2016). However, these reform programs cannot take any actions if government decrease their expenditure. Government revenue is the main source of government spending and tax revenue is the most significant source of government's income. Therefore, the change in tax revenue will effect government spending and also the whole economy.

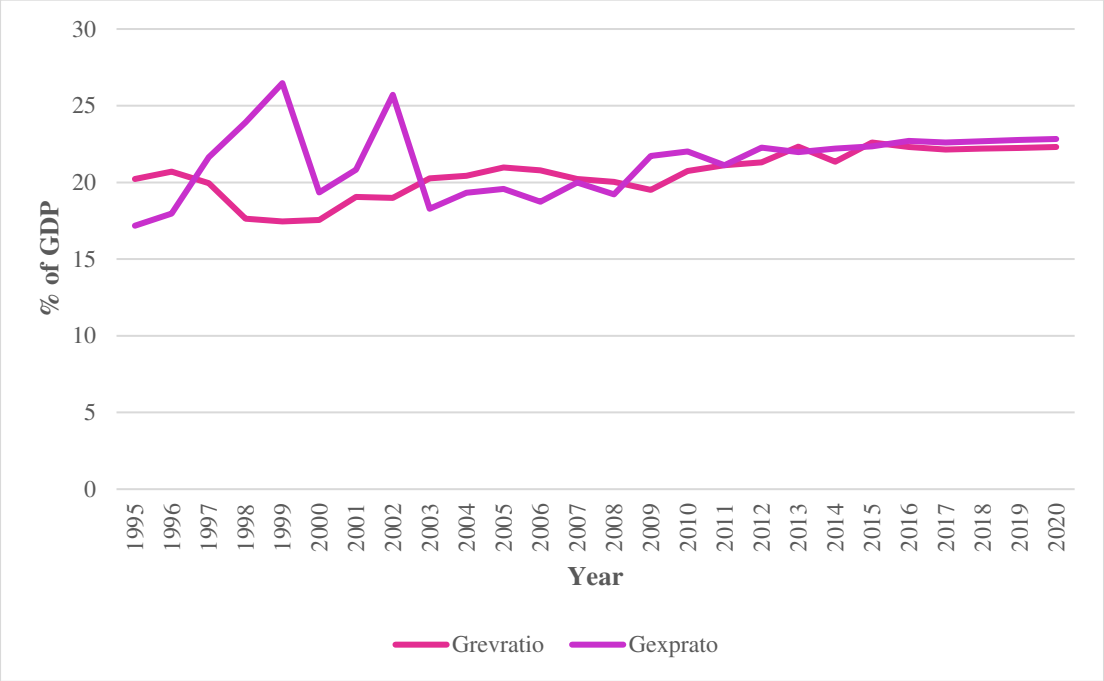

Figure 1: Share of Government in Thai Economy

Source: International Monetary Fund, WEO, 2016

Many of the previous empirical studies tried to examine the impact of tax reform on economy. For instance, Lee and Gordon (2005) employed cross-country data to examine how tax policies affect 70 countries' growth rate during 1970-1997. They found significant negative correlation between statutory corporate tax rates and cross-sectional differences in average economic growth rates. Furthermore, fixed effect regression method also confirmed that lower future

growth rates within countries resulted from rise in corporate tax rates. In addition, Onwuchekwa and Aruwa (2014) used OLS technique to explore the impact of value added tax (VAT) on Nigerian's economy. They concluded that VAT contributes significantly to the total government's tax revenue and by extension to the Nigerian's economic growth. Other existing papers that explain the association between taxes and economic growth include McNabb and LeMay-Boucher (2014), Arnold et al. (2011), Barrell and Weale (2009), and Blundell (2009). However, these works failed to analyse full impacts of taxation policy as they only applied partial equilibrium approaches. Therefore, a gap exists for a more comprehensive approach that can explain the interrelationships between all agents in the economy and effects of any tax policy changes.

Nonetheless, many researchers tried to fill this existing literature gap by applying general equilibrium theory to analyse the impacts of policies and other external shocks on all sectors of the economy. For example, Bhattarai (2007) used input-output table to construct multi-sectoral general equilibrium model to forecast behaviour of consumers and producers in the next hundred years for Hull and Humber Region. He found that tax distortions reduce the level of capital accumulation and welfare across households. Later work of Bhattarai (2011) showed how the insufficient growth rates of capital, caused by higher rate of energy and environmental taxes on use of labour and capital income can slow down the growth rates of output across all sectors and reduce the level of households' welfare. Bergman (1990) used CGE model to examine impacts of environmental constraints on Swedish economy. Amir et al. (2013) used the CGE model to show that in case of Indonesia, under a balanced budget assumption the reductions in personal income tax and corporate income tax increase economic growth. At the same time, these policies also lead to an increase in income inequality. Under non-balanced budget scenarios decrease in Indonesian CIT rate caused the reduction in output and increase in prices of coal, ore and oil mining, food beverages and tobacco, paper and construction sectors. In the case of Malaysia, Al-Amin et al (2008) used CGE model to analyse impacts of environmental taxation policies in the Malaysian economy.

For Thailand, there are some studies applying CGE models for policy analyses. Puttanapong et al. (2014) used CGE model to study impacts of carbon-tax policies on Thai economy. Winyuchakrit et al. (2011) developed CGE model to analyse the possibility for Thailand to become a low-carbon society (LCS) by using the 2005 input-output table and Socio-economic

data. Wianwiwat and Asafu-Adjaye (2013) used a static CGE model to investigate impacts of biofuel-promoting measures contained in the Thai government's 10-year alternative energy development plan. Addition, Field and Wongwatanasin (2007) applied a CGE model to assess the effects of alternative tax and transfer policies on output, trade flows and income distribution for specific industries and on the Thai economy as a whole. They concluded that in the early 1980s export subsidies created the largest effect on the quantity of intermediate output and capital goods industries. The subsidization of industrial institution loans stimulated the second largest effect on the output of intermediate and capital goods industries. While the output levels of secondary agricultural industries increased due to the reduction of the import protection policy, the outward-oriented industrial policy during the 1980s also raised income inequality though it slightly improved during 1981-1985.

Although those previous studies can explain some economy wide impacts of tax policies, we find no specific analysis on the impact of value added taxes (VAT) on Thai economy. This study aims to fill this gap in the literature. The main objective of this paper is to construct a computable general equilibrium (CGE) model of the Thai economy in order to assess the impacts of changes in fiscal policy especially tax policies on the economy. This model contributes to the existing studies as it takes account of the economy-wide income and substitution effects and consequent effects on growth of the Thai economy resulting from various tax reforms under consideration. The focus of this paper will remain in assessing the impacts of changes in the rates of VAT and corporate income tax on output, prices, welfare and sectoral allocation of capital and labour inputs in production. It is important as the VAT and corporate income tax are the first and second largest sources of government revenue in Thailand. Apparently, no systematic study exists assessing the impact of these taxes reforms in Thailand. More specifically, we will study the following questions:

(i) What are the impacts of changes in VAT rates?

(ii) What are the impacts of changes in corporate income tax rates?

(iii) Which tax policy is preferable?

The remainder of the paper is structured as follows; Section 2 presents the overview of taxation in Thailand. The model structure and highlights the structure of production and data description are in section 3. Analysis of model results are reported in Section 4, while Section 5 states the conclusion.

2. Overview of Taxation in Thailand

The Ministry of Finance is authorized to collect taxes through the Department of Revenue, the Department of Excise, and the Department of Customs. The Department of Revenue is in charge of collection of taxes based on income and domestic consumption as provided under the Revenue Code and related laws on personal income tax, corporate income tax, petroleum income tax, value added tax, stamp duties, bird's nest concession. Department of Excise collects tax on 11 types of domestic and import goods and services, namely, spirit, tobacco, playing cards, beverages, electrical lamps and air conditioners, crystal wares and glasses, petroleum products, passenger cars, yatchs and luxury boats, perfumes, and race courses. Lastly, Department of Customs is responsible for import and export tariff. Furthermore, other departments in other ministries are empowered to levy other related charges or fees. For example, the Department of Land collects registration fees on transfer of land ownership. Other revenue sources are profit remittances from the state enterprises, privatization, income of government properties, etc. Figure 2 shows that the biggest source of government revenue come from the Revenue Department which accounted for 49.09 percent and 64.66 percent of total revenue in 1992 and 2015, respectively.

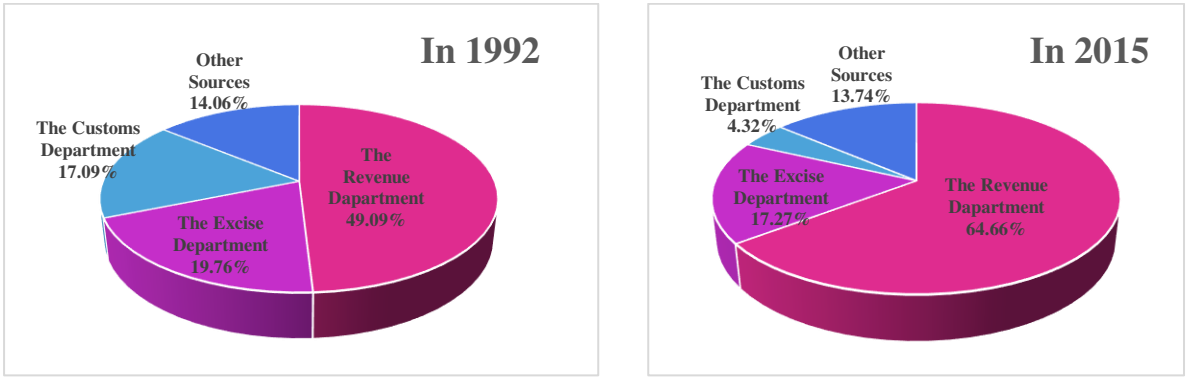

Figure 2: Composition of Government Revenues (in total). Fiscal year 1992 and 2015.

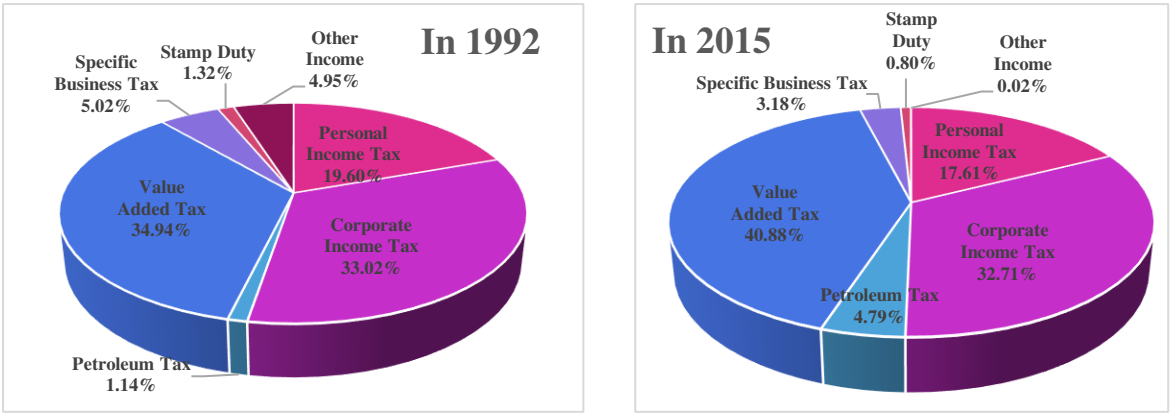

Figure 3: Composition of Revenues collected by the Revenue Department Fiscal year 1992 and 2015.

Figure 3 explains that the biggest source of tax revenue collected by the Revenue Department in 1992 and 2015 is value added tax which accounted for 34.94 percent and 40.88 percent, respectively. It was followed by corporate income tax, personal income tax, petroleum tax, specific business tax, stamp duty and other income. Sujjapongse (2005) stated that the value added tax (VAT) in Thailand was introduced on January 1, 1992 to replace the business tax. At that time, Thai economy was in a rapid growth phase led by a reform in its fiscal and financial sectors. Thai government applied VAT on the amount of the sale invoice at 10 percent. However, in 1997 there was a financial crisis in Thailand and Thai economy was in a weak situation. So Thai government reduced VAT from 10 percent to the current level of 7 percent since April 1, 1999 in order to stimulate the economy. It was a temporary measure that was expected to expire in 2 years, but the government decided to grant the extension until 30 September 2017. Recently, Tantivorawong, Finance Minister, (2017) cited in Bangkok Post (2017) announced that Thai cabinet decided to keep VAT at 7% for another year from Oct 1, 2017 to Sept 30, 2018 in order to maintain people's purchasing power and build public confidence in the Thai economic growth. Despite, the National Legislative Assembly's proposed the cabinet to raise VAT to 8% because the NLA claimed that increasing VAT by one percentage point can boost government revenue by up to 70 billion baht a year. This is consistent with the study of Sujjapongse (2005) who revealed that the increasing 1 percent in VAT leads to 0.95 percent reduction in GDP growth whereas results in 30 billion Baht in additional government revenue. Figure 4 depicts that VAT rate in Thailand which has the same rate as GST rate in Singapore but lower than the ASEAN average rate (10.20 percent).

Figure 4: Indirect Tax Rate by Country in 2016

Source: KPMG and Avalara VATLive, 2016

Furthermore, Figure 3 also showed that the second largest source of government revenue in Thailand is corporate income tax (CIT) which is a direct tax imposed on a juristic company or partnership carrying on business in Thailand or not carrying on business in Thailand but deriving certain types of income from Thailand. Before 2012, the corporate income tax rate in Thailand was 30 percent on net profit which was relatively high compared to those in ASEAN countries as shown in Table 3. In 2012 Thai government decreased CIT to 23 percent and 20 percent in 2013. The purpose of these reductions is to lower the cost of Thai firms to increase the competitiveness in the world market. Firstly the government expected to apply CIT at 20 percent until the end of 2015 and planned to employ 30 percent rate after that. However, Jatusripitak (2015) cited in Dailynews (2015) announced that Thai government decided to retain CIT at 20 percent rate on net profit as a permanent measurement. Although this policy will reduce the government revenue by Baht 179,000 million annually, it will not affect foreign investment and also benefit to Thai companies. Furthermore, the reduction of corporate income tax rate is consistent with other neighbouring countries' policy such as Malaysia (24 percent) and Vietnam (22 percent).

Table 3: Corporate Income Tax Rate by Country

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Brunei Darussalam									18.50
Cambodia		20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Indonesia	28.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Malaysia	25.00	25.00	25.00	25.00	25.00	25.00	24.00	24.00	24.00
Myanmar									25.00
Philippines	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Singapore	18.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
Thailand	**30.00**	**30.00**	**30.00**	**23.00**	**20.00**	**20.00**	**20.00**	**20.00**	**20.00**
Vietnam	25.00	25.00	25.00	25.00	25.00	22.00	22.00	22.00	22.00
China	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Japan	40.69	40.69	40.69	38.01	38.01	35.64	33.86	30.86	30.86
UK	28.00	28.00	26.00	24.00	23.00	21.00	20.00	20.00	19.00
ASEAN Avarage	26.00	24.57	24.57	23.57	23.14	22.71	22.57	22.57	22.39
Asia Average	25.73	23.96	23.10	22.89	22.05	21.91	21.78	21.46	21.40
EU Average	23.11	22.93	22.70	22.51	22.75	22.39	22.20	22.09	21.51
OECD Average	25.64	25.70	25.40	25.15	25.32	24.98	24.84	24.81	24.27
Global Average	25.38	24.69	24.50	24.40	24.09	23.88	23.52	23.47	24.26

Source: KPMG, 2017

*ASEAN average corporate income tax excluding Laos due to data limitation.

3. Model Structure

A general equilibrium model illustrates the interaction of supply, demand and prices in the whole economy. This theory explains the mechanism by which the choices of economic agents are coordinated across all markets.

The general equilibrium model in this study is builds on Bhattarai (2008). It makes some modifications to it to capture the characteristic of the Thai economy. This model includes a representative household, eighteen producers, a government sector and the rest of the world. A representative household supplies capital and labour in factor markets and acts as a consumer who aims to maximizing utility under a budget constraint. The production side is more decentralised in the model. The main purpose for each of these producers is to maximise profit (or minimise cost) conditional on competitive markets with the CES or Cobb-Douglas type production technologies; they produce under the constant return to scale conditions. While government in this model collects revenue from various taxes and uses that revenue to provide public services.

Structure of Production

In this model, as common with many CGE models, capital and labour inputs are used to generate value added. Then intermediate input is combined with value added by a Leontief production technology. In each tradable sector gross domestic supply is either sold in the domestic market or exported to the rest of the world according to a constant elasticity of transformation (CET) function. Total supply of goods in the economy is a constant elasticity of substitution (CES) composite of differentiated domestic and imported Armington commodities as shown in Figure 5.

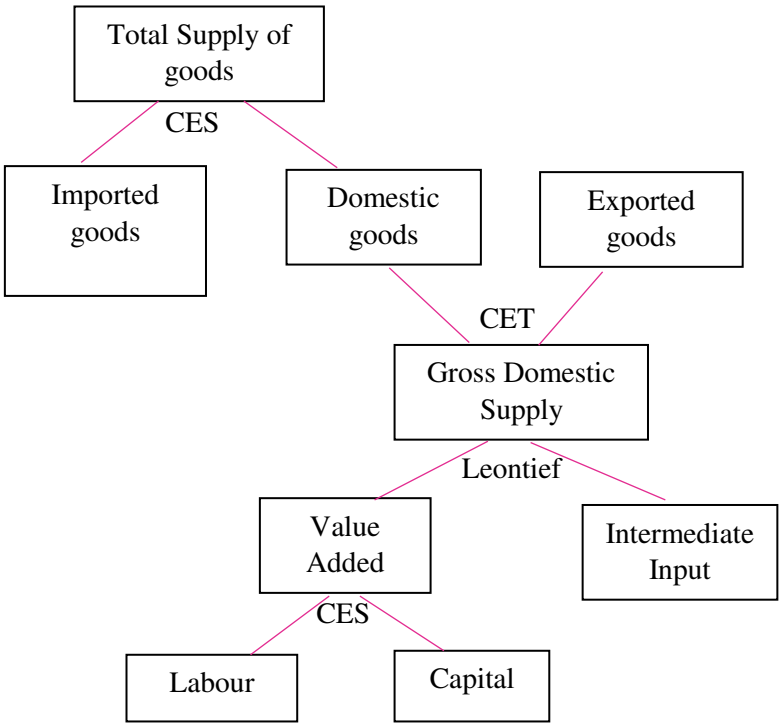

Figure 5: Structure of Production

Output

The aggregate supply of output in economy must be equal to the sum of the values of domestic products and imports and is given by a CES Armington function as:

$$A_i = \Omega_A \left[\delta_i^d \, D_i^{\sigma_A - 1/\sigma_A} + (1 - \delta_i^d) M_i^{\sigma_A - 1/\sigma_A} \right]^{\sigma_A / \sigma_A - 1} \quad \text{.....(1)}$$

Where for each i sector in economy, A_i is the CES aggregate supply composite of domestic output D_i and imported commodies M_i; δ_i^d is the share of domestic supplies for good i and σ_A is the elasticity of substitution between domestic goods and imports; and Ω_A is the shift parameter of the aggregate supply function.

Production

The aggregate production of output in the economy equals to the sum of the values of domestic products and exports commodities.

$$Y_i = \Omega_Y \left[(1 - \delta_i^e) D_i^{\sigma_y - 1 / \sigma_y} + \delta_i^e X_i^{\sigma_y - 1 / \sigma_y} \right]^{\sigma_y / \sigma_y - 1} \quad \text{.....(2)}$$

where Y_i is aggregate domestic production; D_i is domestic supplies; X_i is export products; δ_i^e is the share of export for good i and σ_y is the elasticity of substitution in domestic sales and exports from total production.

Demand

In this model, we assumed the utility of a representative household to be given by a CES function of composite consumption.

$$U = \sum_{i=1}^{N} \delta_i C_i^{\sigma_{ui} - 1 / \sigma_{ui}} \quad \text{.....(3)}$$

where U is the utility of household; C is the composite consumption; δ_i is the share of income that household spent on consumption which is equal to $\frac{C_i}{NI}$; σ_U is the elasticity parameter in the utility function, the elasticity of substitution between goods.

Household Income

Household in this model supplies capital and labour in factor market. Net income of household come from capital income and labour income:

$$NI = \sum_i ((1 - t_r) r K_i + (1 - t_w) w L_i) + TR \quad \text{.....(4)}$$

where NI is net income of household; K_i is capital and L_i is labour; r is rental or return on capital; w is wage rate and TR transfers to households.

Investment and Saving

Total investment is sum of investment in all sectors in the economy. Saving is the rest of net income after consumption:

$$TIV = \sum_i IV_i \quad \text{.....(5)}$$

$$S = NI - \sum_i P_i C_i \quad \text{.....(6)}$$

where TIV is total investment; IV_i is investment and S is saving

Government Revenues

Government receives the revenue from three tax sources that are income tax from labour, capital income (corporate income tax) and value added tax on consumption

$$GREV = \sum_i (t_w w L_i) + \sum_i (t_r r K_i) + \sum_i (t_v C_i) \quad \text{.....(7)}$$

where $GREV$ is total government revenue; w is wage rate and r is capital income; C_i is consumption composite; Tax rate on labour income and capital income are t_w and t_r, respectively. t_v is value added tax on final product and i is the sector in economy.

Budget Balance

In this model, government has a balanced budget, which is the difference between revenue and spending of the government:

$$BBAL = GREV - \sum_i GOV_i \quad \text{.....(8)}$$

where $BBAL$ is a budget balance; $GREV$ is total government revenue and GOV_i is government spending in i sector.

Resource Balance

$$RE = S - TIV + BBAL \quad \text{.....(9)}$$

where RE is resource balance.

International Trade

This model has a small open economy structure for Thailand. It assumes a competitive global economy where Thailand exports goods produced at home and imports commodities from the rest of the world. Therefore, the net export of the country is the difference between volume of exports and imports. The summation of the net export generates trade deficit.

$$NX_i = P_i X_i - P_i M_i \quad \text{.....(10)}$$

$$SNX = \sum_i NX_i \quad \text{.....(11)}$$

where NX_i is net export; $P_i X_i$ is value of export; $P_i M_i$ is value of import and SNX is total trade deficit

Description of Data

This model uses the Thai Input-Output Table 2010 to construct a micro-consistent data for Thailand as given in Appendix A. These were used for calibration of parameters of the model. Then the general algebraic modelling system (GAMS) was used to compute the model.

The advantage of an input-output table is that it represents a snapshot of the economy at one point in time. Then with calibrated parameters Thai CGE model can be used to evaluate the changes in economy or to assess the impacts of policy such as Bergman (1990), Semboja (1994), Bhattarai (2007, 2016, 2017), and Ruamsuke et al. (2015). While input-output tables have two main assumptions, fixed technical coefficients and fixed input proportions, CGE model accommodates more behavioural analysis. Although, the IO table can be used to conduct the backward and forward linkages in the economy to explain current situation and to predict short term of the economy, CGE model based results show outcome of optimisations by households and firms given their resource constraints.

The eighteen sectors input-output model and the Leontief technology for Thailand in this study was constructed following Hull economy model in Bhattarai (2007) and Liu et al. (2012) model of the Chinese economy. This paper used the latest economic data from the 180 sectors input-output table of year 2010 obtained from the Office of the National Economics and Social Development Board (NESDB). For Thai economy in this paper the production is aggregated across 18 sectors distinguishing clearly the energy sector as shown in Table 4.

The data was not perfect as some of the account were not balanced. We modified on labour and capital in each sector adding 300 and 200, respectively to avoid a situation where tax rates could exceed 100 percent. That modification was enough to remove the imbalance in demand and supply and to reach into the optimal solutions of the model.

Table 4: Sectors Classification of Thai Economy

Group Code	Group	I-O Code
1	Agriculture	001-029
2	Mining and Quarrying	032-041
3	Food Manufacturing	042-066
4	Textile Industry	067-074
5	Saw Mills and Wood Products	078-080
6	Paper Industries and Printing	081-083
7	Rubber and Chemical Industries	084-092, 095-098
8	Non-metallic Products	099-104
9	Metal, Metal Products and Machinery	105-128
10	Other Manufacturing and Unclassified	075-077, 129-134, 137 and 180
11	Construction	138-144
12	Trade and services	145-148, 160-178
13	Transportation and Communication	149-159
14	Coal and lignite	030
15	Petroleum and Natural Gas	031
16	Petroleum Refineries	093
17	Other Petroleum Product	094
18	Electricity	135

Table 5 depicts the benchmark dataset for this study. Labour and capital mostly use in trade and services sector which accounted for 24.20% and 29.09% of total labour and capital, respectively. Follow by agriculture sector; metal, metal products and machinery; transportation and communication and food manufacturing sector. For energy sectors, labour accounted highest share in electricity sector, while petroleum and natural gas was capital intensive. At the same time, coal sector used least labour and capital. In this benchmark case, VAT equals to 7 percent.

Table 5: Benchmark dataset by sectors

	Factor inputs		Capital Tax revenues		Tax Rates			
	Labour	**Capital**	**Ktax**	**Import**	**K_tax**	**Ltax**	**VAT**	**Output**
Agric	610.363	957.903	-493.029	605.348	-0.468	-0.017	0.070	1787.359
Mining	310.887	224.329	11.758	220.231	0.070	0.004	0.070	301.623
FoodManu	444.956	488.742	-36.499	410.086	0.034	0.113	0.070	2381.237
Textile	373.989	302.877	-28.446	149.343	0.017	0.032	0.070	771.757
SawMill	325.655	236.599	9.211	18.301	0.076	0.009	0.070	199.232
Paper	321.402	239.188	-44.470	124.547	-0.142	0.012	0.070	256.167
Rubber	421.392	403.069	-41.723	457.122	0.047	0.057	0.070	1578.832
NonMetal	333.343	257.593	-2.921	51.127	0.078	0.019	0.070	399.582
Metal	591.218	764.760	-605.041	2834.137	-0.551	0.241	0.070	5875.675
OthManu	412.092	336.224	62.147	324.392	0.348	0.053	0.070	1323.773
Const	367.580	286.724	30.118	150.000	0.257	0.027	0.070	915.144
Trade	2153.481	2543.785	-1948.928	1977.208	-0.496	0.154	0.070	7433.842
Trans	520.995	454.953	-158.388	65.532	0.270	0.060	0.070	1681.562
Coal	302.722	207.705	-2.987	3.151	-0.012	0.001	0.070	17.421
Petro	377.390	321.559	-163.313	-61.434	-0.249	0.127	0.070	560.217
PetroRefin	312.124	225.043	7.209	1028.813	0.099	0.017	0.070	1210.326
OthPetro	312.122	222.240	-7.738	50.264	-0.005	0.020	0.070	115.311
Electri	406.382	290.878	7.097	139.584	0.302	0.027	0.070	705.733

The 18 sectors Input-Output Coefficient Table of Thailand in Table 6 explains details about forward and backward linkages between the model sectors in Thai economy. For instance activities in the agriculture sector will have strong forward (34.5%) and backward linkages 8.2%) to food manufacturing sector and agriculture sector, respectively. As the agriculture sector supplies raw materials, such as beans and nuts, vegetables and fruits, cassava, meat, seafood for the food manufacturing industry. On the other hand, the agriculture sector itself uses inputs from agriculture industry for example to feed animals.

For energy sector, petroleum and natural gas sector has strong backward and forward linkage (38.2%) to itself. Whilst, petroleum refineries industry has strong backward (7.3%) and forward linkage (19.6%) to petroleum and natural gas production and transportation and communication sectors, respectively.

Table 6: A 18 Sectors Input-Output Coefficient Table of Thailand, 2012

	Agric	Mining	Food Manu	Textile	Saw Mill	Paper	Rubber	Non Metal	Metal	Oth Manu	Const	Trade	Trans	Coal	Petro	Petro Refin	Oth Petro	Electri
Agric	0.082	0.002	0.345	0.005	0.093	0.015	0.087	0.002	0.000	0.009	0.005	0.014	0.001	0.000	0.000	0.000	0.000	0.001
Mining	0.000	0.001	0.001	0.000	0.000	0.000	0.003	0.122	0.002	0.014	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000
FoodManu	0.057	0.000	0.113	0.001	0.001	0.008	0.007	0.003	0.000	0.021	0.000	0.025	0.003	0.000	0.000	0.000	0.001	0.002
Textile	0.001	0.001	0.001	0.261	0.004	0.001	0.006	0.002	0.001	0.016	0.001	0.004	0.002	0.000	0.000	0.000	0.000	0.000
SawMill	0.001	0.003	0.000	0.000	0.078	0.001	0.001	0.001	0.002	0.003	0.017	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Paper	0.000	0.001	0.003	0.004	0.007	0.079	0.004	0.005	0.003	0.007	0.001	0.013	0.003	0.001	0.000	0.000	0.000	0.001
Rubber	0.033	0.029	0.008	0.067	0.055	0.032	0.127	0.023	0.028	0.035	0.012	0.018	0.013	0.000	0.001	0.000	0.010	0.000
NonMetal	0.001	0.000	0.004	0.000	0.003	0.000	0.001	0.106	0.005	0.007	0.194	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Metal	0.015	0.126	0.009	0.008	0.022	0.015	0.011	0.030	0.206	0.032	0.071	0.014	0.091	0.026	0.013	0.001	0.002	0.012
OthManu	0.002	0.003	0.007	0.020	0.012	0.011	0.006	0.013	0.006	0.120	0.002	0.012	0.005	0.001	0.004	0.000	0.001	0.002
Const	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.000	0.000	0.001
Trade	0.082	0.069	0.079	0.106	0.149	0.168	0.114	0.110	0.118	0.139	0.126	0.119	0.119	0.027	0.108	0.010	0.047	0.067
Trans	0.012	0.054	0.019	0.017	0.032	0.031	0.027	0.043	0.017	0.032	0.080	0.031	0.122	0.172	0.006	0.003	0.004	0.009
Coal	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Petro	0.000	0.005	0.001	0.001	0.000	0.001	0.014	0.013	0.001	0.002	0.000	0.002	0.001	0.000	0.382	0.073	0.000	0.190
PetroRefin	0.027	0.060	0.007	0.010	0.005	0.007	0.035	0.038	0.008	0.005	0.011	0.011	0.196	0.109	0.046	0.005	0.031	0.075
OthPetro	0.003	0.023	0.000	0.001	0.001	0.001	0.002	0.005	0.003	0.001	0.006	0.001	0.018	0.000	0.007	0.000	0.122	0.000
Electri	0.003	0.026	0.020	0.053	0.027	0.021	0.030	0.060	0.018	0.019	0.007	0.028	0.014	0.009	0.008	0.003	0.003	0.022

Table 7: Demand composition of domestic output in intermediate and final demands for 2010

	Composition of total demand		Composition of final demands			
	Intermediate demand	Final demand	Consumption	Government expenditure	Investment	Export
Agric	0.70296	0.29704	0.64814	0.00781	0.05493	0.28912
Mining	1.17791	-0.17791	0.00000	0.00000	1.33798	-0.33798
FoodManu	0.25543	0.74457	0.49585	0.00632	0.07102	0.42682
Textile	0.35787	0.64213	0.40244	0.00603	-0.01827	0.60981
SawMill	0.29670	0.70330	0.29442	0.03212	0.33603	0.33743
Paper	0.66480	0.33520	0.19505	0.29438	-0.11430	0.62486
Rubber	0.46583	0.53417	0.11862	0.00862	-0.11661	0.98937
NonMetal	0.68055	0.31945	0.11585	0.01301	0.40815	0.46299
Metal	0.28897	0.71103	0.07230	0.01259	0.26284	0.65227
OthManu	0.26705	0.73295	0.28913	0.04279	0.06606	0.60203
Const	0.04373	0.95627	0.00992	0.00949	0.98058	0.00000
Trade	0.39486	0.60514	0.44225	0.31696	0.05172	0.18907
Trans	0.49486	0.50514	0.42434	0.04410	0.03608	0.49549
Coal	0.27130	0.72870	0.00000	0.00000	0.96730	0.03270
Petro	0.63072	0.36928	0.26851	0.00980	0.51343	0.20826
PetroRefin	0.59999	0.40001	0.32161	0.07503	0.08878	0.51458
OthPetro	0.79261	0.20739	0.54785	0.17893	-1.12841	1.40163
Electri	0.80845	0.19155	0.76477	0.20103	0.00000	0.03420
Total	0.41207	0.58793	0.30071	0.10463	0.15351	0.44115

The data in Table 7 explain the composition of demand for 18 sectors of final demand for domestic output. It indicated that total intermediate demand accounts for 41 percent of total output, whereas the residual 59 percent is sold to final users. The composition of final demand shows that 44 percent of final sales is exported abroad, while domestic consumption account for nearly 30 percent. The investment demand take about 15 percent of final demand and leaving 11 percent to fulfil government expenditure.

In addition, Table 7 clarify that demand structure varies significantly across sectors. Intermediate demand is the most important component of mining and quarrying (117%); electricity (80.84%); other petroleum product (79.26%) and agriculture (70.23%) sectors. Final demand is greater in construction (95.63%); food manufacturing (74.46%); and other manufacturing and unclassified (73.29%).

In the general equilibrium model, the elasticity parameters, which represent the flexibility of markets, play very crucial role in determining the model results. Its influences the magnitude of welfare changes and the marginal excess burden of taxes across model scenarios. Table 8 shows the values of elasticity used in this study based on values generally accepted in the literature.

Table 8: Elasticity parameters of the Model

Parameters	**Values**
Elasticity of substitution between labour and capital (σ_{LK})	2
Armington Elasticity (σ_A)	2
Elasticity of Utility (σ_U)	2
Elasticity of Capital (σ_K)	2

In addition to information on benchmark dataset and elasticity parameters, this model also adjust quantities such that the benchmark price is 1 for goods and also for labour and capital inputs.

4. Analysis of Model Results

As aforementioned, the main objective in this paper is to evaluate the impacts of reform in the overall and sectoral tax structure in the Thai economy. At macro level we focus on the VAT reforms and corporate income tax change. While, the sectoral level we focus on variation in the taxes in the energy sector.

We consider six scenarios in this study:

Case 1: Baseline case when VAT is 7 percent.

Case 2: Increase in VAT from 7 to 10 percent and change in capital tax rate in food manufacturing and petroleum refineries sectors to 10 percent.

Case 3: Decease in VAT to 0 percent and setting capital tax rate in petroleum refineries to 0 percent.

Case 4: Baseline case when CIT is 30 percent

Case 5: Decrease in CIT from 30 to 23 percent

Case 6: Decrease in CIT from 30 to 20 percent

The simulation result in the benchmark case when the value added tax is equal to 7 percent are in Table 9. Trade and services is a predominant sector with the highest share in labour, capital, output, and supply. Mining and quarrying sector has the smallest share in labour, capital, output, and supply. Consequently, output in this sector has the highest price.

For energy sectors, electricity sector has the highest share in labour and output while coal and lignite sector has the smallest share in labour, capital, output, and supply. In term of price, petroleum refineries sector has the highest price and followed by electricity sector.

Table 9: Macroeconomic impacts of 7 percent VAT: benchmark economy

	Labour	Capital	Output	Supply	Price	Rental
Agric	832.958	1194.195	2016.593	2809.816	1.0230	1.012
Mining	4.893	3.225	8.506	11.839	1.0250	1.012
FoodManu	794.386	797.100	2832.77	3530.874	0.9810	1.012
Textile	345.396	255.531	717.049	849.52	0.9600	1.012
SawMill	111.876	74.253	208.313	214.359	0.9820	1.012
Paper	120.736	82.082	208.272	253.46	1.0020	1.012
Rubber	355.51	310.645	615.646	984.422	0.9500	1.012
NonMetal	120.419	85.008	271.669	289.404	0.9910	1.012
Metal	660.635	780.653	728.993	3793.855	1.0000	1.012
OthManu	471.413	351.363	975.449	1329.548	0.9590	1.012
Const	255.972	182.399	836.083	936.015	1.0080	1.012
Trade	3206.943	3460.585	6877.737	9725.767	1.0140	1.012
Trans	638.764	509.557	1946.45	2023.103	0.9770	1.012
Coal	10.244	6.421	16.763	16.865	0.9860	1.012
Petro	298.056	231.999	786.201	739.341	0.9700	1.012
PetroRefin	274.608	180.872	361.217	1231.335	1.0640	1.012
OthPetro	53.481	34.787	86.736	95.035	0.9910	1.012
Electri	341.802	223.496	846.446	958.893	1.0070	1.012

The increasing VAT from 7 percent to 10 percent leads to a significant changes in all macroeconomic variables. This raises employment, capital, output, supply and price in mining and quarrying; paper industries and printing; trade and services and construction sector. Whereas, the prices decrease in textile industry sector; rubber and chemical industries sector; other manufacturing and unclassified sector and transportation and communication sector as shown in Table 10.

For energy sectors, employment, capital, output, and supply decline in coal and lignite sectors with same magnitude of petroleum and natural gas sectors. In addition, price in petroleum and natural gas sector decrease more than price in coal and lignite sector.

We also observe the same amount of decrease by 0.0163 percent in output and supply value in petroleum refineries sector that has biggest influence from VAT policy. In addition, there is a decrease in labour and capital by 0.0169 and 0.0155 percent, respectively. For electricity sector, even though there is moderate decreases in output and supply, there is substitution effect from labour to capital. Consequently, the prices of petroleum refineries sector and electricity sector increase by 0.0291 and 0.0050 percent, respectively.

Other petroleum product sector is the only energy sector where the labour, capital, output and supply increases from the change in VAT policy with decline in price by 0.0020 percent.

Rental rates decrease by 0.0040 percent in all sectors as VAT raises the cost of production in them consistent to assumption that the price of capital are the same in all sectors of the economy.

From these results, we can conclude that the increase in VAT from 7 to 10 percent leads to an increase in price and decrease in output in agriculture and food manufacturing sectors, which are necessary products for every economic agents. Similarly, the cost of petroleum refineries and electricity sector increase leading to a decline in output of these sectors. These are intuitive.

Table 10: Percentage Change in Macroeconomic Variables of increasing in VAT from 7 to 10 percent

	Labour	Capital	Output	Supply	Price	Rental
Agric	-0.0334	-0.0320	-0.0328	-0.0328	0.0117	-0.0040
Mining	0.0241	0.0257	0.0249	0.0249	0.0127	-0.0040
FoodManu	-0.0338	-0.0324	-0.0344	-0.0344	0.0102	-0.0040
Textile	0.0122	0.0137	0.0129	0.0129	-0.0177	-0.0040
SawMill	-0.0010	0.0004	-0.0004	-0.0004	-0.0061	-0.0040
Paper	0.0253	0.0268	0.0259	0.0259	0.0030	-0.0040
Rubber	0.0102	0.0117	0.0109	0.0109	-0.0232	-0.0040
NonMetal	-0.0026	-0.0012	-0.0020	-0.0020	-0.0020	-0.0040
Metal	-0.0042	-0.0027	-0.0037	-0.0037	0.0030	-0.0040
OthManu	0.0187	0.0202	0.0195	0.0195	-0.0188	-0.0040
Const	0.0010	0.0025	0.0017	0.0017	0.0050	-0.0040
Trade	0.0128	0.0143	0.0134	0.0134	0.0089	-0.0040
Trans	0.0034	0.0049	0.0042	0.0042	-0.0102	-0.0040
Coal	-0.0019	-0.0003	-0.0013	-0.0012	-0.0030	-0.0040
Petro	-0.0018	-0.0003	-0.0013	-0.0013	-0.0113	-0.0040
PetroRefin	-0.0169	-0.0155	-0.0163	-0.0163	0.0291	-0.0040
OthPetro	0.0025	0.0040	0.0031	0.0031	-0.0020	-0.0040
Electri	-0.0012	0.0003	-0.0005	-0.0005	0.0050	-0.0040

There are significant changes in many sectors when VAT rate is set to 0 percent from 7 percent in the benchmark. Especially, there are increases in employment, investment, output and supply in most sectors except in paper industries and printing sector; other manufacturing and unclassified sector; construction sector and trade and services sector. For energy sectors, petroleum refineries sector has the biggest increases, followed by petroleum and natural gas sector; other petroleum product sector; electricity sector and coal and lignite sector as shown in Table 11.

Furthermore, the decrease in VAT leads to declining in price of many sectors. For instance, the decrease in price of agriculture sector by 0.0147 percent; mining and quarrying sector by 0.0166 percent. The remarkable decreases in price happen in petroleum refineries sector by 0.0517 percent. On the contrary, the highest increase in price occur in food manufacturing sector.

Lastly, we find that rental rate in this case increase by 0.0059 percent in all sectors as we assumed the price of capital in this study equals in all sectors.

Table 11: Percentage Change in Macroeconomic Variables of Eliminating VAT from 7 to 0 percent

	Labour	Capital	Output	Supply	Price	Rental
Agric	0.0369	0.0369	0.0369	0.0369	-0.0147	0.0059
Mining	0.0157	0.0158	0.0156	0.0157	-0.0166	0.0059
FoodManu	0.0087	0.0087	0.0073	0.0073	0.0296	0.0059
Textile	0.0191	0.0191	0.0191	0.0191	0.0219	0.0059
SawMill	0.0190	0.0190	0.0190	0.0190	0.0092	0.0059
Paper	-0.0505	-0.0505	-0.0505	-0.0505	-0.0040	0.0059
Rubber	0.0020	0.0020	0.0020	0.0020	0.0284	0.0059
NonMetal	0.0069	0.0069	0.0069	0.0069	0.0030	0.0059
Metal	0.0154	0.0154	0.0154	0.0154	-0.0030	0.0059
OthManu	-0.0053	-0.0053	-0.0053	-0.0053	0.0250	0.0059
Const	-0.0031	-0.0031	-0.0031	-0.0031	-0.0060	0.0059
Trade	-0.0252	-0.0252	-0.0252	-0.0252	-0.0108	0.0059
Trans	0.0160	0.0160	0.0160	0.0160	0.0102	0.0059
Coal	0.0024	0.0025	0.0024	0.0025	0.0051	0.0059
Petro	0.0200	0.0200	0.0200	0.0200	0.0134	0.0059
PetroRefin	0.0472	0.0472	0.0494	0.0494	-0.0517	0.0059
OthPetro	0.0130	0.0130	0.0130	0.0130	0.0030	0.0059
Electri	0.0065	0.0065	0.0065	0.0065	-0.0060	0.0059

The finding in Table 12 presents the simulation result in the benchmark case when the corporate income tax equal to 30 percent, trade and services sector has the highest share in labour, capital, output, and supply while mining and quarrying sector has the smallest share. For energy sectors, electricity sector has the highest share in labour, capital, and output while coal and lignite sector has the smallest share in labour, capital, output, and supply.

Table 12: Macroeconomic impacts of 30 percent corporate income tax: benchmark economy

	Labour	Capital	Output	Supply	Price	Rental
Agric	721.6660	1035.5620	1747.1770	2434.4260	1.0780	1.0040
Mining	4.8120	3.1750	8.3690	11.6490	1.0830	1.0040
FoodManu	694.3900	697.3850	2483.2840	3095.2610	0.9980	1.0040
Textile	323.4370	239.4990	672.1870	796.3700	0.9350	1.0040
SawMill	108.4200	72.0230	201.9960	207.8580	0.9760	1.0040
Paper	142.3110	96.8360	245.6340	298.9290	1.0330	1.0040
Rubber	351.5690	307.4750	609.8480	975.1510	0.9180	1.0040
NonMetal	118.7490	83.9030	268.1150	285.6180	1.0050	1.0040
Metal	665.1400	786.6790	737.3770	3657.3370	1.1020	1.0040
OthManu	468.6370	349.6050	971.2590	1323.8380	0.9400	1.0040
Const	258.7960	184.5760	846.1830	947.3220	1.0530	1.0040
Trade	3490.9800	3770.4540	7511.230	10621.5900	1.1150	1.0040
Trans	609.9730	487.0240	1861.9860	1935.3130	0.9880	1.0040
Coal	10.2210	6.4120	16.7320	16.8340	0.9810	1.0040
Petro	277.0520	215.8430	732.870	689.1890	1.0170	1.0040
PetroRefin	257.2740	169.6060	338.670	1154.4780	1.1930	1.0040
OthPetro	53.0340	34.5270	86.0800	94.3160	1.0030	1.0040
Electri	341.6340	223.5860	846.8820	959.3860	1.0540	1.0040

The decreasing in corporate income tax rate from 30 to 23 percent reduces the employment, capital, output and supply in paper industries and printing; metal, metal products and machinery; construction and trade and services sectors also in coal and lignite sectors. At the same time, price rise significantly in food manufacturing sector also labour, capital, output and supple increase as shown in Table 13.

For energy sector, this policy stimulates the production and employment in every energy sectors except coal and lignite sector. The highest increase in employment, capital, output and supply occur in petroleum and natural gas industry and follow by other petroleum product sector; petroleum refineries sector and electricity sector, respectively. However, only the prices in petroleum and natural gas industry and petroleum refineries sector increase slightly.

Table 13: Percentage Change in Macroeconomic Variables of decreasing in corporate income tax from 30 to 23 percent

	Labour	Capital	Output	Supply	Price	Rental
Agric	0.0251	0.0266	0.0258	0.0258	0.0009	0.0000
Mining	0.0326	0.0340	0.0333	0.0333	0.0009	0.0000
FoodManu	0.0165	0.0179	0.0158	0.0158	0.0190	0.0000
Textile	0.0498	0.0513	0.0505	0.0505	0.0000	0.0000
SawMill	0.0225	0.0240	0.0231	0.0231	0.0000	0.0000
Paper	-0.0274	-0.0260	-0.0269	-0.0269	0.0010	0.0000
Rubber	0.0159	0.0173	0.0166	0.0166	0.0011	0.0000
NonMetal	0.0041	0.0055	0.0047	0.0047	0.0000	0.0000
Metal	-0.0182	-0.0168	-0.0178	0.0000	0.0000	0.0000
OthManu	0.0258	0.0272	0.0265	0.0265	0.0011	0.0000
Const	-0.0027	-0.0013	-0.0021	-0.0021	0.0009	0.0000
Trade	-0.0203	-0.0189	-0.0198	-0.0198	0.0009	0.0000
Trans	0.0207	0.0222	0.0215	0.0215	0.0010	0.0000
Coal	-0.0022	-0.0008	-0.0017	-0.0016	0.0000	0.0000
Petro	0.0166	0.0180	0.0171	0.0171	0.0010	0.0000
PetroRefin	0.0106	0.0120	0.0112	0.0112	0.0008	0.0000
OthPetro	0.0131	0.0145	0.0136	0.0136	0.0000	0.0000
Electri	0.0014	0.0028	0.0020	0.0020	0.0000	0.0000

The findings of reducing the corporate income tax rate from 30 to 20 percent show similar results as applied corporate income tax rate at 23 percent. However, the magnitude of changes in every sectors are different. For instance output in food manufacturing sector increases by 0.0158 percent when the CIT is 23 percent and increase to 0.0345 percent when CIT is 20 percent. Furthermore, the remarkable change happens in metal, metal products and machinery industry as supply and price of this sector decreases after CIT rate change to 20 percent compared to benchmark case. In addition, this policy also decrease the price in transportation and communication sector; petroleum refineries sector and electricity sector as illustrated in Table 14.

The finding of reducing corporate income tax rate in this study is consistent with Amir et al. (2013), who indicated that under non-balanced budget decreasing in Indonesian CIT rate caused the reduction in output and increasing in prices of paper and construction sectors. At

the same time, our results are contradictory with their results in case of balanced budget's analysis which disclose all outputs increase whereas all prices decrease.

Table 14: Percentage Change in Macroeconomic Variables of decreasing in corporate income tax from 30 to 20 percent

	Labour	Capital	Output	Supply	Price	Rental
Agric	0.0426	0.0446	0.0435	0.0435	0.0000	0.0000
Mining	0.0424	0.0444	0.0434	0.0434	0.0000	0.0000
FoodManu	0.0349	0.0369	0.0345	0.0345	0.0180	0.0000
Textile	0.0707	0.0728	0.0716	0.0716	0.0000	0.0000
SawMill	0.0312	0.0332	0.0320	0.0320	0.0000	0.0000
Paper	-0.0430	-0.0411	-0.0423	-0.0423	0.0010	0.0000
Rubber	0.0225	0.0245	0.0234	0.0234	0.0000	0.0000
NonMetal	0.0058	0.0077	0.0066	0.0066	0.0000	0.0000
Metal	-0.0290	-0.0271	-0.0284	-0.0013	-0.0009	0.0000
OthManu	0.0358	0.0378	0.0368	0.0368	0.0000	0.0000
Const	-0.0042	-0.0023	-0.0033	-0.0033	0.0000	0.0000
Trade	-0.0324	-0.0305	-0.0318	-0.0318	0.0000	0.0000
Trans	0.0322	0.0343	0.0332	0.0332	-0.0030	0.0000
Coal	-0.0032	-0.0012	-0.0025	-0.0025	0.0000	0.0000
Petro	0.0246	0.0266	0.0253	0.0253	0.0000	0.0000
PetroRefin	0.0198	0.0217	0.0227	0.0227	-0.0134	0.0000
OthPetro	0.0180	0.0200	0.0188	0.0188	0.0000	0.0000
Electri	0.0010	0.0029	0.0019	0.0019	-0.0009	0.0000

In addition, the computable general equilibrium model can explain the change in utility level of households and public welfare as shown in Table 15. An increase in VAT reduces household's utility by 0.031 percent meanwhile increases in public welfare by 0.427 percent. If these welfare are weighted by the respective sizes of private and public sectors at 0.78 and 0.22 percent. Thus, the net welfare in this case equals to 0.069 percent.

On the other hand, the removing of VAT accelerate household's utility by 0.068 percent but deducts public welfare by 0.923 percent. Consequently, net loss to the social 0.15 percent. Therefore, aggregate changes in welfare net effect of 10 percent VAT are better than zero percent VAT becuase utility from the public services for the households more than compensates their loss of utility due to higher taxes. Therefore, increasing VAT from 7 to 10 percent becomes desirable policy action on the basis of economy wide welfare analysis.

The welfare impact of change in corporate income tax rate indicates that a decreasing in corporate income tax from 30 to 23 percent lead to increasing in household's utility by 0.052 percent. In contrast, this policy decreases public welfare by 0.133 percent. In addition, the permanent corporate income tax rate at 20 percent rises household's utility level by 0.080 percent but lessen public welfare by 0.203 percent, compare to benchmark case. Although the reduction of corporate income tax rate increase household's welfare in both cases but the magnitude of changes are less than the decreasing in public welfare. Therefore, the increasing of private's utility cannot compensates the loss of public welfare due to lower corporate income tax rate. Despite, if these welfare are weighted by the respective size of private and public sectors at 0.78 and 0.22 percent. The net gain of 20% CIT rate is slightly higher than 23% CIT rate. As a result, , decreasing CIT from 30 to 20 percent is preferable policy tool as the overall change in welfare net effect of 20 percent corporate income tax are better than 23 percent corporate income tax.

Table 15: Welfare Analysis: Utility from Private and Public Goods and Net-Gains[5]

	Utility from private goods	Change in Utility (%)	Utility from Public goods	Change in Public Welfare (%)	Net gain
VAT 7%	2.734		0.562		
VAT 10%	2.648	-0.031	0.802	0.427	0.069
VAT 0%	2.920	0.068	0.043	-0.923	-0.150
Corporate tax 30%	4.999		2.204		
Corporate tax 23%	5.261	0.052	1.910	-0.133	0.012
Corporate tax 20%	5.400	0.080	1.757	-0.203	0.018

We note that while above results based on our CGE model of the Thai economy are robust within model structure but they are influenced by the structure of the model. On one hand,

[5] In 2010, government expenditure accounted for 22.02% of GDP. So government weight is 0.22 while private weight is 0.78. Net gain = 0.78(-0.031) + 0.22(0.802) = 0.069.

these results coming from the comparative static analysis can at best be said that they represent a steady state behavior of the model economy. Full impact analysis requires a full scale dynamic model. Another point is that while this model has heterogeneity of firms but we still are working with the representative household. As public policy like this is likely to have different impacts on different households, this model should have multiplicity of households. We are doing further works to relaxing both of these assumptions for analysis of growth and equity. Despite this current efficiency analysis in itself is a unique contribution to the current literature on impacts of VAT and corporate income tax in the Thai economy.

5. Conclusion

An attempt has been made here to construct a CGE model of the Thai economy to evaluate the economy wide impacts of changes in VAT and corporate income tax rate on labour and capital inputs, on output and supply as well as on prices and rental rate across sectors and on the levels of household's utility and public welfare. The models is based on micro-consistent data contained in the Input-Output Table published in 2010 by the Office of National Economics and Social Development Board (NESD) with some restructuring into 18 sectors.

Results reveals that an increase in VAT from 7 to 10 percent generates an increase in public welfare with a decrease in household's utility from the consumption of private goods. This result occurs because higher VAT raises prices and lowers outputs in many sectors especially in agriculture and food manufacturing sectors, which are necessary products for every economic agents. Similarly, the increasing in cost of petroleum refineries and electricity sector lead to a decline in output of these sectors. At the same time, this policy has favorable effect to some sectors that cause a rise in both outputs and prices including mining and quarrying; paper industries and printing; trade and services sector and construction sector. For energy sectors, output only increases in other petroleum product sector, whereas prices rise in petroleum refineries and electricity sectors.

The elimination of VAT boosts output in almost all sectors except in paper industries and printing sector; other manufacturing and unclassified sector; construction sector and trade and services sector. The pronounced effects of removing VAT are noticed in petroleum refineries sector, agriculture sector and petroleum and natural gas sector relative to benchmark case. This policy also rises price of capital by 0.0059 percent in all sectors. Economy wide welfare declines slightly as the increase in household's utility from private consumption cannot

compensate enough for reduction in utility from public consumption. Thus VAT can have positive impacts on welfare when revenues are used prudently for providing public services.

In addition, when we take account of aggregate changes in welfare net effect of 10 percent VAT are better than zero percent VAT. Thus, increasing VAT from 7 to 10 percent becomes desirable policy action on the basis of economy wide welfare analysis because utility from the public services for the households more than compensates their loss of utility due to higher taxes.

In case of lower corporate income tax rate from 30 to 23 percent reduces the employment, capital, output and supply in paper industries and printing; metal, metal products and machinery; construction and trade and services sectors also in coal and lignite sectors. At the same time, price rise significantly in food manufacturing sector as well as labour, capital, output and supple increase. For energy sector, this policy stimulates the production and employment in every energy sectors except coal and lignite sector. However, only the prices in petroleum and natural gas industry and petroleum refineries sector increase slightly.

Moreover, the findings of reducing the corporate income tax rate from 30 to 20 percent show the same results as applied corporate income tax rate at 23 percent. However, the magnitude of changes acros sectors are different. The notable change happens in metal, metal products and machinery industry as supply and price of this sector decreases after CIT rate change to 20 percent compared to benchmark case. In addition, this policy also decrease the price in transportation and communication sector; petroleum refineries sector and electricity sector.

Although the reduction of corporate income tax rate increase household's welfare in both cases but the magnitude of changes are less than the decreasing in public welfare. By comparison, decreasing CIT rate from 30 to 20 percent is more preferable policy as the overall net change in welfare of 20 percent corporate income tax are better than 23 percent corporate income tax.

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Appendix A: Thailand's Eighteen Sectors Input-Output Table (in Billion Baht)

	Agric	**Mining**	**FoodManu**	**Textile**	**SawMill**	**Paper**	**Rubber**	**NonMetal**	**Metal**
Agric	146.936	0.162	822.034	4.025	18.605	3.909	137.866	0.750	0.140
Mining	0.143	0.082	1.440	0.044	0.031	0.127	4.649	48.633	13.349
FoodManu	102.010	0.000	269.182	0.415	0.261	2.081	11.451	1.073	0.051
Textile	1.585	0.039	1.394	201.711	0.775	0.228	9.288	0.755	6.611
SawMill	2.200	0.202	1.136	0.081	15.501	0.131	1.685	0.581	10.720
Paper	0.583	0.104	6.698	2.850	1.349	20.357	6.597	1.915	17.999
Rubber	58.153	2.059	18.133	51.817	11.004	8.130	199.724	9.190	163.006
NonMetal	1.012	0.020	8.915	0.027	0.574	0.037	1.466	42.354	27.276
Metal	27.678	9.082	21.560	5.866	4.307	3.900	17.854	12.126	1210.232
OthManu	2.773	0.243	15.786	15.451	2.362	2.731	9.662	5.278	35.237
Const	1.280	0.163	1.233	0.701	0.162	0.336	1.789	0.716	6.015
Trade	146.698	4.988	188.929	81.859	29.747	42.925	180.283	44.028	692.234
Trans	21.826	3.909	44.501	12.784	6.279	8.001	42.944	17.283	100.387
Coal	0.000	0.000	0.381	0.053	0.000	0.399	0.201	0.202	2.317
Petro	0.086	0.335	2.700	1.030	0.051	0.373	22.629	5.239	8.772
PetroRefin	48.846	4.306	16.957	7.707	0.992	1.767	55.998	15.158	48.409
OthPetro	5.453	1.662	0.857	0.882	0.261	0.272	3.127	2.014	15.798
Electri	5.701	1.844	48.553	41.217	5.379	5.442	46.812	24.026	106.107

Appendix A: (continued)

	OthManu	Const	Trade	Trans	Coal	Petro	PetroRefin	OthPetro	Electri
Agric	11.982	4.756	102.911	1.979	0.000	0.000	0.000	0.000	0.388
Mining	18.094	38.873	0.021	0.023	0.000	0.159	0.001	0.001	0.024
FoodManu	27.884	0.000	186.584	5.774	0.000	0.000	0.131	0.134	1.204
Textile	21.409	0.478	28.623	3.157	0.001	0.000	0.000	0.008	0.130
SawMill	3.367	15.668	6.499	1.233	0.000	0.009	0.045	0.002	0.053
Paper	8.814	0.522	96.625	4.900	0.017	0.264	0.141	0.030	0.535
Rubber	46.650	10.596	133.484	21.071	0.001	0.517	0.526	1.096	0.316
NonMetal	9.545	177.534	3.153	0.024	0.000	0.000	0.000	0.000	0.000
Metal	42.252	65.265	105.729	151.373	0.457	10.240	1.183	0.211	8.558
OthManu	158.360	2.130	89.572	9.020	0.013	2.934	0.385	0.124	1.454
Const	1.438	0.890	22.472	1.343	0.010	0.418	0.022	0.030	1.001
Trade	184.458	115.071	883.853	198.948	0.475	85.276	12.210	5.450	47.248
Trans	41.753	73.307	227.319	204.257	2.994	4.510	4.053	0.494	6.185
Coal	0.217	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.956
Petro	3.047	0.432	11.377	2.194	0.000	302.030	88.660	0.032	133.944
PetroRefin	6.672	9.897	80.593	327.701	1.892	36.593	6.280	3.622	52.790
OthPetro	1.939	5.270	4.433	29.602	0.007	5.611	0.077	14.070	0.059
Electri	24.519	6.268	205.634	23.747	0.155	6.360	3.122	0.352	15.316