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An Analysis of the Impact of Tax Policy Changes on Poor and Non-Poor Households in Thailand: An Application of the General Equilibrium Model

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Abstract

Following the pandemic and socioeconomic challenges, Thailand's fiscal deficit has necessitated tax structure adjustments, particularly to VAT, to maintain fiscal discipline and generate appropriate revenue for sustainable economic development. This study develops a general equilibrium model suitable for analyzing the impacts of VAT rate changes on low-income and high-income households in Thailand. The research finds that increasing VAT to 10%, while reducing income taxes for low-income earners, high-income earners, and corporations, results in higher labor supply at equilibrium and increased consumption throughout the economy. Additionally, to help low-income households and support sustainable economic growth, subsidies aligned with working hours increase both consumption and welfare for low-income groups. However, the Thai government must consider appropriate budget allocation, as the study finds that raising VAT above 15% negatively affects labor supply and reduces welfare for both low-income and high-income groups.

Keywords: Taxation, Inequality, General Equilibrium Model
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การวิเคราะห์ผลกระทบของการเปลี่ยนแปลงนโยบายภาษีต่อครัวเรือนยากจนและไม่ยากจนในประเทศไทย: การประยุกต์ใช้แบบจำลองสมดุลทั่วไป

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บทคัดย่อ

งานวิจัยนี้ได้พัฒนาแบบจำลองดุลยภาพทั่วไป (CGE Model) เพื่อประเมินผลกระทบเชิงปริมาณของการปฏิรูปภาษีมูลค่าเพิ่ม (VAT) ต่อครัวเรือนผู้มีรายได้น้อยและสูง ผลการศึกษาเชิงประจักษ์ชี้ว่านโยบายผสมผสานผ่านการปรับขึ้นอัตรา VAT สู่ร้อยละ 10 ควบคู่กับการลดภาระภาษีเงินได้ มีศักยภาพในการกระตุ้นทั้งอุปทานแรงงานและการบริโภคมวลรวม อีกทั้งการใช้นโยบายเงินอุดหนุนที่อ้างอิงกับชั่วโมงการทำงาน (Work-Contingent Subsidy) ร่วมด้วย จะช่วยยกระดับสวัสดิการของกลุ่มรายได้น้อยได้อย่างมีนัยสำคัญ อย่างไรก็ดี แบบจำลองชี้ชัดว่าการกำหนดอัตรา VAT ที่สูงเกินกว่าร้อยละ 15 จะสร้างผลบิดเบือนต่อตลาดแรงงานและส่งผลให้สวัสดิการสังคมโดยรวมลดต่ำลงในท้ายที่สุด

คำสำคัญ: ภาษี, ความเหลื่อมล้ำ, แบบจำลองสมดุลทั่วไป
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1. Introduction

1.1 Implications of Thailand's Future Tax System

The COVID-19 pandemic prompted the Thai government to implement policies and measures to assist citizens in public health and financial relief. Under this fiscal responsibility and burden, the Thai government needed to borrow funds for expenditure and expand the public debt ceiling accordingly. However, as Thailand moves beyond COVID-19 with a K-shaped economic recovery, the government must manage its budget and generate income to service debt and implement policies aligned with national strategies and the 13th National Economic and Social Development Plan, which emphasizes a society of opportunity and equality. Government spending is key in driving the economy and promoting opportunities for Thai citizens.

However, government spending has limitations within the current and future fiscal and economic conditions, particularly regarding tax revenue, which significantly impacts opportunities and equality among Thai citizens. Beyond the increasing public debt burden that has necessitated tax increases or structural changes, the Thai government must consider the impacts on different population groups and economic sectors.

1.2 Importance of Understanding Tax Impacts on Various Income Groups

In theory, tax structure adjustments affect different population groups differently based on income levels, economic status, production sectors, etc., especially when adjusting both direct and indirect tax rates. Currently, the Thai government derives its highest revenue proportion from VAT, followed by corporate and personal income taxes. The Thai government has previously reduced corporate income tax rates and adjusted personal income tax structures by increasing expense deductions and tax allowances (Revenue Department, 2021).

The Thai government has attempted to increase the VAT rate above 7% to compensate for this reduced revenue. However, the government has postponed the VAT increase, maintaining it at 7% until September 30, 2024, to support economic recovery from COVID-19 impacts. Suppose the Thai government must increase VAT by 2024. In that case, economic impacts will inevitably occur, particularly affecting poverty (both current and intergenerational), inequality, social protection, and the sustainable development of SMEs. The government may not achieve its fiscal policy objectives for income distribution.

Under the necessary tax rate restructuring or reform, the government must implement policies to mitigate welfare impacts, especially for vulnerable groups, during the adjustment to these tax structure changes. Economic theory suggests that increasing and reducing tax burdens and compensating specific groups have different effects and are not necessarily linear. For instance, VAT increases may affect other economic sectors unequally, while providing equal monetary compensation across industries may result in unequal social welfare changes. This situation necessitates tax research aligned with sustainable national and social development.

1.3 Research Objectives

This study develops a general equilibrium model to analyze welfare impacts resulting from tax structure changes, focusing on the effects of tax structure changes, particularly by dividing consumption equations according to labor and production sectors, to study differential impacts of tax structure adjustments. The results lead to policy recommendations for analyzing the effects of personal income tax or VAT rate adjustments, or both, to establish appropriate rates and develop compensation mechanisms or mechanisms enabling the state to offset or reduce these impacts of tax structure adjustment. These tax structure adjustments will appropriately affect national welfare, and the study applies general equilibrium models to analyze suitable assistance policy alternatives if tax structure changes are necessary to enhance national fiscal efficiency.

2. Literature Review

2.1 Studies of Tax Policy Impacts and Applications of General Equilibrium Models in Tax Policy Analysis

2.1.1 Tax Restructuring and Economic Growth

Analysis of economic growth and tax structure changes typically occurs within the framework of tax reforms aimed at stimulating economic growth through reducing tax rates and/or expanding tax bases. A key assumption is that tax reductions can stimulate economic growth through multiple channels:

First, tax reductions increase household and business income, which can be utilized for increased spending and investment. Heady (2018) and Lemelin and Lasard (2022) reviewed CGE applications in modeling relationships between private sector and labor willingness-to-work models when tax structures are improved. Under appropriate conditions, increased work leads

to higher economic growth.

However, tax restructuring may negatively impact economic growth. Eldeep and Zaki (2023) used CGE models. They found that tax restructuring to achieve higher revenue and fiscal stability for the Egyptian government adversely affected economic growth by reducing household and business income. This aligns with Thailand's case, where Bhattarai and Benjasak (2021) used CGE models to study personal income tax changes on economic growth and found that income tax reductions positively affected economic growth.

Second, tax reductions can reduce production costs, potentially leading to lower prices for goods and services, stimulating demand and economic growth. CGE models can comprehensively study the tax restructuring of production units, companies, and entrepreneurs, considering impacts on product prices and production costs. Radulescu and Stimmelmayr (2010) found that corporate tax restructuring in Germany positively affected production cost reduction and entrepreneur income and could positively impact economic growth in both the short and long terms. Álvarez-Martínez et al. (2016) found that creating and improving CGE models through calibration demonstrated the effects of tax structure improvements on economic growth in EU countries, with models consistent with the characteristics of entrepreneurs and financial structures of each country that differ in exports, imports, and international investment.

Third, expanding tax bases can stimulate economic growth by increasing budget balance, potentially increasing public spending. Increased public spending can support infrastructure and education investments, benefiting long-term economic growth. Amir et al. (2013) found that improving Indonesia's tax structure positively affected more balanced budget allocation and increased private sector consumption and business production of goods and services.

However, increasing fiscal balance may positively and negatively affect economic growth. For example, Li et al. (2018) found that tax structure improvements to transform resource-dependent economic structures into high-value economies positively impacted economic growth in China's Shaanxi province. However, tax restructuring may negatively affect other provinces with income and intensive resource use. Additionally, Xu et al. (2015) found positive impacts on regional income levels in China from tax structure changes. Still, at the provincial level, tax improvements negatively affected income in provinces highly dependent on natural resources,

reducing overall income and economic growth.

Additionally, being an open or closed economy affects tax restructuring and impacts growth. For example, corporate income tax reductions may benefit economic development in open economies by reducing production costs and making domestically produced goods and services more competitive. However, corporate income tax reductions may harm economic growth in closed economies by potentially leading to capital outflow. In Laos, increased capital inflows and trade were found to accompany economic growth (Kyophilavong et al., 2017).

However, tax structure reforms to stimulate economic growth should consider impacts on resource allocation, poverty, and inequality. Reducing tax rates for large businesses may benefit short-term economic growth but harm long-term growth if it leads to monopolization. Kerkela (2004) used CGE models to demonstrate the positive impacts of reducing monopolization in Russia and improving tax structures and energy subsidies in creating economic balance, growth, and long-term efficiency.

In summary, tax structure reforms aimed at stimulating economic growth may positively affect economic growth. However, these outcomes may vary depending on the types of reform structure and the country's economic structures.

2.1.2 Tax Restructuring, Poverty, and Inequality

Historically, studying tax structure changes to reduce poverty has been important because developing countries face poverty problems, and countries urgently need to manage tax systems to reduce poverty before economic problems lead to significant issues. However, poverty problems are currently interrelated with income and asset inequality problems. The application of CGE models for tax structure changes follows inequality reduction concepts:

A good tax structure promotes income distribution and more equitable resource allocation, reducing poverty. Equitable income distribution means most people receive income close to the average, helping everyone access essential goods and services necessary for modern life, expanding domestic goods and services markets, and significantly reducing inequality and poverty within countries.

Tax structures aimed at income distribution involve improving tax collection systems' efficiency, such as reducing tax avoidance gaps and evasive actions, expanding tax bases to cover

high-income groups more extensively, and improving tax structures to accommodate low-income households better. Expanding tax bases to cover high-income groups more extensively will help the state collect more taxes from high-income groups, helping reduce inequality and poverty. Additionally, the government may improve tax structures to accommodate low-income households, helping them receive more tax returns.

Examples of tax structure adjustments through important scenarios include: * Reducing personal income tax rates for low-income households * Eliminating or reducing VAT for necessary consumer goods * Improving social welfare systems, such as payments to the poor and elderly allowances.

In theory, tax structures aimed at income distribution may positively affect resource allocation and poverty reduction. However, these outcomes may vary by tax structure type and country economic structure. For example, Cororaton and Cockburn (2007) found that reducing necessary goods taxes, both import and product taxes, helps reduce household poverty in the Philippines. However, if the government wishes to increase revenue to compensate for reduced taxes, collecting other direct or indirect taxes will negatively impact poverty and increase inequality, especially trade taxes collected equally between all product types, which most negatively affect poverty resolution, followed by income tax increases.

These findings are similar to those of Amir et al. (2013), who found that reducing citizens' income taxes at all levels may help promote economic growth in Indonesia. However, such tax reductions increase inequality because high-income citizens benefit and experience higher income growth than low-income citizens, especially in urban and rural areas.

However, reducing personal income tax rates for low-income households and increasing tax rates for companies and high-income earners may harm resource allocation and poverty reduction, as it may lead to capital outflow. Roos and Adams (2021) created models. They tested them with CGE for Saudi Arabia and found that increasing corporate taxes negatively impacts economic growth, investment, outflow, and inflow of international capital more than increasing VAT. Additionally, Bhattarai et al. (2018) studied the effects of Trump and Clinton policies on household tax burden adjustments before the presidential election to address poverty, inequality, and economic growth. The study used US CGE models and found that Trump's policies of reducing corporate taxes and income for middle-class and wealthy people

would result in high budget deficit conditions consistent with high economic growth. However, these tax restructurings affected higher inequality conditions, with most benefits accruing to the wealthiest 10% of the country, while Clinton's income tax restructuring, which taxed the rich slightly more, did not significantly affect economic growth or reduce inequality.

After Trump won the election and implemented tax policies to increase employment, the Tax Cuts and Jobs Act (TCJA) of 2018, Beckman et al. (2018) used CGE models. They found these policies reduced both personal and corporate taxes and negatively affected agricultural sector output and growth due to investment outflow to other production sectors receiving more significant positive impacts from tax reductions, as well as manufacturing and service sectors able to export goods or invest in global markets. Additionally, these tax reductions resulted in higher inequality trends between economic sectors. However, the overall result would expand the economy more but at the cost of higher inequality.

In summary, governments can manage suitable tax structures by balancing income distribution and reducing impacts on economic growth. Reducing tax rates for low-income households, high-income households, or companies may positively affect resource allocation and poverty reduction in the short term. However, it may negatively affect long-term economic growth by reducing investment, capital accumulation, and capital outflow to foreign countries.

2.1.3 Tax Restructuring and Social Welfare

Using CGE models is appropriate for analyzing the impacts of tax structure changes on overall social welfare, mainly as these models can cover important issues related to welfare changes, such as consumer welfare, producer welfare, government welfare, income distribution and inequality impacts, waste and efficiency impacts, and overall social welfare. CGE creates representations of stakeholders or economic agents in models to assess overall welfare impacts through aggregating impacts from various sectors.

Historically, important studies include Altig et al. (2001), who used models with simulations to hypothesize scenarios for US tax structure changes. The study found that adjusting tax structures from fixed to floating resulted in higher economic growth and welfare trends. However, negative impacts fell on low-income groups and the elderly.

Therefore, researchers experimented with adjusting tax structures to accommodate these

groups to help reduce negative impacts and contribute to long-term growth. However, social welfare increases were limited, requiring governments to choose between tax levels promoting economic growth or leaving no one behind.

Similarly, Creedy and Sleeman (2006) demonstrated the same findings. Their CGE model study, combined with simulation and regression, showed the significant implications of various tax structure reforms, such as income tax, environmental tax, energy tax, and cigarette tax, on overall social welfare. Trade-offs were expected outcomes of tax restructuring, with the main proposals for the study being to create models and estimates for goods demand to accompany measurements of changing social welfare through increased taxes, such as cigarette and carbon taxes.

Additionally, creating appropriate scenarios consistent with social conditions, such as aging societies and environmental problems, in CGE models will produce clear images and outcomes of indirect tax changes affecting overall social welfare and measuring impacts through losses and income distribution effects. Past studies in ASEAN countries included those in the Philippines, Indonesia, and Malaysia.

For studies in the Philippines, Cororaton and Cockburn (2007) used CGE models to study tax changes from reducing imported goods taxes to income taxes or VAT to maintain government revenue levels. The study found that reducing import taxes would increase overall social welfare but imbalance government income and expenditure burdens. Therefore, if the government wants to maintain balanced budget levels, it may need to increase other taxes.

Income tax adjustments would have less impact than VAT adjustments, especially in basic needs categories. Therefore, if the government needs to compensate for income, with minimal impact on high poverty, progressive income tax collection is most appropriate for minimizing social welfare reduction compared to no tax structure changes.

For Indonesia, Amir et al. (2013) studied the impacts of tax structure changes in 2012 using CGE models. They found results that were not significantly different from those in the Philippines, especially in scenario creation. Reducing income taxes and increasing VAT would reduce social welfare.

However, across-the-board tax reductions would increase poverty and inequality because the model requires increasing other taxes to compensate for lost income. Therefore, tax reform must target beyond income adjustment, especially if the government wants low-income people in urban and non-urban areas to have reduced tax burdens. Additionally, recommendations for increasing productivity and economic growth all indicate that reducing taxes for specific groups and tax burdens for vulnerable groups will promote higher social welfare and reduce poverty and inequality in the country.

For Malaysia, tax structure adjustments were not as important as improving subsidy structures because from 2000 to 2010, Malaysia provided subsidies to various population groups among the highest in the world, affecting fiscal burdens with continuous deficits and government borrowing. Solaymani et al. (2014) used CGE models to study the impacts of market subsidy structure adjustments and goods Malaysian citizens cultivate and consume domestically. The study found that reducing subsidies positively affects production, economic growth, and overall social welfare.

However, the model results showed negative impacts on farmers previously receiving government subsidies, both large and small-scale farmers, and all citizens receiving subsidies for using energy at low prices. Therefore, the study had policy recommendations to reduce subsidies along with policies to reduce poverty through targeted subsidies to ensure social welfare levels do not decrease much compared to no subsidies or subsidizing the old system through government borrowing.

In summary, tax structure changes impact the overall economic system and economic units, including households, businesses, and the government. Under different economic structures, tax collection for government spending redistributes wealth within the economic system and affects economic decisions that will impact welfare overall.

2.2 Literature Gaps Due to Thailand's Tax System

2.2.1 Thailand's Tax Structure

Thailand's tax structure has not changed significantly over the past decade. Nipon Puapongsakorn et al. (2011) found that currently, most of the Thai government's tax revenue comes from indirect taxes, with VAT being the most important tax (accounting for 28.65% of all taxes in 2009), followed by excise and customs duties. However, the proportion of indirect

tax revenue is declining (except for VAT). Direct taxes account for 45.2% of total taxes, with corporate income tax being the most important direct tax (26.04%), followed by personal income tax. The government revenue ratio compared to national income has remained between 16-18% over the past 15 years. Thailand's low tax revenue reflects its tax structure, with the primary revenue bases being expenditure (VAT) and corporate income tax, while property and personal income tax bases are small. Additionally, this problem stems from various government tax deductions when examining details by tax type.

In the direct tax system, studies of personal income tax burdens by Chawala and Worawan Chandoevwit (2011) found that tax deductions, especially from investments in retirement mutual funds (RMF), long-term equity funds (LTF), government pension funds, and provident funds, changed the personal income tax structure for Por Ngor Dor 91 from progressive to regressive rates. Personal income tax burdens for Por Ngor Dor 90 filings have been regressive since 2004 and have shown slightly more progressive rates from 2006-2008, especially for income earners in the 60-90% class of all taxpayers nationwide, who have regressive actual tax rates. Additionally, other reasons for low personal income tax revenue include (a) Thailand's high proportion of informal workers in both agricultural and non-agricultural sectors, who typically have low or irregular income, making them ineligible for taxation or challenging to assess for income, and (b) highly unequal income distribution, resulting in many with income below tax thresholds, while much income is concentrated among a few who have channels to pay lower taxes through tax management tools like deductions, income transfers, and legal entity establishment to achieve lower tax bases.

In the indirect tax system, Chaisit Anuchutwong (2011) found that VAT burdens are slightly progressive, differing from previous studies because this study measured tax burdens in both income and expenditure dimensions. This study found that VAT progression may stem from increasing household income and changing consumption expenditure patterns when measured from the expenditure side. While lower-income households consume food in the highest proportion, most goods in this category are VAT-exempt, and VAT exemptions exist for businesses with annual revenue below 1.8 million baht.

Additionally, lower-income households are more likely to purchase goods from small, informal businesses, resulting in lower tax burdens. Higher-income households consume other goods in higher proportions, which are not VAT-exempt, resulting in higher indirect tax burdens.

However, although consumption taxes are increasingly important worldwide, Thailand still collects VAT at only 7%, which is very low compared to other countries, and there appears to be fraud related to VAT from various sectors.

For customs duties, businesses with higher import values have lower customs duty burdens than those with lower import values, or customs duties are regressive. Large businesses often receive tax benefits from the Board of Investment, various free trade agreement benefits, and special privileges for factories in duty-free zones. Although customs duties have been reformed several times, the reforms remain incomplete, resulting in many customs tariffs not yet adjusted to new target rate frameworks. Chaisit's research also studied the distribution of import tax burdens according to household status (expenditure), finding that tax burdens are neutral, except for the lowest three expenditure groups (or 30% of households) having low import tax burdens, possibly because low-income households primarily consume domestically produced goods.

For excise taxes, businesses with higher sales of excise-taxable goods have lower tax burdens than those with lower sales. Regarding the distribution of excise tax burdens by household income class, tax burdens exhibit a bell curve, with middle-income households having higher tax burdens than poor and wealthy households. The problem with excise taxes is that some goods (like liquor and tobacco) have different tax bases and rates despite being the same type of goods, resulting from using different factory-gate prices or classifying slightly different goods of the same type as different products with different tax bases (such as classifying beer into three types: economy, standard, and premium beer, with economy beer having the lowest tax base). The result is horizontal inequality between producers of the same type of goods. This problem occurs with alcoholic beverages, tobacco, and automobiles.

Beyond the regressive nature of Thailand's tax structure, Pawin Siriprapanukul (2012) found that Thailand's tax system structure is an important part of the Thai state with the following details:

The Thai government's primary revenue source is taxes, which account for about 88-90% of all government-collected revenue. Non-tax revenue, including government service fees and revenue shares from state enterprises, accounts for only about 10-12% of all government-collected revenue. This latter group of government revenue is revenue the government creates

or finds through government and state enterprise services, constituting only a tiny proportion of total government-collected revenue.

Chairat Aemkulwat (2012) found that tax structure revenue changes have two leading causes. First, the government attempts to expand tax bases and incentivize citizens to pay more by making personal income tax changes and reducing tax rates three times. Second, over the past two decades, economic expansion and the formalization of the business sector have resulted in more workers in the personal income tax system and higher corporate income tax and petroleum income tax collection following economic expansion.

Additionally, this revenue plays an important role in national development. Saengsanit (2010) found that tax revenue plays the most significant role not only as an important revenue source but also as a government tool for national administration and development, with the government using this revenue to implement important and necessary investment projects. Additionally, this tax structure has not significantly changed over the past decade. Thorn Pitidol (2017) found that Thailand's tax system has the following summary characteristics:

Consumption-based taxes primarily come from VAT (32% of total tax revenue), followed by excise taxes (17%), with the remainder from customs duties and others like specific business taxes. VAT's importance in Thailand's tax system structure has increased over the past 10 years, while customs duties have decreased due to free trade agreements and economic integration.

For income-based taxes, corporate income tax plays a comparatively more significant role than personal income tax, accounting for 25% of total tax revenue compared to personal income tax at 12%. However, average corporate and personal income tax rates have been reduced in the past few years. When compared as a proportion of national income, over the past decade, total tax revenue has accounted for 15-17% of Thailand's national income, which is relatively low compared to developed countries, especially welfare state countries.

However, when considering income levels, individuals who must start paying personal income tax in Thailand must have an income of 1.2 times the average national income per capita, meaning individuals with average income are not yet required to pay taxes. This differs from almost all OECD countries, which require citizens to pay taxes before reaching average

national income per capita.

Additionally, considering the income level that must pay the highest tax tier, which in Thailand is income exceeding 4 million baht or 20 times the national income per capita, this is higher than all OECD countries, suggesting very few people in Thailand pay the highest tax rate. Although Thailand's income tax rates are moderate, the Thai income tax structure limits the number of people who must pay taxes. From 10 million people in Thailand's tax base, only 4 million have income reaching the threshold. Furthermore, the abovementioned tax rates do not include various deductions, significantly reducing actual tax rates.

For corporate income tax rates, Thailand's rate of 20% is similar to that of neighboring countries. However, Thailand has many corporate income tax deductions and exemption policies to promote investment in the country. Under these economic structural characteristics, tax structure adjustments may positively impact the Thai economy. Historically, studies of Thai tax structure changes have typically been in the context of reforms addressing the following issues:

Tax Structural Reform is the process by which countries or governments find new ways to collect taxes to respond to current and future economic and social needs, which may cover adjusting tax rates, improving or amending tax collection criteria, or changing or adding types of taxes collected. Academic studies typically cover the following issues:

- Tax Rate Adjustment: Adjusting tax rates to be more appropriate, such as reducing income tax rates or increasing VAT rates
- Finding New Tax Collection Methods: Changing tax collection methods, such as changing from indirect to direct taxes
- Collecting Taxes from New Sources: Adding types of taxes collected, such as carbon or digital taxes
- Making Taxes Environmentally Friendly: Adjusting tax structures to promote environmental protection, such as taxes that promote renewable energy use
- Improving Tax Exemption or Deduction Systems: Changing tax exemption or deduction methods to be more fair and efficient mechanisms
- Improving Technology in Tax Collection: Using technology in tax collection to make processes faster and easier

However, tax structure changes will not consider economic and societal impacts, especially inequality issues, which require detailed and careful research and analysis. This study focuses on tax rate adjustments, particularly considering these issues.

3. Research Methodology

The general equilibrium model (CGE) is a model for quantitative economic analysis with significant advantages, including being a model that considers the responses or reactions of all markets (money markets, capital factor markets, labor markets, goods markets) when one market in the economic system changes due to economic factor changes and the implementation of national economic policies, until adjustment to a new equilibrium after the changes. This makes it a model applied to analyze the impacts of macroeconomic variable changes, which will benefit both efficient economic policy planning and serve as a tool to demonstrate anticipated trend changes, allowing economic units (individuals, private businesses, or government) to better prepare for economic changes, thereby increasing or maintaining economic stability.

Typically, general equilibrium models are suitable for analyzing events that have not yet occurred by defining scenarios likely to occur and evaluating impacts on economic models of interest. The CGE model developed in this study will improve on the Simple General Equilibrium Modeling, which is a basic preliminary model that is easy to understand. The constructed general equilibrium model comprises four sectors: household, production, international trade, and labor allocation.

Under this economic structure, households will consume goods and services according to their income after income tax deductions and facing value-added tax on both domestically produced and international goods and services. Therefore, tax burden adjustments may affect consumption, leading to changes in employment rates, hiring, and gross domestic product.

At the same time, under changing tax burdens, the production sector must adapt to align with changes in the household sector affected by tax rate and form changes. Under the general equilibrium model, with open economy assumptions, domestically produced goods and services can be sold in domestic markets and exported to foreign markets. Goods and services for consumption available in domestic markets will be a mix of domestically produced and

imported goods. Therefore, tax adjustments will lead to decisions between producing for domestic sales or export under profit-maximizing decision conditions. Tax structure adjustments within the country will affect the quantity and value of exports and imports.

Additionally, in the labor sector, as goods and services production, exports, and imports adjust according to new tax structures, the labor sector will be affected in terms of wage rates or changing returns. This situation will change the welfare of domestic production factors. Therefore, general equilibrium models have comparative advantages over other macroeconomic models.

3.1 General Equilibrium Model

This general equilibrium model is created by improving a Simple General Equilibrium Model by Shantayaman Devarajan et al., a basic preliminary model suitable for learning by interested individuals and students, especially doctoral students studying macroeconomic theory and examples of using mathematics in macroeconomic studies. The constructed general equilibrium model comprises four sectors: household, production, international trade, and employment.

The model context includes households, the production and foreign sectors, and the labor markets. Households decide on goods consumption and working hours selection to maximize satisfaction, which will be the demand for goods (domestic demand) and labor supply. This model classifies goods into three types: agricultural, industrial, and services.

Producers in each production sector decide how much labor and capital to maximize profits. In the resource allocation sector, producers determine how much of their produced goods sell domestically and internationally. Meanwhile, households must decide how much domestic and foreign goods they consume.

This model emphasizes the impacts of taxes and transfers on the economic system, primarily considering income tax, VAT, and corporate income tax. Therefore, the model is applied to include tax and transfer variables that will ultimately show how increased liberalization affects production in each sector, how each type of good’s price is affected, how foreign labor imports in each production sector change, and whether skilled and unskilled labor wages will change.

1. *Households*
   - Researchers assume the same utility function for different income groups (poor, non-poor) but with different parameters, finding consumption of different goods groups by different people groups using data from the Thailand Socioeconomic Survey.
   - Researchers assume the labor market is exogenous, assuming wage poor and finding wage non-poor by calculating averages where wage non-poor is higher than wage poor according to state welfare card criteria.
   - Non-skill (poor) is calculated from the proportion of people with education below bachelor's degree = 85%, Non-poor = 15%, finding wage poor from the average income of 85% and wage non-poor from the average income of 15%.
     - It is assumed that 20% of the population is wealthy based on World Development Indicator data.
     - The wealthy 20% have 42% of the income (World Development Indicator).

The household sector divides consumers into two groups: low-income groups (poor) and non-poor groups. Households decide on consumption and labor supply levels to maximize utility under limited budget conditions. Both low-income and non-poor groups have the same utility function form but with different parameters (γ and μ), meaning consumption and work responses to happiness or utility differ. The utility function used in this model is the Constant Relative Risk Aversion (CRRA) form, a utility function commonly used in CGE studies.

For budget line conditions, these represent the balance of consumer income from work and consumer expenditures. This model includes two types of taxes: income tax and value-added tax. In this budget equation, income is reduced by income tax, while expenditure includes value-added tax costs. Low-income and non-poor groups differ in income, and because the model separates households into these two groups, it can analyze the different tax collection impacts on these two groups. The utility function and limited budget conditions can be expressed as follows:

$$U_i\left(C_i,\left(1-H_{s,i}\right)\right)=\frac{\left[C_i^{\gamma_i}\left(1-H_{s,i}\right)^{(1-\gamma_i)}\right]^{(1-\mu_i)}}{(1-\mu_i)} \quad (1)$$

Under income conditions:

$$H_{s,i}\left(1-t_{inc,i}\right)w_i + transfer_i = (1+t_{vat})P_{con}C_i \quad (2)$$

From the consumer decision problem above, the conditions for consumption choice and work decision (First order conditions) are as follows:

$$\frac{C_i}{1-H_{s,i}} = \left(\frac{1-t_{inc,i}}{1+t_{vat}}\right)\left(\frac{w_i}{P_{con}}\right)\left(\frac{\gamma}{1+\gamma}\right)$$

$$H_{s,i}\left(1-t_{inc,i}\right)w_i + transfer = (1+t_{vat})P_{con}C_i \quad (3) \text{ and } (4)$$

Where:

C = Quantity of goods consumed by low-income earners (i=p) and other groups (i=np) H_s = Labor supply w_p = Wage rate for low-income households w_{np} = Wage rate for non-poor households $transfer$ = Assistance money for [low-income earners] $\varnothing$ = Proportion of labor that is non-poor P_{con} = Price of goods γ = Share of consumption in the utility μ = Curvature Parameter

2. ***Production Sector***

This model defines the production sector to reflect the production of a representative firm, which has a behavior to select capital production factors (K) and labor (H) to achieve high profits. The model uses a Cobb-Douglas production function, which the following production equation can express:

$$6\ Q_s = AK^{\alpha}H_{d,p}^{\beta_1}H_{d,np}^{\beta_2} \quad (5)$$

The profit equation includes revenue minus costs, then minus corporate income tax, where revenue is price multiplied by production quantity. In contrast, costs include expenses for low-income labor groups and expenses for non-poor labor groups. Low-income labor groups are defined as unskilled labor, while non-poor labor groups are skilled labor. The following equation can express the profit equation:

$$\pi = P_{pro}\left(AK^{\alpha}H_{d,p}^{\beta_1}H_{d,np}^{\beta_2}\right) - \left(H_{d,p}w_p + H_{d,np}w_{np} + rK\right) - t_{cor}\pi$$

From the production decision problem above, the conditions for appropriate goods production selection (First order conditions) are:

$$H_{d,p} = \left[\frac{(1-t_{cor})w_p}{(P_{pro}-t_{cor})A\beta_1 H_{d,np}^{\beta_2} K^{\alpha}}\right]^{\frac{1}{\beta_1-1}}$$

$$H_{d,np} = \left[\frac{(1-t_{cor})w_{np}}{(P_{pro}-t_{cor})A\beta_2 H_{d,p}^{\beta_1} K^{\alpha}}\right]^{\frac{1}{\beta_2-1}}$$

$$K = \left[\frac{(1-t_{cor})\gamma}{(P_{pro}-t_{cor})\alpha A H_{d,p}^{\beta_1} H_{d,np}^{\beta_2}}\right]^{\frac{1}{\alpha}}$$

(6) (7) and (8)

Where:

Q_s = Total production quantity P_{pro} = Product selling price A = Producer's technology multiplier K = Producer's capital factor H_d = Required labor factor w_p = Wage rate for poor labor w_{np} = Wage rate for non-poor labor r = Interest rate α = Producer's Capital Parameter β = Producer's Labor Parameter ρ = Proportion of non-poor labor to total labor t_{cor} = Corporate income tax rate

3.International Trade

Under the open economy assumption, domestically produced goods and services can be sold in domestic markets and exported abroad. Meanwhile, goods and services for domestic consumption come from both domestically produced goods and imported goods. Therefore, decision-making in international trade involves allocating produced goods for domestic and foreign markets.

Export Sector

Producers decide how to allocate produced goods for export and domestic sales to maximize total revenue, under the condition of produced goods and substitution between domestic and foreign goods according to the Constant Elasticity of Transformation (CET) equation. Therefore, the producer's problem in allocating goods for export is:

$$Max\ \ P_{pro} * Q_s = (DomP * DomQ_s) + (ExP * ExQ)\ 3$$

(9)

Under the condition of goods allocation for sales:

$$Q_s = \varnothing_{domex}\left(\vartheta_{domex} ExQ^{\omega_{domex}} + (1-\vartheta_{domex})\ DomQ_s^{\omega_{domex}}\right)^{\frac{1}{\omega_{domex}}} \tag{10}$$

From the goods allocation problem above, the conditions for appropriate goods allocation (First order conditions) are:

$$\frac{ExQ}{DomQ_s} = \left[\frac{ExP}{DomP} * \frac{1-\vartheta_{domex}}{\vartheta_{domex}}\right]^{\frac{1}{\omega_{domex}-1}}$$

$$P_{pro} * Q_s = DomP * DomQ_s + ExP * ExQ$$

$$ExP = ExcR * P_{wex}$$

Where:

ImQ = Quantity of imports $DomQ_d$= Quantity of goods produced for domestic sales ImP = Import price $DomP$ = Consumer price for domestically produced and sold goods ϑ_domim = Armington function share parameter ω_{domim} = Armington function exponent $\varnothing\_domim$ = Armington function shift parameter P_{con} = Price of goods in domestic market (from domestic price and import price) Q_d = Total quantity of goods sold domestically $ExcR$ = Foreign exchange rate imprate = Import tax rate on foreign goods P_{wim} = Price level of goods in foreign markets

Equilibrium Conditions

Markets in this model include goods markets and production factor markets (capital and labor). Equilibrium conditions in goods markets include:

2. $Q_s = DomQ_s + ExQ$

This means that the quantity of domestically produced goods equals the quantity sold domestically plus the quantity of goods exported to foreign countries.

3. $Q_d = DomQ_d + ImQ$

This means that the quantity of goods domestic consumers want equals the quantity of domestically produced goods wanted plus the quantity of goods wanted to be imported from abroad.

4. $DomQ_d = DomQ_s$

This means that the quantity of goods produced for domestic sales from consumer decisions is equal to that produced for domestic sales from producer decisions.

For equilibrium conditions of production factor markets:

5. $s(H_{d,p} * w_p + H_{d,np} * w_{np} = K$

s is consumers' savings rate and is determined by factors outside the equation system (exogenous variable). This equilibrium means domestic consumer savings (low-income and non-poor groups) equal capital value.

6. $H_{s,np} = H_{d,np}$

Meaning equilibrium in the non-poor labor market.

7. $H_{s,p} = H_{d,p}$

This means equilibrium in the poor labor market.

3.2 Calibration

Calibration refers to estimating various parameters in the model. Important sources for parameter estimation include I-O tables, GTAP, the Statistical Office, and foreign labor statistics from the Department of Employment, with details as shown in Table 1.

Table 1: Sources of Parameter Estimation

Parameter Name	Description	Source
Household		
Gamma	Share Parameter between Consumption & Leisure	Self-calculate
shift_u	Shift Parameter of Utility Function	Self-calculate (calculate capital use proportion from NESDC data)
Production Sector		
Tech	Technology Shift Parameter for Production Function	I-O table
Alpha	Share Parameter of Capital for Production Function	I-O table
Beta	Share Parameter of Labor Demand for Production Function	I-O table
International Allocation		
Share ex	Share Parameter between Export & Domestic sales	NESDC statistical reports
Expo ex	Exponent Parameter for CET function	GTAP Database 11.0
Household International Allocation		
Share im	Share Parameter between Import & Domestic Goods	Calculated from Department of Trade import-export data
Expo im	Exponent Parameter for CET function	GTAP Database 11.0

3.3 Scenario Design for Tax Policy Changes

3. Impact of increasing VAT from 7% to 9%, studying effects on consumption, labor supply, and welfare as percentages compared to no tax structure adjustment (status quo).
4. Impact of increasing VAT from 7% to 10%, studying effects on consumption, labor supply, and welfare as percentages compared to no tax structure adjustment (status quo).
5. Impact of increasing VAT from 7% to 10% and reducing low-income income tax from 10% to 0%, studying effects on consumption, labor supply, and welfare as percentages compared to no tax structure adjustment (status quo).

6. Impact of increasing VAT from 7% to 10% and reducing low-income income tax from 10% to a 3% subsidy of wages multiplied by hours worked, studying effects on consumption, labor supply, and welfare as percentages compared to no tax structure adjustment (status quo).
7. Impact of increasing VAT from 7% to 10%, reducing low-income income tax from 10% to 0%, reducing wealthy people's income tax from 30% to 20%, and reducing corporate tax from 20% to 17% on consumption, labor supply, and welfare as percentages compared to no tax structure adjustment (status quo).
8. Study the impacts of VAT increases on labor supply and welfare when VAT is increased and low-income tax is reduced to 0%, experimenting with tax increases up to 20%.

4. Research Results and Discussion

The research results will be divided into two main sections: first, the effects of increasing VAT according to the Thai government's goals to increase it to 9% and 10%, respectively, compared with cases of tax reductions to help low-income earners by reducing income tax to 0%, as well as reducing high-income earners' income tax to 20% and corporate tax to 17%, and experimenting with changing low-income earners' tax burdens to subsidies in the form of Earned Income Tax Credit that helps low-income earners receive more income if they work more hours; second, the study will adjust to have increasingly higher VAT collection to reduce fiscal burdens, with VAT adjusted from 15% up to 20%, specifying low-income earners' tax at 0%, high-income earners' income tax at 30%, and corporate tax at 20%.

4.1 VAT Adjustment According to Government Policy

Increasing VAT rates is necessary for the Thai government's increasing expenditures and higher fiscal burdens in spending and borrowing. Although such tax adjustments can reduce fiscal burdens, the impact on low-income earners and stakeholders must be studied to understand the negative impacts. This study defines stakeholders as comprising low-income and high-income earners, with results shown in Table 4.1.

Table 4.1: VAT Adjustment

	Case 1	Case 2	Case 3
	VAT 9%	VAT 10%	VAT 10%
	Low-income tax 5%	Low-income tax 5%	Low-income tax 0%
	High-income tax 30%	High-income tax 30%	High-income tax 30%
	Corporate tax 20%	Corporate tax 20%	Corporate tax 20%
	% Change	% Change	% Change
Low-income consumption	9.37	13.27	33.62
High-income consumption	9.22	13.00	20.22
Low-income labor supply	8.09	11.29	18.33
High-income labor supply	8.16	11.38	18.48
	Case 1	Case 2	Case 3
Capital	0.30	0.59	0.59
Producer price	-2.08	-3.00	-3.00
Exchange rate	-0.08	-0.11	-0.11
Low-income welfare	0.64	0.87	3.16
High-income welfare	-8.87	-12.90	-23.44

This study specifies increasing VAT from 7% to 9%, assuming average income tax for low-income earners at 5%, high-income earners at 30%, and corporate tax at 20%. The VAT increase results in higher consumption for both low and high-income earners, contrary to the belief that tax increases reduce consumption. Under the labor market characteristics in the model, stakeholders need to work more to maintain welfare levels that do not decrease much due to tax increases. Under these circumstances, consumption increases by about 9% because labor supply increases by about 8% on average. The increase in labor supply corresponds with a 0.3% increase in capital use, making domestically produced goods supply higher and leading to a 2% decrease in domestic goods prices and a 0.08% strengthening of the exchange rate.

Therefore, adjusting VAT to reduce fiscal burdens can reduce fiscal burdens due to increased consumption. Additionally, low-income earners' welfare increases by 0.64%, but high-income earners' welfare decreases by 8.87%. However, these results must be considered in terms of

improved working conditions.

The researchers also adjusted the tax burden to 10% to align with Thai government tax adjustment trends. The study found that stakeholders' consumption and labor supply increased by about 13% and 11%, respectively. This labor force increase aligns with the increase to 9% VAT mentioned earlier. As stated, this labor force increase increases capital use, domestic goods prices decrease, and the exchange rate strengthens. However, low-income earners' welfare increases only slightly at 0.87%, but this welfare comes primarily from increased work. Meanwhile, high-income earners experience reduced welfare due to increased work and higher consumption tax burdens. In Case 3, under labor market assumptions and reducing low-income earners' income tax to 0%, labor supply increases in both income groups, increasing consumption accordingly. However, this situation increases low-income earners' welfare by 3%, but high-income earners' welfare decreases by 23%.

The researchers found that increasing VAT rates and reducing low-income earners' income tax may not significantly affect low-income earners' welfare due to increased labor supply. Therefore, to increase low-income earners' welfare more compared to the current status, the researchers experimented with adjusting low-income earners' income tax rates to negative values or subsidizing if low-income earners have more working hours. To alleviate the negative impacts on high-income earners' welfare, the researchers experimented by reducing high-income earners' income tax to 20% and corporate tax to 17%, as shown in Table 4.2.

In Case 1, subsidizing low-income earners' income results in more work and, consequently, higher welfare for low-income earners. However, this subsidy results in an even more significant decrease in welfare for high-income earners. Therefore, to reduce this impact, the researchers experimented with reducing high-income earners' tax rate to 20% and the corporate tax to 17%. These tax adjustments increase high and low-income earners' work by about 9% compared to the base status. The government has higher revenue, while low-income earners' welfare increases by 3.14% and high-income earners' welfare decreases by 9%. This scenario reflects tax adjustment conditions that positively impact low-income earners. At the same time, high-income earners experience lower impacts than cases without income tax reductions, as shown in Table 4.1.

Under these conditions, if the government needs to adjust VAT to increase revenue, reducing other tax burdens for low-income, high-income, and limited companies may be essential to ensure overall social welfare does not decrease much. Additionally, the government needs to support low-income earners with employment. It can promote this with subsidies dependent on employment and working hours in the form of Earned Income Tax Credit.

Table 4.2: Income Tax Adjustments to Reduce Impacts on Income Earners

	Case (1)	Case (2)
	VAT 10%	VAT 10%
	Low-income subsidy 3%	Low-income tax 0%
	High-income tax 30%	High-income tax 20%
	Corporate tax 30%	Corporate tax 17%
	% Change	% Change
Low-income consumption	39.88	24.89
High-income consumption	22.25	27.14
Low-income labor supply	20.31	9.44
High-income labor supply	20.48	9.51
Capital	0.59	0.89
Producer price	-3.00	-1.92
Exchange rate	-0.11	-0.07
Low-income welfare	3.80	3.14
High-income welfare	-26.93	-9.22

4.2 VAT Collection Impacts on Work and Consumption

In this section, the researchers experimented with increasing VAT to 15% and incrementally increasing it to 20% to examine effects on low and high-income earners' work and welfare, with results in Tables 4.3 and 4.4. The study assumes that low-income earners have 0% income tax, high-income earners face 30% income tax, and corporate tax is 20%. The study found that the government can increase VAT to 15% while low and high-income consumption increases compared to the base case. However, the welfare of high-income earners decreases the most compared to all cases. This result aligns with conditions where taxes reduce society's willingness to work, especially among high-income groups. As seen when adjusting VAT up to 17%, low and high-income labor supply begins to decrease compared to the base, and importantly, producer goods prices tend to decrease below the base case by 9%. This condition is important for the government if changing VAT levels too high may negatively affect

labor supply and producer goods prices. However, it is notable that at 17% VAT, both low and high-income earners' welfare still increases from the base case, with this increased welfare coming from reduced working hours per week, which can negatively affect the economy.

Table 4.3: Increasing VAT with Decreasing Work

	Case 1	Case 2	Case 3
	VAT 15%	VAT 16%	VAT 17%
	Low-income tax 0%	Low-income tax 0%	Low-income tax 0%
	High-income tax 30%	High-income tax 30%	High-income tax 30%
	Corporate tax 20%	Corporate tax 20%	Corporate tax 20%
	% Change	% Change	% Change
Low-income consumption	37.75	32.50	11.75
High-income consumption	22.87	17.91	-0.93
Low-income labor supply	18.40	13.22	-5.10
High-income labor supply	18.55	13.33	-5.15
Capital	1.48	1.78	2.07
Producer price	-7.42	-8.17	-8.92
Exchange rate	-0.27	-0.30	-0.32
Low-income welfare	3.78	3.79	2.97
High-income welfare	-23.39	-15.34	5.34

Finally, the researchers conducted sensitivity analysis by adjusting VAT from 18% to 20% to study the possibility of increasing VAT consistent with high-income countries like those in the European Union, with low-income earners' income tax at 0%, high-income earners at 30%, and corporate tax at 20%. Low-income earners begin to consume less when VAT is at 20%, as shown in Table 4.4, meaning low-income earners cannot work more to compensate for higher tax rates. Low-income earners reduce working hours to ensure overall welfare does not decrease too much.

Table 4.4: Sensitivity Analysis with VAT up to 20%

	Case 1	Case 2	Case 3
	VAT 18%	VAT 19%	VAT 20%
	Low-income subsidy 0%	Low-income tax 0%	Low-income tax 0%
	High-income tax 30%	High-income tax 30%	High-income tax 30%
	Corporate tax 30%	Corporate tax 30%	Corporate tax 30%
	% Change	% Change	% Change
Low-income consumption	2.19	6.45	-4.08
High-income consumption	-9.68	-6.08	-15.65
Low-income labor supply	-13.73	-10.60	-19.89
High-income labor supply	-13.84	-10.69	-20.05
Capital	2.07	2.37	2.66
Producer price	-9.58	-10.42	-11.08
Exchange rate	-0.35	-0.38	-0.40
Low-income welfare	2.32	2.73	1.84
High-income welfare	12.56	10.13	17.08

Additionally, reducing the labor supply results in producer prices decreasing by more than 10%, capital use increasing by 2.66%, and low and high-income earners' welfare increasing due to reduced labor supply. Finally, this study indicates that increasing VAT alone may have unpredictable effects depending on relationships in the economic system where VAT has non-linear relationships with employment and social welfare.

5. Conclusions and Policy Recommendations

5.1 Conclusions

The Thai government's expenditure burden after the COVID-19 pandemic and its aging society affects fiscal sustainability and the government's potential to appropriately use the budget for national development. Therefore, tax structure adjustments are necessary for national development. Important tax adjustments include increasing VAT from 7% to 10%, which requires legal implementation to align with increasing government expenditure and fiscal discipline principles.

In theory, VAT increases lead to more significant consumer burdens and may lead to deadweight loss. Regarding inequality, VAT increases can result in tax burdens for low-income earners being more significant than for high-income earners, with these theoretical effects increasing income inequality in society.

Therefore, this research applied general equilibrium models with data from the Thai economy to analyze impacts of VAT changes, income tax adjustments, and low-income earner subsidies on key variables such as consumption, labor supply, producer goods prices, capital use, and welfare.

From studying the impacts of adjusting VAT to 9% and 10%, it was found that both low and high-income earners' consumption increases because both groups adjust to work more hours to maintain consumption levels that do not excessively reduce welfare due to higher tax rates. However, because low-income earners need to consume at a higher income ratio, the percentage increase in working hours for low-income earners is higher than for high-income earners. This situation increases low-income earners' welfare, while high-income earners' welfare decreases because they have greater total consumption than low-income earners. Increasing tax to 10% will decrease welfare compared to the base case. Additionally, the study experimented with reducing low-income earners' income tax to 0% and adjusting subsidy money per hour for low-income earners at 3%. The study results found that increasing VAT, reducing low-income earners' income tax, or subsidizing according to low-income earners' working hours will result in higher labor supply for low-income earners and increase their welfare. However, high-income earners' welfare significantly decreases. Therefore, the state may reduce high-income earners' income tax and reduce corporate tax to prevent high-income earners' work from changing too much.

Additionally, the study tested sensitivity and found that increasing VAT above 15% will decrease labor supply for both low and high-income earners. Additionally, low-income earners' welfare will be worse than with subsidies. In contrast, high-income earners will reduce the labor supply more than low-income earners, with high-income earners having higher welfare due to reduced work. Finally, increasing VAT to 20% will negatively affect labor supply in all sectors and affect low-income earners' welfare more than high-income earners'.

5.2 Policy Implications

The Thai government's VAT increase to respond to fiscal discipline and higher expenditures can affect both high and low-income earners in Thailand. Beyond considering tax burdens and equality, this study presents another policy angle to consider when increasing taxes: the government can reduce low-income earners' income tax, or those with a tax base at 5%, to 0% because it will stimulate more work. Having a higher labor supply will stimulate more production and higher capital use. In theory, these results will lead to higher domestic production and lower goods prices. However, for such results to be beneficial with higher welfare, the government should change from tax reduction to designing a system providing subsidies to low-income earners with more working hours, similar to the Earned Income Tax Credit.

Finally, the government should be cautious that excessive spending and aiming to increase VAT to reduce fiscal conditions have limitations. Adjusting VAT higher than 15% will negatively affect labor supply and stakeholder welfare in society, creating income inequality and widening the welfare gap between low—and high-income earners.

5.3 Study Limitations

Because the study focuses on comparing important economic variables of low and high-income earners, it does not cover important production sectors in Thailand due to data limitations and parameters of high and low-income workers. The study does not cover international trade sectors such as the GTAP model, which responds more appropriately for skilled and unskilled labor and production sectors connected to foreign countries. Finally, this study does not cover technological development, especially in digital and artificial intelligence areas that may affect low and high-income earners in non-linear and unequal ways.

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