*Journal of Infrastructure, Policy and Development* 2024, 8(16), 5291.
https://doi.org/10.24294/jipd5291

Article

# Wages and return to capital in Thailand in a free trade agreement with the EU

**Hugo Toledo**

Department of Economics, American University of Sharjah, Sharjah 26666, United Arab Emirates
*** Corresponding author:** Hugo Toledo, htoledo@aus.edu

**CITATION**

Toledo H (2024). Wages and return to capital in Thailand in a free trade agreement with the EU. Journal of Infrastructure, Policy and Development. 8(16): 5291. https://doi.org/10.24294/jipd5291

**ARTICLE INFO**

Received: 18 March 2024
Accepted: 12 September 2024
Available online: 24 December 2024



**Abstract:** Thailand and the EU started negotiating a free trade agreement (FTA) in 2005, but negotiations were subsequently suspended in 2014 after the country's military coup. The significance of these negotiations are important because of the mutual benefit of achieving higher levels of trade and investment between the world's largest single market and the second largest ASEAN economy. The Specific Factors (SF) model of production and trade is applied to identify potential winner and loser industries and factors of production in Thailand. The model identifies short-run loses for some labor inputs, return to capital, and output in agriculture and services. In the manufacturing and energy sectors, higher output will benefit some labor inputs and capital owners. Understanding the short-run impact of an FTA could allow policymakers in Thailand to reinforce the institutional infrastructure such as implementing trade adjustment assistance programs (TAA), to help re-train workers who may become unemployed due to free trade.

**Keywords:** Free trade; Thailand-EU; factor payments; specific factors model; income redistribution

## 1. Introduction

After years of delay, in June of 2022, Thailand and the European Union (EU) sealed a partnership and cooperation agreement (PCA), a step that put both sides closer to a free trade agreement (FTA). The PCA will not only facilitate the dialogue on a variety of issues such as trade, investment, human rights, and national security, but it could help thaw up the frosty relations between the two sides as a result of the military coup in Thailand in 2014.

The World Bank reclassified Thailand as an upper middle-income country in 2010. As a result, in 2015, Thailand lost its eligibility to the EU's Generalized System of Preferences (GSP), which granted Thailand access to the EU market at zero tariff rates for non-sensitive goods and lower tariff rates for sensitive goods. An FTA with the EU is an important policy move that will help mitigate the impact of Thailand losing access to the EU market under the GSP scheme potentially contributing to its economic development. At the same time, it will also help boost EU trade and investment with the ASEAN second largest economy.

Thailand is a key member of the Association of Southeast Nations (ASEAN), and an important destination of European investment. According to a 2023 report by the Council of the EU and the European Council, in 2020, EU investment is ASEAN countries was estimated at €314 billion of which €20 billion (or 6.3%) was in Thailand.

Bilateral trade between the EU and Thailand in 2020, reached €29.1 billion, with Thailand exporting €17.7 billion worth of goods and importing €11.4 billion. These levels of trade make Thailand the fourth largest trading partner with the EU after China, Japan, and the US. About 7.5% of Thailand's total trade is with the EU.

In 2020, Thailand's main exports to the EU included machinery and appliances, plastics and rubber, transport equipment, foodstuffs, beverage, and tobacco, pearls and precious metals, (**Table 1**). Main imports from the EU included machinery, appliances, chemicals and related products, transport equipment, optical, and photographic instruments, and base metals, (**Table 2**). Based on this trade data, the degree of complementarity between Thailand and the EU is not necessarily strong but an FTA could open the possibility for further diversification in the exports and imports of goods and services.

**Table 1.** Thailand Leading Exports to the EU, 2020.

| | Value (Billions of €) | Share of Total (%) |
|---|---|---|
| Machinery and Appliances | 9.27 | 52.3 |
| Plastic, rubber, and articles thereof | 1.65 | 9.3 |
| Transport equipment | 1.09 | 6.2 |
| Foodstuffs, beverages, tobacco | 1.08 | 6.1 |
| Pearls, precious metals, and articles thereof | 1.05 | 5.9 |

Source: Council of the EU and the European Council.

**Table 2.** Thailand leading imports from the EU, 2020.

| | Value (Billions of €) | Share of total (%) |
|---|---|---|
| Machinery and Appliances | 4.11 | 36.0 |
| Product of the chemicals and allied industries | 2.08 | 18.2 |
| Transport equipment | 0.752 | 6.6 |
| Optical and photographic instruments | 0.751 | 6.1 |
| Base metals and articles thereof | 0.689 | 6.0 |

Source: Council of the EU and the European Council.

An FTA can lead to major short-run changes in factor payments and outputs. Wages and capital returns could be impacted as Thailand adjusts along its production possibilities frontier to respond to a growing export demand and higher import competition. Higher export demand will lead to higher export prices benefiting capital owners and labor in exporting sectors. By contrast, higher import competition will likely produce the opposite effect, a relationship embedded in the Stolper-Samuelson theorem.

According to a 2021 ASEAN briefing, an FTA with the EU will benefit Thailand exports of machinery and appliances, electronics, and vehicles. The Thai manufacturing sector stands to win due to an increase in export demand. In addition, goods that benefited from the GSP such as food and beverages, pearls, apparel, and stones are winners under the FTA. In 2021, the Thailand Development Research

Institute (TDRI), reported an additional benefit of an FTA by predicting a 2.37% to 3.70% increase in Thailand's GDP.

On the losing side of the FTA are agricultural goods and fisheries, rubber, wood, leather, as well as financial services. The Thai agriculture and services sectors stand to lose under the FTA due to EU rigorous regulatory health requirements, for the case of agricultural exports, and import competition for the case of services.

The energy sector is expected to benefit indirectly with an expanding manufacturing sector that uses energy intensively leading to a higher domestic demand for energy. In turn, higher domestic demand for energy will likely lead to higher capital investment. Although the energy sector represents only 2.7% of Thailand GDP, the worldwide push towards cleaner energy is putting pressure on countries like Thailand as its economy expands. For Thailand, embracing the transition towards cleaner energy sources at a faster pace will be difficult and costly. According to a 2024 US International Trade Administration report, renewable energy in Thailand constitutes only 23% of its overall installed capacity. Natural gas fuels approximately 65% of Thailand electricity generation. Thailand relies on domestic production for about 70% of its natural gas demand with the other 30% coming via pipeline from Myanmar and seaborne LNG in equal shares. Current plans for Thailand to reach carbon neutrality is by 2065–2070. While the focus of this paper is not the energy sector, FTAs do play a significant role on the sector, especially when energy intensive industries such as manufacturing, expands with free trade. Thompson and Toledo (2022) studies the impact of an FTA between Canada and China. They find that an FTA will lead to a decline in demand for renewable energy in Canada.

EU interest in an FTA with Thailand is not however, limited to trade alone. The resumption of talks in 2019 with the same military leaders, who took over the country in the 2014 coup, is an indication that the EU has a geopolitical concern. With the growing influence of China as a competitor in the region and the failure of the EU to reach an FTA with the ASEAN (negotiations suspended in 2009), the EU also seeks to promote the diversification of the ASEAN member countries away from China. So far, the EU has in place FTAs with South Korea and Singapore while FTAs negotiations are ongoing with Indonesia, Malaysia, and Vietnam. These agreements are likely to increase the influence and role of the EU in Southeast Asia.

The road ahead for the EU and Thailand to reach an FTA presents many challenges. For the EU, Thailand's high taxation of alcohol is a problem as is its restrictive access to specific industries, especially agriculture and financial services. For Thailand, the main challenges are the EU's non-tariff barriers. Thailand will need to meet the EU stringent regulatory standards in order to have these non-tariff barriers removed. The fact that the EU and Vietnam are at the verge of reaching an FTA, offers hopes that one with Thailand can also be achieved.

Regional and bilateral trade agreements both in ASEAN as well as in the rest of the world continue to grow. For example, according to a report by the European Commission in 2016, since the South Korea-EU FTA was implemented in 2011, exports from the EU to South Korea increased by 55% while the trade in goods between the 2 parties reached €90 billion in 2015. South Korea is now in the top 10 export markets for the EU. However, there is room for improvement as noted by Evert and Oh (2019), who find that focus and policies in sector specific programs will allow

South Korea to maximize the benefits of an FTA with the EU. Jung (2023), who finds that EU exports to South Korea have risen but South Korean exports to the EU have not been affected significantly, corroborates these findings.

The EU - Singapore FTA is another success story. In place since 2015, the deal removed all tariffs between the two parties. For Singapore, this means access to 500 million consumers in 27 countries, while for EU consumers, the FTA gives them better access to products and services produced in Singapore, including those produced by the more than 10,000 EU firms established in Singapore. Hsieh (2022) calls the EU - Singapore FTA "a pathfinder agreement that signifies a new phase of interregionalism and the EU's new Asia strategy after the Treaty of Lisbon."

Outside ASEAN, the Australia-EU FTA has received much attention. According to the Australian Department of Foreign Affairs and Trade, SMEs in Australia have significantly increased their market share because of the FTA with the EU. This translate into higher levels of domestic employment helping the Australian economy recover after the pandemic.

## 2. The specific factors model

The Specific Factors (SF) model of Jones (1971) and Samuelson (1971) has been interpreted as a short-run version or special case of the Factor Proportions (FP) model (Heckscher-Ohlin model), by Mayer (1974), Mussa (1974), and Neary (1978). As prices adjust due to free trade, the model produces comparative static results of changes in outputs, factor payments, and return to capital. In the SF model, the increase in price of any commodity resulting from higher export demand, holding other prices constant, increases factor payments of the mobile factors. The SF model shows the effects of free trade in an economy in which one factor is specific to an industry. While generally accepted among trade economists, the SF model has some limitations worth noting. The model assumes perfect competition and constant return to scale. Thus, the disadvantage of the model is that it tends to understate the size of the impact of an FTA in the short-run. Another important assumption is that capital is assumed to be sector-specific, while labor is allowed to move across industries. Potential gains/losses due to free trade can be overstated if some capital mobility exists in the short-run. Nonetheless, the model produces results that are important for policymaking. Countries should be able to have a reasonable measure the initial impact of an FTA in order to have a smoother transition to long-run economic growth.

The model for Thailand includes four economic sectors that combined represent 94.7% of GDP. The sectors are agriculture (A), manufacturing (M), services (S), and energy (E). Factors of production include six mobile labor skill categories: managers ($L_1$), professionals ($L_2$), technical workers ($L_3$), services workers ($L_4$), agricultural workers ($L_5$), and machine operators ($L_6$). Additionally, the four sectors of specific capital are capital in agriculture, ($K_A$), manufacturing ($K_M$), services ($K_S$) and Energy ($K_E$).

Results from the SF model allows us to identify winner and loser sectors and factors of production. This is important because the timely implementation of trade adjustment assistance (TAA) programs, to support and re-train workers, who may become unemployed due to free trade related reasons, could help mitigate this adverse effect likely to occur during the transition to long-run economic growth.

The SF model in the literature has been applied to study the impact of free trade on income redistribution in developing and developed countries. In a study of the US economy, Thompson (1997), estimates comparative statics using the SF model and finds price of US manufactures as well as wages of unskilled labor under free trade falls. Yeboah et al. (2012) applies the SF model to simulates the impact of a US-China FTA on the market of US pork. They find that return to capital in this sector is aligned with the increase in the price of pork while agricultural wages increase. Chow et al. (2023) applies the SF model to Taiwan and finds that under free trade, the decline in return to capital are significant while wage increase are moderate in the short-run. Other recent studies have shown that the impact of trade liberalization on income inequality, local labor markets, and poverty, remains unclear. For example, Khan et al. (2021), studies the impact of trade liberalization in Pakistan and finds that trade liberalization does not always reduce income inequality in the short-run. Yu (2024), studies trade liberalization on the local labor market in China and finds that older women are especially vulnerable. Based on this result, the gender effect of trade liberalization must be carefully studied. On the formation of trade agreements, Hur and Qiu (2019), add to the literature by arguing that trade agreements tend to have a larger positive effect on welfare when the tariff gap is smaller between the two trading partners. This suggests that the degree of complementarity between trading partners is not the only factor to be considered in the formation of FTAs. Finally, Kee and Nicita (2024), find that trade welfare losses are mitigated when measured using heterogeneous as opposed to homogeneous elasticities across products.

## 3. Factor and industry shares for Thailand

Factor and industry shares are the key building blocks of the SF model and are derived from the factor payment matrix. The factor payment matrix is built using data from the Central Bank of Thailand and ILOSTAT and presented in **Table 3**.

**Table 3.** Factor payment matrix (Millions USD).

| | **Agriculture (A)** | **Mfg. (M)** | **Services (S)** | **Energy (E)** |
|---|---|---|---|---|
| Managers $L_1$ | 50.08 | 717.74 | 202.97 | 498.82 |
| Professionals $L_2$ | 16.65 | 407.16 | 882.85 | 926.68 |
| Technical workers $L_3$ | 19.79 | 551.61 | 115.42 | 941.10 |
| Services workers $L_4$ | 24.18 | 115.24 | 664.95 | 119.15 |
| Agricultural workers $L_5$ | 12,436.12 | 0.00 | 0.00 | 0.00 |
| Machine operators $L_6$ | 210.50 | 123.56 | 126.41 | 195.00 |
| Ag Capital $K_A$ | 30,534.25 | 0.00 | 0.00 | 0.00 |
| Mfg. Capital $K_M$ | 0.00 | 963.24 | 0.00 | 0.00 |
| Services Capital $K_S$ | 0.00 | 0.00 | 172.51 | 0.00 |
| Energy Capital $K_E$ | 0.00 | 0.00 | 0.00 | 111.14 |
| OUTPUT | 43,291.56 | 126.60 | 292.31 | 137.95 |

Source: Bank of Thailand and ILOSTAT.

Factor shares $\theta ij$, are the share of factor *i* in the revenue of sector *j*, and are presented in **Table 4**. The share of value added paid to labor in each sector is given by $\theta ij \equiv w_L Lij/xj$, where $w_L$ is the average wage of factor *i*, *Lij* is the number of workers (labor input) *i* in sector *j*, and $x_j$ is output in sector *j*.

**Table 4.** Factor shares, $\theta ij$.

| | Agriculture (A) | Mfg. (M) | Services (S) | Energy (E) |
|---|---|---|---|---|
| Managers $L_1$ | 0.001 | 0.057 | 0.069 | 0.036 |
| Professionals $L_2$ | 0.000 | 0.032 | 0.030 | 0.067 |
| Technical workers $L_3$ | 0.000 | 0.044 | 0.039 | 0.068 |
| Service workers $L_4$ | 0.001 | 0.008 | 0.229 | 0.009 |
| Agricultural workers $L_5$ | 0.288 | 0.000 | 0.000 | 0.000 |
| Machine operators $L_6$ | 0.005 | 0.098 | 0.043 | 0.014 |
| Sector capital $K_j$ | 0.705 | 0.761 | 0.590 | 0.806 |

Source: Author's estimates.

Capital share is calculated as a residual. The capital share ($\theta_K j$), in sector *j* is $\theta_K j = 1 - \sum \theta ij$. For example, the factor share for agricultural workers ($L_5$), in the agricultural sector (A), is given by $\theta L_{4A} = 0.288$. Agricultural workers take about 28.8% of the income earned in the agricultural and forestry sector. Agricultural capital ($K_A$) takes the highest share of revenue in the agricultural sector at 0.705. Capital owners in agriculture take 70.5% of the income earned in the agricultural and forestry sector.

Assuming perfect factor mobility across sectors, the average wage rate for each labor input is the same across sectors, thus, industry shares, $\lambda ji$, is the share of sector *j* in the income of factor *i*. Because labor is mobile but capital is specific in each sector, the share of each sector's income to specific capital is 1. Industry shares are presented in **Table 5**. For instance, the services sector contributes 72.4% ($\lambda L_{1s} = 0.724$) to the total income earned by managers ($L_1$). In agriculture, the industry share for agricultural workers and agriculture capital are equal to 1 since agriculture workers work only in the agriculture sector.

**Table 5.** Industry shares, $\lambda ji$.

| | Agriculture (A) | Mfg. (M) | Services (S) | Energy (E) |
|---|---|---|---|---|
| Managers $L_1$ | 0.002 | 0.256 | 0.724 | 0.018 |
| Professionals $L_2$ | 0.001 | 0.294 | 0.638 | 0.067 |
| Technical workers $L_3$ | 0.001 | 0.306 | 0.641 | 0.052 |
| Service workers $L_4$ | 0.000 | 0.017 | 0.981 | 0.002 |
| Agricultural workers $L_5$ | 1.000 | 0.000 | 0.000 | 0.000 |
| Machine operators $L_6$ | 0.000 | 1.000 | 0.043 | 0.014 |
| Sector capital $K_j$ | 1.000 | 1.000 | 1.000 | 1.000 |

Source: Author's estimates.

Manufacturing contributes 30.6% of the total payments made to technical workers ($L_3$) and 100% to the payments made to plant and machine operators ($L_6$).

## 4. The specific factors model for Thailand with employment and capital inputs

The cross-price elasticity between the input of factor *i* and the payment to factor *k*, in sector *j*, are derived from Allen (1938) and written as:

$$E_{ij}^{k} = \hat{a}_{ij}/\widehat{w}_{k} = \theta_{kj}S_{ij}^{k} \quad (1)$$

where ^ represents a percentage change in a variable, $a_{ij}$ is the input of factor *i* in product *j*, $w_k$ is the payment to factor *k*, and $S_{ij}^{k}$ is the Allen partial elasticity of substitution. Assuming a Cobb-Douglas production function, Allen elasticities, $S_{ij}^{k} = 1$. Homogeneity $\sum_k E_{ij}^{k} = 0$ , and the own price elasticity $E_{ij}^{i}$ is the negative of the sum of cross price elasticities.

The cross-price elasticity is a weighted Allen elasticity and with Cobb-Douglas production function, it equals the factor share. Economy wide substitution elasticities are the weighted average of the cross-price elasticities for each sector and are calculated by summing across the elasticities by sectors, as described by Thompson (1994).

The behavioral assumptions are competitive pricing $\Sigma_i a_{im} w_i = p_m$, and full employment $\Sigma_j a_{kj} x_j = v_k$, where $x_j$ is the output of good $j$, $v_k$ is the endowment of factor *k*, $w_i$ is the price of factor *i*, $p_m$ is the price of good m, and $a_{im}$ is the input of factor *i* in product m. We fully differentiate these equations and put into matrix format as in Equation (2).

$$\begin{bmatrix} \sigma & \lambda \\ \theta' & 0 \end{bmatrix} \begin{bmatrix} \widehat{w} \\ \hat{x} \end{bmatrix} = \begin{bmatrix} \hat{v} \\ \hat{p} \end{bmatrix} \quad (2)$$

where σ is the matrix of substitution elasticities, $\lambda$ is the matrix of industry shares, and $\theta'$ is the matrix of factor shares. The system matrix in Equation (2) relates exogenous changes in factor endowments *v* and prices p to endogenous changes in factor prices *w* and outputs *x*, assuming full employment and competitive pricing in the comparative statics of the general equilibrium model.

The focus of this research is on how price changes due to the Thailand-EU FTA affect factor payments. Output changes are also reported at the aggregate level. Comparative static elasticities $\widehat{w}/\hat{p}$ and $\hat{x}/\hat{p}$ are found by inverting Equation (2) and is given by Equation (3). The $N = \widehat{w}/\hat{p}$ matrix describes how prices affect factor payments known as the Stolper-Samuelson result. The $R = \hat{x}/\hat{p}$ R = matrix describes the local surface of production possibilities in which each output should be positively related to its own price, while all other output declines given constant endowments. The matrix $Q = \hat{x}/\hat{v}$ is the Rybczynski result and describes how changing endowments affect output. However, Rybczynski elasticities are outside the focus of the paper since endowments are assumed constant in the short-run.

$$\begin{bmatrix} \hat{w} \\ \\ \hat{x} \end{bmatrix} = \begin{bmatrix} M & N \\ \\ Q & R \end{bmatrix} \begin{bmatrix} \hat{v} \\ \\ \hat{p} \end{bmatrix} \quad (3)$$

## 5. Comparative statics of the sf model

**Table 6** summarizes the Stolper-Samuelson elasticities for Thailand based on a 1% increase in the output price in one sector, while keeping all other output prices constant. For example, in the agricultural sector where agricultural workers are used intensively, their wages increase by 1.07%, the highest among all labor inputs. Payments to capital in agriculture also benefit by 1.07%. Payments to agricultural labor and capital should be equal in the model since both are sector specific. Higher agricultural prices will increase output and draw labor from other sectors. As labor moved move from other sectors, capital returns in those sectors fall; −0.02% in the manufacturing sector, −0.06% in the services sector, and −0.01% in the energy sector.

**Table 6.** Factor price elasticities.

| | $p_A$ | $p_M$ | $p_S$ | $p_E$ |
|---|---|---|---|---|
| $w_1$ | 0.010 | 0.324 | 0.660 | 0.015 |
| $w_2$ | 0.000 | 0.398 | 0.526 | 0.076 |
| $w_3$ | 0.000 | 0.420 | 0.522 | 0.057 |
| $w_4$ | −0.010 | −0.130 | 1.136 | −0.005 |
| $w_5$ | 1.070 | −0.009 | 0.002 | 0.000 |
| $w_6$ | 0.010 | 1.729 | −0.725 | −0.007 |
| $r_A$ | 1.070 | −0.009 | 0.002 | −0.020 |
| $r_M$ | −0.020 | 1.028 | −0.022 | −0.007 |
| $r_S$ | −0.060 | −0.162 | 1.171 | −0.007 |
| $r_E$ | −0.010 | −0.112 | −0.117 | 1.229 |

Source: Author's Estimates.

Based on a similar assumption, a 1% increase in services prices will increase return to capital by 1.17% while wages for services workers increase by 1.13%. These general equilibrium elasticities extend to all CES production functions regardless of the degree of substitution.

As predicted by the theory, in the surface of production possibilities elasticities, all outputs are positively related to their own price as shown in **Table 7**. As the price increases in one sector, output raises and draws labor away from other sectors, lowering output in those sectors. Manufacturing output is the most sensitive to a price change. A 1% increase in price while holding everything else constant, increases manufacturing output by 0.73%. Outputs in all 4 sectors are inelastic with respect to price.

**Table 7.** Output price elasticities.

| | $p_A$ | $p_M$ | $p_S$ | $p_E$ |
|---|---|---|---|---|
| $x_A$ | 0.007 | −0.009 | 0.002 | 0.000 |
| $x_M$ | 0.001 | 0.731 | −0.726 | −0.007 |
| $x_S$ | −0.001 | −0.162 | 0.171 | −0.007 |
| $x_E$ | 0.000 | −0.112 | −0.117 | 0.229 |

Source: Author's Estimates.

## 6. A distance measure of factor intensity

For a number of factors, Thompson (2002), defines factor intensity as the Euclidean distance to the intensity hyperplane relative to factor 1 as:

$$d_{ij} = \left[\left(\frac{a_{2j}}{a_{1j}}\right)^2 + \cdots + \left(\frac{a_{rj}}{a_{1j}}\right)^2\right]^{1/2} \quad (4)$$

The general formulation of the factor intensity distance for factor *h* in product *j* is:

$$d_{hj} = \left[\sum\nolimits_{i\sim h} \cdot \left(\frac{a_{1j}}{a_{hj}}\right)^2\right]^{1/2} \quad (5)$$

Samuelson (1953) defines factor intensity for 2 factors and 2 products with factor 1 intensive in product 1 as $a_{21}/a_{11} < a_{22}/a_{12}$ where $a_{ij}$ is the input of factor *i* in product *j*. Factor intensity distance generalizes the concept of factor intensity to any number of factors and goods. Good m uses factor h intensively relative to good n if $d_{hm} < d_{hn}$.

For each factor, goods can be ranked by factor intensity distance. To eliminate the issue of different units for labor and capital, inputs are weighted by their averages across industries. We focus on labor intensity to gauge the potential impact of higher (lower) output prices on Thai wages by labor skill category. Labor intensity across the 4 economic sectors and 6 labor skilled groups are presented in **Table 8**. Intensity measures are inverted and re-scaled to an index ranging from 0 to 100.

**Table 8.** Distance labor intensity.

| | A | M | S | E |
|---|---|---|---|---|
| $d_{1j}$ | 0.07 | 11.61 | 6.75 | 12.13 |
| $d_{2j}$ | 0.02 | 7.12 | 13.20 | 30.60 |
| $d_{3j}$ | 0.04 | 13.64 | 0.68 | 48.81 |
| $d_{4j}$ | 0.08 | 4.78 | 82.20 | 0.08 |
| $d_{5j}$ | 15.74 | 0.01 | 0.03 | 0.07 |
| $d_{6j}$ | 0.72 | 38.20 | 0.05 | 13.49 |

Source: Author's Estimates.

There are large differences in labor skill intensity as presented in **Table 8**. For example, in the manufacturing sector we observe large difference in skilled distance intensity. $L_6$, machine operators is the most intensive input at 38.2, followed by $L_3$, technical workers, at 13.64. Across industries, we observe that for each input, $L_1$, managers are more intensively used in the services sector while $L_3$, technical workers are most intensively used in the energy sector at 48.81. This is also true for $L_5$, agriculture workers at 15.74 in the agricultural sector.

Alternatively, we also observe across industries that $L_1$, managers and $L_2$, professionals, are the least intensive input used in agriculture at 0.07 and 0.02 respectively. $L_6$, machine operators is the least intensively used input in the services sector at 0.05.

The distance measure of factor intensity anticipates the Stolper-Samuelson results presented in **Table 6**. Factor intensity anticipate winner and loser factors of production due to output price changes with free trade. Factors most intensively used in sectors seeing higher output prices will benefit but will also lose in sectors seeing lower prices. Based on our results, and holding everything else constant, $L_5$, agriculture workers, $L_1$, managers, $L_2$, professionals, and $L_4$, services workers should see their wages falling with free trade with the EU since they are intensively used in sectors facing lower prices due to import competition. On the other hand, $L_3$, technical workers, and $L_6$, machine operators should see their wages increasing since they are more intensively used in sectors that will see higher prices due to higher export demand.

## 7. Projected adjustments to FTA price scenarios

Projected adjustment in factor payments and output resulting from exogenous price changes due to a potential Thailand-EU FTA are not available in the literature. However, Thompson (2016) projects a 10% increase in the price of Thai manufacturing due to a higher export demand. For agriculture, manufacturing, and services, world prices adjusted by trade elasticities following Imbs and Mejean (2016) are used. We consider these price change estimates, however, useful to analyze the potential impact of the Thailand-EU FTA on the distribution of income in these four important economic sectors in Thailand. Gilbert (2003) followed similar methodology to study the impact of the US-Morocco FTA.

Simulated adjustments of factor payments and outputs in the general equilibrium model are based on 3 different scenarios; baseline, optimistic, and pessimistic. These simulated adjustments examine the sensitivity to baseline, optimistic, and pessimistic FTA price change scenarios.

The baseline scenario assumes the price change vector, Baseline ($p_A$, $p_M$, $p_S$, $p_E$) = (−2%, 10%, −3%, 10%).

The optimistic scenario assumes a larger increase in export prices of manufacturers and energy, a larger decrease in agricultural prices, and a lower decrease in services prices, Optimistic ($p_A$, $p_M$, $p_S$, $p_E$) = (−5%, 15%, −1%, 12%).

The pessimistic scenario assumes a lower increase in manufacturing and energy prices and a larger decrease in agricultural and services prices, Pessimistic ($p_A$, $p_M$, $p_S$, $p_E$) = (−8%, 5%, −7%, 8%).

To estimate the impact of projected price changes on factor payments and outputs, these vectors of projected price changes are multiplied by the inverted system matrix $N = \widehat{w}/\hat{p}$ and output elasticities, $R = \hat{x}/\hat{p}$

to as shown in Equations (6) and (7) to derive the general equilibrium adjustments in factor prices and outputs.

$$[N_{10x4}]\begin{bmatrix}\hat{P}_A\\ \hat{P}_M\\ \hat{P}_S\\ \hat{P}_E\end{bmatrix}=\begin{bmatrix}\widehat{w}_{L1}\\ \widehat{w}_{L2}\\ \widehat{w}_{L3}\\ \widehat{w}_{L4}\\ \widehat{w}_{L5}\\ \widehat{w}_{L6}\\ \hat{r}_A\\ \hat{r}_M\\ \hat{r}_S\\ \hat{r}_E\end{bmatrix} \tag{6}$$

$$[R_{4x4}]\begin{bmatrix}\hat{P}_A\\ \hat{P}_M\\ \hat{P}_S\\ \hat{P}_E\end{bmatrix}=\begin{bmatrix}\hat{x}_A\\ \hat{x}_M\\ \hat{x}_S\\ \hat{x}_E\end{bmatrix} \tag{7}$$

In the baseline scenario, agricultural prices fall by 2.0%, ($p_A$ = −2.0%), manufacturing prices increase by 10.0% ($p_M$ = 10.0%), services prices fall by 3.0% ($p_S$ = −3.0%), and energy prices increase by 10.0% ($p_E$ = 10.0%). Consistent with the Stolper-Samuelson result, under the baseline scenario, all wages, except that for professionals ($w_2$), technical workers ($w_3$), and machine operators ($w_6$), as predicted by labor intensity distance, are expected to fall. Machine operators are the ones who will see their wages, $w_6$, jumping the most by 19.4% due to higher manufacturers export demand. Wages for agricultural workers, $w_5$ and for services workers, $w_4$, are expected to decrease by 1.1% and 5.0% respectively. Owners of capital in agriculture and services will see their return on investment falling by 2.6% and 5.1% respectively ($r_A$ = −2.6% and $r_S$ = −5.1%). Owners of capital in manufacturing and energy will see their return on investment increasing, 10.2% in manufacturing ($r_M$ = 10.2%), and 12.0% in energy ($r_E$ = 12.0%). These large changes might require short-run government support in the losing industries.

The optimistic scenario shows a significant short-run increase in the wage of machine operators of up to 27.0% ($w_6$ = 27.0%), and a 15.9% increase in the return to capital in manufacturing ($r_M$ = 15.9%). Losers in the optimistic scenario of price changes are professionals who could see their wages falling by 3.9% ($w_1$ = −3.9%), agricultural workers by 5.5% ($w_5$ = −5.5%), while capital owners in agriculture could see their return on investment falling by 5.9%, ($r_A$ = −5.9%).

The pessimistic scenario of price changes deepens the problem of wage falling for professionals, service workers, and agricultural workers, with wages falling by 4.6%, 9.2%, and 18.0% respectively. This happens because these 3 skilled labor categories are used intensively in losing industries under free trade, that is, agriculture and services. These significant wage adjustments are based on the robust intensive factor elasticities in **Table 6**.

Although not the focus of this study, we also report in **Table 9** changes in outputs in Thailand resulting from an FTA with the EU. Because of the level of aggregation of the data available, output changes are reported by industry. The results are consistent with preliminary studies on the benefits of Thailand FTA with the EU, especially in manufacturing, while short-term losses are expected in services and agriculture. However, in order for the manufacturing sector to take advantage of the FTA, it must improve its technical efficiency. Charoenrat et al. (2013), find that the weighted average of technical efficiency in the Thai manufacturing sector is about 50%. Output adjustments reported in **Table 9** scale according to the degree of CES. For example, if CES = 0.5, output adjustments will be half as large. However, the factor price adjustment will be identical for any degree of CES as shown by Thompson and Toledo (2007).

**Table 9.** Adjustments to FTA price scenarios.

| % Change in Prices | | | | % Change in Factor Prices | | | | % Change in Outputs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Base Opt Pess | | | | Base Opt Pess | | | | Base Opt Pess | | | |
| $p_A$ | −2 | −5 | −8 | $w_1$ | −1.1 | −3.9 | −4.6 | xA | −1.7 | −3.3 | −6.1 |
| $p_M$ | 10 | 15 | 5 | $w_2$ | 2.2 | 4.0 | 1.7 | xM | 6.4 | 8.1 | 4.0 |
| $p_S$ | −3 | 1 | −7 | $w_3$ | 3.3 | 6.1 | 1.6 | xS | −3.7 | −1.1 | −6.8 |
| $p_E$ | 10 | 12 | 8 | $w_4$ | −5.0 | −3.7 | −9.2 | xE | 3.0 | 5.4 | 3.8 |
| | | | | $w_5$ | −2.0 | −5.5 | −18.0 | | | | |
| | | | | $w_6$ | 19.4 | 27.0 | 14.6 | | | | |
| | | | | $r_A$ | −2.6 | −5.9 | −7.8 | | | | |
| | | | | $r_M$ | 10.2 | 15.9 | 5.1 | | | | |
| | | | | $r_S$ | −5.1 | −4.4 | −9.3 | | | | |
| | | | | $r_E$ | 12.0 | 13.3 | 10.4 | | | | |

Source: Author's Estimates.

In all 3 scenarios of price changes due to free trade, results clearly show that the agricultural and services sectors will suffer in the short-run due to import competition. Labor inputs used intensively in these sectors will see their wages falling and so will capital owners. Manufacturing and energy are winners in an FTA with the EU. Wages of labor inputs used intensively in manufacturing and energy will rise and so will the return to capital. Energy benefits indirectly from an FTA via higher demand from the manufacturing sector as it adjusts to increase production to export to the EU.

Lower output in agriculture and services will lead to unemployment in those sectors, thus they are prime candidates to receive trade adjustment assistance in the short-run.

## 8. Conclusions

Empirical studies on how wages of different skilled labor groups and return on investment in some of the most important economic sectors in Thailand will be affected in short-run by a possible FTA with the EU are lacking in the literature. Filling this gap is important, as the negotiations are ongoing. Understanding the short-run implications of free trade is key in the development of polices designed to mitigate any negative short-run effect. While research on economic performance and trade liberalization on group of countries are important, individual country studies on free trade are necessary in order to fine tune trade policies that incorporates the economic realities of each individual country. The SF model of production and trade used in the present study produces general equilibrium results that allow us to visualize how wages, return to capital, and output, will be impacted as Thailand adjusts to long-run equilibrium.

Results of the model show that the FTA will have both negative and positive impact on the Thai economy, thus the policy implications of the results are important. Two of the 4 sectors included in the study, manufacturing and energy, will benefit from the agreement, while agriculture and services will lose. Manufacturing is an important sector in Thailand's economy representing 25% of GDP, while energy is smaller, with only 2.7% of GDP. Agriculture is also an important sector in Thailand employing over 10 million workers (25% of the labor force), and representing 9.0% of GDP. Services is the biggest sector of Thailand's economy with 58% of GDP. Having two key economic sectors winning from free trade with the EU implies working on new economic policies designed to enhance and improve productivity and technical efficiency of these sectors in order to achieve maximum benefit. As previously noted, technical efficiency in manufacturing reaches only 50%. Improvement in technical efficiency will allow the Thai manufacturing sector to take full advantage of the opportunities a free trade agreement with the EU offers, and even to expand to other markets outside the EU as productivity levels improve. In addition, as noted earlier, the energy sector is an indirect winner of a free trade with the EU. However, new energy policies directed at increasing sustainable energy generation will be necessary in order to achieve long-run sustainable economic growth. In Thailand, only 23% of its energy generation is considered clean, thus challenges remain.

With the manufacturing sector expanding, professionals, technical workers, as well as machine operators will see their wages increasing while capital owners benefit with a higher return on their investments. With the agriculture and services sectors losing, agriculture workers, managers, and services workers will see their wages falling. Capital owners in both sectors will also see their return on investment falling. Model results also emphasize the importance of labor and capital mobility. Clear rules and polices to ensure the frictionless mobility of labor and capital will be necessary early in the process of adjustment to free trade. Based on new research on China previously cited, the losses on domestic labor markets could be uneven with female workers probably losing more than their male counterparts. How labor disaggregated by gender is impacted by free trade has received little attention and constitute an important topic for future research.

Studies on how countries that have followed outward oriented policies have developed more efficiently are well documented in the literature. Achieving economic competitiveness resulting from free trade could take decades and requires many structural adjustments along the way. Recognizing that the adjustment process could be painful and lengthy is important in the development of soft infrastructure, such as free trade zones (FTZ), the creation of more efficient logistical operations, maintaining a stable exchange rate regime, the implementation of agricultural health standards, and good governance. Robust soft infrastructure could help accommodate new policies and strategies designed to mitigate the short-run negative effects of free trade in order to maintain the country's socio-economic standards of living while simultaneously, propelling long-run sustainable economic development.

**Conflict of interest:** The author declares no conflict of interest

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## Appendix: Description of variables

| | |
|---|---|
| $\theta_{ij}$ | Share of factor *i* in the revenue of sector *j* |
| $L_{ij}$ | Number of workers *i* in sector *j* |
| $x_j$ | Output in sector *j* |
| $\theta_{kj}$ | Capital share in sector *j* |
| $\lambda_{ji}$ | Share of sector *j* in the income of factor *i* |
| ^ | Percentage change in a variable |
| $S_{ij}^{k}$ | Allen partial elasticity of substitution |
| $E_{ij}^{i}$ | Own price elasticity |
| $v_k$ | Endowment of factor *k* |
| $w_i$ | Payment to factor *i* |
| $p_m$ | Price of good *m* |
| $a_{ij}$ | Input of factor *i* in product |