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Impacts of Trade Diversion from China in the United States Market on Wages in a Third Country: Evidence from Thailand

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Abstract: *Since the latter half of the 2010s, China's exports to the United States (US) have gradually decreased due to the US-China trade war and other factors, such as lockdown measures in China to combat COVID-19. This decrease has resulted in increasing exports from third countries, including Thailand, to the US market by substituting China's exports, i.e. trade diversion. Against this backdrop, this study empirically investigates how the changes in exports to the US driven by the change in China's exports to the US affect wages in Thailand. Especially, we examine the heterogeneous effects according to workers' characteristics. To this end, we conduct regression analyses using individual-level quarterly data from the first quarter of 2017 to the second quarter of 2023. Our main finding is that the wage gap between low- and middle-skilled workers decreased, whilst the gap between middle- and high-skilled workers increased. Namely, the increased exports to the US caused 'wage polarisation' in Thailand. We also find that the increase in exports to the US contributed to expanding the wage gap by age but narrowing it by gender.*

Keywords: US-China trade war; wages; Thailand

JEL Classifications: F15, F53

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1. Introduction

In the latter half of the 2010s, we observed the outbreak of the United States (US)-China trade war. Under Section 301 of the Trade Act of 1974, the US raised tariffs on imports from China in four phases in 2018 and 2019. The raising of the tariffs in the US was gradual and was expanded to a larger number of products over time. In retaliation, China also imposed additional tariffs on an array of products imported from the US. To ease this tension, the two governments concluded the Economic and Trade Agreement (the so-called 'Phase-one Agreement'), which entered into force in February 2020. As a result, additional tariffs were suspended on many products in both the US and China in 2020. However, since 2021, the US again started imposing additional tariffs on those products, except for some medical products. As of October 2023, this trade war shows no signs of ending.

This war has also affected the third countries' economies. For example, by substituting China's exports, they may increase their exports to the US market, i.e. trade diversion. Indeed, Ricoh Company, Ltd., a Japanese multinational electronics company, moved its production base for multi-function printers for the US market from China to Thailand.[1] Also, the additional tariffs by the US may induce Chinese firms to export their products first to third countries and then re-export those products to the US without any substantial transformation, i.e. trade circumvention (Ha and Phuc, 2019).[2] Indeed, to prevent this circumvention, in November 2019, Thailand established a watchlist for high-risk products to US and European Union markets and has required exporters to submit additional documents to prove the origin of goods (see, for example, Hayakawa and Sudsawasd (2024)).

Against this backdrop, we investigate how the changes in exports to the US affect wages in Thailand. US additional tariffs against China have significantly decreased China's exports to the US (Amiti et al., 2019; Amiti et al., 2020; Fajgelbaum et al., 2020). Also, the lockdown measures in China to combat the COVID-19 pandemic may have decreased China's exports to the US. As a result, as shown in the next section, exports from Thailand to the US have gradually increased. Such an increase was realised because competition in the US market became less tough due to the decrease in exports from China. In Thailand, the increase in exports will raise operating

[1] Several examples are available in an article by Nikkei Asia from 18 July 2019: https://asia.nikkei.com/Economy/Trade-war/China-scrambles-to-stem-manufacturing-exodus-as-50-companies-leave.

[2] Many pieces of anecdotal evidence on such trans-shipments are available. See, for example: https://www.woodworkingnetwork.com/cabinets/us-customs-border-protection-finds-us-cabinet-depot-evading-cabinet-duties, https://www.woodworkingnetwork.com/news/woodworking-industry-news/customs-finds-cabinet-importers-evaded-chinese-duties-transshipping and https://www.forest-trends.org/blog/us-customs-and-border-protection-cbp-finds-chinese-timber-products-fraudulently-sold-in-us-as-made-in-vietnam-in-order-to-evade-tariffs/.

profits in exporting firms and thus increase the wages of workers. In this paper, we examine how this increase in exports to the US driven by the change in China's exports to the US changes the wages of Thai workers. Especially, we uncover the heterogeneous effects according to workers' characteristics. Indeed, as shown in the next section, we observe heterogeneous changes in wages in Thailand during our study period. Such differences in wage growth may be associated with the export growth of Thailand to the US.

We use individual-level quarterly data obtained from the Labour Force Surveys in our empirical analyses. Our study period spans from the first quarter of 2017 to the second quarter of 2023, i.e. covering the period of the US-China trade war. With this dataset, we investigate the differences in the wage impact according to age, sex, marital status, company size, education level, occupation, and location (urban or not). To investigate the trade diversion effect in the US market, namely, the effect of the increased exports to the US driven by the change in China's exports to the US, we instrument exports from Thailand to the US by exports from China to the US. Our analyses of the heterogenous impacts on wages will uncover how such a trade diversion effect changes income inequality according to skills or geography. As a result, our main findings can be summarised as follows. The increase in exports to the US contributed to expanding the wage gap by age but narrowing it by gender. Furthermore, the wage gap between low- and middle-skilled workers decreased, whilst the gap between middle- and high-skilled workers increased. These results are unchanged between the periods 2017–2019 and 2020–2023.

Our study belongs obviously to the literature on the US-China trade war.[3] Many studies examine the direct effects of tariffs on the US economy (Amiti et al., 2019; Amiti et al., 2020; Fajgelbaum et al., 2020; Cavallo et al., 2021; Handley et al., 2020; Egger and Zhu, 2020; Blanchard et al., 2024) or China's economy (Ma et al., 2021; Chor and Li, 2021; Cui and Li, 2021). A few studies investigate the trade effects on the third economy. For example, Choi and Nguyen (2023) and Ngoc and Wie (2023) found a substantial rise in US imports of targeted goods from Viet Nam due to the trade war. Cigna et al. (2022) report no significant changes in US imports from third countries in the short term. Ma et al. (2021) demonstrate that the trade diversion effect in China's imports was observed in those from Brazil and South Africa. Hayakawa et al. (2023) demonstrated that the decrease in China's output exports to the US reduced China's input imports from supplier economies, especially from Taiwan, where multinational enterprises use China as an export platform. A more comprehensive analysis of trade diversion effects was undertaken by Fajgelbaum et al. (2020). In contrast to these studies on the trade effect, we focus on the effect on individuals' wages.

[3] See, for example, Fajgelbaum and Khandelwal (2022) for a review of this literature.

The studies closest to ours are Mayr-Dorn et al. (2023) and Rotunno et al. (2023). They investigate the effect of the US-China tariff war on wages in Viet Nam. Indeed, Viet Nam is another typical country that enjoys trade diversion in the US market. In the empirical identification, Mayr-Dorn et al. (2023) and Rotunno et al. (2023) rely mainly on regional variation and industry variation, respectively. Nevertheless, these two studies found similar results, which are that Vietnamese workers and districts more exposed to the trade war displayed higher employment, working hours, and wages. There are some differences between these two studies and ours. First, their study period is until 2019, whilst our period extends to 2023. We believe this extension matters because exports from Thailand to the US increased dramatically after 2019. Second, we investigate the heterogenous effects on wages according to more dimensions. For example, unlike their study, we examine those effects by company sizes and individuals' occupations. Our study will contribute to adding some new findings to this literature.[4]

The rest of this study is organised as follows. Section 2 overviews wages and trade in Thailand. After specifying our empirical framework in Section 3, we present our estimation results in Section 4. Section 5 concludes this study by discussing policy implications.

2. Background

This section takes an overview of wages and exports in Thailand. Table 1 presents the average monthly wages per employee in the first quarters of 2017 and 2023. We use the Labour Force Surveys, of which details are explained in the next section.[5] The percentage change in wages varies depending on the gender, education, and occupation groups. The wage growth is not different between male and female workers. In terms of education, we can see U-shaped changes in wages. The wage change in workers with post-secondary education, bachelor's degree education, or master's degree education shows exceptionally low rates. In particular, wages for bachelor's degree workers declined on average. On the other hand, workers with lower levels of education or doctoral degree education experienced a more than 10% rise in wages. In terms of

[4] There are two more strands of related literature. One is the literature on trade circumvention (Rotunno et al., 2013; Liu and Shi, 2019; Li and Lin, 2022). In the context of US-China trade disputes, Hayakawa (2022) found evidence suggesting that certain Chinese-made products are re-exported to the US via ASEAN countries (including Thailand) to avoid US tariffs imposed on China. The other is the literature on the effects of regional trade agreements on wages at the individual level (e.g., Fukase, 2013; Hakobyan and McLaren, 2016; Kovak and Morrow, 2022). For example, Hakobyan and McLaren (2016) investigated the effects of the North American Free Trade Agreement (NAFTA) tariffs on wages in the US according to individuals' educational attainment. They found that NAFTA tariff reductions were associated with substantially reduced wage growth for married blue-collar women.

[5] In this table, we use weights to recover the population in the whole country.

occupation, only the class of 'managers, senior officials, and legislators' experienced a wage decline. Also, relatively low rises can be found for 'professionals' and 'skilled agricultural forest and fishery workers.'[6]

Table 1: Number of Persons and Average Monthly Wage per Employee in Thailand

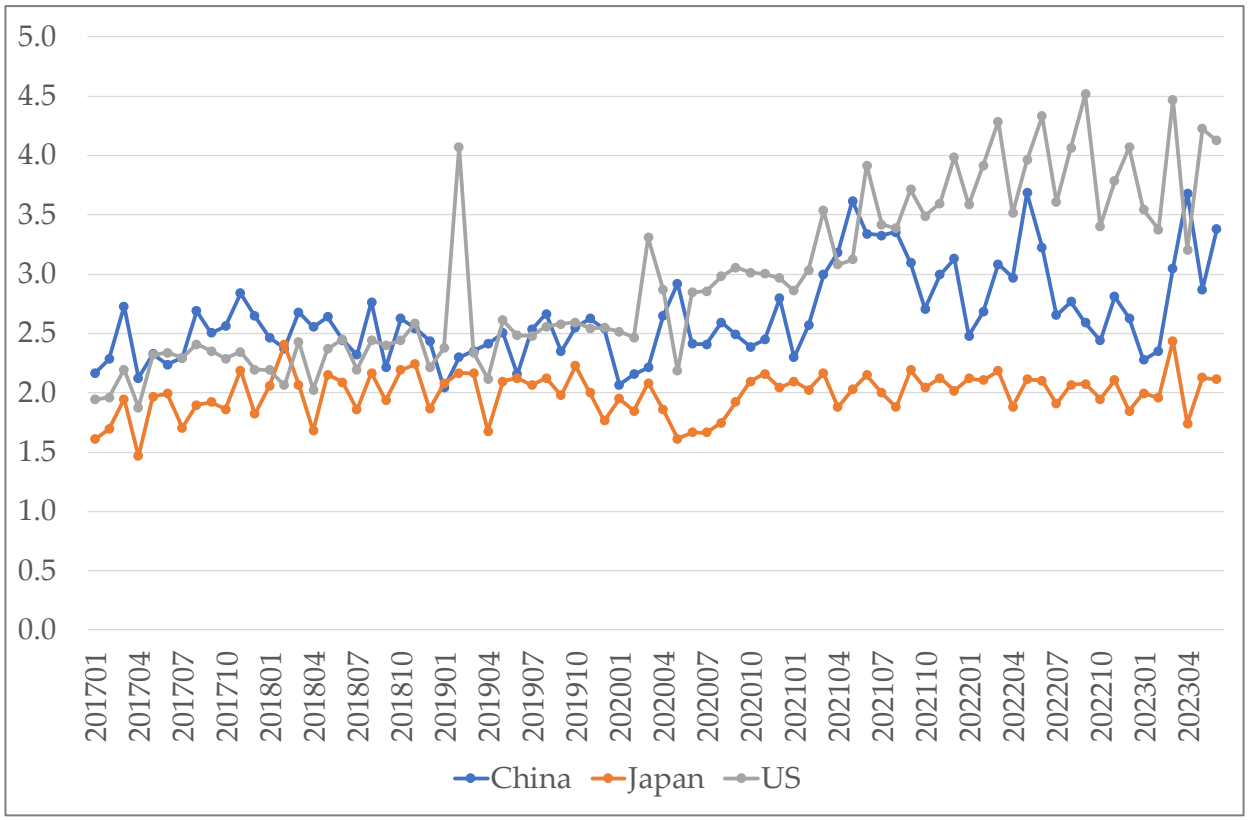
	2017 Q1	2023 Q1	Change
Number of Persons	67,555,030	69,953,421	3.55%
Number of Employed Persons	36,692,615	39,064,904	6.47%
Number of Employees	17,842,806	19,186,568	7.53%
Average monthly wage per employee (Thai baht)			
All	13,938	15,140	9%
By gender			
Male	13,861	15,169	9%
Female	14,030	15,107	8%
By education			
None	7,856	8,950	14%
Lower than elementary	7,768	8,580	10%
Primary education	8,597	9,760	14%
Lower secondary education	9,628	10,870	13%
Upper Secondary level education	11,484	13,000	13%
Post-secondary education	15,188	15,829	4%
Bachelor degree education	22,969	22,965	-0.02%
Master degree level	36,613	38,005	4%
Doctoral degree level	45,926	52,030	13%
Other education	7,838	9,185	17%
By occupation			
Managers, senior officials, and legislators	29,779	29,189	-2%
Professionals	26,461	26,732	1%
Technicians and associate professionals	20,578	22,594	10%
Clerks	14,933	15,904	7%
Service and sales workers	11,076	12,289	11%
Skilled agricultural forest and fishery workers	6,771	6,793	0.3%
Craft and associate professionals	10,323	12,487	21%
Plant and machine controllers and assemblers	10,411	12,500	20%
Elementary occupations	7,501	8,811	17%

Source: Thailand's Labour Force Surveys in 2017 and 2023.

[6] Similar results can also be found in wage growth rates after initiating the US-China trade war, as shown in Table A1 in the Appendix. Table A2 presents the growth rates of employees. Workers with bachelor's degrees have the highest share and have experienced a moderate increase.

Next, Figure 1 depicts the monthly exports from Thailand to the top three destinations, i.e. China, Japan, and the US. The data are obtained from the Global Trade Atlas. The figure includes the period from January 2017 to June 2023. Until 2018, the magnitude differences across these three exports were not large. However, they have changed differently since 2019. Exports to Japan have not changed much and have remained at a low level compared with those to China and the US. Those to China have been unstable and have continued to rise and decline.[7] On the other hand, exports to the US have experienced a gradual rise, especially since the latter half of 2020. Since 2019, the US has been the top export destination for Thailand in terms of value. In exports to the US in 2022, electrical machinery and general machinery accounted for 28% and 24% of total exports, respectively. Specifically, machines for reception, conversion, and transmission (HS 851762) and photovoltaic cells assembled in modules or made up into panels (HS 854143) were the main export products to the US market.

Figure 1: Monthly Exports from Thailand to the Top-three Destinations (US$ billion)



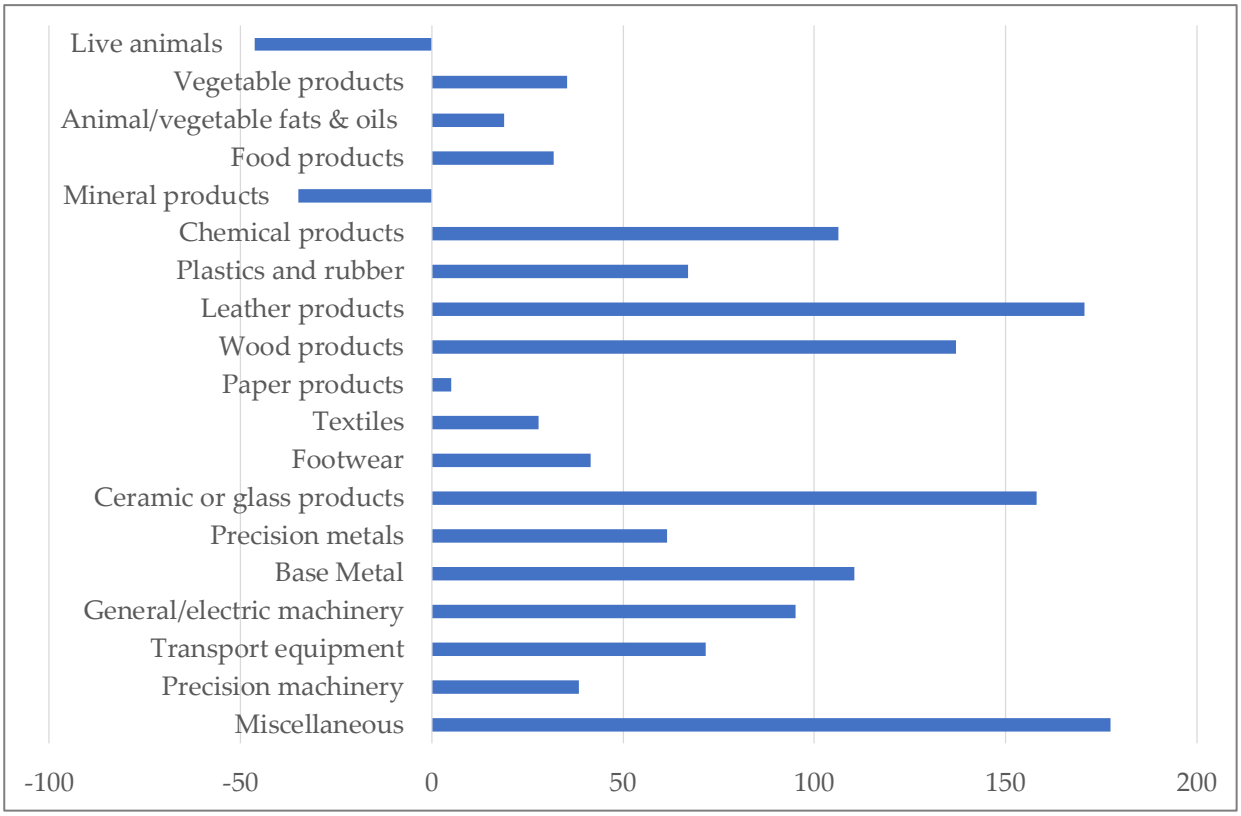
US = United States.

Source: Global Trade Atlas.

[7] This change is the reason why we focus on the effect of exports to the US and do not examine the effect of those to China. Furthermore, since the main products with additional tariffs are different between the US and China, we believe that ignoring the effect of exports to China does not yield endogeneity issues.

We take a closer look at changes in exports from Thailand to the US. Figure 2 shows the growth rate from 2017 to 2022 by industry. Note that although the magnitude of the additional tariffs by the US against China differs by product, additional tariffs were made on almost all products. Namely, all industries in Thailand could potentially increase exports to the US due to the decrease in exports from China. Consistent with this fact, the export decrease in this period can be found only for live animals (-46%) and mineral products (-35%). Other industries record growth. Industries with relatively high growth include miscellaneous industry (177%), leather products (171%), ceramic or glass products (158%), and wood products (137%). In short, the changes in exports to the US are not uniform across industries.

Figure 2. Growth Rates of Exports from Thailand to the US from 2017 to 2022 by Industry (%)



Source: Global Trade Atlas.

3. Empirical Framework

This section explains our empirical framework to investigate the heterogeneous impacts of the recent increase in exports to the US on wages in Thailand. Indeed, the wage impact is expected to be not uniform across individuals according to various dimensions. First, wages will rise more in industries with the increased exports to the US because of the increased operating

profits. Second, since larger-sized firms tend to be exporters, workers in larger-sized firms will enjoy such a wage rise. Third, the wage rise will be more significant for workers intensively inputted in export industries, e.g. unskilled workers in terms of education and occupation. These dimensions will play a key role in the effects of exports to the US on individual wages.

Our main source of data is the Labour Force Surveys from the first quarter of 2017 to the second quarter of 2023 (excluding the second quarter of 2021), collected by the National Statistical Office of Thailand. Since 2001, the survey has been conducted on a quarterly basis, and the population surveyed has included all people aged 15 and older who are classified as either in the labour force or not, according to the activity in which each person was engaged during the survey reference week.[8] Note that we cannot panelise the individuals across years. We can identify an industry where each individual works. Industry codes are available at the four-digit level of the International Standard Industrial Classification (ISIC). This industry code is key to linking individuals with exports to the US. In addition, the weight for each sample unit is available to recover the population in the whole Kingdom.[9] We run our regressions using this weight.

Our baseline equation for logged monthly wages for an individual *i* who works in ISIC four-digit *j* and lives in province *r* at year-quarterly time *t* is specified as follows.

$$\ln Wage_{ijrt} = \mathbf{X}'\boldsymbol{\beta} + \ln TH\ Exports\ to\ US_{jt} \times \mathbf{X}'\boldsymbol{\gamma} + FE_{jt} + FE_{rt} + FE_{jr} + \epsilon_{ijrt}. \qquad (1)$$

X is a vector of individual characteristics, including age, sex, marital status, company size, education level, occupation, and location. $TH\ Exports\ to\ US_{jt}$ refers to the exports of industry *j* from Thailand to the US at time *t*. We control for industry-time, province-time, and industry-province fixed effects (*FE*). In particular, the industry-time fixed effects will address the endogeneity of $TH\ Exports\ to\ US_{jt}$ in addition to controlling for industry-level trade barriers

[8] The survey was based on stratified two-stage sampling. Provinces were constituted strata. Each stratum was divided into two types of local administration, i.e. municipal areas and non-municipal areas. The primary and secondary sampling units were blocks for municipal areas and villages for non-municipal areas, and private households/persons in special households (which include persons living in a group), respectively. Data collection was carried out through the interviewing method.

[9] According to the report of the Labour Force Surveys, there were three steps for calculating a weight for each sample unit: 1) the calculation design weight or base weight and the inverse selection probabilities for each state of the selected sampling unit were calculated; 2) adjustment for non-response and base weights were adjusted to compensate for non-response households; and 3) post-stratification calibration adjustment was performed. The base weight adjusted by non-response data was further adjusted using the projected population and classified by grouped age, sex, region, and administration.

(e.g. tariffs) and domestic institutional changes.[10] The province-time fixed effects will control for minimum wages and other province-specific factors. The wage effect of the COVID-19 pandemic in Thailand may be included in these fixed effects. The availability of primary factors is controlled for by the industry-province fixed effects. ϵ_{ijrt} is a disturbance term.

To focus on the wage effects of the increased exports to the US that were driven by the change in China's exports to the US, we instrument $\ln TH\ Exports\ to\ US_{jt} \times \mathbf{X}'\boldsymbol{\gamma}$ by China's exports to the US, $\ln CN\ Exports\ to\ US_{jt} \times \mathbf{X}'\boldsymbol{\gamma}$.[11] Indeed, if lower wages for workers with specific characteristics enhance export competitiveness, the error term in the equation above is correlated with $\ln TH\ Exports\ to\ US_{jt} \times \mathbf{X}'\boldsymbol{\gamma}$. In short, the estimates of this equation by the ordinary least square (OLS) method suffer from endogeneity bias. Our identification based on the instrumental variable (IV) method relies on trade diversion from China to Thailand in the US market. Specifically, we examine the changes in wages in industries with increased exports to the US market driven by the change in China's exports. Note that such a change in China's exports to the US may be driven not only by the US-China trade war but also other factors such as the lockdown measures in China to combat COVID-19. Our framework cannot exclude those other factors. Due to the trade diversion effect, China's exports to the US will be highly correlated with Thailand's exports to the US.[12] Furthermore, we believe that the exclusion restriction reasonably holds.[13] Nevertheless, we conduct various statistical tests on the validity of our instrument.

More details on the variables of individual characteristics are as follows. We categorise education level into two groups, i.e. university graduates or not. The university graduates include those with post-secondary education, bachelor's degree education, master's degree education, or

[10] The lower wages may increase exports to the US due to the lower production costs. This reverse causality creates a negative correlation between exports to the US and an error term. Therefore, if we estimate the equation with the non-interacted version of exports to the US by the ordinary least square, its estimate will suffer from a downward bias.

[11] We add a value of 1 to exports to the US in Thailand or China before taking a log. In addition, we do not use US additional tariffs on goods from China as an instrument because most of those tariff changes can be observed only before 2020.

[12] When we regress $\ln TH\ Exports\ to\ US_{jt}$ on $\ln CN\ Exports\ to\ US_{jt}$, ISIC four-digit fixed effects, and time fixed effects for the same time period as our estimation of equation (1) by the OLS method, the coefficient for $\ln CN\ Exports\ to\ US_{jt}$ is estimated to be -0.22 at a 10% significance level. Thus, a 1% decrease in China's exports to the US increases exports from Thailand to the US by 0.22%.

[13] The exclusion restriction assumption will be violated if China's exports to the US are related to wages in Thailand through other channels. One possible example may be a channel via supply chains between China and Thailand. The reduction in China's exports of downstream products to the US may decrease China's imports of upstream products from Thailand. However, the former reduction in a downstream industry will not have effects on China's imports of that downstream industry from Thailand or, therefore, on wages in that downstream industry in Thailand. Furthermore, this supply chain channel may be weak because as we found in Figure 1, Thailand did not decrease exports to China much.

the doctoral degree level[14]. We exclude workers with 'other education' in Table 1. According to the definition by the International Labour Organization, the occupation category is classified into three groups: high-skilled (managers, professionals, and technicians), middle-skilled (clerical support workers, service and sales workers, skilled agricultural, forestry, and fishery workers, craft and related trades workers, and plant and machine operators and assemblers), and low-skilled (elementary occupations). Company sizes are grouped into small (1–100 persons), medium (101–199 persons), and large (over 200 persons). The location category includes urban or rural.

There are some more data issues. First, since our interest lies in the wage effects of goods trade, we restrict workers only to those in non-services industries. Second, we restrict observations to employers or employees in private companies. In other words, our study observations do not include unpaid family workers, self-employed without employees, or government employees and state-owned enterprise employees. Third, our interest is based on the narrow definition of employed persons defined as persons who, during the survey week, were employed, worked for wages/salary, profits, dividends, or any other kind of payment, or worked in a family business. Hence, our observations do not include those who did not work at all or worked without pay in business enterprises. Last, we restrict the study to workers aged 25–60 because teenagers cannot be university graduates by definition, and the official retirement age in Thailand is 60. The basic statistics for our study observations are reported in Table 2. The table shows that high-skilled workers occupy 9%, whilst small-sized companies account for nearly 40%. Also, the share of university graduates is 17% of the total observations.

[14] We do not differentiate doctoral degree holders from other university graduates because there are few persons with doctoral degrees in our study observations (less than 50 persons).

Table 2: Basic Statistics

	Obs.	Mean	Std. Dev.	Min.	Max.
ln Wage	287,845	9.191	0.435	8.006	10.127
ln TH Exports to US	287,845	15.806	5.287	0	22.145
ln Age	287,845	3.564	0.304	2.708	4.522
Male	287,845	0.547	0.498	0	1
Married	287,845	0.644	0.479	0	1
Urban	287,845	0.456	0.498	0	1
University graduates	287,845	0.169	0.375	0	1
Occupation: Unskilled (Base)					
Middle skilled	287,845	0.735	0.441	0	1
High skilled	287,845	0.089	0.285	0	1
Company size: Small (Base)					
Medium	287,845	0.187	0.390	0	1
Large	287,845	0.428	0.495	0	1

US = United States.

Source: Authors' computation.

4. Empirical Results

This section reports our estimation results. In all estimations, we cluster standard errors by industry (ISIC four-digit code). As a basic analysis, we first regress on non-interacted variables only. The results for the OLS method are shown in column (I) in Table 3. In this estimation, we do not control for industry-time fixed effects to incorporate exports to the US into the model. The coefficient for exports to the US is insignificantly estimated, indicating no significant impacts of exports to the US on wages on average. The results for individual characteristics show significant contributions to the wage. Specifically, individual wages are higher for older persons, males, married persons, urban residents, higher educated persons, skilled persons, and workers in larger-sized companies. Overall, these results are consistent with our intuition. In column (II), we control for industry-time fixed effects and drop the variable of exports to the US. The results for individual characteristics are almost the same.

Table 3: Basic Results

	(I)	(II)
ln TH Exports to US	0.000	
ln Age	0.113***	0.111***
Male	0.078***	0.078***
Married	0.025***	0.025***
Urban	0.008***	0.008***
University graduates	0.244***	0.242***
Occupation: Unskilled (Base)		
Middle skilled	0.105***	0.106***
High skilled	0.372***	0.374***
Company size: Small (Base)		
Medium	0.091***	0.093***
Large	0.114***	0.117***
Industry-time FE		X
Province-time FE	X	X
Industry-province FE	X	X
Number of observations	287,845	287,696
Adjusted R-squared	0.633	0.637

FE = fixed effects, US = United States.

Notes: Estimation results were obtained using the OLS method. The dependent variable is the log of monthly wages. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are clustered by industry (ISIC four-digit code).

Source: Authors.

Next, we estimate equation (1), i.e. the equation with interacted terms. To save space, we do not report non-interacted variables on individual characteristics. In column (I) in Table 4, we introduce exports to the US without controlling for industry-time fixed effects. The coefficient for exports to the US is again insignificant. Amongst interaction terms, only some of them have significant coefficients. Specifically, the interaction terms with the male dummy, married dummy, and middle-skilled dummy have significantly negative coefficients, whilst the coefficients for those with dummy variables on medium and large company sizes are estimated to be significantly positive. The latter result indicates that workers in larger-sized companies receive a greater rise in wages from the increased exports to the US. This equation is also estimated by using the IV method. The results are shown in column (II). The test statistics for under-identification (Kleibergen-Paap rk *LM* statistic) and weak identification (Kleibergen-Paap rk Wald *F* statistic) show low values. Whilst the low value in the former test indicates that the rank condition is not

satisfied and that the equations are not identified, the low value in the latter test suggests that our IV estimates are likely to suffer from bias due to weak instruments. In short, our instruments do not work well in this estimation.

Table 4: Results of Interaction Terms

	(I)	(II)	(III)	(IV)
Method	**OLS**	**IV**	**OLS**	**IV**
ln TH Exports to US	-0.020	0.008		
Interaction of ln TH Exports to US with				
ln Age	0.006	0.009***	0.006	0.009***
Male	-0.001**	-0.001***	-0.001**	-0.001***
Married	-0.002***	-0.002***	-0.002***	-0.002***
Urban	-0.001	-0.001	-0.001	-0.001
University graduates	-0.002	0.000	-0.001	0.000
Occupation: Unskilled (Base)				
Middle skilled	-0.003**	-0.002*	-0.003**	-0.003**
High skilled	0.000	0.001	-0.001	0.001
Company size: Small (Base)				
Medium	0.004***	0.002	0.004**	0.002
Large	0.004**	0.002	0.003**	0.001
Industry-time FE			X	X
Province-time FE	X	X	X	X
Industry-province FE	X	X	X	X
Under-identification test		0.453		11.718
Weak identification test		0.039		13.345
Number of observations	287,845	287,845	287,696	287,696
Adjusted R-squared	0.634	0.238	0.638	0.247

FE = fixed effects, US = United States.

Notes: Estimation results were obtained using the OLS or IV method. The dependent variable is the log of monthly wages. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are clustered by industry (ISIC four-digit code). To save space, we do not report the results in non-interacted variables on individual characteristics. Under-identification and weak identification tests indicate the Kleibergen-Paap rk *LM* statistic and the Kleibergen-Paap rk Wald *F* statistic, respectively.

Source: Authors.

Next, we control for industry-time fixed effects. The OLS results are shown in column (II) and are very similar to those in column (I). The IV results are reported in column (IV). The test statistics for both under-identification and weak identification show reasonably high values. Thus, our instruments become valid if we control for industry-time fixed effects. This change may indicate the existence of confounding factors defined at an industry-time level in the first-stage regressions of the IV estimation. There are two main differences with the OLS results. One is that the coefficients for the interaction term with the dummy variables on company size turn out to be insignificant. The other is that the interaction term with the age variable has a significantly positive coefficient in the IV results, which indicates that the increase in exports to the US contributed to expanding the wage gap by age. The interaction terms with the male dummy, married dummy, and middle-skilled dummy again have significantly negative coefficients. Given the higher average wages in males found in Table 2, the result on gender indicates that the increase in exports to the US contributed to narrowing the wage gap between males and females. The result on middle-skilled workers indicates that the wage gap between low and middle-skilled workers decreased, whilst the gap between middle and high-skilled workers increased.[15]

We conduct two kinds of robustness checks. One is to take into account the possible time lag in the effect of exports to the US on wages. Namely, the increase in export sales in the US market may be reflected in individual wages a few months after exporting. Therefore, in Table 5, we introduce interaction terms with one-quarter or two-quarter lagged export variables. Comparing the IV results between Tables 4 and 5, we do not see differences in the significance. Thus, taking this lag into account does not change our results. The other is to split the study period into the periods 2017–2019 and 2020–2023. As mentioned in the introductory section, most changes in US tariffs against China were made in 2018 and 2019. In the latter period, on the other hand, China's exports to the US would have been affected by the COVID-19 pandemic in addition to the delayed effects of the US-China trade war. Thus, the wage impacts may be different between the two periods. The results are reported in Table 6 but show similar results between the two periods, which are also not different from the results in Table 4. However, as found in Figure 1, a greater increase in exports to the US was observed in the latter period. Thus, in terms of absolute magnitude, the wage change should be larger in the latter period.

[15] The magnitude of this effect may not be so large. For middle-skilled workers, the sample average of logged exports from Thailand to the US is 16.10 in 2017 and 16.77 in 2022, indicating their increase by 0.67. The coefficient for the interaction term between exports to the US and middle-skilled workers' dummy is estimated to be −0.003. Thus, the increase in exports to the US from 2017 to 2022 shrank the wage gap between low- and middle-skilled workers by 0.2% (=−0.003*0.67).

Table 5: Lagged Exports

	(I)	(II)	(III)	(IV)
Method	OLS	IV	OLS	IV
Lag	1	1	2	2
Interaction of ln TH Exports to US with				
ln Age	0.006	0.009***	0.006	0.009***
Male	-0.001**	-0.001***	-0.001**	-0.001**
Married	-0.002***	-0.002***	-0.002***	-0.002***
Urban	-0.001	-0.001	-0.001	-0.001
University graduates	-0.001	0.000	-0.001	0.000
Occupation: Unskilled (Base)				
Middle skilled	-0.004**	-0.003**	-0.003**	-0.002**
High skilled	-0.001	0.001	-0.001	0.001
Company size: Small (Base)				
Medium	0.004**	0.002	0.004***	0.002
Large	0.003*	0.001	0.004**	0.001
Industry-time FE	X	X	X	X
Province-time FE	X	X	X	X
Industry-province FE	X	X	X	X
Under-identification test		11.301		11.077
Weak identification test		15.123		17.145
Number of observations	287,696	287,696	287,696	287,696
Adjusted R-squared	0.638	0.247	0.638	0.247

FE = fixed effects, US = United States.

Notes: Estimation results were obtained using the OLS or IV method. The dependent variable is the log of monthly wages. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are clustered by industries (ISIC four-digit codes). To save space, we do not report the results in non-interacted variables on individual characteristics. Under-identification and weak identification tests indicate the Kleibergen-Paap rk *LM* statistic and the Kleibergen-Paap rk Wald *F* statistic, respectively.

Source: Authors.

Table 6: Splitting the Study Period

	(I)	(II)	(III)	(IV)
Method	OLS	IV	OLS	IV
Period	<2020	<2020	>2019	>2019
Interaction of ln TH Exports to US with				
ln Age	0.006	0.009**	0.006	0.009***
Male	-0.001*	-0.002**	-0.001*	-0.001**
Married	-0.002***	-0.002***	-0.001*	-0.002***
Urban	-0.001*	-0.001	-0.001	-0.001
University graduates	-0.001	0.001	-0.002	0.000
Occupation: Unskilled (Base)				
Middle skilled	-0.004**	-0.002*	-0.003**	-0.002**
High skilled	-0.001	0.000	0.000	0.001
Company size: Small (Base)				
Medium	0.005***	0.003	0.003	0.001
Large	0.005***	0.002	0.003	0.001
Industry-time FE	X	X	X	X
Province-time FE	X	X	X	X
Industry-province FE	X	X	X	X
Under-identification test		10.277		11.311
Weak identification test		11.345		12.971
Number of observations	147,236	147,236	139,716	139,716
Adjusted R-squared	0.634	0.261	0.649	0.23

FE = fixed effects, US = United States.

Notes: Estimation results were obtained using the OLS or IV method. The dependent variable is the log of monthly wages. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are clustered by industry (ISIC four-digit code). To save space, we do not report the results in non-interacted variables on individual characteristics. Under-identification and weak identification tests indicate the Kleibergen-Paap rk *LM* statistic and the Kleibergen-Paap rk Wald *F* statistic, respectively.

Source: Authors.

5. Policy Implications

This study empirically investigated how the changes in exports to the US driven by the change in China's exports to the US affected wages in Thailand. In particular, we examined the heterogeneous effects according to workers' characteristics. To this end, we conducted regression analyses using the individual-level quarterly data from the first quarter of 2017 and the second quarter of 2023. Our findings can be summarised as follows. The increase in exports to the US

contributed to expanding the wage gap by age and gender. Furthermore, the wage gap between low- and middle-skilled workers decreased whilst the gap between middle- and high-skilled workers increased. These findings perhaps indicate that an increase in middle-skilled wages is shown to be smaller than increases in low- and high-skilled wages.

Our result on skills implies that the trade diversion in the US market caused 'wage polarisation' in Thailand. Such labour market polarisation has been observed in many countries including not only developed but also developing countries (e.g., Autor and Dorn, 2013; Lehn, 2020; Wang et al., 2021). The literature on labour market polarisation has emphasised the role of technological changes in the development of polarisation.[16] Therefore, our results may indicate that Thailand has increased exports to the US market in the industries where automation develops well and, thereby, international competitiveness is relatively high.

Our results have some policy implications against middle-skilled workers. As in the recommendation to China by Wang et al. (2021) and to Thailand by Paweenawat and Liao (2024), the Thai government should provide on-the-job education and skill training to middle-skilled workers to upgrade their skill levels to high skills. In addition, the government should pursue policies aimed at improving the quality of education that directly enhances workers' skills, such as vocational education and training. These policies can strengthen working-skill development and facilitate the school-to-work transition leading to higher middle-skilled wages.

The changes in the wage gap amongst low-, middle-, and high-skilled workers may also reflect the problem of skill mismatch amongst Thai workers. There are a number of studies on this subject. For instance, Vivatsurakit and Vechbanyongratana (2021) showed high rates of the incidence of overeducation amongst young workers. The average wage penalty by overeducation was estimated at 20.9%, as many workers lack the ability to capitalise on their educational investments in Thailand's labour market. Vivatsurakit and Vechbanyongratana emphasised the need for policies to reduce skill mismatch, such as better targeting the amount of necessary education or improving channels for young workers to be well-matched in formal employment. Vandeweyer et al. (2020) suggested strengthening the responsiveness of the education system to the needs of the labour market and providing high-quality life-long learning opportunities to help workers maintain and upgrade their skills, such as improving access to training opportunities that are aligned with skill needs. Clearly, these policies can be applied and targeted to middle-skilled workers in Thailand.

[16] Lehn (2020) argues that 'the technological progress has reduced the price of machines capable of performing similar tasks (commonly described as routine tasks) as middle skilled occupations, which has led to decreased demand for labor in these jobs. Simultaneously, since lower and, especially, higher skilled occupations perform tasks complementary to routine tasks, demand for these jobs has increased.'

Finally, the findings of this study may point to wage inequalities and unequal benefits in the labour market. These inequalities possibly reflect the relatively low bargaining position of middle-skilled workers, as compared to the other two groups of workers. Therefore, the government should find a way to enhance middle-skilled workers' collective bargaining power to obtain higher wages, such as more support to strengthen the role of unions in the labour market. This support may in turn lead to a better position for middle-skilled workers and create more equal opportunities as well as contribute to lowering wage inequality.

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Appendix: Other Tables

Table A1: Growth Rates of Average Monthly Wage per Employee in Thailand

	2017 Q1–2018 Q1	2022 Q1–2023 Q1
Number of Persons	0.28%	3.55%
Number of Employed Persons	0.13%	6.47%
Number of Employees	-5.91%	7.53%
Average monthly wage per employee		
All	3.22%	0.39%
By gender		
Male	3.43%	1.09%
Female	2.96%	-0.40%
By education		
None	0.10%	3.69%
Lower than elementary	3.36%	3.00%
Primary education	1.77%	4.50%
Lower secondary education	2.23%	3.80%
Upper Secondary level education	1.91%	1.74%
Post-secondary education	-0.15%	0.10%
Bachelor degree education	0.13%	-2.12%
Master degree level	4.82%	-3.54%
Doctoral degree level	6.53%	13.13%
Other education	2.26%	6.25%
By occupation		
Managers, senior officials, and legislators	2.25%	-3.21%
Professionals	2.41%	-4.92%
Technicians and associate professionals	1.89%	0.76%
Clerks	2.37%	-0.21%
Service and sales workers	5.10%	-0.48%
Skilled agricultural forest and fishery workers	-13.94%	-3.04%
Craft and associate professionals	3.82%	1.77%
Plant and machine controllers and assemblers	2.94%	3.89%
Elementary occupations	5.88%	7.02%

Source: Thailand's Labour Force Surveys.

Table A2: Growth Rates of Employees in Thailand

	2017 Q1	2023 Q1	Change
Number of Persons	67,555,030	69,953,421	3.55%
Number of Employed Persons	36,692,615	39,064,904	6.47%
Number of Employees	17,842,806	19,186,568	7.53%
Number of Employees			
By gender			
Male	9,689,275	10,163,834	4.90%
Female	8,153,531	9,022,734	10.66%
By education			
None	596,646	551,968	-7.49%
Lower than elementary	1,576,044	986,857	-37.38%
Primary education	3,192,232	3,146,484	-1.43%
Lower secondary education	3,163,041	3,238,362	2.38%
Upper Secondary level education	3,252,868	4,058,708	24.77%
Post-secondary education	1,176,342	1,566,421	33.16%
Bachelor degree education	3,924,906	4,608,869	17.43%
Master degree level	680,198	565,000	-16.94%
Doctoral degree level	36,561	47,154	28.97%
Other education	120,923	165,921	37.21%
By occupation			
Managers, senior officials, and legislators	904,757	805,927	-10.92%
Professionals	2,047,779	2,184,205	6.66%
Technicians and associate professionals	1,518,667	1,628,265	7.22%
Clerks	1,452,740	1,737,079	19.57%
Service and sales workers	2,707,019	3,014,227	11.35%
Skilled agricultural forest and fishery workers	715,277	710,226	-0.71%
Craft and associate professionals	2,575,357	2,496,178	-3.07%
Plant and machine controllers and assemblers	2,885,345	3,131,135	8.52%
Elementary occupations	2,992,583	3,375,510	12.80%

Source: Thailand's Labour Force Surveys.

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