Chapter 4
Impacts of International Bridge on Border Trade

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Abstract: Major parts in the national boundary between Thailand and Laos consist of a river with a large width, i.e., Mekong River. In this study, we empirically examine whether or not the establishment of international bridges between Thailand and Laos increases Thailand's border trade. We use the data on trade in Thailand's border gates with Laos during 2000-2017. Our instrumental variable estimation shows that the establishment of bridges does not significantly change Thailand's exports but does so her imports. The magnitude of the impacts is rather large. It increases Thailand's imports around thirteenfold. We also found that there are no anticipated effects of bridge construction.

Keywords: Bridge; Border; Thailand; Laos
JEL Classification: F15; F53

1. Introduction

International transport costs play an important role in international trade. Various factors contribute to reducing those costs. The reduction in freight costs is an obvious factor. Also, the development of new roads or routes may reduce international transport costs. Those costs will greatly decrease if two regions divided by the river are connected by the bridge. Such reduction leads to the increase of international trade through increasing exports by existing exporters and through creating new exporters. Therefore, the reduction of international transport costs is an important policy for governments to enhance national trade. Particularly after the construction of new infrastructure, it becomes important to evaluate whether or not and how much it contributed to reducing

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transport costs. One way of this evaluation is to investigate how much international trade increases by such construction.

The purpose of this paper is to examine whether or not the establishment of international bridges between Thailand and Laos increases Thailand's border trade. Laos is the 13th destination in terms of Thai exports in 2014. Exports to Laos in 2014 are 122 billion Thai Baht (THB, approximately 3.5 billion US dollars), accounting for 2% in total exports even though these two countries share a national border. One significant reason will be the small economic size of Laos, which is still a least developed country. Another reason might be high transport costs between the two countries. Except for a part of the national boundary, these two countries are segmented by Mekong River. The maximum width of this river along the boundary between the two countries is 14 kilometers. Without bridges, goods need to go across the Mekong River by truck ferries. As of 2018, four bridges are established to connect two countries. These bridges were completed in 1994, 2006, 2011, and 2013. The construction of international bridges is expected to reduce transport costs between the two countries and thus to increase their trade.

Specifically, we use the data on border trade between Thailand and Laos during 2000-2017. There are eight border gates between the two countries. Thus, we empirically work with 144 (= 8 borders x 18 years) observations though those in five borders are missing during 2000-2002. With such data, we regress (a log of) trade values on a dummy variable that takes the value one if a concerned border has an international bridge and the value zero otherwise. In order to control for inherent location characteristics and macroeconomic changes, we introduce border and year fixed effects. Thus, our empirical framework is a difference-in-differences (DID) analysis. Naturally, we expect the positive coefficient for the dummy variable on international bridges. In addition, we also investigate the switching effect that the trade in a border gate decreases if international bridges are constructed in its neighboring other borders. To this end, we introduce a dummy variable that takes the value one if the neighboring other borders have any international bridges and the value zero otherwise.

It is natural that the construction of international bridges is endogenous to the trade value. For example, high growth of trade in a border will call for an international bridge there. Thus, the estimation of the above model by the ordinary least square (OLS) method yields biased estimates. To address this endogeneity issue, we use an instrumental variable (IV) method. The instrument must be able to explain in which border and when the international bridge is constructed. We use an interaction term of two variables as an instrument. One is to explain "in which border" and is the trade value in each

border as of 1993, in which any international borders did not exist between Thailand and Laos. At that time, goods are transported across the Mekong River by truck ferries. We identify the potential importance of each bridge in terms of trade by the luminous intensity at night light around 15 kilometers from a border gate in 1993. The other is to explain "when" and is a dummy variable that takes the value one if Thakshin Partisan (i.e., Thai Rak Thai Party and Phak Pheu Thai) is a governing party in Thailand. This variable is motivated by the fact that this party tends to invest in rural development. By using this interaction term as an instrument, we investigate the causal effect of international bridges on border trade.

This paper is related to the growing literature on the effects of infrastructures on economic variables at the municipality- or firm-level. In particular, unlike the traditional studies in infrastructures, these recent studies uncover the causal impacts of infrastructures. The examples include Ahlfeldt and Feddersen (2018), Akerman (2009), Albarran et al. (2013), Baum-snow et al. (2017), Donaldson (2018), Donaldson and Hornbeck (2016), Faber (2014), Holl (2016), Lin (2017), Martincus and Blyde (2013), Martincus et al. (2014; 2017), and Mayer and Trevien (2017). These studies use a quasi-natural experiment or instruments to investigate the causal impacts of infrastructures on the economic variables. In particular, as we did, Akerman (2009) and Marincus et al. (2014) examined the effect of international bridges between two countries rather than that of domestic infrastructure. The former investigates the establishment of a bridge between Denmark and Sweden while the latter does the block (by protests) of a bridge between Argentine and Uruguay. We add to this literature, the evidence on international bridges between Thailand and Laos.

The rest of this paper is organized as follows. The next section introduces bridges between Thailand and Laos. After discussing our empirical framework in Section 3, we report our estimation results in Section 4. Last, Section 5 concludes on this paper.

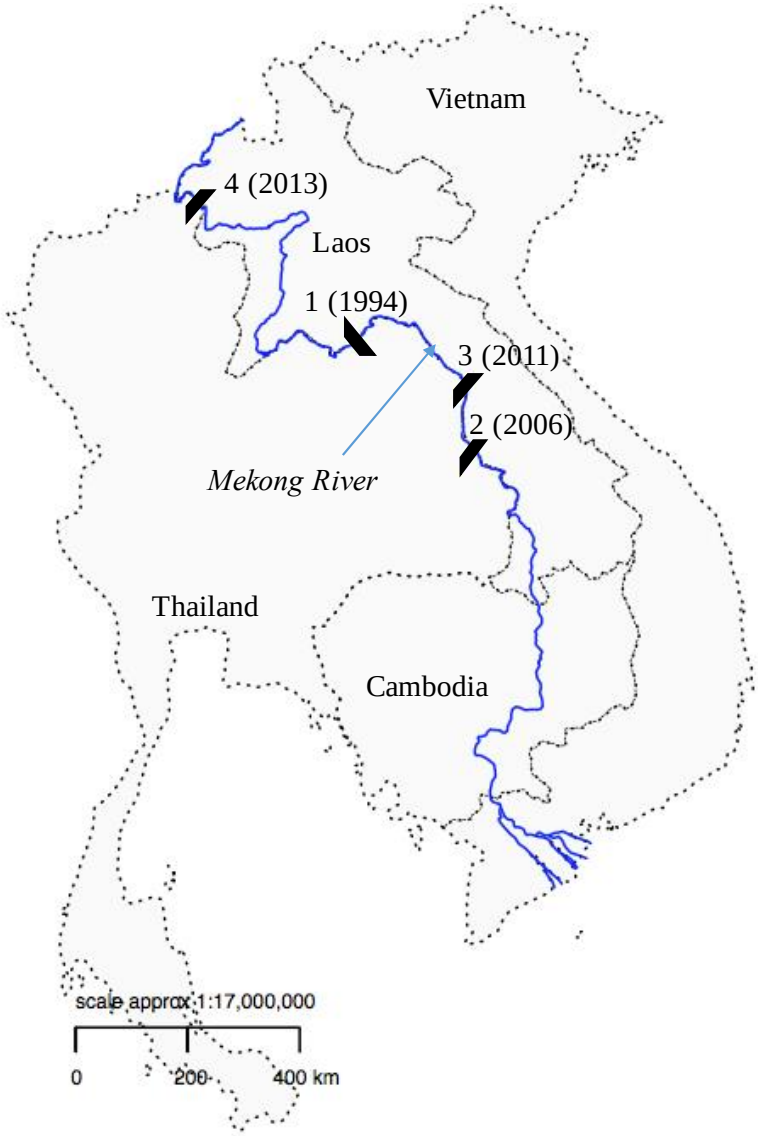
2. Thai-Lao Friendship Bridges

Mekong bridges are essential for onland linkages in the Great Mekong Sub-Region (GMS). In fact, all major economic corridors in the GMS program have one of their sections over the Mekong River.[*] Since the early 1990s, many international and domestic Mekong bridges have already been constructed, are under construction, or are planned in Cambodia, Laos, Thailand, and Vietnam.

[*] Major economic corridors in the GMS program include North-South Economic Corridor (NSEC), East-West Economic Corridor (EWEC), and Southern Economic Corridor (SEC).

Mekong bridges are especially important to international trade between Thailand and Laos because the Mekong River itself constitutes major part of border line between Thailand and Laos (Figure 1). As of mid-2016, there are four international, commonly known as the Thai-Lao Mekong Friendship Bridges (here after bridges or bridge). The first bridge was built by grant aid from the Australian government, between Nong Khai, a province in the northeastern region of Thailand and Vientiane Capital of Laos, and opened to facilitate the cross-border movements of people, goods, and investment since April 8 1994.

Figure 1. Locations of Thai-Lao Mekong Friendship Bridges



Source: Authors' compilation
Note: In the parenthesis is the year of completion.

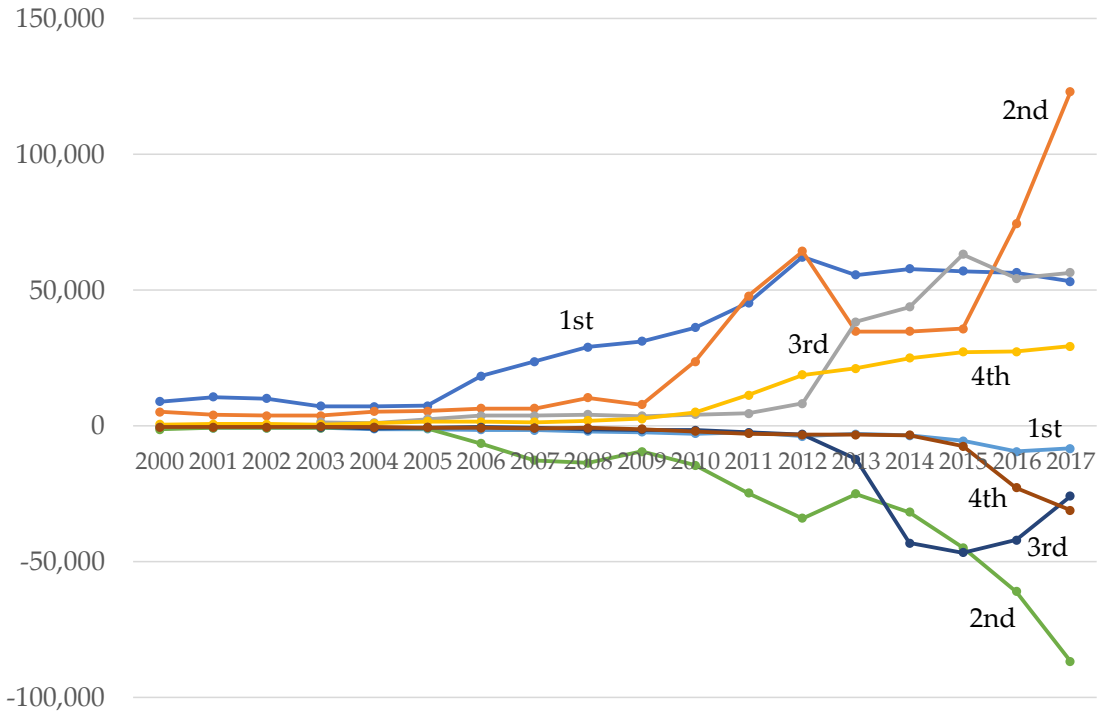
The other bridges were established after the year 2000. The second bridge between Mukdahan in north-eastern Thailand and Savannakhet in Central Laos, which was financed by low-interest loans from the government of Japan to Laos and Thailand, was completed on December 20, 2006. Nevertheless, regular service did not begin until early 2007. The opening ceremony of the third bridge, funded unilaterally by the government of Thailand to connect Nakhon Phanom province in north-eastern Thailand with Khammouan province in central Laos, was held on November 11, 2011. Regular service of the third bridge commenced by the end of 2011. The fourth bridge between Chiang Rai province in northern Thailand and Bokeo province in northern Laos, along the North-South Economic Corridor, co-financed by the government of Thailand and China was completed in June 2013.

Although these bridges make possible onland link over Mekong River, they are not used the same way in reality. In Thailand's context, the first bridge links the capital city of Thailand, through many of its northeastern provinces, and the capital city of Laos. It is mainly used for export from Thailand to Laos' capital city and plays little role in transit trade between Thailand and Vietnam. Although the distance from the first bridge to Hanoi is relatively short, high mountain range to the northeastern towards Vietnam makes transportation to and from Vietnam difficult. The second bridge, a part of the East-West Economic Corridor, is aimed to link Bangkok, the capital city of Thailand with Da Nang, Vietnamese third largest city in central Vietnam. On the contrary, the use of the third bridge enables transportation with a shorter land route between Bangkok and Hanoi, the capital city of Vietnam, compared with the second bridge. Namely, the third bridge is built to enhance the connection of Bangkok with Hanoi and beyond. The fourth bridge is built to complete onland link through North-South Economic Corridor (NSEC), whose primary purpose is linking Thailand with China's Southern province of Kunming via Laos.

Figure 2 depicts trade values by Thailand according to bridges. The data source of this figure is the Bank of Thailand, which publishes data on border trade values by province based on data collected by the Department of Trade, Ministry of Commerce. Those do not include transit trade with the third country. Before the completion of bridges, goods go across the Mekong River by truck ferries. Therefore, even before the completion of bridges, figures include transactions cleared at customs in which bridges are established in the future. As is illustrated in Figure 2, while the export over the first bridge is comparable to the rest (the second and the third bridges), import through this route was minimal. While the import via the second bridge increased sharply in 2006, the year of its completion, the export via the second bridge increased slowly during

the first few years, but jumped and surpassed that of the first bridge within five years after its completion. However, the growth of trade via the second bridge stopped after the completion of the third bridge. A significant part of trade shifted from the second bridge to the third bridge in 2013. The trade through the second bridge regained the top spot again since 2016, mainly as a result of the opening of the first ever Inland Container Depot, or the Land Port in early 2016.

Figure 2. Trade Values by Thailand across Thai-Lao Mekong Friendship Bridges (Million THB)



Source: Bank of Thailand
Notes: Positive and negative values indicate exports and imports, respectively.

3. Empirical Framework

This section explains our empirical framework to investigate the effect of international bridges on border trade. We examine trade through all border gates in Thailand with Laos, which include eight borders; Bung Kan, Chiang Khan, Chiang Khong, Khemmarat, Mukdahan, Nakhon Phanom, Nong Kai, and Phipun Mangsahan. Among them, four gates have an international bridge with Laos; Nong Kai in 1994, Mukdahan in 2006, Nakhon Phanom in 2011, and Chiang Khong in 2013. The sample years for estimation include from 2000 to

2017.

As briefly introduced in the introduction, we estimate the following equation.

$$\ln Value_{gt}^{Flow} = \alpha \times Bridge_{gt} + \beta \times Neighbors_{gt} + \mathbf{FE}_g + \mathbf{FE}_t + + \epsilon_{gt}, \quad (1)$$

where $Flow = \{Trade, Export, Import\}$. $Value_{gt}^{Flow}$ indicates the value of trade through border gate g in year t. We estimate for the export from Thailand to Laos (*Export*), the import of Thailand from Laos (*Import*), and their sum (*Trade*) separately. $Bridge_{gt}$ is a dummy variable that takes the value one if gate g has an international bridge in year t and the value zero otherwise. As mentioned in Section 1, to investigate the switching effect, we also introduce a dummy variable, $Neighbors_{gt}$, which takes the value one if either of two border gates the first and second nearest to gate g has any international bridges and the value zero otherwise. By examining two neighboring borders, we investigate the existence of bridges in northern and southern borders. We include gate and year fixed effects.

We instrument for $Bridge_{gt}$ because it is obviously endogenous to our dependent variable, trade. As mentioned in Section 1, we use the interaction term between two variables. One is a ranking among nine gates on the luminous intensity at night light around 15 kilometers from a border gate in 1993. This variable is motivated to capture the potential importance of each bridge in terms of trade by examining the economic development around the border area in the year before constructing any international bridges. The other variable is a dummy variable that takes the value one if Thakshin Partisan is a governing party in Thailand since this party tends to invest in rural development. Specifically, Thai Rak Thai Party and Phak Pheu Thai were the governing party during 2001-2006 and 2011-2014, respectively. Since there would be some time lag from the decision of construction to the completion, by setting five years to such lag, we use the dummy variable taking the value one if sample years fall into any year of 2006-2011 and 2016-2017. We use the interaction term between these two variables as an instrument for $Bridge_{gt}$.

Our main data source is as follows. The data on the border trade are obtained from the same source used in Figure 2. In order to identify the potential importance of each bridge in terms of trade, the luminous intensity at night light around 15 kilometers from a border gate in 1993 was also generated from the data collected by the Defense Meteorological Satellite Program - Operation Linescan System. The night light sensed by the system reflects the magnitude of the human light emitting activities. We assume that such activities are positively correlated with the future use of bridges.

4. Estimation Results

This section reports our estimation results. Table 1 shows the results of the sum of exports and imports. Before employing the IV method, we tried the estimation by the OLS. In column (I), we include only the bridge dummy in addition to border and year fixed effects. The coefficient for the bridge dummy is significantly positive, indicating that the establishment of international bridges increases border trade by 260% (=exp(1.279)−1). As shown in column (II), this result does not change after introducing the dummy variable on the existence of bridges in neighboring borders. However, we do not find a significant switching effect. Thus, the construction of bridges in neighboring border gates does not significantly affect the trade in a concerned border.

Table 1. Estimation Results for Trade

	(I)	(II)	(III)	(IV)
Bridge	1.279***	1.228***	0.874**	1.229
	[0.197]	[0.200]	[0.385]	[1.134]
Neighbors		0.169		
		[0.134]		
Bridge $(t+1)$			0.341	
			[0.356]	
Method	OLS	OLS	OLS	IV
Number of obs	147	147	138	147
Adj R-squared	0.9199	0.9202	0.9188	
Centered R2				0.9341

Notes: The dependent variable is a log of the sum of exports and imports in border gate g at year t. We estimate our model by using OLS or IV. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error.

The other results in Table 1 are as follows. In column (III), we also examine the anticipated effect of international bridges by introducing a one-year-lead dummy variable on the bridge. While the coefficient for the concurrent bridge dummy is again significantly positive, that for the lead dummy is insignificant. Namely, there are no significant anticipated effects of bridges on border trade. This insignificant result would be because of the physical absence of bridges. Without bridges, the capacity of transportation does not change before their competition. Also, due to the completion of bridges near future, the government will not increase truck ferries. Last, we report the estimation result by the IV method in column (IV). In contrast to the above results, the coefficient for the bridge dummy is estimated to be insignificant. Namely, once we take into

account the endogeneity of bridge construction, we do not find its significant effect on border trade.

The estimation results for Thailand's exports are shown in Table 2. As in the results for the sum of exports and imports, both columns (I) and (II) show the significantly positive coefficients for the bridge dummy variables. Unlike Table 1, in column (II), we find a significantly positive coefficient for the bridge dummy in neighboring gates. However, the positive sign is opposite to our expectation and implies that the establishment of bridges in neighboring gates increases, rather than decreases, the border trade. Although it is difficult to interpret this result, we can say at least that there are no switching effects. One reason for this unexpected result might be because we do not fully control for the effect of demand sizes. Although we expect some part of the demand effect is captured by year fixed effects, it is difficult to fully control for this effect because the destination of goods transported via each gate is overlapped across gates and changes depending on the availability of bridges. This incomplete control is another reason for calling for instruments.

Table 2. Estimation Results for Exports

	(I)	(II)	(III)	(IV)
Bridge	0.982***	0.900***	0.545	0.604
	[0.216]	[0.218]	[0.402]	[1.312]
Neighbors		0.270*		
		[0.155]		
Bridge $(t+1)$			0.37	
			[0.375]	
Method	OLS	OLS	OLS	IV
Number of obs	147	147	138	147
Adj R-squared	0.8984	0.8997	0.8978	
Centered R2				0.9133

Notes: The dependent variable is a log of exports in border gate g at year t. We estimate our model by using OLS or IV. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error.

The other results are as follows. In column (III), both the coefficients for the concurrent and lead dummy variables are insignificantly estimated. Also, column (IV) shows no causal effects of the international bridge on Thailand's exports, as in the case of the sum of exports and imports. One interpretation of the difference between the results by OLS and IV methods is that international bridges were established in the gate where Thailand's exports are expected to

grow. This is consistent with the fact that expect for the first bridge, all other bridges are fully or partly financed by the Thai government. Thus, the Thai government could choose the location of international bridges to increase Thailand's exports. This selection mechanism results in overestimating the OLS estimator.

The estimation results for Thailand's imports are shown in Table 3. The results are similar to those for the sum of exports and imports shown in Table 1. The OLS results show positive effects of international bridges on imports as shown in columns (I)-(III). Also, there are no significant switching and anticipated effects. One notable difference is found in column (IV). The coefficient for the bridge dummy is still positively significant in the IV estimation. This result is a sharp contrast to the case of exports and might indicate that the Thai government selected the location of international bridges to increase exports rather than imports. Furthermore, the magnitude of the coefficient is rather large, indicating that the establishment of international bridges increase Thailand's imports around thirteenfold.

Table 3. Estimation Results for Imports

	(I)	(II)	(III)	(IV)
Bridge	1.937***	2.001***	1.545***	2.708*
	[0.245]	[0.247]	[0.445]	[1.587]
Neighbors		-0.213		
		[0.205]		
Bridge $(t+1)$			0.391	
			[0.415]	
Method	OLS	OLS	OLS	IV
Number of obs	147	147	138	147
Adj R-squared	0.8925	0.8927	0.8817	
Centered R2				0.9013

Notes: The dependent variable is a log of imports in border gate g at year t. We estimate our model by using OLS or IV. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error.

5. Concluding Remarks

Bridges undoubtedly increase capacity and reduce the time needed of cross-border trade when compared to the ferry. In other words, bridges enhance cross-border connectivity. In this study, we empirically examined whether or

not the establishment of international bridges between Thailand and Laos increases Thailand's border trade. Our IV estimation shows that the establishment of bridges does not significantly change Thailand's exports but does so her imports. The magnitude of the impacts is rather large. It increases Thailand's imports around thirteenfold. We also found that there are no anticipated effects of bridge construction. The smaller impacts on export to Laos is to be expected considering Laos' relatively small population and economy. The population of Laos is currently about one-tenth of Thailand, while the total GDP is less than 4%. Although the data cannot be assembled during this study, accounting for Thailand's transit export via Laos may derive larger positive impacts of bridges on export. The sharp increase in import indicates that better cross-border connectivity would greatly expand. It also suggests that as far as Thailand is concerned, cross-border connectivity with Laos is less about trade with Laos, and is much more about cross-border trade with countries beyond Laos.

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