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Foreign Aid and Productivity in Thailand

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Abstract

This study examines the relationship between foreign aid and total factor productivity (TFP) in Thailand from 1972 to 2013 using the VAR model and Granger causality. While discussing the role of foreign aid in the economy of recipient countries, it is important to examine whether foreign aid contributes to the productivity of the recipient country. Estimation results do not show any evidence of a relationship between foreign aid and the TFP in Thailand, indicating that foreign aid does not necessarily directly affect productivity. This result is also considered to be suitable for previous studies.

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1 Introduction

Whether foreign aid positively impacts economic growth is still under discussion. In recent times, it is widely believed that it depends on the policy of the recipient countries (Burnside and Dollar 2000). In contrast, Easterly (2004, 2006, 2007) claimed that foreign aid does not positively impact economic growth. Even if economists believe that foreign aid contributes to economic growth, most of them claim that the effect is through capital accumulation. In addition, sometimes foreign aid is considered to strengthen human capital by way of education or on-the-job training. However, it is hard to ascertain if foreign aid directly affects total factor productivity (TFP)—a source of technological advancement.

Thailand is a good example of a long-term recipient of foreign aid and foreign direct investment, which is considered to be one of the main sources of the rapid economic growth since the 1980s. In contrast, it is not the exception of attaining this rapid economic growth by mainly increasing the capital and labor, not TFP, as Krugman mentioned as the Asian Miracle in Krugman (1984). In this regard, examining whether foreign aid to Thailand directly raised economic growth through TFP is meaningful.

This study examines the relationship between foreign aid and TFP in Thailand from 1972 to 2013 using the VAR model and Granger causality and investigates the impact of foreign aid on TFP. Rest of this paper is structured as follows. Section 2 describes the literature review including the relationship between foreign aid and productivity. Section 3 presents the data for key variables and methodology. Section 4 provides the estimation results and a discussion with interpretation. Section 5 summarizes and concludes the study.

2 Literature Review

Existing literature relevant to this study is divided into the following three groups:

The first group comprises theoretical literature on the relationship between foreign aid and TFP. The economic growth model has been extended since the 1980s. Lucas (1988) and Romer (1990) focused on the human capital, and Jones and Williams (1998) analyzed the returns to investment of the Research and Development (R&D). After the economic growth model was extended, Stokey (2015) developed a theoretical model between technology, a public input from abroad, and human capital, which imagines developing countries. This model diverges into two types of behavior: technology frontier and stagnation by the policy and initial conditions, and policy change can display the rapid growth.

The second group includes empirical literature on the relationship between foreign aid and TFP. Normally, the growth accounting is used to divide the economic growth into labor, capital, and TFP. In this regard, finding the element of extending TFP is important. Aschauer (1989) analyzes the effect of the social infrastructure in the U.S. by using the growth accountant, and showed that the productivity of the public spending is similar to TFP. In addition, Benhabib and Spiegel (1994) shows that the human capital accumulation, one of the aims of foreign aid, is positive to TFP. Although many studies examine capital and labor, there are few studies on the relationship between foreign aid and TFP. Although many studies examine capital and labor, there are few studies on the relationship between foreign aid and TFP. In this regard, Groß and Nowak-Lehmann (2022) examined the relationship between foreign aid and TFP by conducting a time series analysis of panel data on 51 countries from 1972 to 2009; they found that sometimes this relationship is negative.

The third group consists of literature on measuring TFP in Thailand. Growth accounting is calculated in the Capital Stock statistics prepared by the National Economic and Social Development Council (NESDC), Thai government every five years as an outcome of the economic and social development plan. Sakurai (2021) used growth accounting in the same way as the NESDC. In addition, Thailand Development Research Institute (TDRI) calculated the TFP in a more sophisticated manner (Nakornthab 2013, Tinakorn and Sussangkarn 1996). Bank of Thailand (BOT) also calculated TFP through economic growth accounting (Chuenchoksan and Nakornthab 2008).

3 Data and Methodology

3.1 Methodology

We estimate equation (1) by using six variables as shown in Groß and Nowak-Lehmann (2022).

$$TFP_t=\alpha_t+\beta X_t+u_t \quad (1)$$

where t refers to the year, and X_t comprises trade, inflation, government consumption divided by GDP, capital-labor ratio, and ODA divided by GDP.
The method of estimation is as follows. First, we use unit root tests to determine whether these variables are I(1). If at least one variable is I(1), we use the first difference to estimate equation (1) or check cointegration. Next, we check if equation (1) is a cointegration relationship by using unit root test of the residuals in the level series. Finally, we use the cointegrated vector auto-regression (CVAR) model if equation (1) is a cointegration relationship. If it is not a cointegration relationship, the VAR model and Granger causality test are used.

3.2 Data

We use the TFP data and capital-labor ratio (K/L) from the System of National Account in Thailand (prepared by NESDC). TFP is calculated the same way as NESDC and Sakurai (2021). Other statistics are from World Development Indicators of the World Bank because System of National Account (SNA) statistics in Thailand during the 1970s and 1980s were not prepared. TRADE is the total of export and import divided by GDP; it is an indicator of the freedom of trade. INFLATION is measured using the GDP deflator because the consumer price index does not cover the whole period. Governmental consumption per GDP (GC/GDP) indicates governance. K/L is capital-labor ratio calculated the same way as NESDC making TFP. ODA divided by GDP (ODA/GDP) uses the net base of ODA. The data is described in Table 1. Since the trade ratio in Thailand is relatively high partly because Thai government promote free trade. In contrast, the government consumption is relatively low as a result of the experience of the currency crisis in the head of the 1980s and the end of the 1990s. Capital labor ratio is widely changed partly because many labors go back to the rural area as farmers during the recession.

Table 1: Descriptive Statistics

	TFP	TRADE	INFLATION	GC/GDP	K/L	ODA/GDP
obs	42	42	42	42	42	42
mean	1.304	0.772	0.604	0.153	62.147	0.000
std	1.269	0.337	0.214	0.020	398.586	0.000
max	4.712	1.364	1.091	0.190	2613.552	0.002
min	-0.793	0.370	0.214	0.123	-44.800	-0.001

Notes
TFP: Total Factor Productivity calculated by the author
TRADE: total of export and import divided by GDP
INFLATION: GDP deflator
GC/GDP: Government Consumption divided by GDP
K/L: capital-labor ratio
ODA/GDP: net ODA divided by GDP

4 Estimation Results

First, we perform the unit root test to see the trend of each variable since economic statistics have upward trend. As shown in Table 2, most variables are I(1), meaning upward trend. The exceptions are the ODA and capital-labor ratio since the ODA is offset by returning and capital-labor-ratio depends on the business cycle. From this result, we perform the cointegration test to estimate equation (1) as the level series. Unit root test of the residual term of equation (1) shows I(1), which reveals that equation (1) is a spurious regression. Consequently, we use the regression or the VAR model by converting to the first difference.

Table 2: Unit root tests

TFP: I(2)

	ADF		PP	
	intercept	intercept&trend	intercept	intercept&trend
level	-2.480	-2.140	-2.824*	-1.973
first difference	-2.389	-2.802	-1.920	-2.086
second difference	-3.835***	-3.883**	-2.301	-2.319

TRADE: I(1)

	ADF		PP	
	intercept	intercept&trend	intercept	intercept&trend
level	0.144	-2.140	0.577	-2.916
first difference	-5.870***	-6.046***	-7.463***	-7.726***

INFLATION: I(1)

	ADF		PP	
	intercept	intercept&trend	intercept	intercept&trend
level	-0.400	-2.856	-0.386	-1.771
first difference	-4.208***	-4.202**	-4.132***	-4.118**

GC/GDP: I(1)

	ADF		PP	
	intercept	intercept&trend	intercept	intercept&trend
level	-2.484	-1.824	-1.738	-1.726
first difference	-4.477***	-4.411***	-4.514***	-4.450***

K/L: I(0)

	ADF		PP	
	intercept	intercept&trend	intercept	intercept&trend
level	-6.388***	-6.360***	-6.388***	-6.361***
first difference	-	-	-	-

ODA/GDP: I(0)

	ADF		PP	
	intercept	intercept&trend	intercept	intercept&trend
level	-3.871***	-4.680***	-3.791***	-4.487***
first difference	-	-	-	-

Notes
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INFLATION: GDP deflator
GC/GDP: Government Consumption divided by GDP
K/L: capital-labor ratio
ODA/GDP: net ODA divided by GDP
***, **, and * indicate the significance level at 1%, 5%, and 10%, respectively

Next, we estimate equation (1) as OLS and the first difference, including the auto-regressive (AR) and moving average (MA) processes. We also estimate with and without inflation since other variables are considered to be adjusted by the GDP deflator. As a result, we estimate six equation types as shown in Table 3. In Table 3, from the equation ① to ③ show results of including the inflation in explanatory variables. In addition, equation ① excludes both AR and MA process whereas the equation ② includes AR process and the equation ③ includes AR and MA process. Similarly, from the equation ④ to ⑥ show the difference of the AR process and MA process without the inflation.. Results are summarized in the following three points. First, all estimation results are statistically non-significant, indicating that TFP has almost no relationship with foreign aid, trade, and capital-labor ratio. Second, all estimations have serial correlations, as suggested by the low value of the Durbin-Watson statistic. Serial correlations are observed even if the AR and MA process is used in equations ②,③, ⑤, and ⑥. Third, the adjusted R^2 in estimations ① and ④are low, which infer that the estimation is not suitable. Seeing the estimation result shown in Table 3, foreign aid and TFP does not have any relationship, inferring that the foreign aid itself does not necessarily cause the extension of the productivity directly.

Table 3: Estimation results of the first difference

dependent variable: D(TFP)
estimation period: 1972-2013

	①	②	③	④	⑤	⑥
C	-0.045	-0.126	-0.136	-0.094	-0.134	-0.135
	(0.043)	(0.177)	(0.185)	(0.044)**	(0.184)	(0.184)
D(TRADE)	1.012	0.072	0.003	0.549	0.002	0.008
	(0.678)	(0.195)	(0.043)	(0.730)	(0.201)	(0.042)
D(GC/GDP)	-2.659	-0.405	0.027	-3.975	-0.859	-0.197
	(0.884)***	(0.368)	(0.130)	(5.448)	(1.575)	(0.310)
D(INFLATION)	-8.023	-1.864	-0.150			
	(5.106)	(1.901)	(0.344)			
D(K/L)	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
D(ODA/GDP)	78.097	22.706	5.473	37.364	14.558	5.655
	(86.130)	(27.681)	(7.361)	(94.074)	(22.848)	(7.327)
AR(1)		0.946	0.941		0.946	0.941
		(0.066)***	(0.063)		(0.062)	(0.062)
MA(1)			1.000			1.000
			(5034.189)			(5165.9)
Adjusted R^2	0.138	0.890	0.967	-0.055	0.889	0.968
Durbin-Watson stat	0.343	0.435	0.344	0.176	0.270	0.365

Notes
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GC/GDP: Government Consumption divided by GDP
K/L: capital-labor ratio
ODA/GDP: net ODA divided by GDP
D(--) denotes the first difference
Standard error in parentheses
***, **, and * indicate the significance level at 1%, 5%, and 10%, respectively

Finally, we estimate the VAR model and Granger causality as another estimation way since the estimation result of the OLS does not have any relationship between foreign aid and TFP. As per the unit root test shown in Table 2, the VAR model should be in the first difference. We estimate it with and without inflation since other variables are treated as the constant term. We estimate with the inflation first. Table 4 shows the estimation result of VAR model and Granger causality with the six variables: the TFP, trade, inflation, government consumption (GD/GDP), capital-labor ratio(K/L), and foreign aid (ODA/GDP) in the previous year and present year. This VAR model shows that foreign aid (ODA/GDP) in previous year is estimated effectively only with the government consumption in 10%, which infer the possibility that the

increase of the foreign aid will reduce the government consumption as a substitute. Table 5 shows the estimation result of the Granger causality used by the VAR model shown in Table 4. The estimation result also shows the relationship between foreign aid and government consumption at 10% level. In contrast, other relations by foreign aid estimates ineffectively.

We also estimate the VAR model and Granger causality without the inflation next. Table 6 shows the estimation result of VAR model and Granger causality with the five variables: the TFP, trade, government consumption, capital-labor ratio, and foreign aid. Estimation results of Table 6 shows that the foreign aid in the previous year estimates ineffectively with all variables of the present year. Table 7 shows the estimation result of the Granger causality without the inflation used by the VAR model shown in Table 6. Table 7 shows the foreign aid in the previous year may affect to the government consumption at 10% level where other variables from foreign aid does not have any relations in the Granger causality tests.

Table 4: Estimation results of the VAR model with inflation

	D(TFP)	D(TRADE)	D(INFLATION)	D(GC/GDP)	D(K/L)	D(ODA/GDP)
D(TFP(-1))	0.916	0.064	0.012	-0.006	45.271	0.000
	(0.048)***	(0.044)	(0.034)	(0.005)	(375.997)	(0.000)
D(TRADE(-1))	0.047	-0.296	-0.163	0.002	-221.936	-0.001
	(0.200)	(0.182)	(0.140)	(0.023)	(1560.34)	(0.001)
D(INFLATION(-1))	-0.681	0.113	0.478	0.027	-1056.517	0.000
	(0.283)***	(0.258)	(0.197)**	(0.032)	(2205.63)	(0.002)
D(GC/GDP(-1))	3.402	-0.960	0.327	0.305	13915.740	0.007
	(1.501)**	(1.369)	(1.047)	(0.169)*	(11709.4)	(0.010)
D(K/L(-1))	0.000	0.000	0.000	0.000	-0.532	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.144)***	(0.000)
D(ODA/GDP(-1))	-4.403	18.328	-3.446	-5.116	-204734.500	-0.108
	(24.773)	(22.605)	(17.285)	(2.798)*	(193295)	(0.162)
C	0.013	0.033	0.015	-0.001	20.786	0.000
	(0.013)	(0.012)***	(0.009)*	(0.001)	(98.540)	(0.000)
Adj. R-squared	0.930	-0.012	0.027	0.111	0.223	-0.043

Notes
TFP: Total Factor Productivity calculated by the author
TRADE: total of export and import divided by GDP
INFLATION: GDP deflator
GC/GDP: Government Consumption divided by GDP
K/L: capital-labor ratio
ODA/GDP: net ODA divided by GDP
D(--) denotes the first difference, and (-1) denotes the previous period.
Standard error in parentheses
***, **, and * indicate the significance level at 1%, 5%, and 10%, respectively

Table 5: Estimation results of the Granger causality with inflation

Null Hypothesis:	Obs	F-Statistic	Null Hypothesis:	Obs	F-Statistic
D(TRADE) does not Granger Cause D(TFP)	40	2.077	D(K/L) does not Granger Cause D(TRADE)	40	0.100
D(TFP) does not Granger Cause D(TRADE)	40	2.689	D(TRADE) does not Granger Cause D(K/L)	40	0.834
D(INFLATION) does not Granger Cause D(TFP)	40	14.429***	D(ODA/GDP) does not Granger Cause D(TRADE)	40	1.338
D(TFP) does not Granger Cause D(INFLATION)	40	0.022	D(TRADE) does not Granger Cause D(ODA/GDP)	40	0.624
D(GC/GDP) does not Granger Cause D(TFP)	40	12.566***	D(GC/GDP) does not Granger Cause D(INFRATION)	40	0.252
D(TFP) does not Granger Cause D(GC/GDP)	40	2.970*	D(INFRATION) does not Granger Cause D(GC/GDP)	40	1.233
D(K/L) does not Granger Cause D(TFP)	40	0.284	D(K/L) does not Granger Cause D(INFRATION)	40	0.000
D(TFP) does not Granger Cause D(K/L)	40	0.003	D(INFRATION) does not Granger Cause D(K/L)	40	1.988
D(ODA/GDP) does not Granger Cause D(TFP)	40	1.150	D(ODA/GDP) does not Granger Cause D(INFRATION)	40	0.086
D(TFP) does not Granger Cause D(ODA/GDP)	40	1.362	D(INFRATION) does not Granger Cause D(ODA/GDP)	40	0.490
D(INFLATION) does not Granger Cause D(TRADE)	40	0.049	D(K/L) does not Granger Cause D(GC/GDP)	40	0.061
D(TRADE) does not Granger Cause D(INFLATION)	40	1.609	D(GC/GDP) does not Granger Cause D(K/L)	40	3.083*
D(GC/GDP) does not Granger Cause D(TRADE)	40	1.389	D(ODA/GDP) does not Granger Cause D(GC/GDP)	40	3.075*
D(TRADE) does not Granger Cause D(GC/GDP)	40	0.003	D(GC/GDP) does not Granger Cause D(ODA/GDP)	40	0.594
			D(ODA/GDP) does not Granger Cause D(K/L)	40	2.094
			D(K/L) does not Granger Cause D(ODA/GDP)	40	1.112

Notes
TFP: Total Factor Productivity calculated by the author
TRADE: total of export and import divided by GDP
INFLATION: GDP deflator
GC/GDP: Government Consumption divided by GDP
K/L: capital-labor ratio
ODA/GDP: net ODA divided by GDP
D(--) denotes the first difference
Standard error in parentheses
***, **, and * indicate the significance level at 1%, 5%, and 10%, respectively

Table 6: Estimation results of the VAR model without inflation

	D(TFP)	D(TRADE)	D(GC/GDP)	D(K/L)	D(ODA/GDP)
D(TFP(-1))	0.969	0.055	-0.008	127.663	0.000
	(0.046)***	(0.039)	(0.005)	(330.538)	(0.000)
D(TRADE(-1))	-0.105	-0.271	0.008	-456.871	-0.001
	(0.203)	(0.171)	(0.021)	(1464.38)	(0.001)
D(GC/GDP(-1))	4.626	-1.163	0.256	15815.040	0.007
	(1.509)***	(1.273)	(0.159)	(10892.1)	(0.009)
D(K/L(-1))	0.000	0.000	0.000	-0.537	0.000
	(0.000)	(0.000)	(0.000)	(0.142)***	(0.000)
D(ODA/GDP(-1))	-17.003	20.420	-4.610	-224281.400	-0.099
	(25.869)	(21.832)	(2.724)	(186785)	(0.156)
C	0.006	0.034	0.000	9.674	0.000
	(0.000)	(0.011)***	(0.000)	(0.000)	(0.000)
Adj. R-squared	0.920	0.012	0.118	0.240	-0.014

Notes
TFP: Total Factor Productivity calculated by the author
TRADE: total of export and import divided by GDP
GC/GDP: Government Consumption divided by GDP
K/L: capital-labor ratio
ODA/GDP: net ODA divided by GDP
D(--) denotes the first difference, and (-1) denotes the previous period
Standard error in parentheses
***, **, and * indicate the significance level at 1%, 5%, and 10%, respectively

Table 7: Estimation results of the Granger causality without inflation

Null Hypothesis:	Obs	F-Statistic
D(TRADE) does not Granger Cause D(TFP)	40	2.077
D(TFP) does not Granger Cause D(TRADE)	40	2.689
D(GC/GDP) does not Granger Cause D(TFP)	40	12.566***
D(TFP) does not Granger Cause D(GC/GDP)	40	2.970*
D(K/L) does not Granger Cause D(TFP)	40	0.284
D(TFP) does not Granger Cause D(K/L)	40	0.003
D(ODA/GDP) does not Granger Cause D(TFP)	40	1.150
D(TFP) does not Granger Cause D(ODA/GDP)	40	1.362
D(GC/GDP) does not Granger Cause D(TRADE)	40	1.389
D(TRADE) does not Granger Cause D(GC/GDP)	40	0.003
D(K/L) does not Granger Cause D(TRADE)	40	0.100
D(TRADE) does not Granger Cause D(K/L)	40	0.834
D(ODA/GDP) does not Granger Cause D(TRADE)	40	1.338
D(TRADE) does not Granger Cause D(ODA/GDP)	40	0.624
D(K/L) does not Granger Cause D(GC/GDP)	40	0.061
D(GC/GDP) does not Granger Cause D(K/L)	40	3.083*
D(ODA/GDP) does not Granger Cause D(GC/GDP)	40	3.075*
D(GC/GDP) does not Granger Cause D(ODA/GDP)	40	0.594
D(ODA/GDP) does not Granger Cause D(K/L)	40	2.094
D(K/L) does not Granger Cause D(ODA/GDP)	40	1.112

Notes
TFP: Total Factor Productivity calculated by the author
TRADE: total of export and import divided by GDP
GC/GDP: Government Consumption divided by GDP
K/L: capital-labor ratio
ODA/GDP: net ODA divided by GDP
D(--) denotes the first difference
standard error in parentheses
***, **, and * indicate the significance level at 1%, 5%, and 10%, respectively

Additionally, we summarize the estimation results of the VAR model and Granger causality shown from Table 4 to Table 7 for the following two points. First, the coefficient of foreign aid in the previous period of TFP is statistically non-significant in Tables 4 and 6. Second, the ODA's Granger causality also shows no relationship with the TFP, regardless of inflation shown in Tables 5 and 7. From these results, it is inferred that no relationship exists between foreign aid and productivity.

Since there are relatively many variables in the previous VAR model and Granger causality tests, we focus on the relationship between foreign aid and TFP as an additional examination. As shown in Table 8, the results reveal a non-significant relationship; it is the same as estimated previously.

Table 8: Estimation results of the VAR model and Granger causality with only foreign aid and TFP

	D(TFP)	D(ODA/GDP)
D(TFP(-1))	0.943	0.000
	(0.050)***	(0.000)
D(ODA/GDP(-1))	-29.985	-0.151
	(27.958)	(0.151)
C	0.004	0.000
	(0.013)	(0.000)
Adj. R-squared	0.902	0.004

Null Hypothesis:	Obs	F-Statistic
D(ODA/GDP) does not Granger Cause D(TFP)	40	1.150
D(TFP) does not Granger Cause D(ODA/GDP)	40	1.362

Notes
TFP is Total Factor Productivity calculated by the author, and ODA/GDP is net ODA divided by GDP.
D(--) denotes the first difference, and (-1) denotes the previous period
Standard error in parentheses
***, **, and * indicate the significance level at 1%, 5%, and 10%, respectively

In summary, we estimate the relationship between foreign and and TFP in three ways: the OLS, VAR model, and the Granger causality. All estimation results show insignificantly estimated, inferring that there is no direct relationship foreign aid and TFP. This result is similar to previous studies. Although Thailand used foreign aid relatively efficiently, foreign aid does not extend the productivity directly.

5 Conclusion

Using the VAR model and Granger causality, this study examines the relationship between foreign aid and total factor productivity in Thailand from 1972 to 2013. Estimation results show that foreign aid does not have a relationship with the TFP in Thailand, indicating that foreign aid does not necessarily directly affect productivity. This result is in line with previous studies discussed in the introductory section and also with Krugman (1994), as productivity is not necessarily fostered by just constructing social infrastructure. Productivity will be raised mainly by technological advance, and foreign aid is one of the instruments of raising productivity.

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