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Analysing the Sources of Growth in an Emerging Market Economy: The Thailand Experience

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Abstract

This paper investigates the sources of economic growth in Thailand during the period 1975 to 2014. The results show that, in the long run, human capital and inflation exert a positive and significant impact on output, while foreign direct investment and foreign aid have negative and significant impact on output. The results also show that, in the short run, physical capital, labour and human capital have a positive and significant impact on growth, while the initial level of human capital, government expenditure, the initial level of inflation, foreign direct investment and foreign aid have a negative and significant impact on growth. Based on these findings, we offer some policy implications.

JEL Codes: C22; O47; O53

Keywords: sources of growth; Thailand; ARDL bounds testing

1. Introduction

Apart from the Asian miracles achieved by the four Asian tigers, Thailand has been widely recognised as one of the Asian growth success stories. Over the past few decades, the country has achieved impressive growth progress, elevating it from a low-income to an upper-middle income economy in 2011 (World Bank, 2017). During the boom years of 1986 to 1996, the economy grew at an average annual rate of 7.5%. Despite the negative spill-over effects of the Asian financial crisis during the late 1990s, the country's growth momentum remained strong. The average annual growth rate of the economy was 5% during the period 1999 to 2005. The average growth rate only slowed down to 3.5% in the recent period 2005 to 2015 (World Bank, 2017). Against this backdrop, efforts to identify the sources of growth would be invaluable to the policymakers of the country. To this end, our study serves to provide a comprehensive understanding of economic drivers of growth during the past few decades. It provides some insights into how policymakers could raise long-term growth to further push the country towards attaining a high-income status in the future, amidst the recent economic slowdown.

The literature shows that there are various studies investigating the long-term growth. However, these studies have mainly focused on the relationship between individual factors and growth. Among the individual factors are energy consumption, export, government expenditure and foreign direct investment (see, for example, Feder, 1983; Ahmad and Harnhirun, 1996; Asafu-Adjaye, 2000; Zhang, 2001; Yoo, 2006; Brahma-srene and Jiranyakul, 2007). Even though there are a handful of studies attempting to examine the growth by including multiple factors in the growth function, the factors are confined to those featuring in the conventional neoclassical model. These factors are capital, labour and the residual factor of total factor productivity (see Bosworth 2005; Chuenchoksan and Nakornthab, 2008; Lathapipat and Chucherd, 2013). Furthermore, the existing studies have focused mainly on the long-run sources of growth. The short-run sources are

largely ignored in these studies. Although the goal of growth-related policies is to achieve long-run growth; the short-run dynamics of growth rates are equally valuable.

The paper enriches the literature by exploring both the short and long-run sources of growth of the country. We specifically investigate the impact of multiple factors, among which are physical capital, labour, human capital, government expenditure, inflation, trade openness, foreign direct investment, and foreign aid on growth within an augmented Solow growth model by employing the ARDL bounds testing procedure. Our findings can be summarised as follows. In the long run, both human capital and inflation exert a positive and significant impact on output, while foreign direct investment and foreign aid have a negative and significant impact on output. In the short run, physical capital, labour and human capital have a positive and significant impact on growth, while the initial level of human capital, government expenditure, the initial level of inflation, foreign direct investment and foreign aid have a negative and significant impact on growth.

The next section of the paper, section 2, presents the empirical methodology; section 3 presents the empirical results; and a conclusion is drawn in section 4.

2. Methodology and data

2.1. Model specification

We adopt the augmented Solow model in this study by allowing technology (A_t) to change overtime. This approach is also used by other empirical studies, such as Chen and Feng (2000), Wang and Yao (2003), Li and Liu (2005) and Takumah and Iyke (2017). According to the literature, factors such as human capital, government expenditure, inflation, foreign direct investment, trade openness and foreign aid may cause A_t to change overtime. Therefore, the functional form of A_t can be stated as:

$$A_t = F(HC_t, GOV_t, INF_t, FDI_t, OPEN_t, AID_t) \quad (1)$$

Suppose that A_t is Cobb-Douglas, then Eq. (1) can be restated as:

$$A_t = \theta HC_t^{\delta_1} GOV_t^{\delta_2} INF_t^{\delta_3} FDI_t^{\delta_4} OPEN_t^{\delta_5} AID_t^{\delta_6} \quad (2)$$

where θ is a constant. By replacing technology A_t with Eq. (2) in a simple growth function, which exhibits Cobb-Douglas characteristics, we have:

$$Y_t = \theta K_t^\alpha L_t^\beta HC_t^{\delta_1} GOV_t^{\delta_2} INF_t^{\delta_3} FDI_t^{\delta_4} OPEN_t^{\delta_5} AID_t^{\delta_6} \quad (3)$$

where Y is the aggregate output; K is physical capital; L is labour; HC is human capital; GOV is government expenditure; INF is inflation; FDI is foreign direct investment; $OPEN$ is trade openness; AID is foreign aid; δ_i are the shares of these inputs in the aggregate output and t denotes time. For estimation purposes, we proceed to log-linearise Eq. (3) by taking the natural logarithm on both sides. The resulting specification is of the form:

$$\ln Y_t = \ln \theta + \alpha \ln K_t + \beta \ln L_t + \delta_1 \ln HC_t + \delta_2 \ln GOV_t + \delta_3 \ln INF_t + \delta_4 \ln FDI_t + \delta_5 \ln OPEN_t + \delta_6 \ln AID_t + \mu_t \quad (4)$$

Suppose that $\ln \theta = \gamma$, where γ is a constant term, then we have:

$$\ln Y_t = \gamma + \alpha \ln K_t + \beta \ln L_t + \delta_1 \ln HC_t + \delta_2 \ln GOV_t + \delta_3 \ln INF_t + \delta_4 \ln FDI_t + \delta_5 \ln OPEN_t + \delta_6 \ln AID_t + \mu_t \quad (5)$$

where \ln is the natural logarithm operator and μ_t denotes the white-noise error term.

2.2. ARDL bounds testing procedure for cointegration

The main limitation of Eq. (5) is that this testing does not recover the short-run impacts of the growth determinants. Hence, the policymaker will be unable to assess the short-run impacts of these factors on growth. We use the autoregressive distributed lag (ARDL) bounds testing procedure to deal with this limitation. This approach is preferred to other approaches owing to various reasons. First, it allows the examination of both the short and long-run relationships between growth and its determinants. Second, unlike other approaches, it does not impose the restrictive assumption that all the variables in the model must be integrated of the same order. It is applicable irrespective whether the variables are integrated of order zero, one, a mixture of both, or fractionally integrated. Third, the approach does well even when the sample size is small (see Pesaran et al., 2001). Based on the above considerations, the ARDL approach is used for our empirical analysis. The specification of Eq. (5) in the ARDL setting will be of the following form:

$$\begin{aligned} \Delta \ln Y_t = & \rho_0 + \sum_{i=1}^n \rho_{1i} \Delta \ln Y_{t-i} + \sum_{i=0}^n \rho_{2i} \Delta \ln K_{t-i} + \sum_{i=0}^n \rho_{3i} \Delta \ln L_{t-i} + \sum_{i=0}^n \rho_{4i} \Delta \ln HC_{t-i} \\ & + \sum_{i=0}^n \rho_{5i} \Delta \ln GOV_{t-i} + \sum_{i=0}^n \rho_{6i} \Delta \ln INF_{t-i} + \sum_{i=0}^n \rho_{7i} \Delta \ln FDI_{t-i} + \sum_{i=0}^n \rho_{8i} \Delta \ln OPEN_{t-i} \\ & + \sum_{i=0}^n \rho_{9i} \Delta \ln AID_{t-i} + \sigma_1 \ln Y_{t-1} + \sigma_2 \ln K_{t-1} + \sigma_3 \ln L_{t-1} + \sigma_4 \ln HC_{t-1} + \sigma_5 \ln GOV_{t-1} \\ & + \sigma_6 \ln INF_{t-1} + \sigma_7 \ln FDI_{t-1} + \sigma_8 \ln OPEN_{t-1} + \sigma_9 \ln AID_{t-1} + \varepsilon_t \end{aligned} \quad (6)$$

where ε , ρ and σ are the white-noise error term, the short-run coefficients and the long-run coefficients of the model, respectively; and Δ is the first-difference operator. t denotes time period; and n is the maximum number of lags in the model selected by the Akaike Information Criterion (AIC). The variables $\ln Y$, $\ln K$, $\ln L$, $\ln HC$, $\ln GOV$, $\ln INF$, $\ln FDI$, $\ln OPEN$ and $\ln AID$ are the natural logarithm of output, physical capital, labour, human capital, government expenditure, inflation, foreign direct investment, trade openness and foreign aid, respectively.

For the long-run results to be reliable, the variables have to be cointegrated. The cointegration relationship among the variables is tested through the joint significance of the coefficients δ_1 , δ_2 , δ_3 , δ_4 , δ_5 , δ_6 , δ_7 , δ_8 and δ_9 . That is, we verify the existence of cointegration by testing the null hypothesis of the no cointegration relationship among the variables in the form of $\delta_1 = \delta_2 = \delta_3 =$

$\delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = \delta_9 = 0$. Pesaran et al. (2001) have constructed two sets of critical values under this null hypothesis. The first set of critical values are constructed by assuming that the variables in Eq. (6) are integrated of order zero, while the second set are constructed by assuming that they are integrated of order one. One can reject the presence of cointegration if the calculated F -statistic is smaller than the first set of critical values, but one cannot reject the presence of cointegration if the calculated F -statistic is larger than the second set of critical values. However, if the calculated F -statistic lies in between both sets of critical values, the test is inconclusive.

If the variables are cointegrated, then Eq. (6) can be reformulated into the following error-correction model:

$$\begin{aligned} \Delta \ln Y_t = & \rho_0 + \sum_{i=1}^n \rho_{1i} \Delta \ln Y_{t-i} + \sum_{i=0}^n \rho_{2i} \Delta \ln K_{t-i} + \sum_{i=0}^n \rho_{3i} \Delta \ln L_{t-i} + \sum_{i=0}^n \rho_{4i} \Delta \ln HC_{t-i} \\ & + \sum_{i=0}^n \rho_{5i} \Delta \ln GOV_{t-i} + \sum_{i=0}^n \rho_{6i} \Delta \ln INF_{t-i} + \sum_{i=0}^n \rho_{7i} \Delta \ln FDI_{t-i} + \sum_{i=0}^n \rho_{8i} \Delta \ln OPEN_{t-i} \\ & + \sum_{i=0}^n \rho_{9i} \Delta \ln AID_{t-i} + \sigma ECM_{t-1} + \varepsilon_t \end{aligned} \quad (7)$$

where σ is the coefficient of the error-correction term, ECM_{t-1} . σ is expected to have a negative sign. This means that growth adjusts to its steady-state level when it drifts away in the short run.

2.3. Variable definition and justification

2.3.1. Economic growth (Y)

Economic growth is the continuous increase in the total amount of goods and services per person in economy overtime. In the study, we use GDP per capita (constant 2010 US\$) to measure the real output (Y) so that the changes in it represent the rate of economic growth. The real GDP per capita is defined as the value of all goods and services produced in a given year expressed in the base year prices divided by the mid-year population of the country (see WDI, 2016). This proxy has been used in other empirical studies such as Arestis and Demetriades (1997), Temple and Wöβmann (2006) and Hartwig (2012).

2.3.2. Physical capital (K)

We use gross capital formation (percentage of GDP) to measure physical capital (K). Gross capital formation covers the outlays on additions to the fixed assets of the economy and net changes in the level of inventories, which reflect the essence of physical capital formation (see WDI, 2016). This proxy has been widely used in other studies such as Barro (1991, 2003), Mankiw et al. (1992) and Takumah and Iyke (2017). Both the neoclassical and endogenous growth models demonstrate that a higher investment ratio results in a higher growth rate, keeping other variables unchanged (see Mankiw et al., 1992; Barro, 2003; Mirestean and Tsangarides, 2016).

2.3.3. *Labour (L)*

We use population growth (annual percentage) to measure labour (*L*). This proxy has been used in other studies, such as Li and Liu (2005) and Mirestean and Tsangarides (2016). Some empirical studies have found that population growth can have a negative impact on growth (see for example, Moral-Benito, 2012) or a positive impact on growth (see Beaudry and Green, 2002). The negative impact is due to the fact that a higher population growth will reduce the capital per capita, thereby lowering the output per capita. Other studies show that population growth can accelerate the process of adopting a new technology, thereby fostering growth (see Beaudry and Green, 2002).

2.3.4. *Human capital (HC)*

Human capital represents a set of intangible resources embedded in labour which improve productivity. We use the human capital index provided by the Penn World Table version 9.0 to measure human capital (*HC*). The index is compiled based on years of schooling and returns to education. This proxy has been used in other studies, such as Temple and Wößmann (2006), Rajan and Zingales (2008) and Moral-Benito (2012). The theoretical literature demonstrates that human capital has a positive impact on growth. This is because when workers become more educated, they will be more productive and innovative and will invent new products, thereby improving factors of productivity (see Romer, 1990; Benhabib and Spiegel, 1994). The empirical literature supports this view. For example, studies such as Barro (1991); Bodman and Le (2013) and Teixeira and Queirós (2016) find that human capital exerts a positive impact on economic growth.

2.3.5. *Government expenditure (GOV)*

We use general government final consumption expenditure (percentage of GDP) to measure government expenditure (*GOV*). The general government final consumption expenditure covers all current government expenditure on goods and services; compensation of employees and expenditure on national defences and security (see WDI, 2016). The proxy has been used in other studies, such as Levine and Zervos (1996) and Barro (2003). The literature shows that the impact of government expenditure on growth is inconclusive. Some studies found that government expenditure has a negative impact on output through the distortionary effects of taxation on savings (see Barro, 2003; Mirestean and Tsangarides, 2016). Some studies found that government expenditure has a positive impact on output when the expenditure is on infrastructure programmes, such as road construction and electricity provision (Easterly and Rebelo, 1993; Fölster and Henrekson, 2006; Bergh and Karlsson, 2010).

2.3.6. *Inflation rate (INF)*

We use the annual percentage change of the consumer price index to measure inflation rate. This measure reflects the annual percentage change in the cost to an average consumer of purchasing a basket of goods and services. The measure has been used in other studies, such as Fischer (1993) and Eriş and Ulaşan (2013). Some studies suggest that higher inflation may hurt growth. This is because inflation could increase the cost of capital, thereby inhibiting capital accumulation and capital productivity, which in turn slow down growth (see De Gregorio, 1993, 2006; Eriş and Ulaşan, 2013). It is argued in some studies that inflation may enhance growth. Dotsey and Sarte (2000) show that higher inflation usually generates increases in inflation uncertainty, thereby enhancing precautionary savings, investment and growth. Similarly, Aghion and Saint-Paul (1998) and Blackburn (1999) argue that increases in inflation can enhance growth in models with technological change and R&D. Other studies have also found that there is a threshold relationship

between inflation and growth (see Sarel, 1996; Bruno and Easterly, 1998; Yilmazkuday, 2013). These studies find that inflation has a negative impact below a certain level of inflation and a positive but sometimes insignificant impact on growth beyond that threshold level.

2.3.7. *Foreign direct investment (FDI)*

We use the net inflows of foreign direct investment (percentage of GDP) to measure foreign direct investment. Foreign direct investment captures the sum of equity capital, reinvestment of earnings and other short and long-term capital as shown in the balance of payments (see WDI, 2016). This measure has been used in other studies as well such as Alfaro et al. (2004), Herzer and Klasen (2008) and Takumah and Iyke (2017). The literature suggests that foreign direct investment can promote or hurt economic growth. Foreign direct investment promotes growth by technology transfer through the introduction of new products and production processes (see Grossman and Helpman, 1991; Barro and Sala-i-Martin, 1995). Similarly, foreign direct investment promotes growth by providing direct capital financing to domestic firms (see Alfaro et al., 2004). The positive impact of foreign direct investment on growth is also supported in the empirical literature (see, for example, Blomstrom et al., 1996; Alfaro et al., 2004, Ongo Nkoa, 2014). In contrast, Li and Liu (2005) contend that foreign direct investment can hurt growth if the level of human capital and the technology-absorptive ability of the host country are too low. Empirical studies, such as Sjöholm (1999) and Bende-Nabende et al. (2003), find that foreign direct investment exerts a negative impact on growth.

2.3.8. *Foreign aid (AID)*

We use net official development assistance (ODA) (percentage of GNI) to measure foreign aid (*AID*). ODA covers the disbursements of grants and loans made on concessional terms (net of repayments of principal) by official agencies to promote economic development and welfare in the countries listed by the Development Assistance Committee of ODA recipients (see WDI, 2016). This proxy has been used in other studies, such as Asteriou (2009) and Mirestean and Tsangarides (2016). The impact of foreign aid on growth is highly controversial in the literature. On the one hand, some argue that foreign aid can promote growth by increasing the amount of physical capital, the level of human capital through education and by improving health (see Rajan and Subramanian, 2011). This positive view is supported in empirical studies such as Burnside and Dollar (2000), Clemens et al. (2004) and Minoiu and Reddy (2010). On the other hand, foreign aid can also impair growth by reducing the competitiveness of the tradable sector through pushing up the real exchange rate in the recipient country (see Van Wijnbergen, 1986; Torvik, 2001). This negative view is supported by empirical studies, such as Kourtellos et al. (2007) and Rajan and Subramanian (2011).

2.3.9. *Trade openness (OPEN)*

We use the ratio of the sum of exports and imports to GDP as our measure of trade openness (*OPEN*). This measure has been used in studies, such as Alfaro et al. (2004) and Eriş and Ulaşan (2013). The theoretical literature suggests that international trade can benefit growth in various ways. It encourages technology diffusion by importing high-tech products and services. It also increases the market size, thereby allowing economies of scale in production. In addition, it pushes governments to launch reforms to build the local economies for competition in the world market (see Grossman and Helpman, 1990; Barro and Sala-i-Martin, 1997; Rajan and Zingales, 2003).

The empirical studies supporting the positive impact of trade openness include Balassa (1978), Romer (1990), Dollar and Kraay (2003), Squalli and Wilson (2011), among others.

2.4. Data source

This study uses annual time-series data covering the period 1975 to 2014. The data have been sourced from the World Development Indicators (WDI) database (2016) compiled by the World Bank and the Penn World Table version 9.0 (2016). We use GDP per capita (constant 2010 US\$) in the study to measure growth (Y); gross capital formation (percentage of GDP) to measure physical capital (K); population growth (annual percentage) to measure labour (L); human capital index to measure human capital (HC); general government final consumption expenditure (percentage of GDP) to measure government expenditure (GOV); annual percentage change in consumer price index to measure inflation rate (INF); trade (percentage of GDP) to measure trade openness ($OPEN$); the net inflows of foreign direct investment (percentage of GDP) to measure foreign direct investment (FDI) and net official development assistance (percentage of GNI) to measure foreign aid (AID). All the variables are in natural logarithm except AID which has several negative observations. Table 1 reports the descriptive statistics of the variables.

Table 1: Descriptive statistics of the variables.

	lnY	lnK	lnL	lnHC	lnGOV	lnINF	lnOPEN	lnFDI	AID
Mean	7.920	3.356	-0.015	0.721	2.530	1.283	4.407	0.398	0.538
Median	8.096	3.321	0.129	0.757	2.557	1.502	4.416	0.612	0.565
Maximum	8.637	3.758	0.945	0.978	2.841	2.542	4.945	1.862	1.445
Minimum	6.976	2.999	-1.947	0.403	2.221	-1.637	3.722	-1.600	-0.646
Std. Dev.	0.516	0.212	0.779	0.179	0.163	0.770	0.423	0.898	0.512
Skewness	-0.326	0.499	-0.970	-0.420	0.012	-1.470	-0.214	-0.383	-0.210
Kurtosis	1.734	2.511	3.077	1.974	2.410	6.474	1.540	2.118	2.065
Jarque-Bera	3.379	2.056	6.288	2.930	0.581	33.658	3.862	2.275	1.751
Probability	0.185	0.358	0.043	0.231	0.748	0.000	0.145	0.321	0.417
Sum	316.813	134.254	-0.584	28.858	101.195	50.041	176.270	15.931	21.529
Sum Sq. Dev.	10.397	1.750	23.646	1.252	1.032	22.551	6.976	31.443	10.241
Observations	40	40	40	40	40	39	40	40	40

Notes: Std. Dev. denotes standard deviation and Sum Sq. Dev. denotes sum square deviation.

3. Empirical results

3.1. Results of stationarity tests

The first step of our empirical analysis is to test the stationary properties of growth and its determinants. We use the logarithm of real GDP per capita as our measure of real output to do this. Therefore, its annual changes measure economic growth. The determinants of growth investigated

in this study include physical capital, labour, human capital, government expenditure, inflation, trade openness, foreign direct investment and foreign aid. We use two-unit root tests: the Dickey-Fuller Generalised Least Squares (DF-GLS) test and the Ng-Perron test to examine their stationary properties. See for example, Elliott et al. (1996) and Ng and Perron (2001) for detailed discussion of these tests. Table 2 shows the results of the unit root tests of the variables in their levels and at first differences.

From these results, *lnINF* and *lnFDI* are stationary at levels, while *lnY*, *lnK*, *lnL*, *lnHC*, *lnGOV*, *lnOPEN* and *AID* are stationary at the first differences. On establishing that the variables are integrated of either order zero or order one, we can proceed to test the long-run relationships between growth and its determinants by employing the ARDL bounds testing procedure.

Table 2: Results of unit root tests of the variables in their levels and first differences.

Dickey-Fuller Generalized Least Squares (DF-GLS) Test								
Variable	Stationarity of all variables in levels				Stationarity of all variables at first differences			
	Without trend	Lag	With trend	Lag	Without trend	Lag	With trend	Lag
<i>lnY</i>	0.074	1	-1.730	1	-3.376***	0	-3.677**	0
<i>lnK</i>	-2.000**	0	-2.127	0	-5.069***	0	-5.566***	0
<i>lnL</i>	0.675	4	-3.310**	3	-4.322***	3	-4.296***	3
<i>lnHC</i>	-0.614	1	-2.205	1	-1.932*	0	-7.309***	9
<i>lnGOV</i>	-0.851	1	-2.252	1	-3.241***	0	-3.483**	0
<i>lnINF</i>	-3.839***	0	-4.790***	0	NA	NA	NA	NA
<i>lnOPEN</i>	0.083	0	-1.956	0	-6.231***	0	-6.337***	0
<i>lnFDI</i>	-2.162**	0	-3.299**	0	NA	NA	NA	NA
<i>AID</i>	-1.406	0	-3.0038	0	-2.631***	1	-7.472***	0

Ng-Perron Test								
Variable	Stationarity of all variables in levels				Stationarity of all variables at first differences			
	Without trend	Lag	With trend	Lag	Without trend	Lag	With trend	Lag
<i>lnY</i>	0.154	1	-1.996	1	-2.569**	0	-2.723*	0
<i>lnK</i>	-1.826*	0	-1.895	0	-3.014***	0	-3.028**	0
<i>lnL</i>	0.167	4	-9.027***	3	-6.049***	3	-6.338***	3
<i>lnHC</i>	-2.142**	1	-2.315	1	-1.752*	0	-3.417**	4
<i>lnGOV</i>	-1.112	1	-2.279	1	-2.530**	0	-2.651*	1
<i>lnINF</i>	-2.710***	0	-2.926**	0	NA	NA	NA	NA
<i>lnOPEN</i>	0.540	0	-1.768	0	-3.070***	0	-3.077**	0
<i>lnFDI</i>	-1.912*	0	-3.396**	3	NA	NA	NA	NA
<i>AID</i>	-1.347	0	-2.272	0	-2.005**	1	-2.958**	0

Notes:

(1) *, ** and *** denote significance at 10%, 5% and 1%, respectively.

(2) NA denotes non-applicable.

3.2. Results of the cointegration test, using the ARDL bounds testing procedure

Table 3 reflects the results of ARDL bounds test for cointegration and the critical values of the lower and upper-bound, respectively. The calculated F -statistic of the ARDL bounds test for cointegration is 5.445, which is higher than the upper bound critical values reported by Pesaran et al. (2001) at 1% level of significance. Therefore, the results show that the variables are cointegrated.

On establishing that $\ln Y$, $\ln K$, $\ln L$, $\ln HC$, $\ln GOV$, $\ln INF$, $\ln OPEN$, $\ln FDI$ and AID are cointegrated, we proceed to estimate the short and long-run models discussed in the methodology section. In order to do this, we first need to determine the optimal lag length to be used in the model. By using Akaike Information Criterion (AIC), the optimal lag length selected is 2. The preferred specification is ARDL (1, 1, 0, 1, 2, 2, 1, 1, 1). Table 4 provides the resulting long-run and short-run estimates of the growth specification.

Table 3: Results of the ARDL bounds test for cointegration.

Dependent Variable	Function	F -statistic	Cointegration Status
$\ln Y$	$F(\ln Y \ln K, \ln L, \ln HC, \ln GOV, \ln INF, \ln OPEN, \ln FDI, AID)$	5.445***	Cointegrated

The critical values of ARDL bounds test

Pesaran et al. (2001) critical values		
Level of significance (%)	Lower bound	Upper bound
1	2.79	4.10
5	2.22	3.39
10	1.95	3.06

Notes: *** denotes significance at 1%. Critical values are based on Pesaran et al. (2001), Table CI (iii) Case III.

Table 4: The long and short-run results of the selected growth specification.

Panel 1				
Long-run results				
Dependent variable is $\ln Y$				
Regressor	Coefficient	Standard Error	T-statistics	P-value
$\ln K$	0.098	0.089	1.101	0.287
$\ln L$	0.015	0.015	0.979	0.342
$\ln HC$	2.438***	0.363	6.714	0.000
$\ln GOV$	-0.186	0.110	-1.693	0.110
$\ln INF$	0.076**	0.029	2.634	0.018
$\ln OPEN$	0.194	0.132	1.469	0.161
$\ln FDI$	-0.052**	0.020	-2.574	0.020
AID	-0.138***	0.029	-4.708	0.000

Panel 2				
Short-run results				
Dependent variable is $\Delta \ln Y$				
Regressor	Coefficient	Standard Error	T-ratio	P-value
$\Delta \ln K$	0.141***	0.016	8.637	0.000

$\Delta \ln L$	0.048***	0.011	4.382	0.001
$\Delta \ln HC$	0.690*	0.390	1.769	0.096
$\Delta \ln HC(-1)$	-1.550***	0.432	-3.591	0.002
$\Delta \ln GOV$	-0.191***	0.054	-3.514	0.003
$\Delta \ln INF$	0.001	0.004	0.184	0.857
$\Delta \ln INF(-1)$	-0.024***	0.004	-6.478	0.000
$\Delta \ln OPEN$	-0.066	0.038	-1.747	0.100
$\Delta \ln FDI$	-0.019***	0.004	-5.196	0.000
ΔAID	-0.019**	0.009	-2.252	0.039
<i>Constant</i>	2.267***	0.199	11.373	0.000
<i>ECM(-1)</i>	-0.405***	0.037	-11.086	0.000

Notes:

(1) *, ** and *** denote 10%, 5% and 1% significance levels, respectively;

(2) Δ = first difference operator.

Now let us examine the coefficient estimates of the long-run results that are reflected in panel 1 of table 4. In the long run, the key determinants of growth are human capital, inflation, foreign direct investment and foreign aid. The results show that human capital has a positive and significant impact on real output in the long run. In particular, a percentage increase in human capital index leads to a 2.44% increase in real GDP per capita, keeping the other factors constant. This finding is well-supported by other empirical studies (see, for example, Grossman and Helpman, 1991; Barro, 1991; Bodman and Le, 2013; Teixeira and Queirós, 2016). In addition to the human capital, inflation also has a positive and significant impact on real output in the long run. A percentage increase in inflation rate leads to a 0.08% increase in real GDP per capita, leaving the other factors unchanged. A similar finding is documented in Aghion and Saint-Paul (1998), Blackburn (1999), Dotsey and Sarte (2000) and Phiri (2018). The results also show that some determinants exert a negative impact on real GDP per capita in the long run. For example, the results show that foreign direct investment has a negative and significant impact on real output in the long run. A percentage increase in the foreign direct investment to GDP ratio leads to a 0.05% decrease in real GDP per capita, other factors unchanged. There are three possible explanations for the negative impact of foreign direct investment on the output of the host countries. First, the impact of foreign direct investment on output is conditioned on the level of human capital. If the level of human capital is too low, the benefit of foreign direct investment could not be diffused to the host country (Li and Liu, 2005). Second, the impact of foreign direct investment on output is also conditioned on the technology-absorptive ability of the host countries. If the technology gap between the foreign and host countries is too large, it may adversely affect the impact of foreign direct investment on output (Li and Liu, 2005). Third, the negative impact of foreign direct investment on growth may also be due to the crowding out effect of foreign direct investment on domestic investment. Klobodu and Adams (2016) show that the effect of foreign direct investment is less important than domestic investment in promoting growth. Finally, foreign aid has a negative and significant impact on the output in the long run. A percentage increase in net official development assistance ratio leads to 0.14% decrease in real GDP per capita, keeping other factors unchanged. The negative impact of foreign aid could be explained by the ineffective and inefficient use of foreign aid. It could lead to a decline in the competitiveness of the tradable sector in that it pushes up the real exchange rate of the country (see Van Wijnbergen, 1986; Torvik, 2001). In fact, this finding is consistent with the findings in other studies (see Kourtellos et al., 2007; Rajan and Subramanian, 2011).

We now turn to the short-run results indicated in panel 2 of table 4. These results suggest that the key determinants of the growth are physical capital, labour, initial and current level of human capital, government expenditure, initial level of inflation rate, foreign direct investment and foreign aid. The results show that physical capital exerts a positive impact on growth in the short run. A percentage increase in gross capital formation to GDP ratio leads to a 0.14% increase in output growth, keeping the other factors constant. This result is consistent with those found in Mankiw et al. (1992) and Barro (2003). The results also show that labour is positively and significantly associated with growth in the short run. A percentage increase in population growth leads to a 0.05% increase in output growth, and the other factors remain constant. The positive relationship between labour and growth is documented by Beaudry and Green (2002).

The results further show that the initial and current level of human capital is significantly associated with growth. On the one hand, the current level of human capital is positively and significantly associated with growth in the short run. A percentage increase in the human capital index leads to a 0.69% increase in the growth, keeping the other factors constant. This finding is similar to the other growth studies we discussed in the long-run results. On the other hand, the initial level of human capital is negatively and significantly associated with growth in the short run. In particular, a percentage increase in the initial level of human capital leads to a 1.55% decrease in growth, keeping the other factors constant. The negative relationship between the initial level of human capital and growth implies that there is convergence in growth. That is, the lower the initial level of human capital, the higher the growth rate will be via the channel of school advancement. This finding is consistent with the ones documented by Barro (1991; 2003) and Mankiw et al. (1992).

In addition, the results show that government expenditure is negatively and significantly associated with growth. Specifically, a percentage increase in the current level of government expenditure ratio leads to a 0.19% decrease in the growth, keeping the other factors constant. The negative impact of government expenditure on growth could be explained by the distortionary effects of taxation on savings, thereby compromising growth (see Barro, 2003; Mirestean and Tsangarides, 2016). The negative relationship between government expenditure and growth is supported by similar studies in the literature (see Barro, 1991; 2003; Moral-Benito, 2012; Mirestean and Tsangarides, 2016). Moreover, the results show that the initial level of inflation is negatively and significantly associated with growth in the short run. Specifically, a percentage increase in the initial level of inflation leads to a 0.02% decrease in the growth, with other factors remaining the same. The negative relationship between inflation and growth is supported by other studies (see, for example, Fischer, 1993; Barro, 2003; Eriş and Ulaşan, 2013).

The study also found that foreign direct investment is negatively and significantly associated with economic growth in the short run. A percentage increase in foreign direct investment leads to a 0.02% decrease in the growth, leaving other factors unchanged. The negative relationship between foreign direct investment and growth is supported by other studies (see the long-run results). Furthermore, foreign aid is negatively and significantly associated with growth in the short run. In particular, a percentage increase in net official development assistance ratio per capita leads to a 1.92% decrease in the growth, with the other factors remaining unchanged. The negative

relationship between aid and growth, in the short run, is similar to the long run result we have discussed.

Finally, the results show that the coefficient of the error-correction term is negative and statistically significant. The term measures the short-run dynamics and the adjustment towards the long-run equilibrium path. The results show that when the variables drift apart from the equilibrium level by 1% in the short run, they will adjust back in the next period at a rate of 0.41%. In general, the selected ARDL specification is well-fitted since the adjusted R-squared is approximately 84%. The diagnostic tests are reported in table 5. These tests reveal that there is no serial correlation, heteroscedasticity, or functional misspecification. In addition, the estimates reported above are structurally stable as shown by the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) plots in figure A1 and A2 in the Appendix, respectively.

Table 5: Results of diagnostic tests.

Test	Statistic	P-value
Serial Correlation: CHSQ(1)	2.307	0.129
Functional Form: F(1,15)	2.132	0.165
Normality: CHSQ (2)	2.776	0.250
Heteroscedasticity: CHSQ (1)	0.013	0.908

3.3. Robustness check

In this section, we check for the robustness of the main model by estimating the second model that includes standard variables and variables with significant results. They are physical capital, labour, human capital, government expenditure, inflation, foreign direct investment and foreign aid. The long-run model is formulated as:

$$\begin{aligned}
\Delta \ln Y_t = & \rho_0 + \sum_{i=1}^n \rho_{1i} \Delta \ln Y_{t-i} + \sum_{i=0}^n \rho_{2i} \Delta \ln K_{t-i} + \sum_{i=0}^n \rho_{3i} \Delta \ln L_{t-i} + \sum_{i=0}^n \rho_{4i} \Delta \ln HC_{t-i} \\
& + \sum_{i=0}^n \rho_{5i} \Delta \ln GOV_{t-i} + \sum_{i=0}^n \rho_{6i} \Delta \ln INF_{t-i} + \sum_{i=0}^n \rho_{7i} \Delta \ln FDI_{t-i} + \sum_{i=0}^n \rho_{8i} \Delta \ln AID_{t-i} \\
& + \sigma_1 \ln Y_{t-1} + \sigma_2 \ln K_{t-1} + \sigma_3 \ln L_{t-1} + \sigma_4 \ln HC_{t-1} + \sigma_5 \ln GOV_{t-1} + \sigma_6 \ln INF_{t-1} \\
& + \sigma_7 \ln FDI_{t-1} + \sigma_8 \ln AID_{t-1} + \varepsilon_t \tag{8}
\end{aligned}$$

where ε , ρ and σ are the white-noise error term, the short and long-run coefficients of the model, respectively; Δ is the first-difference operator; t denotes time period and n is the maximum number of lags in the model. The variables $\ln Y$, $\ln K$, $\ln L$, $\ln HC$, $\ln GOV$, $\ln INF$, $\ln FDI$ and $\ln AID$ are the natural logarithm of output, physical capital, labour, human capital, government expenditure, inflation, foreign direct investment and foreign aid, respectively.

The short-run error-correction model is reformulated from Eq. (8) as:

$$\begin{aligned} \Delta \ln Y_t = & \rho_0 + \sum_{i=1}^n \rho_{1i} \Delta \ln Y_{t-i} + \sum_{i=0}^n \rho_{2i} \Delta \ln K_{t-i} + \sum_{i=0}^n \rho_{3i} \Delta \ln L_{t-i} + \sum_{i=0}^n \rho_{4i} \Delta \ln HC_{t-i} \\ & + \sum_{i=0}^n \rho_{5i} \Delta \ln GOV_{t-i} + \sum_{i=0}^n \rho_{6i} \Delta \ln INF_{t-i} + \sum_{i=0}^n \rho_{7i} \Delta \ln FDI_{t-i} + \sum_{i=0}^n \rho_{8i} \Delta \ln AID_{t-i} \\ & + \sigma ECM_{t-1} + \varepsilon_t \end{aligned} \quad (9)$$

where σ is the coefficient of the error-correction term, ECM_{t-1} .

In this model, the optimal lag selected by AIC is ARDL(1, 1, 1, 2, 0, 2, 0, 1). The calculated F -statistic of the ARDL bounds test for cointegration is 5.386, which is higher than the upper bound critical values reported by Pesaran et al. (2001) at a 1% - level of significance. The results show that variables in the model are co-integrated. Table 6 reports the long-run and short-run estimates of the second model.

Table 6: The long and short-run results of the second model.

Panel 1				
Long-run results				
Dependent variable is $\ln Y$				
Regressor	Coefficient	Standard Error	T-statistics	P-value
$\ln K$	-0.042	0.096	-0.439	0.665
$\ln L$	0.028	0.018	1.536	0.141
$\ln HC$	2.985***	0.251	11.897	0.000
$\ln GOV$	-0.282	0.172	-1.643	0.117
$\ln INF$	0.114***	0.023	5.022	0.000
$\ln FDI$	-0.059**	0.020	-2.881	0.010
AID	-0.166***	0.029	-5.648	0.000

Panel 2				
Short-run results				
Dependent variable is $\Delta \ln Y$				
Regressor	Coefficient	Standard Error	T-ratio	P-value
$\Delta \ln K$	0.131***	0.020	6.514	0.000
$\Delta \ln L$	0.051***	0.013	3.810	0.001
$\Delta \ln HC$	1.010**	0.473	2.133	0.046
$\Delta \ln HC(-1)$	-1.808***	0.527	-3.429	0.003
$\Delta \ln GOV$	-0.143**	0.066	-2.181	0.042
$\Delta \ln INF$	-0.004	0.004	-1.072	0.297
$\Delta \ln INF(-1)$	-0.031***	0.004	-7.250	0.000
$\Delta \ln FDI$	-0.023***	0.004	-5.243	0.000
ΔAID	-0.029**	0.010	-2.808	0.011
<i>Constant</i>	2.440***	0.265	9.192	0.000
$ECM(-1)$	-0.361***	0.040	-8.990	0.000

Notes: (i) ** and *** denote 5% and 1% significant levels, respectively; (ii) Δ =first difference operator.

Similar to the findings of the main model, the long-run results in the second model show that both human capital and inflation exert a positive impact on output, while foreign direct investment and foreign aid have a negative impact on output. The short-run results of the second model are also consistent with the main model. They show that physical capital, labour and human capital have a positive impact on growth, while the initial level of human capital, government expenditure, the initial level of inflation, foreign direct investment and foreign aid have a negative impact on growth. In addition, the second model passes all the diagnostic tests that we perform on the main model. Based on the above findings, we argue that the estimates in the main model are robust to alternate model specification.

4. Conclusion

In this paper, we attempted to investigate the sources of economic growth in Thailand during the period 1975 to 2014. In addition to the four Asian tigers, this country has been widely cited as a successful growth story. In less than a generation, it has improved from a low-income to an upper-middle income country. The country's impressive growth during the past four decades has attracted research attention with most studies attempting to understand the sources of the country's growth. The previous studies either focused on the relationship between individual factors and economic growth or on the impact of a few macroeconomic factors on growth within a standard growth model. Moreover, all the previous studies mainly focused on the long-run impacts of these factors on growth, neglecting their short-run impacts. Against this background, our study enriched the literature by exploring both the short and long-run sources of growth. By employing the ARDL bounds testing procedure, we investigated the impact of physical capital, labour, human capital, government expenditure, inflation, trade openness, foreign direct investment and foreign aid on growth within an augmented Solow growth model. We obtained the following key results. First, in the long run, both human capital and inflation exerted positive and significant impact on real GDP per capita, while foreign direct investment and foreign aid have a negative and significant impact on it. Second, in the short run, physical capital, labour and human capital have positive and significant impact on real GDP per capita growth, while the initial level of human capital, government expenditure, the initial level of inflation, foreign direct investment and foreign aid have a negative and significant impact on it. These results were robust to the alternate model specification.

The findings imply that policymakers should pursue policies that could boost the quality of human capital to promote and sustain growth in the country. According to the Global Competitiveness Report 2015 - 2016, the quality of the educational system in the country lags behind those of its ASEAN neighbours and other upper-middle income countries in the recent decade (see World Economic Forum, 2015). Therefore, reforms are required to improve the country's educational system. Improvement in the quality of human capital will go a long way to strengthen the human capital base of labour. Foreign direct investment is found to have a negative impact on long-run growth, probably due to the low level of human capital and technology-absorptive ability of the country. Hence, improvement in the level of human capital will not only directly affect the positive impact of human capital on growth but may also indirectly alter the negative impact of foreign direct investment into a positive one. The average rate of inflation during the study period was around 4% – with lower inflation rates being recorded in the 2010s. Perhaps, an expansionary monetary policy could be pursued to boost growth. Finally, given that foreign aid was found to

have a negative impact on growth, government should target effective and efficient use of foreign aid such as increasing the amount of physical capital in infrastructure and improving the level of human capital by providing education and upgrading public health facilities. Such measures could enhance the productivity of labour, thereby fostering economic growth.

Lastly, although we employed the ARDL bounds test technique to cater for the small sample size in our study, a larger sample size either in the form of a long time span or quarterly data might produce more consistent estimates. As data become available in future, researchers could revisit the study to compare the consistency of our estimates. In addition, it would be interesting to include some other growth determinants, such as financial development and exchange rate, in the model to provide a comprehensive picture on the sources of growth.

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Appendix

Figure A1: Plot of cumulative sum of recursive residuals (CUSUM)

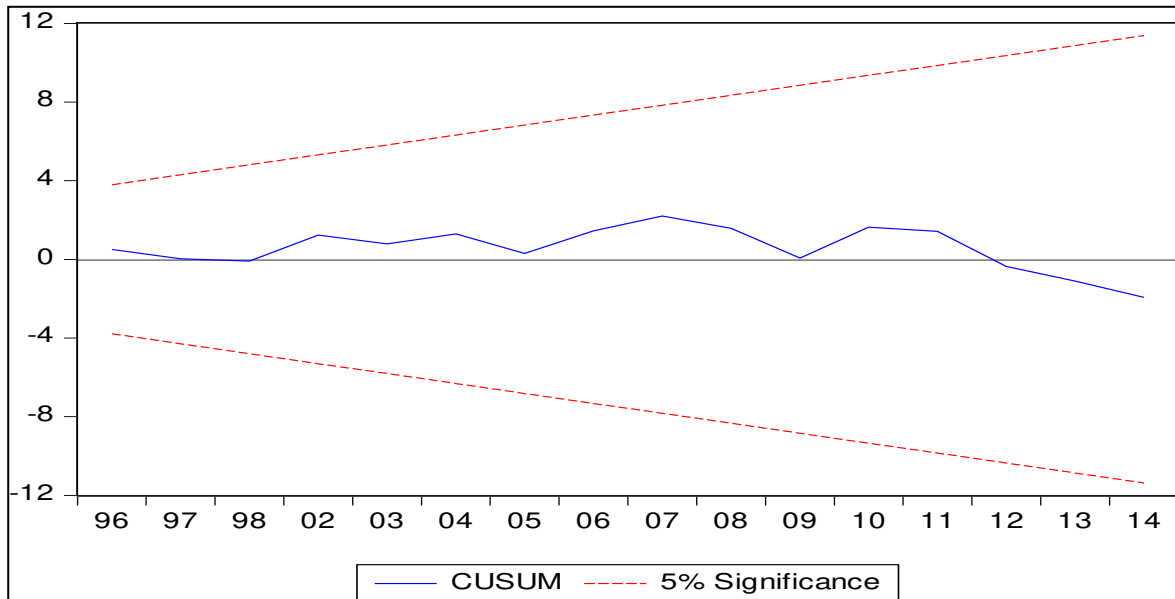


Figure A2: Plot of cumulative sum of squares of recursive residuals (CUSUMSQ)

