LUND UNIVERSITY
School of Economics and Management

Master's Programme in Economic Development

The Role of Remittances for Economic Development in Asia and the Pacific Economies

by

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Abstract

There has been little empirical study of the relationship between remittance inflows and economic growth, especially with a focus in Asia and the Pacific (APAC) region. In this paper, this relationship for 23 APAC economies is examined. A panel data set of remittances and financial development indices for the period 1990 – 2017 is set up to explore the impact of financial development on remittance – growth nexus. A newly cross-country data series of financial inclusion indices which covers 177 countries over the time period from 1990 to 2017 is also constructed to study the enhancement factor of financial inclusion on the impacts of remittance on growth in APAC. This data set presents the largest and longest running data sample constructed to date. The interactions between remittances, financial development and financial inclusion as well as their impacts on growth are tested. The results show that remittances have a positive impact on long-run economic growth in the APAC. Besides, both financial development and financial inclusion enhance the impact of remittance inflows on growth. Another finding is that in most APAC economies, remittances can promote growth in a less financially developed country whereas the remittances-driven growth is less important in more financially developed economies.

EKHS21
Master's Thesis (15 credits ECTS)
June 2019
Supervisor: Anders Ögren
Examiner: Edoardo Altamura
Word Count: 15,778

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1. Introduction

The past decades saw a strong growth in GDP in both East Asia & the Pacific as well as Europe & Central Asia as shown in Figure 1. During the period from 1965 to 1990, the East Asian countries within APAC region grew faster than all other regions of the world (World Bank, 1993). According to World Bank (1993), most of this achievement was attributable to growth in the following economies: Japan, Hong Kong, the Republic of Korea, Singapore, Taiwan, China and the three newly industrializing economies of Southeast Asia, Indonesia, Malaysia and Thailand. From the 1990s till date, most countries in APAC have maintained their growth. Japan held its position as the country with the highest GDP in the region until 2009 when it was overtaken by China, as shown in Figure 2. China has achieved the highest growth rates compared to all other APAC economies during the period from 1990 – 2017. By 2017, China's GDP has grown more than 12 times compared to 1990. GDPs of Lao PDR, Vietnam, India, Malaysia, Bangladesh and Sri Lanka have increased more than 4 times between 1990 and 2017, according to GDP data from the World Bank's World Development Indicators.

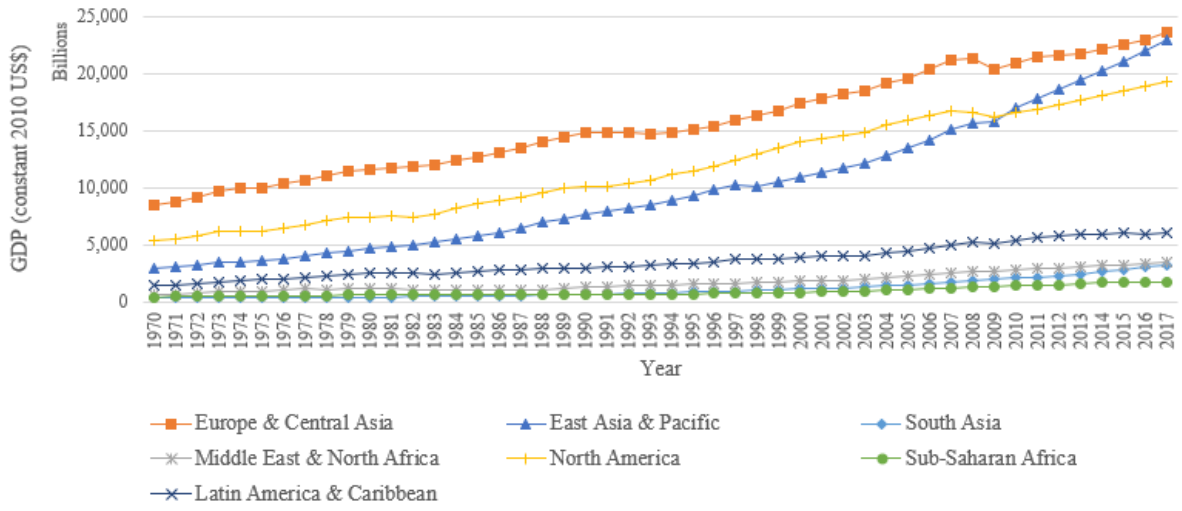

Figure 1: Gross Domestic Product (GDP) (constant 2010 US$) by regions

Source: World Development Indicators and author's illustration

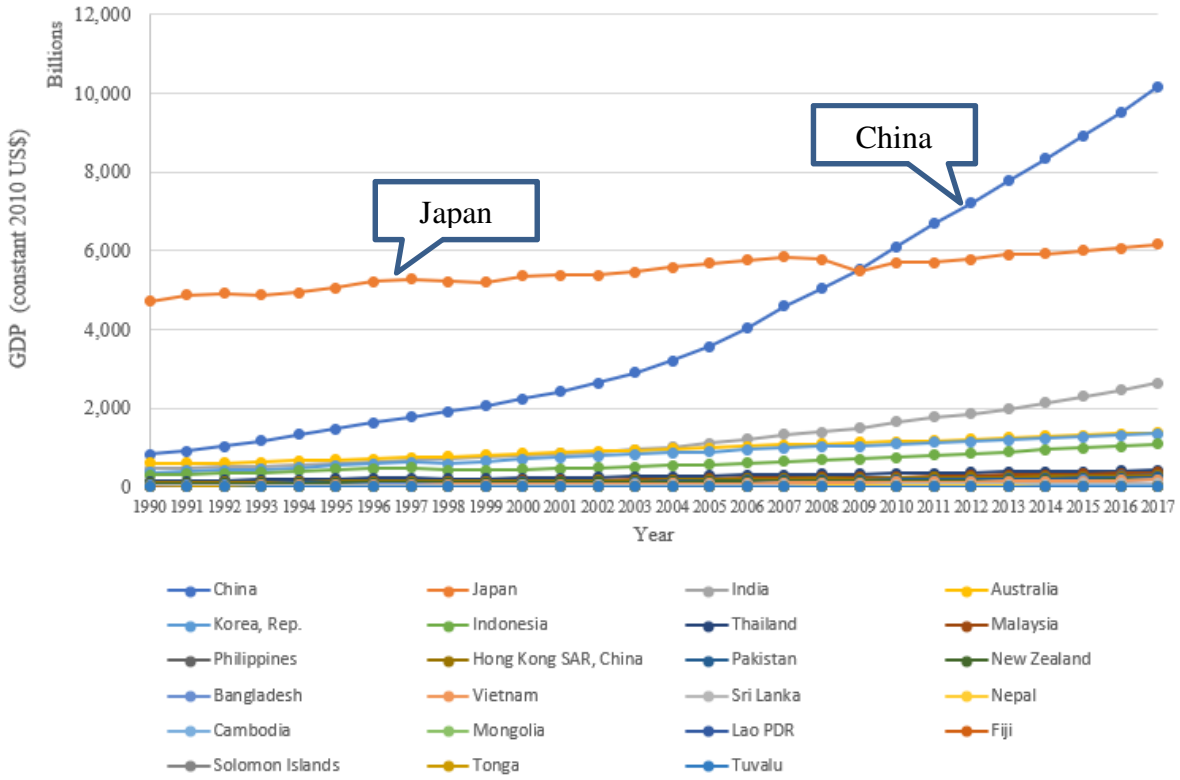

Figure 2: Gross Domestic Product (GDP) (constant 2010 US$) by 23 APAC countries

Source: World Development Indicators and author's illustration

Several scholars found empirical evidence to highlight that finance fosters economic growth (Popov, 2017). Bagehot (1873) emphasized that finance played a crucial role in the success of the Industrial Revolution in England by facilitating the mobilization of capital. Schumpeter (1912, p. 74) argued that the efficient financial intermediaries and well-functioning banks encouraged technological innovation and spurred technological progress by reallocating funding to those entrepreneurs with the best chances of successfully implementing innovative products. The modern empirical research in the finance-and-growth nexus started by Goldsmith (1969). He found a positive association between financial development and economic growth. There have also been several historical evidences regarding the impact of finance, financial development on growth in several economies (Ögren, 2009; 2010, p. 6; 2019). In Asia, a recent research by the Asian and Development Bank (ADB) suggested that the development of the financial sector brought positive impact on developing Asia's growth (Estrada, Park, & Ramayandi, 2010).

Taking into account the importance of finance on economic growth, in this paper, besides analysing the impacts of remittance on economic growth, two important aspects of finance,

which are financial development and financial inclusion will be taken into account to examine the remittance – growth nexus in APAC.

There are 36 countries in APAC according to the classification of International Monetary Fund (IMF) (2019). However, due to data availability, only 23 out of 36 APAC economies are included in this research. Table 1 lists the countries included in this research. Also due to data availability, this study only looks into the time period of 28 years from 1990 – 2017.

Table 1: List of 23 countries included in this study by country classification

Source: World Bank (2019)

No	Country	Country Status Code	Country Status
1	Australia	HIC	High-income country
2	Hong Kong SAR, China	HIC	High-income country
3	Japan	HIC	High-income country
4	Korea, Rep.	HIC	High-income country
5	New Zealand	HIC	High-income country
6	China	UMIC	Upper-middle-income country
7	Fiji	UMIC	Upper-middle-income country
8	Malaysia	UMIC	Upper-middle-income country
9	Thailand	UMIC	Upper-middle-income country
10	Tonga	UMIC	Upper-middle-income country
11	Bangladesh	LMIC	Lower-middle-income country
12	Cambodia	LMIC	Lower-middle-income country
13	India	LMIC	Lower-middle-income country
14	Indonesia	LMIC	Lower-middle-income country
15	Lao PDR	LMIC	Lower-middle-income country
16	Mongolia	LMIC	Lower-middle-income country
17	Pakistan	LMIC	Lower-middle-income country
18	Philippines	LMIC	Lower-middle-income country
19	Solomon Islands	LMIC	Lower-middle-income country
20	Sri Lanka	LMIC	Lower-middle-income country
21	Vanuatu	LMIC	Lower-middle-income country
22	Vietnam	LMIC	Lower-middle-income country
23	Nepal	LIC	Low-income country

1.1. Remittances

In this paper, remittances are defined as personal remittances. The definition of personal remittances was introduced in the sixth edition of the IMF Balance of Payments and

International Investment Position Manual (BPM6) (IMF, 2009a). According to that definition, personal remittances are the sum of the two components below:

- "Compensation of employees" represents remuneration in return for the labour input to the production process contributed by an individual in an employer-employee relationship with the enterprise.
- " Personal transfers" comprise all current transfers in cash or in kind made or received by resident households to or from non-resident households.

The role of remittances and economic development has attracted increasing attention from several researchers and policymakers. The past decades have also seen a sharp rise in values of remittances in total international capital flows (Chami, Fullenkamp, & Jahjah, 2003; Matuzeviciute & Butkus, 2016). Current remittance flows are more than three times the size of official development assistance (World Bank, 2018). In some countries, personal remittances represent more than 10 percent of Gross Domestic Product (GDP) (refer to Figure 3). In Asia and the Pacific (APAC) region, for example, a few countries such as Tonga, Nepal, and the Philippines, have personal remittances receipts of more than 10 percent of GDP.

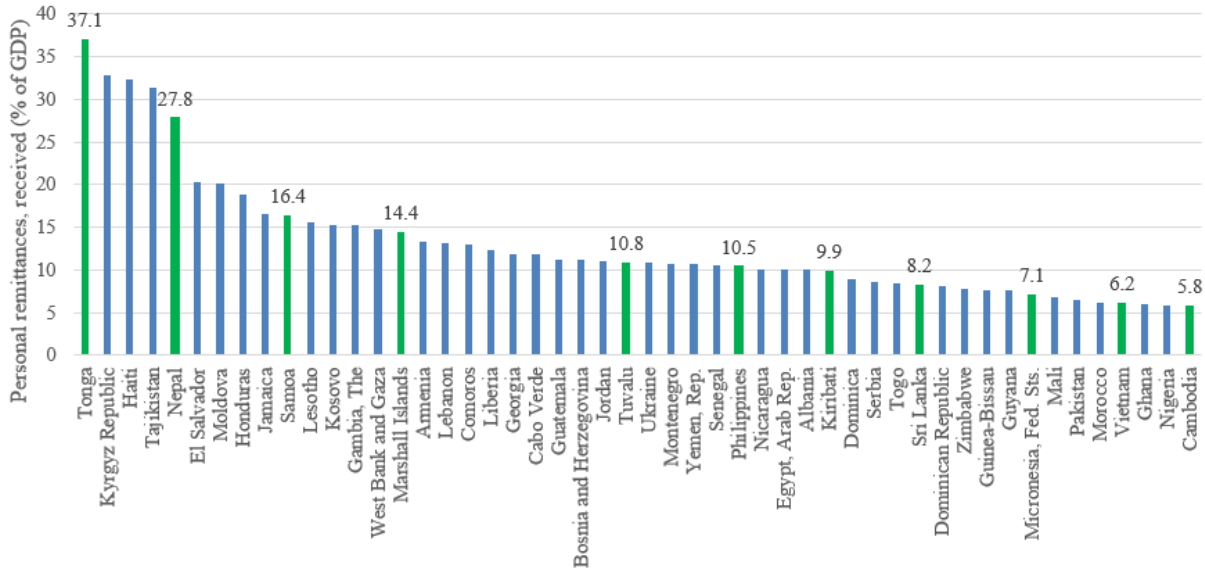

Figure 3: Largest recipients of personal remittances in 2017

Source: World Development Indicators and author's own illustration

Among all regions, South Asia, East Asia & Pacific and Europe & Central Asia have consistently been top destinations for remittances worldwide over decades (refer to Figure 4).

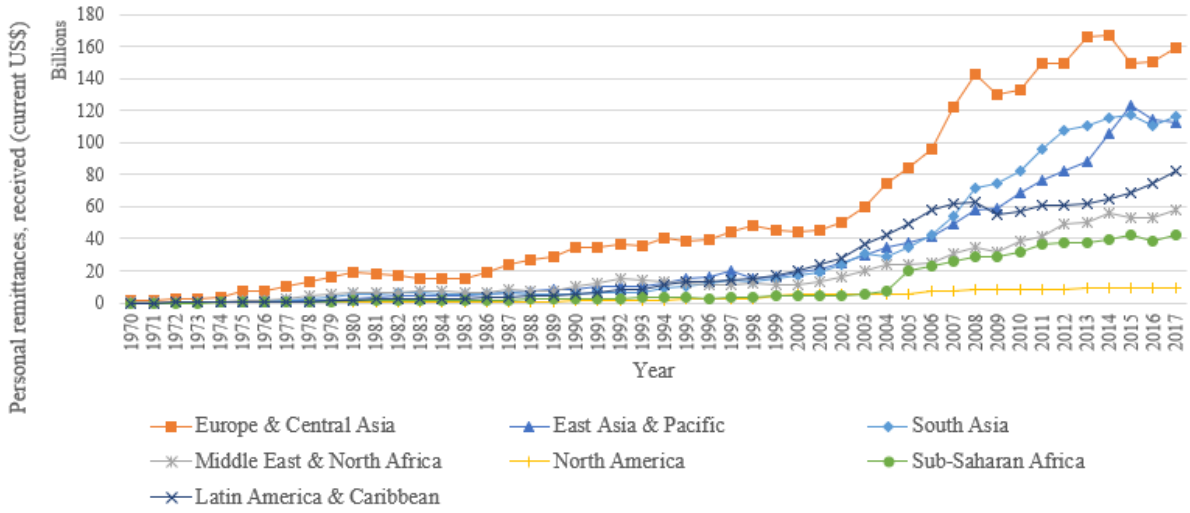

Figure 4: Personal remittances, received (current US$) by regions

Source: World Development Indicators and author's own illustration

During the period 1990 – 2017, strong economic growth in APAC (refer to Figure 1 and Figure 2) was accompanied by an increase in the values of remittances received in most APAC countries, as shown in Figure 5. In value terms, India received most remittances from 1990 – 2017, followed by the Philippines and China. Remarkably, the values of remittances into China have grown more than 140 times from 1990 to 2017. Between 1990 and 2017, the values of remittances sent to Indonesia, India, Lao PDR and the Philippines have increased by 54, 29, 23 and 22 times.

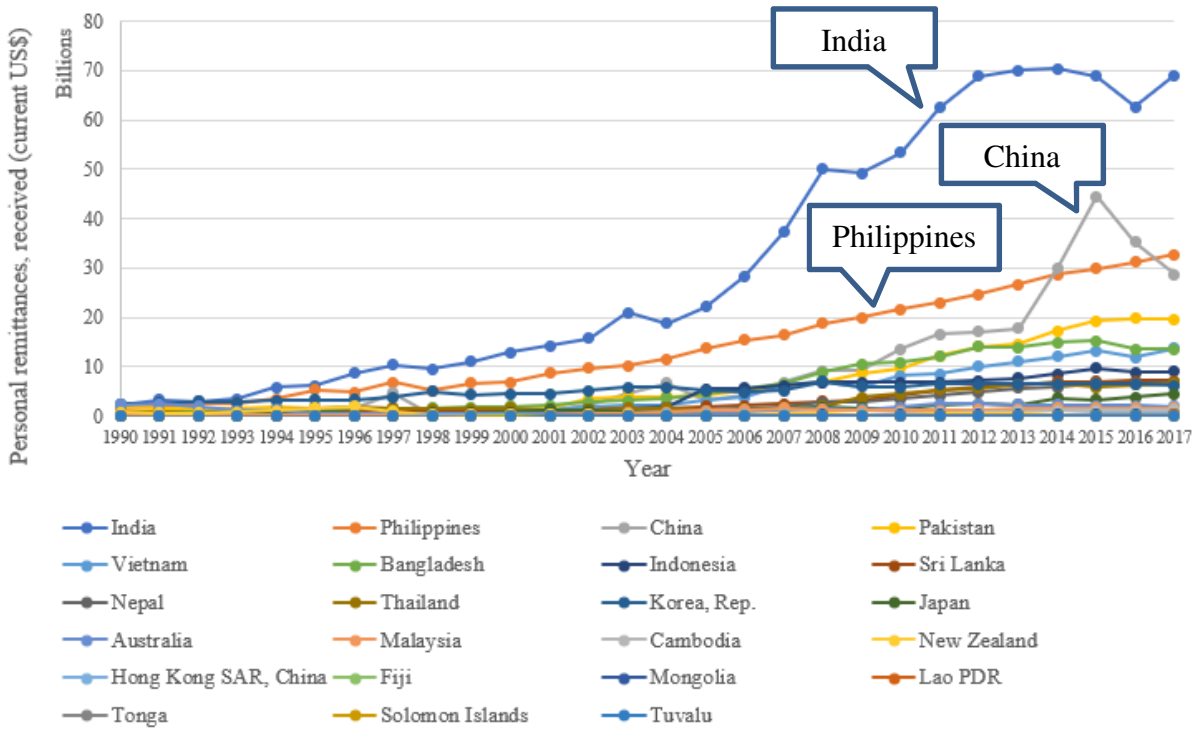

Figure 5: Personal remittances, received (current US$) by 23 APAC countries

Source: World Development Indicators and author's own illustration

Despite of an increasing number of research which look into the roles of remittance in economic growth, the role of remittance inflows in economic growth globally, especially in the APAC is not well understood. Research into the topic has had mixed conclusions. Only when the role of remittances in economic development is well understood can policymakers come up with plans to support and sustain the long-term positive effects that remittances can bring to economies.

There is a general assumption that remittance activities are associated with cross-border movements of people (Ghosh, 2006, p. 22), or international migration. Figure 6 shows the number of migrants by country of origin in 5 years 1990, 2000, 2010, 2013 and 2017. There is a clear growth trend of migrants from most APAC countries, especially from India, China, Bangladesh, Pakistan, and the Philippines during the past decades. Most of countries have doubled their number of migrants moving overseas. From 1990 to 2017, the number of Cambodians moving overseas as migrants increased by 5 times, while the number of Laotians and Indonesians moving overseas as migrants increased by 4 times. The number of migrants from the Philippines, Malaysia, Thailand, Sri Lanka, Nepal, Fiji and Solomon Islands has also tripled from 1990 to 2017.

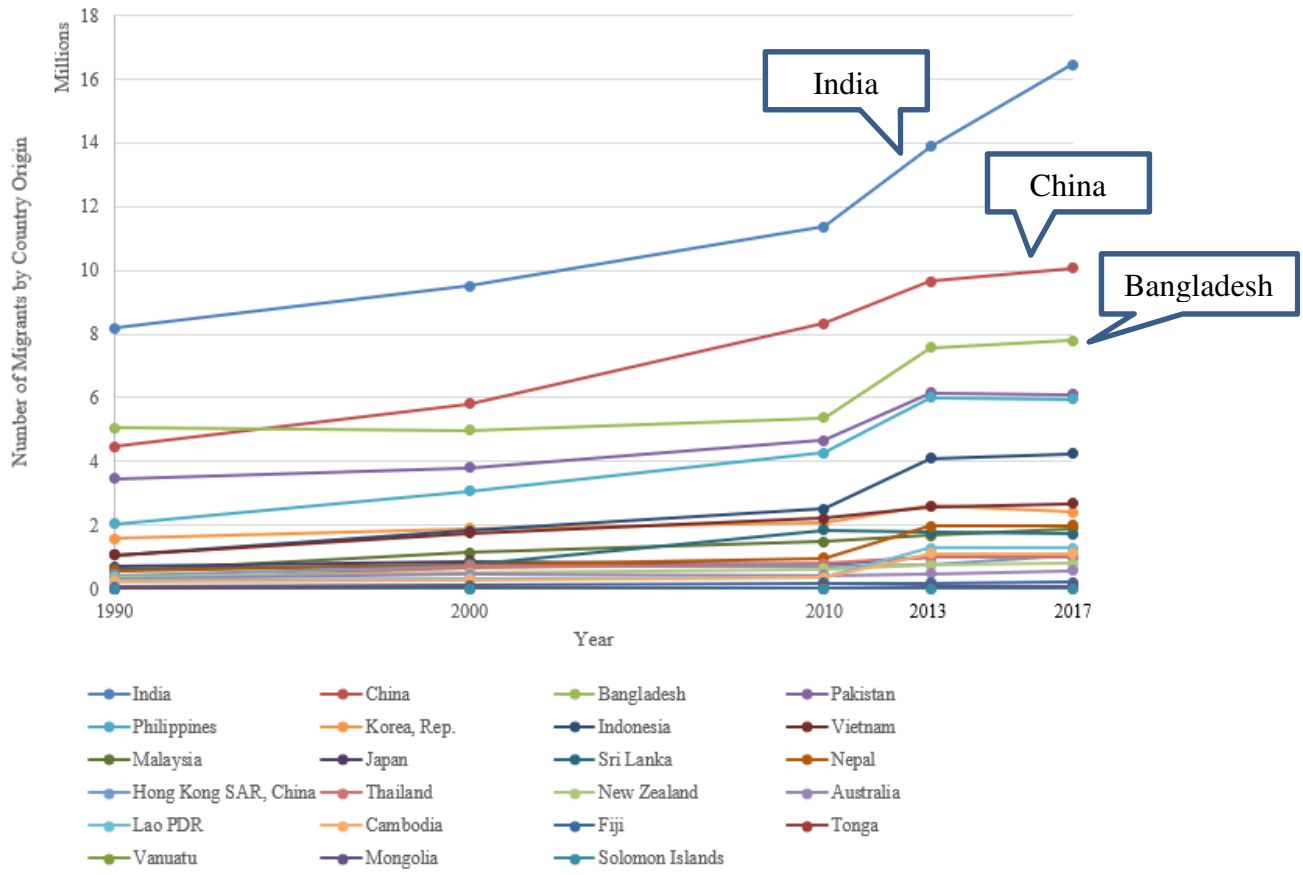

Figure 6: Number of migrants from 23 APAC countries in the year 1990, 2000, 2010, 2013 and 2017

Source: World Bank's Migration & Remittances Data and author's own illustration

There might be a correlation between the number of migrants and remittances received in their home countries. However, due to the limitations of data on migration (only 5 years availability), this avenue will not to be explored within the scope of this thesis. It is also important to note that remittances are not always sent to migrants' relatives and/or to the country of origin (Lubambu, 2014).

1.2. Financial Development

Levine (1997) documented a powerful relationship between financial development and growth. According to him, there was evidence that the level of financial development was a good predictor of future rates of economic growth, capital accumulation, and technological

change. Financial development along with a sound banking system contributes in increasing the momentum of economic growth.

Financial development is defined as the development of local financial institutions and markets. In this study, I follow the definition and related financial development indices derived by Svirydzenka (2016) from the International Monetary Fund (IMF). The financial development indices summarize how developed financial institutions and financial markets are in terms of their depth (size and liquidity), access (availability of individuals and companies to access financial services), and efficiency (ability of institutions to provide financial services at low cost, sustainable revenues and the level of activity of capital markets). Svirydzenka (2016) used a set of 20 variables to define 3 sub-indices Depth, Access, Efficiency for Financial Institutions and Financial Markets accordingly. Financial Institutions and Financial Markets sub-indices were then aggregated to compute the final index for financial development. Figure 7 summarizes the indicators and sub-indices to construct the financial development indices that Svirydzenka (2016) used.

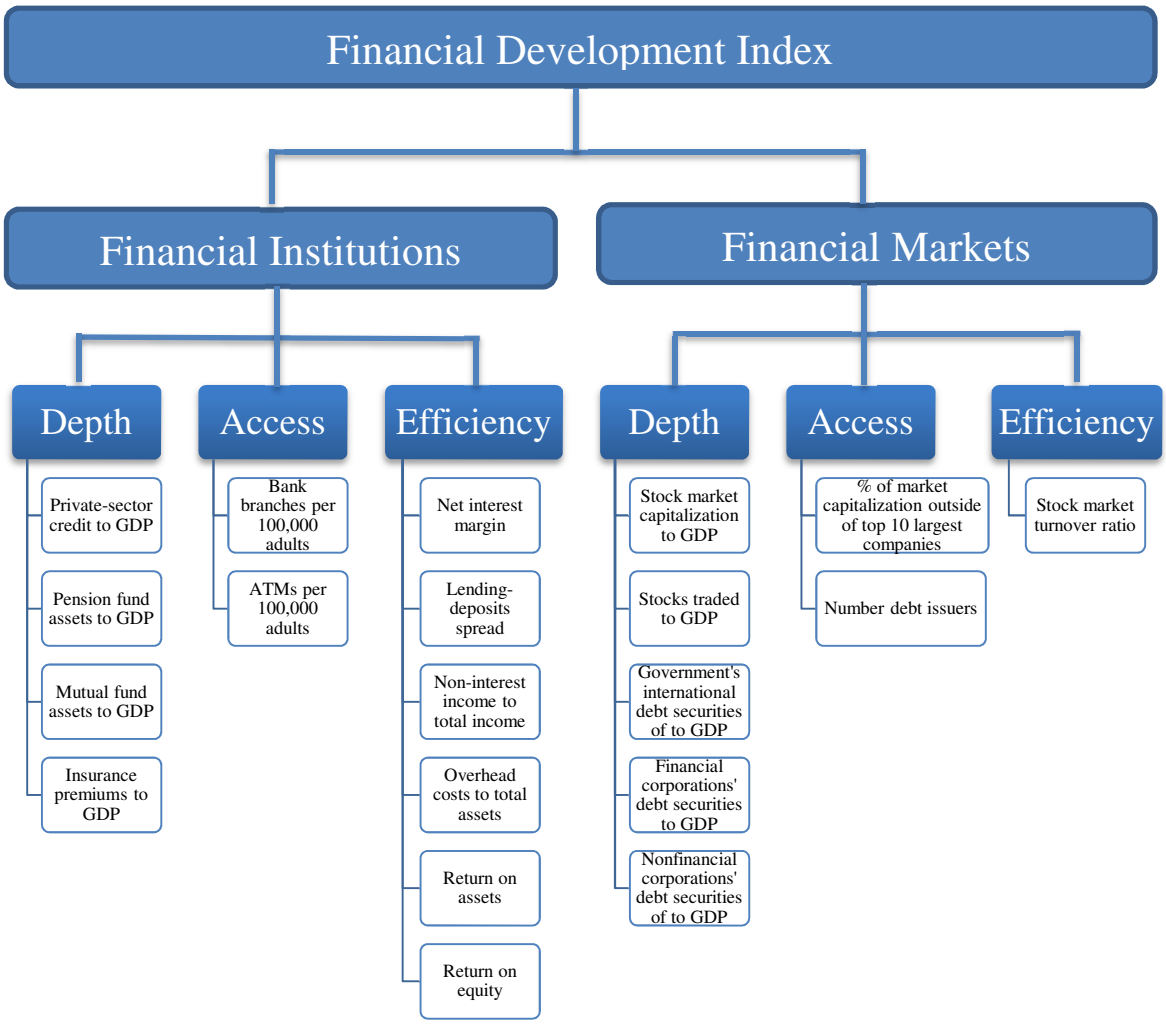

Figure 7: Financial Development Index indicators

Source: Svirydzenka (2016) and author's illustration

1.3. Financial Inclusion

Financial inclusion is broadly defined as a stage where individuals and firms have access, usage and minimal barriers to basic financial services (Sarma, 2008). Note that the definitions of financial inclusion vary and there is no available standardised financial inclusion data across countries to the author's knowledge. This definition of financial inclusion serves as an anchor to construct financial inclusion index in a later part of this paper for the purpose to explore the role of financial inclusion on remittance – growth nexus.

Despite several dedicated studies, there are only limited data sets available with limited time series. There is no available data set which has a long time series with cross-country coverage. The first attempt to construct financial inclusion indices was made by Sarma (2008). She defined financial inclusion as a process that ensures the ease of access, availability and usage of a formal financial system for all members of an economy. With that, she used three dimensions – banking penetration, availability of banking services and usage – to calculate indices of financial inclusion in 2004 of 100 countries worldwide, where 0 denoted complete financial exclusion and 1 indicated complete financial inclusion in an economy. She first computed a sub-index for each dimension and then aggregated each index as the normalized inverse of the Euclidean distance, where the distance is computed from a reference ideal point and then normalized by the number of dimensions included in the aggregate index. The drawback of this method is that it does not impose varying weights for each dimension and assumed all factors has the same effects on financial inclusion.

Cámara and Tuesta (2017) recognized this weakness and used two-stage principal component analysis to estimate the dimension weights and the overall financial inclusion index in two years 2011 and 2014 for 138 countries. The dimension sub-indices were used in the first stage as explanatory variables. Three sub-indices were named as usage, barriers (i.e. quality) and access. Using a similar method of principal component analysis, Amidžić, Massara, and Mialou (2014) leveraged the IMF's Financial Access Survey (FAS) database to compute financial inclusion indices in 23 countries for the period 2009 – 2012. Park and Mercado (2018) combined Sarma (2008)'s multidimensional approach with the normalized weights from principal component analysis of Cámara and Tuesta (2017) to compute financial inclusion indices on a larger set of economies in 2011 and 2014. Covering the largest set of countries per the author's knowledge, 179, Yorulmaz (2018) took into account additional variables from the financial system's demand and supply sides to define four indicators: outreach, usage, ease, and cost to construct a set of financial inclusion indices during the period 2004 – 2011.

In brief, the few attempts to measure financial inclusion through composite indices are either limited in terms of countries or time periods. Hence, for the purpose of this study, a new cross-country data set with a time series from 1990 – 2017 of financial inclusion indices for 177 countries globally is constructed. Chapter 2 is dedicated for this task. This newly constructed financial inclusion indices data set is significant as it contributes to the literature

of financial inclusion indices data set by covering the most countries over the longest time period.

1.4. Aim, Purpose and Hypotheses

The purpose of this study is to investigate the role of remittance inflows in economic development in the APAC by a sample set of 23 countries in APAC region, and to identify the factors possibly affecting this relationship, which are hypothesized to be financial development and financial inclusion levels in the country.

The dependent variable in this empirical research is defined as economic growth, expressed in the form of GDP growth annually. The independent variables are defined as remittance inflows growth over years, financial development and financial inclusion while the control variables include indicators representing the economic conditions in the countries.

The research questions are therefore:

1. What effects have remittance inflows brought to economic growth in the APAC region?, and
2. Do two factors, financial development and financial inclusion, enhance the impact of remittance inflows on growth?

There are two hypotheses associated with the above research questions:

1. Overall, remittances inflows have brought positive impacts on economic growth in APAC, and
2. In the APAC region, both financial development and financial inclusion have enhanced the impact of remittance inflows on economic growth.

1.5. Thesis Outline

The remainder of this thesis is organized into five sections. Section 2 is a selective review of relevant research on remittance receipts and economic growth. Due to non-existent data for financial inclusion, section 3 is dedicated to constructing a cross-country time series of financial inclusion indices for 177 countries globally from 1990 – 2017. Section 4 presents

the methodology and data used for this study, while section 5 highlights the results. Finally, section 6 concludes.

2. Literature Review

The impact of remittances has been studied several times, in both a global and a regional context. Most researchers agree that incoming remittances have increased the income of the recipient country, which encouraged both consumer spending and financial sector development, therefore stimulated economic growth and consequently also reduced poverty (Ratha, Mohapatra, & Scheja, 2011). On the other hand, remittance receipt is sometimes said to have a negative effect on labour force participation when the recipient households become dependent on the remittance and see it as a substitute source for labour income (Barajas, Chami, Fullenkamp, Gapen, & Montiel, 2009). Moreover, remittances may also have adverse macroeconomic impacts by increasing income inequality (Orrenius, Zavodny, Canas, & Coronado, 2010).

One of the first cross-country study on remittances and growth was done by Chami et al. (2003). They found a negative effect of remittance flows on economic growth by looking into a data set of 113 countries over the period 1970 – 1998. They argued that remittances take place under asymmetric information and might generate moral hazard problems. Barajas et al. (2009) commented that there was very little evidence that incoming remittances had contributed to the growth of developing economies worldwide, after examining the remittance data of 84 countries from 1970 – 2004. This was also in line with what Rajan and Arvind (2005) found earlier. Recent research has found mixed results of the impacts of remittances on economic development too. Matuzeviciute and Butkus (2016) noted that in general remittances had positive impacts on long-run economic growth in 116 countries with remittance data from 1990 – 2014 while Feeny, Iamsiraroj, and McGillivray (2013) concluded that there was no impact with empirical evidence from 136 developing countries, from 1971 – 2010. Notably, Giuliano and Ruiz-Arranz (2005) with his empirical analysis on 73 developing countries from the sample period 1975 – 2002 showed that remittances could only promote growth in less financially developed countries. The reason proposed was that remittances could compensate for a bad financial system by loosening liquidity constraints

and channel resources toward productive investments, and hence promote economic growth. On the contrary, Chowdhury (2016) found insignificant contribution of financial development and financial systems on economic growth by looking into 33 top remittance recipient developing countries from 1979 to 2011. Seven developing economies from APAC, consisting of Bangladesh, Fiji, India, Pakistan, the Philippines, Sri Lanka and Thailand, were included in that study.

Beside the mixed findings of the impacts of remittances on economic development globally, there have been several attempts to examine the effects of remittances on economic growth in different regions. Nwaogu and Ryan (2015) examined African, Latin American and Caribbean countries from 1970 – 2009 and found a positive impact of remittances on economic development. A research piece on Central and Eastern Europe done by Goschin (2014) from 1995 – 2011 showed a significant positive influence of remittances on GDP growth. For the Caribbean Community and Common Market, there was no evidence of a long-run relationship between remittances and real GDP per capita according to Lim and Simmons (2015).

Regarding Asia, Cooray (2012) researched Bangladesh, India, Nepal, Maldives, Pakistan and Sri Lanka and found that remittances had a positive effect on economic growth when the countries' educational levels were high and the financial sector was comparatively advanced. In Nepal, there was a mixed impact on remittances inflow on the country's economic growth (Dahal, 2014). Focusing on Vietnam, Kumar and Vu (2014)'s study reported a bidirectional causality between remittances and economic growth. For Asia on a larger scale, a recent research by Imai, Gaiha, Ali, and Kaicker (2014) indicated that remittance flows had been beneficial to economic growth for 24 Asian countries. However, the research did not identify the factors making remittances positively affect economic development in those countries.

In short, there has been little systematic empirical study on the topic of remittances and economic growth with a focus in the APAC region. Crucially, there is no paper attempting to identify the factors which may influence the positive or negative impact direction of remittances on economic growth in the countries in APAC.

3. Constructing Financial Inclusion Indices for 177 Countries Globally from 1990 – 2017

3.1. Data Sources and Methodology to Construct Financial Inclusion Indices

To construct the data set of financial inclusion indices, I follow closely the procedure laid out by the Organisation for Economic Co-operation and Development (OECD)'s Handbook on Constructing Composite Indicators (OECD, 2008). This procedure was also referenced by the IMF to construct a database of annual financial development indices for 179 countries from 1980 to 2017 (Svirydzenka, 2016).

Following World Bank (2014) and most of the scholars (Cámara & Tuesta, 2017; Sarma, 2008), I define an inclusive financial system as a system that maximizes usage and access, while minimizing involuntary financial exclusion. Involuntary financial exclusion is measured by a set of barriers perceived by those individuals who do not participate in the formal financial system. These barriers include the affordability and trustworthiness of the local banking systems. Hence, I postulate that the degree of financial inclusion is determined by three dimensions: access, usage and barriers (Figure 8). These dimensions are determined by a set of 8 indicators, including supply-side country level indicators for access and demand-side individual level indicators for the dimensions of usage and barriers.

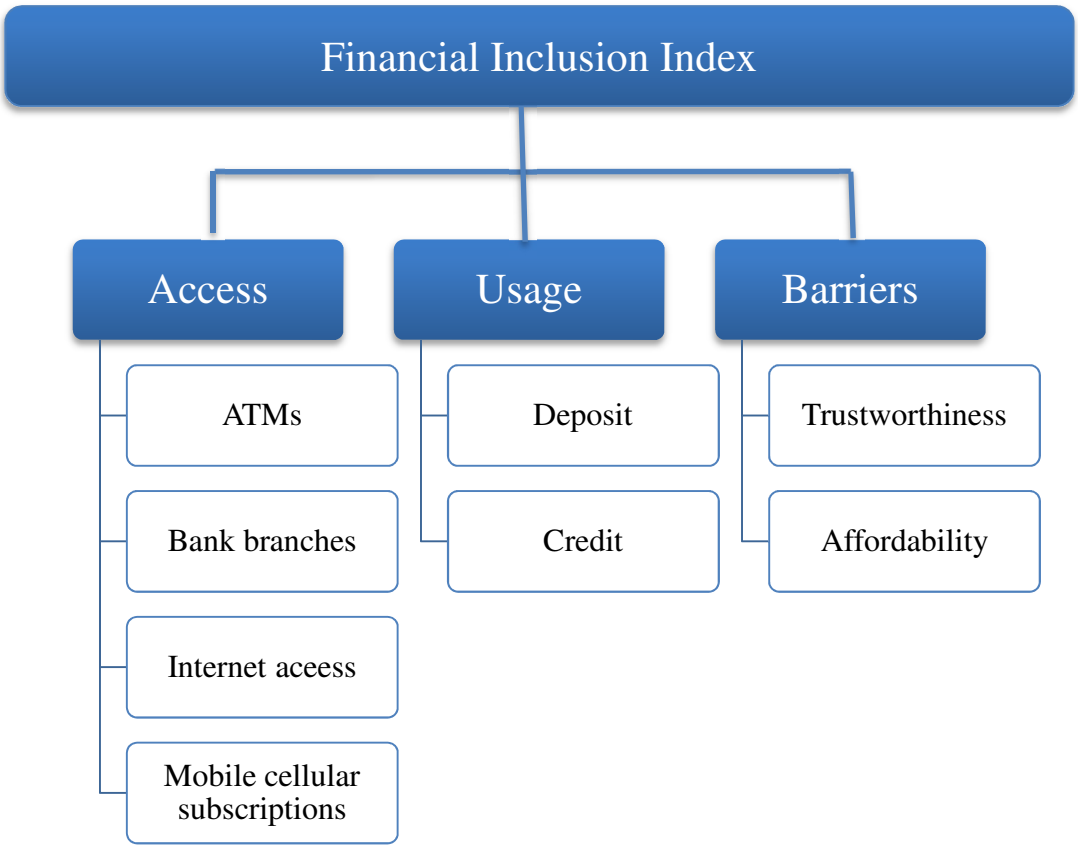

Figure 8: Dimensions of Financial Inclusion Index

Access to financial services represents the possibility of individuals to use them. I construct the access dimension with supply-side data at country level from four indicators, two of which were frequently chosen by several scholars to construct financial inclusion indices (Amidžić et al., 2014; Cámara & Tuesta, 2017; Park & Mercado, 2015; Sarma, 2008; Yorulmaz, 2018): automated teller machines (ATMs) per 100,000 adults and commercial bank branches per 100,000 adults. More indicators should have been considered to measure the degree of access to financial system, such as retail agents, non-branch outlets of commercials banks, or branch, non-branch retail agent outlets of microfinance institutions, credit unions, financial cooperatives, or mobile money agent outlets. However, due to limited data availability, I am unable to include them in my calculations. With the rise of internet and mobile banking across regions in the past decades (Hanafizadeh, Keating, & Khedmatgozar, 2014; Kapfer & Aggarwal, 2008; Wang, 2017), it is necessary to take internet and mobile banking penetration into account to correctly compute the Access dimension. However, due to scarce data resources, I use internet access and mobile cellular subscription rates to proxy

the internet and mobile banking penetration. This way of proxies has been used in various studies about internet and mobile banking penetration in different regions (Andrianaivo & Kpodar, 2012; Lenk & Barik, 2018).

To assess the extent of Usage of the formal financial services by individuals, I tried to proxy the utility derived of using such services by considering the use of different products: savings, payment accounts, deposits, credits, loans and insurance policies, offered by either commercial banks, microfinance institutions, credit unions, financial cooperatives, insurance corporations or mobile money service providers. However, the data sources are rare for most indicators. I therefore need to drop most of the indicators and follow Sarma (2008) and Park and Mercado (2015) to choose only domestic debit and credit to GDP ratio as proxies for usage dimension.

The dimension of Barriers, proposed by Cámara and Tuesta (2017), is used to offer an additional angle to access the extent of involuntary financial exclusion. Cámara and Tuesta (2017) used distance to a financial access point, lack of documentation, cost and lack of trust in the financial system with data from the World Bank Global Financial Inclusion (Global Findex) database to measure this dimension. However, Global Findex database does not cover a sufficiently long time period (only available for 3 years 2011, 2014 and 2017). I therefore need to look for other data sources for my construction. Due to data availability, I decide to use the cost and lack of trust in the financial system as two main obstacles for financial inclusion. The rise of digital banking and stricter anti-money laundering (AML) policies required consistently across the globe are also other reasons for me to choose not to include distance and documentation as barriers. Therefore, only trustworthiness and affordability of the local financial systems are used in my calculation to measure the barrier dimension.

3.1.1. Data Sources

A set of key indicators is used to capture different aspects of financial inclusion characteristics. The data set puts together 28 years of annual data between 1990 and 2017 for 177 countries. It draws from 4 data sources: World Bank's World Development Indicators (WDI), World Bank's Global Financial Development Database (GFDD), IMF's Financial Access Survey (FAS), and World Economic Forum (WEF)'s Global Competitiveness Index

Historical Data set (GCI), which is also featured on World Bank's TCdata360 initiative. Table 2 gives detailed information about the data sources, while Table 3 provides the descriptive statistics of the raw data to construct the financial inclusion indices.

Table 2: Data sources of to compute Financial Inclusion Indices

Category	Indicator	Description	Data Source
Access	*FIA*		
ATMs	FIA01	Automated teller machines (ATMs) (per 100,000 adults)	World Development Indicators (WDI), World Bank
Bank branches	FIA02	Branches of commercial banks (per 100,000 adults)	Financial Access Survey (FAS), IMF
Internet access	FIA03	Individuals using the Internet (per 100,000 people)	World Development Indicators (WDI), World Bank
Mobile phone subscriptions	FIA04	Mobile cellular subscriptions (per 100,000 people)	World Development Indicators (WDI), World Bank
Usage	*FIU*		
Deposit	FIU01	Financial system deposits to GDP (%)	Global Financial Development Database (GFDD), World Bank
Credit	FIU02	Financial system credits to GDP (%)	Global Financial Development Database (GFDD), World Bank
Barriers	*FIB*		
Trustworthiness	FIB01	Trustworthiness and confidence of financial market development, 1-7 (best)	Global Competitiveness Index Historical Data set, World Economic Forum (WEF)
Affordability	FIB02	Affordability of financial services, 1-7 (best)	Global Competitiveness Index Historical Data set, World Economic Forum (WEF)

Table 3: Descriptive statistics of data to compute Financial Inclusion Indices

Category	Indicator	Obs	Mean	Std. Dev.	Min	Max
Access	*FIA*					
ATMs	FIA01	2,198	43.03	44.46	0.00	313.15
Bank branches	FIA02	2,344	32.89	70.01	0.13	920.08
Internet access	FIA03	4,028	22,831.56	27,308.76	0.02	98,240.02
Mobile phone subscriptions	FIA04	4,326	53,178.53	52,441.67	0.13	321,803.00
Usage	*FIU*					
Deposit	FIU01	4,445	46.08	48.21	0.07	763.78
Credit	FIU02	4,469	44.28	45.16	0.05	906.38
Barriers	*FIB*					
Trustworthiness	FIB01	1,483	4.51	0.86	1.96	6.72
Affordability	FIB02	1,111	4.12	0.85	1.99	6.11

From the original data set of 217 countries for time period 1990 – 2017, I choose to include only countries with data availability of at least 33%. Therefore, the total number of countries shrinks to 177.

3.1.2. Data Processing

3.1.2.1. Missing Data Treatment

There is a trade-off between creating a comprehensive measure of financial inclusion and data availability. The amount of missing data varies considerably across indicators (Table 4) and countries (Table 5), but is mostly concentrated during the 1990s. In most cases, the reason for missing data is that data started to be collected from different years in different countries. For example, WEF started to collect data for GCI data set from 2007 whereas the World Bank commenced their data collection for WDI database much earlier, since the 1960s for some countries.

Table 4: Percentage of data availability across financial inclusion's indicators

Category	Indicator	Description	Data availability			
			1990 - 1999	2000 - 2009	2010 - 2017	Total
Access	*FIA*					
ATMs	FIA01	Automated teller machines (ATMs) (per 100,000 adults)	0%	50%	93%	44%
Bank branches	FIA02	Branches of commercial banks (per 100,000 adults)	0%	56%	95%	47%
Internet access	FIA03	Individuals using the Internet (per 100,000 people)	56%	98%	92%	81%
Mobile phone subscriptions	FIA04	Mobile cellular subscriptions (per 100,000 people)	67%	98%	99%	87%
Usage	*FIU*					
Deposit	FIU01	Financial system deposits to GDP (%)	88%	98%	82%	90%
Credit	FIU02	Financial system credits to GDP (%)	88%	98%	83%	90%
Barriers	*FIB*					
Trustworthiness	FIB01	Trustworthiness and confidence of financial market development, 1-7 (best)	0%	21%	78%	30%
Affordability	FIB02	Affordability of financial services, 1-7 (best)	0%	0%	78%	22%
		Total	37%	65%	88%	62%

Table 5: Percentage of data availability across countries

Data availability	33 - 39%	40 - 49%	50 - 59%	60 - 69%	≥ 70%	Total
Number of Countries	2	11	42	116	6	177

Several approaches have been taken by scholars to deal with similar missing data matters. For example, Yorulmaz (2018) used unconditional mean imputation method across each indicator. I choose to closely follow the OECD Handbook on Constructing Composite Indicators (OECD, 2008) and IMF's methods in computing a similar indices data set for financial development (Svirydzenka, 2016). For instance, there was only 41% data available in total in the data set used by IMF to construct financial development indices database, according to author's own calculations from the data availability listed.

I take several approaches to address the missing data problem. Where data are not yet available for the latest year (e.g. 2017), the values are set equal to the latest available observations (e.g. 2016). If the data series is completely unavailable for a country, in most cases, the entire series is set at zero, indicating an implicit assumption that its access, usage properties are very poor, or the barriers to financial inclusion in the country are large. However, there are some exceptions. For example, both barrier indicators of Macao are missing. This does not mean that the financial system of Macao, as a high income country according to World Bank (2019)'s classification, is entirely untrustworthy or extremely costly. In such cases, I choose a country with the closest conditions to mirror the data, meaning Hong Kong to mirror in the case of Macao.

A more complicated case of missing variables arises when putting together series where database collection started at different points in time. I follow IMF, Svirydzenka (2016)'s methods to deal with it in several ways: (i) treat the data as truly missing, excluding the series from the index average when the data are not available; (ii) treat the data as zero, assuming that the absence of data implies this indicator does not exist. Another method used by Svirydzenka (2016) was to splice the two indices from before and after the data series becomes available. For the splicing process of treating missing data to compute financial development indices, Svirydzenka (2016) chose the first year when all data becomes available across countries, then she calculated a weighted average across the performance of various indicators and took this level of the index to determine the cross-country levels of

financial development. When some data became unavailable as she went back in time, she would move the index backwards using the average growth rate in the available series. I do not use this approach as a linear relationship between the final inclusion index and indicators should not be assumed, as each indicator might react differently when moving across the time series. Another method recommended by OECD Handbook on Constructing Composite Indicators (OECD, 2008) is a unconditional mean imputation to fill in blank data with the sample mean. This method was used by Yorulmaz (2018) to construct his financial inclusion indices. However, the financial inclusion characteristics should be unique in each country, especially across high, upper-middle or lower-middle, low income economies or across continents. For example, the data show that there is a declining trend in the number of ATMs and branches in most European countries while there is still a growing trend in most Asian and African countries. It does not mean that there is less accessibility to the financial system in the Europe. In fact, this trend happens because more European banks are moving to digital banking; hence ATMs and branches are less needed to reach their customers. Therefore, unconditional mean imputation seems not to be the most appropriate method to employ for missing data in my study. Overall, I choose to interpolate missing data according to the average growth rate in the available time period of the same series in the same country. Unlike financial development, in which a rapid financial development process might happen, financial inclusion is more a cumulative process over time, especially across some indicators chosen such as trustworthiness. However, I am also aware that this method may not be the most ideal. I therefore employ this strategy with caution by looking into available data of each country separately to understand the potential trends one by one instead of all available data across countries as a whole.

It is very important to stress that the goal of this exercise is not to create artificial data. I try to retain as many available data as possible while trying to preserve the missing parts to reflect the most comprehensive global financial inclusion landscape.

3.1.2.2. Treatment of Outliers and Normalization

Before the step to normalize each time series to values ranging from 0 – 1, each series is winsorized to prevent outliers of extreme values from distorting the 0 – 1 indicators. I set 5^{th} and 95^{th} percentiles as cut-off levels to perform this treatment.

I use min-max procedure to normalize each winsorized series to between 0 and 1, with which 0 and 1 represent the lowest and highest value. The equation to perform this normalization is as follows:

$$I_x = \frac{\mathrm{x} - x_{min}}{x_{max} - x_{min}}$$

where x is the raw indicator data, I_x is the normalized data and x_{max} and x_{min} are the highest and lowest values in each time series respectively.

3.1.3. Weight Assignment and Aggregation by Principal Component Analysis (PCA)

The weight assignment of the indicators or sub-indices is critical to maximize the information from a data set included in an index. A good composite index should comprise important information from all the indicators, but not be strongly biased towards one or more of these indicators. As recommended in the OECD Handbook on Constructing Composite Indicators (OECD, 2008) and followed by the vast majority of researchers (Amidžić et al., 2014; Cámara & Tuesta, 2017; Park & Mercado, 2018; Svirydzenka, 2016; Yorulmaz, 2018), I use principal component analysis (PCA) to compute normalized weights for each indicator. PCA is used in constructing composite indices by explaining the variance of the observed indicators (x_1, x_2, …, x_p) through fewer linear combinations a smaller number of variables (or principal components) (Z_1, Z_2, …, Z_p) (Jolliffe, 2002, p. 2).

$$Z_1 = \propto_{11} x_1 + \propto_{12} x_2 + \cdots + \propto_{1p} x_p$$
$$Z_2 = \propto_{21} x_1 + \propto_{22} x_2 + \cdots + \propto_{2p} x_p$$
$$\cdots$$
$$Z_p = \propto_{p1} x_1 + \propto_{p2} x_2 + \cdots + \propto_{pp} x_p$$

Sub-indices FIA, FIU and FIB (listed in Table 4) are constructed as weighted averages of the normalized series, where the weights are the squared factor loadings from the principal component analysis of the corresponding underlying series. The factors were rotated through the Varimax method in order to minimize the number of the indicators that have a large loading on the same factor. Factor loadings are coefficients that relate the observed variables to the principal components, or factors. The square of factor loadings represents the proportion of the total unit variance of the indicator which is explained by the factor. The

series that contributes more to the direction of common variation in the data gets a higher weight. Weighting intervenes only to correct for overlapping information between two or more correlated indicators and is not a measure of the theoretical importance of the associated indicator. I follow the standard practice to choose the factors that: (i) have associated eigenvalues larger than one; (ii) contribute individually to the explanation of overall variance by more than 10%; and (iii) contribute cumulatively to the explanation of the overall variance by more than 60% (OECD, 2008).

After assigning the weights according to the importance of the indicators found by PCA, the below formula is used to construct the sub-index:

$$D_i = \frac{\sum i_1 w_i}{n}$$

where D_i represents the dimension or sub-index FIA, FIU or FIB, i_1 refers to the first indicator in the time series of the sub-index and w_i implies the corresponding weights of the sub-index. After computing, FIA, FIU, and FIB indices are renormalized to between 0 and 1 and then aggregated in the financial inclusion (FI) index using the same PCA process.

3.2. Results and Verification with Existing Financial Inclusion Indices

The first step is to check the correlation structure of the data. If the correlation between the indicators is very weak, then it is unlikely that they share common factors. Table 6 shows the correlations between variables of the financial inclusion index and between variables in each sub-index. Overall the correlation matrix shows high correlations across indicators in each sub-index. The only exception is found among FIA's indicators. The weakest correlation is found between the bank branches penetration (FIA02) and the other components ATMs (FIA01), internet (FIA03) and mobile (FIA04) access. This can be explained by the costs to run branches are normally much higher compared to the other channels. It makes ATMs and internet, mobile banking seen as cost-effective substitutes for banks to gain reach in the market.

Table 6: Correlation matrix of Financial Inclusion Index's indicators

FI's indicators - Observations: 879

	FIA01	FIA02	FIA03	FIA04	FIU01	FIU02	FIB01	FIB02
FIA01	1.0000							
FIA02	-0.0641	1.0000						
FIA03	0.6649	-0.0992	1.0000					
FIA04	0.4293	-0.1286	0.6113	1.0000				
FIU01	0.4112	-0.0244	0.5185	0.3295	1.0000			
FIU02	0.5709	-0.0581	0.6444	0.4138	0.6589	1.0000		
FIB01	0.2346	0.0083	0.387	0.3378	0.3044	0.409	1.0000	
FIB02	0.3654	-0.0914	0.5754	0.4763	0.5031	0.5633	0.6846	1.0000

FIA's indicators - Observations: 2,053

	FIA01	FIA02	FIA03	FIA04
FIA01	1.0000			
FIA02	0.0775	1.0000		
FIA03	0.712	0.0684	1.0000	
FIA04	0.5347	0.0875	0.705	1.0000

FIU's indicators - Observations: 4,439

	FIU01	FIU02
FIU01	1.0000	
FIU02	0.6414	1.0000

FIB indicators - Observations: 1,103

	FIB01	FIB02
FIB01	1.0000	
FIB02	0.7126	1.0000

All PCA results for FIA, FIU, FIB and aggregated for FI show only one factor each with eigenvalue greater than one, which also contributes individually to the explanation of overall variance by more than 10% and contributes cumulatively to the explanation of the overall variance by more than 60% (refer to Table 7).

Table 7: Eigenvalues of the factors of FIA, FIU, FIB and FI

FIA:

FIA	Eigenvalue	Proportion	Cumulative
Factor 1	**2.75322**	**0.68830**	**0.68830**
Factor 2	0.72577	0.18140	0.86970
Factor 3	0.39856	0.09960	0.96940
Factor 4	0.12245	0.03060	1.00000

FIU:

FIU	Eigenvalue	Proportion	Cumulative
Factor 1	**1.79934**	**0.8997**	**0.8997**
Factor 2	0.200656	0.1003	1.0000

FIB:

FIB	Eigenvalue	Proportion	Cumulative
Factor 1	**1.8697**	**0.9349**	**0.9349**
Factor 2	0.1303	0.0651	1.0000

FI:

FI	Eigenvalue	Proportion	Cumulative
Factor 1	**2.02507**	**0.675**	**0.675**
Factor 2	0.637407	0.2125	0.8875
Factor 3	0.337521	0.1125	1.0000

The factor loadings, rotated factor loadings, squared factor loadings and normalized weights for each indicator are presented in Table 8.

Table 8: Weights of the index indicators

Category	Indicator	Factor Loading	Rotated Factor Loading	Sq. Factor Loading	Weight
		Factor 1	Factor 1	Factor 1	
FIA					
ATMs	FIA01	0.5035	0.4208	0.1123	0.1771
Bank branches	FIA02	0.4208	0.7556	0.3619	0.5709
Internet access	FIA03	0.5475	0.4934	0.1543	0.2434
Mobile phone subscriptions	FIA04	0.5193	-0.0924	0.0054	0.0085
FIU					
Deposit	FIU01	0.7071	0.7071	0.35355	0.50
Credit	FIU02	0.7071	-0.7071	0.35355	0.50
FIB					
Trustworthiness	FIB01	0.7071	0.7071	0.35355	0.50
Affordability	FIB02	0.7071	-0.7071	0.35355	0.50
FI					
Access	FIA	0.5991	0.5131	0.1802	0.2633
Usage	FIU	0.6147	0.8531	0.4981	0.7277
Barriers	FIB	0.5131	0.095	0.0062	0.0090

The PCA process assigns the highest weight to bank branches penetration (more than 50%) among the factors in the access dimension. This suggests that bank branches still represent the accessibility of the financial systems in most countries over time. For the usage dimension, both deposit and credit have even contribution. A similar observation is found under the barrier dimension where trustworthiness and affordability of the financial system have the same effect on defining the obstacles to achieve financial inclusion. The even contribution of these two indicators is in line with Cámara and Tuesta (2017)'s results. And overall, the usage dimension contributes the most to measure financial inclusion with more than 70% weights. The barrier dimension barely has 1% effect on the final financial inclusion scores. After assigning the weights, the final financial inclusion index FI is computed by aggregating the sub-indices FIA, FIU and FIB.

Table 9 presents the descriptive statistics of the newly constructed financial index time series for 177 countries over the period 1990 – 2017. The computation of the financial inclusion index and sub-indices to estimate the dimensions can be useful information for policymakers and governments when designing financial inclusion strategies. Policymakers can obtain useful information to design interventions by using the information provided by the weights in such a way that optimizes financial inclusion strategies.

Table 9: Descriptive statistics of Financial Inclusion Index and its sub-indices

Variable	Obs	Mean	Std. Dev.	Min	Max
FIA	4,956	0.2543334	0.2397745	0	0.9983758
FIU	4,956	0.3124796	0.2635886	0	1
FIB	4,956	0.5358872	0.2989433	0	1
FI	4,956	0.2991803	0.2394956	0	0.9930252

Table 10 shows the financial inclusion indices and rankings in 2017 of 23 APAC economies included in this thesis. The arrows indicate the improvement or deterioration in global rankings compared to 2016.

Table 10: Financial Inclusion Indices, 2017 rankings of APAC countries

Country	FIA	Rank/177	FIU	Rank/177	FIB	Rank/177	FI	Rank/177
Australia	0.669	28	0.946	6	0.884	21	0.872	10 ▼
Bangladesh	0.645	38	0.315	96	0.589	99	0.404	93 ▼
Cambodia	0.709	22	0.535	48	0.712	58	0.582	44 ▲
China	0.315	130	0.704	24	0.725	52	0.602	39 ▼
Fiji	0.799	11	0.599	40	0	148	0.646	31 ▲
Hong Kong SAR, China	0.5	73	1	1	0.999	2	0.868	11
India	0.25	140	0.447	66	0.747	43	0.397	95 ▼
Indonesia	0.33	124	0.264	114	0.776	36	0.286	130
Japan	0.707	23	1	1	0.91	13	0.922	3
Korea, Rep.	0.553	57	1	1	0.691	66	0.879	8
Lao PDR	0.134	158	0.615	36	0.687	67	0.489	66 ▲
Malaysia	0.403	104	0.95	5	0.892	19	0.806	15
Mongolia	0.783	13	0.366	88	0.476	130	0.477	70 ▼
Nepal	0.296	133	0.613	37	0.638	83	0.529	56 ▲
New Zealand	0.575	53	1	1	0.974	5	0.888	7
Pakistan	0.639	40	0.168	138	0.596	96	0.296	126
Philippines	0.294	134	0.41	75	0.727	50	0.382	98 ▼
Solomon Islands	0.628	44	0.278	109	0	148	0.368	104 ▼
Sri Lanka	0.285	137	0.299	101	0.613	90	0.298	125
Thailand	0.445	87	0.986	4	0.747	42	0.841	14
Tonga	0.574	54	0.308	98	0	148	0.375	101 ▼
Vanuatu	0.315	131	0.53	49	0	148	0.469	74 ▼
Vietnam	0.228	144	0.48	62	0.666	71	0.415	85 ▼

To validate this newly constructed financial inclusion indices and rankings with those existing from past research, I use Kendall's W index. Kendall's W ranges from 0 (no agreement) to 1 (complete agreement). Table 11 shows the results. Accordingly, by comparing both indices and rankings from my results with available results from Sarma (2008), Cámara and Tuesta (2017) and Yorulmaz (2018), it shows that my results are significant and positively associated with these earlier established findings despite different time periods and size of the countries set coverage.

Table 11: Kendall's index of concordance in 2004 – 2011 and 2014 for self-constructed indices, rankings versus past constructed indices, rankings

Indices/Rankings to compare	Kendall's W Index
Index comparison, sample of 55 countries in 2004, by Sarma (2008)	0.6718***
Index comparison, sample of 41 countries in 2004, by Yorulmaz (2018)	0.8029***
Index comparison, sample of 41 countries in 2005, by Yorulmaz (2018)	0.7718***
Index comparison, sample of 41 countries in 2006, by Yorulmaz (2018)	0.7480***
Index comparison, sample of 41 countries in 2007, by Yorulmaz (2018)	0.7674***
Index comparison, sample of 41 countries in 2008, by Yorulmaz (2018)	0.7589***
Index comparison, sample of 41 countries in 2009, by Yorulmaz (2018)	0.7436***
Index comparison, sample of 41 countries in 2010, by Yorulmaz (2018)	0.7468***
Index comparison, sample of 41 countries in 2011, by Yorulmaz (2018)	0.7430***
Ranking comparison, sample of 135 countries in 2014, by Cámara and Tuesta (2017)	0.6119***

Note: ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1

4. Data Sources and Methodology to Study the Impacts of Remittances on Economic Growth

4.1. Data Sources and Variables' Descriptive Statistics

I use Gross Domestic Product (GDP) growth to represent economic growth. The raw data for GDP and remittance receipts values are from the World Development Indicators (WDI), World Bank, with data coverage from roughly 1970 – 2017. GDP is estimated in 2010 constant US dollar while remittance receipts are measured in current US dollar. From the raw number of GDP and remittance receipts, I derive the GDP growth and remittance receipts growth by the differences between values of current year and the year before. Natural logarithmic transformations of both variables are done to account for possible heteroscedasticity and other estimation problems.

I choose two control variables to account for the initial economic conditions: investments and trade openness. These two variables and underlying indicators are drawn by influences from several past studies (Chami et al., 2003; Feeny et al., 2013; Giuliano & Ruiz-Arranz, 2005; Kumar & Vu, 2014). The gross fixed capital formation as a share of GDP is used to proxy the aggregated investments, while sum of exports and imports as a share of GDP is used to measure the trade openness levels. All data for control variables is transformed into natural logarithmic form for analysis. The raw data is taken from the World Development Indicators (WDI), World Bank and available from roughly 1970 – 2017 for some countries.

Data for financial development is taken from the Financial Development Index Database, IMF by Svirydzenka (2016), which was introduced in section 1.2. The latest database covers 183 countries over the period from 1980 – 2016. Since its introduction from 2013, the Financial Development Index Database has been updated annually in July for the period from 1980 to the year before.

Finally, financial inclusion indices are self-computed as presented in section 2, and is available for the period 1990 – 2017. Note that two indicators Bank branches per 100,000 adults and ATMs per 100,000 adults which were used to self-calculate financial inclusion indices in section 2 were also included in the computation of financial development index by Svirydzenka (2016) (refer to Table 2 and Figure 7 and Figure 8). Therefore, a correlation between financial development and financial inclusion variables might be expected.

Table 12 shows a summary of variables' definitions and sources.

Table 12: Definitions and sources of variables

Variable	Variable Description	Data Source
ΔGDP	Growth of real GDP in constant 2010 US$	World Development Indicators, World Bank
ΔRem	Growth of personal remittances receipts in current US$	World Development Indicators, World Bank
FD	Financial Development Index	Financial Development Index Database, IMF
FI	Financial Inclusion Index	Self-constructed, refer to Section 2
TradeGDP	Exports plus imports as a share of GDP	World Development Indicators, World Bank
InvestGDP	Gross fixed capital formation as a share of GDP	World Development Indicators, World Bank

Due to data availability, the sample countries consist of 23 out of 36 APAC economies over the period 1990 – 2017. Table 13 shows a summary of the mean, standard deviation, min, max and the number of observations of the dependent variable – economic growth, represented in natural logarithm form of GDP growth (lnΔGDP). It further shows three independent variables – remittance growth, represented in natural logarithm (lnΔRem), financial development index (FD), financial inclusion index (FI), and finally two control variables – sum of exports and imports as a share of GDP in natural logarithm form (lnTradeGDP) and gross fixed capital formation as a share of GDP in natural logarithm form (lnInvestGDP).

Table 13: Descriptive statistics of variables lnΔGDP, lnΔRem, FD, FI, lnTradeGDP and lnInvestGDP

Variable	Obs	Mean	Std. Dev.	Min	Max
lnΔGDP	592	21.72162	2.802112	10.30206	27.20921
lnΔRem	442	18.29895	2.525096	10.16364	23.40017
FD	622	0.3567446	0.2315038	0	0.948395
FI	644	0.379229	0.2636629	0.0035736	0.9220372
lnTradeGDP	633	4.251284	0.6349466	2.752037	6.092711
lnInvestGDP	594	3.180697	0.3003263	1.574214	3.879755

4.2. Methodology and Model Specifications

In order to avoid generating spurious results, unit root tests on all variables need to be conducted. The data set used is unbalanced because some variables are only available in different countries from different time periods. Besides, there is a fixed number of panels N (23 countries) with a long period of T (28 years from 1990 – 2017). Therefore, unit root tests Im, Pesaran and Shin (IPS) developed by Im, Pesaran, and Shin (2003) and Fisher-type tests developed by Choi (2001) using both augmented Dickey–Fuller (ADF) (Dickey & Fuller, 1979) and Phillips–Perron (Phillips & Perron, 1988) are used. The null hypothesis for these tests is that the variable contains a unit root (or non-stationary), and the alternative is that the variable was generated by a stationary process.

The next step in the analysis is to test for the existence of a stable long-run relationship, or cointegration, between economic growth, remittances, financial development and financial inclusion. A panel vector autoregressive (PVAR) lag selection is run to choose the optimal lag length. After that, Westerlund (2007)‘s error-correction model for panel cointegration test is employed with a null hypothesis of no cointegration. The Granger-causality relationships between economic growth, remittances, financial development and financial inclusion are also examined. The main reason to investigate both cointegration and Granger-causality relationships is to observe the causal dynamics among the variables under consideration and at the same time determine the long run dynamics between each pair of variables. This thesis adopts a PVAR model developed by Abrigo and Love (2015) for lag length selection and Granger-causality tests. The choice of the order length on the PVAR is based on the tests of moment selection criterions based on the work of Andrews and Lu (2001). These criterions

consist of a vector construction that aims to minimize the modified Bayesian information criterion (MBIC), the modified Akaike information criterion (MAIC), and the modified Hannan-Quinn information criterion (MQIC).

To analyse the effects of remittances on growth, both pooled ordinary least squares (pooled OLS) and fixed effects (FE) models for panel data are estimated. A pooled OLS is a linear regression that does not account for any specific countries' characteristics. The impact of remittances on economic growth is estimated by the following equation:

$$\Delta GDP_{it} = \beta_0 + \beta_1 \Delta GDP_{i,t-1} + \beta_2 \Delta Rem_{it} + \beta_3 X_{it} + u_{it}$$

in which,

- $\Delta GDP_{i,t-1}$is initial level of GDP growth expressed in natural logarithm form
- ΔRem the increase in the incoming remittance value expressed in a natural logarithm form
- X_{it} is a matrix of control variables representing initial economic conditions
- u_{it} is an error term

The difference between pooled OLS and FE lies in how the specification deals with the error term. FE model offers a way to deal with unobserved heterogeneity and omitted variable bias (OVB), where an OLS can suffer from this. In the FE estimation, the variables are the same as in pooled OLS, but the error term is divided into $\eta_i + \varepsilon_{it}$ where η_i is the country-specific error term and ε_it is an error term for the specific country in a specific time t.

$$\Delta GDP_{it} = \beta_0 + \beta_1 \Delta GDP_{i,t-1} + \beta_2 \Delta Rem_{it} + \beta_3 X_{it} + \eta_i + \varepsilon_{it}$$

The regression tests whether there is an impact of remittances on growth or not. In other words, the analysis is to know if β_2 in OLS and FE estimation is statistically significant. If β_2 is positive and statistically significant, the first hypotheses defined in section 1.4 that remittances have a positive effect on economic growth in a long run is supported.

In the second set of regressions, I test the roles of remittances on growth through the interactions with financial development and financial inclusion. The hypotheses I want to explore is whether the financial development and financial inclusion level in a country can

influence the impact of remittances on growth. I do this by first interacting the remittance variable with the financial development variable. Then I repeat the process to interact the remittance variable with the financial inclusion variable. The regression equations are as follows:

$$\Delta GDP_{it} = \beta_0 + \beta_1 \Delta GDP_{i,t-1} + \beta_2 \Delta Rem_{it} + \beta_3 FD_{it} + \beta_4 \Delta Rem_{it} * FD_{it} + \beta_5 X_{it} + u_{it}$$

$$\Delta GDP_{it} = \beta_0 + \beta_1 \Delta GDP_{i,t-1} + \beta_2 \Delta Rem_{it} + \beta_3 FI_{it} + \beta_4 \Delta Rem_{it} * FI_{it} + \beta_5 X_{it} + u_{it}$$

for pooled OLS estimation and

$$\Delta GDP_{it} = \beta_0 + \beta_1 \Delta GDP_{i,t-1} + \beta_2 \Delta Rem_{it} + \beta_3 \Delta FD_{it} + \beta_4 \Delta Rem_{it} * FD_{it} + \beta_5 X_{it} + \eta_i + \varepsilon_{it}$$

$$\Delta GDP_{it} = \beta_0 + \beta_1 \Delta GDP_{i,t-1} + \beta_2 \Delta Rem_{it} + \beta_3 FI_{it} + \beta_4 \Delta Rem_{it} * FI_{it} + \beta_5 X_{it} + \eta_i + \varepsilon_{it}$$

for FE estimations, in which, FD_{it} and FI_{it} are financial development and financial inclusion indices which represent the country's financial development and financial inclusion levels respectively.

Another method for panel data modelling is random effects (RE). Between fixed effects and random effects models, the fixed effects model captures the sources of change within countries, while the random effects model assumes a random variation across countries and is more appropriate if differences among countries affect the dependent variable. A Hausman's specification test is performed to compare which of the FE or RE linear regression model is more appropriate to estimate (Hausman, 1978). With a p-value < 0.01 as a result of Hausman test, the null hypothesis is rejected, and the model is estimated with fixed effects instead of random effects.

5. Results and Discussions

One of the prerequisites of running PVAR, OLS and FE models is that the variables analysed in the models must be stationary. Stationarity simply means that a variable has a mean and variance that does not change over time. A non-stationary process is the case where the mean of the sample constantly changes during different points of time. Appendix 1 presents trends of six main variables in 23 countries from 1990 – 2017. These graphs indicate a possible trend of upward and constant movement in the variables, notably on the FI variable in most countries. This may be an indication of a non-stationary process. Unit root tests are therefore formally conducted on the variables to verify the observations. Refer to Appendix 2 for the

test results. The main variables lnΔGDP, lnΔRem, FD, and control variables lnTradeGDP, lnInvestGDP are stationary in their original forms. So, it can be concluded that they have long run relationships and satisfy the requirement to be tested in a times series panel data analysis. This test also partially supports the first hypothesis that economic growth and remittance receipts have long-run relationships. Regarding the variable FI, even though it is non-stationary at its level form, it is stationary at its first difference. The first difference variable, which denotes as ΔFI, is therefore used in panel data analysis instead of its original form FI. Descriptive statistics of final set of variables to be used in PVAR and regression OLS, FE models (with ΔFI instead of FI) is shown in Table 14 below.

Table 14: Descriptive statistics of variables lnΔGDP, lnΔRem, FD, ΔFI, lnTradeGDP and lnInvestGDP

Variable	Obs	Mean	Std. Dev.	Min	Max
lnΔGDP	592	21.72162	2.802112	10.30206	27.20921
lnΔRem	442	18.29895	2.525096	10.16364	23.40017
FD	621	0.3568031	0.2316858	0	0.948395
ΔFI	621	0.0117289	0.0231496	-0.11395	0.1450917
lnTradeGDP	633	4.251284	0.6349466	2.752037	6.092711
lnInvestGDP	594	3.180697	0.3003263	1.574214	3.879755

Correlation tests were also conducted to test if the variables might suffer from multicollinearity, and hence might affect the regression test results. Refer to Appendix 3 for the results. Even though the variables FD and ΔFI do not show a high correlation, in order to avoid being biased because of two overlapping indicators used in calculating financial development and financial inclusion indices (explained in section 4.1), a separate regression analysis for these two variables as specified in section 4.2 are still being used.

5.1. Cointegration and Granger-Causality Tests

This step in the analysis is to test for the existence of a stable long-run relationship and observe causal dynamics among four variables economic growth, remittances, financial development and financial inclusion. In order to run lag selection and Granger-causality tests under the PVAR model developed by Abrigo and Love (2015) on Stata 14 econometric

package, the data set is required to be balanced and have complete data. I therefore need to perform imputation for missing data. Where data is not yet available for the latest year (e.g. 2017), the values are set equal to the latest available observations (e.g. 2016). This method is mainly applied for 2017 data of FD as FD data set is only available till 2016. If the missing data is in between two years with available data, the missing data is imputed by the average of these two nearest years. In some cases, data are missing because that data started to be collected from different years in different countries. The missing data in these cases are imputed by the average of the available data of the same country in the later years.

Note that is imputed data set is only used in this section to observe the causal dynamics among the variables under consideration. For all other tests and model specifications in this thesis, the original data set with descriptive statistics presented in Table 14 is used.

Due to the sensitivity nature of both the co-integration and the Granger-causality tests to lag lengths, the PVAR lag length selection criteria are employed in choosing the appropriate lag lengths. The result is presented in Table 15. While Hansen's J statistic needs to be minimized, it does not correct for the degrees of freedom in the model based on what Andrews and Lu (2001) suggested. Abrigo and Love (2015) also proposed an overall coefficient of determination (CD) which captured the proportion of variance explained by the PVAR model. Hence, based on the model selection criteria and the overall coefficient of determination by Andrews and Lu (2001) and Abrigo and Love (2015), the first-order panel VAR is preferred since it has the smallest CD, MBIC, MAIC, and MQIC.

Table 15: Lag length criteria selection results

Lag	CD	J	J p-value	MBIC	MAIC	MQIC
1	**0.999742**	**100.5003**	**0.773792**	**-574.397**	**-123.5**	**-301.817**
2	0.9998	83.59897	0.812736	-494.884	-108.401	-261.245
3	0.999796	50.25966	0.996253	-431.81	-109.74	-237.11
4	0.999816	32.97156	0.999546	-352.684	-95.0284	-196.924
5	0.999828	25.25461	0.997208	-263.987	-70.7454	-147.167
6	0.999842	20.55157	0.941013	-172.276	-43.4484	-94.3963
7	0.999869	7.539969	0.961398	-88.8739	-24.46	-49.934
No. of obs = 414, No. of panels = 23, Ave. no. of T = 18						

Next I use the Westerlund (2007)'s cointegration tests with one lag order to investigate the long-run relationship among variables lnΔGDP, lnΔRem, FD and ΔFI. Table 16 reports four cointegration test results based on Westerlund (2007). Two group-mean tests G_t and G_a, are designed to test the alternative hypothesis that at least one cross-sectional unit is cointegrated. The other two, panel tests G_t and P_t, are designed to test the alternative that the whole panel is cointegrated. Among four statistics results, Westerlund (2007) contends that the G_t and P_t statistics generally perform the best as they are more robust (Lim & Simmons, 2015). With p-value of G_t and P_t at 0.038 and 0.003, the null hypothesis of no cointegration is rejected. A long-run relationship among four variables lnΔGDP, lnΔRem, FD and ΔFI is therefore indicated.

Table 16: Panel cointegration test results

H0: no cointegration

Statistic	Value	Z-value	P-value
G_t	-2.089	-1.776	0.038
G_a	-7.014	0.612	0.73
P_t	-9.893	-2.729	0.003
P_a	-6.894	-1.993	0.023

However, long-run relationships among variables do not provide details of the directions and magnitudes of causation between any two of four variables. Therefore, panel pairwise Granger-causality tests are performed. Granger-causality test is a method of determining whether a variable, such as, x_t has any information on y_t when regressing y_t on its own lagged values and on lagged values of x_t. Using the PVAR framework allows me to test if the

included variables have any explanatory power on other variables included in the regression analysis later. The results Granger-causality tests are shown in Table 17.

Table 17: Granger-causality test results of 23 APAC economies

Variables	lnΔGDP	lnΔRem	FD	ΔFI
lnΔGDP	-	2.736*	0.021	2.843*
lnΔRem	6.673**	-	0.004	9.373***
FD	0.218	0.052	-	3.389*
ΔFI	0.005	0.119	0.349	-

Note: ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1

The Granger-causality directions among four variables at 10% significance level are illustrated in Figure 9. The results suggest bidirectional causal relationships between economic growth and remittance growth in a sample of 23 APAC economies during the period 1990 – 2017. This is in line with what Feeny et al. (2013) found earlier: while remittances might determine economic growth, economic growth rates might also determine the level of remittances. The results from Granger-causality tests also signal that economic growth, remittance and financial development may lead to an improvement in financial inclusion but not the other ways round.

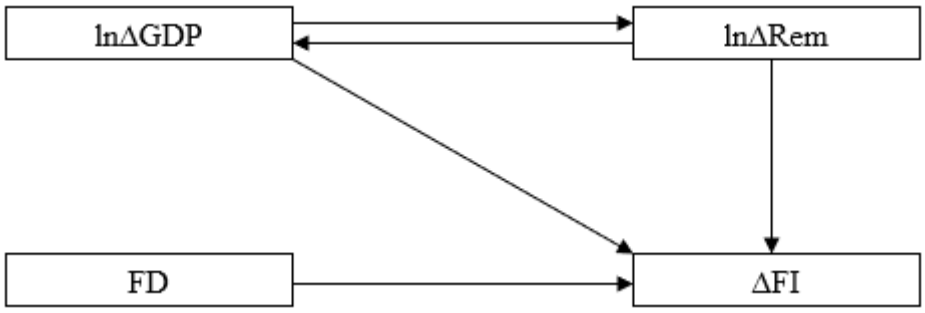

Figure 9: Granger-causality direction of 23 APAC economies (at 10% significant level)

Granger-causality tests are also run according to countries' development status listed in Table 1 to examine if there might be any difference in causal relationships due to countries' income level status. For high and upper-middle income economies, no significant causal relationship is observed. In the case of low and lower-middle economies, the results in Table 18 and Figure 10 indicate that remittance growth might lead to economic growth and improvement in financial inclusion during the period 1990 – 2017.

Table 18: Granger-causality test results of low and lower-middle economies in APAC

Variables	lnΔGDP	lnΔRem	FD	ΔFI
lnΔGDP	-	0.197	1.327	0.727
lnΔRem	5.776**	-	0.326	10.016***
FD	0.222	2.417	-	0.295
ΔFI	0.145	0.205	0.095	-

Note: ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1

Figure 10: Granger-causality direction of low and lower-middle economies in APAC (at 5% significant level)

Among 23 countries, China is the economy with the highest growth in APAC and highest GDP since 2009 (refer to Figure 2, Table 19 and Appendix 1). Granger-causality tests are therefore run on 22 countries excluding China with results shown in Table 20 and Figure 11 to observe any different causal relationship present. The results indicate a causal relationship between remittance receipts and economic growth. Besides, both remittance inflows and financial development seem to have brought financial inclusion improvement in these countries.

Table 19: Summary of lnΔGDP of 23 economies in APAC

	Summary of lnΔGDP		
Country	Mean	Std. Dev.	Freq.
China	26.299812	0.76844	28
Japan	25.06028	0.83945	22
India	24.815788	0.827016	28
Korea, Rep.	24.31345	0.42422	27
Indonesia	24.086603	0.546344	27
Australia	24.016117	0.512275	27
Thailand	23.174072	0.500901	25
Malaysia	23.082107	0.582801	26
Hong Kong SAR, China	22.573491	0.637631	26
Philippines	22.550304	0.88608	26
Pakistan	22.32886	0.615949	28
Vietnam	22.269396	0.50483	28
Bangladesh	22.165882	0.58762	28
New Zealand	21.956854	0.628849	26
Sri Lanka	21.459247	0.502257	27
Cambodia	20.00953	1.044833	23
Nepal	19.8927	0.840219	28
Lao PDR	19.49479	0.664029	28
Mongolia	19.435988	0.963547	23
Fiji	18.114352	0.746956	23
Solomon Islands	17.21087	0.522846	21
Vanuatu	16.611598	0.8335	25
Tonga	15.707892	1.380326	22
Total	21.721617	2.802112	592

Table 20: Granger-causality test results of 22 APAC economies excluding China

Variables	lnΔGDP	lnΔRem	FD	ΔFI
lnΔGDP	-	2.243	0.009	2.69
lnΔRem	7.074***	-	0.042	9.207***
FD	0.286	0.003	-	2.795*
ΔFI	0.000	0.387	0.215	-

Note: ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1

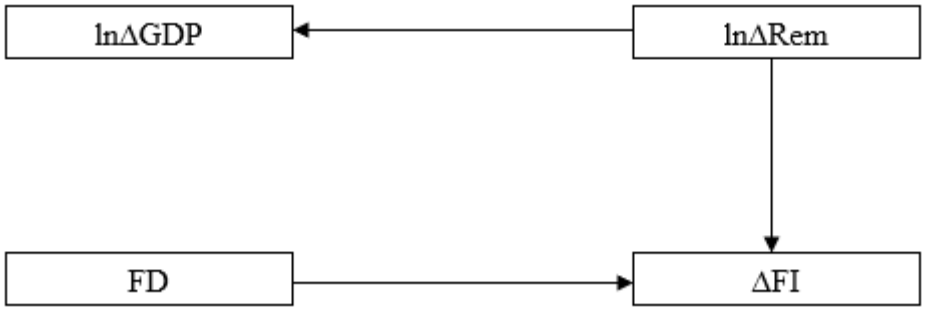

Figure 11: Granger-causality direction of 22 APAC economies excluding China (at 10% significant level)

5.2. Regressions Results

5.2.1. Estimations with 23 APAC Economies

The Hausman test performed in Stata with p-value < 0.01 indicates a rejection of null hypothesis and that FE models are more suitable than RE. Therefore, only FE results, together with pooled OLS, are reported. The results from running the pooled OLS and FE regression models are presented in Table 21. Six estimations results show overall fit with R-squared ranging from 0.15 to 0.70 and the F ratio is significant at the 1% level. It is also noteworthy that pooled OLS is said to almost certainly yield biased and misleading results owing to the likely endogeneity of remittances and a number of the control variables (Feeny et al., 2013; Giuliano & Ruiz-Arranz, 2005). Therefore, FE estimates might bring more reliable results compared to pooled OLS.

The main result stemming from both OLS and FE models (with country fixed-effects) is the significant positive influence of remittances in the panel of 23 APAC countries sample as shown on all estimations (1) - (6) at 1% level, with or without the effects of financial development and financial inclusion. These results strongly support the first hypothesis in this study that remittance inflows have brought positive impacts on economic growth in APAC.

Table 21: Pooled OLS and fixed-effects regression estimates

	Pooled OLS			FE		
	(1)	(2)	(3)	(4)	(5)	(6)
lnΔRem	0.573***	0.488***	0.608***	0.102***	0.116***	0.107***
	(0.039)	(0.055)	(0.044)	(0.023)	(0.036)	(0.024)
FD	-	9.589***	-	-	5.099**	-
		(3.333)			(2.110)	
lnΔRem*FD	-	-0.229	-	-	-0.144	-
		(0.180)			(0.103)	
ΔFI	-	-	42.060	-	-	9.418
			(32.566)			(11.493)
lnΔRem*ΔFI	-	-	-2.789	-	-	-0.500
			(1.781)			(0.625)
lnTradeGDP	-0.499***	-0.855***	-0.443***	0.532***	0.273	0.472***
	(0.146)	(0.123)	(0.148)	(1.157)	(0.167)	(0.159)
lnInvestGDP	3.094***	2.000***	3.219***	1.098***	1.108***	1.041***
	(0.325)	(0.275)	(0.333)	(1.182)	(0.181)	(0.196)
Constant	3.627***	8.332***	2.480*	14.401***	14.361***	14.750***
	(1.389)	(1.428)	(1.457)	(0.840)	(0.990)	(0.894)
Observations	395	384	386	395	384	386
Country Fixed-effects	No	No	No	Yes	Yes	Yes
Number of countries	23	23	23	23	23	23
R-squared within	-	-	-	0.2020	0.2437	0.1859
R-squared between	-	-	-	0.2176	0.5503	0.2648
R-squared overall	0.5329	0.7042	0.5408	0.1527	0.4658	0.1876
F	150.85***	183.37***	91.69***	31.14***	22.94***	16.35***

Note: Dependent variable is GDP growth in natural logarithm form. Robust standard errors in parentheses. ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1

The findings from estimations (1) and (4) pose the question of whether the impact of remittances is homogeneous across countries or whether it might vary by the influence of other factors which has not been properly included in the estimated specification. Estimations (2), (3), (5) and (6) therefore investigate this avenue further to explore if the financial development and financial inclusion of the recipient country influences the impacts of remittance receipts on growth. Estimations (2) and (5) are with the interaction of remittances (lnΔRem) and financial development index (FD) while estimations (3) and (6) are with the interaction of remittances (lnΔRem) and the first difference of financial inclusion (ΔFI).

In both pooled OLS and FE estimates, by introducing a financial development variable, evidence of positive and significant coefficients of both remittance and financial development on economic growth is observed. Financial development index variable is statistically significant in both OLS and FE estimates. In FE estimation (5), it is statistically significant at a 5% level. With the coefficient of 5.099, a one-unit increase in financial development index results in a 163-unit increase in the growth of GDP ($e^{5.099}$-1 = 162.858).

By comparing FE results of estimations (4) and (5), there is an evidence that financial development enhances the effect of remittance on economic growth. Specifically, under the

impact of financial development, a 1% change in the growth value of remittance receipts results in a 0.116% change in GDP growth, whereas without the impact of financial development, a 1% change in the increasing value of remittance receipts is associated with only 0.102% change in economic growth in APAC. A similar result was discovered in Latin American and Caribbean countries by (Mundaca, 2009) that the impact of remittances on economic growth became stronger if a measure of financial development was included in the regression. An interesting result is the negative coefficient on the interaction of remittance and financial development suggested by both pooled OLS and FE estimates even though it is not significant ($p=0.203$ and $p=0.162$ for the interaction of $\ln\Delta Rem$ on FD under pooled OLS and FE estimates respectively).

In term of financial inclusion, financial inclusion also enhances the impact of remittance on economic growth by comparing results of estimation (4) and (6). Under the impact of financial inclusion, a 1% increase in the growth of remittance receipts results in 0.107% increase in GDP growth, improved from 0.102% when financial inclusion is not included in the regression analysis. The interaction between remittance and financial inclusion is, however, not significant while the coefficients on the interaction of remittance and financial inclusion shows negative signs in both pooled OLS and FE estimates. It is important to note that all remittances data are from World Bank, which only captures the remittance flows through the formal financial system. Hence, it is possible that these remittance recipients are already involved in some kinds of banking services to receive their remittance through official channels. It is more likely that recipients of informal remittances flows suffer more from financial exclusion.

In summary, both hypotheses of this study have been supported by regression results. Remittance receipts have brought positive impacts on economic growth in APAC during the period 1990 – 2017. Besides, both financial development and financial inclusion have enhanced the impact of remittance inflows on economic growth thus far.

5.2.2. Estimations without China

According to Granger-causality test results presented in section 5.1, the samples of lower and lower-middle income countries and the samples of countries excluding China might bring

different results. The same regressions are therefore run for the lower and lower-middle income countries sample and the countries data set excluding China. While the regression results for lower and lower-middle income countries show somewhat similar results with those reported in Table 21, the pooled OLS and FE estimates for 22 countries without China show more interesting results as captured in Table 22. Six estimations results for the sample of 22 APAC countries show overall fit with R-squared ranging from 0.15 to 0.69 and the F ratio is significant at the 1% level.

Table 22: Pooled OLS and fixed-effects regression estimates of 22 APAC economies excluding China

	Pooled OLS			FE		
	(1)	(2)	(3)	(4)	(5)	(6)
lnΔRem	0.578***	0.506***	0.608***	0.096***	0.126***	0.105***
	(0.040)	(0.054)	(0.044)	(0.024)	(0.038)	(0.026)
FD	-	11.289***	-	-	6.120***	-
		(3.462)			(2.290)	
lnΔRem*FD	-	-0.320*	-	-	-0.208*	-
		(0.187)			(0.114)	
ΔFI	-	-	45.903	-	-	9.742
			(32.9515)			(11.933)
lnΔRem*ΔFI	-	-	-2.962	-	-	-0.505
			(1.807)			(0.651)
lnTradeGDP	-0.340**	-0.710***	-3.130**	0.437***	0.214	0.398**
	(0.148)	(0.122)	(0.150)	(0.166)	(0.177)	(0.168)
lnInvestGDP	2.444***	1.299***	2.553***	0.984***	0.993***	0.940***
	(0.349)	(0.284)	(0.361)	(0.190)	(0.191)	(0.204)
Constant	4.829***	9.514***	3.925**	15.037***	14.628***	15.189***
	(1.449)	(1.391)	(1.518)	(0.923)	(1.049)	(0.971)
Observations	372	361	364	372	361	364
Country Fixed-effects	No	No	No	Yes	Yes	Yes
Number of countries	22	22	22	22	22	22
R-squared within	-	-	-	0.1527	0.1895	0.1539
R-squared between	-	-	-	0.2278	0.5565	0.2699
R-squared overall	0.4796	0.6874	0.4838	0.1455	0.4605	0.1747
F	114.99***	159.32***	69.04***	20.85***	15.62***	12.26***

Note: Dependent variable is GDP growth in natural logarithm form. Robust standard errors in parentheses. ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1

Most of the results are similar with results shown in Table 21 when China is included in the country samples. There is a strong significant positive effect of remittance on economic growth across estimations (1) – (6), with or without the effects of financial development and financial inclusion. The FE estimates results shown in estimations (4), (5), and (6) also confirm the enhancing roles of financial development and financial inclusion on the effects of remittance receipts on economic growth. In term of financial inclusion, again, neither pooled OLS nor FE estimates indicates an impact of financial inclusion on growth. The interaction between remittance and financial inclusion is not significant either while the coefficients on

the interaction of remittance and financial inclusion still show negative signs in both pooled OLS and FE estimates.

However, the results from 22 APAC economies excluding China shows a significant negative coefficient on the interaction of remittance and financial development on both pooled OLS and FE estimates. This negative interaction signals that remittances are more effective in APAC countries with less developed financial systems. This finding is supported by Giuliano and Ruiz-Arranz (2005) when they looked into 73 developing countries from the sample period 1975 – 2002 and found that remittances could only promote growth in less financially developed countries. Sobiech (2019) also drew a similar conclusion recently from her research on 61 emerging and developing countries over the time period 1970 – 2010 that in economies with less advanced financial markets, there were positive effects of remittance inflows on growth, but not in those countries with more advanced financial systems.

Resolving the equation from estimation (5) to examine when financial development starts to not enhance the impacts of remittance on economic growth gives a result of 0.6027761 (0.1255866 / 0.208347). In other words, in countries with financial development index below 0.60, remittances support economic growth better compared to countries with financial development index higher than 0.60. Figure 12 is plotted to illustrate the interaction of lnΔRem and FD on lnΔGDP while keeping other variables constant with FE estimate results shown in estimation (5).

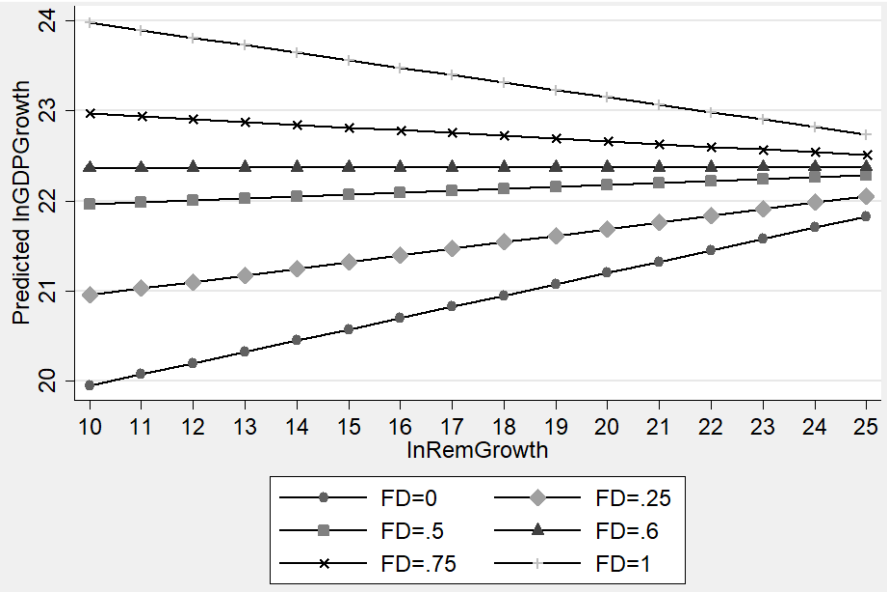

Figure 12: Interactions between lnΔRem and FD on lnΔGDP

There are some plausible reasons in explaining why financial development makes remittance flows more productive in less financially developed countries. Remittances can work as a substitute or a complement under different levels of financial development (Giuliano & Ruiz-Arranz, 2005) to offer the needs for credit and insurance that the market might have failed to provide. Remittances in this case are more likely to be devoted to financial activities which generate growth, such as financing investments, contrary to when the needs for credit and insurance can be easily met by a well-functioning financial system. Remittances received by recipients can also be saved in the form of deposits in the financial system thus improving their lending abilities, whereas this additional deposit flow might not be a significant contribution in more financially developed countries. In short, remittances-driven growth might be less important the more developed the financial system is.

5.3. Limitations

As mentioned earlier, the difference between pooled OLS and FE lies in how the specification deals with the error term. FE model offers a way to deal with unobserved heterogeneity and omitted variable bias, where an OLS can suffer from this. However, in my thesis, even though FE models seem better fits compared to OLS according to robustness tests presented in the Appendix 4, FE models still suffer from heteroscedasticity problems. Heteroskedasticity causes standard errors to be biased (Williams, 2015). Hence, the results should be treated with care, even though the results drawn from this thesis are supported by several earlier research. Please refer to Appendix 4 for more discussions regarding this thesis' limitations, including several methods to address the heteroscedasticity problems. The data challenges are also discussed in Appendix 4.

6. Concluding Remarks

The study, which analyses the latest available data of a sample of 23 APAC countries during a period of 28 years 1990 – 2017, provides a new evidence for the impact of remittances on economic growth in the APAC region. The thesis also goes beyond the direct effects of remittances on growth by introducing and estimating the interactive effects of remittances

and financial development, financial inclusion variables. Besides, this paper is significant in contributing to the literature of a newly constructed financial inclusion indices data set comprised of the greatest number of countries, 177, over the longest time period, 28 years from 1990 to 2017. The data set shows high correlations with past constructed financial inclusion data set which covers much fewer countries and less years.

The empirical results, even though should be treated with care, support both hypotheses of this study. Remittances have a significant positive impact on long-run economic growth in the APAC from 1990 – 2017. Both financial development and financial inclusion enhance the impact of remittance inflows on economic growth. Another finding of this study (from the sample of APAC economies excluding China) is that remittances can promote growth in a less financially developed country whereas the remittances-driven growth is less important in more financially developed economies.

If data of informal remittances is available in the future, empirical studies may uncover stronger effects of financial development, financial inclusion and discover more factors which affect the remittance – growth nexus. The future research can also look into more potential factors enhancing the impacts of remittances on economic growth, such as financial literacy levels to understand more in depth the remittance – growth nexus. A detailed agenda to enhance financial development, financial inclusion, and financial literacy can then be made available to recommend to state's policymakers.

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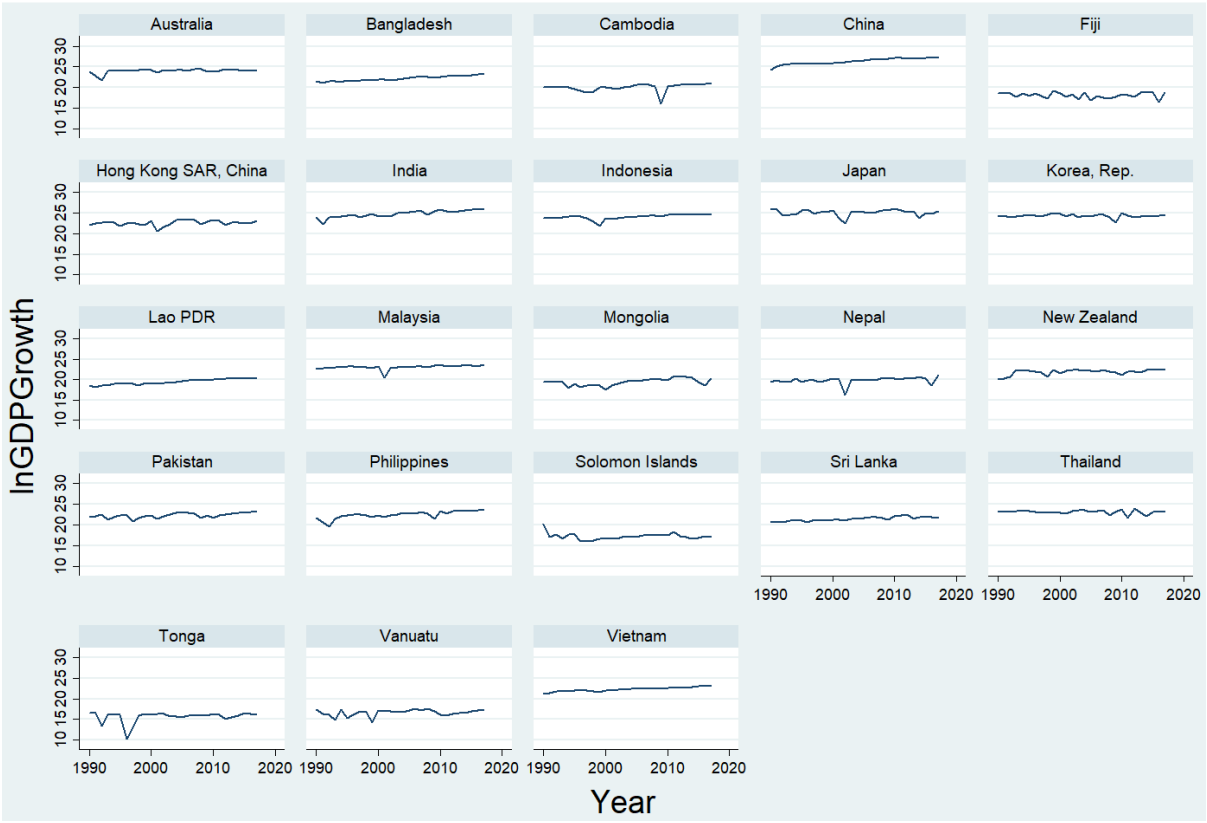
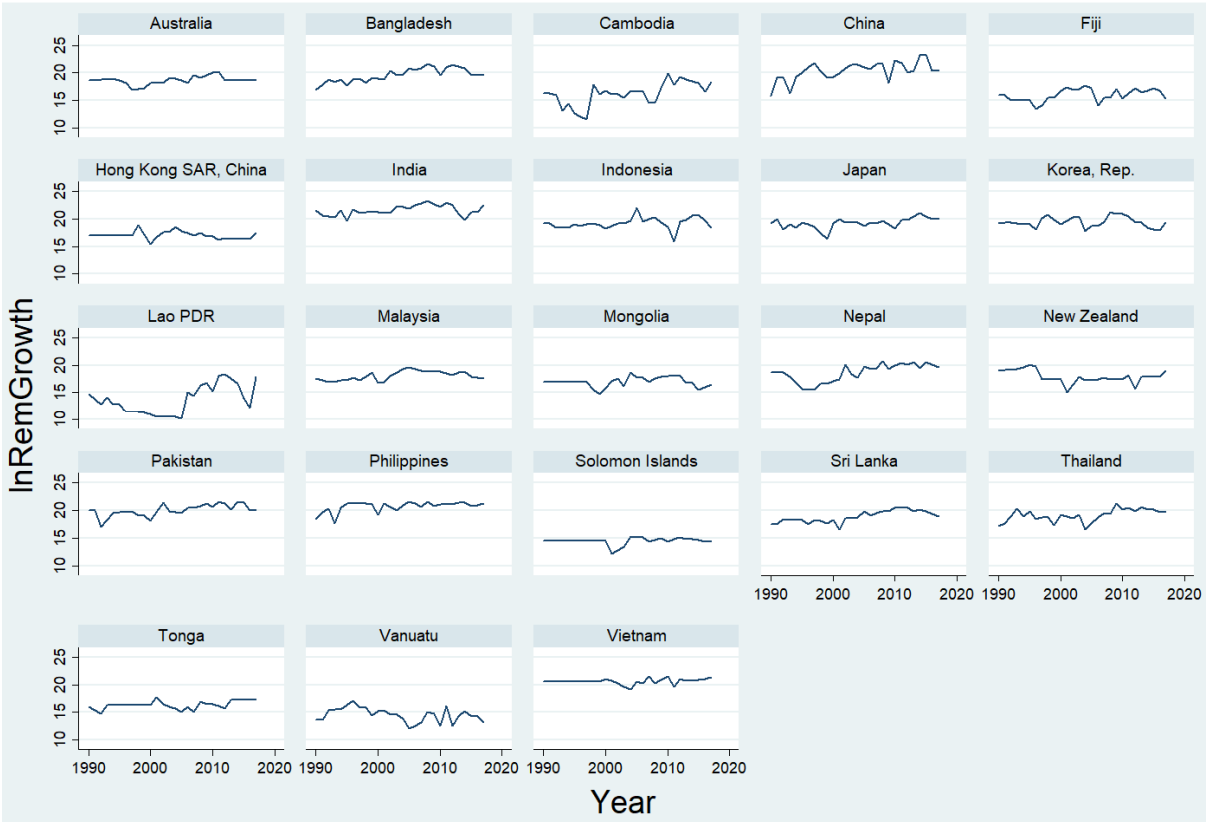
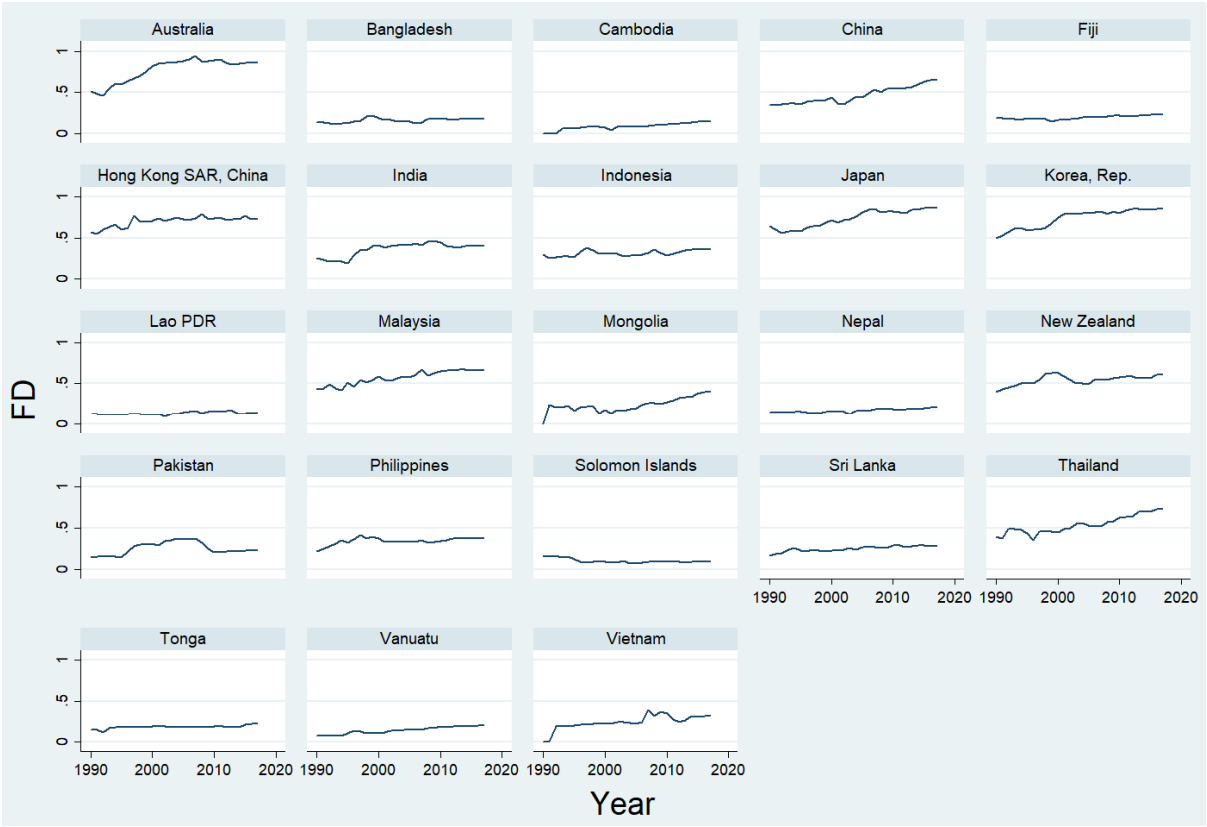
Appendix 1: Trends in Variables



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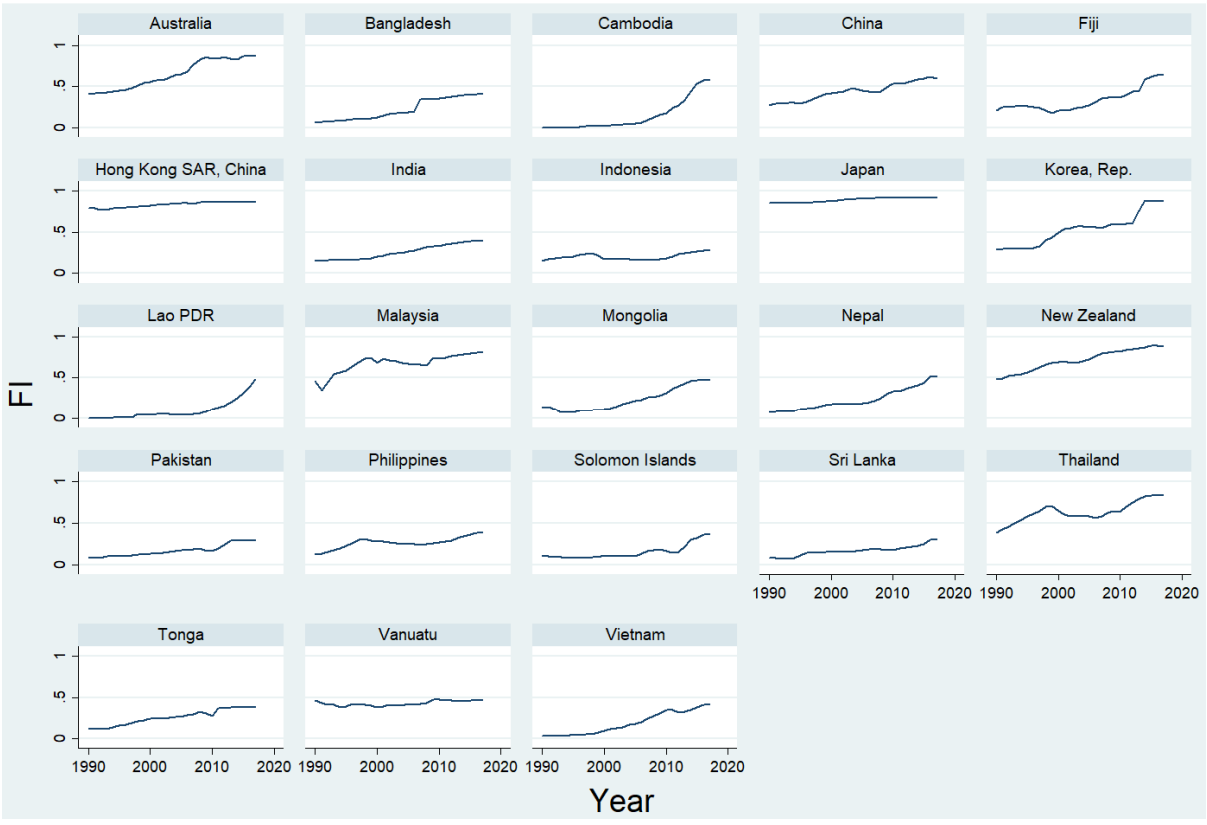
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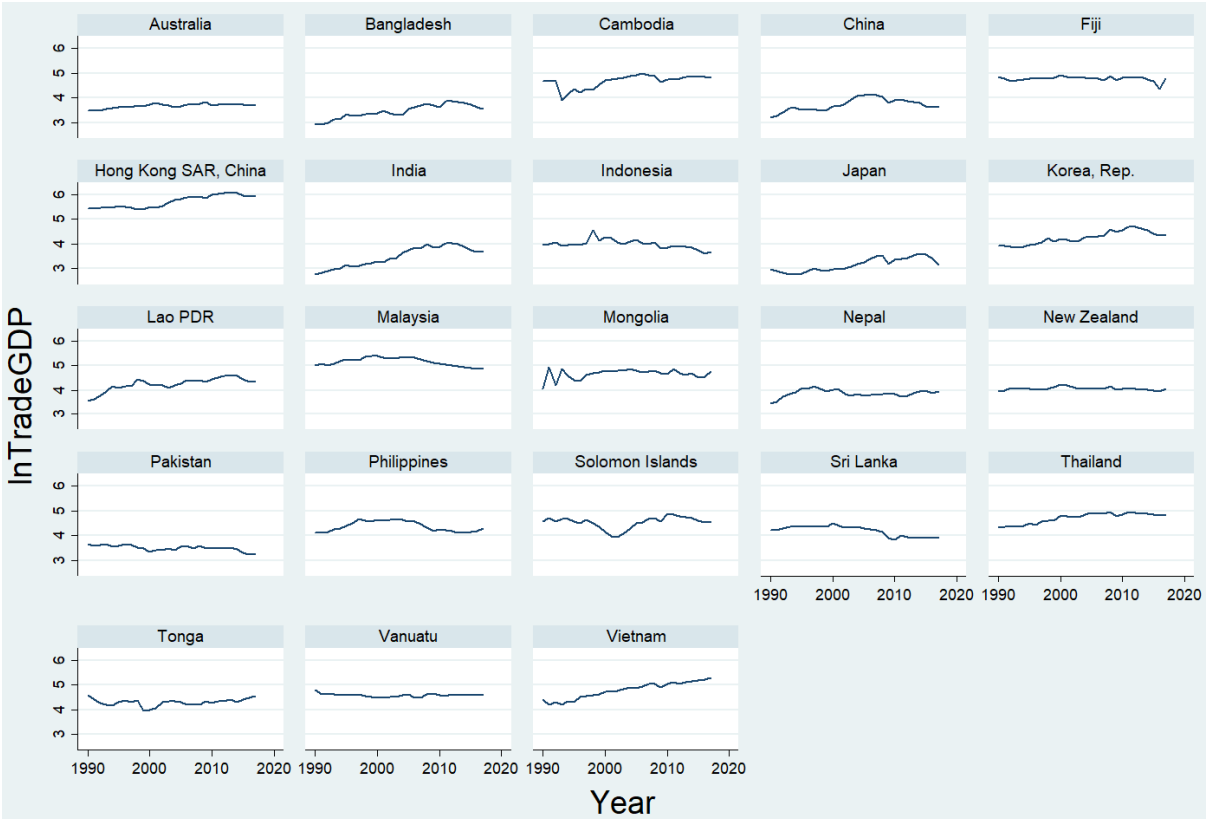
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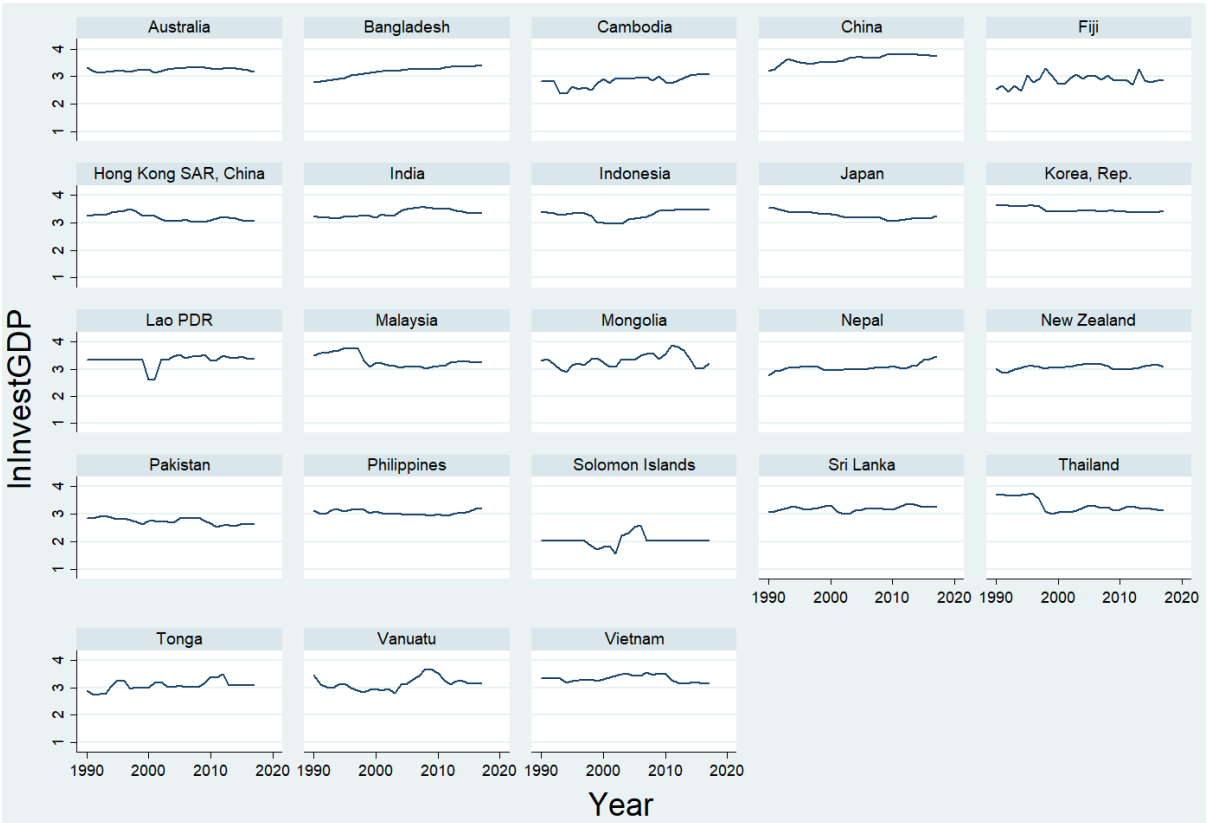
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Appendix 2: Unit Root Tests

Due to data availability, some of the tests on some variables are unable to perform (noted with N/A in the result table). With the statistically significant results for all variables except FI, the null hypothesis that these variables have unit roots is rejected.

Variable	Im, Pesaran and Shin W-test Ho: All panels contain unit roots Ha: Some panels are stationary		Fisher-ADF test Ho: All panels contain unit roots Ha: At least one panel is stationary		Fisher-PP test Ho: All panels contain unit roots Ha: At least one panel is stationary	
	No trend	With trend	No trend	With trend	No trend	With trend
lnΔGDP	N/A	N/A	5.1583***	15.5963***	24.1398***	49.9871***
lnΔRem	N/A	N/A	N/A	N/A	16.9706***	27.1955***
FD	-1.4227*	-3.8120***	6.1716***	8.7614***	1.2567	2.3860***
FI	6.4011	0.8543	-2.7504	1.3391*	-4.6378	-2.1278
lnTradeGDP	-4.0252***	0.1283	6.0631***	1.3886*	8.3516***	3.31***
lnInvestGDP	N/A	N/A	8.4701***	4.8264***	4.8849***	-0.1160
Note: All tests are done with lags(1). ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1						

Variable	Im, Pesaran and Shin W-test Ho: All panels contain unit roots Ha: Some panels are stationary		Fisher-ADF test Ho: All panels contain unit roots Ha: At least one panel is stationary		Fisher-PP test Ho: All panels contain unit roots Ha: At least one panel is stationary	
	No trend	With trend	No trend	With trend	No trend	With trend
ΔFI	-8.7055***	-6.8297***	18.2405***	13.7421***	28.1150***	21.9111***
Note: All tests are done with lags(1). ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1						

Appendix 3: Correlation Tests

Correlation tests are to test if the variables might suffer from multicollinearity, and hence might affect the regression test results. A correlation test result close to 0 shows a weak correlation whereas a test result close to 1 indicate a high correlation.

Observations: 376

	lnΔGDP	lnΔRem	FD	ΔFI	lnTradeGDP	lnInvestGDP
lnΔGDP	1.0000					
lnΔRem	0.6505	1.0000				
FD	0.6284	0.2839	1.0000			
ΔFI	0.0026	0.0315	0.0093	1.0000		
lnTradeGDP	-0.3109	-0.3296	0.0552	0.0568	1.0000	
lnInvestGDP	0.4510	0.2056	0.3337	0.1791	-0.0265	1.0000

Appendix 4: Diagnose Tests and Limitations

Diagnose tests for estimations with 23 APAC economies reported in Table 21

Regarding pooled OLS estimations, the multicollinearity VIF tests are performed for each estimations (1), (2) and (3). The results show that multicollinearity is not a problem in any estimations. However, the results from normality tests show that the residuals of all 3 estimations (1), (2) and (3) are not normally distributed. Besides, results from both Breusch-Pagan and White's tests indicates that all 3 estimations also suffer from heteroscedasticity problem.

Diagnose Tests for Pooled OLS Estimations (1), (2) and (3) reported in Table 21

	Normality tests		Heteroscedasticity tests	
	Skewness/Kurtosis chi2	Jarque-Bera chi2	Breusch-Pagan chi2	White's chi2
Estimation (1)	24.16***	27.77***	33.73***	47.60***
Estimation (2)	41.62***	66.30***	48.17***	58.44***
Estimation (3)	27.24***	32.65***	35.04***	58.97***
Note:, ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1				

Diagnose tests are also run to validate the FE Estimations (4), (5) and (6). According to (Baltagi, 2013, p. 10), a panel data with long time series (over 20 – 30 years) might suffer from cross-sectional dependence problem. Cross-sectional dependence can lead to bias in tests results. With a data set coverage of 28 years used in this study, a formal Pesaran cross-sectional dependence test needs to be performed as part of robustness checks. The results in table below show that no cross-sectional dependence is present in all 3 estimations (4), (5) and (6). A serial correlation test proposed by Drukker (2003) and Wooldridge (2002) is also performed as a long time series might also suffer from this problem. Serial correlation causes the standard errors of the coefficients to be smaller than they actually are and a higher R-squared. The null hypothesis of the test implies no first order autocorrelation. The results reject the null hypothesis of serial correlation in all 3 estimations. However, Wald's test for heteroskedasticity shows the presence of heteroskedasticity in all estimations (4), (5) and (6).

Diagnose Tests for FE Estimations (4), (5) and (6) reported in Table 21

	Pesaran's test of cross-sectional independence CD	Wooldridge test for autocorrelation F	Wald's test for heteroskedasticity chi2
Estimation (4)	-0.256	0.608	1000.39***
Estimation (5)	-0.196	0.432	817.16***
Estimation (6)	0.149	1.592	1081.74***
Note:, ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1			

Diagnose Tests for Estimations with 22 APAC Economies (excluding China) reported in Table 22

Robustness tests results for estimations without China are similar to the estimations with China. Multicollinearity is not a problem in any OLS estimations. Normality tests results show that the residuals of all 3 estimations (1), (2) and (3) are not normally distributed. Besides, results from both Breusch-Pagan and White's tests indicates that all 3 estimations also suffer from heteroscedasticity problem.

Diagnose Tests for Pooled OLS Estimations (1), (2) and (3) reported in Table 22 when China is excluded

	Normality tests		Heteroscedasticity tests	
	Skewness/Kurtosis chi2	Jarque-Bera chi2	Breusch-Pagan chi2	White's chi2
Estimation (1)	23.20***	26.15***	34.50***	44.63***
Estimation (2)	39.50***	63.52***	72.62***	58.78***
Estimation (3)	26.28***	30.83***	35.85***	53.74***
Note:, ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1				

Regarding FE estimations, no cross-sectional dependence is present in all 3 estimations (4), (5) and (6). The results in table below also reject the null hypothesis of serial correlation in all 3 estimations. However, heteroskedasticity is still present in all estimations (4), (5) and (6).

Diagnose Tests for FE Estimations (4), (5) and (6) reported in Table 22 when China is excluded

	Pesaran's test of cross-sectional independence CD	Wooldridge test for autocorrelation F	Wald's test for heteroskedasticity chi2
Estimation (4)	1.009	0.608	1010.49***
Estimation (5)	0.907	0.432	969.79***
Estimation (6)	1.344	1.592	1076.28***
Note:, ***, ** and * refer to significant level at p<0.01, p<0.05 and p<0.1			

Several attempts were employed to address this heteroskedasticity issue. To avoid improper model specifications, a few additional control variables to proxy other conditions in the countries such as education, population, and more economic indications were introduced. A one-year, two-year, three-year, four-year and five-year lag of economic growth, remittance, and of other control variables were also tested one by one to take into accounts the unobserved historical effects of these conditions into the countries. However, the heteroscedasticity problems were still present. Both "robust" and "vce" options in regression were also applied on Stata to address the standard errors issues of models being heteroskedasticity. The regressions assume that the errors of the specified models are independent and identically distributed while robust standard errors can relax either or both assumptions. So, when heteroskedasticity is present, robust standard errors tend to be more trustworthy. The use of weighted least squares was also exploited to deal with the heteroscedasticity issue. This is a technique that aims to yield estimators that are BLUE when heteroskedasticity is present and helps to minimize a weighted sum of squared residuals. However, heteroscedasticity still exists after the attempts.

It is important to note that the remittance data used in this research is not perfect even though it is from official data sources, ie. the World Bank. The data issues might be a reason leading to imperfect models fitting. The International Monetary Fund (IMF) (2009b) acknowledged the challenges in remittance data collection and published a comprehensive compilation guideline in 2009 to try to standardize the remittance data collection and reporting process by central banks. Moreover, till date, only the official data recorded by the Migration and Remittances Data of World Bank can be captured. The flow of remittances sent through informal channels, unregulated money transfers, or money sent in cash, remains unaccounted for. Freund and Spatafora (2005) estimated that the informal remittances amounted to about 35 – 75 percent of official remittances.

Even though World Bank data sets are rich in information, they also suffer from missing data for some countries and time periods for not only dependent, independent, but also control variables. Therefore, the number of observations for each variable varies and the regressions results may be sensitive to large outliers. The financial development indices data set computed and published by IMF (Svirydzenka, 2016) also suffers from the same problem of missing data for the indicators used to construct the final indices with only 41% available data. Also due to lack of data, the self-constructed financial inclusion indices could not take into accounts a few possibly relevant factors, and the final data set used to compute the indices has limited available data (62% availability). It is possible that these limitations make the financial development indices and self-constructed financial inclusion indices not reflect the best financial development and financial inclusion situations in the countries analysed, and hence, alongside with the remittance data issues, affect the final regression model specifications.