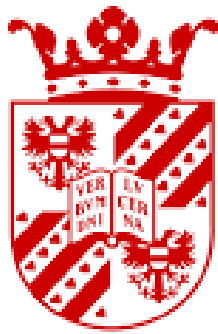


Financial technologies paving a bright new path for the world's unbanked population



**university of
 groningen**

FinTech play a pivotal role in facilitating access to financial products and services. At the moment, the country characteristics that facilitate the use of FinTech are not adequately identified in the literature. This paper attempts to contribute to the understanding of which country characteristics facilitate the use of FinTech and how FinTech can drive sustainable economic development. Based on a sample of 62 developing countries, the 3SLS regression results find a positive effect of the quality of infrastructure and business ecosystem on the use of FinTech. Moreover, the results provide support for a positive significant effect of use of FinTech on financial inclusion and of financial inclusion on sustainable economic development. These findings provide new insight into which country conditions influence the use of FinTech and how improvements in the use of FinTech do affect the level of sustainable economic development.

Field Key Words: financial technologies, financial inclusion, FinTech climate, sustainable economic development

JEL codes: O00, O10, O11, O16, O57

Joris J.A. Wolbers, s2107481

Supervisor: prof. dr. B.W. (Robert) Lensink

MSc International Financial Management - Faculty of Economics and Business

University of Groningen, December 15th, 2017

MSc Business Economics - Department of Business Studies

Uppsala University, December 15th, 2017

1. Introduction

Is it possible to wipe poverty from the face of the earth? This is a question everyone most probably has asked themselves sometime. In order to find an appropriate answer, the scope and role of the financial system, that promotes economic growth and reduces poverty, should be analyzed (Honohan, 2004). Currently, the financial system excludes two billion people from using financial products and services, whereby women, rural poor, small and medium-sized enterprises (SME's), and other hard-to-reach populations are overrepresented (Fuller and Mellor, 2008). This group of financially excluded people and companies has no access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance – delivered in a responsible and sustainable way. The absence of access to these financial products and services is constraining companies and individuals in many day-to-day activities (Dev, 2006). Moreover, a large share of the financially excluded population has developed a deep mistrust and suspicion about the financial system, which makes them reluctant to put effort in getting access to financial products and services (Claessens, 2006). In order to remove this mistrust and include all people in the financial system, the entire system should be fundamentally redesigned (World Bank, 2017a).

Having access to financial products and services facilitates day-to-day living and helps families and businesses plan for everything, from long-term goals to unexpected emergencies. On top of that, accountholders are more likely to use other financial services, such as credit and insurance, to start and expand businesses, invest in education or health, manage risk, and weather financial shocks (Worldbank, 2017a). In other words, financial access improves the overall quality of accountholders lives. Therefore, the World Bank Group and the International Financial Corporation consider financial inclusion as a key enabler to reduce extreme poverty and boost shared prosperity. Moreover, financial inclusion is seen as an enabler for sustainable grow in the long term and is likely to reduce income inequality (Sarma and Pais, 2011).

Recent empirical research of Allen et al. (2014) shows that population density plays an important role in explaining low financial inclusion levels in many developing countries. Presumably, bank branch penetration figures remain low in sparsely populated, low income areas, since there are difficulties in achieving minimum viable scale. Large physic distance to financial institutions is a major obstacle to gain access to financial products and services at affordable costs. Innovations in financial technologies (hereafter referred to as FinTech), such as internet banking, blockchain, P2P lending, and cloud computing are not subject to physic distance and could be accessed at lower cost. This enables users of financial services to be

located far away from financial institutions, providing a promising way to facilitate financial inclusion outside major cities in more rural areas where many people are financially excluded. The advent of FinTech has created a way for all entities to have access to all financial products and services at reasonable costs everywhere at any time (Arner, Barberis, and Buckley, 2015).

While the importance of FinTech for enabling access to financial institutions, especially in developing countries, is supported by the literature (Agrawal, 2008), the use of FinTech is dependent on the presence of appropriate country characteristics that facilitate the use of FinTech. For example, the absence of a stable electricity network or the presence of a conservative and bureaucratic business climate can preclude the use of FinTech. It is interesting to identify which countries have the appropriate characteristics that facilitate the use of FinTech, since FinTech helps financially excluded people to get access to financial products and services (Arner et al., 2015). To my knowledge, this paper is the first that researches which country characteristics are significantly associated with the use of FinTech. Moreover, this paper uses an index that measures the use of FinTech in general instead of focusing on one kind of FinTech to determine the relation between the use of FinTech and financial inclusion (Donovan, 2012). The positive association between financial inclusion and economic growth is widely recognized in the literature (Dev, 2006; Mbiti and Weil, 2011; Mohan, 2006). However, the literature on financial inclusion lacks a clear explanation on the relationship with sustainable economic development which measures the overall well-being in an economy. This research attempts to fill this gap by using a structural simultaneous equation model to investigate if the extent of supportiveness of a countries' FinTech Climate has a positive effect on the use of FinTech, measuring the relation between the use of FinTech and the level of financial inclusion, and testing if financial inclusion does increase sustainable economic development.

The main findings are as follows. The use of FinTech is significantly affected by the quality of infrastructure and a country's innovation and business environment, also known as their business ecosystem. This suggests that improvements in the infrastructure or business ecosystem of developing countries would result in a higher share of the population that uses FinTech. However, there is no evidence that a more stable government policy contributes to a higher use of FinTech, since this effect is insignificant. Regarding the use of FinTech, the results show that a higher use of FinTech has a significant positive effect on financial inclusion. This confirms the theory that FinTech can overcome cost and distance obstacles that are associated with the accessibility of financial products and services. Moreover, higher financial inclusion has a positive and significant effect on sustainable economic development. This result is in line

with the theory that financial inclusion improves social inclusion, consumption, and government investments.

This research contributes to the current literature in three ways. First, analyzing the supportiveness of a country's FinTech climate provides insights into the ease of implementing FinTech in that particular country. Easy implementers are countries with high scores on the quality of business ecosystem and infrastructure. These countries have the appropriate characteristics in order to use FinTech and are attractive for commercially-oriented FinTech companies that financially benefit by introducing FinTech in developing countries. The supportiveness of a country's FinTech climate could be used as a guideline for these FinTech companies to allocate their investments. Countries with lower scores on the quality of business ecosystem and infrastructure are less attractive for commercially-oriented companies since these countries do not have the appropriate characteristics to facilitate the use of FinTech. Moreover, the results can guide governments to invest in country characteristics that need specific investments in order to induce a process of FinTech investments. Second, the results confirm the importance of FinTech as a mechanism for developing countries to improve the level of sustainable economic development by means of enabling financially excluded people to access financial products and services. The positive significant relationship emphasizes that FinTech is a key enabler in reducing extreme poverty and boosts shared prosperity in developing countries. Third, this research also contributes in terms of methodology. To the best of my knowledge, this study is the first that estimates the relationships between country characteristics, the use of FinTech, financial inclusion, and sustainable economic growth with a structural simultaneous equation model.

The remainder of the paper is structured as follows. Section 2 gives an overview of the current literature about the effect of country characteristics on the use of FinTech, the association between the use of FinTech and financial inclusion, and the effect of financial inclusion on sustainable economic development. Section 3 describes the dataset and the variables that are used to test the hypotheses and Section 4 explains the methodology. Thereafter, the results are presented in section 5, and robustness tests are conducted in section 6. The conclusion, limitations and suggestions for further research are provided in section 7.

2. Literature review

Financial inclusion, having access to financial products and services at affordable prices, is a first step for the unbanked population to take charge of their lives by means of financial

planning and management. For many countries, improving financial inclusion is an important milestone on their road to economic development. Research by the World Bank Group, the IMF, the OECD, and private sector studies show that billions can be added to global GDP by financially including the unbanked population (Worldbank, 2017d). With the introduction of FinTech, such as mobile banking, alternative credit scoring, and identification technologies it is easier for the financial excluded population to overcome the obstacles that withhold them from access financial products and services. This emphasizes the importance for a country of having a supportive FinTech climate that consists of country characteristics that facilitate the use of FinTech.

2.1 Relation between a country's supportive FinTech climate and the use of FinTech

The speed and breadth of innovation in financial technologies is fascinating. However, these new possibilities create new expectations and new information needs. Essentially, countries must be able to adapt quickly to keep up with this rapid pace of new FinTech. In order to do so, countries need more insight regarding their FinTech Climate. Country characteristics that influence the use of FinTech help countries to understand which aspects are important. For example, China has a reliable electricity network, an innovative climate, and high mobile phone penetration. This might be important conditions for the use of mobile banking (Pousttchi and Schurig, 2004; Xu and Chen, 2006). The enormous unbanked population in India makes the urgency for mobile banking high as well there. However, the low level of internet penetration makes their FinTech climate less appropriate for the use of mobile banking. This example illustrates that countries have big difference in the supportiveness of their FinTech climate and that the current state of their climate influences the use of FinTech and the likelihood that new FinTech will successfully be enrolled and used (Buckley and Webster, 2016).

2.1.1. Governance policy

In order to have a supportive FinTech climate, governments must lead in creating the right political circumstances and steer the industry in the right direction in order to shape an innovative environment. Clear and stable political governance will give companies a reliable outlook for the future, which enhances growth rates (Barro, 1991). Countries that have achieved the most progress toward the introduction and use of FinTech have put in place an enabling regulatory and policy environment with little room for corruption. However, creating this stable and competitive climate has to be accompanied by appropriate consumer protection measures,

legal rights and regulations to ensure responsible provision of financial technologies. If the government has created a stable governance policy that consists of understandable and appropriate consumer rights, people trust the new technologies and are willing to use them (Pousttchi and Schurig, 2004).

H1a: Increasing the stability of governance policy will have a positive effect on the use of FinTech

2.1.2. Infrastructure

Besides a stable governance policy, countries should also supply the right infrastructure that facilitates the use of FinTech. Since many FinTech products and services make use of the electricity network, broad electricity availability and reliable networks are important indicators to forecast the use of FinTech. For example, an unreliable electricity supply in Africa, due to base stations that were powered by diesel generators, has slowed down the enrolment of FinTech and decreased the willingness among citizens to use FinTech (Alhborg and Hammar, 2011). Other important determinants that influence the quality of the infrastructure are the availability of the internet and mobile coverage. For example, mobile banking requires internet and mobile coverage in order to work in a sufficient way (Aker, and Mbiti, 2010). The quality of the infrastructure is especially important in countries with poor roads, vast distances and low population densities, since the large distance to financial institutions is a big obstacle in these countries for becoming financially included. The use of FinTech can mitigate this distance-obstacle (Mbiti, and Weil, 2011).

H1b: Increases in the quality of the infrastructure will have a positive effect on the use of FinTech

2.1.3. Business ecosystem

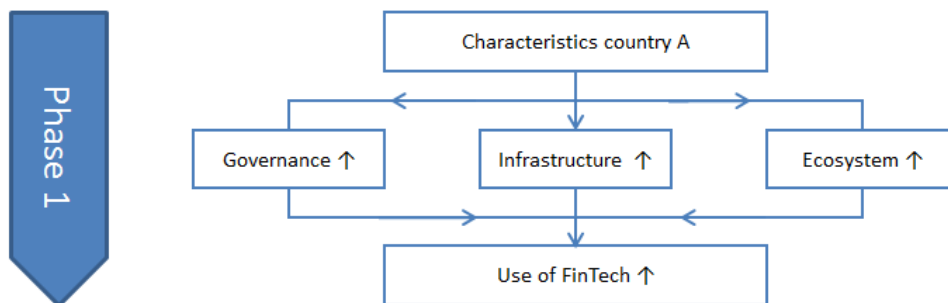
On top of the previously mentioned governance policy and infrastructure characteristics, there are also business ecosystem characteristics that assess a country's speed of innovation and business environment that could influence the use of FinTech. Business ecosystems that offer attractive conditions to (foreign) companies, could make the country an interesting investment opportunity for foreign firms. If a country has business friendly regulations that make the ease of doing business high in combination with an innovative culture, there is a higher likelihood that FinTech will be successfully introduced. Moreover, the time it takes to start a business is

an important determinant of the entrepreneurial climate and the likelihood that entrepreneurial companies are willing to develop and roll out (new) FinTech.

H1c: Increases in the quality of the business ecosystem will have a positive effect on the use of FinTech

The relations between the aforementioned country characteristics that determine the supportiveness of a country's FinTech climate and the use of FinTech are graphically illustrated in Figure 1.

Figure 1; Phase 1 illustrates how the country characteristics, that determine the supportiveness of a countries FinTech climate, influence the use of FinTech.



2.2 Relation between the use of FinTech and the level of financial inclusion

An article on the website of the Economist covering the impact of FinTech reported: “Proliferating mobile phones open another delivery channel for basic financial services to poor people” (Economist, 2017). Moreover, Paul Kagame, President of Rwanda, even called the mobile phone “a basic necessity in Africa” in an article on the website of the Africa Summit (Connect Africa Summit, 2007). These two statements underline the importance of the use of FinTech for a country's level of financial inclusion (Hannig and Jansen, 2010). Increases in the use of FinTech seem to have filled the void of the inaccessibility to financial products and services (Dapp, Slomka, and Hoffmann, 2014). FinTech attempts to bridge the gap and facilitate access to financial products and services for financially excluded people (Mbiti and Weil, 2011). Access to traditional bank locations for conducting transactions may come at high costs in terms of banking fees and travelling great distances. For groups that are relatively unbanked such as women, rural poor, and SME's, FinTech offers great opportunities to become financially included. Moreover, becoming financially included reduces the necessity to carry out transactions in cash or checks, which makes them less vulnerable to theft and street frauds (Blumenstock, Eagle and Fafchamps, 2011; Jack and Suri, 2011). On top of that, FinTech offers

financial excluded people great opportunities to become financially independent and manage shocks in income.

Agrawal (2008) and Mbiti and Weil (2011) explain the indicators that influence the accessibility of financial products and services and how this will be affected by FinTech. First, the physic distance to financial institutions becomes less important through the digitalization of products and services. Digitalization enables users to conduct payment transactions without being physically present. Second, accounts become accessible at affordable costs through the increased competition between banks and non-banks, and the replacement of manual operations by automatic operations. Moreover, lower costs reduce the minimum deposit requirements making saving accessible for people with small saving amounts. Third, the introduction of identification technologies that enables official registration for poor people has eased the access to formal financial institutions. These institutions always require documents of proof regarding a person's identity and income. People without these documents are generally excluded from financial products and services (Agrawal, 2008). Fourth, FinTech enables the collection and storage of a greater amount of customer data and thereby allows providers to design tailor made digital financial products and services that better fit the needs of financially excluded individuals (Jack, Suri and Townsend, 2010; Mbiti and Weill, 2011). Fifth, FinTech companies have come up with innovations that promote transparency in their dealing with customers. They designed easy to understand financial products and services in order to alleviate the deep mistrust about financial institutions, since this has impeded a big part of the financial excluded population to use financial products and services.

Empirical research on the impact of FinTech such as the global spread of internet- and mobile banking confirms the opportunity for financially excluded groups to become financial included. Aker et al. (2011), Mbiti and Weil (2011), and Morawczynski and Pickens (2009) found that these technologies not only support and facilitate money transfers between current accountholders and thereby allowing households to better manage shocks, but also increase the access to financial services for unbanked households and SME's at low cost and risk. In line with these findings, Mbiti and Weil (2011) concluded in their research that the universal adoption of M-Pesa, a digital money transfer system, would increase the proportion banked by 28 percentage points. Another example that confirms the positive effect of FinTech on financial inclusion is found in Mexico. The Mexican government implemented the digitalization of government to person (G2P) money transfers. As a result, over 6 million people who previously

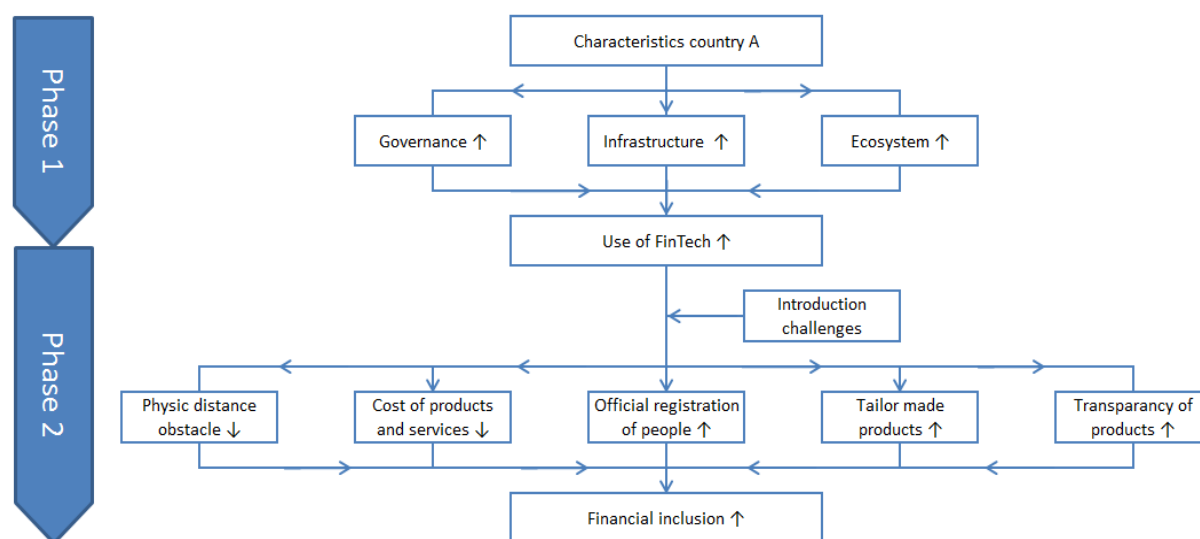
received their wages in cash are receiving their payments now on their (new) debit account and thereby avoid the risk of corruption and fraud (Klapper and Singer, 2014).

While there is widespread evidence of the importance of FinTech for financial inclusion, many FinTech innovations, such as mobile banking, present logistical, operational and security introduction challenges. These challenges can reduce the effectiveness of digital cash transfer programs compared with traditional types of banking (Aker et al., 2011).

The advent of FinTech has created a way for all people and enterprise to have access to financial products and services, and thereby disrupted the financial world by including participants in the money sector that were previously excluded. The developments that explain the relation between the use of FinTech and the level of financial inclusion are illustrated in Figure 2 and lead to the following hypothesis:

H2: An increase in the use of FinTech has a positive effect on the level of financial inclusion.

Figure 2: Phase 2 illustrates the indicators that describe the relation between use of FinTech and the level of financial inclusion.



2.3 Relation financial inclusion and sustainable economic development

The World Bank Group puts forward an ambitious global goal to bank all financial excluded people and companies to be able to reach universal financial access by 2020. This ambitious goal points financial inclusion as a priority for development agencies, regulators and policy makers globally. The World Bank Group considers financial inclusion a key enabler to

reduce extreme poverty and boost shared prosperity. In line with this statement, De Gregorio and Guidotti (1995) found that financial inclusion is positively correlated with long-run growth. Theoretically, financial inclusion creates enabling conditions for economic growth through supply-leading (financial inclusion spurs growth) and demand-following (growth generates demand for financial products) channels. A large body of empirical research supports the view that better access to financial products and services contributes to economic growth (Banerjee and Newman, 1993; Banerjee, 2004; Burgess and Pande, 2005; Levine, 2005; Rajan and Zingales, 2003). At the cross-country level, these findings confirm that various measures of financial inclusion are robustly and positively related to economic growth (King and Levine, 1993; Levine and Zervos, 1998). Moreover, Kind and Levine (1993), Kpodar and Andrianaivo (2011), and Levine (1996) confirm the supply-leading effect that finance ‘leads’ economic growth.

The reduction in credit constrained individuals and SME’s, facilitated by higher financial inclusion, spurs the GDP through two channels. The first one is an increase in private investments. FinTech facilitates an efficient allocation of productive resources and activities, thereby increasing the financing of productive resources and reducing the financing through exploitative and less secure informal sources of credit (Mohan, 2006). On top of that, access to appropriate financial products improves the day-to-day management of capital and reduces the risk associated with financial shocks. This enables firms to finance their investments more easily (De Weerd and Dercon, 2006). Second, since micro-enterprises would become more active in the trade sector there are potential effects for net exports as well. Companies might increase the export of natural resources, handmade items or agricultural products to foreign buyers (From, 1978). The export of products might be necessary to sustain the higher level of production. These two channels create new jobs to address the demand for local products and expansive investments, thereby creating income-generating opportunities in rural areas.

Increased investments and higher exports are likely to improve the labor market when companies grow their business. Being employed can provide (higher) income stability needed by poor households, and likely results in increased consumption. Employment would also help poor households to reduce the threat of becoming social excluded, a threat that many unemployed people face. Moreover, employment offers them an opportunity to acquire skills and attend trainings that will improve their future income potential. Higher job creation in the labor market and increased business activities will increase the government’s tax income and potentially leads to higher government expenditures. The government could also benefit from

the increased transparency of payments facilitated by FinTech. Digitalization and automation of transactions reduce the need for cash payments and can improve the monitoring of cash flows. This increased transparency about income streams will lead to higher tax revenues. As a result, increases in national income are expected to improve consumer and producer confidence and trigger new rounds of investments. As such, introducing FinTech could be the start of a vicious cycle of economic growth.

However, economic growth is not an all-inclusive measurement of the well-being in a country, since it does not describe social features or the sustainability of the realized economic growth. In India for example, there is reason to believe that the amount of people that live below the poverty line has hardly decreased, despite high economic growth rates of around 8% per year (Raghbendra, 2002). Moreover, if short run growth has been realized at the expense of environmental resource depletion, this growth might be reached at the expense of long run economic growth (Chambers, 1986). On top of that, most low income countries are even poorer than their GDP per capita suggest, because of a combination of enormous income inequality and shorter life expectation. In these countries, the inequality in welfare is even larger than the income inequality (Jones and Klenow, 2010). Therefore, it is important to not only ascertain economic growth, measured by GDP per capita, but also consider for example income inequality and sustainability (Mohan, 2006). Increasing recognition that the overall goals of environmental conservation, reducing income inequality and economic development are not conflicting but can be mutually reinforcing, has prompted calls for sustainable economic development (Barbier, 1987).

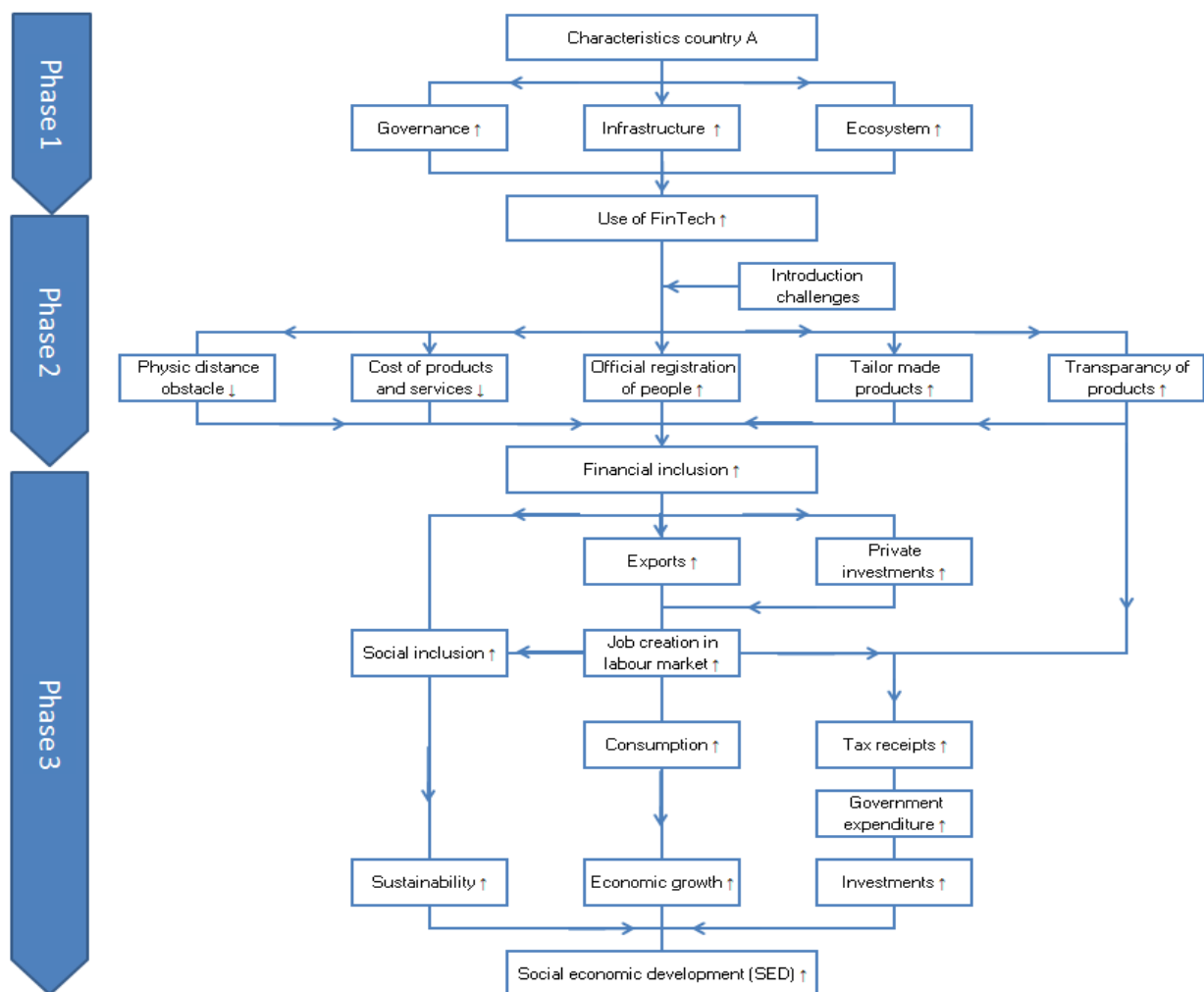
Research of The Boston Consulting Group supported the notion that financial inclusion is also beneficial for sustainable economic development (bcgperspectives, 2017a). A significant relationship is found between financial inclusion and sustainable economic development, even when controlling for income level. This indicates that amongst countries with the same income level, those with higher levels of financial inclusion are likely to have higher levels of sustainable economic development. The logical explanation for the above mentioned, is that financial inclusion is linked to many aspects of sustainable economic development that have little to do with income, such as social inclusion or government investments in a country. For example, holding an account at a financial institution generally causes people to physically hold less cash money, which in turn reduces exposure to robbery and violence. As a result, financial inclusion will have a positive influence on personal safety, which is a measure of social inclusion. Moreover, especially for these hard to reach communities such as rural areas and

low-income households, becoming employed results in more social contacts during the day and more financial freedom to attend social activities. On top of that, a bank account can give some independence to woman by giving them control over their own money, improving women's rights and opportunities.

The channels that influence the relation between financial inclusion and sustainable economic development are graphical illustrated in Figure 3 and lead to the development of the following hypothesis:

H3: An increase in the level of financial inclusion will have a positive effect on the level of sustainable economic development

Figure 3: Phase 3 illustrates how an increase in financial inclusion of a country will lead to an increase in social economic development of that country.



3. Data

Based on the data availability of indicators that determine a countries' FinTech climate, 96 countries are selected from the website of the World Bank (Worldbank, 2017). However, for 14 of these 96 countries there is no data available on the use of FinTech, for four countries there is no data available on the level of financial inclusion and for 11 countries there is no data available to determine the sustainable economic development level. Moreover, five non-developing countries are left out since the focus of this research is on the developing world. Therefore, the sample size of the final data set that is used to test the hypotheses consists of 62 countries (see Appendix 1 and 2). The summarized descriptive statistics about income level and region are displayed in Table 1.

Table 1: Shows the income levels and regions of the sample population that consists of 62 countries

Income level	%	# Countries	Region	%	# Countries
Upper-middle income	37	23	South East Asia	19	12
Lower-middle income	44	27	Latin America & Caribbean	23	14
Low income	19	12	Europe & Central Asia	21	13
			Africa	37	23
		<hr/> 62			<hr/> 62

Because of limited longitudinal data availability, for example the indicators that describe the use of FinTech are only available at one point in time, this research focuses on performing cross-sectional data analyses whereby the data from 2014 is used. Putting this together, the dataset will provide one observation per country for all the variables in our regression analysis.

3.1 Indicators for supportiveness of the FinTech Climate:

The use of FinTech in a country is expected to be determined by the supportiveness of a country's FinTech Climate. In order to determine the supportiveness of a country's FinTech climate, the supply of a high quality and widely spread infrastructure, the supply of an appropriate business ecosystem that assesses countries' innovation and business environment, and the presence of stable governance policy resulting in a low risk investment climate are investigated. The indicators that determine the supply of a high quality and widely spread FinTech infrastructure are described and explained in Table 2.

Table 2: Description of indicators that determine the quality of a country's infrastructure.

Indicator and description	Relationship	Source
Mobile subscription density: subscription per 100 inhabitants	Positive	World Bank, 2017e
Internet penetration: percentage of inhabitants using internet	Positive	World Bank, 2017f
Electricity coverage: share of population connected to the electricity grid	Positive	World Bank, 2017g
Electricity reliability: number of electrical outages in a month	Negative	World Enterprise Survey, World Bank, 2017a

The supply of an appropriate FinTech business ecosystem is measured by the following indicators that are specified in Table 3.

Table 3: Description of indicators that determine the quality of a country's business ecosystem.

Indicator and description	Relationship	Source
Time to start a business: time to start a business (number of days)	Negative	World Bank, 2017h
Innovation: index	Positive	Global Innovation Index, 2017
Ease of doing business: index (lower number is more ease)	Negative	World Bank, 2017i

The stability of a governance policy that determines the risk of a country's investment climate is measured by a country's political stability, the likelihood of corruption, and the strength of legal rights. These indicators are described in Table 4.

Table 4: Description of indicators that determine the stability of a country's governance policy.

Indicator and description	Relationship	Source
Political stability: index	Positive	World Bank, WGI, 2017
Control of corruption: index	Positive	World Bank, WGI, 2017
Strength of legal rights: index	Positive	World Bank Data, 2017c

3.1.1 Construction of sub-indices

In order to combine the mentioned variables in the three sub-indices that determine the supportiveness of the FinTech climate, all values are standardized. Standardization is necessary to compare indicators with different scales. In this research standardization is preferred over normalization, since the data range is disproportionate spread. In case of normalization, the ‘outliers’ will scale the ‘normal’ data to a very small interval, making normalization less suitable in this dataset. Standardization is conducted through the following formula:

$$1) X_{standardized} = \frac{X-\mu}{\sigma},$$

for all variables for which a higher value leads to a positive outcome, and

$$2) X_{standardized} = \frac{X-\mu}{\sigma} * -1,$$

for all variables for which a lower value leads to a positive outcome. Hereafter, the standardized variables are aggregated per indicator by means of an unweighted average, whereby a higher score indicates a more supportive FinTech climate for that particular indicator. The aggregation of the variables per indicator is relevant, because the aim is not to argue that a specific variable of an indicator is more relevant than another. The indicator scores provide country specific information about how supportive their characteristics in that specific area are in order to facilitate the use of FinTech.

Figure 4, 5 and 6 display the association between the indicators of the supportiveness of the FinTech climate and use of FinTech. These show that higher scores on stable governance policy, quality of infrastructure, and quality of business ecosystem are expected to increase the use of FinTech. Based on these expected associations, improving the supportiveness of a countries’ FinTech climate should lead to a higher use of FinTech. Analyzing the indicator scores of different countries helps FinTech investors to find countries with high scores whereby the likelihood is high that FinTech investments will result in an increased use of FinTech. On top of that, it helps identifying the strong and weak spots of every country’s characteristics in order to facilitate the use of FinTech.

Figure 4: Scatterplot of the association between a countries' infrastructure quality and the use of FinTech. The scatterplot shows a positive association between both.

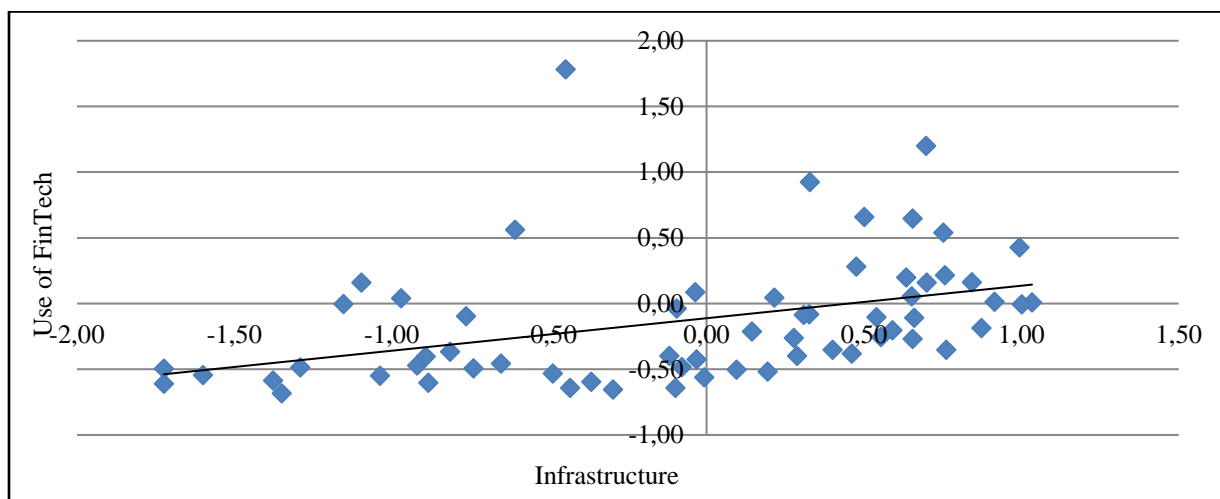


Figure 5: Scatterplot of the association between a countries' business ecosystem quality and the use of FinTech. The scatterplot shows a positive association between both.

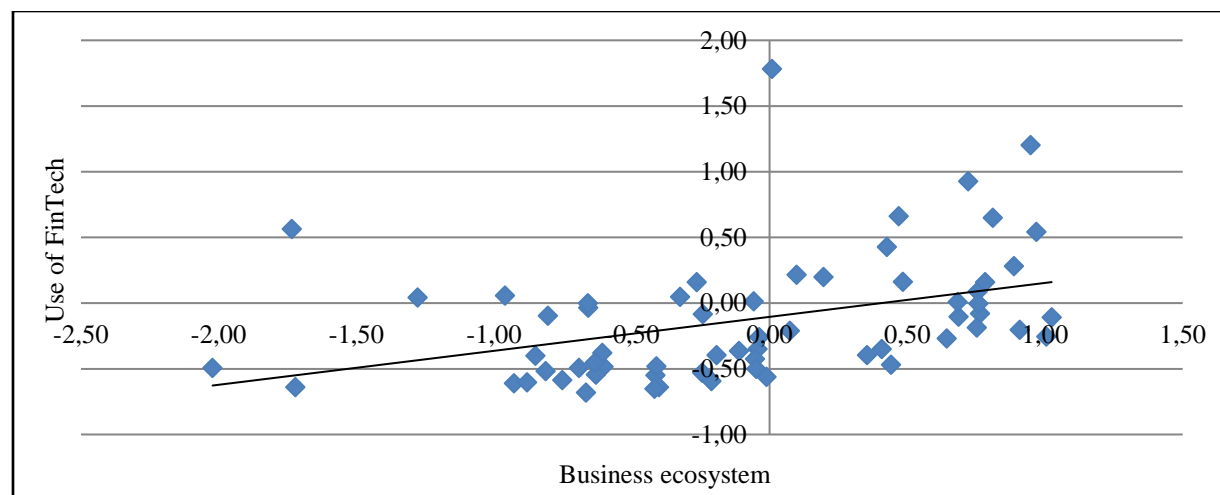
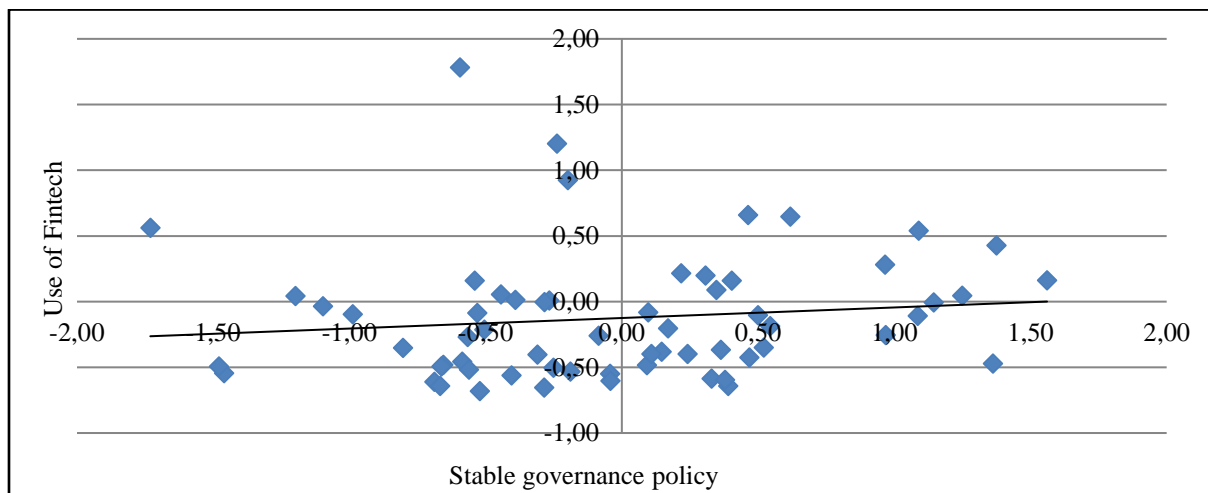


Figure 6: Scatterplot of the association between a countries' governance policy stability and the use of FinTech. The scatterplot shows a positive association between both.



Several notes should be made regarding the interpretation of these indicators. First, the indicators measure relative performance of countries and not absolute values. Second, high scores do not indicate that all problems are solved. For example, several countries have a high control of corruption, however this does not mean that there is no corruption at all in these countries. Third, the indicators use proxy variables that do not tell the full story. For example, internet coverage in terms of share of population gives an indication about the accessibility of internet for the entire population. However, this does not tell anything about the quality of this coverage.

3.2 Use of FinTech

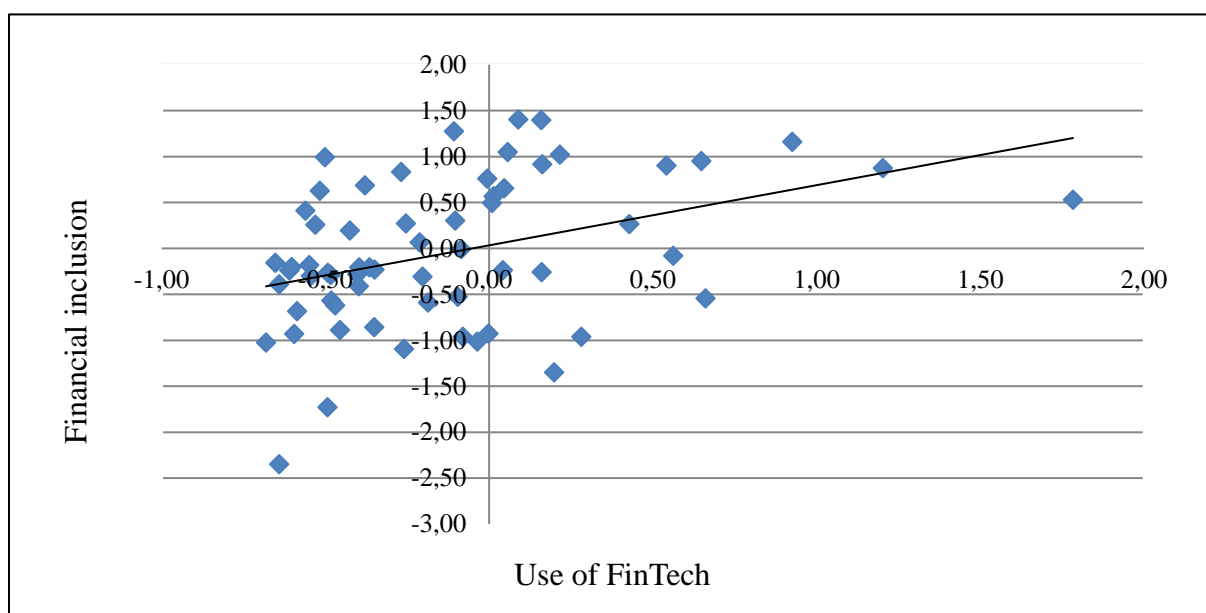
To determine the extent of FinTech use in a country, an index of three indicators is used (Chishti and Barberis, 2016; Allen et al., 2014). The first indicator is mobile banking penetration which is determined by the percentage of age 15+ population that uses their mobile phone for 1) sending money, 2) receiving money, or 3) paying bills. These three variables are highly correlated as can be seen in Table 5. Therefore, Principal Component Analysis (PCA) is conducted to determine the principal component that determine the value of the first indicator (Dunteman, 1989). This methodology constructs uncorrelated principal components that measure the same underlying principles as the three variables do. Consequently, the results of a regression analysis whereby a principal component replaces the correlating indicators as independent variables could be used without potential multicollinearity problems. The data that determines the first indicator is obtained from the Global Financial Inclusion Database (Worldbank, 2017d). The second indicator to determine the use of FinTech is the percentage of the population that is registered, resulting in having a legal identity according to identification technology ID4D (Data.worldbank, 2017a). The third indicator is the percentage of age 15+ people that used the internet to manage their financials by means of saving and borrowing money (Data.worldbank, 2017b).

Table 5: Correlation table between the factors that determine the mobile banking penetration.

	Mobile banking - Pay bills	Mobile banking - Receive money	Mobile banking - Send money
Mobile banking - Pay bills	1		
Mobile banking - Receive money	0,55	1	
Mobile banking - Send money	0,50	0,98	1

These three indicators are aggregated in an index called ‘use of FinTech’ by means of unweighted averaging. This aggregation is relevant since this research measures the influence of country characteristics on the use of FinTech and the influence of the use of FinTech on financial inclusion, instead of testing these relationships with one specific form of FinTech. Based on the theory described in section 2, the use of FinTech is expected to have a positive effect on the level of financial inclusion. This association is displayed in Figure 7.

Figure 7: Scatterplot of the association between countries’ use of FinTech and the level of financial inclusion. The scatterplot shows a positive association between both.

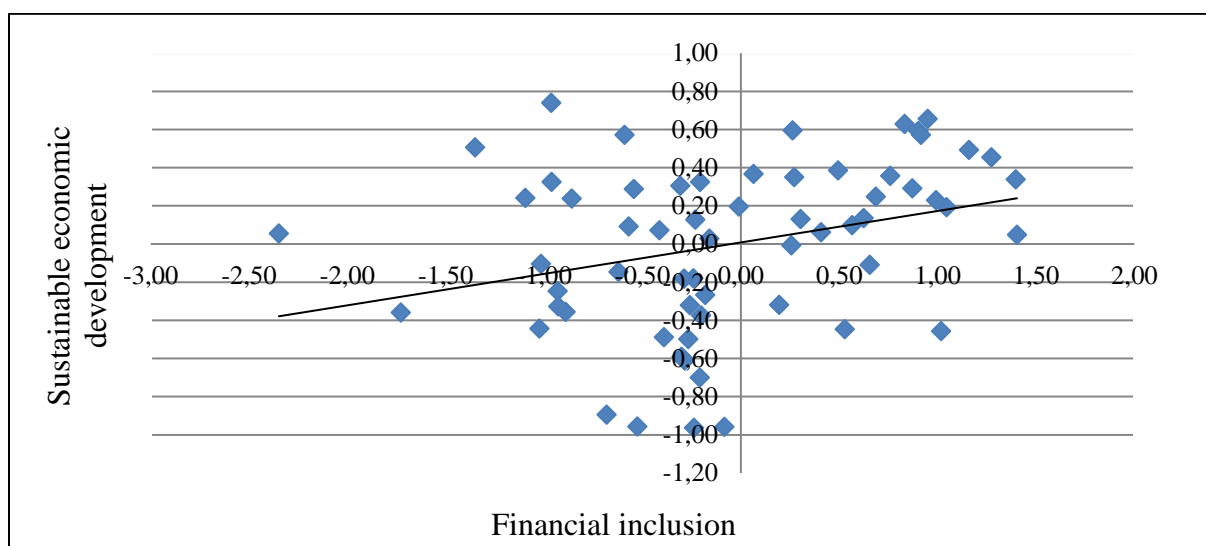


3.3 Financial inclusion measures

The paper of Demirgüç-Kunt and Klapper (2012) provides the first analysis of the Global Financial Inclusion Database. This is a set of indicators that measure how adults (age 15+) in almost 150 economies around the world, borrow, save, manage risk, and make payments. The data show that the account penetration varies widely across countries, but also across income groups and regions. Although the use of accounts is common for most of us, there are two billion people unbanked around the world and face barriers as high costs, physical distance, and lack of proper documentation to be able to get an account at a financial institution. In comparable research, such as Allen et al. (2014), the most common measure for financial inclusion is the percentage of adults (age 15+) that have an account at a bank, credit union, or other financial institution such as microfinance or the post office (Worldbank, 2017d). The Global Financial Inclusion Database covers the years 2011 and 2014, and most recent data is used.

Besides the former mentioned measure, a second variable is used for determining the level of financial inclusion in a country. This variable is the % of SMEs with an account at a financial institution. This data is obtained from the World Bank Enterprises Survey website (Enterprisesurveys, 2017b). Both indicators are aggregated by means of unweighted averaging. According to the literature in Section 2, the level of financial inclusion is expected to have a positive effect on sustainable economic development. The association between these two variables is displayed in Figure 8.

Figure 8: Scatterplot of the association between the level of financial inclusion and the level of sustainable economic development in countries. The scatterplot shows a positive association between both.



3.4 Sustainable economic development

Leaders around the world increasingly recognize that GDP per capita alone does not give a full picture of a country's performance. The well-being of citizens is a more comprehensive measure than rather focusing on GDP per capita alone. Sustainable economic development (SED) offers an objective measure of the relative standards of well-being experienced by people in countries around the world. SED defines overall well-being by examining 3 elements based on 10 dimensions.

The first element in assessing SED is a country's economics. This element gauges how a country is performing in terms of generating balanced growth. It provides a basis for a country to have the resources in order to facilitate in the other two elements. The Economic element is measured according to the dimensions described in Table 6.

Table 6: Describes the dimensions that influence the ‘Economic element’ of sustainable economic development. The indicators of these dimensions and their sources are described as well.

Dimensions	Indicators	Sources
Income	GDP per capita, purchasing-power parity	World Bank, World DataBank; International Monetary Fund, World Economic Outlook database
Economic stability	Inflation, average consumer prices	International Monetary Fund, World Economic Outlook database
	Inflation-rate volatility	International Monetary Fund, World Economic Outlook database
	GDP per capita growth volatility	World Bank, World DataBank
Employment	Unemployment, total (% total labor force)	World Bank, World DataBank; International Monetary Fund, World Economic Outlook database
	Employment rate, population ages 15-64 (%)	World Bank, World DataBank; BCG analysis

The second element in assessing SED are a country’s investments. Short and long term investments drives improvements in both economic growth and well-being overtime. Investments are measured according to the dimensions described in Table 7.

Table 7: Describes the dimensions that influence the ‘Investments element’ of sustainable economic development. The indicators of these dimensions and their sources are described as well.

Dimensions	Indicators	Primary data sources
Health	Life expectancy at birth, total (years)	World Bank, World DataBank
	Mortality rate, under age 5 (per 1000 live births)	World Bank, World DataBank
	Prevalence of HIV, % total population aged 15-49	World Bank, World DataBank
	Prevalence of undernourishment (% of population)	World Bank, World DataBank
Education	School enrollment, tertiary (% gross)	World Bank, World DataBank
	Teacher-to-pupil ratio, primary	World Bank, World DataBank
Infrastructure	Quality of roads network (1-7)	World Economic Forum Global Competitiveness reports

Quality of railroads infrastructure (1-7)	World Economic Forum Global Competitiveness reports
Improved water source (% of population with access)	World Bank, World DataBank
Improved sanitation facilities (% of population with access)	World Bank, World DataBank

The third element in assessing SED is a country's sustainability. Sustainability is defined broadly to encompass social inclusion and the environment. It is measured according to the dimensions described in Table 8.

Table 8: Describes the dimensions that influence the 'Sustainability element' of sustainable economic development. The indicators of these dimensions and their sources are described as well.

Dimensions	Indicators	Primary data sources
Income equality	Gini index (0-100)	World Bank, World DataBank; Eurostat
Civil society	Level of civic activism (0-1)	Indices of Social Development
	Interpersonal safety and trust index (0-1)	Indices of Social Development
	Intergroup cohesion measure (0-1)	Indices of Social Development
	Level of gender equality (0-1)	Indices of Social Development
Governance	Rule of law (-2,5 to 2,5)	Worldwide Governance Indicators
	Voice and accountability (-2,5 to 2,5)	Worldwide Governance Indicators
	Press freedom (0-100)	Freedom house, Freedom of the Press
	Property rights (0-100)	Heritage Foundation, Index of Economic Freedom
Environment	Air pollution, effect on human health (0-100)	Environmental Performance Index (Yale University)
	Carbon dioxide intensity (kg per kg of oil-equivalent energy use)	World Bank, World DataBank
	Terrestrial and marine protected areas (% total territorial area)	World Bank, World DataBank

As a result of differences in scale used in the original sources, we needed to create a comparable scale for the data before calculating the dimensions of SED. Therefore, the individual variables are standardized, with zero mean and standard deviation one, as described

in Section 3.1.1. As a result, SED scores for a particular country – whether overall or for any dimension – are always relative scores to those of other countries. Hereafter, the standardized elements are aggregate by means of unweighted average into one index that measures the SED of a country. Table 9 presents an overview of the correlation between the dimensions of SED and GDP per capita. GDP per capita is a measure of economic growth and is used in various other studies to define a country’s development (Mankiw, Romer and Weil, 1992). The correlation of the SED elements with GDP are positive and moderately strong indicating that the elements of SED determine a countries development in another way than GDP per capita does. Appendix 3 contains an overview of the scores on the elements and their unweighted average SED score, of every country in the sample.

Table 9: Correlation table between the elements that determine the level of sustainable economic development and GDP which measures economic development.

	Economic	Investments	Sustainability	GDP
Economic	1			
Investments	0.29	1		
Sustainability	0.35	0.72	1	
GDP	0.74	0.48	0.34	1

3.5 Control variables

The associations between the control variables and the dependent variables are described below per dependent variable. The measurement and data sources of these variables are described in Appendix 4.

3.5.1 Control variables use of FinTech

In determining the control variables to include for determining the use of FinTech, this paper relies on exogenous variables that describe the ability of the population to understand financial products and be willing to use new FinTech.

Education: primary school enrolment provides people with the basics of reading, writing and mathematical skills, which have a positive effect on financial management. This knowledge enables people to manage their own financials by means of FinTech (Boissiere, 2004).

Age 15-65: large population share between age 15 and 65 is expected to have a positive effect on the use of FinTech. Morris and Venkatish (2000) find that age does have important influence on the adoption and use of technology. Older people are less willing to adopt new technologies, and people below age 15 generally do not use FinTech.

3.5.2 Control variables financial inclusion

In determining control variables for the level of financial inclusion, the research focuses on the variables that influence the accessibility of financial products and services.

Rural population: living in rural areas often results in great physical distance to banks. Travelling such distance is costly and time-consuming, and therefore is likely to result in financial exclusion (Allen et al., 2014; Scott et al., 2001).

Literacy rate: increasing citizens' (financial) literacy enables them to independently understand and manage financials. Therefore, literacy is likely to have a positive influence on the amount of people that trust financial institutions and are willing to create an account at a financial institution (Chithra and Selvam, 2013; Hogarth and Hilgert, 2002).

Population density: in high population density regions is it easier to achieve minimum viable scale in order to start financial institutions. Higher population density will increase scale effects and make the region area more attractive for financial institutions leading to higher financial inclusion (Kumar, 2013).

3.5.3 Control variables sustainable economic development

Control variables to investigate the effect of financial inclusion on sustainable economic development are based on exogenous variables that describe the environment and macroeconomic variables.

Geography: include (the scaled absolute value of) latitude, because temperature zones further away from the equator have more productive agriculture and healthier climates, enabling them to develop their economy as well (Landes, 1998).

Government expenditure: high government expenditure should improve sustainable economic development since the government provides services and products that are accessible for everyone. Access to more services and products such as health care and education will increase life standards of citizens and thereby improving sustainable economic development (Williamson, 2009).

Environmental policy protection: Measures the extent NGO's influence the policy of companies, institutions and governance regarding the protection of the environment in a country. More influence of these organizations is expected to result in an increase in the government policy sustainability (Baumol and Oates, 1988).

4. Research methodology

As Section 2 describes, this study measures the supportiveness of developing countries' FinTech climate based on several indicators. A cross-country regression analysis is used to examine whether the indicators of the supportiveness of a countries' FinTech Climate have a positive effect on the use of FinTech. Hereafter, the use of FinTech is tested to have a positive effect on the level of financial inclusion, which is expected to have a positive influence on a country's sustainable economic development. All results are controlled for several variables that are described in Section 3.5. These tests help to clarify if a higher use of FinTech is expected to lead to higher sustainable economic development, and which country characteristics facilitate the use of FinTech.

To test the first hypotheses from the literature and examine if the supportiveness of a country's FinTech Climate influences the use of FinTech in that country, all three indicators of a country's supportive climate are separately included in the equation, instead of one overall variable that measures a country's supportive climate. This is necessary to specific which country characteristics do have a significant effect on the use of FinTech and which not. The control variables education and age 15-65 are added;

$$\begin{aligned} 3) \quad Y_{use\ of\ FinTech} \\ = \alpha + \beta_1 Governance\ policy + \beta_2 Infrastructure \\ + \beta_3 Business\ ecosystem + \beta_4 Education + \beta_5 Age\ 15 - 65 + \varepsilon_i. \end{aligned}$$

Hereafter, the second hypothesis, the exogenous effect of changes in the use of FinTech on the level of financial inclusion, is tested. The control variables rural areas, literacy rate, and population density are added. This leads to the following structural equation;

$$\begin{aligned} 4) \quad Y_{Financial\ inclusion} \\ = \alpha + \beta_1 Use\ of\ FinTech + \beta_2 Rural\ areas + \beta_3 Literacy\ rate \\ + \beta_4 Population\ density + \varepsilon_i. \end{aligned}$$

Lastly, the third hypothesis, the exogenous effect of changes in the level of financial inclusion on the level of sustainable economic development, is tested. The control variables geography, government expenditure, and environmental policy protection are added. This leads to the following structural equation;

$$\begin{aligned}
5) \ Y_{\text{sustainable financial development}} &= \alpha + \beta_1 \text{Financial inclusion} + \beta_2 \text{Geography} \\
&+ \beta_3 \text{Government expenditure} + \beta_4 \text{Environmental policy protection} \\
&+ \varepsilon_i.
\end{aligned}$$

Awareness is required for the fact that the variables use of FinTech in the second equation and financial inclusion in the third equation are endogenous. This indicates that these variables might be correlated with the error term (Covariance (Use of Fintech, ε_i) $\neq 0$ and Covariance (Financial inclusion, ε_i) $\neq 0$). In these cases, for example higher use of FinTech has two effects on financial inclusion. There is a direct effect between use of FinTech and financial inclusion, and an indirect effect via ε_i . Changes in the value of ε_i affect the use of FinTech, which in turn affects the level of financial inclusion. To test the second and third hypothesis, the regression analysis should only estimate the direct effect.

Therefore, equation 3, 4, and 5 are estimated as a simultaneous system with use of Three Stage Least Squares (3SLS) regression analysis. Estimating the equations individually, despite their endogenous variables, would lead to biased results. In order to calculate the structural form coefficients of the simultaneous system, there should be enough information in the reduced form equations. This implies that all structural equations of the system should be identified. To determine this, the ‘order condition’ should be satisfied (Brooks, 2008). Table 10 gives an overview of the system of equations corresponding to the expected relationships between endogenous and exogenous variables from the literature. The ‘order condition’ states that an equation is identified if the number of all exogenous and endogenous variables that are not present in the particular equation are equal to $G - 1$. Whereby G is the number of structural equations in the system (Brooks, 2008). Table 10 shows that all equations in the system are overidentified, since in every equation more than $G - 1$ variables are absent.

In the first stage, 3SLS conducts a regular OLS whereby instrumental variables (IVs) create a new estimated value for the endogenous variables. In the second stage, the model-estimated value from stage one replaces the endogenous variables, to compute an OLS model for the dependent variables. In the third stage, feasible generalized least squares regression is applied to the equations in the system in a manner analogous to the seemingly unrelated regression (SUR) estimator. Hereby, the correlation between the error terms across the structural equations are taken into account. This is asymptotically more efficient than 2SLS, since the latter ignores the information that may be available concerning the error covariances (Brooks, 2008).

Table 10: Presents an overview of the simultaneous equation system and the endogenous and exogenous variables of each equation of the simultaneous system.

$Y_{Use\ of\ FinTech} = \alpha + \beta_1 Governance\ policy + \beta_2 Infrastructure$ $+ \beta_3 Business\ ecosystem + \beta_4 Education + \beta_5 Age\ 15 - 65 + \varepsilon_i.$ $Y_{Fin.\ inclusion} = \alpha + \beta_6 Use\ of\ FinTech + \beta_7 Rural\ areas + \beta_8 Literacy\ rate$ $+ \beta_9 Population\ density + \varepsilon_i.$ $Y_{SED} = \alpha + \beta_{10} Financial\ inclusion + \beta_{11} Geography$ $+ \beta_{12} Environmental\ policy\ protection$ $+ \beta_{13} Government\ expenditure + \varepsilon_i.$
<p>Endogenous variables: use of FinTech, financial inclusion, and sustainable economic development (SED)</p> <p>Exogenous variables: governance policy, business ecosystem, infrastructure, education, age 15-65, rural areas, literacy rate, population density, geography, government expenditure, and environmental policy protection</p>

5. Results

The aforementioned simultaneous system is estimated using 3SLS regression. The first stage reduced form results using OLS regression are presented in Table 11 and show the strength of the instruments. It is important to analyze these results, since weak instruments that are poor predictors of the endogenous regressor in the first stage could lead to biased statistical properties (Stock, Wright and Yogo 2002). The F-statistics for excluded instruments for all three equations are larger than 10 indicating that there is no need to worry about weak instruments, since the excluded instruments are jointly significant (Staiger and Stock, 1997). The null hypothesis that the excluded instruments are irrelevant is rejected.

Column 1 presents the coefficients of the variables effective on the use of FinTech. The effect of business ecosystem is positive and significant ($p < 0.10$), a finding in line with our theory. However, the effect of both governance policy and infrastructure are insignificant. The coefficient of the constant is negative and significant ($p < 0.10$). Column 2 presents the coefficients of the variables that have an effect on the level of financial inclusion. The coefficient of rural areas is negative and significant ($P < 0.05$) and the coefficient of government expenditure is positive and significant ($p < 0.01$), both coefficients correspond with the literature. Column 3 presents the coefficients of the variables that have an effect on the level of sustainable economic development. The coefficient of the effects of business ecosystem and age 15-65 are

positive and significant ($p < 0.01$). However, the effects of geography, government expenditure and environmental policy protection are insignificant.

Table 11: The first stage of the 3SLS regression that measure the effects on use of FinTech, on financial inclusion, and on sustainable economic development (SED).

	Use of FinTech	Financial inclusion	SED
Governance policy	-0.075 (0.114)	-0.155 (0.168)	0.070 (0.054)
Infrastructure	0.101 (0.182)	0.350 (0.269)	0.110 (0.087)
Business ecosystem	0.220* (0.122)	0.305 (0.195)	0.134** (0.063)
Education	0.008 (0.108)	0.119 (0.159)	-0.016 (0.052)
Age 15-65	-0.109 (0.138)	-0.000 (0.203)	0.221*** (0.066)
Rural areas	-0.042 (0.086)	-0.263** (0.128)	-0.004 (0.041)
Literacy rate	0.091 (0.108)	-0.194 (0.159)	0.025 (0.052)
Population density	-0.054 (0.080)	0.159 (0.118)	0.005 (0.038)
Geography	-0.003 (0.074)	-0.088 (0.109)	-0.003 (0.035)
Environmental policy protection	-0.072 (0.068)	-0.147 (0.100)	0.026 (0.032)
Government expenditure	-0.050 (0.065)	0.380*** (0.096)	-0.041 (0.031)
Constant	-0.104* (0.059)	-0.006 (0.086)	0.020 (0.028)
#Observations	62	62	62
Adjusted R-square	0.13	0.31	0.76
F-statistic for excluded instruments	10.98	11.72	18.58

Note. SEs are shown in parentheses.

* Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

The coefficients of column 1 present the effect on the use of financial technologies, the coefficients of column 2 present the effect on the level of financial inclusion, and the coefficient of column 3 present the effect on the level of sustainable economic development. The predictive power of excluded instruments is determined by the F-statistic for excluded instruments.

The results of the third stage of 3SLS are presented in Table 12. The estimated values of the first stage replace the endogenous variables and the correlation between the error terms across the structural equations is taken into account. The Hansen J-test tests the validity of the overidentifying restrictions. The J-statistics do not reject the null hypothesis, indicating that the overidentifying restrictions are valid, since their values are insignificant. This indicates that the instruments are uncorrelated with the error term and are therefore correctly excluded from the

second stage regression for all equations (Brooks, 2008). Therefore, the instrument set is assumed to be valid and the model as such is correctly specified.

Column 1 presents the coefficients of the variables that are expected to have an effect on the use of FinTech. The effect of governance policy on the use of FinTech is negative and insignificant, which does not support Hypothesis 1a stating that a more stable governance policy increases the use of FinTech. In contrast, the coefficients of infrastructure and business ecosystem are positive and significant ($P < 0.05$). This is in line with the theory and these results confirm Hypothesis 1b and 1c which indicate that increases in the quality of infrastructure and business ecosystem will have a positive effect on the use of FinTech. Their economic impact on the use of FinTech is also significant based on an increase of 19.8% and 18.2% of its mean per standard deviation increase in the quality of respectively infrastructure and business ecosystem. The coefficients of the variables education and age 15-65 are insignificant and the constant is negative and significant ($P < 0.10$).

Column 2 shows the coefficients of the variables that are expected to influence the level of financial inclusion. The effect of use of FinTech on financial inclusion is expected to be positive based on the literature. The results confirm this expectation and show a significant coefficient ($P < 0.05$) for the effect of the use of FinTech on the level of financial inclusion. This finding provides support for hypothesis 2 that a higher use of FinTech will have a positive effect on the level of financial inclusion and corresponds with the findings of Dapp, Slomka, and Hoffmann (2014). This finding is also economic significant since an one-standard deviation increase in the use of FinTech increase the level of financial inclusion by 11.9% of its mean. The effect of rural areas is negative and significant ($P < 0.10$). This corresponds with the literature (Scott et al., 2001; Allen et al., 2014), since people in rural areas on average have a greater distance to physical banks which is an obstacle to become financially included. The coefficients of literacy rate and population density are positive, which is in line with the theory, although their effects are insignificant.

Table 12: The results of the 3SLS regression analysis that measures the effects on use of FinTech, on financial inclusion, and on sustainable economic development (SED).

	Use of FinTech	Financial inclusion	SED
Governance policy	-0.148 (0.098)		
Infrastructure	0.262** (0.132)		
Business ecosystem	0.240** (0.115)		
Education	0.006 (0.096)		
Age 15-65	-0.101 (0.112)		
Use of FinTech		0.462** (0.210)	
Rural areas		-0.209* (0.111)	
Literacy rate		0.121 (0.108)	
Population density		0.097 (0.098)	
Financial inclusion			0.180** (0.075)
Geography			0.120** (0.054)
Environmental policy protection			0.020 (0.056)
Government expenditure			-0.040 (0.061)
Constant	-0.093* (0.056)	0.009 (0.094)	0.009 (0.053)
#Observations	62	62	62
Hansen J-statistic: p-value		0.33	0.13

Note. SEs are shown in parentheses.

* Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

The coefficients of column 1 present the effects on the use of financial technologies, the coefficients of column 2 present the effect on the level of financial inclusion, and the coefficient of column 3 present the effect on the level of sustainable economic development. The test of overidentifying restrictions, Hansen J-statistic, tests the joint null hypothesis that the excluded instruments are uncorrelated with the error term and are correctly excluded after the first stage.

Column 3 shows the coefficients of the variables that are expected to affect the level of sustainable economic development. The results indicate that financial inclusion has a positive and significant effect ($P < 0.05$) on the level of sustainable economic development. This finding corresponds with the results from other literature, and confirms previous research that financial inclusion is a driver for sustainable economic growth (Banerjee, 2004; Banerjee and Newman, 1993; Burgess and Pande, 2005; Levine, 2005; Mohan, R., 2006; Rajan and Zingales, 2003).

Moreover, this result provides support for hypothesis 3 stating that an increase in the level of financial inclusion has a positive effect on the level of sustainable economic development. The coefficient is also economically significant, because a one-standard deviation increase in the level of financial inclusion increases the level of sustainable economic development by 23.4% of its mean. The coefficient for geography is significant and positive, a finding in line with the theory of Landes (1998). The author argues that temperature zones further away from the equator have more productive agriculture and healthier climates, which enables these countries to develop a more sustainable economy. The effects of environmental policy protection and government expenditure are both insignificant.

6. Robustness

In this section, concerns about the robustness of the results described in the previous section are addressed. Robustness checks are conducted to investigate if our results are influenced by the ‘low-income trap’, the ‘demand-effect’ of financial inclusion on the use of FinTech, and the reverse causality between financial inclusion and sustainable economic development.

6.1 ‘Low-income trap’

One concern about the results in Table 12 is that the significant relationships between infrastructure and use of FinTech, and business ecosystem and use of FinTech are not applicable to low-income countries. The absence of a minimum level of governance policy, infrastructure and business ecosystem in these countries is called the ‘low-income trap’. Most low-income and some lower-middle income countries are stuck in a situation where the need for financial inclusion is high, however the enabling elements to improve financial inclusion are absent. Political and regulative institutions are weak and appropriate knowledge and equipment are missing. In these countries, the effect of the riskiness of governance policy, and the quality of infrastructure and business ecosystem on the use of FinTech might be faded away. For example, improvements in innovativeness or a reduction in the time it takes to start a business, both indicators of an appropriate business ecosystem, will not increase the use of mobile banking if there is no electricity coverage in the country. Low-income countries might find themselves in a stage whereby the supportiveness of their FinTech climate should first be heavily improved to a certain minimum level in order to be able to use FinTech at all. If the ‘low-income trap’ is significantly present, there is need for international development agencies to step in to attract

private investment and push low-income countries in the right direction to achieve a minimum level of the supportiveness of their FinTech climate.

The ‘low-income trap’ is tested using a dummy variable that is [1] for low-income countries and [0] otherwise, based on their income according to the World Bank 2017 (Data.worldbank, 2017). Moreover, the interaction between the dummy variable and stability of governance policy, quality of the infrastructure and quality of the business ecosystem are added in the first equation. The dummy variable is only included in the first equation since the ‘low-income trap’ is expected to influence the effects of the indicators that determine the supportiveness of a country’s FinTech climate. These interaction terms indicate if low-income countries are subject to a different effect between the indicators of supportiveness of FinTech climate and the use of FinTech compared to non low-income countries. The relationships of use of FinTech on financial inclusion and financial inclusion on sustainable economic development are expected to be unaffected.

The first stage results are shown in Table 13 and the third stage results are shown in Table 14. The F-statistics for excluded instruments reject the null hypothesis in all columns in Table 13. This indicates that the excluded instruments are relevant. In Table 14, the J statistics do not reject the null hypothesis, which states that the overidentification restrictions are valid. Therefore, it can be assumed that the instrument set is valid and the model is correctly specified. Column 1 shows the coefficient of the variables that are expected to affect the use of FinTech. The coefficients of the stability of the governance policy and the quality of the infrastructure are insignificant. Therefore, these results do not provide support for Hypothesis 1a and 1b. However, the effect of the quality of the business ecosystem is positive and significant ($P < 0.05$) and therefore provides support for Hypothesis 1c. The dummy variable is significant and negative ($P < 0.10$). This indicates that low-income countries have on average a lower use of FinTech compared to non low-income countries. The coefficients of the interaction terms are insignificant, implying that there is no significant difference in the relationship between the determinants of the supportiveness of FinTech climate and the use of FinTech for low-income countries compared to the non low-income countries in the sample. Therefore, these results reject the presence of a ‘low-income’ trap that fades away the relationship between the indicators of the supportiveness of a country’s FinTech climate and the use of FinTech. The results of column 2 and 3 are consistent with our earlier findings and provide support for Hypothesis 2 and 3.

Table 13: The first stage of the 3SLS regression analysis that measures the effects on use of FinTech, on financial inclusion, and on sustainable economic development (SED) in order to test the presence of a 'low-income trap'.

	Use of FinTech	Financial inclusion	SED
Governance policy	0.064 (0.179)	0.043 (0.268)	0.117 (0.087)
Infrastructure	-0.220 (0.354)	0.420 (0.531)	0.098 (0.173)
Business ecosystem	-0.267 (0.209)	-0.045 (0.313)	0.145 (0.102)
Education	0.039 (0.111)	0.133 (0.167)	-0.007 (0.054)
Age 15-65	-0.150 (-0.143)	0.019 (0.214)	0.206*** (0.070)
Dummy	-0.249 (0.213)	-0.095 (0.319)	0.070 (0.104)
Dummy * Governance policy	-0.207 (0.217)	-0.265 (0.324)	-0.070 (0.106)
Dummy * Infrastructure	0.122 (0.354)	-0.141 (0.531)	0.007 (0.173)
Dummy * Business ecosystem	-0.115 (0.253)	0.559 (0.379)	-0.034 (0.123)
Rural areas	-0.006 (0.094)	-0.018 (0.142)	0.008 (0.046)
Literacy rate	-0.092 (0.110)	-0.223*** (0.065)	0.028 (0.054)
Population density	-0.059 (0.081)	0.137 (0.121)	0.003 (0.039)
Geography	0.021 (0.076)	-0.086 (0.114)	0.006 (0.037)
Environmental policy protection	-0.042 (0.070)	-0.154 (0.105)	0.036 (0.034)
Government expenditure	-0.051 (0.070)	0.354*** (0.105)	-0.042 (0.034)
Constant	0.040 (0.182)	0.087 (0.273)	0.054 (0.089)
#Observations	62	62	62
Adjusted R-square	0.17	0.31	0.76
F-statistic for excluded instruments	10.21	10.49	13.22

Note. SEs are shown in parentheses.

* Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

The coefficients of column 1 present the effect on the use of financial technologies, the coefficients of column 2 present the effect on the level of financial inclusion, and the coefficient of column 3 present the effect on the level of sustainable economic development. The predictive power of excluded instruments is determined by the F-statistic for excluded instruments.

Table 14: The results of the 3SLS regression analysis that measures the effects, on use of FinTech, on financial inclusion, and on sustainable economic development (SED) in order to test the presence of a 'low-income trap'.

	Use of FinTech	Financial inclusion	SED
Governance policy	0.026 (0.167)		
Infrastructure	-0.036 (0.314)		
Business ecosystem	0.326** (0.157)		
Education	0.053 (0.098)		
Age 15-65	-0.148 (0.114)		
Dummy	-0.300* (0.176)		
Dummy * Governance policy	-0.248 (0.205)		
Dummy * Infrastructure	0.280 (0.319)		
Dummy * Business ecosystem	-0.163 (0.232)		
Use of FinTech		0.555*** (0.019)	
Rural areas		-0.429** (0.167)	
Literacy rate		0.063 (0.109)	
Population density		0.299** (0.136)	
Financial inclusion			0.195* (0.112)
Geography			-0.079 (0.104)
Environmental policy protection			0.098* (0.057)
Government expenditure			0.007 (0.061)
Constant	0.103 (0.164)	0.233 (0.153)	-0.275 (0.290)
#Observations	62	62	62
Hansen J-statistic: p-value		0.30	0.17

Note. SEs are shown in parentheses.

* Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

The coefficients of column 1 present the effects on the use of financial technologies, the coefficients of column 2 present the effect on the level of financial inclusion, and the coefficient of column 3 present the effect on the level of sustainable economic development. The test of overidentifying restrictions, Hansen J-statistic, tests the joint null hypothesis that the excluded instruments are uncorrelated with the error term and are correctly excluded after the first stage.

6.2 ‘Demand-effect’ of financial inclusion

The theory section describes the positive relation between the use of FinTech on financial inclusion. Using FinTech can overcome physic distance and cost obstacles that withhold consumers and firms from access to financial institutions. However, the relation between the use of FinTech and financial inclusion could also be explained by the ‘demand-effect’ of financial inclusion. This means that not only use of FinTech has a positive effect on financial inclusion, but increases in financial inclusion could also generate an increase in demand for FinTech. People that become financially included are also willing to experience the ease that FinTech offer. Therefore, according to the ‘demand-effect’ of financial inclusion do increases in the level of financial inclusion have a positive effect on the use of FinTech. This ‘demand-effect’ is added to the first equation and is tested using 3SLS. The first stage results are shown in Table 15 and the third stage results are shown in Table 16.

The F-statistics for excluded instruments reject the null hypothesis in all columns in Table 15. This indicates that the excluded instruments are not irrelevant. In Table 16, the J statistics do not reject the null hypothesis, which states that the overidentification restrictions are valid. Therefore, it can be assumed that the instrument set is valid and the model is correctly specified. Column 1 of Table 16 shows the coefficient of the variables that are expected to affect the use of FinTech. The coefficient of financial inclusion is positive and significant ($P < 0.10$), which confirms the ‘demand-effect’ theory. This indicates that the relation between the use of FinTech and financial inclusion is reverse causal. On the one hand, the use of FinTech facilitates financial inclusion, on the other hand financial inclusion creates demand for the use of FinTech. The effects of the quality of the infrastructure and business ecosystem remain positive and significant ($P < 0.10$) and the effect of the riskiness of the governance policy remains insignificant. This is in line with the previous results and confirms Hypothesis 1b and 1c. The results of column 2 and 3 are also consistent with the previous results and in line with Hypothesis 2 and 3.

Table 15: The first stage of the 3SLS regression analysis that measures the effects on use of FinTech, on financial inclusion, and on sustainable economic development (SED) whereby the ‘demand effect’ of financial inclusion is added in the first equation.

	Use of FinTech	Financial inclusion	SED
Governance policy	-0.075 (0.114)	-0.155 (0.168)	0.070 (0.054)
Infrastructure	0.101 (0.182)	0.350 (0.269)	0.110 (0.087)
Business ecosystem	0.220* (0.122)	0.305 (0.195)	0.134** (0.063)
Education	0.008 (0.108)	0.119 (0.159)	-0.016 (0.052)
Age 15-65	-0.109 (0.138)	-0.000 (0.203)	0.221*** (0.066)
Rural areas	-0.042 (0.086)	-0.263** (0.128)	-0.004 (0.041)
Literacy rate	0.091 (0.108)	-0.194 (0.159)	0.025 (0.052)
Population density	-0.054 (0.080)	0.159 (0.118)	0.005 (0.038)
Geography	-0.003 (0.074)	-0.088 (0.109)	-0.003 (0.035)
Environmental policy protection	-0.072 (0.068)	-0.147 (0.100)	0.026 (0.032)
Government expenditure	-0.050 (0.065)	0.380*** (0.096)	-0.041 (0.031)
Constant	-0.104* (0.059)	-0.006 (0.086)	0.020 (0.028)
#Observations	62	62	62
Adjusted R-square	0.13	0.29	0.76
F-statistic for excluded instruments	10.98	11.72	18.58

Note. SEs are shown in parentheses.

* Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

The coefficients of column 1 present the effect on the use of financial technologies, the coefficients of column 2 present the effect on the level of financial inclusion, and the coefficient of column 3 present the effect on the level of sustainable economic development. The predictive power of excluded instruments is determined by the F-statistic for excluded instruments.

Table 16: The results of the 3SLS regression analysis that measures the effects, on use of FinTech, on financial inclusion, and on sustainable economic development (SED) whereby the ‘demand effect’ of financial inclusion is added in the first equation.

	Use of FinTech	Financial inclusion	SED
Financial inclusion	0.144* (0.079)		0.179** (0.074)
Governance policy	-0.142 (0.096)		
Infrastructure	0.217* (0.131)		
Business ecosystem	0.206* (0.114)		
Education	0.002 (0.094)		
Age 15-65	-0.101 (0.110)		
Use of FinTech		0.467** (0.211)	
Rural areas		-0.208* (0.109)	
Literacy rate		0.120 (0.106)	
Population density		0.099 (0.098)	
Geography			0.121** (0.051)
Environmental policy protection			0.020 (0.056)
Government expenditure			-0.041 (0.060)
Constant	-0.093* (0.056)	0.009 (0.095)	0.010 (0.052)
#Observations	62	62	62
Hansen J-statistic: p-value	0.49	0.33	0.12

Note. SEs are shown in parentheses.

* Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

The coefficients of column 1 present the effects on the use of financial technologies, the coefficients of column 2 present the effect on the level of financial inclusion, and the coefficient of column three present the effect on the level of sustainable economic development. The test of overidentifying restrictions, Hansen J-statistic, tests the joint null hypothesis that the excluded instruments are uncorrelated with the error term and are correctly excluded after the first stage.

6.3 Reverse causality between financial inclusion and sustainable economic development

The theory section describes the relationship between financial inclusion and sustainable economic development. Higher financial inclusion should increase social inclusion, private consumption and government expenditure which all lead to higher sustainable economic development. This is in line with the results of King and Levine (1993), Levine (1996), and Kpodar and Andrianaivo (2011) that finance ‘leads’ economic growth and determines future growth. However, the relation between financial inclusion and sustainable economic development could be reversely causal as well. Shan, Morres and Sun (2011) argue in their paper based on the Granger causality procedure that improvements in finance might results in higher growth, but that the effect is also reverse causal. This implies that finance does not ‘lead’ economic growth. Therefore, countries with higher sustainable economic development might also see higher levels of financial inclusion, since for example higher income can overcome cost-obstacles that prevented citizens from making use of financial products and services.

The first stage results of this reverse causality are presented in Table 17 and the third stage results are shown in Table 18. The F-statistics for excluded instruments in Table 17 reject the null hypothesis which indicates that the excluded instruments are not irrelevant. In Table 18, the J-statistics do not reject the null hypothesis. Therefore, it can be assumed that the instrument set is valid and the model is correctly specified. Column 1 shows the coefficients of the variables that are expected to affect the use of FinTech. The results remain consistent with previous findings and provide support for Hypothesis 1b, 1c. Column 2 shows the coefficients of the variables that influence financial inclusion. The effect of sustainable economic development is insignificant. This indicates that there is no support for reverse causality between financial inclusion and sustainable economic development. The coefficient of the use of FinTech remains positive and significant, providing evidence for Hypothesis 2. Column 3 shows the coefficients of the variables that influence sustainable economic development. The results remain consistent with the previous findings and provide support for Hypothesis 3.

Table 17: The first stage of the 3SLS regression analysis that measures the effects on use of FinTech, on financial inclusion, and on sustainable economic development (SED) whereby the reverse causality effect between financial inclusion and sustainable economic development is included in the second equation.

	Use of FinTech	Financial inclusion	SED
Governance policy	-0.075 (0.114)	-0.155 (0.168)	0.070 (0.054)
Infrastructure	0.101 (0.182)	0.350 (0.269)	0.110 (0.087)
Business ecosystem	0.220* (0.122)	0.305 (0.195)	0.134** (0.063)
Education	0.008 (0.108)	0.119 (0.159)	-0.016 (0.052)
Age 15-65	-0.109 (0.138)	-0.000 (0.203)	0.221*** (0.066)
Rural areas	-0.042 (0.086)	-0.263** (0.128)	-0.004 (0.041)
Literacy rate	0.091 (0.108)	-0.194 (0.159)	0.025 (0.052)
Population density	-0.054 (0.080)	0.159 (0.118)	0.005 (0.038)
Geography	-0.003 (0.074)	-0.088 (0.109)	-0.003 (0.035)
Environmental policy protection	-0.072 (0.068)	-0.147 (0.100)	0.026 (0.032)
Government expenditure	-0.050 (0.065)	0.380*** (0.096)	-0.041 (0.031)
Constant	-0.104* (0.059)	-0.006 (0.086)	0.020 (0.028)
#Observations	62	62	62
Adjusted R-square	0.12	0.31	0.76
F-statistic for excluded instruments	10.98	11.72	18.58

Note. SEs are shown in parentheses.

* Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

The coefficients of column 1 present the effect on the use of financial technologies, the coefficients of column 2 present the effect on the level of financial inclusion, and the coefficient of column 3 present the effect on the level of sustainable economic development. The predictive power of excluded instruments is determined by and the F-statistic for excluded instruments.

Table 18: The results of the 3SLS regression that measures the effects, on use of FinTech, on financial inclusion, and on sustainable economic development (SED) whereby the reverse causality effect between financial inclusion and sustainable economic development is included in the second equation.

	Use of FinTech	Financial inclusion	SED
Governance policy	-0.142 (0.099)		
Infrastructure	0.234** (0.118)		
Business ecosystem	0.261** (0.132)		
Education	0.007 (0.092)		
Age 15-65	-0.103 (0.111)		
Use of FinTech		0.461** (0.212)	
Sustainable economic development		-0.034 (0.310)	
Rural areas		-0.214* (0.122)	
Literacy rate		0.130 (0.132)	
Population density		0.100 (0.102)	
Financial inclusion			0.176** (0.075)
Geography			0.118** (0.056)
Environmental policy protection			0.015 (0.056)
Government expenditure			-0.043 (0.068)
Constant	-0.094 (0.058)	0.009 (0.091)	0.008 (0.053)
#Observations	62	62	62
Hansen J-statistic: p-value		0.16	0.44

Note. SEs are shown in parentheses.

* Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

The coefficients of column 1 present the effects on the use of financial technologies, the coefficients of column 2 present the effect on the level of financial inclusion, and the coefficient of column three present the effect on the level of sustainable economic development. The test of overidentifying restrictions, Hansen J-statistic, tests the joint null hypothesis that the excluded instruments are uncorrelated with the error term and are correctly excluded after the first stage.

7. Conclusion

The introduction of this paper poses the question which aspects of the supportiveness of a country's FinTech climate have a significant positive effect on the use of FinTech. According to the results, it can be concluded that the stability of the governance policy does not have a significant positive effect on the use of FinTech. These results do not provide evidence to support Hypothesis 1a and indicate that, on average, countries with a stable governance policy do not have a higher use of FinTech compared to countries with an unstable governance policy. However, the results do provide significant evidence that supports 1b and 1c. These results are in line with the current literature and indicate that the quality of infrastructure and business ecosystem contribute to a higher use of FinTech (Aker, J. and Mbiti, I., 2010). These findings are also economically significant. The practical implication of these findings is that improvements in the quality of infrastructure and business ecosystem will considerably help countries to increase the use of FinTech in their country.

With respect to the relation between the use of FinTech and financial inclusion, the results confirm the positive and significant relationship which is proposed in the theory (Agrawal, 2008; Mbiti and Weil, 2011). This supports Hypothesis 2 and indicates that higher use of FinTech helps financial excluded people to overcome cost and distance obstacles enabling them to access financial products and services. Moreover, the expectation from the theory that financial inclusion increases the level of sustainable economic development is also confirmed by the results. This finding supports Hypothesis 3 and is in line with the current literature which suggests that financial inclusion has a positive effect on social inclusion, consumption, and government expenditure, all determinants of sustainable economic development (Barbier, 1987). The results are robust to the inclusion of control variables, the 'low-income trap', 'demand-effect' of financial inclusion, and reverse causality between financial inclusion and sustainable economic development.

Regarding the managerial implications of this research, the findings provide insight in the FinTech climate factors that facilitate the use of FinTech. These findings can help the governments of developing countries to allocate investments to appropriate investment areas, such as infrastructure, in order to increase the use of FinTech and stimulate improvements in the level of financial inclusion. Moreover, the findings highlight the importance of the use of FinTech since it has a positive effect on the level of financial inclusion for fostering sustainable economic development.

The results also present a trade-off for FinTech investors to determine in which countries they are going to invest their money and where launch new FinTech products. Commercial investors, who invest from a financial point of view, are less interested in countries with a less supportive FinTech climate. In these countries, the introduction of (new) FinTech has less impact on the use of FinTech, since several country characteristics are not appropriate for using FinTech. Therefore, commercial investors are more likely to focus on the easy implementers whereby the business ecosystem and infrastructure are already on a high level and investments will facilitate the use of FinTech. In contrast, donor investors, who are more concerned about the social return of their investments, search for countries where the need for FinTech investments is the highest. Donor investors do not shy away from capacity building investments, and focus on low-income countries whereby country specific investments are needed to improve the supportiveness of a countries FinTech climate. The country scores on the supportiveness of their FinTech climate hereby provide useful information for commercial and donor investors for allocating their investments. All in all, countries offer different FinTech investment opportunities for different groups of investors to improve their sustainable economic development levels.

It is important to be aware of several limitations while interpreting the results in this study. First of all, during the construction of the database, several data availability restrictions were encountered that influenced the composition of the final database. The reliable data availability for low-income countries is somewhat restricted. This results in a database with relative less low-income countries which might lead to somewhat biased results. Second, the data availability with respect to the use of FinTech is limited to identification technology and mobile and internet banking for low-income countries. It would be useful to include data about alternative credit scoring, virtual currencies, cloud computing, business monitoring apps, and blockchain to have a more all-encompassing measure of the use of FinTech. This would provide insight in the effect on, and the effect of, use of FinTech in general, instead of focussing on a few types of FinTech. Third and last, one of the relationships this study investigates is the effect of financial inclusion on sustainable economic development. This paper and the existing literature, that examines the relationship between financial inclusion and economic growth, refer to a causal ‘homogeneous effect’ across countries (Sarma and Pais, 2011). However, the limitation that only the ‘homogeneous effect’ is tested is particularly severe as the possibility of differences in causality patterns across countries is likely (Demetriades and Hussein, 1996). This suggests that causality patterns vary across countries and highlights the danger of treating

different economies as homogeneous entities (Arestis and Demetriades, 1997). Levine (1997) confirms this and examines that economic growth, a determinant of sustainable economic development, could also be dependent on other country characteristics such as technological innovation and human development.

Avenues for further research include the analysis of a database consisting of a larger sample of low and high income countries to be able to analysis possible different impacts of supportiveness of country climate factors between low and high income groups. Furthermore, it would be interesting to gain more insights into differences in efficiency of investments in FinTech. In other words, in which countries do investments, measured by the Euro invested in the supportiveness of a country's FinTech climate, have the highest increase in use of FinTech. There could for example be differences in efficiency of investments per region or per income level. These insights could serve as guidelines for investors to allocate their investments to the most efficient countries and launch their new FinTech products in these specific countries.

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9. Appendix

Appendix 1: Overview of the countries in the sample population and their income level (Low income, Lower middle income, Upper middle income)

Country	Income level	Country	Income level
Albania	Upper middle income	Madagascar	Low income
Angola	Upper middle income	Malawi	Low income
Argentina	Upper middle income	Mali	Low income
Armenia	Lower middle income	Mauritius	Upper middle income
Azerbaijan	Upper middle income	Mexico	Upper middle income
Bangladesh	Lower middle income	Mongolia	Lower middle income
Belarus	Upper middle income	Montenegro	Lower middle income
Benin	Low income	Nepal	Low income
Bosnia Herzegovina	Upper middle income	Nicaragua	Lower middle income
Botswana	Lower middle income	Nigeria	Lower middle income
Brazil	Upper middle income	Pakistan	Lower middle income
Bulgaria	Upper middle income	Panama	Upper middle income
Burkina Faso	Low income	Peru	Upper middle income
Burundi	Low income	Philippines	Lower middle income
Cambodia	Lower middle income	Romania	Upper middle income
Cameroon	Lower middle income	Rwanda	Low income
Chile	Upper middle income	Senegal	Lower middle income
China	Upper middle income	Serbia	Upper middle income
Colombia	Upper middle income	South Africa	Upper middle income
Costa Rica	Upper middle income	Sri Lanka	Lower middle income
Dominican Republic	Upper middle income	Sudan	Lower middle income
Ecuador	Upper middle income	Tajikistan	Lower middle income
El Salvador	Lower middle income	Tanzania	Low income
Georgia	Lower middle income	Thailand	Upper middle income
Ghana	Lower middle income	Togo	Low income
Guinea	Low income	Uganda	Low income
Honduras	Lower middle income	Uruguay	Upper middle income
India	Lower middle income	Uzbekistan	Lower middle income
Indonesia	Lower middle income	Vietnam	Lower middle income
Kazakhstan	Lower middle income	Zambia	Lower middle income
Kenya	Lower middle income	Zimbabwe	Lower middle income

Appendix 2: Overview of the countries in the sample population and their region (South East Asia, Latin America & Caribbean, Europe & Central Asia, Africa)

Country	Region	Country	Region
Albania	Europe & Central Asia	Madagascar	Africa
Angola	Africa	Malawi	Africa
Argentina	Latin America & Caribbean	Mali	Africa
Armenia	Europe & Central Asia	Mauritius	Africa
Azerbaijan	Europe & Central Asia	Mexico	Latin America & Caribbean
Bangladesh	South East Asia	Mongolia	South East Asia
Belarus	Europe & Central Asia	Montenegro	Europe & Central Asia
Benin	Africa	Nepal	South East Asia
Bosnia Herzegovina	Europe & Central Asia	Nicaragua	Latin America & Caribbean
Botswana	Africa	Nigeria	Africa
Brazil	Latin America & Caribbean	Pakistan	South East Asia
Bulgaria	Europe & Central Asia	Panama	Latin America & Caribbean
Burkina Faso	Africa	Peru	Latin America & Caribbean
Burundi	Africa	Philippines	South East Asia
Cambodia	South East Asia	Romania	Europe & Central Asia
Cameroon	Africa	Rwanda	Africa
Chile	Latin America & Caribbean	Senegal	Africa
China	South East Asia	Serbia	Europe & Central Asia
Colombia	Latin America & Caribbean	South Africa	Africa
Costa Rica	Latin America & Caribbean	Sri Lanka	South East Asia
Dominican Republic	Latin America & Caribbean	Sudan	Africa
Ecuador	Latin America & Caribbean	Tajikistan	Europe & Central Asia
El Salvador	Latin America & Caribbean	Tanzania	Africa
Georgia	Europe & Central Asia	Thailand	South East Asia
Ghana	Africa	Togo	Africa
Guinea	Africa	Uganda	Africa
Honduras	Latin America & Caribbean	Uruguay	Latin America & Caribbean
India	South East Asia	Uzbekistan	Europe & Central Asia
Indonesia	South East Asia	Vietnam	South East Asia
Kazakhstan	Europe & Central Asia	Zambia	Africa
Kenya	Africa	Zimbabwe	Africa

Appendix 3: Overview of the standardized scores on the Economic, Investments, and Sustainability indicators of sustainable economic development. The column 'Total' is an unweighted average of the indicators.

Country	Total	Economic	Investments	Sustainability
Albania	0.29	-0.17	0.80	0.24
Angola	-0.96	-1.30	-1.21	-0.38
Argentina	0.10	-0.84	0.95	0.19
Armenia	0.30	-0.35	0.70	0.57
Azerbaijan	0.24	-0.06	0.55	0.22
Bangladesh	-0.18	0.13	-0.11	-0.56
Belarus	0.29	-0.34	0.82	0.40
Benin	-0.18	0.42	-0.93	-0.04
Bosnia and Herzegovina	0.25	-0.54	1.11	0.17
Botswana	-0.11	-0.05	-0.49	0.22
Brazil	0.19	-0.46	0.73	0.31
Bulgaria	0.66	0.49	0.75	0.73
Burkina Faso	-0.27	0.49	-0.96	-0.33
Burundi	-0.59	-0.37	-0.90	-0.51
Cambodia	0.06	0.65	-0.38	-0.11
Cameroon	-0.36	0.28	-0.79	-0.56
Chile	0.59	0.34	0.85	0.59
China	0.49	0.74	0.62	0.11
Colombia	0.13	-0.10	0.50	-0.01
Costa Rica	0.57	0.41	0.94	0.36
Dominican Republic	0.37	0.51	0.59	0.00
Ecuador	0.13	0.00	0.49	-0.09
El Salvador	0.13	0.23	0.34	-0.18
Georgia	0.35	0.07	0.77	0.21
Ghana	-0.32	-0.62	-0.41	0.07
Guinea	-0.61	-0.19	-1.05	-0.59
Honduras	0.07	0.01	0.43	-0.23
India	-0.01	0.12	-0.11	-0.03
Indonesia	0.24	0.31	0.31	0.11
Kazakhstan	0.39	0.07	0.68	0.40
Kenya	-0.45	-0.30	-0.77	-0.27
Madagascar	-0.44	0.14	-1.03	-0.44
Malawi	-0.89	-1.04	-1.11	-0.54
Mali	-0.49	0.12	-0.96	-0.63
Mauritius	0.45	0.50	0.43	0.43
Mexico	0.33	0.34	0.58	0.05
Mongolia	0.05	0.11	-0.08	0.11
Montenegro	0.36	-0.12	0.84	0.35
Nepal	0.03	-0.14	0.17	0.05
Nicaragua	0.09	0.15	0.21	-0.09
Nigeria	-0.96	-1.05	-1.02	-0.80
Pakistan	-0.36	0.00	-0.46	-0.62

Panama	0.57	0.73	0.67	0.32
Peru	0.32	0.35	0.49	0.13
Philippines	0.19	0.37	0.24	-0.02
Romania	0.74	0.79	0.68	0.74
Rwanda	-0.15	0.28	-0.81	0.09
Senegal	-0.25	-0.47	-0.31	0.03
Serbia	0.34	-0.13	0.83	0.31
South Africa	-0.46	-0.98	-0.32	-0.07
Sri Lanka	0.23	0.12	0.59	-0.03
Sudan	-0.96	-1.18	-0.82	-0.87
Tajikistan	-0.11	-0.16	-0.22	0.06
Tanzania	-0.33	0.21	-1.24	0.05
Thailand	0.63	0.83	0.79	0.26
Togo	-0.38	0.22	-1.07	-0.28
Uganda	-0.32	0.22	-1.04	-0.15
Uruguay	0.59	-0.04	1.06	0.76
Uzbekistan	0.06	0.14	0.31	-0.26
Vietnam	0.51	0.66	0.51	0.35
Zambia	-0.70	-0.62	-1.54	0.06
Zimbabwe	-0.50	0.11	-1.19	-0.41

Appendix 4: Control variables, variable description and source.

Control variable	Description	Source
Education	Primary school completion rate	onlinelibrary.wiley.com /wol1/doi/10.1002/ jid.1698/full
Age 15-65	Percentage of population with age between 15 and 65	https://data.worldbank.org/indicator/SP.POP.1564.TO.ZS
Literacy rate	Percentage of age 15+ people who can read and write	onlinelibrary.wiley.com /wol1/doi/10.1002/ jid.1698/full
Rural population	Share of population that are living in rural areas	World Bank. 2017l
Population density	Midyear population divided by land area in square kilometers	https://data.worldbank.org/indicator/EN.POP.DNST
Environmental policy protection	Extent of NGO influence on sustainable policy (1-6)	https://data.worldbank.org/indicator/IQ.CPA.ENVR.XQ
Government expenditure	Government expenditure divided by GDP (in %)	World Development Indicators. World Bank Theglobaleconomy.com/rankings
Geography	Latitude	Cia.gov. 2016