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**Giovanni M. Pérez and
Miguel Ruiz M.**

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Economy and Employment: The Case of
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EDITORIAL NOTE

Considering the prevailing and recent major economic developments in the OIC Member States, ASEAN economic communities and South Africa and the links between these developments and those of developing and developed countries as well as the world economy as a whole, this issue of the Journal of Economic Cooperation and Development - March 2019 analyses trends in the main economic indicators of these countries based on recent projections regarding risk-taking behaviour in the Ecuadorian private banking industry and the effect of minimum wage policies on economy and employment of Thailand. It highlights assets and poverty alleviation in South Africa and provides a meta-analysis approach to investigate the statistical significance of financial contagion based on past empirical contagion studies. This issue also analyses the determinants of intra-OIC trade and the impact of IDB trade financing on intra-OIC trade and examines electricity consumption, trade openness and economic growth in South Africa.

The first article examines the effects of deposit insurance implementation on risk-taking behaviour in the Ecuadorian private banking system. Aggregated financial annual data of private banks financial statements from January 2007 to January 2015 were used. Time series analysis employing system-wide financial ratios are meant to support the hypothesis that the levels of risk increased after deposit insurance was implemented in Ecuador on May 2009. In addition, the increase of risk-taking behaviour was observed to be mainly driven by large banks, which hold more than 60% of the banking system assets in total. This can, in fact, easily have devastating effects on the insurance system and the whole economy if the moral hazard problem is left unattended.

The second article attempts to estimate the impact of wage policies on the economy and employment of Thailand as a part of the AEC. The paper also suggests appropriate policies for a sustainable Thai economy in the long run. The results indicated that negative correlations between minimum wage and the gross domestic product, and minimum wage and employment are the result of higher costs of production. Therefore, in this paper, increasing minimum wage or subsidy wage policies are not appropriate for Thailand under the AEC because these policies would reduce investment and reduce incentives to accumulate human capital. The study found that increasing labour productivity can compensate the

effect from these negative wage policies. However, a lower minimum wage led to an increase in the gross domestic product, investment, and employment for both the skilled and unskilled labour force in every sector.

The third article investigates a number of factors responsible for asset poverty in South Africa. Data was selected from the first four waves of the National Income Dynamic Study to bring new evidence to bear on the determinants of assets poverty. The Principal Component Analysis (PCA) was used to create the asset index and the logit model to identify the main determinants of asset poverty in South Africa. Results of the logit model show that some factors such as education levels (secondary, matric and tertiary), race dummies and location dummies (farms and urban areas) have a reducing effect on asset poverty in South Africa. Yet, other factors such as employment and household size seem to have no significant effect on asset poverty.

The fourth article investigates the phenomenon of financial contagion in numerous pieces of research. In spite of its severe implications for the stability of domestic financial systems as well as potential diversification benefits of international portfolio investment, there has yet to be a universally agreed conclusion on the relevance of financial contagion. Therefore, this study has been designed to apply the meta-analysis approach to investigate the statistical significance of financial contagion based on past empirical contagion studies. As implications, policy makers should establish contingent credit lines to ensure the liquidity of financial market during the turbulence time, and portfolio investors should diversify away from the potentially contagious markets. It is suggested that future contagion-based meta-analysis may include contagion studies with different methodologies, as well as meta-regression analysis to provide more insights on the sources of variability in the contagion studies.

The fifth article tries to shed a light on the determinants of intra-OIC trade and the impact of IDB trade financing on intra-OIC trade. By using gravity model both the intuitive and the theoretical one; this article observes eighteen OIC countries from 2000 until 2014. It finds that GDP, distance of two capitals, IDB trade financing, common language, common colony, colony, landlocked, contiguous, the Arab Spring events and Asian as PTA are statistically significant factors in determining

export. In the end, this article focuses on producing an output that can guide OIC member countries and IDB in developing a trade-financing scheme meant to increase intra-OIC trade.

The sixth and last article examines the short- and long-run relationships as well as the causal directions between electricity consumption, trade openness and economic growth in South Africa from 1984 to 2015 using auto regressive distributed lag (ARDL) model. It found that both the electricity consumption and trade openness have a positive and significant effect on economic growth in the long run. Granger-causality test revealed that electricity consumption and trade openness Granger-cause economic growth without any feedback effects. This concluded that South Africa's economy significantly benefits from boosting energy production and trade openness.

SESRIC and its JECD team will continuously work to serve its readers by consistently screening the most appropriate articles with long-term valuable and constructive information, which will be useful and serve the best interests of the OIC countries by upholding their commitment to contribute to the expansion of economic and technical cooperation among them on a long-term basis and beyond.

Nebil DABUR
Editor-in-chief

Deposit insurance effects on risk-taking behavior in the Ecuadorian private banking industry

Giovanni M. Pérez¹ and Miguel Ruiz M.²

This paper examines the effects of deposit insurance implementation on risk-taking behavior in the Ecuadorian private banking system. We use aggregated financial annual data of private banks financial statements from January 2007 to January 2015. Time series analysis employing system-wide financial ratios support our hypothesis that the levels of risk increased after deposit insurance was implemented in Ecuador on May 2009. Also, we observe that the increase of risk-taking behavior was mainly driven by large banks, which hold more than 60% of the banking system assets in total. This can easily have devastating effects on the insurance system and the whole economy if the moral hazard problem is left unattended.

1. Introduction

A Deposit Insurance System (DIS) is a set of policies and rules developed by economic authorities in order to protect banks depositors against possible losses caused by financial institutions failures. These measures are not meant to solve systemic banking crisis but to help stabilize the system in case of failure of a specific bank and to reestablish depositors' trust. It has been shown that deposit insurance can help reduce the probability of bank runs by creating a safety net that offers protection to banks' creditors (Diamond and Dybvig, 1983; Calomiris and Kahn, 1991; Eichengreen and Arteta, 2000; and Hoggarth et al., 2005). However, it is also widely accepted in the literature that DIS implementation increases the propensity by banks to take on excessive (and unnecessary) risk, also referred to as moral hazard (Merton, 1977, 1978; Kareken and Wallace, 1978; Keeton, 1984; Demirgüç-Kunt and Kane, 2002; Gropp and Vesala, 2004; Nier and Baumann, 2006). As explained by economist Paul

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Krugman, the term moral hazard refers to “any situation in which one person [or firm] makes the decision about how much risk to take, while someone else bears the cost if things go badly. Borrowed money is inherently likely to produce moral hazard” (Krugman 2009, pg. 63). The International Association of Deposit Insurers (IADI) describes moral hazard in the case of deposit insurance as “the incentive for increased risk taking by insured institutions that can result when depositors and other creditors are, or believe they are, protected from losses and thus do not monitor the institution’s performance”. This means that insured institutions have an incentive to use lower-cost insured deposits to undertake higher risk projects than would otherwise be optimal (IADI 2013).

In a system without deposit insurance, financial institutions are subject to market discipline (i.e., depositors and other creditors monitoring) that constrains risk-taking behavior. Depositors will demand higher expected returns if they perceive banks are taking on greater risk (e.g., holding riskier portfolio of assets or low capital ratios). Thus, the cost of borrowing will be higher and this will discourage further risk taking. With deposit insurance, the threat of deposits withdrawal or higher funding cost is virtually eliminated because the value of debt is guaranteed. Furthermore, insured depositors are insensitive to asset choice or capital levels because they now hold a risk-free asset. If we consider the fact that higher returns can be obtained by investing in riskier assets, it is easy to see how banks have incentives to take on higher level of risk in order to obtain higher returns while shifting risk to the deposit insurer. Inattention to the moral hazard problem by regulators can have negative consequences. Effective regulation needs to be design in order to prevent moral hazard, excessive risk taking can lead to increased losses to taxpayers and to a misallocation of economic resources.

Empirical evidence on the effects of deposit insurance on bank risk taking offers mixed results. Karels and McClatchey (1999) could not find evidence that deposit insurance implementation increased risk levels of the US credit unions on the 70’s and 80’s. Wheelock and Wilson (1994) and Alston et al. (1994) could not find a relationship between bank failures rates and deposit insurance in the US on the 20’s. Conversely, Wheelock (1992) and Thies and Gerlowski (1989) found a positive and significant relationship. Studies by Kane (1989), McKenzie et al. (1992) and Cole (1993) suggest that moral hazard behavior was responsible for

a significant portion of the Savings & Loans losses of the 80's. Other studies proposed that the degree of risk taking of banks may be influenced by the amount of uninsured debt banks carry on their balance sheets (Dewatripont and Tirole, 1993a; and Calomiris, 1999).

This paper aims to contribute with the ongoing debate about the effects of introducing explicit deposit insurance on risk-taking behavior of banks. Existing empirical evidence on this topic tends to use U.S. or European data or uses samples that pool developing and developed countries information that usually are at different stages of financial sophistication³. There is limited evidence for developing countries, regarding the effects of DIS on risk taking behavior in an environment without a market system in which banks are publicly traded. Moreover, the studies that use data from emerging market economies perform their analysis at the cross-country level (Demirgüç-Kunt and Huizinga, 2004; Brown and Dinç, 2005; Apanard and Class, 2010). This paper tries to fill this void by testing the effects of DIS on moral hazard from a single emerging market economy perspective. Specifically, we want to empirically test our hypothesis that risk, measured through various financial indicators, increased in the Ecuadorian private banking system after deposit insurance was implemented in 2009.

We have two main reasons for using data on the Ecuadorian banking system to analyze whether deposit insurance implementation increases risk-taking behavior or not. First, Ecuador, a country with a turbulent economic and political history, offers a unique economic setting to examine DIS effects. With a dollarized economy⁴, the Central Bank of Ecuador (BCE) cannot use orthodox monetary policy tools (e.g., currency devaluation or exchange rates adjustments) to stabilize the economy and has limited ability to act as the lender of last resort (i.e., to help banks in liquidity or solvency problems). In fact, the country's constitution⁵ expressly prevents the government (central bank included) from bailing-out banks. For this reason, it is very important for Ecuador to have

³ For example, Angkinand and Wilhborg 2010 analyzes specifically how government foreign ownership and shareholder rights affect the disciplinary effect of partial deposit insurance systems in a cross-section analysis of industrial and emerging market economies, as well as in emerging markets alone.

⁴ The Ecuadorian economy was officially dollarized on March 13th, 2000 when President Gustavo Noboa signed the "dollarization law".

⁵ The current constitution is the 20th to be in place in Ecuador. It was approved by a constitutional referendum on September 28th, 2008.

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a strong financial system that can serve as an efficient tool to promote economic development and growth. A stable financial system has, as one of its pillars, a sound deposit insurance system that serves to promote confidence and trust among depositors. Our second reason to use Ecuador as the object of our analysis is related to deposit insurance. The country has a relatively young deposit insurance system that was full operational on May 2009⁶. Therefore, data on private banks financial statements is easily available, allowing us to compare risk levels between the pre and post deposit insurance periods.

The remainder of the paper is organized as follows. Section 2 describes the link between deposit insurance and moral hazard. In section 3 we provide some background of the Ecuadorian economic and political history. In Section 4 we describe the dataset we use and provide some summary statistics. Section 5 presents the methodology and empirical specification. Results are reported in section 6. Section 7 examines the robustness of our results and section 8 concludes.

2. Deposits insurance systems and moral hazard

The first deposit insurance system was established in the US as a response to the banking crisis of 1933. These were the times of the great depression when banking conditions deteriorated rapidly. Although it is not possible to point out any single factor that caused the crisis, we can say that the suddenness of deposits withdrawals played an important role by starting a panic of great proportions. There was a massive bank run affecting most of the states which quickly started declaring bank holidays. The panic reached its peak on March 1933 forcing President Roosevelt to proclaim a nationwide bank holiday on March 6⁷. Between 1932 and 1933, 5453 banks failed and the losses borne by depositors added up to USD \$709 million (on average 16,4% of deposits in failed institutions)⁸. In the aftermath of the banking crisis, the Federal Deposit Corporation (FDIC) was created in order to provide deposit insurance guaranteeing the safety

⁶ Actually, Ecuador had already created the Agencia de Seguro de Depositos (AGD) in 1998. However, the AGD was a complete failure partly due to mismanagement and corruption. Depositors perceived the AGD to serve only banks' interest and lost confidence on the agency from early on.

⁷ Roosevelt was elected on November 1932 and his inauguration day was on March 4 1933. The bank holiday proclamation was one of the first official acts as the US president.

⁸ Source: Federal Deposit Insurance Corporation (FDIC) www.fdic.gov

of depositors' accounts in member banks. The main purpose for its creation was to prevent bank runs from happening again. Since FDIC inception on January 1st, 1934, no depositor has lost any insured funds as a result of a bank failure⁹. Due to its success, many countries have followed the US example and have implemented deposit insurance systems to protect bank deposits. As of January 2014, 113 countries have instituted some form of explicit deposit insurance up from 12 in 1974 and another 40 are considering its implementation¹⁰.

As mentioned above, deposit insurance is born from the necessity to prevent sudden bank runs that may contribute to the collapse of the whole banking system. In order to serve its primary objective, DIS needs to promote and maintain public confidence in a stable system. Thus, by protecting depositors from the risk of loss, DIS removes incentives for rapid deposits withdrawals in the case of a bank failure. Given its role of promoting financial stability and protecting savers from loss, DIS is considered a fundamental pillar of any financial system safety net. Still, deposit insurance also has its detractors. Much of the criticism focus on moral hazard issues that can be introduced after DIS is implemented. In systems without deposit insurance, depositors and creditors have strong incentives to monitor banks' behavior. If high levels of risk are perceived, depositors will demand higher returns, increasing funding cost and discouraging risky behavior. However, as explained in Weinstein 1992, with deposit insurance "[Banks] are sheltered from the rigors of the market [discipline] because risky activities are unlikely to cause depositors to depart undercapitalized [or risky] banks". Depositors have no incentive to punish risky behavior because the insurance scheme in place protects them from the risk of loss¹¹. Because deposit insurance may separate risk from reward, that insurance can catalyze moral hazard (Weinstein 1992). Moreover, with deposit insurance, banks can shift risk towards the insurer. The direct cause of moral hazard lies in the incentives for an insured financial institution to operate in a risky fashion without real economic risk to its owner and/or managers.

The FDIC proposes three methods to contain the effects of moral hazard when DIS is implemented. First, regulators need to promote good

⁹ Taken from the article: Who is the FDIC? Retrieved from <https://www.fdic.gov/about/learn/symbol/index.html>

¹⁰ Source: International Association of Deposit Insurers (IADI) www.iadi.org

¹¹ In fact, no punishment from depositors is a signal of confidence in the system, the main objective of any DIS.

corporate governance and management of individual institutions. Second, market discipline may be exercised by uninsured depositors and other creditors. And third, regulatory discipline exercised by supervisors and deposit insurers. Literature in this topic also offers possible mechanisms to constrain moral hazard. Benston et al. (1986) also argue that uninsured depositors, other debtors, and equity holders can constrain risk-taking behavior through the threat of higher funding cost. Marcus (1984) points out that bank charter values may limit excessive risk-taking behavior. Saunders et al. (1990) shows that risk-averse managers may limit risky behavior. Cooper and Ross (2002) argue that introducing additional capital requirements can reduce the problems associated with deposit insurance.

3. Ecuador's economic and political historical background

Even though this is not a paper about the economic history of Ecuador, we think it is important to highlight the most relevant economic and, inevitably, political events that preceded the implementation of DIS in 2009. Taking into consideration this historical context will help us understand the importance of DIS and of its possible negative effects (i.e., increase in risk-taking behavior) in a country like Ecuador. In 1927, the “Law of Banks” was enacted in order to regulate the organization and functioning of financial institutions. More than six decades later, in 1994, this law was reformed by the “General Law of Institutions of the Financial System”. This law enabled a liberalization and deregulation process in the banking system by eliminating certain controls and regulations imposed by the previous law (e.g., “off-shore” branches are legalized). Around the same time of the expedition of this law, Ecuador started to experience great political and economic instability. Between 1995 and 2000 there were four different presidents¹², Sixto Durán-Ballén (1992-1996), Abdalá Bucaram Ortiz (1996-1997), Fabián Alarcón Rivera (1997-1998) and Jamil Mahuad Witt (1998-2000). This political instability had consequences at the economic level. As we can see in Table 1 below, macroeconomic indicators worsened during this period and eventually resulted in the financial crisis of 1999.

¹² By the Ecuadorian constitution each presidential mandate should last four years.

Table 1: Macroeconomic indicators in Ecuador (1995 – 1999)

	1995	1996	1997	1998	1999
GDP growth	1,75	2,40	4,05	2,12	(6,30)
Inflation	22,80	25,50	30,70	43,40	60,70
International reserves (in millions USD)	1,557	1,831	2,093	1,698	1,276
Lending interest rate	59,92	45,96	39,02	60,53	74,97
Borrowing interest rate	47,72	33,68	31,53	49,45	47,71
Exchange rate*:					
Buy USD (in sucres)	2.563,94	3.198,51	3.997,70	6.573,98	11.767,80
Sell USD (in sucres)	2.566,00	3.191,34	3.998,96	6.582,08	11.838,76

* Average rate for the period

Source: Central Bank of Ecuador

In addition to this political environment, Ecuador was ending its international border warfare dispute against Peru, “the Cenepa War”, in 1995. Oil prices fell down to USD 9,20 per barrel in 1998. The country’s external debt increased because of a problematic fiscal deficit that was partly caused by the strong effects of the “Niño Weather Phenomenon” that struck the Pacific in this same year. By the end of 1999, the Ecuadorian economy collapsed affecting the real and financial sectors. The “sucre” (the official currency at the time) lost almost 70% of its value in one year. There was a financial crisis during which the government declared a bank holiday and deposits were frozen. Some banks were bailed out and others were forced to merge; a total of 24 private banks failed and the government took over the ownership of 2 others. In January 9th 2000, in what is perhaps the most shocking economic event in the history of Ecuador, Jamil Mahuad, president at the time, announced the official dollarization of the economy by adopting the American dollar as the country’s legal tender¹³. The decision was made as an extreme solution to control a massive devaluation of the Ecuadorian sucre which lost 17% of its value in the first week of January and the hyperinflation of around 100% by June 2000¹⁴. This situation had consequences at the social level as well. These measures did not have social support and people’s street demonstrations against them ended with president Mahuad overthrown from power¹⁵.

¹³ The official exchange rate at which the economy was dollarized was \$25.000 sucres per US dollar.

¹⁴ Exchange rate and inflation information was taken from the Central Bank of Ecuador

¹⁵ President Jamil Mahuad was overthrown from power on January 21st, 2000

It is evident that the collapse of the Ecuadorian economy by the end of year 1999 was caused by a combination of many unfortunate events. However, the root of the problems that caused many banks to fail during the crisis aroused from moral hazard issues that were common practice in the banking sector of the time. Since the deregulation of the banking industry that started in 1994, many important banks started concentrating their loans portfolios on a small number of borrowers, usually businesses owned by the own banks shareholders or by the shareholders' acquaintances. The loans concentration ratios, in terms of banks' technical capital¹⁶, ranged from 35% in Banco La Previsora to 299% in Banco Litoral (Análisis Semanal, No. 6, 1999). This situation evidenced a clear example of bank mismanagement that benefited a small group of businesses and people that had personal connections with banks' managers and owners. At the same time, banks started facing liquidity problems caused in part by the slowdown of the economy. In order to alleviate this issue, the Central Bank of Ecuador started to offer emergency loans to banks in need of liquidity. Still, instead of using the extra funds to solve the issue, banks immediately transfer the money as loans to the same "connected" businesses and people, exacerbating the problem even further. The highly concentrated loans and the liquidity issues affected the solvency of many banks that ended up bankrupt and liquidated. When the biggest banks¹⁷ started to have solvency issues, the government initiated a bail-out plan to avoid a systemic crisis. There was a generalized panic among depositors that lost confidence in banks and demanded their deposits back. In order to avoid a massive bank run, on March 1st 1999, Mahuad's government declared a bank holiday that froze deposits nationwide for a whole year.

After the bank holiday was declared, the government created the Agencia de Garantía de Depósitos (AGD), Ecuador's first attempt to protect its citizens bank deposits. The AGD was a public institution not only in charge of guarding deposits and building back depositors' trust but also of reestablishing the proper functioning of the banking system. Regarding this last point, the AGD had the authority to intervene in banks and to provide them with financial resources necessary to overcome their solvency problems. Up to a great extent, the AGD was playing the role of

¹⁶ The maximum lawful limit for this type of loans was 20% (Central of Ecuador)

¹⁷ Filanbanco and El Progreso were the two biggest banks (in terms of their assets) in Ecuador that had to be bailed out and eventually failed (Revista Gestion, No. 45, marzo 1998)

a central bank in terms of regulating the financial system as well as the role of a superintendence of banks in terms of supervising and controlling. However, the AGD was not successful in achieving its objectives. On the one hand, AGD's failure was partly caused by political maneuvering and corruption that prevented it from effectively performing its duties. On the other hand, banks kept having liquidity and solvency issues due to deep structural problems of the financial system and a very slow economic recovery.

As mentioned above, Ecuador adopted the dollar as a policy alternative to bring economic and financial stability. The country started enjoying the expected benefits of dollarizing the economy soon after it was announced. For example, bank deposits that were frozen a year earlier were released in March 2000 and this did not translate into a bank run. By the first quarter of 2000 the economy started showing signs of recovery. Real GDP grew 5,1% in 2001, 3.4% in 2002, 2.7% in 2003, and bouncing back to 7% in 2004. By 2003 inflation rate dropped to single digits¹⁸ to 7,9%, reflecting the stabilizing effect of dollarization. In 2004, as expected from a dollarized economy, inflation finally converged to US rates. In this year inflation for the year was only 2,7%.

Politically things did not change a lot. After Mahuad was deposed in early 2000, the political environment was still chaotic and fragile. There were three more presidents in a period of only six years (2000-2006). However, since January 2007, when President Rafael Correa was elected for his first mandate¹⁹, Ecuador has lived a period of political stability. From the beginning, Correa's government started a great reform of the political and economic environment with new and unorthodox ideas. One of the changes more relevant to this paper is the creation of the so called "Financial Safety Net (FSN)" in late 2008. The FSN was created to contribute to the stability of the financial system, to stimulate depositors' confidence, to establish an efficient payment system, and to promote economic growth through domestic savings. Given the unfortunate economic history of the country, the FSN main objective is to reduce the probability of bank failures and prevent systemic contagion. The FSN was created based on four fundamental pillars for economic stability: (1)

¹⁸ It was the first year since 1972 that Ecuador registered single digits inflation rates.

¹⁹ Rafael Correa was officially declared president on December 4th, 2006 and was sworn into office on January 15th, 2007

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prudential regulation and supervision, (2) lender of last resort, (3) banking resolution mechanism, and (4) deposit insurance.

Given the nature of this paper we will focus the last part of this section describing pillar number four from above. The Deposit Insurance Corporation (COSEDE) was created in 2008²⁰ and is in charge of managing the deposit insurance system of private banks. It insures all deposits in financial institutions that are subject to the control of the Superintendence of Banks up to USD \$32.000. Since 2011, it also insures deposits in financial institutions that belong to the cooperative sector up to USD \$11.000²¹. As of September of 2014, COSEDE is in charge of promoting two of the fundamental pillars of the FSN. Under the new monetary law enacted in 2014, COSEDE serves as the insurer of deposits in the private banking system, as the insurer of deposits in the cooperative and popular system, as the insurer of private insurance companies, and it also manages the “liquidity fund”. This means that COSEDE not only manages the deposit insurance system but also serves as the lender of last resort in case of banks are in need of liquidity (these two functions correspond to pillars 2 and 4). The law that created COSEDE explicitly excludes from the insurance system deposits from people or businesses that have direct or indirect connection with bank managers and/or owners. It also excludes deposits in off-shore branches and commercial paper issued by financial institutions. These exclusions aim to prevent risk shifting towards the insurer through misappropriation of funds. We cannot forget that these three exclusions are related to the main reasons why many banks failed during the financial crisis of 1999. Finally, the deposit insurance scheme is financed with financial institutions premiums. Banks have to make two different kinds of payments every month: a fixed premium and a risk adjusted premium. These premiums are calculated as a percentage of the average of daily deposits registered by each bank. The fixed premium is set within the range of 0.3% to 0.65% annual rate. While the risk adjusted premium can go from 0% to 0.35% annual rate. In any case, payments of both premiums cannot add up to more than 0.65% of the average of daily deposits. COSEDE’s board of directors is in charge to set the annual rates for both premiums within the ranges described above.

²⁰ Although created on December 2008, COSEDE began to operate on May 2009.

²¹ Deposits in financial institutions that are under supervision of the Superintendence of the Cooperative and Popular Sector are also insured by COSEDE. Depending in the size of the financial institution on this sector, the maximum amount insured is either \$1.000 or \$11.000.

4. Data

This paper uses aggregated monthly financial statements data (i.e. balance sheet and income statement) from the Ecuadorian private banking system²² from January 2007 to December 2014. The data was obtained from a number of different sources. The balance sheet and income statements are from the Superintendence of Banks. Macroeconomic data (e.g., GDP, inflation, Economic Activity Index) are either from the Central Banks of Ecuador or the World Bank database. As we aggregate financial statements information for the whole private banking system, we did not require banks to have observations for the entire sample period. This process yields a sample of 1507 variables²³ with 96 observations each. We further compute other variables needed to calculate the different financial ratios that are used as our proxies to measure risk. Adding these new variables and ratios, the final aggregated dataset contains 1699 variables with 96 monthly observations each. Macroeconomic variables collected are Nominal GDP, inflation, Economic Activity Index (EAI), and lending and borrowing rates. Table 2 presents some descriptive statistics for the main variables of this paper.

We can see that the average monthly amount of total assets in the private banking system was USD \$21,4 billion which grew at a rate of 1,14 percent per month during the sample period. Average insured deposits amounted to USD \$16,3 billion and represented on average 95,6 percent of all deposits in the system. Private banks obtained positive net gains during the period with an average of USD \$161 million per month. We also grouped banks as BIG²⁴ and SMALL in terms of their size (i.e., total assets).

²² For most of the sample period, from January 2007 to December 2014, there were 26 private banks operating in Ecuador. No monthly observations include aggregated financial statements information of less than 22 private banks at any point.

²³ Corresponding to every account of the balance sheet and income statements that banks required to report to the Superintendence of Private Banks.

²⁴ We follow the Superintendence of Private Banks classification of the big group that includes the four largest banks in terms of total assets. We classified all the other 22 banks in the SMALL group.

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Table 2: Descriptive statistics for main variables in the dataset (2007 – 2014)

Variable	N	Mean	Min.	Max.	Std. Dev.
Capital adequacy ratio 1	96	0,043	0,024	0,061	0,010
Capital adequacy ratio 2	96	0,024	0,013	0,034	0,005
Capital adequacy ratio 3	96	0,011	0,007	0,012	0,001
Capital adequacy ratio 4	96	0,017	0,013	0,023	0,003
Loan delinquency ratio	96	0,031	0,023	0,037	0,003
Liquidity ratio 1	96	0,207	0,150	0,270	0,028
Liquidity ratio 2	96	0,289	0,226	0,362	0,027
Liquidity ratio 3	96	0,434	0,396	0,486	0,019
Financial risk	96	0,103	0,093	0,116	0,004
Operating risk	96	0,531	0,480	0,565	0,018
Leverage risk	96	8,758	7,657	9,735	0,406
Diversification	96	0,377	0,290	0,496	0,056
Percentage change in total assets (%)	96	1,144	-18,49	22,434	3,475
Percentage change in total liabilities (%)	96	1,168	-15,23	20,355	3,146
Insured Deposits (\$1,000)	96	16.382.923,00	8.487.741,92	26.347.108,90	5.150.668,20
Insured Deposits/Deposits	96	0,956	0,944	0,974	0,005
Total assets (\$1,000)	96	21.417.667,60	11.597.185,20	33.466.917,70	6.475.417,23
Deposits/Assets	96	0,762	0,724	0,787	0,015
Net Income (\$1,000)	96	161.309,40	15.699,67	394.773,90	96.414,95
Economic Activity Index	96	403,03	307,03	530,03	78,05

Note: for variables definitions see Appendix 1

In appendix 1, we present summary statistics for each group in order to compare their differences; the main ones are described here. The BIG group includes the four biggest banks²⁵ in the system while the SMALL group includes the other twenty-two. Big banks hold 62,6 percent of all the assets in the private banking system. In terms of insured deposits the BIG group holds 62,4 percent of them. One can easily think of the devastating effects that a failure of one of these banks can have on the deposit insurance system. Also, these four banks can be considered as too-big-to-fail for the systemic effect that individually can cause in case of failure.

5. Empirical methodology

This paper uses time series methodology and tests in order to analyze the moral hazard effects of deposit insurance in the Ecuadorian private banking sector. As banks are not publicly traded, there is not market price information available and instead we use non-market measures of risk-taking behavior. We use some of the financial ratios proposed in Karels

²⁵ The four biggest banks are: Pichincha, Guayaquil, Produbanco, and Pacifico.

and McClatchey (1999) and three others²⁶, commonly used in the literature of this topic, as our measures of risk. Using balance sheet and income statement information, we construct these indicators and group them as follows²⁷: (1) capital adequacy; (2) loan delinquency; (3) liquidity; (4) other financial indicators commonly used; and (5) indicators to be used in our robustness analysis. In table 3 below, we have a complete list of all the risk measures used in this paper.

Table 3: Risk measures and their expected effect

These financial indicators are used as dependent variables in our regression analysis. We use this ratios to test our hypothesis that risk has increased in the Ecuadorian banking system after deposit insurance was implemented on 2009. The first column lists the different groups of indicators we use. Then, the second column presents the actual ratios and the financial accounts used to construct them. The last column shows the sign of the normalized time trend (t), independent variable, from the regression analysis that we expect to observe as evidence to support our hypothesis.		
Group:	Financial indicator:	Expected signed of normalized time trend*
Capital adequacy	CA1: total capital over total loans CA2: total capital over total assets	negative
Loan delinquency	LD1: loans delinquent 2 months or more/ total loans	positive
Liquidity	LR1: cash & due from banks / total assets LR2: 1-(total loans / deposits) LR3: 1-(total loans / total assets)	negative
Other commonly used	Financial risk (FR): equity over assets Operating risk (OR): net loans over assets Leverage risk (LevR): liabilities over equity	negative positive positive
Robustness indicators	CA3: legal reserves over total assets CA4: total reserves to total assets DM: diversification measure	no effect negative negative

* the normalized time trend takes the value of 0 for observations before May 2009. It equals 1 for May 2009 and increases by one thereafter.

These indicators are used as dependent variables in our regression analysis. The second column (Table 3) presents the actual ratios and the financial accounts used to construct them. The last column shows the

²⁶ These are: financial risk, operating risk, and leverage risk

²⁷ We follow Karels and McClatchey (1999) classification of these indicators.

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expected sign of the normalized time trend (independent variable) used in our regression analysis. We are interested in the sign of this coefficient because it will provide us with evidence to support our main hypothesis. More details on this trend and its interpretation will be given as we further describe our methodology.

Risk can be measure through capital adequacy ratios because of how total capital is composed. In this paper we calculate total capital as:

$$\text{total capital} = \text{reserves} + \text{retained earnings}$$

The reserves account reflects capital determined by regulation while retained earnings are the funds retained from each period's net income. This last component of capital is complete under managerial control. Without deposit insurance, banks' managers would have used retained earnings as an extra safety. Conversely, insurance would have replaced this safety, thus changes in retained earnings are expected to reflect effects on risk behavior²⁸.

Loans delinquency is directly related to asset risk. This paper uses the proportion of delinquent loans²⁹ in the loans portfolio as another measure of risk. With deposit insurance, depositors perceive the system as more stable and trust more of their money to banks. Then, with higher deposits intake, banks can issue more loans, increasing the probability of a higher proportion of problematic loans in the portfolio, thus increasing asset risk. Banks with lower liquidity face higher risk in the case depositors demand their money back suddenly. As deposit insurance eliminates the probability of these sudden withdrawals, banks are able to hold more long-term assets that pay higher returns by decreasing liquidity. But, keeping low liquidity ratios for long times may increase the risk of insolvency.

Chernykh and Cole (2011) examines the benefits and cost of deposit insurance in the Russian banking system. The authors use as measures of risk the financial risk ratio and the operating risk ratio. The former is measured by the ratio of bank equity to assets ratio and the latter is

²⁸ There was no regulatory changes on the minimum amount of legal reserves that a bank must hold in Ecuador.

²⁹ Loans on default of interest and capital payments for two months or more.

measured by the ratio of bank loans to assets. These two indicators are also use in our analysis. Following Gropp and Vesala (2004), we also use the leverage risk as another risk measure. Leverage risk is defined as the ratio of equity to assets. The rationale for the use of this ratio is given by the authors in their paper, “It measures the degree of gearing of the bank; the more highly geared a bank is, the riskier it, as its cushion against an unexpected deterioration in the quality of its assets is smaller than in a less leveraged bank”.

Finally, we need a model to test our hypothesis that risk has increased in the Ecuadorian banking system after deposit insurance was implemented on 2009. This model would need to capture changes in the trend of the dependent variable (i.e. financial indicators described above) during the post-insurance period. If deposit insurance influenced the behavior of risk ratios, their value would have changed from the pre-insurance level to a post-insurance level. Thus, we use the following reduced form model to test our hypothesis:

$$risk_t = \beta_0 + \beta_1 trend + \beta_2 X_t + \beta_3 X_{t-1} + \beta_4 Z + \varepsilon_t$$

where $risk_t$ is the financial indicator used to measure risk in each period t . $trend$ is a normalized time trend that takes the value of 0 for observation before May 2009, equals 1 for May 2009, and increases by one unit thereafter. A significant $trend$ coefficient suggests that the risk ratio value changed after deposit insurance was implemented. The expected sign of this coefficient is listed in table 3 for each of the financial indicators used. The variable $X_t = (assets_t - assets_{t-1})/assets_{t-1}$ in the capital and liquidity regressions or $X_t = (liabilities_t - liabilities_{t-1})/liabilities_{t-1}$ in the delinquency regressions. The percent change in assets or loans (X_t), and its lag value (X_{t-1}), are used in order to control for changes in economic conditions and cyclical fluctuations. Month dummies are also included in the model in order to control for the seasonality of deposits and other macroeconomic changes (these dummies are included in matrix Z).

6. Results³⁰

Monthly aggregated financial statements data is employed to calculate industry financial indicators for the period 2007 – 2014. All regressions are corrected for first-order autocorrelation and also report robust standard errors. Estimation results for the capital adequacy ratios and the loan delinquency ratio are presented in Table 4. Results for liquidity ratios are in Table 5 and Table 6 shows results for the last three financial indicators used.

Table 4: Capital adequacy ratios and loan delinquency ratio regression results

This table presents regression results for the capital adequacy ratios and the loan delinquency ratio (our proxies to measure risk). For each indicator, results in column (1) were estimated using OLS while column (2) results were corrected for first-order autocorrelation. In both cases, monthly dummies were also included in the regressions; however this results are not reported due to space. All regressions report heteroskedasticity corrected standard errors. Sample period Jan. 2007 to Dec. 2014						
	CA1: Total Capital to Total Loans		CA2: Total Capital to Total Assets		LD1: Loans Delinquent 2+ months/Total Loans	
Variables	(1)	(2)	(1)	(2)	(1)	(2)
trend	-0.000198*** (1.63e-05)	-0.000193*** (3.01e-05)	-8.97e-05*** (8.48e-06)	-8.75e-05*** (1.61e-05)	-3.35e-05*** (1.11e-05)	-1.85e-05 (4.50e-05)
pctTA	0.000285* (0.000167)	0.000123 (0.000133)	9.01e-05 (7.92e-05)	2.53e-05 (6.85e-05)	-0.000265** (0.000133)	-6.09e-06 (7.53e-05)
L.pctTA	0.000244 (0.000236)	3.39e-05 (9.44e-05)	7.71e-05 (0.000115)	-1.14e-05 (4.66e-05)	-0.000203 (0.000210)	7.22e-05* (3.91e-05)
Constant	0.0358*** (0.00191)	0.0366*** (0.00211)	0.0193*** (0.000877)	0.0197*** (0.00105)	0.0309*** (0.00112)	0.0310*** (0.00214)
Observations	94	94	94	94	94	94
R-squared	0.893	0.878	0.888	0.883	0.337	0.768

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As we can see in Table 4, capital adequacy ratios were affected by the implementation of deposit insurance. Coefficients for the normalized time trend are negative and significant at the 1 percent level. This suggests that discretionary capital (retained earnings) decreased during in the period with deposit insurance. On the other hand, the proportion of delinquent loans in the loans portfolio was not affected by deposit insurance. In fact, the negative coefficient for the time trend in these regressions suggests that loans delinquency ratios have decreased overall

³⁰ Results are obtained running OLS estimations and Pries-Winsten estimation to correct for autocorrelation of first-order (see Prais and Winsten 1954). Heteroscedasticity corrected standard errors are also reported for all regressions.

in the banking industry. However, this result is not statistically significant after controlling for autocorrelation at any of the standard confidence levels. A reason to explain the lack of effect of deposit insurance over delinquency on loan is that Ecuador has lived relatively good and economic times during this period³¹. Thus, the possible negative effects of deposit insurance over this indicator were offset by people's stable income stream that was used to repay their debts on time. In terms of liquidity risk, Table 5 shows mixed results. In general, system-wide liquidity measures were not affected by deposit insurance implementation. Two of the three indicators used to measure liquidity risk are

Table 5: Liquidity ratios regression results

This table presents regression results for the capital adequacy ratios and the loan delinquency ratio (our proxies to measure risk). For each indicator, results in column (1) were estimated using OLS while column (2) results were corrected for first-order autocorrelation. In both cases, monthly dummies were also included in the regressions; however this results are not reported due to space. All regressions report heteroskedasticity corrected standard errors. Sample period Jan. 2007 to Dec. 2014						
	LR1: Cash & Due from Banks / Total Assets		LR2: 1-(Total Loans / Shares & Deposits)		LR3: 1-(Total Loans / Total Assets)	
Variables	(1)	(2)	(1)	(2)	(1)	(2)
trend	-0.000843*** (8.32e-05)	-0.000746*** (0.000277)	-4.35e-05 (0.000107)	0.000179 (0.000515)	-0.000310*** (6.83e-05)	-0.000219 (0.000279)
pctTA	0.00123** (0.000602)	0.00102*** (0.000365)	0.00191 (0.00120)	0.000819*** (0.000301)	0.00161* (0.000837)	0.000712*** (0.000210)
L.pctTA	0.00115** (0.000481)	0.000745** (0.000308)	0.00190** (0.000803)	0.000583* (0.000350)	0.00142** (0.000608)	0.000400* (0.000234)
Constant	0.229*** (0.00525)	0.223*** (0.0144)	0.290*** (0.0100)	0.277*** (0.0285)	0.443*** (0.00779)	0.437*** (0.0152)
Observations	94	94	94	94	94	94
R-squared	0.642	0.612	0.130	0.444	0.329	0.818

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

negative but only one of them is significant (at the 1% level). The other one is insignificant and even positive. Table 5 does not provide any conclusive results.

As shown in Table 6, banks have increased their leverage in response to the implementation of deposit insurance. The trend coefficient is positive, as expected, and significant at the 1% level. Results in this table also provide further evidence that capital adequacy indicators have been

³¹ The effects of the world economic crisis of 2007-2008 did not severely impact the Ecuadorian economy.

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negatively impacted by deposit insurance. Financial risk as measured by the ratio of equity over assets has decreased during the post-insurance period. We also observe that operating risk increased for the post-DIS period suggesting that the proportion of loans in the assets portfolio increased after deposit insurance. As explained above, this can translate into a problem of higher defaults on loans payments. However, the trend coefficient in this case is not significant.

Table 6: Alternative ratios to measure risk regression results

This table presents regression results for the capital adequacy ratios and the loan delinquency ratio (our proxies to measure risk). For each indicator, results in column (1) were estimated using OLS while column (2) results were corrected for first-order autocorrelation. In both cases, monthly dummies were also included in the regressions; however this results are not reported due to space. All regressions report heteroskedasticity corrected standard errors. Sample period Jan. 2007 to Dec. 2014						
	Financial risk: equity over assets		Operating risk: net loans over assets		Leverage risk: liabilities over equity	
Variables	(1)	(2)	(1)	(2)	(1)	(2)
trend	-0.000143*** (1.12e-05)	-0.000150*** (3.16e-05)	0.000235*** (6.67e-05)	0.000149 (0.000266)	0.0136*** (0.00104)	0.0148*** (0.00311)
pctTA	-0.000170 (0.000184)	-0.000175*** (4.99e-05)	-0.00141 (0.000908)	-0.000555*** (0.000188)	0.0144 (0.0155)	0.0146*** (0.00406)
L.pctTA	-0.000131 (0.000203)	-8.63e-05** (4.06e-05)	-0.00128** (0.000562)	-0.000335 (0.000214)	0.0116 (0.0178)	0.00769** (0.00329)
Constant	0.107*** (0.00105)	0.107*** (0.00166)	0.525*** (0.00796)	0.530*** (0.0144)	8.345*** (0.0997)	8.353*** (0.152)
Observations	94	94	94	94	94	94
R-squared	0.681	0.934	0.265	0.899	0.692	0.910

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The time series results suggest that capital adequacy ratios and leverage ratios in the Ecuadorian private banking system have decreased after deposit insurance was implemented in 2009. In terms of liquidity and loans delinquency, we observed the expected signs for the coefficients (negative for liquidity and positive for delinquency) but these results are not conclusive as they are not statistically significant. Overall, the time series evidence suggests that the adoption of deposit insurance in Ecuador has led to an increase in risk-taking behavior as proxied by various financial indicators.

7. Robustness

For our robustness analysis we have taken two approaches. First, we use alternative financial indicators that ex-ante should not have been affected

by deposit insurance implementation. CA3 is the ratio of legal reserves to assets. The legal reserves account is out of control of banks' managers. CA4 is the ratio of total reserves to assets. Although it includes a discretionary component, Ecuadorian banks total reserves are mainly composed of legal reserves. We also include the proportion of non-interest income in total income to measure banks' willingness and ability to diversify into non-lending, non-traditional activities, and to some extent will also proxy for the banks' "innovation ability" as in Gropp and Vesala 2004. It is expected that as a bank diversifies its operations, its risk levels decrease. Thus, we expect to observe a negative and significant coefficient as support for our hypothesis. Table 7 shows the estimation results for the first approach of our robustness analysis. We can see how deposit insurance had no effect on the time trend of the alternative capital adequacy ratios, as expected³². From the diversification aspect, we find that the private banking industry in Ecuador has decreased its diversification activities, increasing its loans portfolios and thus increasing risk-taking behavior.

Table 7: Robustness analysis regression results

This table presents regression results for the financial indicators used to check the robustness of our specification. For each indicator, results in column (1) were estimated using OLS while column (2) results were corrected for first-order autocorrelation. In both cases, monthly dummies were also included in the regressions; however this results are not reported due to space. All regressions report heteroskedasticity corrected standard errors. Sample period Jan. 2007 to Dec. 2014

Variables	CA3: Legal Reserves to Total Assets		CA4: Total Reserves to Total Assets		Diversification: non- interest income over	
	(1)	(2)	(1)	(2)	(1)	(2)
trend	2.94e-05*** (4.35e-06)	2.87e-05 (1.97e-05)	-1.76e-05*** (6.02e-06)	-1.68e-05 (1.19e-05)	-0.00206*** (9.96e-05)	-0.00216*** (0.000491)
pctTA	-2.81e-05 (4.36e-05)	-3.84e-05*** (1.11e-05)	-2.49e-05 (6.16e-05)	-7.67e-05** (2.95e-05)	0.000449 (0.00102)	0.000121 (0.000166)
L.pctTA	-1.44e-05 (4.03e-05)	-2.72e-05** (1.23e-05)	-3.25e-06 (4.75e-05)	-5.43e-05 (4.02e-05)	0.000278 (0.00111)	-2.02e-05 (0.000133)
Constant	0.0100*** (0.000374)	0.00937*** (0.00127)	0.0168*** (0.000770)	0.0169*** (0.000943)	0.413*** (0.00954)	0.428*** (0.0268)
Observations	94	94	94	94	94	94
R-squared	0.386	0.572	0.747	0.724	0.857	0.868

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

³² Both coefficients are statistically insignificant at all conventional levels.

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In our second approach, we run the time series analysis for BIG and SMALL banks separated. We group banks into two groups in terms of their total assets. This is based on the notion that big banks, which constitute a large share of the banking system³³, do not adjust their risk taking with deposit insurance. Even more, we propose that big banks increase their risk-taking behavior reflecting the “too-big-to-fail” issue. Table 8 shows the estimation results for regressions including only big banks data. Conversely, Table 9 shows results for small banks only. For the Big group we observe that for all but two financial indicators, the coefficient of the time trend has the expected sign and is also significant at least at the 5% level. On the other hand, the SMALL group regressions show mixed results. For the most part, small banks have either decreased or have had no impact on their risk level during the post-insurance period. We interpret this finding as evidence that “too big to fail” has become an even more relevant issue after the adoption of deposit insurance and further that the limit of the safety net to depositors is only credible for smaller banks.

³³ As mentioned in section 4, the BIG group is composed by the four largest banks in Ecuador that hold 62.7% of the system assets.

Table 8
Regression results for financial indicators using BIG banks aggregated data only

This table presents regression results for the various financial indicators used as proxies to measure risk in this paper. Description of each indicator is the same as in the tables used above (see appendix 1 for further detail). Data used in this table comes from the aggregated financial statements of BIG banks only for the period 2007 -2014. For each indicator, results were corrected for first-order autocorrelation. Monthly dummies were also included in the regressions; however this results are not reported due to space. All regressions report heteroskedasticity corrected standard errors.

Variables	CA1	CA2	ID1	LR1	LR2	LR3	Fin. Risk	Oper. Risk	Lev. Risk	Diversification
trend	-0.000340*** (4.92e-05)	-0.000161*** (2.11e-05)	6.53e-05 (4.28e-05)	-0.000949*** (0.000347)	-0.000300 (0.000473)	-0.000578** (0.000231)	-0.000168*** (3.51e-05)	0.000498** (0.000215)	0.0163*** (0.00354)	-0.00216*** (0.000223)
pcfTA	-1.69e-05 (0.000120)	-4.34e-05 (6.39e-05)	-7.09e-05 (5.63e-05)	0.000762** (0.000377)	0.000588** (0.000237)	0.000717*** (0.000186)	-0.000206*** (5.73e-05)	-0.000470*** (0.000154)	0.0158*** (0.00439)	0.000218 (0.000189)
L.pcfTA	-5.77e-05 (0.000104)	-4.57e-05 (5.05e-05)	8.68e-07 (3.30e-05)	0.000596* (0.000321)	0.000422 (0.000302)	0.000394* (0.000209)	-9.02e-05** (4.33e-05)	-0.000283 (0.000185)	0.00737** (0.00326)	1.58e-05 (0.000147)
Constant	0.0462*** (0.00339)	0.0247*** (0.00150)	0.0256*** (0.00187)	0.220*** (0.0184)	0.302*** (0.0255)	0.458*** (0.0126)	0.109*** (0.00181)	0.503*** (0.0116)	8.162*** (0.162)	0.458*** (0.0115)
Observations	94	94	94	94	94	94	94	94	94	94
R-squared	0.814	0.836	0.653	0.505	0.487	0.836	0.920	0.888	0.886	0.884

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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Table 9
Regression results for financial indicators using SMALL banks aggregated data only

This table presents regression results for the various financial indicators used as proxies to measure risk in this paper. Description of each indicator is the same as in the tables used above (see appendix 1 for further detail). Data used in this table comes from the aggregated financial statements of SMALL banks only for the period 2007-2014. For each indicator, results were corrected for first-order autocorrelation. Monthly dummies were also included in the regressions; however this results are not reported due to space. All regressions report heteroskedasticity corrected standard errors.

Variables	CA1	CA2	CA3	CA4	LD1	LRI	LR2	LR3	finrisk	operatrisk	leverrisk	diversif
trend	5.44e-05*	2.42e-05	2.87e-05	6.69e-05***	-0.000123***	-0.000383**	0.000911*	0.000325	-0.000124***	-0.000362	0.0126***	-0.00233**
	(2.93e-05)	(2.54e-05)	(1.97e-05)	(1.33e-05)	(4.00e-05)	(0.000161)	(0.000541)	(0.000339)	(3.34e-05)	(0.000332)	(0.00328)	(0.00101)
pctTA	0.000206*	8.79e-05	-3.84e-05***	-1.97e-05	0.000142	0.00181***	0.00182***	0.00103***	-0.000199***	-0.000101***	0.0201***	-0.000562*
	(0.000119)	(7.03e-05)	(1.11e-05)	(6.13e-05)	(0.000129)	(0.000333)	(0.000446)	(0.000334)	(4.75e-05)	(0.000306)	(0.00476)	(0.000316)
LpctTA	0.000171	7.51e-05	-2.72e-05**	3.86e-05	0.000206**	0.00105***	0.00122***	0.000677**	-0.000131***	-0.000665**	0.0131***	-0.000331*
	(0.000112)	(6.62e-05)	(1.23e-05)	(4.29e-05)	(8.54e-05)	(0.000299)	(0.000395)	(0.000289)	(4.40e-05)	(0.000268)	(0.00420)	(0.000190)
Constant	0.0201***	0.0120***	0.00937***	0.00980***	0.0368***	0.226***	0.240***	0.405***	0.104***	0.572***	8.649***	0.386***
	(0.00167)	(0.00134)	(0.00127)	(0.000558)	(0.00208)	(0.00810)	(0.0312)	(0.0190)	(0.00160)	(0.0186)	(0.154)	(0.0630)
Observations	94	94	94	94	94	94	94	94	94	94	94	94
R-squared	0.902	0.896	0.572	0.723	0.801	0.699	0.406	0.733	0.926	0.885	0.903	0.738

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

8. Conclusions

This paper analyzed the effects of the implementation of deposit insurance in the private banking system of Ecuador. Using time series analysis, we find evidence to support our hypothesis that the adoption of explicit deposit insurance may significantly increase risk-taking behavior of banks. We observed that this increase in risk has mainly been driven by larger banks behavior. Small banks risk levels have either decreased or remained unchanged during the post-insurance periods. Our finding suggest that from a single emerging market economy perspective, the implementation of deposit insurance create incentives for banks to increase their risk-taking behavior, as other papers have shown. Previous papers that concluded that deposit insurance does not increase moral hazard have largely used data from developed economies (i.e., US and EU) or have use panel datasets with countries at different stages of financial sophistication. A reason for the difference in results may be that developed economies have stronger institutions and well developed financial markets through which market discipline is better exercised. Deposit insurance main objectives are to promote a stable banking system and to protect depositors from the risk of loss. Although the Ecuadorian banking system has been stable during our sample period, regulator should pay more attention to the moral hazard issue. Only four banks hold more than 60% of the assets in the banking system. Failure of one of these banks will have devastating effects not only in the deposit insurance system but also in whole economy.

Our estimation results are in the most part conclusive and support our hypothesis that deposit insurance increases moral hazard. However, we have performed our analysis using aggregated financial data. Future research on this topic can perhaps pool data on individual banks to test for deposit insurance effects on moral hazard. Deposit insurance also promotes depositors trust in the banking system as reflected by an increase in deposits. This is another area that has not been tested in the Ecuadorian case. Finally, the use of different methodology as well as the use of alternative measures of risk can strengthen the result on this paper.

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Appendix 1

Table A2: Descriptive Statistics for both BIG and SMALL banks in the sample (2007 – 2014)

BIG					
Variable	N	Mean	Min.	Max.	Std. Dev.
Capital adequacy ratio 1	96	0,049	0,025	0,078	0,013
Capital adequacy ratio 2	96	0,027	0,014	0,041	0,007
Capital adequacy ratio 3	96	0,012	0,007	0,015	0,002
Capital adequacy ratio 4	96	0,020	0,014	0,029	0,004
Loan delinquency ratio	96	0,029	0,021	0,036	0,003
Liquidity ratio 1	96	0,201	0,133	0,280	0,035
Liquidity ratio 2	96	0,300	0,248	0,370	0,030
Liquidity ratio 3	96	0,445	0,391	0,495	0,024
Financial risk	96	0,104	0,093	0,121	0,005
Operating risk	96	0,514	0,467	0,565	0,021
Leverage risk	96	8,589	7,272	9,772	0,426
Diversification	96	0,409	0,317	0,501	0,055
Percentage change in total assets (%)	96	1,266	-22,77	29,992	4,321
Percentage change in total liabilities (%)	96	1,350	-18,57	26,335	3,892
Insured Deposits (\$1,000)	96	10.226.667,00	5.139.409,00	17.300.000,00	3.373.382,00
Insured Deposits/Deposits	96	0,960	0,945	0,973	0,005
Total assets (\$1,000)	96	13.391.848,00	7.027.539,00	22.100.000,00	4.297.802,00
Deposits/Assets	96	0,761	0,722	0,785	0,014
Net Income (\$1,000)	96	105.354,50	10.152,64	273.040,60	64.492,25
Economic Activity Index	96	403,03	307,03	530,03	78,05
SMALL					
Capital adequacy ratio 1	96	0,034	0,014	0,045	0,008
Capital adequacy ratio 2	96	0,020	0,008	0,027	0,005
Capital adequacy ratio 3	96	0,008	0,006	0,010	0,001
Capital adequacy ratio 4	96	0,013	0,009	0,020	0,003
Loan delinquency ratio	96	0,034	0,023	0,044	0,005
Liquidity ratio 1	96	0,217	0,183	0,257	0,019
Liquidity ratio 2	96	0,272	0,188	0,350	0,034
Liquidity ratio 3	96	0,417	0,369	0,475	0,021
Financial risk	96	0,100	0,092	0,108	0,004
Operating risk	96	0,559	0,502	0,606	0,021
Leverage risk	96	9,047	8,246	9,922	0,405
Diversification	96	0,323	0,239	0,489	0,066
Percentage change in total assets (%)	96	0,961	-11,79	12,062	2,669
Percentage change in total liabilities (%)	96	0,891	-10,30	12,355	2,422
Insured Deposits (\$1,000)	96	6.156.256,00	3.320.820,00	9.313.793,00	1.785.578,00
Insured Deposits/Deposits	96	0,951	0,929	0,976	0,009
Total assets (\$1,000)	96	8.025.819,00	4.544.426,00	11.800.000,00	2.189.093,00
Deposits/Assets	96	0,763	0,722	0,798	0,018
Net Income (\$1,000)	96	55.954,87	5.547,03	126.113,70	32.982,75
Economic Activity Index	96	403,03	307,03	530,03	78,05

Note: the BIG group is composed by the 4 biggest banks in terms of total assets. The SMALL group is composed by the other 22 banks.

The Effect of Minimum Wage Policies on Economy and Employment: The Case of Thailand as a Part of the AEC

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The ASEAN Economic Community (AEC), established at the end of 2015, created an integrated regional economy with a single market and production base. This study attempts to estimate the impact of wage policies on the economy and employment of Thailand as a part of the AEC by using a computable general equilibrium model. The paper also suggests appropriate policies for a sustainable Thai economy in the long run.

The results indicated that negative correlations between minimum wage and the gross domestic product, and minimum wage and employment are the result of higher costs of production. Therefore, in this study, increasing minimum wage or subsidy wage policies are not appropriate for Thailand under the AEC because these policies would reduce investment and reduce incentives to accumulate human capital. The study found that increasing labor productivity can compensate the effect from these negative wage policies. However, a lower minimum wage led to an increase in the gross domestic product, investment, and employment for both the skilled and unskilled labor force in every sector. The study measured various adjustments in both minimum wage and labor productivity for policy makers.

Keywords: ASEAN Economic Community, Computable General Equilibrium, Minimum wage, Productivity of labor

1. Introduction

The minimum wage in Thailand is an important topic for debate. The potential effects of minimum wage government interventions on the economy and employment in Thailand with the newly liberated labor market under the ASEAN Economic Community (AEC)³ is a concern

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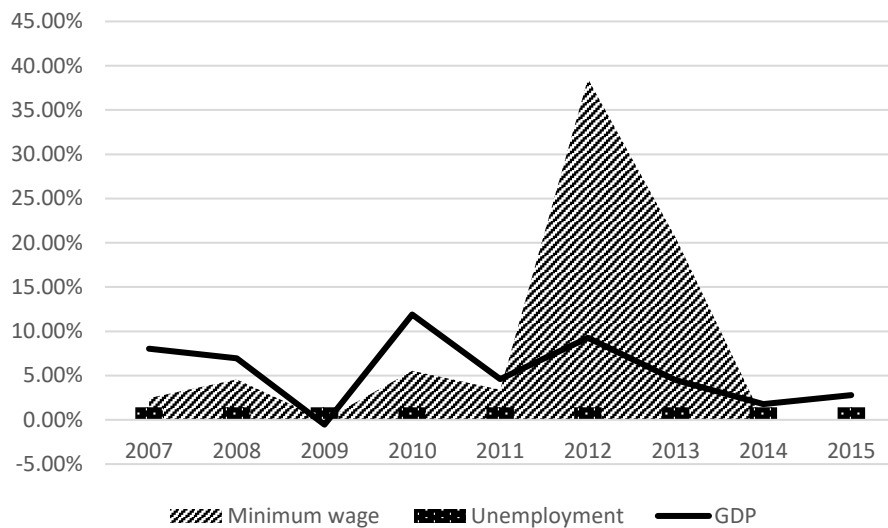
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³ At the Bali Summit in October 2003, ASEAN leaders declared that the AEC shall be the goal of the regional economic integration (Bali Concord II) by 2020 (AEC Blueprint). However, at the

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The Case of Thailand as a Part of the AEC

among Thai policy makers. Therefore, it is important to consider the policy options available to the Thai government.

Figure 1: Growth of gross domestic product (GDP), growth of the minimum wage, and the unemployment rate of Thailand



Source: Bank of Thailand, National Statistical Office of Thailand, and Ministry of Labour

Before the creation of the AEC, unemployment in Thailand was very low at around 1% on average from 2007 to 2015, see Figure 1. This indicates a tight labor market in Thailand. In 2012, the Thai government increased the minimum wage to 300 baht per day. This policy coincided with a lower Thai GDP growth rate. The change in the minimum wage policy was probably not the only factor behind the fall in GDP growth. Therefore, it is important to quantify the effect of the wage policy on the economy using a more thorough approach.

This study investigated the ways in which wage policies in Thailand, under the AEC, affect the economy as a whole and the labor market in particular. We considered the effects of three policy mechanisms which are (i) a minimum wage increase, (ii) a rise in minimum wages with government subsidization, and (iii) a minimum wage cut. The outcomes

12th ASEAN Summit in January 2007, ASEAN leaders have changed the establishment date of the AEC to 2015.

of these policy changes were then compared in order to determine which approach might be the most beneficial option for the Thai economy.

The paper is divided into three parts. The first part is a literature review including literature on minimum wage policies and on the relationship between economic integration, the minimum wage, and labor productivity. The second part discusses the methodology containing the conceptual framework and the setup of the scenarios of the minimum wage adjustment and the labor productivity shock. The third part shows the results and the policy implications of the wage policy and labor productivity shocks on the economy and employment of Thailand under the AEC.

2. Literature Review

All countries around the world have some type of wage intervention by their government. The impact of a minimum wage policy has many aspects both social and economic impacts. Policy makers have often claimed that an increase in the minimum wage results in an increase in the income of the low-wage labor force, thereby serving as a means to reduce both inequality and poverty (Jayanthakumaran, Sangkaew, & O'Brien, 2013; Dolado, et al., 1996). However, its opponents have argued that it may take low-skill laborers out of jobs (Dolado, et al., 1996). There are studies which revealed that setting the minimum wage at a higher level can result in a lower level of employment (Holland, Bhattacharjee, & Stodick, 2006; Carpio, Nguyen, & Wang, 2012; Akpansung, 2014). This can be seen as a trade-off between wages and employment. The occurring employment reduction are spread broadly across all industries and regions and are not just focused on the industries which are highly labor intensive (Dixon, Madden, & Rimmer, 2009).

However, it has been shown that increasing the minimum wage does not in every case result in an increase in the unemployment rate (Reich, Jacobs, & Bernhardt, 2014). Raising wages can help to increase productivity as the employees are encouraged to work harder. This leads to a fall in turnover and companies are thus more likely to provide training to their staff (Raff & Summers, 1987; Levine, 1992).

Terra, Bucheli, Laens and Estrades (2006) stated that subsidy policies have a positive impact on GDP. They conducted a study in which wages

of unskilled workers were subsidized and found that wages increased, while GDP also benefitted due to efficiency gains derived from the fall in informal employment or unemployment. The subsidy stimulated the demand for unskilled laborers, thereby offsetting some of the fall in demand that would result from the inefficiencies caused by the wage premium. Subsidizing unskilled laborers' wages may therefore lead to higher employment levels and a better income distribution. However, the long term effects of such a policy may not be beneficial due to potentially negative consequences. The shortcomings are a likely fall in investment and a potential reduction in the incentive to accumulate human capital. This could adversely affect future growth rates. Thus, it is advisable to apply this policy only to specific labor sectors (Terra, Bucheli, Laens, & Estrades, 2006).

A study in the Democratic Republic of Congo by Erero, Pambudi, and Bonga (2013) examined the effects of subsidizing wages in the formal employment sector for unskilled laborers. The researchers employed a multi-sectoral empirically-calibrated general equilibrium (CGE) model to assess all the transactions taking place within the economy between the informal and formal sectors. The simulation showed that when the wage of the unskilled labor force was subsidized, household incomes in both formal and informal sectors increased, thus narrowing the income gap between rich and poor households, and also between informal and formal sectors. Also, targeting the unskilled formal laborers with the wage subsidy caused an increase in GDP in both the short-run and long-run.

According to Heckscher–Ohlin's predictions, increased trade openness should narrow the wage gap between the skilled and unskilled labor force in developing countries due to an increase in the demand of unskilled labor. Revenga and Montenegro (1998) studied the evolution of average industry wages in Mexico relative to the United States. They found that the Mexico-U.S. wage gap was positively correlated with Mexican tariffs. A reduction in tariffs were associated with a reduction of the relative Mexico-U.S. wage gap for the unskilled as well as the skilled labor force (Revenga & Montenegro, 1998). Moreover, Hanson (2003) reported wage changes in Mexico were positively correlated with wage changes in the United States (Hanson, 2003).

Although eliminating trade barriers would presumably lower profit margins of domestic firms and cause a proportional decline in wages, it

induces higher productivity. Casacuberta, Fachola, and Gandelma (2004) found that in response to reductions in trade barriers, the Uruguayan manufacturing sector undertook a technological update in favor of more capital-intensive technologies which positively affected labor productivity (Casacuberta, Fachola, & Gandelman, 2004).

In developing economies, the effect of minimum wage changes on employment is negative and statistically significant, especially on small businesses and workers who have a low level of education (Carpio, Nguyen, & Wang, 2012; Carpio, Messina, & Galdeano, 2014). The impact is typically less dramatic for large companies and educated workers with a high school or higher degree. Moreover, Carpio *et al.* (2014) studied minimum wages in Thailand and found that minimum wages had a negative effect on employment, especially among less-educated or unskilled laborers. Understanding the effects of minimum wage policies, labor productivity, and policy changes on the economy and employment are important, especially for Thailand where many sectors rely on small or informal businesses.

3. Methodology

The study used a dynamic multi-countries CGE model to investigate the potential effects of wage policy decision on the economy and employment in Thailand. The objective of this study is to estimate the effects of different wage policies and changes in labor productivity on the Thai economy under the AEC.

A CGE model can capture interactions of economic factors due to wage policy changes (Maechler & Holst, 1995). Thus, it is an appropriate model for this study.

The model in this study is structured into nine sets of equations, which are production, income and saving, producer supplies of products and international trade, prices, equilibrium conditions of all markets, GDP, dynamic conditions of investment variables, Walras' law, and closure rules. The complete list of equation sets, variables and parameters are available upon request. It is calibrated from the 2007 GTAP 8 Data Base with 2007 also being the baseline year.

3.1 Model's assumptions

The basic assumptions for the CGE model are as follows. Prices were set at market-clearing levels, while businesses and consumers maximized their profits and utilities respectively. The proposed economy was expected to reach equilibrium in each market after supply and demand adjusted themselves in response to the relative costs of production. The production structure of businesses was assumed to encompass zero economic profits. The exogenous growth projection variables were drawn from several sources, see Table 1.

There are 7 closure rules: government spending growth equals to GDP growth, investment growth equals to GDP growth, household saving growth equals to GDP growth, the exchange rate is fixed, the GDP deflator of the rest of the world (ROW) is a numeraire, minimum consumption growth equals labor supply growth, and migrant labor wage growth equals to inflation growth. Different assumptions may affect the results of this studies empirical simulation.

Table 1: Growth rates of exogenous variables (unit in percentage per year)

Country	GDP growth (percent per year)	Labor supply growth ⁴ (percent per year)	Saving growth (percent per year)
Cambodia	4.49	2.35	-3.88
Indonesia	5.89	1.66	3.87
Lao PDR	7.94	2.88	-0.30
Malaysia	4.10	2.05	-3.60
Philippines	4.43	2.35	-3.34
Singapore	4.89	2.41	-0.01
Thailand	3.27	1.02	-1.84
Vietnam	6.06	1.90	1.11
REST OF ASEAN	9.75	1.95	5.11
ROW	1.85	1.38	-0.04

Source: (Fouré, Bénassy-Quéré, & Fontagné, 2012)

⁴ The labor force is composed of workers aged 15 years and older who are defined by the International Labour Organization (ILO) as members of the economically active population. The labor force includes employed and unemployed people, but members of the armed forces or people in seasonal or part time work may sometimes be considered differently depending on the country concerned. Housewives, caregivers who are not paid and informal laborers are not included in the labor force, *Key indicators of the labor market database* (ILO).

The model contains nine production sectors and commodities, five primary factors of production, four agents (households, firms, government, ROW), three types of taxes (import tax, indirect tax, and direct tax), and ten countries, see Table 2.

The model differentiates four types of factors of production which are capital, land, natural resources, and labor. Capital can flow freely. Land and natural resource are assumed to be completely immobile. There is one type of household and two types of workers which are either skilled or unskilled. Labor is assumed not to be freely mobile in the model. There is one government in each country. The governments in each country get their funds from the three previously defined types of taxes.

Table 2: Countries, production sectors and commodities and primary factors classification

Countries	Sectors and Commodities	Factors
Thailand	Grains and crops	Unskilled labor force ⁵
Singapore	Livestock and meat products	Skilled labor force
Malaysia	Mining and extraction	Capital
Philippines	Processed food	Land
Indonesia	Textiles and clothing	Natural resource
Vietnam	Light manufacturing	
Cambodia	Heavy manufacturing	
Lao PDR	Utilities and construction	
Rest of ASEAN ⁶	Other services	
ROW		

3.2 Data

The CGE model used in this study is based on a dynamic multi-country model developed by Partnership for Economic Policy (Decaluwé, Lemelin, Maisonnave, & Robichaud, 2013). The model parameters are calibrated with a multi-country Social Accounting Matrix based on data provided by the 2007 GTAP 8 Data Base (Narayanan, Aguiar, &

⁵ Labor was splitted by skill level — skilled and unskilled — based on ILO's classification of occupations, (Narayanan, Aguiar, & McDougall, 2012).

⁶ Data in the GTAP 8 Data Base (Narayanan, Aguiar, & McDougall, 2012) combines Myanmar and Brunei and we use Rest of ASEAN to represent these two countries.

McDougall, 2012). The model was implemented in the General Algebraic Modeling System ⁷.

3.3 Model setup

3.3.1 Business as usual (BAU)⁸ setup

The study simulated the effect of minimum wage policies and changes in labor productivity on the Thai economy under the AEC. The AEC was simulated according to elements of economic integration; zero import and export taxes, improvement of the investment climate, and a reduction in trade costs, see Table 3.

Table 3: Components of the AEC

Condition	Description
Zero tariff	The conclusion of the terms of the ASEAN Free Trade Agreement which sought to eliminate all remaining tariffs within ASEAN. In the model, the tariffs did set import and export taxes between ASEAN countries equal to 0%.
Improved investment climate	The investment climate were was modeled by increased FDI foreign direct investment inflows to each ASEAN country by 1% of relative to its GDP (Petri, Plummer, & Zhai, 2012)
Reduced trade costs	Lower trade barriers reduces the costs of international trade which reflects from the elimination of administrative burden and customs processes and procedures. Since the details of these barriers are neither clear nor available, the model assumes a reduction in trade costs of 5% of trade values (Petri, Plummer, & Zhai, 2012)

Table 4 reports the average real GDP value per country for the BAU case in 8 years in the first column. The second column compares the AEC effect on the real BAU GDP by showing the percentage change the AEC would induce on real BAU GDP per country after 8 years under the AEC. The last two columns compare the yearly GDP growth rates over the 8 years for these two scenarios. The base model found that Cambodia and Vietnam have the highest gains of GDP growth from the AEC by 6.07%

⁷ <https://www.gams.com/>

⁸ Business as usual (BAU): AEC integration is occurred but no change in wage policy.

and 4.60% respectively while Thailand would gain a 2.35% GDP increase relative to the BAU case. The results from Table 4 are consistent with the existing literature as economic integration normally had a positive effect on the member countries (Plummer & Yue, 2009; Akapaiboon, 2010; Petri, Plummer, & Zhai, 2012). The percent growth of each country under the AEC are more than in the BAU scenario. Thus, the AEC clearly has a positive effect for every ASEAN member country.

Table 4: Effects of scenario shock to real GDP (the first 8 years under the AEC)

Country	Billion US Dollar	Average percent change from BAU	Average percent growth per year	
	BAU	AEC	BAU	AEC
Cambodia	8.62	6.07	3.77	4.46
Indonesia	501.91	1.28	4.99	5.23
Lao PDR	5.30	4.15	6.64	7.27
Malaysia	201.51	3.14	4.06	4.53
Philippines	157.48	1.75	4.33	4.60
Singapore	163.10	3.32	3.63	4.08
Thailand	248.93	2.35	2.81	3.18
Vietnam	64.57	4.60	3.57	4.24
REST OF ASEAN	37.21	2.79	8.48	8.89
ROW	54,728.16	-0.02	1.88	1.88

Source: Results from the study's model

3.3.2 Wage policy scenarios

The following models assumed wage to be exogenous. Wage increases cause a lower level of employment because the demand for labor will decline as the labor factor price increases. At the same time however, labor income increases together with demand for goods and services. We studied the following four different wage policies for Thailand.

- i. Minimum wage increase: The Thai government increases the minimum wage of unskilled labor in Thailand.

- ii. Minimum wage subsidy: The Thai government subsidizes the entire wage gap from the old to the new theoretical minimum wage by using the government budget to prevent rising costs on the production side.
- iii. Minimum wage decrease: The most extreme policy scenarios. The study assumed that there is no political backlash upon the government and that the labor force accepts the lower minimum wage.
- iv. Minimum wage and labor productivity increase: In order to compensate the negative impact of the increased minimum wage, the productivity of the workers who earned the minimum wage increased as well.

This paper studied different levels of minimum wage increases and decreases. The government set wage of the unskilled workforce in Thailand increased or decreased by either 6.7%, 20%, or 50% while that of the other countries in the AEC remained the same. These adjustment is assumed arbitrarily to observe a scaling effect of the different levels of changes in minimum wage. Since we do not have the minimum wage variable in the model, we computed the average change of wage by a rise of the minimum wage from 300 to either 320, 360, or 450 baht per day, respectively. We assumed that only 10%⁹ of the labor force in Thailand were paid the minimum wage of 300 baht per day. This group of labor is mostly from neighboring countries (CLM). Thai labors generally earn more than minimum wage. For simplicity, we assumed that the other 90% of labor in Thailand is unaffected by changes in minimum wage.

4. Results

This section consists of two parts. The first part shows the results of the combination of the minimum wage and labor productivity adjustments which simulated the effects of each scenario on the Thai and the other ASEAN economies. The second part discusses policy suggestions related to the results from the first part.

⁹ The report shows that about 3 million people were paid at minimum wage rate compared with the total labor force in Thailand at about 37 million people. Consequently, we arbitrarily assume a value of 10% for convenience (source: <http://service.nso.go.th/nso/nweb/statseries/statseries03.html>).

4.1 Effect of minimum wage adjustment and labor productivity of Thailand

Table 5 shows the simulation results of the effects of the different minimum wage policies and the labor productivity adjustment on real GDP (average for the first 8 years). In the case of Thailand, the model shows that the real GDP has a negative relationship with the minimum wage, it decreases with a higher minimum wage but increases with a lower minimum wage. When comparing an increase in the minimum wage and in productivity, the changes in GDP depend on two opposing effects. The increased minimum wage causes higher production costs and the firms decide to decrease their production level in turn causing GDP to fall. On the other hand, the higher labor productivity leads to an increase in the level of output, this causes the GDP to rise.

Under the AEC, Cambodia, the Lao PDR, and the Rest of ASEAN are affected significantly by changes in the minimum wage and labor productivity in Thailand. This is because Thailand is the major trading partner for these countries, see Table 6. When Thai firms produce more output it causes a higher volume of trade between Thailand and these countries, hence the effect is felt more significantly in these countries relative to the others in the study. This result is in line with the study of Hanson (2003) who studied the effects of the US wages on Mexico's wages.

From the results from Table 5, when minimum wage increased from 300 to 320 baht per day (6.67%) and unskilled labor productivity increased by 2.5%, then the Thai GDP declined by 0.40% per year comparing to a 0.54% yearly fall without the increase in unskilled labor productivity (The effect in term of average percent change per year of real GDP from BAU and average percent growth of real GDP for each scenario in the first 8 years under each scenario.). This can be explained by the effects of changes in wage and changes in labor productivity. A change in the minimum wages could lead to a substitution of labor for capital and, also, labor intensive sectors may reduce production. On the other hand, increasing unskilled labor productivity has some positive effects. First, given the competitive markets assumption, a fall in production costs as a result of increased productivity will be passed on to consumers through lower product prices. This will increase the domestic demand and, hence, increase output level. Also, the direct effect of the increase in labor

productivity will be a higher demand for that factor which will increase the Thai economy's output due to the wealth effect of the employees.

Table 5: Percentage change of ASEAN countries' GDP from BAU by varying minimum wage, government subsidy and labor productivity
(unit in percent change)

	Change in Labor Productivity Percentage	Change in Minimum Wage								
		Minimum Wage Increases			Government Subsidy			Minimum Wage Decreases		
		6.67	20	50	6.67	20	50	6.67	20	50
Thailand	0	-0.54	-1.58	-4.50	-0.12	-0.35	-1.11	0.55	1.70	5.61
	2.5	-0.40	-1.44	-4.37	0.02	-0.21	-0.97	0.69	1.84	5.77
	10	0.01	-1.03	-3.97	0.44	0.20	-0.56	1.11	2.27	6.22
	20	0.56	-0.50	-3.46	0.99	0.75	-0.02	1.66	2.83	6.81
Cambodia	0	-0.07	-0.21	-0.60	-0.03	-0.09	-0.29	0.07	0.22	0.72
	2.5	-0.05	-0.19	-0.59	-0.01	-0.08	-0.28	0.09	0.24	0.73
	10	0.00	-0.14	-0.54	0.04	-0.03	-0.23	0.14	0.29	0.78
	20	0.06	-0.08	-0.47	0.10	0.04	-0.16	0.20	0.35	0.85
Indonesia	0	0.02	0.05	0.14	0.01	0.02	0.06	-0.02	-0.05	-0.18
	2.5	0.02	0.05	0.14	0.01	0.02	0.06	-0.02	-0.05	-0.18
	10	0.02	0.05	0.15	0.01	0.02	0.06	-0.02	-0.05	-0.18
	20	0.02	0.05	0.15	0.01	0.02	0.06	-0.02	-0.05	-0.18
Lao PDR	0	-0.17	-0.49	-1.42	-0.07	-0.20	-0.61	0.17	0.53	1.73
	2.5	-0.14	-0.47	-1.40	-0.04	-0.17	-0.58	0.20	0.55	1.76
	10	-0.07	-0.40	-1.33	0.03	-0.10	-0.51	0.27	0.62	1.83
	20	0.02	-0.31	-1.24	0.12	-0.01	-0.42	0.36	0.72	1.93
Malaysia	0	0.00	-0.01	-0.02	0.00	-0.01	-0.04	0.00	0.01	0.03
	2.5	0.00	-0.01	-0.02	0.00	-0.01	-0.04	0.01	0.01	0.03
	10	0.01	0.00	-0.02	0.00	0.00	-0.03	0.01	0.02	0.04
	20	0.01	0.01	-0.01	0.01	0.00	-0.02	0.02	0.03	0.05
Philippines	0	0.01	0.04	0.12	0.00	0.01	0.04	-0.01	-0.04	-0.15
	2.5	0.01	0.04	0.12	0.00	0.01	0.04	-0.02	-0.05	-0.15
	10	0.01	0.04	0.12	0.00	0.01	0.04	-0.02	-0.05	-0.15
	20	0.01	0.04	0.11	0.00	0.01	0.04	-0.02	-0.05	-0.15
Singapore	0	0.02	0.05	0.16	0.00	0.00	0.00	-0.02	-0.06	-0.19
	2.5	0.02	0.05	0.15	0.00	0.00	0.00	-0.02	-0.06	-0.19
	10	0.01	0.05	0.15	-0.01	-0.01	-0.01	-0.03	-0.07	-0.20
	20	0.01	0.04	0.14	-0.01	-0.01	-0.02	-0.03	-0.07	-0.21
Vietnam	0	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	-0.01
	2.5	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00
	10	0.01	0.01	0.01	0.01	0.01	0.02	0.00	0.00	0.00
	20	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.01
Rest of ASEAN	0	-0.13	-0.38	-1.08	-0.04	-0.11	-0.35	0.13	0.41	1.39
	2.5	-0.12	-0.37	-1.06	-0.02	-0.10	-0.34	0.15	0.43	1.41
	10	-0.07	-0.33	-1.03	0.02	-0.06	-0.29	0.19	0.48	1.46
	20	-0.02	-0.27	-0.98	0.08	0.00	-0.24	0.25	0.54	1.53
ROW	0	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.01
	2.5	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.01
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01

Source: Results from the study's model

The ASEAN economies that are important Thai trading partners, Cambodia, the Lao PDR, and Rest of ASEAN, saw a reduction in their yearly GDP growth figures compared to the BAU case. This effect may be due the lower Thai output, this would cause a lower trade volume between Thailand and these countries which in turn impacts their GDP negatively.

Table 6: Share of ASEAN intra-trade from 2015-2023 (unit in percentage)

	Cambodia	Lao PDR	Rest of ASEAN	Thailand	Malaysia	Philippines	Singapore	Indonesia	Vietnam
Cambodia		0.00	0.01	19.52	1.77	0.15	3.81	1.45	7.45
Lao PDR	0.01		0.02	51.79	1.90	0.06	0.55	0.32	9.98
REST OF ASEAN	0.01	0.00		21.21	4.14	0.12	5.06	8.89	0.55
Thailand	0.71	0.59	1.70		6.65	1.83	4.77	3.61	2.09
Malaysia	0.06	0.02	0.30	6.03		1.95	13.16	3.63	1.40
Philippines	0.01	0.00	0.02	4.23	4.98		5.13	2.56	1.55
Singapore	0.11	0.00	0.32	3.78	11.50	1.76		6.61	1.96
Indonesia	0.07	0.00	0.94	4.76	5.28	1.46	10.99		1.42
Vietnam	0.74	0.31	0.12	5.69	4.20	1.82	6.75	2.93	

Source: Results from the study's model

In order to compensate the GDP loss from a 6.67% increase in minimum wage, a boost in unskilled workers' productivity by at least 10% expanded GDP by at least 0.01%, see Table 5. On the other hand, implementing a government subsidy to compensate for the 6.67% increase in minimum wage will require unskilled labor productivity to increase only by 2.5% to compensate for the negative effect on GDP which is 0.02% relative to BAU because the government will pay for the wage gap to support the production side.

Table 7: Percentage change of investment in Thailand from BAU by a 20 percent increase in labor productivity (unit in percent change)

Government Subsidy (%)	2016	2017	2018	2019	2020	2021	2022	2023
	-	-						
6.67	0.90	1.06	-1.09	-1.18	-1.29	-1.42	-1.55	-1.69
	-	-						
20	2.71	3.18	-3.28	-3.53	-3.87	-4.24	-4.64	-5.07
	-	-						
50	8.29	9.74	10.02	10.76	11.80	12.92	14.11	15.39

Source: Results from the study's model

Total investment was reduced overtime as shown in Table 7. This result is in line with the results of Terra *et al.* (2006). Agénor and Aynaoui (2003), also, found that, in the long run, minimum wage subsidy policy led to a disincentive of human capital accumulation and an unsustainable increase in fiscal deficits overtime.

In the decreased minimum wage scenario with increased unskilled labor productivity, Thai GDP increased since both changes have positive effects on GDP. The study arbitrarily assumes that the minimum wage of unskilled labor in Thailand will decrease without the political context and that the workers can accept the minimum wage. From our results, we can see that producers produced more products and hired more employees because of the cheaper costs of labor in Thailand relative to other countries in the AEC. Moreover, the higher labor productivity also had a positive impact on Thai GDP.

When minimum wage increased, the firm's cost were higher resulting in lower labor demand. Firms then decided to produce less. On the other hand, higher labor productivity per unskilled worker led to a higher output level.

Regarding government subsidizes, output decreased less than when the government increased the minimum wage because consumption increased due to a higher household income. However, output still declined since total investment decreased due to a lower amount of government saving.

Table 8: Percentage change of sectoral employment from BAU by varying minimum wage policies with a 2.5% increase in unskilled labor productivity in Thailand (unit in percent change)

	Percentage	Minimum Wage Increases			Government Subsidy			Minimum Wage Decreases		
		6.67	20	50	6.67	20	50	6.67	20	50
Unskilled Labor	Grains&Crops	-0.84	-3.03	-9.09	0.25	0.11	-0.43	1.49	3.94	12.52
	LiveStk&Meat	-1.03	-3.70	-11.01	0.51	0.76	1.51	1.82	4.85	15.57
	Mining&Extractn	-0.73	-2.65	-7.89	-0.12	-0.89	-3.21	1.31	3.49	11.22
	Procfood	-1.56	-5.59	-16.34	0.80	1.24	2.56	2.80	7.51	24.70
	Textiles&Clothing	-1.91	-6.82	-19.66	0.84	1.10	1.86	3.44	9.29	31.10
	LightMnfc	-1.83	-6.55	-18.94	0.72	0.80	1.03	3.29	8.87	29.52
	HeavyMnfc	-1.71	-6.13	-17.81	0.53	0.30	-0.38	3.08	8.28	27.43
	Util&Constuct	-1.95	-6.99	-20.24	-0.24	-2.18	-8.35	3.51	9.46	31.44
	OthServices	-1.80	-6.48	-18.78	0.71	0.75	0.84	3.28	8.80	29.23
Skilled Labor	Grains&Crops	-0.52	-1.86	-5.60	0.11	-0.03	-0.57	0.88	2.35	7.37
	LiveStk&Meat	-0.44	-1.50	-4.50	0.24	0.50	1.25	0.68	1.85	5.83
	Mining&Extractn	-0.50	-1.79	-5.33	-0.22	-0.99	-3.31	0.87	2.33	7.49
	Procfood	-0.28	-0.86	-2.48	0.23	0.67	1.98	0.31	0.93	3.02
	Textiles&Clothing	-0.48	-1.54	-4.53	0.20	0.45	1.21	0.63	1.79	5.75
	LightMnfc	-0.40	-1.25	-3.69	0.08	0.16	0.39	0.48	1.40	4.47
	HeavyMnfc	-0.28	-0.81	-2.34	-0.12	-0.34	-1.02	0.28	0.85	2.79
	Util&Constuct	-0.41	-1.27	-3.86	-0.92	-2.85	-8.99	0.47	1.35	4.15
	OthServices	-0.26	-0.74	-2.16	0.02	0.06	0.15	0.25	0.76	2.46

Source: Results from the study's model

From Table 8 we see that the net employment changes are negative in all sectors for both unskilled and skilled labors for a Thai minimum wage increase of 6.67% and a labor productivity hike of the unskilled labor force of 2.5%. Hence, the negative effect of the 6.67% minimum wage increase outweighed the positive effect of the unskilled labor productivity increase. Furthermore, the employment of unskilled labor decreased more than the employment of skilled labor in every sector, while the utilities & construction sector was most severely affected. This is because unskilled labor responses more to a change in the minimum wage than skilled labor

as the skilled labor wage stays constant. However, skilled labor is affected indirectly due to a lower level of production but with a relatively low amount because firms can partially use skilled labor instead of unskilled labor under the constant elasticity of substitution production function assumption. The simulation result is in line with Carpio *et al.* (2012) and Carpio *et al.* (2014) who claimed that the employment effects of a rise in the minimum wage are significant and negative on firms and on the less educated labor force or unskilled labor. Additionally, our result showed there is negative effect on skilled labor as well while Carpio *et al.* (2012) found no effect of an increased minimum wage on skilled labor.

Concerning the minimum wage subsidy scenario, sectoral employment changes are ambiguous while more subsidies on the minimum wage will cause higher labor demand for both skilled and unskilled labors in sectors with more favorable working conditions. From Table 8 we can see that the mining, agricultural, heavy manufacturing, and construction sectors lost workers to the other sectors, especially when the subsidies increase in size. Moreover, the employment of unskilled labor was affected by the minimum wage subsidy scheme more than the skilled labor force. This is because the relative price between unskilled and skilled labors becomes closer. As the subsidies increased, firms with hard working conditions which normally had paid more to attract workers, were not able to compete with firms in less demanding sectors anymore because the effective wage was in a similar range and the firms were not able to increase wages to much due to market competition both domestically and internationally.

In the decreased minimum wage scenario, employment increased in every sector for both unskilled and skilled labor. The minimum wage adjustment affected employment for both types of workers in the same direction but different in magnitude. Employment of unskilled labor was affected directly while skilled laborers were affected indirectly from the increase of the production level. However, this indirect effect was relatively lower since firm shifted to use unskilled labor instead of skilled labor under the constant elasticity of substitution production function assumption.

Table 9 shows the percentage changes from the BAU scenario of sectoral employment in Thailand of an increased unskilled labor productivity of 10% and varying minimum wages. Under this condition, employment of

unskilled labor mostly increased due to the higher productivity effect that outweighed the effect of the minimum wage hike for the lower values. However, employment of skilled labor still decreased. Additionally, in the subsidy and minimum wage decrease case, the employment numbers of unskilled labor increased more than the growth in employment of the skilled labor force in every sector. The utilities & construction sector showed the largest swings in employment. Some skilled workers may have lost jobs to unskilled ones due to the substitution effect as GDP remained almost unchanged, see Table 5.

Table 9: Percentage change of sectoral employment from BAU by varying minimum wage with a 10% increase in unskilled labor productivity for Thailand (unit in percent change)

	Percentage	Minimum Wage Increases			Government Subsidy			Minimum Wage Decreases		
		6.67	20	50	6.67	20	50	6.67	20	50
Unskilled Labor	Grains&Crops	0.08	-2.14	-8.25	1.17	1.03	0.48	2.42	4.90	13.56
	LiveStk&Meat	0.08	-2.63	-10.03	1.63	1.89	2.65	2.96	6.02	16.87
	Mining&Extractn	0.07	-1.87	-7.17	0.69	-0.10	-2.46	2.14	4.34	12.17
	Procfood	0.15	-3.96	-14.89	2.55	2.99	4.33	4.58	9.37	26.85
	Textiles&Clothin g	0.17	-4.84	-17.96	2.98	3.24	4.02	5.64	11.60	33.88
	LightMnfc	0.15	-4.65	-17.30	2.76	2.84	3.08	5.38	11.06	32.12
	HeavyMnfc	0.15	-4.35	-16.25	2.43	2.20	1.51	5.03	10.33	29.85
	Util&Constuct	0.17	-4.97	-18.49	1.92	-0.06	-6.34	5.74	11.80	34.21
	OthServices	0.21	-4.56	-17.12	2.77	2.81	2.90	5.39	11.02	31.86
Skilled Labor	Grains&Crops	-0.02	-1.36	-5.13	0.61	0.47	-0.07	1.38	2.86	7.91
	LiveStk&Meat	-0.11	-1.18	-4.19	0.58	0.84	1.59	1.01	2.19	6.19
	Mining&Extractn	0.00	-1.30	-4.88	0.28	-0.50	-2.86	1.39	2.86	8.08
	Procfood	-0.25	-0.83	-2.45	0.26	0.70	2.00	0.34	0.96	3.05
	Textiles&Clothin g	-0.28	-1.34	-4.34	0.40	0.66	1.42	0.83	2.00	5.96
	LightMnfc	-0.29	-1.15	-3.58	0.19	0.27	0.50	0.59	1.51	4.58
	HeavyMnfc	-0.29	-0.83	-2.35	-0.13	-0.35	-1.03	0.26	0.84	2.77
	Util&Constuct	-0.32	-1.17	-3.74	-0.84	-2.76	-8.87	0.55	1.42	4.19
	OthServices	-0.28	-0.76	-2.17	0.00	0.04	0.13	0.22	0.74	2.43

Source: Results from the study's model

In regard to the minimum wage subsidy scenario of a subsidy equal to an increase of the minimum wage of 6.67% and a 10% jump of the unskilled labor productivity, employment for unskilled labor increased in every sector and in most sectors for skilled labor. Higher subsidies caused a higher labor demand in sectors with relatively more favorable working conditions. These results are basically the same as the scenario where the

labor productivity was increased by 2.5%. However, we observe a smaller negative impact on employment due to the higher labor productivity increase which can keep firms competitive. In the decreased minimum wage scenario, employment in all sectors increased in both unskilled and skilled labor.

Table 10: Percentage change of sectoral employment from BAU by varying minimum wage with a 20% increase in unskilled labor productivity for Thailand (unit in percent change)

	Percentage	Minimum Wage Increases			Government Subsidy			Minimum Wage Decreases		
		6.67	20	50	6.67	20	50	6.67	20	50
Unskilled Labor	Grains&Crops	1.28	-0.97	-7.16	2.38	2.24	1.68	3.65	6.16	14.92
	LiveStk&Meat	1.54	-1.21	-8.72	3.11	3.38	4.15	4.46	7.57	18.58
	Mining&Extractn	1.13	-0.84	-6.22	1.76	0.94	-1.48	3.23	5.47	13.43
	Procfood	2.41	-1.79	-12.97	4.86	5.32	6.68	6.95	11.84	29.72
	Textiles&Clothin g	2.95	-2.21	-15.68	5.83	6.10	6.91	8.56	14.70	37.59
	LightMnfc	2.80	-2.13	-15.11	5.47	5.56	5.81	8.16	14.00	35.60
	HeavyMnfc	2.64	-1.98	-14.17	4.97	4.74	4.02	7.64	13.07	33.07
	Util&Constuct	2.99	-2.27	-16.14	4.80	2.78	-3.65	8.71	14.93	37.92
	OthServices	2.89	-2.01	-14.89	5.52	5.56	5.65	8.21	13.98	35.37
Skilled Labor	Grains&Crops	0.63	-0.72	-4.51	1.27	1.13	0.58	2.05	3.54	8.62
	LiveStk&Meat	0.33	-0.75	-3.77	1.02	1.28	2.04	1.46	2.64	6.66
	Mining&Extractn	0.67	-0.66	-4.28	0.95	0.14	-2.26	2.07	3.57	8.87
	Procfood	-0.21	-0.78	-2.41	0.30	0.74	2.04	0.39	1.01	3.09
	Textiles&Clothin g	-0.01	-1.08	-4.09	0.67	0.93	1.69	1.10	2.27	6.25
	LightMnfc	-0.15	-1.00	-3.44	0.33	0.41	0.65	0.73	1.65	4.71
	HeavyMnfc	-0.31	-0.85	-2.37	-0.15	-0.37	-1.05	0.24	0.82	2.75
	Util&Constuct	-0.21	-1.05	-3.59	-0.73	-2.64	-8.73	0.65	1.51	4.24
	OthServices	-0.30	-0.78	-2.19	-0.03	0.01	0.10	0.20	0.71	2.39

Source: Result from the study's model

Table 10 shows the percentage changes from the BAU scenario of sectoral employment in Thailand of an increased unskilled labor productivity of 20% and varying minimum wages. Employment of unskilled labor increased in most cases due to the higher productivity effect that outweighed some of the effect of an increased minimum wage. Further, employment of skilled labor still decreased in some sectors. Additionally, employment of unskilled labor increased more than employment of skilled labor in every sector and the utilities & construction sector gained or lost the most, respectively. Again, some skilled workers may have lost jobs to unskilled laborers due to the substitution effect.

For the 6.67% minimum wage subsidy scenario and a 20% jump of unskilled labor productivity, employment for the unskilled labor force increased in every sector and in most sectors for skilled employees, while more subsidies on the minimum wage caused a higher labor demand. In the decreased minimum wage scenario, employment in all sectors increased for both types of skill levels.

4.2 Policy suggestions

An increased minimum wage enhances the well-being of low-wage workers and strengthens domestic demand because laborers have more income for domestic consumption. Moreover, it induces the adjustment to a more knowledge and skilled-based society and firms focus on hiring staff with more knowledge and experience to make the higher cost of labor worth it. However, large and sudden increases in the minimum wage produce adverse effects as well because it causes lower employment due to the higher production costs. Small and medium-sized firms with large proportion of labor costs to total costs are hard hit in particular¹⁰. On the other hand, if Thai real wages do not grow, it is difficult to keep domestic demand growing steadily. Further, with a relatively low unemployment rate¹¹, Thailand has some room for higher minimum wages. Nevertheless, the Thai government should have a long-term plan for their wage policy.

In order to minimize the potential adverse impacts, the minimum wage should be increased along other policies that offset the adverse impacts. In this study for example, an increase in the minimum wage should be implemented after a productivity rise of the unskilled labor force has been recorded, otherwise the new minimum wage policy may help some groups of workers but increases the cost of living for everyone in the country including farmers. Furthermore, when wage grows faster than productivity, it will weaken the competitiveness of the country.

As seen in Table 5, if the Thai government intends to implement a 6.67% increase in the minimum wage from 300 to 320 Baht per day, unskilled

¹⁰ According to a study project on SME with the input-output table, the cost of labor and salary of SMEs, on average, accounted for 16.2% of all costs of inputs. Meaning if the minimum wage increased by 1 %, the cost of labor would increase by 0.16 %. *Source: The Office of SMEs Promotion (OSMEP) <http://www.sme.go.th/Lists/EditorInput/DispF.aspx?List=15dca7fb-bf2e-464e-97e5-440321040570&ID=1525>*

¹¹ *National Statistical Office of Thailand.*

labor productivity should increase at least 10% in order to have a positive real GDP change over the BAU scenario. However, a 10% labor productivity increase in one year is not realistic considering the historical growth rate of Thai labor productivity since the year 2000, see Table 11. However, assuming a similar skilled and unskilled labor productivity growth rate, a 2.5% per year increase is potentially possible. Thus, it takes about 4 years to accumulate an increase of 10% in unskilled labor productivity which then may fully compensate a real GDP loss from a 6.67% increase in the minimum wage. Therefore, if the Thai government wants to increase the minimum wage to 450 Baht per day it needs implement policies that increase labor productivity of all labor classes to shorten the time of compensation.

Table 11: Growth of labor productivity per person employed in Thailand

Growth of labor productivity per person employed (percent growth)										
Year	2000	2001	2002	2003	2004	2005	2006	2007	Average	Standard deviation
LP growth	2.35	0.83	3.08	4.72	3.57	2.61	3.65	3.81		
Year	2008	2009	2010	2011	2012	2013	2014	2015	2.62	2.36
LP growth	-0.46	-2.67	6.48	-0.5	5.75	2.98	2.91	2.84		

Source: The Conference Board 2015¹²

The simulation also shows that, currently, the relative wage in Thailand is high comparing to other ASEAN member states. A minimum wage policy has to be used with caution. The model suggests that, unless we improve the productivity of the unskilled workforce, a minimum wage policy that increases the minimum wage creates a negative effect on both the GDP growth and employment in Thailand. Also, the best policy to improve the well-being of low-wage workers and to sustain economic growth is to use a minimum wage subsidy policy together with an improving labor productivity of both skilled and unskilled labor. Using a government subsidy policy generates adverse effects on sectors with less favorable working conditions *i.e.* the agriculture, mining, heavy manufacturing, and utility and construction sectors. Other government actions are needed to mitigate these adverse effects if these sectors are strategically important to the country in the long run.

¹² The Conference Board Total Economy Database™, May 2015, <http://www.conference-board.org/data/economydatabase/>

5. Conclusions

The minimum wage in Thailand is an important topic for debate, with labor representatives seeking to increase the minimum wage. Higher wages of the unskilled labor force improves the livelihood of the low-income group and, also, increase domestic consumptions. A higher average wage induces demand for higher labor productivity in the private sector as a mean to preserve profit. This can be achieved by improving the productivity of the overall labor force, through a higher use of equipment, investment in knowledge and training of the unskilled staff or a shift of labor demand to skilled workers. Some unskilled workers may be negatively affected by the minimum wage policy. Furthermore, a single economy that raises its minimum wage will raise its wages relative to its competitors with adverse effects on the economy because of the higher costs of producing goods and services. This may lead to the relocation of the production to countries where labor is relatively cheaper, especially in labor-intensive industries. With the economic integration under the AEC, the Thai government must take a careful approach on any wage policy concerning the minimum wage.

The result of the study indicates negative correlations between the minimum wage and both the GDP and employment due to higher costs of production in Thailand. Therefore, increased minimum wage and subsidy wage policies are not appropriated for Thailand as a part of AEC because these policies reduce investment as well as bring about a disincentive to accumulate human capital. Although a lower minimum wage leads to a rise in GDP, investment, and employment for both skilled and unskilled laborers in every sector, it is politically hard to implement for policy makers.

Further, an increase in the minimum wage without any labor productivity growth could affect the economy harshly. In response to an increased minimum wage, productivity of workers who earn the minimum wage should increase in order to compensate for the negative impact of the minimum wage policy. This is because the advantages of the productivity increase causes producers to become more competitive which may lead to a substantial higher growth in the economy. The study measured the effects of adjustment in both the minimum wage and labor productivity which policy makers can use as a basis for adjusting minimum wages in Thailand. Also, the study reveals how different sectors react to the wage

policies as the effective wage increases, the sectors with unfavorable working conditions will see an adverse effect relative to the other sectors. Furthermore, it is clear that there will be a shift in employment from skilled to unskilled labor with policies that aim to increase the effective wages of the unskilled labor force.

This study provides results that support the findings of previous research in this field. Policies designed to support and enhance the condition of the Thai economy should be carefully constructed with full consideration of the connections of these wage policies on employment and the economy and the possible negative effects thereof.

For the further research, it would be interesting to specify the nature of the interactions between the formal and informal sectors of the economy as they are likely to affect the implementation of any wage policy on the labor market and the whole economy.

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Assets and Poverty Alleviation in South Africa: Evidence from the National Income Dynamics Study (NIDS)

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This paper investigates a number of factors responsible for asset poverty in South Africa. We use data from the first four waves of the National Income Dynamic Study to bring new evidence to bear on the determinants of assets poverty. We use the Principal Component Analysis (PCA) to create the asset index and the logit model to identify the main determinants of asset poverty in South Africa. Results of the logit model show that some factors such as education levels (secondary, matric and tertiary), race dummies and location dummies (farms and urban areas) have a reducing effect on asset poverty in South Africa. However, other factors – employment and household size have no significant effect on asset poverty.

Keywords: asset poverty, logit model, Principal Component Analysis, Kaiser-Meyer-Olkin.

JEL Classifications: I32

1. Introduction

Although poverty has decreased in South Africa in the past years, it remains high compared to other emerging market economies. For instance, the percentage of population living on less than \$1.90 a day in 2011 purchasing power parity (PPP) is 16.6% in South Africa compared to only 1.7% in Argentina, 3.7% in Brazil and 0.08% in Russia. Appropriate poverty policy responses in South Africa clearly require more understanding regarding the nature and causes of poverty.

Perhaps unsurprisingly, the issue of poverty has been on the agenda of the South African government for many years. For example, in 2004 the

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Accelerated and Shared Growth Initiative for South Africa (ASGISA) acknowledged the challenges of prolonged poverty and other related problems (unemployment, and low earnings, and the jobless nature of economic growth). The New Growth Path raised similar issues – unemployment and poverty remains extremely high by international standards. The most recent government policy (the National Development Plan) introduced in 2013 as South Africa's long-term socio-economic development roadmap placed even more emphasis on similar issues and was viewed as a policy blueprint for eradicating poverty and reducing inequality in South Africa by 2030 (Biyase and Zwane, 2017). While efforts to alleviate poverty have been somewhat successful, poverty remains very high by international standards.

Despite the fact that levels of poverty are high, there are reasons to believe that poverty headcount and income/consumption inequality indicators may not be the most appropriate measures to use. Sen (1981) has shed some light on why money metric measures may not be appropriate or adequate to use. He argues that pattern of consumption behaviour may not be uniform, so attaining the poverty line level of income does not guarantee a person will meet the minimum needs. Moreover, people may face different prices, reducing the accuracy of the poverty line. As regards income inequality, a most recent paper by Wittenberg and Leibbrandt (2017) find evidence to suggest that “the money-metric approach to inequality measurement in South Africa may have obscured the real progress in large portions of the population and in important dimensions of inequality”. Given these challenges there is a need for a more nuanced understanding of the complex socio-economic pathologies (such as poverty) facing South Africa.

The contribution of this paper is twofold. First, we apply asset index method to the measurement of poverty in South Africa. This asset index is constructed using Principal Component Analysis. An obvious strength of the principal component (see detailed discussion of its advantages in subsection 3.2) is that it is computationally easier and the weights assigned to each component in the analysis are not difficult to interpret since the weight assigned to any variable relates to the extent of the information provided about the other variables (Van der Berg et al., 2003; Bhorat et al., 2014). The second contribution of this study is that we further investigate the determinants of asset poverty using the logit model.

The paper proceeds as follows. In section two we review the existing empirical literature on asset poverty and its determinants. Section three then, describe the dataset and discusses the methods used in this paper. Section four presents the results, and section five concludes.

2. Literature survey

2.1. Problems associated with money-metric poverty measures

Much of the theoretical and empirical work on poverty in general, has focused on money-metric measures of poverty (for example, Serumaga-Zake and Naude, 2002; Van der Walt, 2004; Sekhampu, 2012; Statistics South Africa, 2014). These money-metric measures (such as income or consumption) are considered to be a good proxy of the well-being of households and have been very useful in guiding policy action and raising public concern for poverty (Brandolini et al., 2009; Michelson et al., 2013). Money-metric measures are also useful when comparing differences in poverty between nations or regions.

Recent analysis (Carter and Barrett, 2006; Vandemoortele, 2009; Naschold, 2012; Wietzke, 2015; Brandolini et al., 2010; Filmer and Pritchett, 2001; Wooldridge, 2002; Vyas and Kamaranayake, 2006; Habyarimana et al., 2015) have been critical of money-metric approach as an adequate measures of poverty and its determinants. They contend that in spite of its intuitive appeal and use, these measures cannot sufficiently and convincingly capture the overall amount of resources (real and financial assets) used by households to cope with various shocks. Secondly, it fails to account for the numerous dimensions of human well-being.

A forceful proponent of this view is Sen (1999) who takes the view that while the money-metric measures shed some light on poverty, the existence of ineffective institutions and social arrangements alongside with having no political freedom are extremely important to consider. The needs of the poor are not only made evident on the amount of their income, but also, for instance, on mortality rates, malnutrition, and illiteracy.

Money-metric measures have also been criticized because they ignore aspects of poverty that are related to commodities not typically transacted in the market — education or health outcomes that have intrinsic values beyond their costs while the welfare loss from unemployment is potentially associated not only with the observed income loss but also with a lower perception of the quality of life and human dignity. Health, nutrition, education, physical security, voice, justice, and capacity and opportunity to improve one's life are also essential dimensions of poverty and wellbeing (World Bank, 2010).

Perhaps a common criticism of the money-metric approach relates to measurement errors. First, collecting data on income and expenditure can be time and money consuming (Vyas and Kamaranayake, 2006). Secondly, measurement of consumption and expenditure in low-income countries is fraught with difficulties such as problem of recall and reluctance to divulge information (Akinbode and Hamzat, 2017). Thirdly, prices of goods often differs substantially across times and areas, forcing complex adjustment of the expenditure figures to reflect these price differences (Xhafaj and Nurja, 2013; Habyarimana et al., 2015). Fourthly, consumer price indices in developing countries are unavailable and unreliable, especially when inflation tends to be high or variable (Habyarimana et al., 2015). Other issues has also been raised in the literature, such as problems of sampling bias, under-reporting of income and difficulties of converting household products into money terms (Xhafaj and Nurja, 2013; Habyarimana et al., 2015; Akinbode and Hamzat, 2017).

In view of the problems associated with money metric measures, attempts have been made to broaden these measures beyond the narrow confines of consumption/income (to be discussed in the subsequent sections). For example, recent analysis (Filmer and Pritchett, 1998; Sahn and Stifel, 2000; Booysen et al., 2005) has used data on ownership of assets and access to services to derive alternative indicators of household socio-economic status.

2.2. Non-money metric measures

As noted in the previous section, attempts have been made in the literature to expand money- metric measures beyond the narrow confines of consumption or income. Recently, most studies have resorted to using

asset index to measure the well-being/socio-economic status and determinants of household poverty (see for example, Achia, Wangombe and khadioli, 2010; Filmer and Pritchett, 2001; Sahn and Stifel, 2003, Vyas and Kumaranayake, 2006; Xhafaj and Nurja, 2013; Habyarimana et al., 2015; Booysen, 2002; Farah, 2015).

Although there are different methods used to construct the asset index, the Principal Component Analysis (discussed in more detail in the next section) remains the most popular technique used in this field. For example, using the Demographic health Survey dataset and the principal component analysis Habyarimana et al. (2015) constructed an asset index for Rwanda. They found that flush toilet, cement, electricity, piped water to the yard had high and positive factors scores. While other variables such as sand floor material, borehole and river/dam as source of drinking water and latrine as toilet facility had a negative factor scores.

Filmer and Pritchett (2001) used a similar method to construct an asset index and use the index to investigate the relationship between household wealth and children school enrolment in India. Their results suggest that owning a watch, radio and television, flushing toilet, light electricity and dwelling in a high quality material was associated with positive SES for the households in India. In contrast, drinking water from open pump and dwelling in low quality materials were associated with negative SES. Booysen (2002) found that electricity for cooking, flush toilet, piped water in a dwelling and public had a high SES. Other assets such as using paraffin, wood and dung for cooking as well as number of members per sleeping room had a negative SES.

A study by Vyas and Kumaranayake (2006) used the Principal Component Analysis to construct a separate asset index for urban and rural areas in Brazil and Ethiopia. Using the factors scores from the first principal component they found that in the urban areas of Brazil, pipe drinking water to residence, sanitation facility, finished floor and the number of rooms for sleeping were associated with high social-economic status (SES) of households. Similar results were obtained for rural Brazil except for the fact that it comprised any sanitation facility and a well in the residence. In urban Ethiopia, drinking water pipe to the compound achieved high SES. Whereas in rural Ethiopia access to infrastructure facilities and ownership of any assets was associated with high SES of the households.

Similarly, Xhafaj and Nurja (2013) used the Principal Component Analysis to construct a separate index for urban and rural areas in Albania. They found that computer, mobile phone, and owning a car were associated with high SES of households both in rural and urban areas. The other assets such as gas/electric stove, washing machine and color television were also associated with positive SES of households, although their magnitude were relatively lower. They also found that a household with a wood stove were ranked lower in terms of SES than a household that does not own a wood stove.

Other studies performed a Principal Components Analysis first and then apply a logistic regression of the socio-economic status (SES) as response variable and the demographic characteristics of the household as explanatory variables. For example, a study by Habyarimana et al. (2015) used a logistic regression model to assess the determinants of asset poverty in Rwanda. They used asset index as dependent variable and number of household's demographics as explanatory variables. Their finding suggest that age of household head, education level and gender of household head are important determinants of asset poverty in Rwanda.

In another study, Achia et al. (2010) also used logistic regression treating the asset index as a dependent variable. They found that religion, age of household head, region and ethnicity of a household head were significant predictor of asset poverty in Kenya. In this paper we follow a similar approach of firstly constructing the asset index using Principal Component technique. We then apply the logistic regression model to assess the determinants of asset poverty in South Africa.

3. Methodology

This section looks at the methodology used to examine an asset based approach to poverty analysis in South Africa. To analyse assets poverty we use a variety of methods. We start with the Principal Component Analysis (section 3.2). In the next step we investigate the determinants of asset poverty using the logit model.

3.1. Data Source

The National Income Dynamics Study (NIDS) used in this paper to analyse asset poverty is an ongoing longitudinal survey conducted by the

Southern African Labour and Development Research Unit (SALDRU), based at the University of Cape Town's School of Economics. The NIDS started in 2008 with over 28 000 individuals in 7 300 households across the country. The subsequent waves of the NIDS were implemented in 2010, 2012 and 2014, and re-surveyed original NIDS wave1 households.

The reasons for using the NIDS dataset is that it comprise comprehensive set of questions on various types assets (both public and private), which are important for our paper. At the time of performing the analyses data from four waves were available. However the first three waves did not have as much information on assets compared to wave 4. Therefore we limit the analyses to wave 4 of the NIDS data. Wave 4 comprise a wide range of assets: ownership of a radio, television, satellite, DVD player, computer, camera, cell phone, electric/gas/paraffin stove, microwave, fridge, washing machine, sewing/knitting machine, lounge suite, private or commercial vehicle, motorcycle, bicycle, boat, cart and various kinds of agricultural equipment and so forth (Yu, 2012). In this wave participants are further asked to provide in-depth information about their access to services such as sanitation facilities, source of drinking water, housing material and so forth.

3.2. Statistical technique for computing a poverty index

Earlier studies have relied heavily on equal weighting approach when dealing with asset ownership. Equal weighting approach involves according equal weights to all assets that a household owns (Bhorat et al., 2014). However, the use of this approach has been criticized since it does not have much to recommend it, except ease of use. McKenzie, 2005 cited in Bhorat et al. (2014) notes that equal weighting makes it more difficult to include measures of quality, for assets or services, when there are more than two quality options. Reaching a similar conclusion, Wittenberg (2009) writes "It can also have paradoxical effects when certain assets are "inferior goods", so that their ownership makes households look more affluent when in reality it might signal less affluence".

Recent studies recognising this problem have attempted to avoid it by making use of either the Principal Component Analysis, Factor Analysis, Multiple Correspondence Analysis and a Livelihood Regression (see for example, Filmer and Pritchett, 2001; McKenzie, 2005; Naschold, 2006; Sahn and Stifel, 2003; Xhafaj and Nurja, 2013; Habyarimana et al., 2015;

Vandenberg et al., 2008; Adato et al., 2006; Naschold, 2009). These methods weight assets differently, letting the correlation structure between the assets determine which assets should count for more. Notwithstanding the availability of these numerous techniques, the Principal Component Analysis has proved to be an intriguing technique for use in any poverty studies. There are several reasons to prefer a Principal Component Analysis over other methods. First, it is relatively intuitive as a way of regrouping variables into a limited set of clusters based on shared variance. As Filmer and Pritchett (2001: 116) put it, “the first principal component of a set of variables is the linear index of all the variables that captures the largest amount of information that is common to all the variables”.

Secondly, it is computationally easier and the weights assigned to each component in the analysis are not difficult to interpret since the weight assigned to any variable relates to the extent of the information provided about the other variables (Van der Berg et al., 2003; Bhorat et al., 2014). For example, if ownership of one type of asset is highly indicative of ownership of other assets for a given population, these assets will receive a positive weight and vice versa (Habyarimana et al., 2015). Moreover, assets that are more unequally distributed across households are accorded greater weight in a Principal Component Analysis (see Van der Berg et al., 2003; Bhorat et al., 2014; Habyarimana et al., 2015 for more illustrative examples) Finally, PCA can provide insight into which variables have greater influence on the dimension(s) of SES. Generally, a variable with a positive factor score is associated with higher SES. While a variable with a negative factor score is associated with lower SES (Habyarimana et al., 2015).

Following many important scholars in this field, (Van der Berg et al., 2003; Schiel, 2012; Schroeder et al., 1992; Pollitt et al., 1993) we employ the Principal Components Analysis to construct the weights of asset index.

The Principal Components Analysis takes the following form:

$$\begin{aligned}
 PC_1 &= \forall_1 X_1 + \forall_2 X_2 + \forall_3 X_3 \dots \dots + \forall_n X_n \\
 PC_m &= \forall_{m1} X_1 + \forall_{m2} X_2 + \forall_{m3} X_3 \dots \dots \\
 &\quad + \forall_{mn} X_n
 \end{aligned} \tag{1}$$

Where the subscript $\forall_{mn}$ denotes the weights for the m^{th} principal component and variable X_n .

Generally the components are ordered in such a way that the first principal component has the largest variance (i.e. captures the largest variation in the original dataset), the second principal component, which is uncorrelated with the first component comprise the second largest variance, and the subsequent components comprise additional but less variance than the first component.

Following many scholars in this field we adopt a three-step estimation procedure in implementing the PCA. First an attempt is made to verify whether there is enough correlation between the variables (Habyarimana et al., 2015). This is often achieved by applying the Kaiser-Meyer-Olkin (KMO), which is called a measure of sampling adequacy (Henry et al., 2003). The KMO computes the degree of intercorrelations among the variables in the dataset (Córdova, 2008). KMO values less than 50% are considered inadequate and unacceptable, while values above 60% are acceptable and recommended.

The second step is to decide on the number of components to be extracted. In this case, we used the Kaiser's criterion which recommends retaining the components that have an eigenvalue greater or equal to one (Xhafaj and Nurja, 2013). We complemented the Kaiser criterion with the scree plot showing the proportion of variance explained by each principal component. The last step involves the rotation of the data set. After extracting the components, the factor loading of each variable is calculated (Tsehay and Bauer, 2012). The main objective of rotation according to (Vyas and Kumaranayake, 2006) is to minimise the variables that have a higher loading on certain components. Appendix Table 1.1 shows the rotation of the component using varimax rotation.

An in-depth analysis of poverty should go beyond a routine description of poverty profiles (which is only suggestive of the correlations between variables) if we are to adequately deal with the factors underlying poverty. Thus, this section will place more emphasis on the determinants of poverty. Specifically, we applied a logistic regression analysis of the socio-economic status (SES) as response variable and the demographic characteristics of the household as explanatory variables.

3.3 Logistical regression Model

To identify the determinants of poverty in this study, a logit regression model was adopted. The logit (or binary choice model) is a model with a zero-one dummy variable being the dependent variable. The logit model is expressed as follows:

$$Y^* = \alpha_0 + \beta X + \mu \quad (2)$$

Y is household poverty and the 40th percentile was used as the poverty line (Achia, Wangombe and Khadioli, 2010; Vyas and Kamaranayake, 2006; Booysen, 2002). We classified the social economic status as poor if the household poverty index is below the 40th percentile, otherwise it was classified as not poor. The α and β are coefficients to be estimated, μ is a stochastic error term. In determining the variables contained in the X vector, we followed existing studies which suggest that the probability of being poor depends on various explanatory variables such as education of the head of the household, the age of the head of the household, employment status of the head of household, household size (represented by number of household members in the household), location, and race of the head of household.

4. Results

This section reports the results obtained by using the methods outlined in the previous sections. Section 3.1 reports the results obtained by using the Principal Component Analysis, while section 3.2 reports the results using logit method.

4.1 Results from the Principal Components Analysis

To assess the appropriateness of our data set for implementing the Principal component analysis, we computed the KMO score. We found the data to be supportive of the analysis in question: the KMO score was 0.70 suggesting that the data is suitable for the implementation of the Principal Component Analysis. To determine the number of factors to be extracted, we applied the basic rule of Kaiser's criterion complemented with the scree plot and the rotated component matrix. Table 1.1 below present the results of the extracted components. There are three columns depicted in Table 1.1. The first column present the original eigenvalues, while the second column depicts the results of the extracted components. The number of components extracted based on the Kaiser rule is equal to 11. The extracted 11 components contains 59% of the variation of the observed 31 original variables. Basically, component 1 describes 15% of the variation, component 2 explains 7% and the last component 11 explains 3%, etc.

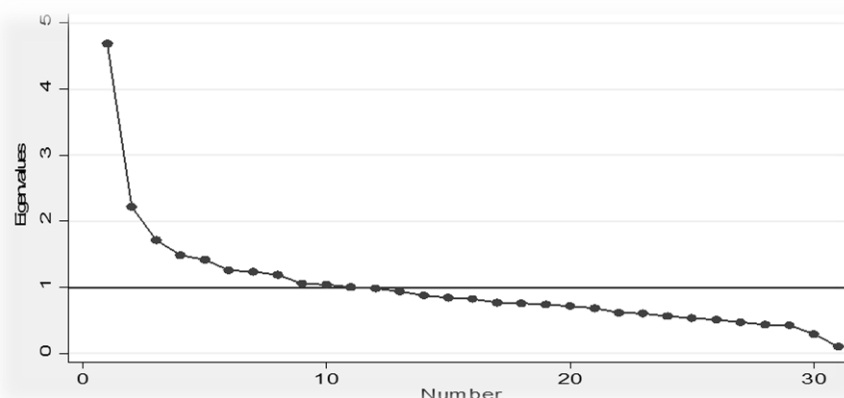
To validate the number of components extracted we used the scree plot showing the cut-off point of the precise number of components extracted based on the magnitude of the variance of the principal component. These results are shown in Figure 1.1 below.

Table 1.1: Extracted components for the analysis of poverty using Principal Component Analysis

Components	First eigenvalues			Eigenvalues of extracted components		
	Total	% of variance		% cumulative	Total	% of variance
1	4.68978	0.1513		4.68978	0.1513	0.1513
2	2.22162	0.0717		2.22162	0.0717	0.2229
3	1.71388	0.0553		1.71388	0.0553	0.2782
4	1.48766	0.048		1.48766	0.048	0.3262
5	1.41648	0.0457		1.41648	0.0457	0.3719
6	1.25716	0.0406		1.25716	0.0406	0.4125
7	1.23623	0.0399		1.23623	0.0399	0.4523
8	1.1888	0.0384		1.1888	0.0384	0.4907
9	1.05478	0.034		1.05478	0.034	0.5247
10	1.03928	0.0355		1.03928	0.0355	0.5582
11	1.00175	0.0323		1.00175	0.0323	0.5905

Source: Own calculations using NIDS data

Figure 1: The scree plot graphing the percentage of variation explained by each component.



Lastly, we affirmed the number of components extracted by means of rotated component matrix. Thus an orthogonal rotated solution was implemented as a tool of choice meant to attain the highest factor loadings of indicators on each component using varimax rotation technique. For a complete analysis of the eigenvalues of rotated extracted component results, see appendix Table A1.1.

We now turn to key results from the Principal Component Analysis. Table 1.2 below reports the scoring factors or weights for the index based on the PCA (the first principal component). Many weights entered with its predicted signs, with positive signs indicating that the ownership of assets is associated with higher SES. Relatively large positive weights were derived for the following assets: television; satellite dish; DVD/player; computer; electricity stove; fridge/freezer; washing machine; private car) and piped drinking water to dwellings etc.

Although other assets such as ownership of a camera, cell phone, gas stove, sewing machine, and having access to flush toilet on site have lower magnitude based on their factors scores, they still contribute positively to household socio-economic status. In contrast, relatively large negative weights were derived for the following assets: ownership of mixture of mud and cement, livestock, having access to drinking water from a public tap, mud bricks etc. Only the factor scores of the first principal components were used in the computation of a poverty index following studies such as those of Farah (2015) and Habyarimana et al. (2015).

Table 1.2: Factor scores and summary statistics of the variables used in the computation of a poverty index

Variables	Mean	Std. dev.	Factor score	Min	Max	Variables	Mean	Std. dev.	Factor score	Min	Max
Radio	0.667	0.471	0.091	0	1	Tractor	0.062	0.241	0.045	0	1
Television	0.783	0.412	0.27	0	1	Grinding mill	0.03	0.171	0.037	0	1
Satellite dish	0.271	0.444	0.266	0	1	Livestock	0.594	0.491	-0.102	0	1
DVD/player	0.345	0.475	0.218	0	1	Flush toilet onsite	0.134	0.34	0.187	0	1
Computer	0.125	0.331	0.228	0	1	Chemical toilet	0.008	0.093	-0.009	0	1
Camera	0.044	0.206	0.182	0	1	Bucket toilet	0.041	0.198	-0.03	0	1
Cell phone	0.919	0.272	0.14	0	1	Bricks	0.579	0.493	0.264	0	1
Electric stove	0.767	0.422	0.274	0	1	Cement block/concrete	0.777	0.416	0.287	0	1
Gas stove	0.193	0.394	0.118	0	1	Mixt. of mud/cement	0.082	0.275	-0.205	0	1
Paraffin stove	0.211	0.408	-0.058	0	1	Mud bricks	0.079	0.27	-0.18	0	1
Fridge/freezer	0.768	0.421	0.281	0	1	Iron/zinc	0.802	0.398	-0.105	0	1
Washing Machine	0.248	0.431	0.281	0	1	Asbestos	0.01	0.103	0.064	0	1
sewing machine	0.096	0.096	0.135	0	1	Piped water in dwelling	0.222	0.415	0.211	0	1
Private car	0.211	0.408	0.224	0	1	Piped water to yard	0.325	0.468	0.065	0	1
Bicycle	0.092	0.289	0.135	0	1	Public tap water	0.219	0.413	-0.121	0	1
Plough	0.062	0.241	0.012	0	1						

Source: Own calculations using NIDS data

Table 1.3 : Logit estimates of the determinants of assets poverty, 2014

Asset poverty	Coefficients	Robust Std. Err.
HH_size	0.0020865	(0.0010811)
Primary education	-0.0174809	(0.0113477)
Secondary education	-0.0432344***	(0.0110238)
Matric education	-0.0589375***	(0.0113444)
Tertiary education	-0.0600557***	(0.0107489)
HHH_age	0.0006642***	(0.0001897)
HHH_empl	-0.0080079	(0.0050213)
Coloured	-0.0372193***	(0.0076092)
Indian	-0.0409316***	(0.0083023)
White	-0.0372002***	(0.0075267)
Farms	-0.0435521***	(0.0124253)
Urban	-0.0345608***	(0.010273)
Eastern Cape	0.0337868***	(0.0091272)
Northern Cape	-0.0121904	(0.0112192)
Free State	0.0524215***	(0.0093509)
KwaZulu-Natal	0.0106365	(0.0101205)
North West	0.0675567***	(0.0105076)
Gauteng	0.0201411**	(0.0087474)
Mpumalanga	0.0108493	(0.0121262)
Limpopo	0.0117658	(0.0141377)
Cons	0.0296899	(0.0206059)
Number of obs	9235	
Notes: Clustered standard errors are reported in parentheses with ***, **, and *, denoting significance at the 1%, 5%, and 10% levels, respectively.		

4.2 Result from logistic regression

Table 1.3 present the estimation results from the logit model. As it is evident from the results presented with the exception of household size, head of household employment status, primary education and some provinces (Limpopo, Mpumalanga, KZN etc), all the specified socio-economic characteristics, demographic characteristics and location variables are statistically significant at 10 percent or lower level. As

expected, education significantly decreases the likelihood of falling into poverty. The higher the level of education attained by the household head the lesser the likelihood of falling into poverty. For example, the completion of secondary education by the household head reduces the likelihood of the household being poor by 4.3%, of matric by 5.8% and tertiary education by 6.0%. These findings are consistent with our expectation and are similar to those found in other international studies (see Achia et al., 2010)

With regards to the geographical variables, the results suggest that the location of the household influences the likelihood of falling into poverty. Specifically, households in urban and farm areas are less likely to be poor than households in traditional rural areas. The coefficient estimates on urban and farm areas are all negative and significant at the 1% level of significance. Moreover, we find that households in provinces of North West, Free State, Gauteng and Eastern Cape are more likely to be poor than households in Western Cape province (reference category). It is interesting to note that households in the Eastern Cape Province which contain a higher percentage of traditional areas are more likely to be a poor than Western Cape Province.

Perhaps unsurprisingly, probabilities of being in poverty also differ by race, with Africans significantly more likely than White, Indians and Coloureds to be in poverty. The results also show that the household size are positively associated with the incidence of poverty, although insignificant. These findings are largely consistent with the work of Imai et al., (2011) who found that household size increase with the risk of falling into poverty in Vietnam.

5. Conclusion

This paper employs the Principal Component Analysis to create the asset index. This paper also attempts to extend the existing South African studies that focus on asset based approaches, which have mostly provided a descriptive analysis of the household welfare computation. Specifically, this paper applies the logit model to identify the main determinants of asset poverty in South Africa. Results of the logit model show that some factors such as education levels (secondary, matric and tertiary), race dummies and location dummies (farms and urban areas) have a reducing

effect on asset poverty in South Africa. Unsurprisingly, education significantly decreases the likelihood of falling into poverty. The higher the level of education attained by the household head the lesser the likelihood of falling into poverty. For example, the completion of secondary education by the household head reduces the likelihood of the household being poor by 4.3%, of matric by 5.8% and tertiary education by 6.0%. These findings are consistent with our expectation and are similar to those found in other international studies (see Achia et al., 2010; Daka and Fandamu, 2016; Akinbode and Hamzat, 2017).

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These results have important policy implications for design and implementation of poverty reduction policies for South Africa. For instance, education was found to significantly decrease the likelihood of falling into poverty in South Africa. This suggests the need to prioritize education and training of labour force as key priority area in the struggle against poverty which can help in the way of enhancing the skills and productivity among poor households. In South Africa, the government should increase its funding through the National Student Financial Aid Scheme (NSFAS) to avoid high dropout rates in institutions of higher learning. This will help broaden the country's skills development base

amongst the youth, while producing graduates who are able to contribute to the growth of our economy.

Given that the rural household residing in Limpopo, Eastern Cape, Kwazulu natal and other province are more likely to be poor compared to other households from Western Cape province (reference variable), policy makers should formulate targeted provincial/rural interventions. Thus policies that would improve the provision of infrastructure, quality service delivery and further promote investment and employment creation.

The results further indicate that poverty increases with increased in household size, suggesting that policies should be drawn that priorities the use of family planning initiatives. Awareness creation on family planning would go a long way in reducing the household size especially in rural areas of South Africa where the majority of the poor lives. Basically, policy makers should formulate policies that enables women to make their own choices about their fertility thereby empowering and offering better economic and social opportunities. Thus, public education should be geared towards influencing sexual behavioural change to the South Africans.

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Appendix A

Table A1.1: Eigenvalues of rotated extracted component

	Eigenvalues of rotated extracted component		
Components	Total	% of variance	% cumulative
1	2.49044	0.0803	0.0803
2	2.36269	0.0762	0.1566
3	2.18991	0.0706	0.2272
4	1.95808	0.0632	0.2904
5	1.55316	0.0501	0.3405
6	1.45537	0.0469	0.3874
7	1.43571	0.0463	0.4337
8	1.40297	0.0453	0.479
9	1.20987	0.039	0.518
10	1.18702	0.0383	0.5563
11	1.0614	0.0342	0.5905

Financial Interdependence or Contagion? Evidence from a Meta-analysis

Zhang Heng Chao¹, Azhar Mohamad² and Zarinah Hamid³

During the last two decades, the phenomenon of financial contagion has been investigated in numerous pieces of research. In spite of its severe implications for the stability of domestic financial systems as well as potential diversification benefits of international portfolio investment, there has yet to be universally agreed conclusion on the relevance of financial contagion. Thus, our current study has been designed to apply the meta-analysis approach to investigate the statistical significance of financial contagion based on past empirical contagion studies. Our meta-analysis concludes that financial contagion is a significant phenomenon. As implications, policy makers should establish contingent credit lines to ensure the liquidity of financial market during the turbulence time, and portfolio investors should diversify away from the potentially contagious markets. It is suggested that future contagion-based meta-analysis may include contagion studies with different methodologies, as well as meta-regression analysis to provide more insights on the sources of variability in the contagion studies.

1. Introduction

Since the 1990s, financial liberalization and globalization have become significant phenomena across both developed and developing economies. It is believed that the enthusiastic liberalization efforts of the domestic policy makers, as well as the subsequent hike in cross-country capital

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flows and financial transactions, have intensified such phenomena (Ceballos et al., 2012). Despite the traditionally perceived benefits brought about by financial integration, namely economic growth and enhanced risk-adjusted returns (Arteta et al., 2001; Kose et al., 2009), integrated financial markets will also increase the vulnerability of domestic markets to adverse external shocks (Caramazza et al., 2004). In other words, the integrated financial markets tend to co-move more closely with their global counterparts in the wake of economic turmoil.

Traditionally, the adverse shocks are transmitted through fundamental economic linkages between countries, particularly through international trade and financial networks. Such phenomenon has been commonly referred to as the market interdependence (Forbes and Rigobon, 2002). Since 1990s a series of financial crises have revealed a unique mechanism on the cross-market spread of the adverse financial shocks. In contrast with the traditional transmission mechanism of cross-market fundamental economic linkages, the market turmoil has been spread rapidly from the crisis-originated market to other markets that share little economic linkages or with different markets structures (Billio and Caporin, 2010). These crises include the 1994 Mexico Peso crisis, the 1997 Asian financial crisis, the 1999 Russian Ruble crisis, and even the recent 2008 US Subprime crisis. For example, when Hong Kong was severely hit by the 1997 Asian financial crisis, its stock market declined dramatically in October 1997. Being countries with different market sizes and structures, the stock markets of Brazil and South Africa have co-moved closely with the sharp falls of the Hong Kong stock market (Forbes and Rigobon, 2002).

Since adverse shocks can be transmitted to countries with little economic linkages, shared economic fundamentals are insufficient to explain the increased cross-market co-movements of asset market returns (Billio and Caporin, 2010). In the scenario that the excess cross-market co-movements are beyond the explanatory power of the economic fundamentals, the shift of the transmission mechanism rather than the shared economic fundamentals is believed to be the primary cause for the intensified co-movements during economic turmoil. More specifically, such phenomenon has been commonly perceived as the contagion effects of the financial turbulence (Bekaert et al., 2005).

The differentiation between financial interdependence and contagion is an important topic in the field of international finance, the importance of which can be understood from its two-dimensional implications: the stability of the domestic financial system, and the potential diversification benefits for international portfolio investors. As for the domestic policy makers, it is of foremost important for them to understand the mechanisms through which an external shock could be transmitted to the domestic economy. With an adequate knowledge on the transmission mechanism of shocks, they can structure appropriate preventive policies to safeguard the domestic economy against the adverse effects of the external shocks. If a crisis is spread through the fundamental economic linkages between countries, the policies should emphasize on the improvement of macroeconomic fundamentals (Moser, 2003).

As for international portfolio investors, their primary concern is to optimize the potential diversification benefits of their portfolio investments. Finance theory suggests that the potential benefits of portfolio diversification can be maximized when the basket of investments are diversified into weakly correlated markets (Masih and Masih, 2001). Since financial contagion effect will significantly increase the cross-market co-movements in wake of the adverse financial shocks, the potential diversification benefits of the portfolio investments will be severely undermined, when it is needed the most (Pericoli and Sbracia, 2003). Thus, it is crucial for the international portfolio investors to take into account the financial contagion risk in structuring their optimal portfolio investments.

Motivated by the enormous implications of the contagious crises, voluminous researches have been undertaken to investigate the presence of the financial contagion among emerging as well as mature equity markets. Such trend has been dramatically picked-up after the incidence of the 1997 Asian financial crisis (Khalid and Kawai, 2003), and then pushed into new height after the demise of the recent 2008 US Subprime Crisis (Forbes, 2012). However, past researches have revealed mixed evidences on the presence of financial contagion, even if the crisis period and countries under investigation are same. Some believed that the cross-market transmission of crisis is because of the fundamental links between countries, others upheld that it is the contagion effects of the crisis induced those transmissions.

In order to answer whether financial contagion is a relevant phenomenon based on the past contagion researches, a number of qualitative systematic reviews have been undertaken, for instance (Cheung et al., 2009; Dornbusch et al., 2000; Paas and Kuusk, 2012) to name a few. Although these qualitative syntheses have provided comprehensive overview on the findings of the past empirical contagion researches, there has yet to be solid conclusions on whether contagion effects or fundamental economic linkages play the dominant role in the transmissions of financial crises during the last two decades. As an effective remedy, it is proposed that the Meta-analysis, being a quantitative approach of systematic review, could be a better alternative to explore the variability in the past contagion researches (Paas and Kuusk, 2012).

According to our knowledge on financial contagion, there has been no Meta-analysis on the subject except the study of Kuusk (2012). In his study, Kuusk (2012) revealed that on average there has been confirmed evidence on the presence of financial contagion among the past empirical studies, but the effect is only moderate. In addition, the variations of the empirical methodology and the choices of the focused financial crisis have played significant moderating roles in the heterogeneity of the past empirical results. In spite of its fruitful insights, his study has only focused on studies that adopted linear correlation approach to assess financial contagion. To extend the study of Kuusk (2012), our current meta-analysis focuses on contagion studies that applied Copulas model, a non-linear correlation approach, to examine the existence of financial contagion.

The remainder of the paper is organized as follows. In Section 2, we provide a brief theoretical background on financial contagion. In Section 3, we elaborate on the application of Copulas theory on financial contagion. Section 4 thoroughly explains on the methodology of meta-analysis. Detailed results of meta-analysis results are discussed in Section 5. In the end, Section 6 concludes the study.

2. Theory of Financial Contagion

Theories pertaining to the cross-country propagations of shocks can be generalized into two broad categories, namely the Crisis-Contingent and Non-Crisis Contingent theory (Forbes and Rigobon, 2001). In particular, the former assumes that the cross-country transmission mechanisms will

change in the wake of a crisis, whereas the latter upholds that the mechanisms are stable across tranquil and crisis periods. As implications, the Crisis-Contingent Theory explains the increased cross-market co-movements during the crisis period, whereas the Non-Contingent theory enlightens the relative constant cross-market correlations across the two periods. Putting it differently, the Crisis-Contingent Theory provides support for the incidence of contagion, whereas the Non-Crisis-Contingent Theory explains the phenomenon of interdependence (Billio and Pelizzon, 2003).

Crisis-Contingent Theory

According to Forbes and Rigobon (2001), the Crisis-Contingent theory can be divided into dimensions, including jumps between multiple equilibria, endogenous liquidity, and political contagion. Each dimension can be perceived as a transmission mechanism that propagates shocks from one country to another, holding that the mechanism is stable across tranquil and turmoil periods. First, the propagation of shocks can be explained through multiple equilibria. In particular, the theory of multiple equilibria upheld that a crisis in a country may act like sunspots that coordinate the devaluation expectations of investors in another country (Jeanne and Masson, 2000). Such revision of expectations will shift the economic equilibrium of the second country from a good to a bad one, even if the economic fundamentals of the second country remain stable and healthy (Masson, 1999).

The jumps between multiple equilibria can also be explained by investors' self-fulfilling beliefs and the incomplete information in the market (Pericoli and Sbracia, 2003). In addition, they explained that when an adverse shock hits one country and the market is dominated by investors' devaluation belief, investors' herding speculative attacks on the currency will increase the cost of defending the peg. Consequently, it will force the authority of the country to abandon its defense. Thus, the self-fulfilling expectations of the investors may become the primary culprit for the incidence of currency crises.

As for the shift of economic equilibria stems from the incomplete market information, Pericoli and Sbracia (2003) stated that when an adverse shock hits a country but yet to affect the economic fundamentals of another country, the news of the crisis in the first country may act as the

sunspot to coordinate market participants' investment actions towards a speculative attack. In other words, when uninformed investors fail to tell whether the devaluation of an asset is because of liquidity or fundamental shocks, the decline of one asset price may serve as the signal for these investors in predicting the devaluations in all assets (Halstead et al., 2004). As the result of such incomplete market information, the coordinated investment actions of the uninformed investors may force the economic fundamentals of the second country to shift from a good to a bad equilibrium.

The endogenous liquidity theory is another Crisis-Contingent approach to explain the cross-market transmission of crises. When a crisis hits one country, the liquidity of its market participants will be negatively affected. Because of the regulatory requirements of the first country, investors' liquidity constrain will pressure them to short some of their portfolio investments in other countries to fulfill these requirements, even if the economic fundamentals of the latter countries have yet to be affected (Valdes, 1997).

Last but not least, the Crisis-Contingent theory can also be elaborated through the aspect of political contagion. The political contagion theory suggests that the transmission of crises can be partially explained by the political-oriented decisions of the policy makers (Drazen, 1999). In a related study, such theory has been named differently as membership contagion (Moser, 2003).

Non-Crisis Contingent Theory

In contrast with the Crisis-Contingent Theory that assumes structure-breaks in the transmission mechanisms of shocks, this category of theories upholds the stable transmission mechanism throughout the tranquil and crisis periods. In other words, the increased cross-country co-movements of asset market returns in wake of economic turbulences are the continuation of linkages existing prior to the crisis. Such linkages have been commonly referred to as the fundamentals-based transmission mechanisms, which comprises of trade spillovers, policy coordination, country re-evaluation, and random aggregate shocks (Forbes and Rigobon, 2001). The explanations on each aspect of the Non-Crisis Contingent theory are elaborated in the following paragraphs.

Trade spillover refers to the scenario when a country is hit by an adverse economic shock, the economic contraction in the country will result in the decline of the domestic demand and then the devaluation of the home currency. Consequentially, the imports volume from its major trading partners to the crisis-hit country will decrease (Moser, 2003). If the contraction of the domestic demand and the devaluation of home currency are severe enough, the exports of its trading partners will decrease dramatically. Eventually, it will result in the devaluation of currency in the major trading partners of the crisis-hit country (Forbes and Rigobon, 2001). And this in turn will bring about the increased probability of currency attacks in these countries, particularly for countries with fixed exchange rate regime (Dornbusch et al., 2000). Similarly, countries tend to link with each other through financial linkages as well. In fact, the integration process of a country into the global economic system can be attributed to both trade and financial links (Dornbusch et al., 2000). In particular, the financial links can be divided into direct and indirect ones. The direct financial links refer to the bilateral cross-market investments, whereas the indirect ones are the common international investors such as banks, mutual funds, and pension funds (Moser, 2003).

In terms of policy coordination, it is believed that when an economic crisis hits one country the policy response of the country induces another country to follow the similar policy adopted in the first country. Consequentially, it will result in the intensified cross-market co-movements (Forbes and Rigobon, 2001). The authors further explained that when a group of countries are bonded by a trade agreement, the expansionary monetary policy in one country may force other member countries to raise trade barriers in order to secure their trade account.

The third category of the non-crisis contingent theory refers to investors' re-evaluation or learning process (Forbes and Rigobon, 2001). This theory assumes that after one country is hit by a crisis, investors tend to apply the lessons learned in this country on other countries with similar macroeconomic structure and policies. In other words, the crisis in the first country acts as the wake-up call for the investors in the second country, which induces these investors to reevaluate the economic fundamentals in their country (Goldstein, 1998). If investors detect some problems or risks that failed to be observed before, it may lead to contagion (Moser, 2003).

Last but not least, the random aggregate shock or global shock is another non-crisis contingent theory that explains the cross-country transmission of crisis. According to Forbes and Rigobon (2001), this theory assumes that a crisis will affect the economic fundamentals of several economies simultaneously. For instance, when there is an increase in the international interest rate, a decrease in the international capital supply, or a contraction in the international demand for commodities, many countries will suffer economic depression simultaneously. As the result of such simultaneous adverse shock, the cross-market co-movements tend to increase significantly. In other studies, such phenomenon of simultaneous shocks have been named differently, including common shocks (Dornbusch et al., 2000), common external shocks (Costinot and Roncalli, 2000), and monsoonal effects (Masson, 1998).

3. Financial Contagion and Copulas Theory

Copulas are functions that model joint multivariate distributions with univariate marginal functions (Nelsen, 2006). Introduced by Sklar (1959), Copulas capture information about non-linear dependence of a vector of random variables (Rodriguez, 2007). Since Copulas enable researchers to model multivariate distributions with varying patterns of tail behavior as well as different kinds of asymmetry, it is believed to be an effective alternative to the linear correlation approach in modeling the financial risks (Rodriguez, 2007).

It is believed that the cornerstone of the Copula theory is derived from the Sklar theorem (Horta et al., 2010). According to Sklar's theorem, let a n -dimensional joint distribution function D with a vector of univariate marginal distribution functions $F_1, \dots, F_n$. Then there exists a n -dimensional Copula $C: [0,1]^d \rightarrow [0,1]$ such that:

$$D(x_1, \dots, x_n) = C(F_1(x_1), \dots, F_n(x_n)) \quad (1)$$

The copula C capture all the information pertaining to the dependence between univariate marginal distribution function F_n (Bergmann et al., 2015). An important advantage of the Sklar's theorem is that it enables flexible modeling of the multivariate joint distribution (Aloui et al., 2013). Horta et al. (2010) explained that when both the marginal distribution function and copula function are known, the joint distribution will be derived directly through the Sklar's theorem, represented by function (1)

above. Thus, the copulas function alone can construct the dependence, through the probability distribution of the random variables for the given marginal distributions (Bergmann et al., 2015).

The variety of Copulas model can be classified into three major families, namely elliptical, Archimedean, and extreme value (Aloui et al., 2013). The elliptical family consists of both Gaussian Copula and the *t*-student Copula, which are commonly applied to examine the symmetric dependence structure (Horta et al., 2010). In terms of the Archimedean family it includes Gumbel, Clayton, and Frank Copula, which are appropriate for measuring the right tail dependence, left tail dependence, and symmetric with tail dependence, respectively (Horta et al., 2010). As for the extreme value copula, it usually uses the mixed versions of Copulas to examine the extreme dependence between random variables (Aloui et al., 2013). For instance, the Gumbel-Clayton Copula model is adequate for modeling dependence when random variables assemble symmetry relationship. Such hybrid model is also appropriate to model variables with different forms of asymmetry and even independence (Horta et al., 2010).

In order to quantitatively measure the dependence between variables in the copula model, rank correlation coefficients such as the Kendall's τ and Spearman's ρ have been commonly used (Schmidt, 2006). In reference to Nelsen (2006), both τ and ρ can be derived directly from the bivariate Copulas functions such that:

$$\tau_{kendall}(X_1, X_2) = 12 \int_0^1 \int_0^1 (C(u_1, u_2) - u_1 u_2) du_1 du_2 \quad (2)$$

$$\rho_{spearman}(X_1, X_2) = 1 - 4 \int_0^1 \int_0^1 \frac{\partial C(u_1, u_2)}{\partial u_1} \frac{\partial C(u_1, u_2)}{\partial u_2} du_1 du_2 \quad (3)$$

Since the specification of copulas function could be different for different random variables, the dependence parameters of the copulas function are not comparable. In contrast, as the value of the rank correlations ranges between -1 and 1, Kendall's τ and Spearman's ρ enables comparative analyses of dependence structure.

In addition, dependence between variables in the Copulas functions can also be examined through the dependence in the tails of the distribution. In particular, upper (λ_U) and lower tail asymptotic coefficient (λ_L) associated with the Copulas can be used to measure the tendency for markets to boom and crash together, respectively (Aloui et al., 2013; Horta et al., 2010). In reference to Aloui et al. (2013), the λ_U and λ_L are defined as:

$$\lambda_U = \lim_{t \rightarrow 1} P(Y > G^{-1}(t) | X > F^{-1}(t)) \quad (4)$$

$$\lambda_L = \lim_{t \rightarrow 0} P(Y \leq G^{-1}(t) | X \leq F^{-1}(t)) \quad (5)$$

where X and Y are the random variables with marginal distribution functions of F and G .

If financial contagion is defined in accordance with Forbes and Rigobon (2002) as the increased cross-market linkages during the crisis period, the existence of the phenomena can be assessed by investigating whether dependence between variables has increased significantly (Horta et al., 2010). If financial contagion does exist, the null hypothesis as follows deems to be rejected:

$$\begin{cases} H_0: \Delta\tau(i) = \tau_{crisis}(i) - \tau_{tranquil}(i) \leq 0 \\ H_1: \Delta\tau(i) = \tau_{crisis}(i) - \tau_{tranquil}(i) > 0 \end{cases} \quad (6)$$

where $\tau_{crisis}(i)$ and $\tau_{tranquil}(i)$ refers to the dependence between the crisis-hit and potential-affected market i during the crisis and tranquil period, respectively, and $\Delta\tau(i)$ represents the increases in the cross-market dependence from the tranquil to crisis period.

In addition, financial contagion can also be assessed by assessing the changes in the lower tail dependence during the crisis period (Bergmann et al., 2015). In particular, if financial contagion does exist, the null hypothesis as follows will be rejected:

$$\begin{cases} H_0: \Delta\lambda_L(i) = \lambda_{Lcrisis}(i) - \lambda_{Ltranquil}(i) \leq 0 \\ H_1: \Delta\lambda_L(i) = \lambda_{Lcrisis}(i) - \lambda_{Ltranquil}(i) > 0 \end{cases} \quad (7)$$

where $\lambda_{Lcrisis}(i)$ and $\lambda_{Ltranquil}(i)$ refers to the lower tail dependence between the crisis-hit and potential-affected market i during the crisis and tranquil period, respectively, and $\Delta\lambda_L(i)$ represents the increases in the cross-market lower tail dependence from the tranquil to crisis period.

4. Methodology of Meta-analysis

Meta-analysis can be simply defined as “the analysis of analyses”. The application of such statistical technique can be traced back to its origin in 1976 by Gene Glass. In particular, Glass defined it as the “statistical analysis of a large collection of results from individual studies for the purpose of integration the finding” (Glass, 1976). More recently, it has been referred to as the statistical approach to synthesize the empirical evidences on a particular research subject (Kuusk and Paas, 2010), with the considerations of the heterogeneous characteristics among the studies (de Dominicis et al., 2008). In short, it is a quantitative approach to summarize the empirical findings through a series of statistical analyses.

In reference to the meta-analysis research guidelines of Glass et al., (1981) and Hunter et al., (1982), our current meta-analysis is conducted in accordance with the following procedures:

1. Define the research subject, or the dependent variable.
2. Construct the sample article database which includes all the relevant studies.
3. Calculate the effect size for each primary estimates.
4. Compute the meta-effect size with weights assigned to the effect size of each independent estimate.

The detailed explanations for each of the preceding steps are discussed in the following paragraphs.

Define the Dependent Variable

In our current meta-analysis, financial contagion has been defined in accordance with Forbes and Rigobon (2002) as the phenomena that cross-market linkages have intensified significantly in wake of adverse external shocks. The chosen definition is preferred because of the following two advantages. First, it enables to test for the presence of financial contagion effect through a straightforward approach. Second, it avoids the complex measurement of the turbulence transmission mechanism (Horta et al., 2010). Since our current meta-analysis focuses on the Copula-based contagion studies only, the presence of financial contagion can be assessed either through the changes of cross-market dependence from the tranquil to crisis period, or by the increase in the cross-market lower tail dependence during the crisis period.

Construct the Sample Article Database

The second step in our meta-analysis is to collect all the available studies pertaining to the research subject. In particular, we have relied on the Scopus database to look for the relevant articles. Having said that the primary objective of this study is to investigate the relevance of financial contagion. The following searching and screening criteria are used to select the relevant articles for our analysis:

- 1) The keyword “financial contagion” will be used to perform the initial search from the Scopus database.
- 2) The theoretical and qualitative oriented research papers are excluded from the analysis, and only empirical studies are retained.
- 3) Among the empirical studies, we only select the researches that define financial contagion according to Forbes and Rigobon (2002). Thus the sampled studies are further narrowed down to those that examine the changes in cross-market dependence and lower tail dependence.

The Effect Size

After the filtering process on the sampled studies, the next step in the meta-analysis is to select a singular statistic measure that is applicable for

all the sampled studies. Such measure has commonly known as the “effect size”. According to Lipsey and Wilson (2001), it is the statistics that standardizes a collection of empirical findings, and consequentially it ensures the comparability of the findings across different studies. In theory, so far as a measure takes into account the direction and strength of a relationship, able to be expressed as a point estimate with confidence interval, and enables the comparisons across studies, it can be used as an effect size (Littell et al., 2008).

Three categories of effect size have been commonly used in the past researches, including mean-based, coefficient or odds ratio-based, and correlation-based measures (Borenstein et al., 2009). They further explained that the choice of a proper effect size measure depends on the type of data used in the primary studies. In particular, the means-based measure is adequate for the means and standard deviations of the sample groups, the odds ratio-based measure is suitable for binary outcomes, and the correlation-based measure is appropriate for the correlation coefficient between random variables. Since our study primarily concerns about the changes in the cross-country dependence of financial market, none of the three types of effect size measures can be directly used as the effect size in the meta-analysis. Instead, the effect size can be measured through the difference in the cross-market dependence, namely the changes in Kendall’s τ coefficient ($\Delta\tau(i)$) and lower tail asymptotic coefficient ($\Delta\lambda_L(i)$) between variables.

Thus, the effect sizes for each independent estimate can be computed through

$$ES_{ij} = \tau_{crisis}(ij) - \tau_{tranquil}(ij), \quad (8)$$

Or

$$ES_{ij} = \lambda_{Lcrisis}(ij) - \lambda_{Ltranquil}(ij) \quad (9)$$

where ES_{ij} denotes the effect size for the i th independent estimate in the j th study.

As the weight assigned to the effect size is inversely associated with the variance of the estimate (i.e. $1/V_{ij}$), the use of the simply correlation coefficient approach to measure the effect size will provide biased results

in the meta-analysis. This is because an estimate that has larger correlation tends have lower standard error (or variance), consequentially more weights are assigned to these estimates. To address such biasness, the correlation coefficients of the sampled studies need to undergo the Fisher's Z value transformation to improve the accuracy of the meta-analysis results (Borenstein et al., 2009). Statistically, the individual effect size based on the transformed changes of correlations between two sub-periods ($\Delta\tau(ij)$ or $\Delta\lambda_L(ij)$) can be computed as

$$ES_{Z_{ij}} = 0.5 \ln\left(\frac{1+\Delta\tau(ij)}{1-\Delta\tau(ij)}\right), \quad (10)$$

Or

$$ES_{Z_{ij}} = 0.5 \ln\left(\frac{1 + \Delta\lambda_L(ij)}{1 - \Delta\lambda_L(ij)}\right) \quad (11)$$

This transformed effect size will be used latter to calculate the pooled effect size of the sampled studies.

Meta-effect Size

Once the measure of the common statistics is established, the next step is to assign weights to each individual estimates. According to the inverse variance method of Hedges and Olkin (1985), such weight can be computed through:

$$w_{Z_{ij}} = \frac{1}{V_{Z_{ij}}} = \frac{1}{\frac{1}{n_{ij}-3}} = n_{ij} - 3, \quad (12)$$

where $V_{Z_{ij}}$ denotes the variance of the effect size for the i th independent estimate in the j th study, and n_{ij} refers to the sample size of the corresponding estimate.

Consequentially, the pooled effect size or meta-effect size is computed through the weighted average of all the individual effect sizes. In particular, such meta-effect size can be computed through fixed effects or random effects estimators.

The fixed effects estimator assumes the homogeneity among the empirical findings, and the variability among the findings is solely due to the

sampling error (Borenstein et al., 2009). In other words, there is only one true effect that underlies all the primary estimates. The equation below formally depicts the fixed effects model:

$$TES_{FE} = \hat{\theta} = \frac{\sum_{i=1}^k w_{Z_{ij}} ES_{Z_{ij}}}{\sum_{i=1}^k w_{Z_{ij}}}, \quad (13)$$

where $w_{Z_{ij}}$ denotes the weight assigned to the i th independent estimate in j th study, k indicates the total number of the independent estimates, and $ES_{Z_{ij}}$ is the effect size for the corresponding primary estimate. Putting it differently, the total effect size is the sum of the products of $w_{Z_{ij}} ES_{Z_{ij}}$ (individual effect size multiply by its assigned weight) divided by the sum of the weights.

On the other hand, the random effect estimator assumes the heterogeneous effect size in the sampled studies (Borenstein et al., 2009). And the pooled effect size is believed to be comprised of two normally distributed components, namely the random variations of the primary estimate effect size ($\mu_{Z_{ij}}$) and the sampling error ($\varepsilon_{Z_{ij}}$) (de Dominicis et al., 2008). The formal representation of the random effect model can be depicted as:

$$TES_{RE} = \frac{\sum_{i=1}^k w_{Z_{ij}}^* ES_{Z_{ij}}}{\sum_{i=1}^k w_{Z_{ij}}^*}, \quad (14)$$

where “*” denotes random effect approach.

Homogeneity Test

Since the assumptions underlying the fixed and random effects estimators are mutually exclusive, it is necessary for a meta-analysis to determine which estimator is more appropriate for the sampled studies (Feld and Heckemeyer, 2011). In order to choose an adequate meta-analysis estimator, past researches have commonly applied Q -test to examine the homogeneity of findings between studies. In particular, this test investigates whether the between-study variance, $\sigma_{\mu_{Z_j}}^2$, is zero. Such Q -test will be performed based on the χ^2 distributed Q -statistics through

$$= \sum_{i=1}^k w_{ij} ES_{Z_{ij}}^2 - \frac{\left(\sum_{i=1}^k w_{ij} ES_{Z_{ij}} \right)^2}{\sum_{i=1}^k w_{ij}} \quad (15)$$

So far as the Q -test rejects the null hypothesis of zero between-study variance, it is safe to conclude that the random-effect estimator is a more appropriate approach to conduct the Meta-analysis. On the other hand, if the null hypothesis is failed to be rejected, it indicates that the fixed-effect estimator is a better choice.

5. Results and Discussion

Given that the objective of this study is to assess the relevance of financial contagion effect based on the past Copula-based contagion studies, a thorough investigation of research papers dealing with our research subject was performed by querying the Scopus database. First, a query was performed in the database using the keyword “financial contagion” for research topic. In addition, the search was confined among English literature, published between 1990 and 2016, and in the area of business economics. The search was performed on 29 January, 2016, and the total number of relevant articles obtained was 908.

Then we screened the title and abstract of the obtained studies to filter out theoretical/qualitative researches and studies that do not test the statistical significance of financial contagion effect. At the end of this filtering process we were left with 61 research papers on our topic of interest. In the final round of literature screening, we finalized the sampled articles to be used in our meta-analysis. In particular, we only retain contagion studies that apply Copulas model to assess the existence of contagion. Furthermore, the included studies must have reported the measure of precision for the test of financial contagion (i.e. standard error, t-statistics, or p-values), which is required data for meta-analysis. Finally, the dependent variables have to be either Kendall’s τ coefficient ($\Delta\tau(i)$) and lower tail asymptotic coefficient ($\Delta\lambda_L(i)$) between variables to ensure the comparability of the estimated effect. Subsequently, only 6 studies passed all three rounds of the literature screening process. The descriptive statistics on the selected studies is presented in Table 1.

Table 1: Descriptive Statistics on the Studies Included in the Meta-analysis

Study	Year	Country	Estimate	Crisis	Market	Contagion
Chen, Wei Lang, et al (2014)	2014	China	2	SC	SM	Y
Durante & Jaworski (2010)	2010	Austria	9	NA	SM	Y
Hoesli & Reka (2013)	2013	UK	1	SC	RE, SM	Y
Horta, Lagoa, & Martins (2014)	2014	Portugal	14	SC, EDC	SM	Y
Rodríguez (2007)	2007	Netherlands	7	AFC, MC	SM	Y
Wen, Wei & Huang (2012)	2012	China	3	SC	EM, SM	Y

Note: "SC", "NA", "EDC", "AFC", "MC" denotes "Subprime Crisis", "Not Available", "European Debt Crisis", "Asian Financial Crisis", and "Mexican Crisis", respectively; "SM", "RE", "EM" represents "Stock Market", "Real Estate Market", and "Energy Market", respectively; "Y" indicates the financial contagion effect is statistically significant.

As we can observe from Table 1, the Copula-based contagion is a new research trend that has become increasingly popular after 2007. In addition, most of these studies were conducted in developed countries, on the contagion effect of the 2008 US Subprime crisis. Only 23.3% (or 2 studies) were initiated in the developing country, and 17% (or 1 study) focus on the contagion effect of 1994 Mexican crisis and 1997 Asian financial crisis. Interestingly, all of the studies have examined the stock markets contagion, and concluded the presence of statistical significant financial contagion.

Table 2: Results of Meta-analysis

Model	No. Studies	Point Estimate	Std Error	Variance	Lower limit	Upper limit	Z-value	P-value (2-tails)
Fixed-Effect	6	0.047	0.008	0.000	0.031	0.062	5.942	0***
Random-Effect	6	0.044	0.011	0.000	0.023	0.023	4.085	0***

Noted: *** denotes financial contagion is significant at 1% significance level.

The results of the meta-analysis are given in Table 2. Since all the studies contains more than one estimates and most of them are not independent from one another, the sample data used in our meta-analysis are the mean estimates extracted from the 6 studies covered. In addition, we have run both fixed-effect and random-effect models to assess the statistical significance of financial contagion. Looking at the detailed results, Table 2 documents that the meta-effect size of financial contagion is indeed statistically significant ($P < 0.001$) for both fixed-effect and random-effect models, regardless of the level of significance applied. In addition, we found that the meta-effect size of fixed-effect model (0.047) is very close to the one obtained from the random-effect model (0.044).

Table 3: Results of Homogeneity Test			
Q-value	df (Q)	P-value	I-squared
8.077	5	0.152	38.093

In the end, a homogeneity test was performed to examine the homogeneity of the population effect size (de Dominicis et al., 2008). If the null-hypotheses of homogeneity is rejected, it indicates the differences between the sample effect size and the population mean cannot be explained by the sampling error alone (Paas and Kuusk, 2012). In other words, Paas and Kuusk (2012) added that, in such case the variability of the effect sizes may be associated with different study characteristics. In addition, the homogeneity test will also provide information on whether fixed-effect meta-analysis model is suitable. Specifically, if the null hypothesis of between-study homogeneity is rejected, it indicates that the fixed-effect meta-analysis is not adequate (Feld and Heckemeyer, 2011).

In our case, the Q-statistic is equal to 8.077, which fails to reject the null hypothesis of homogeneity, with a p -value > 0.10 . In other words, the individual effect size from the sample is not significantly different from the population mean effect size. Hence, the fixed-effect model is suitable to be applied in our meta-analysis.

6. Conclusion

Due to its severe adverse effects on the vulnerability of a financial system as well as the potential diversification benefits of international portfolio investments, financial contagion has become an important theme in the field of international finance. Despite the increased researches on the notion during the last three decades, researchers have yet to reach universally agreed conclusion on the existence of statistically significant financial contagion. The variations of the research findings can be caused by a number of factors. Recently, contagion studies have revealed that one of the major culprits for such variability is the research model applied.

In order to provide more adequate picture on the relevance of financial contagion, this study has applied a meta-analysis approach to assess the statistical significance of the phenomenon based on the past empirical contagion studies. Having defined financial contagion as the significantly intensified cross-market dependence during the crisis period, our meta-

analysis has focused on non-linear Copulas-based contagion studies. It is believed that our chosen definition enables us to examine financial contagion through a straight-forward approach, which only needs to compare the cross-market dependence coefficients between crisis and tranquil period. In addition, our emphasized copulas model enables us to examine financial contagion from a non-linear approach, with varying patterns of tail behavior as well as different kinds of asymmetry.

After a series of screening process, only 6 researches are selected in our meta-analysis. And the meta-analysis results reveal that, financial contagion is statistically significant for both fixed-effect and random effect models, regardless of the level of significance used. In addition, the homogeneity test shows that the individual effect size from our sampled studies are not significantly different from that of the population mean. Hence, the fixed-effect model is an adequate choice for our meta-analysis.

Since financial contagion is found to be a statistically significant phenomenon, adverse financial shocks can be rapidly transmitted from one market to another, even if these markets share little economic linkages or of different markets structures and sizes. As implications, policy makers should be cautious about the vulnerability of the domestic market to the potential contagion effect in structuring the monetary and financial policies. It is recommended that country should establish contingent credit lines from private financial institutions to ensure the availability of financial resources during a crisis (Claessens and Forbes, 2004). By doing so, it would restore the investors' positions closer into line with economic fundamentals (Moser, 2003). As for the portfolio investors, since some markets would plague together with contagion in wake of financial turmoil, they should avoid diversifying investment portfolio from those potentially contagious markets (Phylaktis and Xia, 2009).

One of the most limitations of our study is that our meta-analysis is confined to empirical studies that apply Copula-based studies. It is suggested that future researches could include different methodologies, both linear and non-linear ones, into the contagion meta-analysis. In addition, meta-regression analysis is also advised to be applied in the future researches to quantitatively examine the sources of heterogeneous findings in the past contagion studies.

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Intra-OIC Trade: The Impact of IDB Trade Financing

Shafia S. A. Arifai¹ and Fithra Faisal Hastiadi²

To increase intra-OIC trade, defined as intra-OIC imports as a share of total imports of OIC countries, Islamic Development Bank (IDB) has been implementing trade finance activities. This study tries to shed a light on the determinants of intra-OIC trade and the impact of IDB trade financing on intra-OIC trade. Using gravity model both the intuitive and the theoretical one, this study observes eighteen OIC countries from 2000 until 2014. This study finds that GDP, distance of two capitals, IDB trade financing, common language, common colony, colony, landlocked, contiguous, the Arab Spring events and Asian as PTA are statistically significant factors in determining export. This study focuses on producing an output that can guide OIC member countries and IDB in developing a trade financing scheme that can increase intra-OIC trade.

Keywords: Intra-OIC Trade, IDB Trade Financing, The Gravity Model

JEL Classification: F13, F15

1. Introduction

IDB member countries are now facing at least three ongoing challenges: to create and sustain employment, to increase income, and to improve performance on human development. To overcome these challenges, the Islamic Development Bank Group (IDBG) has been performing trade finance activities designed to accelerate income and growth and create new employment opportunities in IDB member countries by fostering, facilitating, and expanding trade within OIC region and between the OIC region and the rest of the world.³

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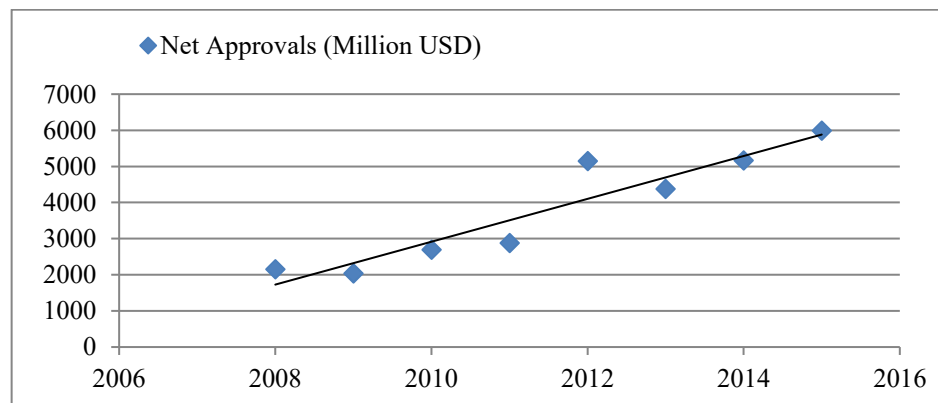
³ ITFC Group Operations Evaluation (GOE) Department, Proposed Approach Paper For ITFC's Trade Finance Evaluation, 2015, page 1

IDB trade finance activities have been operating for more than 35 years. In 2008, trade finance activities reach two IDBG entities. One of it is International Islamic Trade Finance Corporation (ITFC). Since ITFC's inception in 2008, cumulative funded financing reached thirty five (35) billion US dollars. In terms of insurance, 12.4 billion US dollars in member countries' export and a further eight (8) billion US dollars in imports.⁴

As shown in Figure 1.1, ITFC's net approval for all OIC member countries has increasing trend from 2008 to 2015. Further, by comparing positive trend of ITFC's net approval with real condition of intra-OIC trade, this study obtains a thorough glimpse of the relationship between IDB trade financing and intra-OIC trade.

In Figure 1.2, we can see that overall trade volume from OIC countries to OIC countries (intra-OIC trade or trade within OIC region), to developed countries, and to developing countries are increasing. However, the trade volume to OIC Countries is still below the trade volume to developed countries and to developing countries.

Figure 1.1 ITFC's Net Approvals Yearly



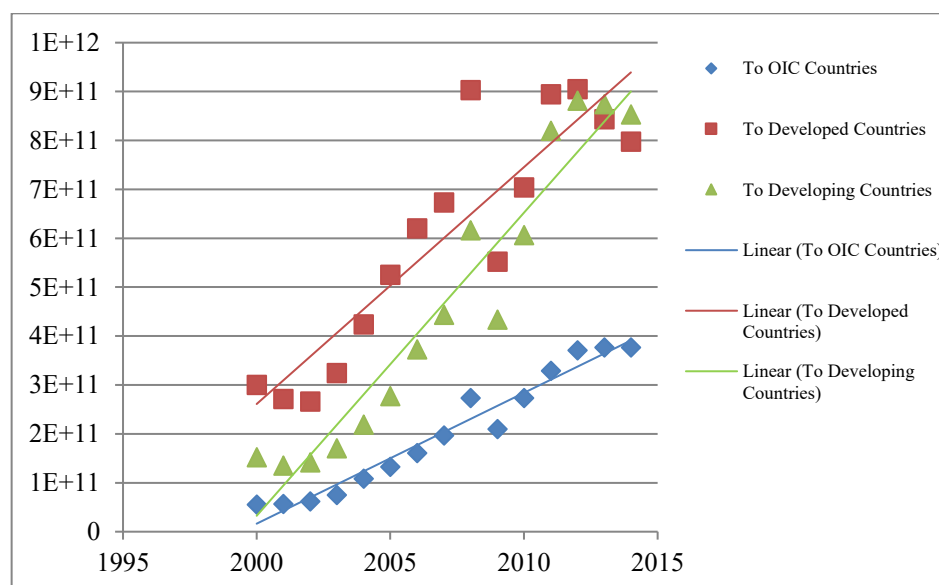
Source: Author. Data is from IDB.

In Figure 1.2, we can also observe that in year 2000, trade volume to developing countries and to OIC countries was not very different.

⁴ ITFC Group Operations Evaluation (GOE) Department, loc. cit.

However, from 2006 up until now, the export gap continues to grow. One reasonable explanation of this phenomenon is that purchasing power of developing countries is bigger than that of the OIC countries' purchasing power. Twenty two (22) out of fifty five (55) LDCs countries, or almost 40%, are OIC member countries⁵. Moreover, it can be an indication that the intervention of IDB trade financing has been relatively small, that the impact on intra-OIC trade tends to look insignificant. Additionally, considerable event to be noted is the unstable political condition that occurred in eighteen (18) OIC member countries in late 2010 and in 2011, namely, the Arab Spring Events. This motivates the study to include additional factor capturing the Arab Spring Events as one of intra-OIC trade's determinants.

Figure 1.2 OIC Countries' Export Volume to OIC Countries, Developed Countries, and Developing Countries

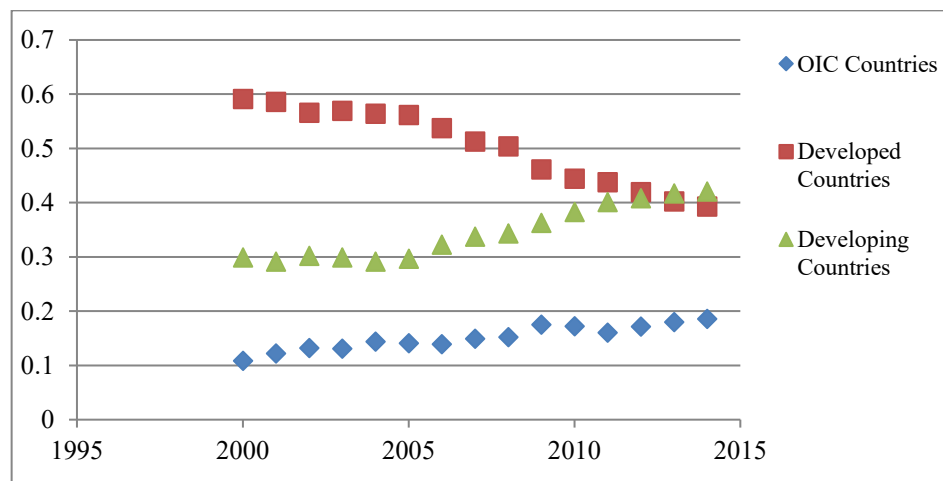


Source: Author. Data is from IMF Direction of Trade Statistics.

⁵ SESRIC, Economic Problems of The Least-Developed and Land-Locked OIC Countries, SESRIC Publication Department, Ankara, 2009

It is interesting to note, as seen in Figure 1.3, that the portion of the export to developed countries keeps decreasing while the export to developing countries and OIC countries keep increasing. Moreover, for 2013 and 2014, the portion of export to developing countries can exceed the portion of export to developed countries. Furthermore, the gap between developing and OIC countries has been increasing since 2006.

Figure 1.3. Export Portion from OIC Countries to OIC Countries, Developed Countries and Developing Countries



Source: Author. Data is from IMF Direction of Trade Statistics.

Most of the above descriptions are based on aggregate data. Based on the non-aggregate analysis provided in Table 1.1, we can conclude that the export of each of the eighteen countries to all OIC countries have positive trend, despite the increasing or decreasing or constant zero trade financing from year 2000 to 2014. By comparison, we see that some OIC countries increase the export every year, irrespective of the IDB trade financing. To understand the impact of IDB trade financing on intra-trade of OIC countries in more detail, we need further research.

Table 1.1 Comparison Between Trend of IDB Trade Financing For 18 OIC Countries (Sample in this study) and Their Export Trend to All OIC Countries from year 2000 to 2014

Countries	IDB Trade Financing	Export	Countries	IDB Trade Financing	Export
Algeria	-	+	Libya	0	+
Bahrain	-	+	Malaysia	-	+
Cote D'ivore	+	+	Nigeria	+	+
Egypt	+	+	Oman	0	+
Indonesia	+	+	Pakistan	-	+
Iran	-	+	Qatar	+	+
Jordan	+	+	Saudi Arabia	-	+
Kazakhstan	+	+	Turkey	-	+
Kuwait	-	+	UAE	+	+

Source: Author. Data is from IDB.

The research conducted by Bendjilali (2000) uses cross sectional data in 1994 to examine the main determinants of intra-bilateral trade with reference to the characteristics of the OIC member countries that will help make the percentage of intra-OIC trade increase. Bendjilali (2000) finds that GDP of exporters and importers, distance, IDB trade financing, ASIAN economic block, and GCC economic block are significant determinants of intra-OIC trade. On the other hand, this study tries to obtain results using panel data from 2000 until 2014 not only with intuitive gravity model, but also with theoretical gravity model by Anderson & van Wincoop (2003).

Gundogdu (2009) scrutinizes the determinant of intra-OIC trade and adds tariff, proxy for trade facilitation and liberalization, and depreciation of real exchange rate, together with depreciation of US dollar against Euro. It is argued that the recent increase in intra-OIC trade is likely to be a product of the combined effects of oil price surge and Euro appreciation rather than the trade diversion effect of OIC membership (Gundogdu, 2009).

Jafari, Ismail, & Kouhestani (2011) identify the factors affecting the export flows among the D8. The results based on the panel data demonstrate that the trading partners' GDP, exchange rate, population of exporter country, border and distance are the notable factors affecting the volume of export flow among the countries in the D8 group.

The research conducted by Abdullah, Abdullah, and Abuhriba (2015) use data set of 1989-2009 to find the determinants of trade and trade direction of Arab Maghreb Union. The results indicate that there are strong positive and negative relationship between trade and GDP, population, distance, foreign country reserves (FOC) and real exchange rate (RER) among AMU countries.

On the one hand, this study tries to conduct the research by expanding the population to OIC member countries, different with Jafari, Ismail, & Kouhestani (2011) and Abdullah, Abdullah, and Abuhriba (2015) which focused on D8 and AMU. In addition, this study also considers IDB trade financing as the main variable and the Arab Spring events that prevailed in 2011 as one of control variables which are not included in Gundogdu (2009), Jafari et al. (2011) and Abdullah et al. (2015).

After considering the descriptive analysis, past literatures and research gaps, this study tries to find the determinants of intra-OIC trade and the impact of IDB trade financing on intra-OIC trade.

2. Literature Review

Recent studies on determinants of trade focused primarily on the determinants of trade of a particular region. Gundogdu (2009) confirms that the trade creation but not diversion effect of OIC membership through trade liberalization and facilitation efforts together with Terms of Trade improvement of OIC member countries boosts OIC imports from both imports from OIC countries and non-OIC countries.

Jafari, Ismail, & Kouhestani (2011) identify the factors affecting the export flows among the D8 countries, which comprise eight developing countries: Malaysia, Iran, Turkey, Indonesia, Egypt, Bangladesh, Pakistan, and Nigeria. The results based on the gravity model applied to the panel data between 1990 and 2007, which is estimated using Panel Correlated Standard Errors (PCSE), show that the trading partners' GDP, exchange rate, population of exporter country, border and distance are the notable factors affecting the volume of export flow among the countries in the D8 group.

Abdullah, Abdullah, and Abuhriba (2015) examine the determinants of inter-regional trade in the AMU countries. Using data set of 1989-2009

and standard gravity model, the study measures the pattern and trend of bilateral trade. The study indicates that there are strong positive and negative relationships between trade and GDP, Population, distance, foreign currency reserves (FOC) and real exchange rate (RER) among AMU countries (Abdullah, Abdullah, & Abuhriba, 2015).

Recently, studies using gravity model have been successful in explaining flows of goods and the production factor that occurs between regions or countries. Batra (2004) stated that gravity model which used for analyzing bilateral trade was developed separately by Tinbergen (1962) and then by Poyhonen (1963).

Tinbergen (1962) and Poyhonen (1963) specified the gravity model as:

$$\text{Trade}_{ij} = \alpha \frac{\text{GDP}_i \cdot \text{GDP}_j}{\text{Distance}_{ij}} \quad (2.1)$$

Where:

- Trade is the export or import volume of bilateral trade between regions i and j
 - GDP_i and GDP_j is national income of country i and j
 - Distance_{ij} is the distance between the two countries
- The logarithmic equation then will become:

$$\log(\text{Trade}_{ij}) = \alpha + \beta_1 \log(\text{GDP}_i \cdot \text{GDP}_j) - \beta_2 \log(\text{Distance}_{ij}) + \varepsilon_{ij} \quad (.2)$$

The equation above is the core equation from gravity model where national income has positive effect and distance has negative effect in bilateral trade flows.

In the most basic gravity model, total bilateral trade is assumed to increase along with the size of their economies, which is measured by the national income, and to decrease along with increase in transportation cost, which is measured by the distance between the centers of economy in the two countries.

Early studies on the determinants of trade focused basically on the relation between distance and trade (Srivastava & Green, 1986). In general, it has been well set that distance is a strong determinant of the intensity of trade flows that occur between nations (Beckerman 1956; Ullman 1956; Smith 1964; Linneman 1966; Yeats 1969).

One of the reasons the distance is included in the gravity model is that distance reflects difficulty in communication and cultural differences. To overcome this problem, two more variables are added to the model, *common language* for the communication problem and *colonial links* for the cultural difference (Putranto, 2007).

Evidence shows that the trade between countries use the same language is two to three times bigger compared to that between countries that use different language (Head, 2003). Ghani (2007) also shows that common language variable affecting trade positively.

Colonial links variable is included because in general there is a transfer in institution, language and culture, so the similarities in those matters may increase the trade volume. There are two variables that describe relation of past colonial history: colony and common colony. Colony variable shows whether there is colonial relationship between countries. Rose (2004), Batra (2004), Soderling (2005), and Ghani (2007) included colony variable and showed that there is positive effect on trade. Common colony variable shows whether both countries had the same colonialist after 1945. Common colony variable shows positive effect on trade by Rose (2004), Batra (2004), and Ghani (2007).

Variable *landlocked* shows whether a country has access to the sea. Rose (2003), Batra (2004), Soderling (2005), and Ghani (2007) found that lack of sea access has negative effect on trade.

Another variable is *adjacency*, sometimes called *contiguous* or *border that intersects directly*. Ghani (2007) finds that common border is positively affecting trade.

Free trade agreement is also included as a variable because it is expected to stimulate trade between countries. Signing free trade agreement is found by Batra (2004) and Clarete, Edmonds and Wallack (2002) to give positive effect on trade.

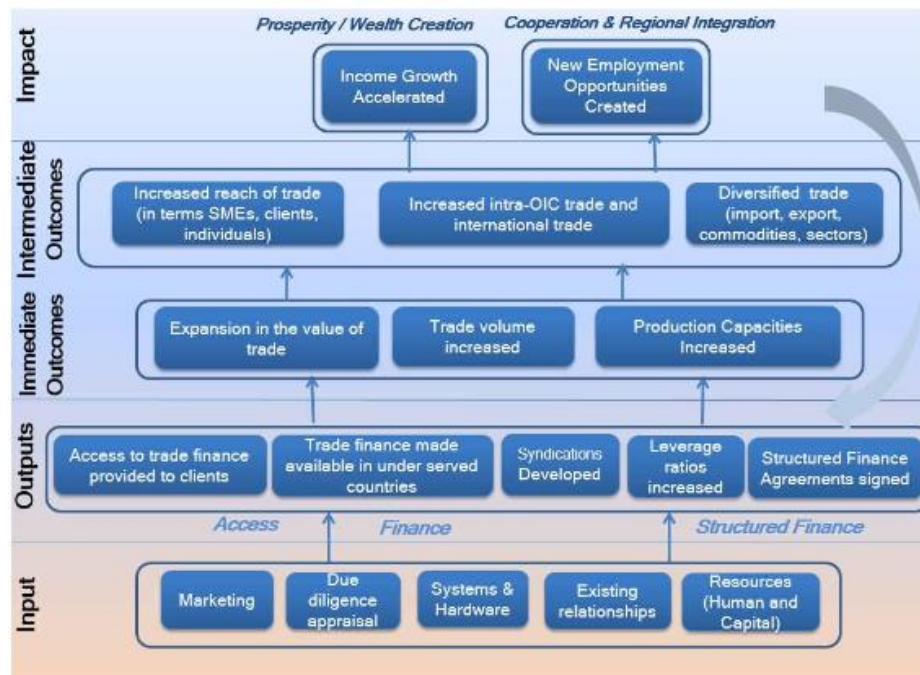
Other variable is the Arab Spring Event. The expression *Arab Spring* refers to the anti-government protests which started in late 2010 (see Oncel & Malik, 2015). Before the revolt of the Arab Spring Event, the economies of the Arab countries were generally in a better condition (Oncel & Malik, 2015). There is notable empirical evidence that political instability is not favorable to economic growth (Alesina et al. (1996); Khandelwal and Roitman (2013)), to investment (Alesina & Perotti, 1996) or to price stability (Aisen & Veiga, 2006).

Trade finance, in addition to other factors, is an important determinant of trade flow patterns (Love & Zicchino (2006); Levchenko, Lewis, & Tesar (2010); Thomas, (2009); Chor & Manova (2011)). Ronci (2004) indicates that trade finance is only slightly positively correlated with export and import volumes in the short run. However, he further notes that in periods of financial turmoil, there exists a significantly larger positive relationship between these two variables. Specifically, Bendjilali (2000) has examined the relationship between IDB trade financing and intra-OIC trade. His study shows that IDB trade financing statistically significant in affecting intra-OIC trade.

Trade Finance activities reach two IDBG entities – the International Islamic Trade Finance Corporation (ITFC) and Islamic Corporation for the Insurance of Investment and Export Credit (ICIEC). ITFC was established to encourage trade among the member countries of the OIC by providing trade finance.

The principal outcome from the trade finance activities is the improvement of livelihoods and regional cooperation among member countries through boosting income growth and creating new employment opportunities. These, as illustrated in **Figure 2. 1**, should be accomplished through a set of immediate and intermediate outcomes.⁶

⁶ ITFC Group Operations Evaluation (GOE) Department, op. cit. page 3

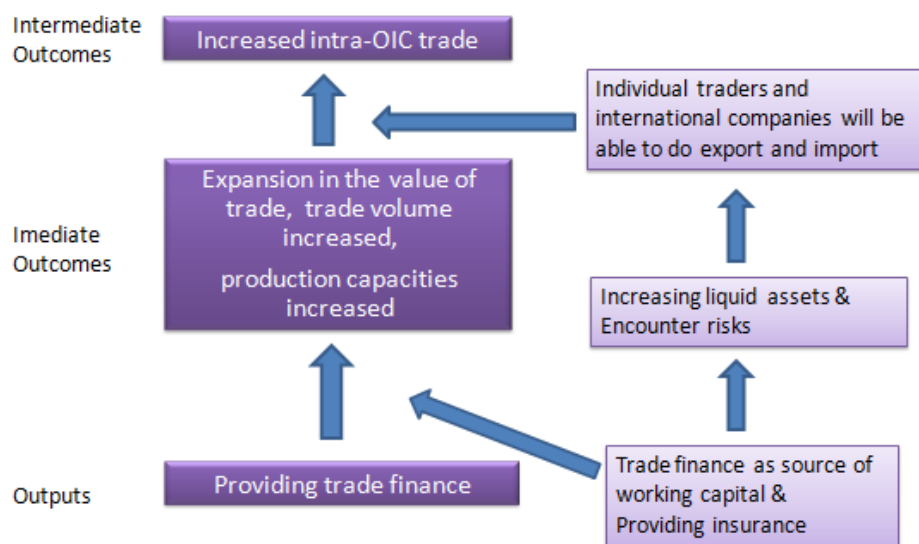
Figure 2. 1 Theory of Change For ITFC's Trade Finance Activities⁷

Specifically ITFC seeks to bring about an expansion in the value, volume and diversity of traded goods between OIC member countries and the rest of the world by expanding syndications and giving access to finance to clients and under-served countries. To perform these activities, ITFC depends on its internal resources, existing relationships and corporate processes such as marketing and due diligence appraisal.⁸

Banks and financial institutions essentially give trade finance for two purposes. First it provides a source of working capital for individual traders and international companies in need of liquidity. Second, it provides insurance to encounter the risks involved in international and domestic trade, such as price or currency fluctuations, and especially non-payments (Silvio & de Nicola, 2013).

⁷ ITFC Group Operations Evaluation (GOE) Department, op. cit. page 3

⁸ ITFC Group Operations Evaluation (GOE) Department, op. cit. page 3

Figure 2. 2 The Transmission of Trade Finance to Intra-trade

Source: Author. Elaborating ITFC's framework and Silvio & de Nicola (2013)

Elaborating the framework given by ITFC and Silvio and de Nicola (2013), the channel of trade finance to intra-OIC trade is summarized in Figure 2. 2.

3. Methods

The data used in this study is between 2000 and 2014. All variables are entered as natural logarithm, except for the dummy variable and the IDB trade financing variable (see Bendjilali, 2000). Additionally, to estimate the export data with zero values, they will be changed to other small value, which is 0,0001; 0,025; 0,05 (Kalbasi, 2004). The assumption is that there will always exist some bilateral trade even if very small.

The sample is selected from fifty-seven OIC member countries using selection criteria based on the percentage of exports defined as the ratio of the export from a given country to the other member countries over the total intra-OIC export. Note that, while Syrian is eligible to be a part of the sample, its export portion to OIC countries being 3.77 per cent, this country is excluded from the sample because its GDP data is not complete. Therefore, the sample includes 18 countries accounting for 86.69 per cent trade in OIC countries.

Table 3. 1 Sample for Exporting Countries

1	Algeria	10	Libya
2	Bahrain	11	Malaysia
3	Cote d'Ivoire	12	Nigeria
4	Egypt	13	Oman
5	Indonesia	14	Pakistan
6	Iran	15	Qatar
7	Jordan	16	Saudi Arabia
8	Kazakhstan	17	Turkey
9	Kuwait	18	United Arab Emirates

After this study has settled the sample, further this study will explain the variables that will be examined. The statistics summary of variables which used in the analysis is summarized in Table 3.2.

Table 3. 2 Statistics Summary of Variables in General

Variable	Observation	Mean	St. Dev.	Min.	Max.
Export	13230	1.80e+08	8.35e+08	.05	2.90e+10
GDPexpimp	13230	1.69E+22	5.25E+22	1.73E+18	7.49E+23
distance	13230	4960.292	3104.38	139.007	18364.3
idbf	13230	7.61e+07	1.38e+08	0	1.20e+09
Contig	13230	0.054422	0.226857	0	1
Comlang	13230	0.24709	0.431336	0	1
Colony	13230	0.007937	0.088736	0	1
comcol	13230	0.170068	0.375707	0	1
landlocked	13230	0.047921	0.213608	0	1
Asian	13230	0.309448	0.462284	0	1
AMU	13230	0.00907	0.094809	0	1
GCC	13230	0.034014	0.181271	0	1
ArabSpring2011	13230	0.0666667	0.2494533	1	1

1. Export

In general, the biggest export volume is UAE's export to Iran in 2014, Iran's export to Turkey 2011-2012 and the smallest value is Iran's export in 2007 to Suriname.

Table 3. 3 Statistics of Export for Each Country (US Dollar) 2000-2014

Country	Mean	To Country (Max)	To Country (Min)
Algeria	7.87e+07	Turkey, Morocco, Tunis	Albania, Bahrain, Brunei, and many others
Bahrain	4.90E+07	Saudi Arabia, UAE, Qatar	Chad, Mozambique, Djibouti, and many others
Cote d'Ivoire	4.34E+07	Gabon, Nigeria, Burkina Faso	Maldives, Turkmenistan, Kazakhstan, and many others
Egypt	1.05E+08	Saudi, Turkey, Libya	Guyana, Kyrgyzstan, Turkmenistan, and many others
Indonesia	2.66E+08	Malaysia, UAE, Saudi Arabia	Chad, Guinea Bissau, Tajikistan, and many others
Iran	1.79E+08	Turkey, Pakistan, UAE	Mauritania, Sierra Leon, Uzbekistan, and many others
Jordan	3.11E+07	Saudi Arabia, UAE, Lebanon	Benin, Burkina Faso, Comoros, and many others
Kazakhstan	8.13E+07	Turkey, Iran, Uzbekistan	Comoros, Guinea Bissau, Maldives, and many others
Kuwait	1.94E+08	Egypt, Pakistan, Indonesia	Burkina Faso, Chad, Comoros, and many others
Libya	3.56E+07	Turkey, Tunisia, Indonesia	Bangladesh, Comoros, Kazakhstan, and many others
Malaysia	3.01E+08	Indonesia, UAE, Pakistan	Guinea Bissau, Chad, Burkina Faso, and many others
Nigeria	8.43E+07	Indonesia, Cote d'Ivoire, Cameroon	Kyrgyzstan, Libya, Maldives, and many others
Oman	1.08E+08	UAE, Saudi Arabia, Pakistan	Suriname, Kyrgyzstan, Guinea Bissau, and many others
Pakistan	8.61E+07	UAE, Turkey, Saudi Arabia	Lebanon, Albania, Suriname, and many others
Qatar	1.12E+08	UAE, Indonesia, Saudi Arabia	Albania, Guyana, Comoros, and many others
Saudi Arabia	5.27E+08	Pakistan, Indonesia, Bahrain	Comoros, Gabon, Guinea Bissau, and many others
Turkey	3.74E+08	Iran, UAE, Egypt	Brunei, Comoros, Guinea Bissau, and many others
United Arab Emirates	6.41E+08	Iran, Oman, Pakistan	Burkina Faso, Mali, Sierra Leon, and many others

Source: Author. Data from IMF Direction of Trade Statistics.

2. GDP

Since GDP measure the scale of economic effect, the larger the values of GDP country i and country j, the larger the value of exports. The expected sign is positive. For GDP exporter, the biggest value is Indonesia in 2012 and Turkey in 2014 and the smallest value is Jordan in 2000. For smallest GDP importer is Comoros in 2000 (0.022 per cent of Indonesia's GDP in 2012).

Table 3. 4 Statistics Summary of GDP for Each Country (US Dollar) 2000-2014

Country	Mean	Min	Max
Algeria	1.31E+11	5.50E+10	2.10E+11
Bahrain	2.07E+10	9.00E+09	3.40E+10
Cote d'Ivoire	2.07E+10	1.10E+10	3.40E+10
Egypt	1.61E+11	7.90E+10	2.90E+11
Indonesia	5.01E+11	1.60E+11	9.20E+11
Iran	3.27E+11	1.10E+11	5.90E+11
Jordan	1.97E+10	8.50E+09	3.60E+10
Kazakhstan	1.08E+11	1.80E+10	2.30E+11
Kuwait	1.03E+11	3.50E+10	1.70E+11
Libya	5.13E+10	2.00E+10	8.70E+10
Malaysia	1.98E+11	9.30E+10	3.40E+11
Nigeria	2.29E+11	4.40E+10	5.70E+11
Oman	4.59E+10	1.90E+10	8.20E+10
Pakistan	1.48E+11	7.20E+10	2.40E+11
Qatar	9.43E+10	1.80E+10	2.10E+11
Saudi Arabia	4.35E+11	1.80E+11	7.50E+11
Turkey	5.53E+11	2.00E+11	8.20E+11
United Arab Emirates	2.41E+11	1.00E+11	4.00E+11

Source: Author. Data from World Bank.

3. Distance

Since the proxy of distance which is a composite of transport cost, transport time etc., the larger the distance, it will reduce the export values. Therefore, the expected sign for this variable is negative. For distance between two capitals, the farthest is between Indonesia and Guyana, on the contrary the nearest is between Qatar and Bahrain.

Table 3. 5 Statistics of Distance for Each County (Km)

Country	Min	To Country	Max	To Country
Algeria	642.7219	Tunisia	11649.4	Indonesia
Bahrain	139.007	Qatar	11530.45	Guyana
Cote d'Ivoire	715.0526	Mali	13268.58	Brunei
Egypt	494.248	Jordan	9584.535	Guyana
Indonesia	1174.2	Malaysia	18364.3	Guyana
Iran	540.446	Azerbaijan	11313.54	Guyana
Jordan	217.1311	Lebanon	10003.49	Guyana
Kazakhstan	950.3396	Kyrgyzstan	11996.13	Guyana
Kuwait	434.559	Bahrain	11192.6	Guyana
Libya	527.665	Tunisia	10819.99	Brunei
Malaysia	1174.2	Indonesia	17540.31	Guyana
Nigeria	568.2081	Benin	11872.48	Brunei
Oman	438.894	UAE	12386.11	Guyana
Pakistan	673.4186	Tajikistan	13210.75	Guyana
Qatar	139.007	Bahrain	11644.75	Guyana
Saudi Arabia	425.211	Bahrain	11193.37	Guyana
Turkey	714.7758	Lebanon	9620.562	Guyana
United Arab Emirates	303.944	Qatar	11948.63	Guyana

Source: Author. Data from CEPII.

4. IDBF

Increasing the IDB trade financing is hypothesized to increase the export values. For IDB trade financing, the biggest value is for Egypt in 2014 and second biggest is for Turkey in 2014.

Table 3. 6 Statistics of IDB Trade Financing (US Dollar) 2000-2014

Country	Mean	Country	Mean
Algeria	1.00e+07	Libya	0
Bahrain	1.87E+07	Malaysia	9733333
Cote d'Ivoire	6933333	Nigeria	3.29E+07
Egypt	3.25E+08	Oman	0
Indonesia	6.98E+07	Pakistan	1.80E+08
Iran	1.46E+08	Qatar	100000
Jordan	5.00E+07	Saudi Arabia	1.79E+08
Kazakhstan	4.29E+07	Turkey	1.84E+08
Kuwait	8.55E+07	United Arab Emirates	2.94E+07

Source: Author. Data from IDB.

5. *Contiguous*

This variable is dummy variable which 1 if country *i* and *j* is neighboring country, zero otherwise. Neighboring countries are expected to stimulate trading activities because of similarity in tastes and awareness of common interests (Balassa, 1963). The expected sign is positive for this variable. Countries that has neighboring relationship are Egypt-Libya, Indonesia-Malaysia, Iran-Pakistan, Iran-Turkey, Jordan-Saudi Arabia, Kuwait-Saudi Arabia, Libya-Algeria, Oman-Saudi Arabia, Oman-UAE, Saudi Arabia-Qatar, UAE-Qatar, Tsaudi Arabia-UAE, Algeria-Mali, Algeria-Mauritania, Algeria-Morocco, Algeria-Nigeria, Algeria-Tunisia, Cote d'Ivoire-Burkina Faso, Cote d'Ivoire-Guinea, Cote d'Ivoire-Mali, Egypt-Sudan, Iran-Azerbaijan, Iran-Turkmenistan, Kazakhstan-Turkmenistan, Kazakhstan-Uzbekistan, Libya-Chad, Libya-Niger, Libya-Sudan, and so on.

6. *Common language*

If country *i* and country *j* has same language, it is expected the trade activities between them increase. Therefore the export values will increase too. The expected sign is positive for this variable. Algeria, Bahrain, Benin, Burkina Faso, Cameroon, Chad, Comoros, Cote d'Ivoire, Djibouti, Egypt, Gabon, Guinea, Jordan, Kuwait, Lebanon, Libya, Mali, Mauritania, Morocco, Niger, Oman, Qatar, Saudi Arabia, Senegal, Sudan, Togo, Tunisia, and UAE is one of the examples of countries that having same language. Kazakhstan and Kyrgyzstan is also having common language. Pakistan, Cameroon, Guyana, Nigeria, Sierra Leon, and Uganda are another group of countries having common language.

7. *Colony*

If country *i* and country *j* has colonizer and colony relationship, it is expected the trade activities between them increase so that the export values will increase too. The expected sign is positive for colony. This study's samples that have past colonizer-colonized relationships are Turkey-Egypt, Turkey-Libya, Egypt-Sudan, and Turkey-Tunisia.

8. Common colony

If country *i* and country *j* at least has one same colonizer, it is expected the trade activities between them increase. Therefore the export values will increase too.

This study's sample that has same colonizer is Bahrain, Bangladesh, Brunei, Guyana, Kuwait, Malaysia, Maldives, Uganda, Jordan, Nigeria, Qatar, Pakistan, and United Arab Emirates colonized by United Kingdom.

Algeria, Benin, Burkina Faso, Cameroon, Chad, Comoros, Djibouti, Gabon, Guinea, Mauritania, Morocco, Senegal, Togo, Tunis and Cote d'Ivoire are colonized by France.

Indonesia and Suriname are colonized by Netherlands. Kazakstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Azerbaijan are colonized by Russian Federation.

9. Landlocked

If the country is surrounded by land, it is expected that its trade will be reduced since the cost of trading is increasing by its landlockedness. In this study, Kazakhstan is the only sample which is surrounded by land.

10. PTAs (Asian, AMU, GCC)

If the pairing countries are one of the PTA's members, it is expected that its trade will tend to increase since the cost of trading is reduced by tariff reduction, quota derogation, and trade facilitation.

Countries joining Asian are Indonesia, Malaysia, Azerbaijan, Bangladesh, Bahrain, Iran, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Maldives, Pakistan, Oman, Qatar, Saudi Arabia, Tajikistan, Turkmenistan, United Arab Emirates, and Uzbekistan.

Countries joining GCC are Arab Saudi, United Arab Emirates, Bahrain, Kuwait, Qatar, and Oman.

Countries joining AMU are Algeria, Libya, Mauritania, Morocco, and Tunisia.

Table 3. 7 Variable Description

<i>Variable Dependent</i>	<i>Explanation</i>	<i>Sources</i>	<i>Expected Sign</i>
Export	Export Values (US Dollar)	IMF Direction of Trade Statistics	
<i>Variable Independent</i>	<i>Explanation</i>	<i>Sources</i>	<i>Expected Sign</i>
GDPexpimp	GDP exporter multiplied by GDP importer (US Dollar)	World Bank's World Development Indicator	+
distance	Distance between capital of both countries (Km)	Cepii (<i>The Centre d'Études Prospectives et d'Informations Internationales</i>)	-
idbf	Trade finance from IDB (US Dollar)	Islamic Development Bank	+
contig	dummy variable 1 if both countries adjacent to each other; 0 otherwise	Cepii	+
comlang	dummy variable 1 if both countries have same language; 0 otherwise	Cepii	+
Colony	dummy variable 1 if both countries have colonizer-colonized relationship; 0 otherwise	Cepii	+
comcol	dummy variable 1 if both countries have same colonizer; 0 otherwise	Cepii	+
landlocked	dummy variable 1 if the country is landlocked; 0 otherwise	Cepii	-
Asian	Dummy variable 1 if the country is member of the PTA; 0 otherwise		+/-
AMU (Arab Maghreb Union)	Dummy variable 1 if the country is member of the PTA; 0 otherwise		+/-
GCC (Gulf Cooperation Council)	Dummy variable 1 if the country is member of the PTA; 0 otherwise		+/-
ArabSpring2011	Dummy year 1 for 2011 and 0 other years		+/-

3.1 Intuitive Gravity Model

The intuitive gravity model in this study takes the following log-linearized form:

$$\begin{aligned} \log(X_{ij}) = & \alpha + \beta_1 \log(Y_i Y_j) + \beta_2 \log(Disctcap_{ij}) + \\ & \beta_3(IDBF) + \beta_4(ComLang) + \beta_5(Comcol) + \beta_6(Colony) + \\ & \beta_7(Landlocked) + \beta_8(Contig) + \beta_9(PTA) + \\ & \beta_{10}(ArabSpring2011) + \varepsilon_{ij} \end{aligned} \quad (1)$$

The intuitive model will be estimated with OLS. It is important to understand the nature of OLS. OLS minimizes the sum of squared errors ε . There are three necessary and sufficient conditions in estimating the model with OLS (Shepherd, 2013) :

1. The errors must have average zero and be uncorrelated with any of the explanatory variables
2. The homoscedasticity assumption
3. The full rank assumption

If all three properties are maintained, then OLS estimates are consistent, unbiased, and efficient within the class of linear models (Shepherd, 2013).

3.2 Theoretical Gravity Model

Theoretical gravity model starts from the intuitive gravity model. Theoretical gravity model consider not only bilateral trade costs, but also the level of trade costs incurred on other routes. Intuitive gravity model bring several significant empirical regularities, but has been stated without any explicit theoretical foundation. Theoretical gravity model tries to incur the relative cost problem. To this day, Anderson and Van Wincoop- AvW 2003 represent the most formal benchmark for theoretical gravity model (Anukoonwattaka, 2015).

Anderson and Van Wincoop (2003) empirical implications (see Anukoonwattaka, 2015):

1. The intuitive gravity model does not include relative price so that the model has omitted variables which in turn the model is claimed to be bias and inconsistency.
2. Since the relative trade costs is significant, two types of trade costs have to be taken into account: trade costs between i and j & trade costs of i and j with third parties.
3. Trade flows are “unidirectional” trade flows for every observation, not total trade of a country pair.
4. Variables must be in nominal terms since price indices are included separately in the multilateral trade resistance terms.
5. Using aggregate GDP, not GDP per capita
6. Must account the estimated “trade costs”, not just distance in gravity models.

The base line can be:

$$\log \tau_{ij} = \beta_1 \log(\text{Disctcap}_{ij}) + \beta_2(\text{ComLang}) + \beta_3(\text{Comcol}) + \beta_4(\text{Colony}) + \beta_5(\text{Contig}) \quad (2)$$

Policy related variables can be augmented into trade cost functions

7. $\hat{\beta}$ is not fully as a trade cost elasticity, but incorporated with elasticity of substitution (σ)

After understanding the nature of the model, next this study introduces its own model based on AvW (2003) model with fix effect estimation.

$$\log(X_{ij}) = -\log Y + \log Y_i - \log \Pi_i + \log Y_j - \log P_j + (1 - \sigma) [\log \tau_{ij}] \quad (3)$$

$$\log \tau_{ij} = \beta_1 \log(\text{Disctcap}_{ij}) + \beta_2(\text{IDBF}) + \beta_3(\text{ComLang}) + \beta_4(\text{Comcol}) + \beta_6(\text{Colony}) + \beta_7(\text{Landlocked}) + \beta_8(\text{Contig}) + \beta_9(\text{PTA}) + \beta_9(\text{ArabSpring2011}) \quad (4)$$

Explanations:

$$\log Y_i - \log \Pi_i = \text{exporter fix effect} \quad (5)$$

$$\log Y_j - \log P_j = \text{importer fix effect} \quad (6)$$

$$\log \tau_{ij} = \text{estimated trade costs} \quad (7)$$

Actually this model can be estimated with random effect approach but UNESCAP himself is not recommending it due to a strong assumption: multilateral resistance terms must be normally distributed across countries, with a given standard deviation. Another reason is that accounting for both inward and outward multilateral resistances need specification of a two-dimensional random effects model – random effects by exporter and by importer – which is rarely used in the literature. Although such models can be used in Stata using *xtmixed* command, they have obtained few considerations either in the econometrics literature or in the applied policy literature. The plausible reason is that fixed effects modelling is generally preferred for gravity work because theoretical models do not explain anything about the statistical distribution of trade costs or multilateral resistance (UNESCAP, 2012).

4. Findings And Discussions

My findings are shown in Table 4.1.

Table 4.1 Regression Result

Independent Variable	Intuitive Gravity Model	
	Coefficient	Robust Standard Error
lnGDPexpimp	1.635343***	0.081129
LnDistance	-0.86993**	0.370876
Idbf	3.98E-09***	7.64E-10
Comlang	2.475493***	0.535507
Comcol	1.68515***	0.501951
Colony	3.34154***	0.975155
Landlocked	-2.59135***	0.721971
Contig	2.150018***	0.728325
Asian	2.386055***	0.487784
GCC	-1.37298	0.847066
AMU	-1.23094	1.710605
ArabSpring2011	-0.76225***	0.13562
Constant	-62.4772***	4.704163
N	13230	
Fstat	F(12, 730) = 94.67	
R-squared	0.3644	
Significance level: *p<0,1 **p<0.05, ***p<0.01		

Source: Computed by Author.

The overall goodness of fit is reflected by the R-Square term. It can be concluded that the specified models explain almost 37 percent of the total variation in the exports variable can be attributed to a linear relationship between the explanatory variables.

As shown in Table 4.1, GDP of the country pair has significant positive relationship with trade. The positive coefficient on GDP is expected since scale effects are bigger than proximity effects (Bendjilali, 2000).

Distance variable shows the expected sign as the gravity model suggested, negative and statistically significant. This means that distance which is

proxy of transportation and communication costs is inversely related with export. The result consistent with Batra (2004) which suggests that distance is a proxy for *transportation costs*, indicator for time needed in delivering commodities, *cost of synchronization* (when factories combining many types of input, punctuality must be synchronized for avoiding production's resistor), and *transaction costs* (distance has correlation with cost of finding trading opportunities and building trusts between trading partners); those costs have negative relationship with trade.

Common language as proxy of cost from culture - where there is possibility that the more further the geographical distance between two countries, the cultural difference between two countries will be bigger (Batra, 2004) - shows positive sign in this study. This finding is consistent with other previous studies.

Common colony variable shows positive relationship with trade, significant at level 1 per cent. This variable shows positive effect on trade. We can infer from the positive relation that countries having same colonizer is likely to trade more than countries not having same past colonizer. Transfer in institution, language and culture from the same colonizer can increase trade volume.

Institution can be interpreted as the law that has been implemented in the country. Indonesia, as example, is still using many laws, especially its private law, that was given by Dutch colonial government. Pakistan and Malaysia's common law is based on English common law. Mauritania and Libya are using French Civil Codes mixed with Islamic law.

This study concludes that political factor, precisely colonial ties, has continuous effect and strong in international economy, both in trade and foreign direct investment. Colony variable is statistically significant affecting trade. It means that having past colonizer-colonized relationship does contribute positively on trade. In spite of attaining the independence, the ties of former colonial times is expected to influence the bilateral relations. It is understood since businesses of the former colonists are happened in the previous colonies and, in many cases, since close political ties still bonds between nations and their former colonies (Srivastava & Green, 1986).

Landlocked variable shows whether a country has direct contact with sea or not. The finding shows that landlocked has negative relationship with trade significant at level 1 per cent. It means that a country which has no direct contact with sea, its trade volume will be reduced. On the other hand, country that has direct contact with sea will not. Because having direct contact with sea is considered to facilitate trade because of a possibility to build harbors. Not having a harbor will increase transport cost because of utilize other country's harbor.

In the regression results, contiguous variable is found to have statistically significant positive relationship with trade. With the inclusion of adjacency variable, it will verify the probability of exaggerating on real effective distance between countries which are neighbors, because generally, countries with such condition always have larger trade on their border line (Head, 2003).

Asian is the only statistically significant variable that affects intra-OIC trade among the Preferential Trade Agreements (GCC, Asian and AMU). Asian variable has positive sign and significant less than 1 per cent. This finding is consistent with Al- Atrash and Yousef (2000) and Bendjilali (2000) which show that ASEAN give significant positive effect for trade. This implies that the pairing countries joining Asian block, their trade are likely to increase more than the pairing countries not joining Asian block.

For GCC and AMU that insignificant at any levels may be explained by the large effect of distance on the determination of trade flows. It is interesting to note that most nations in an economic union are relatively nearby to each other, so that a large part of the associated trade ties would have been integrated in the distance factor (Srivastava & Green, 1986).

The Arab Spring variable has negative relationship with intra-OIC trade and statistically significant. It is consistent with the expected sign. It means that the Arab Spring events in 2011 have decreased intra-OIC trade. Although the trade category is different, this finding is also consistent with Taleb Rifai (2011) which stated that trade in services and export services were devastated as an immediate effect of the Arab Spring events.

The sign of IDB trade financing is positive and statistically significant at level 1 per cent⁹. This result supports Bendjilali's work (2000). It means IDB trade financing has contributed positively to the bilateral trade of the OIC member countries even though the coefficient of this variable is considerably small, 3.98E-09.

To shed a light on how IDB trade financing concretely operates, this study will elaborate the practice and notable achievements of ITFC in affecting trade performance of some OIC member countries.

It has been signed US\$2.2 billion financing program in Egypt between ITFC and the Government of Egypt to help the government in maintaining foreign currency reserves with syndicated murabaha financing as instrument. It is estimated that the aggregate financing amount reached 0.5% of the GDP to finance imports such as petroleum products, wheat and other foodstuff which are strategic commodities (ITFC Report, 2013).

In Cote D'Ivoire syndicated murabaha financing operation is signed in the amount of \$27.39 million for farmers to purchase fertilizers, urea, pesticides, and another agricultural inputs vital for Cote D'Ivoire's strategic cotton crop which support in reviving the country's cotton production and was significantly benefit the employment of 10,000 cotton farmers. Moreover, for the cotton sector, it provides direct and indirect income to some 3.5 million Ivoirians. The murabaha financing operation was extended to Yebe Wagnon, an umbrella organization integrating some cooperatives of cotton growers, through Compagnie Ivoirienne pour le Developpement des Textiles (CIDT), the distribution channel for trade financing funds. Not only enhance the country's economic welfare by providing a significant improvement to the livelihood of the country's cotton farmers, but also this operation assist to alleviate the poverty level in the rural areas (ITFC Report, 2013).

Hastiadi (2015) reports that ITFC sign a US\$2-million murabaha trade finance operation for the coffee sector in Indonesia to assist their pre-export financing necessities. This affects by financing the pre-export working capital requirements of the exporter and by making payment to the suppliers who were the cooperatives, the 6,450 farmers in all 5

⁹ This result is consistent with Theoretical Gravity Model conducted in this research, positively significant affecting trade.

cooperatives so that they were able to get paid earlier. ITFC's financing also assists the farmers to obtain a better price by lower interest charged by the exporters so that it also boosts the growth of the exporter and the co-ops.

Furthermore, Hastiadi (2015) suggests that ITFC financing has been very helpful during the period of global economic crisis in 2008. Without ITFC financing, the clients would have faced difficulties in fulfilling their trading activities.

WTO's Secretariat (2009) confirms that the global liquidity situation has been a significant matter in 2008 since some banks cannot meet the request from their customers for new trade operations, let a "market gap" approximated to be round \$25 billion in November 2008, out of global market for trade finance around ten (10) trillion US dollars a year.

For the betterment of ITFC, Hastiadi (2015) suggests that ITFC best consider in diversifying its portfolio so that it may reduce idiosyncratic risks in its portfolio. Also ITFC should try to syndicate with local banks (domestic or foreign) to finance trade in various sectors so that ITFC may increase its trade finance volume. In addition, ITFC may reconsider its administrative fees and provide expertise to guide customers on the type of financing mechanism, define the terms and conditions, and serve assistance during the lifespan of the transaction. Lastly, ITFC might need to consider the syndication with other banks based in Indonesia to finance trade in various sectors to be able to infiltrate into the private sector with objective of diversification.

5. Conclusion

The finding in this study reveals that intra-OIC trade is positively affected by the size of their economics, the extent of IDB trade financing, common language, common colony and negatively affected by transportation and communication costs as proxy by the distance factor. Also this study shows that colony, contiguous, Asian has significant positive relationship with trade, while landlocked and the Arab Spring has significant negative relationship with trade. Afterwards, AMU and GCC are not significantly affecting trade. It was found that IDB trade financing has significant positive relationship with intra-OIC trade, although the coefficient is considerably small. The regression results offer an opportunity to initiate

and develop optimal trade financing strategy that stimulates and enhances intra-OIC trade potentials. The IDB policy makers can develop different scenarios to help obtain concrete trade strategies that increase trade between the OIC member countries.

Trade policymaker can also use explanatory variables by increasing the variables that are positively correlated to the export variable and by decreasing those that are negatively correlated. For instance, by improving communication network, they would achieve reduction of distance proxy variable. Distance may also be decreased through the substitution effect. Countries that are trading with far countries may change for closer OIC member countries with the requirement that the same goods be traded.

There are other variables that may affect trade such as appreciation of real exchange and tariff. Including these variables in the model would enrich our understanding of trade determinants.

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Electricity consumption, trade openness and economic growth in South Africa: An ARDL approach

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Holistic economic system which involves production, distribution and consumption of goods and services depends on energy; implying that the growth of most developing and emerging economies is directly or indirectly tied to energy access and its consumption. Thus, energy plays a crucial role in the production of goods and services consumed locally or exported abroad through international trade. Energy production and trade openness are therefore among the essential variables of a country's economic wellbeing. This study examines the short- and long-run relationships as well as the causal directions between electricity consumption, trade openness and economic growth in South Africa from 1984 to 2015 using autoregressive distributed lag (ARDL) model. This study found that both the electricity consumption and trade openness have a positive and significant effect on economic growth in the long-run. Granger-causality test revealed that electricity consumption and trade openness Granger-cause economic growth without any feedback effects. This concluded that South Africa's economy significantly benefits from boosting energy production and trade openness.

Keywords: ARDL, economic growth, energy consumption, trade openness, South Africa

1. Introduction

The role that electricity continues to play in meeting the socioeconomic needs of the increasing population and in boosting the economic growth of sub-Saharan Africa cannot be over- emphasized. Energy generally, and electricity specifically has become the bloodline of most economies as it

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drives every sector of the economy (Mensah, 2014). The overall economic system which involves production, distribution and consumption of goods and services depends on energy. This implies that the growth of most developing and emerging economies is directly or indirectly tied to energy access and its consumption. There has been a growing debate on the impacts of different sources of electricity generation in various countries in the recent time (Zaidi et al., 2016; Akinwale et al., 2015; Akinwale et al., 2013). This is as a result of the environmental challenges facing the globe ranging from carbon emission, flood risk, and melting glacier among others (Akinwale et al., 2014). This has posed a serious argument, which resulted into the suggestion of energy conservation policy, for many countries especially those wasting energy and those using unfriendly means to generate electricity (Zerbo, 2016; Dorgan, 2016). While some studies such as Soytaş and Saris (2003) as well as Lean and Smyth (2010) suggested conservation policy in an economy where energy consumption reduction will not affect economic growth, others such as Akinlo (2009) and Narayan and Smyth (2009) believed that such policy will have negative effect on the economic growth which may reduce the pace of industrialisation of such country. This line of studies remain inconclusive as many developing countries especially in Africa and Asia still depend largely on fossil fuel and coal to generate energy and electricity. Energy is utilised in the production of goods/services which are finally consumed locally or exported abroad through international trade. International trade and trade openness involves the movement of goods and services produced from one country to another for consumption or further production (Sadorsky, 2011). Production of those goods would have been difficult or impossible without the effective use of energy (Shahbaz et al., 2014). Trade openness is expected to stimulate domestic production which hitherto engenders economic growth. It also facilitates developing economies to import advance technologies from developed economies. Thus, energy consumption, economic production and international trades tend to move together which makes it interesting to examine the relationship between them in an economy (Nasreen and Anwar, 2014).

Despite that South Africa accounted for the largest proportion of electricity generation and consumption in sub-Saharan Africa (Central Intelligence Agency, 2014), the country still faces various social and economic challenges. Government-owned power company 'Eskom' produced over 90 per cent of the country's electricity, while coal-fired

plant contributes an average of 92 per cent to electricity generation making it the main source of electricity generation in the country's energy mix (StatSA, 2015). The electricity consumption per capita in South Africa was 4,841 kwh in 2015 while that of Egypt was 1,697 kwh and that of Nigeria was 142 kwh (World Bank Development Indicators, 2016). This clearly shows that an average South African enjoys electricity access than other countries in Africa.

South Africa is an upper middle-income country and the second largest African economy behind Nigeria with a gross national income per capita of US\$ 7,575 in 2015 using GDP per capita at 2010 constant US\$ (WDI, 2016). South Africa is part of the South African Customs Union (SACU) which comprises Botswana, Lesotho, Namibia and Swaziland (Kumar et al., 2015). The population size stands at about 55 million, while the services sector accounts for an average of 68 per cent of South Africa's GDP, the manufacturing and mining sector accounts for approximately 22 per cent and agriculture an average 3 per cent (WDI, 2016). The South African total export trade declined from \$91 billion in 2014 to \$81.6 billion in 2015 and the total import trade also declined from \$122 billion in 2014 to \$104.6 billion in 2015. The GDP per capita (at constant 2010 US\$) also fell from \$7,603 in 2014 to \$7,575 in 2015. South Africa like many countries in the world faced a declined economic growth in 2015 but remains the second largest economy in Africa. Looking at the potentials of South African economy, based on the electricity usage, level of import and export among others, there is need to investigate some variables and proffer means to improve the growth and productivity in the country.

Albeit, there are numerous studies on the relationship between electricity consumption and economic growth as well as the relationship between trade openness and economic growth, but there is a dearth of study on the relationship between trade openness and electricity consumption as well as on the joint relationship between electricity consumption, trade openness and economic growth in a single model. Sardosky (2012) argued that understanding the relationship between energy consumption, trade and output is important to understanding current energy and environmental policy, and developing new effective energy and environmental policy. As the population of the country is growing rapidly and economic growth is seen as imminent, there is need to investigate the long run relationship as well as the causal direction between trade

openness, electricity consumption and economic growth in South Africa so as to provide policy suggestions that could assist the government in channelling its efforts towards the right direction. While few studies (Sardosky, 2012; Siddique and Majeed, 2015) available on the three variables are mainly panel data which might not capture the country-specificity very well, other studies (Soytas and Sari, 2003; Nasreen and Anwar 2014) focus mainly on countries in Asia, America and Europe. Thus, a South African study combining electricity consumption, trade openness and economic growth in a single model would shed more light on the topic in the African context.

2. Literature review

This section reviews the relationship between electricity consumption, trade openness and economic growth in different countries. Some of the studies focus on electricity consumption and economic growth, trade openness and economic growth, electricity consumption and trade openness and the three variables together. The direction of causality of each of these variables has an important implication towards a country's government policy. In the case of electricity consumption and economic growth, if the causality runs from electricity consumption to economic growth, it depicts a growth hypothesis because electricity consumption is vital to economic growth; while the reverse depicts the conservation hypothesis where reduction in electricity consumption will not affect economic growth (Payne, 2010). For trade openness and economic growth, the causality from former to later means export-led growth hypothesis; while the reverse is the trade restriction hypothesis. Finally, the causality from trade openness to electricity consumption indicates that implementing energy conservation policy will not affect export and import trade; whereas the unidirectional causality from electricity consumption to trade openness shows that electricity conservation policy will impair the nation's international trade (Sardosky, 2012).

Dorgan (2016) analysed the short run and long run relationship between energy consumption (renewable and non-renewable) and economic growth in Turkey, and found that renewable energy consumption has an insignificant impact on economic growth, while non-renewable energy consumption has a significant positive effect on it. However, energy consumption (both renewable and non-renewable) has a feedback effect on economic growth in Turkey. Studies such as Zaidi et al. (2016) in sub-

Saharan Africa; Yang (2000) in Taiwan; Gurgul and Lach (2012) in Poland; Yoo (2005) in Korea; and Odhiambo (2009) in South Africa among others found a feedback effects between electricity consumption and economic growth in various countries and regions. Unidirectional causality was found from economic growth to electricity consumption in some studies such as Lean and Smyth (2010) in Malaysia; Akinwale et al. (2013) in Nigeria and Soytas and Sari (2003) in Italy and Korea. While unidirectional causality from electricity consumption to growth was also found in studies like Soytas and Sari (2003) also found in France, Germany, Japan and Turkey; Acaravci et al. (2015) in Turkey; and Akinlo (2009) in Nigeria, no causality was found by Huang et al. (2008) in low-income countries; and Ozturk and Acaravci (2013) in Turkey. There are also mixed result on the relationship and direction of causality between electricity/energy consumption and trade openness. While there was no causality between energy consumption and trade openness in the study of Lean and Smyth (2010) in Malaysia; unidirectional causality was found by Sultan (2011) and Sbia et al. (2014) in Mauritius and Bahrain respectively; and bidirectional causality was found by Shahbaz et al. (2013a) and Kyophilavong et al. (2015) in Indonesia and Thailand respectively. The studies on openness and economic growth also found differing results (Giles and Williams, 2000; Saibu 2004; Al-Mawali, 2004; Awokuse, 2008; Burange et al., 2013; Ulasan, 2015; Hye and Lau, 2015; Sakyi et al., 2015).

The studies which investigate the relationship and direction between electricity consumption, economic growth and international trade together in a model are very few and quite recent. The study by Lean and Smyth (2014) was among the few studies that examined the relationships between these variables using an augmented production framework between 1980 and 2013. The results showed that a 1 per cent increase in electricity consumption generates 0.03 per cent to 0.05 per cent increase in output; a 1 per cent increase in total trade results in 0.5 per cent increase in output; and a 1 per cent increase in trade openness results in 1 per cent increase in total output. Lean and Smyth (2014) found that electricity consumption Granger causes GDP in Bhutan; however, all other variables were found to be independent. Thus, their study suggested that Bhutan is energy dependent and it could only promote economic growth through further investment in electricity generation. Shakeel et al. (2014) investigated the relationship between energy consumption, trade and economic growth in five South Asian countries using a panel framework.

Their main results were that the three variables have feedback effects on one another in the short run, while in the long run there was bidirectional Granger causality only between energy and economic growth and unidirectional Granger causality running from exports to energy, and from exports to GDP. Nasreen and Anwar (2014) explored the causal relationship between economic growth, trade openness and energy consumption using panel cointegration regression and causality approaches for the period of 1980–2011 in 15 Asian countries. Their empirical results confirmed the presence of cointegration between variables and also revealed the bidirectional causality between economic growth and energy consumption, trade openness and energy consumption. Also, Siddique and Majeed (2015) using the data from 1980 to 2010 examine the relationship between trade, energy consumption, financial development and economic growth with panel co-integration approach in five South Asian countries. They found that there is a long run relationship among the variables and the variables positively affect the economic growth. Furthermore, they found that bidirectional relationship only exists between growth and energy, and between trade and financial development in the long run.

Sadorsky (2011) in eight Middle Eastern countries found a bidirectional causality between imports and energy consumption and a unidirectional causality from exports to energy consumption. The results indicated that increasing trade trend positively affects the demand for energy. In another study by Sardosky (2012), a panel cointegration technique was used to examine the relationship between energy consumption, output and trade in seven South American countries covering the period 1980 to 2007. The results of the short-run dynamics showed a bi-directional feedback relationship between energy consumption and exports, output and exports and output and imports but there is evidence of a one way short-run relationship from energy consumption to imports. In the long-run on the other hand, there is evidence of a causal relationship between trade (exports or imports) and energy consumption. Narayan and Smyth (2009) using a panel of six Middle Eastern countries (Iran, Israel, Kuwait, Oman, Saudi Arabia, and Syria) found short-run Granger causality running from electricity consumption to real GDP and from income to exports. They also found evidence of a long-run Granger causality relationship running from exports and electricity consumption to real income and from exports and real income to electricity consumption. Also, Shahbaz et al. (2013b) investigated the relationship between energy consumption and economic

growth by incorporating financial development, international trade and capital as important factors of production function in case of China over the period of 1971–2011 using the Auto-regressive distributed lag (ARDL). All the variables were found to have positive impact on economic growth, and there was a unidirectional causal relationship running from energy consumption to economic growth, and bidirectional causality between international trade and energy consumption, between financial development and international trade, between capital and energy demand, and between international trade and economic growth. Furthermore, Acaravci et al. (2015) examined both the long run and causal relationships between electricity consumption per capita, real GDP per capita, trade openness and foreign direct investment inflows per capita in Turkey during the time period 1974–2013. The results revealed the evidence of long run relationship between the variables, and strong causalities running from the electricity consumption per capita, trade openness, and FDIs per capita to real GDP per capita. Kumar et al. (2015) explored the role of energy, trade and financial development on economic growth using ARDL with data of 1971–2011 in South Africa. Granger causality results show that a unidirectional causality from capital stock and energy consumption to output; and from capital stock to trade openness; a bidirectional causality between trade openness and output; and absence (neutrality) of any causality between trade openness and energy and between financial development and output.

It could be seen from the literature that there are diverse results from the past studies and these could be traced to country-specific peculiarities, index used to proxy variables and methodological differences. Some earlier literature may suffer from the problem of omitting important variables while using only two variables in the model and many of the studies in sub-Saharan Africa are mainly panel data which may not be able to critically examine the specificity within a country. There are some studies that use either only export or import to proxy trade openness and a particular study by Kumar et al. (2015) in South Africa which used energy consumption per capita to proxy energy consumption, and imports plus exports as percentage of GDP to proxy trade openness. Our study uses electricity consumption per capita to proxy electricity consumption, and the additions of import and export as a ratio of the country's population to obtain trade openness so as to ensure that all the variables are on the same base of per capita, and this is seen as an improvement to the earlier work in this regard.

3. Methodology

3.1 Data and sample period

Annual time series data covering the period 1980–2015 on electricity consumption per capita (in Kwh), GDP per capita (Constant at 2010 US\$) and trade openness (export plus import as a ratio of population) were collected from the 2016 update of World Bank's World Development Indicator (WDI) as published through the online database of World Bank. The variables used in the models are: GDP for real GDP per capita; ELE for total electricity consumption per capita; and TOPN for trade openness per capita. The sample period was selected based on the availability of data.

3.2 Model specification

This study adopted the autoregressive distributed lag (ARDL) model by Pesaran et al. (2001) to test the relationship between electricity consumption, trade openness and economic growth. This model was selected because it can accommodate a mixture of variables that are stationary at level, $I(0)$ and those that are stationary at first difference, $I(1)$. The ARDL model can therefore be used when variables are $I(0)$, $I(1)$, or a mixture of $I(0)$ and $I(1)$, but it cannot be used when variables are stationary at the second difference, $I(2)$ (Pesaran and Shin, 1998). Before conducting formal tests, descriptive statistics and correlation analysis were used to conduct a preliminary analysis of trend and variability of the variables. In addition to the ARDL, Granger's (1969) causality test was employed to establish the causal relationships between electricity consumption, trade openness and economic growth. The ARDL model used to test for the short and long run relationships between the variables is expressed as follows:

$$\Delta LGDP_t = \alpha_0 + \sum_{j=0}^n \beta_j \Delta LGDP_{t-j} + \sum_{j=0}^n \gamma_j \Delta LELE_{t-j} + \sum_{j=0}^n \delta_j \Delta LTOPN_{t-j} + \varphi_1 LGDP_{t-1} + \varphi_2 LELE_{t-1} + \varphi_3 LTOPN_{t-1} + u_t \quad (1)$$

Where: $\Delta LGDP_t$ represents the change in the natural log value of GDP at time t ; $\Delta LELE_t$ is the change in the natural log value of electricity consumption at time t and $\Delta LTOPN_t$ is the change in the natural log value of trade openness. α_0 is the intercept, n is number of lags and u_t is the error term. Coefficients β_j , γ_j and δ_j represent the short-run dynamics of

the model; while φ_1 , φ_2 , and φ_3 are used to test for the long-run relationship known as bound cointegration test. Based on Equation 1, the following hypothesis was therefore set to test for co-integration:

Null hypothesis (H_0) for no co-integration: $\varphi_1 = \varphi_2 = 0$

Alternative hypothesis (H_1) for co-integration $\varphi_1 \neq 0$, $\varphi_2 \neq 0$

To test this joint hypothesis, bound cointegration tests were used where the estimated F-statistic was compared to the critical values from the Pesaran *et al.* (2001) table with unrestricted intercept and no trend. This table has lower and upper critical values and if the estimated F-value is greater than the upper critical value, the H_0 is rejected in favour of H_1 . This would imply that there is a cointegrating relationship between the variables. However, if the lower critical value is greater than the estimated F-value, the H_0 cannot be rejected and this implies that there is no cointegration between the variables. Lastly, unless there is additional information, the result remained inconclusive if the calculated F-statistics lay between the upper and lower critical values. The existence of cointegration provides evidence for a long-run relationship between the variables and it means that an error correction model (ECM) has to be estimated to capture the adjustment to the equilibrium (Muzindutsi and Sekhampu, 2013). The ECM equation derived from the ARDL model in Equation (1) is as follows:

$$\begin{aligned} \Delta LGDP_t = & \alpha_0 + \sum_{j=0}^n \beta_j \Delta LGDP_{t-j} + \sum_{j=0}^n \gamma_j \Delta LEL_{t-j} + \\ & \sum_{j=0}^n \delta_j \Delta LTOPN_{t-j} + \lambda u_{t-1} + e_t \end{aligned} \quad (2)$$

Where u_{t-1} is the error correction term (ECT) and λ is the ECT coefficient which measures the speed of adjustment to the equilibrium. The ARDL was estimated using EViews 9 and the best ARDL model was selected based on the comparison of Akaike Information Criterion (AIC) and the Schwarz's Bayesian information criterion (SBIC). Various diagnostic tests such as serial correlation, heteroscedasticity, structural breaks and normality tests were conducted to check if the selected ADL model met the required econometric assumptions.

4. Results and discussion

4.1 Descriptive and correlations analysis

Table 1 summarise the descriptive information for the three variables. The mean of the natural log seem to be in the same range and standard deviations appeared to be small indicating low variability around the means. However, trade openness has a higher standard deviation than electricity consumption and economic growth, suggesting that it has been more volatile than the other two variables. This is expected as the trade openness is normally affected by both external and internal factors (Saibu, 2004; Shahbaz et al., 2013b). The skewness for all three variables seems to be close to zero, suggesting a normal distribution. The normal distribution is also confirmed by Jarque-Bera test (p-values > 0.05), which shows that the three variables are normally distributed.

Table 1: Descriptive statistics

	LELE	LGDP	LTOPN
Mean	8.399263	8.798986	7.467065
Median	8.396130	8.783138	7.260551
Maximum	8.529359	8.937158	8.417292
Minimum	8.200958	8.671902	6.769473
Std. Dev.	0.070829	0.089576	0.500322
Skewness	-0.772778	0.217023	0.700966
Kurtosis	3.694325	1.652433	2.000578
Jarque-Bera	4.306242	3.006497	4.446389
Probability	0.116121	0.222407	0.108263
Observations	36	36	36

Correlation results in Table 2 show that all coefficients are positive, suggesting a positive association between the variables. However, the p-value for LELE and LTOPN is greater than 0.05, implying that the correlation between electricity consumption and economic growth is not statistically significant at 0.05 significant level. The significant positive association is therefore observed between electricity consumption and trade openness, and between economic growth and trade openness. This is in line with the literature and other studies (Lean and Smyth, 2014; Kyophilavong et al., 2015) which found a positive association between trade openness, electricity consumption and economic growth. Since the

existence of significant correlation does not imply causality, it is important to conduct more econometric tests to establish the short- and long-run relationships between the variables.

Table 2: Correlation coefficients and p-values

	LELE	LGDP	LTOPN
LELE	1.000000		

LGDP	0.059158	1.000000	
	(0.7318)	-----	
LTOPN	0.408890	0.802310	1.000000
	(0.0133)	(0.0000)	-----

p-values in brackets

4.2 Results of unit root tests

Given that the ARDL model can produce unreliable results when variables are stationary at the second difference $I(2)$; the unit root test was conducted, to ensure that none of the variables is $I(2)$. The unit root testing of the variables was based on the Augmented Dickey-Fuller (ADF) test by Dickey & Fuller (1981) and complemented by Phillips-Perron (PP) test by Phillips-Perron (1988). Unit root test results, in Table 3, showed that electricity consumption is $I(0)$, while trade openness and economic growth are $I(1)$. Thus, there is a mixture of $I(0)$ and $I(1)$ but none of the variables is $I(2)$, suggesting that ARDL is the appropriate model to test for cointegration.

Table 3: Results of unit root tests

Variable	Model	ADF		PP		Order of integration
		Levels	First Difference	Levels	First Difference	
LELE	Constant Trend	-3.002** -3.430*	-- --	-3.006** -3.422*	---- -----	I(0)
LTOPEN	Constant Trend	-0.8618 -2.2836	-4.0593*** -4.9267***	-0.4927 -2.6953	-4.5432*** -4.6198***	I(1)
LNGDP	Constant Trend	-0.2711 -2.6914	-4.5876*** -4.6204***	-0.5703 -1.3507	-4.1943*** -4.9267***	I(1)

(***), (**), (*) indicate 1%, 5% and 10% level of significance, respectively

4.3 Analysis of the long-run relationship

The best ARDL model was estimated and the comparison of AIC and SBIC information criteria showed that ARDL (2, 1, 1) is the best model to estimate short- and long-run relationships between the variables. Results of bounds cointegration test are shown in Table 4. These results showed that the estimated F-value is greater than the upper critical values at 0.01 significant level. Thus, the null hypothesis for no-cointegration is rejected in favour of the alternative hypothesis for cointegration. This implies that there exists a long-run relationship between electricity consumption, trade openness and economic growth. The estimated of this long-run relationship are summarised by Equation 3 below.

Table 4: ARDL Bounds Test

Test Statistic	Value	K
F-statistic	5.900312	2
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.17	3.19
5%	2.72	3.83
2.5%	3.22	4.5
1%	3.88	5.3

$$\text{LGDP} = 1.7763 + 0.8506 \text{LELE} + 0.2175 \text{LTOPN} \quad (3)$$

Equation 3 shows that both LELE and LTOPN have positive long-run effects (significant at 0.05 significance level) on LGDP. The coefficient for LELE indicates that a one per cent increase in electricity consumption increases the economic growth by 0.8506 per cent, holding other factors constant. For LTOPN, a one per cent increase in trade openness is associated with 0.2175 per cent increase in economic growth, holding other factors constant. These results suggest that, in the long-run, South African economy can benefit from increasing the energy production and trade openness. These results are in line with findings from other studies (Nasreen and Anwar, 2014; Zaidi et al., 2016) which found a positive long-run relationship between economic growth and electricity/energy consumption and trade openness. South Africa's economic tends to benefit from increase in trade openness because countries which

experience positive long run relationship between export and economic growth are more open to outside influences and generate externalities, such as the incentive to innovate (Ahmad, 2001);. These efficiency gains increase GDP through increasing total factor productivity (TFP) in the Solow-Swan growth accounting framework (Lean and Smyth, 2014). Thus, these findings suggest that the country's economy can benefit from boosting energy production and this can eventually grow export and allow South Africa to benefit more from trade openness.

4.4 Analysis of the short-run relationships

Table 5 summarizes the ECM results estimated from Equation 2. Before interpreting these results, the diagnostic tests were conducted (results are reported in Section 4.6) and the ECM model passed all the diagnostic tests. The error correction term (u_{t-1}) coefficient has the desired negative sign and is statistically significant at 0.05 significance level because its absolute t-Statistic (4.912) is greater than the upper bound of the critical t-value (3.22) from Pesaran et al. (2001). The coefficient of -0.17681 suggests that approximately 17.68 per cent of any deviation from equilibrium is corrected each year. In other words, any changes in electricity consumption and trade openness take about 5.656 ($1/0.1768$) years to have the full effect on economic growth. The coefficient for lag of LGDP is significant at 0.1 level of significance, suggesting that a previous change in economic growth has a positive effect on the current economic growth. The coefficients for changes in electricity consumption and trade openness are positive and significant at 0.01 significant level; implying that these two variables have a significant short-run effect on economic growth. These results suggest that changes in energy consumption and trade openness can be used to boost the short-run growth of the South Africa's economy. This is similar to the results of Acaravci et al. (2015) in Turkey and Kumar et al. (2015) in South Africa. Policies to increase the level of electricity consumption and trade liberalisation should be encouraged in the South African economy.

Table 5: ECM results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	0.228284	0.121267	1.882492	0.0702
D(LELE)	0.190180	0.065998	2.881602	0.0075
D(LTOPN)	0.082736	0.019482	4.246845	0.0002
u_{t-1}	-0.176810	0.03599	-4.912754	0.0103

4.5 Analysis of causal relationships

Pairwise Granger-causality tests were used to further analyse the short-run relationships between variables. Results in Table 6 shows that there are two significant unidirectional Granger-causality relationships. The Granger-causal relationships from LELE to LDGP and from LTOPN to LDGP are significant at 0.1 and 0.05 significant levels, respectively. This suggests that both electricity consumption and trade openness Granger-cause the economic growth. Thus, electricity consumption and trade openness have a significant effect on current changes in economic growth. However, the economic growth does not Granger-cause electricity consumption and trade openness. This indicates that conservation and restriction policies will hamper the economic growth of South Africa. Government should energise the generation of more electric power to boost the economic activities in the country. Trade liberalisation that is properly monitored by the government officials should also be strengthened as this will boost the level of economic growth and also fosters indigenous capabilities of the South Africans. These Granger-causality results confirm the ECM results that consumption and trade openness have a short-run effect on economic growth.

Table 6: Pairwise Granger Causality Results

Null Hypothesis:	F-Statistic	Prob.	Causality
D(LGDP) does not Granger Cause D(LELE)	0.20623	0.8148	No
D(LELE) does not Granger Cause D(LGDP)	2.93424	0.0691	Yes at 10%
D(LTOPN) does not Granger Cause D(LELE)	0.31503	0.7322	No
D(LELE) does not Granger Cause D(LTOPN)	1.70629	0.1993	No
D(LTOPN) does not Granger Cause D(LGDP)	3.69427	0.0372	Yes at 5%
D(LGDP) does not Granger Cause D(LTOPN)	0.67036	0.5193	No

4.6 Results of diagnostic tests

Residual diagnostic tests and stability tests were conducted to test if the estimated ARDL model met the econometric assumptions. Results in Table 7 show that the model passed all the tests. The null hypotheses for no presence of autocorrelation and heteroscedasticity were not rejected and residuals were found to be normally distributed. Ramsey RESET Test shows that the model is correctly specified and this suggests that the parameters in the model are stable. The stability was also confirmed by the CUSUM graphs as shown in Figure 1 and 2. This evidence of parameter stability; implies that the relationship between the variables was consistent throughout the sample period. This suggests that major changes in the political environment such as the 1994 democracy or the presence of major economic events did not affect the consistency of the estimated relationship. Thus, there is no need for accounting for changes in political and economic conditions.

Table 7: Summary of diagnostic tests results

Test	Null hypothesis (H ₀)	P-values	Decision
ARCH	No conditional heteroscedasticity	0.8899 (F) 0.8854 (Chi-Square)	Do not reject H ₀
Breusch-Godfrey Serial Correlation LM Test	No serial correlation	0.4281 (F) 0.3093 (Chi-Square)	Do not reject H ₀
Jarque-Bera (JB)	There is normality	0.2167	Do not reject H ₀
Ramsey RESET Test	The model is correctly specified	0.3517 (F)	Do not reject H ₀

Figure 1: CUSUM at 5% level of significance

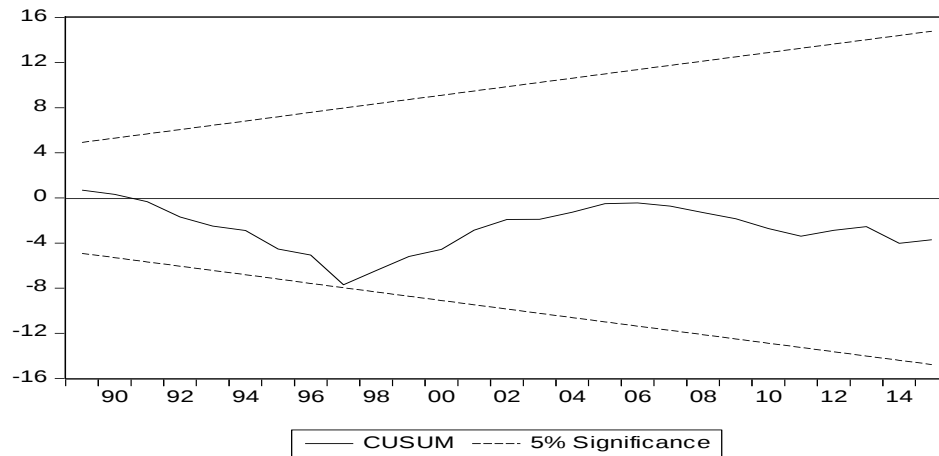
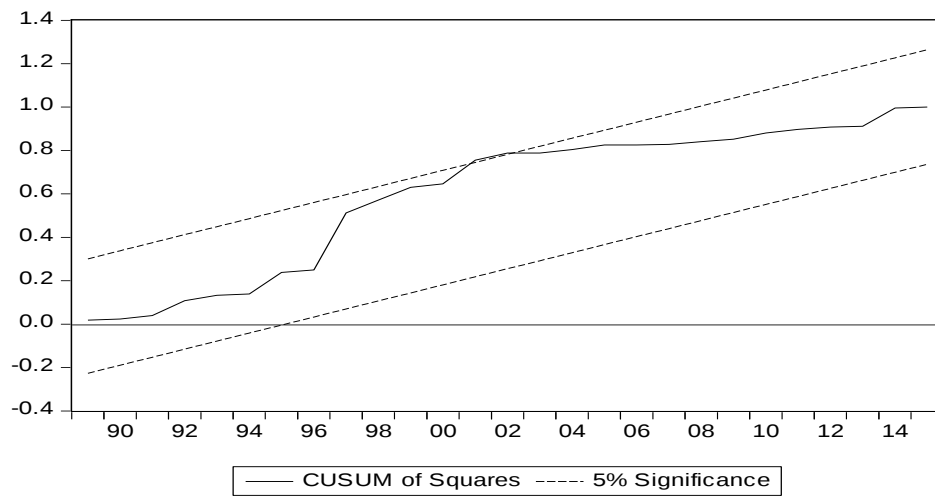


Figure 2: CUSUM of Squares at 5% level of significance



5. Conclusion

This study examined the short run and long run relationships between electricity consumption, trade openness and economic growth. Although more literatures recently show the relationship between electricity consumption and economic growth as well as between trade openness and economic growth, but there is dearth of studies considering the three variables together in a single equation. ARDL approach was adopted for analysis as a result of the advantage it has over other approaches such as combining $I(0)$ and $I(1)$ together. This study found that there is long-run relationship among the three variables as indicated by the co-integration results. Both the electricity consumption and trade have a positive and significant effect on economic growth in the long-run. Granger-causality tests show that electricity consumption and trade openness Granger-cause economic growth without any feedback effects.

Finding of this study showed that South Africa's economy significantly benefits from boosting energy production and trade openness. Thus, the South African government should uphold the policies which encourage the generation and consumption of more electricity in order to boost local production and further create economic growth. Furthermore, the government should also engage in trade liberalisation so as to be able to export some of the goods it has comparative advantage over and the same time import other products especially technologically-related machinery so as to be able to build indigenous innovative capabilities which will boost the country's economic growth.

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