

## Money Laundering in APEC Countries: A Gravity Model Analysis of Attractiveness and Destination Choices

Amaryllis Enika Noora Ariesiyani<sup>1</sup>, Lalu Garin Alham<sup>2\*</sup>

<sup>1</sup> Deputy Office of Information & Data - Komisi Pemberantasan Korupsi, Jakarta, Indonesia

<sup>2</sup> Risk & Fraud Management Group - PT FINARYA (*LinkAja*), Jakarta, Indonesia

\*Corresponding author: lalu.garin@sbm-itb.ac.id

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### Abstract

This paper has three main contributions. First it attempts to measure which APEC countries are attractive destinations for money laundering to Indonesia. Second it measures and ranks the degree of money laundering attractiveness in-between APEC country members themselves. Third, it tests the variables contributing to a country's money laundering attractiveness. The attractiveness is measured using the Gravity model derived from Newtonian gravitational equations by utilizing variables ranging from countries' wealth, government attitude on money laundering, corruption perception index, SWIFT membership, conflict, financial secrecy, and physical & cultural distances. Pearson correlation analysis is also employed to test the statistical interaction & correlation between corresponding variables. Our simulations show that several countries consistently sit on the top 3 (three) most attractive money laundering destinations: Singapore, Hongkong, and the United States. It is also found that financial secrecy and GNI per capita significantly correlate with the degree of money laundering attractiveness. This analysis unveils that an attractive financial regime (beneficial ownership and bank secrecy) and a strong economy attract money launderers to conceal their ill-gotten money in a country.

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### Introduction

Money laundering is the process of concealing and disguising the origin of illicit funds. The United Nations Office on Drugs and Crime (UNODC) defines money laundering as the conversion or transfer of property, knowing that such property is derived from any offense(s), to conceal or disguise the illicit origin of the property or of assisting any person who is involved in such offense(s) to evade the legal consequences of his actions (UNODC, n.d.). Money laundering has detrimental economic consequences on economic growth by decreasing productivity in the economy's real sector by misallocating resources to less productive activities. It also facilitates crime and corruption, slows economic growth, and curbs capital and trade flows that hinder economic development (Kumar 2012, 115-116).

The practice of disguising the origin of illicit money dates to centuries ago when Chinese merchants transported illegal merchandise and proceeds of trading (Linde and Unger 2013, 3).

Literature often cites Al-Capone as the “inventor” of money laundering as he disguised the proceeds of his crime, including prostitution, bootlegging, and narcotics trafficking, by placing his dirty money in laundromat businesses (Ryder 2008, 635). Unger also mentioned another potential origin of the ‘money laundering’ term referring to the washed coins in the casino back in the 1900s, so the ladies whose gloves are white are not dirty when playing casino. However, the media first explicitly expressed the term ‘money laundering’ in the, reporting the United States’ Watergate scandal 1973 (Linde and Unger 2013, 3). In the judicial context, this expression appeared in the case US vs \$4,255,625.39 551 F. Supp. 314 (1982) regarding civil forfeiture actions of business used to conceal proceeds of narcotics transactions (Caselaw Access Project 1982).

Although money laundering has existed for centuries, the regulation and comprehensive anti-money laundering measures were established fairly recently. In 1970, the United States established the Bank Secrecy Act (BSA) which requires private individuals, banks and other financial institutions to conduct recordkeeping and reporting obligations (Financial Crimes Enforcement Network, n.d.). Other regulations developed by other countries followed this. In 1989, the Financial Action Task Force was established to set global standards that member countries can adopt to help address this global phenomenon by writing and enforcing anti-money laundering regulations in their respective court systems (History of the FATF, n.d.). Then, the 11 September 2001 attack triggered a global response to minimize the risk of terrorist financing and money laundering by establishing tighter regulations.

With the growing concern to develop comprehensive and effective money laundering countermeasures, attempts to estimate the size of money laundering have intensified. In FATF’s 1990 report, the need to quantify money laundering also became a concern (FATF 1990, 4). However, estimating the precise amount of money laundering in a country is perceived as impossible since the movement of funds cannot be traced. Thus, some prefer estimating the degree of a country’s attractiveness to help authorities in identifying neighboring countries’ money laundering risks, the level of response needed and prioritize the remedial actions according to the area most affected.

Accordingly, this paper attempts to measure which APEC countries are the most attractive destinations for Indonesia’s money laundering flow and ranks the degree of money laundering attractiveness in-between APEC country members using an econometric model, the Walker Gravity Model. It also tests the variables contributing the most to a country’s money laundering attractiveness using Pearson correlation analysis. While there have been contributions related to analyzing the impacts of money laundering in Indonesia, little to no literature discuss the degree of Indonesia’s money laundering attractiveness compared to other countries and its contributing factors. This paper will allow key stakeholders, especially governments and law enforcement agencies, to develop more effective enforcement guidelines and policies to reduce this illicit activity.

This paper is structured as follows: Methods which describes the methods that we employ; Conceptual Framework section, which explains our conceptual frameworks, which are Walker Gravity Model, graph approach, and correlation analysis; Data section describes our data sources, and data set we use in this research; and The Result and Discussion section shows the econometric results of our analysis using gravity models. In the last section, we conclude our findings.

## Methods

### a. Walker Gravity Model

This paper employs a quantitative approach by using data from various sources and statistical tools to understand how and where the laundered money flows. We use the “Walker Model”, a proposed model to estimate the global flow volume of laundered funds. John Walker

formulated the Walker model, taking inspiration from the Newtonian universal law of gravity, which states that the attraction between two objects is determined by the mass of these objects and inverse squared by mutual distance and the gravity constant (Ferwerda et al. 2020, 2).

According to the gravity model, the amount of trade (or *force of attraction*) from place A to place B depends on the population size in place A, the “attractiveness” of place B to people based in A, and the distance between the two places. (Walker and Unger 2009, 830). Walker’s gravity formula assumes the following:

$$F_{ij}/M_i = \text{Attractiveness}_j / \text{Distance}_{ij}^2, \text{ where}$$

$$F_{ij}/M_i = (GNP/Capita)_j * (3BS_j + GA_j + SWIFT_j - 3CF_j - CR_j + 15) / \text{Distance}_{ij}^2$$

Where  $F_{ij}/M_i$  is the share of proceeds of crime that was sent from country  $i$  to country  $j$ ,  $(GNP/capita)_j$  is GNP per capita,  $BS_j$  is the perceived rate of Banking Secrecy,  $GA_j$  is the perceived Government Attitude toward the implementation of AML-CFT,  $SWIFT_j$  is SWIFT member notation label,  $CF_j$  is Conflict, and  $CR_j$  is Corruption. The  $\text{Distance}_{ij}^2$  is a for denominator in inverse perceived distance between the countries (Walker and Unger 2009, p.830).

This paper measures the degree of money laundering attractiveness and tests factors contributing to attracting money launderers using openly public data sets. Then, we use distance data between each APEC country and Indonesia to analyze what APEC countries are top money laundering destinations for money launderers from Indonesia.

The description of each variable for the gravity function’s composition is listed in the following table:

**Table 1. Variable Description**

Variable	Notation	Description
GNI per Capita	$(GNP/capita)_j$	Gross National Income per Capita of the observed country
CPI	$CR_j$	The corruption Perception Index represents Corruption Risk. The lower the score, the more perceived risk of corruption to be present in the country
Bank Secrecy	$BS_j$	The rate of Bank Secrecy by the <i>Tax Justice Network</i> Organization of the country is measured by combining multiple factors, such as; how much financial secrecy the jurisdiction's laws allow and how much financial services the jurisdiction supplies to residents of other countries. A higher score rating means more disclosure is available for a Financial Institution's customer
SWIFT	$SWIFT_j$	Denote the status of SWIFT membership of the country, where 1 = is a member country and 0 = non-membership
Conflict	$CF_j$	The instances of internal/civil or external conflicts by the Uppsala Conflict Development Programme (UCDP). The conflicts observed were those which occurred between 1946 and 2016
Government Attitude	$GA_j$	The index score for the country government's implementation status of AML-CFT provisions and restrictions on the Financial Industry supplied by the US INSCR (2016) report. The higher the score, the stronger perception of the government put on the implementation of AML-CFT
Distance	$Distance_{ij2}$	The index score for the country's distance supplied by CEPII (Centre d'Etudes Prospectives et d'Informations Internationales) elaborates geographical, cultural, and economic perspectives. The Author composed this score by combining composites of variables, namely; averaged distance between related capital cities, whether the countries are contiguous or not, averaged trade flows between the observed countries, commonality of colonial status circa 1945, average commonality of same language users, and coverage of Regional Trade Agreement (whether there is a presence of goods, services, or both being traded)

### b. Graph Approach

It is assumed that money laundering flow follows the logic of international trade flows. It is assumed that what is significant for legal trade also holds for money laundering flows. To test this assumption, we use the graph centroid (Chartrand, 1985) approach and volume of commercial trades data. The graph centroid approach enables us to model the gravitational strength between the observed entities by determining the connected entities (*nodes*) and how they connect (*edges*). The authors also use two graph network approaches to connect the countries by differentiating the source (originating point) and target (destination point) nodes.

The first objective is to measure which APEC countries have significant money laundering relations with Indonesia. Following the gravity model of international trade flows, we assume that countries with significant trade relations with Indonesia may have more extensive money laundering flows from and to Indonesia (Hataley, 2020). The authors set Indonesia as the nexus node within the graph. Hence, any distance measurement will be measured with Indonesia as one of the endpoints of the edges. Where the connection *edges* can be explained as,

$$Country_i \Rightarrow \underline{Indonesia}$$

For the second objective of estimating the money laundering relations between APEC country members, the second graph network is composed of connecting each APEC country with their corresponding connection within the whole network from the CEPII gravity data. The connection *edges* can be regarded as,

$$Country_i \Rightarrow Country_j$$

### c. Correlation Analysis

The authors also employ correlation analysis to test which variables correlate significantly to the degree of money laundering attractiveness by testing statistical relationships between dependent and independent variables. In this paper, the dependent variable is the function of the gravity index, while the rest are independent variables. It is to be noted that the presence of a statistically significant correlation between the variables does not directly imply contextual causation. The correlation model utilized is the correlation coefficient ( $\rho$ ) (Pearson, 1895) between variables X and Y were,

$$\rho_{X,Y} = \frac{cov(X,Y)}{\sigma_X \sigma_Y}$$

## Conceptual Framework

The UNODC estimates that annually 2 - 5% of global GDP, or \$800 billion - \$2 trillion in current US dollars, is laundered globally. Although this estimation is often cited in the literature, the UNODC acknowledges that measuring the total amount of money laundering is difficult due to its obscure nature (UNODC, n.d.) Various methods to determine the extent of money laundering have been proposed, but there is still no consensus on which methodology can accurately estimate the extent of money laundering. One of the most used models is the gravity model.

The gravitational force formula has been derived to be empirically used in multiple disciplines, including economics, geography, and sociology. In economics, Jan Tinbergen analyzed bilateral trade flows by predicting trade flows as the product of a constant and two countries' gross domestic products divided by the distance between them raised to a  $\theta$  power (Bates 2014, p.12). Prior to Tinbergen, in geography, Ravenstein (1885) and Zipf (1946) used gravity concepts to model migration flows (Benedictis and Taglioni 2011, p.3).

In the first application of a gravity model to crime flows, gravity models are applied to analyze the "flow" of crimes among urban locations. The "flow of crime," as Smith defined in his research, refers to the several streams of criminal migration among urban locations. This research does not aim to acquire social and economic matters that influence particular decisions

to commit crimes at given locations within urban areas, but instead correlate the density of crime across town and the distances between crime locations (Smith 1976, p.xxx).

In 1999, Walker introduced his gravity model to determine the degree of a country's attractiveness and quantify the amount of money laundering. According to Walker, to estimate how large money laundering is, we could look at how much money laundering flows in a country. Money laundering is a flow of funds, it flows from a place where the money is acquired to a place where it is laundered. It either be laundered in the same country in which it was generated or transported to another country (or other countries) for laundering. Moreover, it may be sent from its first placement to other countries and may return to the originating country so that the offenders can invest their money into legitimate businesses (Walker 1999, 26). As already mentioned, Walker's gravity formula assumes the following:

#### **Distance**

Referring to the international trade flows model, Walker assumes that what is significant for legal trade also holds for illegal transactions. Distance is important for trade flows because it determines transport costs and the damage or loss of the goods which may occur. Since money can be easily transmitted across the world, currently, physical distance is less relevant for money flows than it formerly was. However, distance affects communication costs, transaction costs, and cultural barriers that may still be significant for illegal transactions such as money laundering. Therefore, Walker emphasizes the roles of cultural distance, common historical backgrounds, and trade relations in his gravity models. Fawerda et al. also confirmed larger bidirectional money laundering flows between neighboring countries. They also find that cultural proximity, such as practicing a common religion and speaking the same language, facilitates money laundering between countries (Ferwerda et al. 2020, 9).

#### **GNP per capita**

GNP measures the total monetary value of finished products and services produced by citizens of a country in a given financial year. Walker assumes that wealthier countries attract more laundered money than poorer countries. Fawerda et. al. confirmed this assumption and proved that countries with bigger GDP become pools of larger money laundering flows, *ceteris paribus* (Ferwerda et al. 2020, 9).

#### **Bank Secrecy**

Bank secrecy requires employees to keep customers' personal and financial information confidential. It is often said that banking secrecy is one of the main barriers of anti-money laundering measures because it complicates access to customers' information. It attracts offenders to launder their money in a country with strict bank secrecy as they can keep their account and personal information confidential, and they may escape regulatory checks and legal sanctions (Yu 2019, 19).

#### **Government Attitude**

Government attitude is countries' willingness to establish and enforce anti-money laundering measures (Ferwerda et al. 2013, 3173). This may include but is not limited to, joint anti-money-laundering initiatives, membership in a multilateral anti-money-laundering group (such as the FATF), and the actual amount of money-laundering-related court prosecutions and/or convictions (Balani, Lewer, and Saenz 2017, 16). As such, to estimate money laundering flows in Indonesia, government attitudes will be defined as the availability of provisions regulating several aspects tied to combating money laundering. Within this paper, aspects of Government Attitude (*Gn*) towards money laundering can be clustered into:

1. Criminalization of Money Laundering (*G1*)
2. Freezing and Confiscation (*G2*)
3. Reporting Requirements for Financial Institutions (*G3*)
4. Customer Due Diligence (CDD) (*G4*)
5. Shell Banking (*G5*)

6. Correspondent Banking (G6)
7. Alternative Remittance Systems (ARS) (G7)
8. Supervision and Regulation of Financial Institutions (G8)
9. National and International Cooperation (G9)

Where GA Indexed Score  $GA_j$  is  $\Sigma Gn = G1 + G2 + G3 + \dots + G9$ . Should the countries fulfill or possess the required provisions of each aspect,  $Gn = 1$ , or if only partially,  $Gn = 0.5$ .

### **SWIFT Membership**

The Society for Worldwide Interbank Financial Telecommunication (SWIFT) is a cooperative society based in Belgium which provides the execution of financial transactions and payment services between banks worldwide. SWIFT delivers the "messages" containing the payment instructions between financial institutions involved in a transaction. Before SWIFT, financial institutions communicated through Telex or Telegraphic Transfer technology, which involved telegraphic printers for exchanging messages. There was no standard for the messages; every transaction had to be described in text. Thus, the process was slow and allowed human error. SWIFT allows banks to transmit money globally rapidly and support multi-currency transactions, which attract money launderers.

### **Conflict**

Economic literature shows that conflicts severely impact economies ranging from production, distribution of traded goods, consumer buying power, and foreign investment (Kamin 2022, 4). Specifically, conflict is assumed to hamper trade by raising costs, including retaliatory tariffs, quotas, embargoes, and other trade prohibitions. Thus, conflict makes at least one of the countries worse off associated with potential trade losses (Polachek 1980, 60). Countries with significant trade relations would thus engage in less conflict, because they face the greatest danger from welfare losses brought on by lost trade (Polachek 1980, 67). Assuming that money laundering picks up similar characteristics as legal trade, conflict would also discourage the money laundering flow of funds. Author utilized Uppsala Conflict Data Programme (UCDP, 2023) data with conflicts from 1946 to 2016, embedded with the corresponding intensity level ('*cumulative intensity*'). Where '0' is conflict yet to reach the 1,000 fatalities threshold, and '1' has passed the threshold.

### **Corruption**

High levels of corruption may make countries desirable for money laundering. On the one hand, bribes increase the expense of money laundering. Corruption creates uncertainty for the investor and increases investment risk (Alfada 2019, 2). Corruption is also linked to political instability as politicians, leaders, and public servants illegally collect wealth using public office for private gains (Adefeso 2018, 1-2). The unconducive investment climate and political instability often discourage offenders who want to place their illegitimate money in a country to avoid the risk of losing their money. On the other hand, it may be easier to avoid detection of money laundering in corrupt countries. In this paper, authors assume that corruption is directly proportional to the countries' attractiveness for money laundering destinations.

### **Assumptions**

The above-mentioned Walker model's parameters can be assumed as follows.

- 1) Crime generates profits in all countries and is distributed and concealed through money laundering schemes.
- 2) The prevalence of different types of crime and the average proceeds per crime determine the income generated from crime.
- 3) Generally, sophisticated and organized crimes generate more proceeds of crime than petty and individual crimes.

- 4) Wealthier countries generally generate more income per crime than poorer ones. Income inequality or corruption may support a rich criminal class even in a poor country.
- 5) Not all illegitimate income is laundered, criminals use some for consumption.

The assumptions built into the model about laundering processes were:

- 1) In some cases, offenders concealed their proceeds of crime in the origin country whose finance sectors enable sufficient cover for domestic money laundering
- 2) Corruption is closely linked with money laundering thus; corrupt countries generate a high level of domestic money laundering and attract international money laundering flows.
- 3) Criminals seek countries with attractive banking regimes that could be exploited for money laundering, bank secrecy, and tax havens.
- 4) Distance, common culture, language, and trade relations will determine launderers' preferred destinations.
- 5) Conflict hampers the enforcement of financial integrity, thus increasing the prevalence of money laundering. In this paper, the Author utilized the UCDP (Uppsala Conflict Data Program) as a scoring variable of the total conflict-related fatalities.
- 6) The Walker Model consists of two parts. First it calculates the proceeds from the domestic crime being laundered, and second it estimates the proceeds from the foreign crime that flow into a country for laundering. The second part is the more controversial one in the debate on money laundering (p.841).

## Data

Authors utilize datasets from various sources to determine whether certain countries are attractive for money laundering. This paper selects APEC countries following the assumption that what is significant for legal trade also holds for illegal transactions, thus, the regional trade economy, which reduces costs of cross-border trade and simplifies regulatory and administrative processes, may attract money laundering within the member countries. We also want to test whether similar patterns hold for countries with different levels of economy, in different continents. Therefore, we focus our analysis on the estimates for the 21 APEC countries. APEC membership includes Australia; Brunei Darussalam; Canada; Chile; People's Republic of China; Hong Kong, China; Indonesia; Japan; Republic of Korea; Malaysia; Mexico; New Zealand; Papua New Guinea; Peru; the Philippines; the Russian Federation; Singapore; Chinese Taipei; Thailand; the United States of America; Vietnam.

The general hypothesis in Newton's gravity models postulates that the force of attraction between two bodies is inversely proportional to the square of the distance between them and the product of their masses (Encyclopaedia Britannica, n.d.). Following this hypothesis, the larger money laundering flows occur between larger (in terms of wealth) and nearby countries. Thus, we believe that the wealthier countries closer to Indonesia are more attractive to money launderers.

**Table 2. Distance Index Table**

Country	AVERAGE of distcap	AVERAGE distcap in 10,000 km	AVERAGE of comlang_ethno	AVERAGE of rta_coverage	AVERAGE of contiguous	AVERAGE of common colonizer	% of all tradeflow	Dij2 index
Australia	8558	0,86	0,50	0,94	0,00	0,06	0,05	0,30
Brunei Darussalam	7083	0,71	0,07	0,83	0,00	0,00	0,07	0,75
Canada	9830	0,98	0,48	0,79	0,10	0,00	0,05	0,55
Chile	12573	1,26	0,24	0,91	0,09	0,00	0,06	0,95
China	7039	0,70	0,18	0,79	0,11	0,00	0,06	0,58
Hong Kong SAR	6623	0,66	0,56	0,64	0,08	0,00	0,03	0,35
Indonesia	6753	0,68	0,14	0,72	0,03	0,00	0,04	0,74
Japan	7747	0,77	0,00	0,74	0,00	0,07	0,06	0,90
Malaysia	7152	0,72	0,29	0,81	0,13	0,00	0,07	0,42
Mexico	10240	1,02	0,29	0,71	0,07	0,00	0,04	0,91
New Zealand	9074	0,91	0,45	0,94	0,00	0,00	0,05	0,47
Papua New Guinea	7259	0,73	0,47	0,11	0,00	0,11	0,02	1,02
Peru	11159	1,12	0,26	0,77	0,10	0,00	0,06	0,93
Philippines	5776	0,58	0,50	0,69	0,00	0,04	0,05	0,30
Russia	9119	0,91	0,00	0,11	0,06	0,00	0,02	1,73
Singapore	8062	0,81	0,66	0,94	0,00	0,00	0,06	0,15
South Korea	7505	0,75	0,50	0,79	0,00	0,04	0,04	0,38
Taiwan (Chinese Taipei)	6530	0,65	0,15	0,20	0,00	0,05	0,04	1,21
Thailand	6425	0,64	0,00	0,76	0,00	0,00	0,04	0,85
United States	9933	0,99	0,76	0,60	0,20	0,04	0,03	0,36
Viet Nam	6582	0,66	0,00	0,85	0,06	0,00	0,06	0,69

GNI per capita serves as the economical mass in our gravity model. GNI per capita has shown to be a useful and accessible indicator that is closely correlated with other, non-monetary measures of the quality of life, such as life expectancy at birth, child mortality rates, and enrollment rates in school, even though it does not entirely summarize a country's level of development or measure welfare (The World Bank Group, n.d.). We access the GNI per capita data (Atlas method) from the World Bank website (The World Bank 2017). The distance variables measure the geographical and cultural distance between any two countries. Authors obtain the physical distance in kilometers between capital cities for each country, common language, contiguous (sharing a common border), common colonial/hegemony, and trade coverage (total volume of trades between two countries) from the CEPII (Centre d'Etudes Prospectives et d'Informations Internationales, 2022) dataset.

This paper adds a variable that measures the magnitude of conflict - a total of state-based violence, non-state violence, and one-sided violence- from the Uppsala Conflict Data Program (UCDP 2022). To measure the corruption level, we refer to the CPI (Corruption Perception Index) which reports and ranks 180 countries and territories around the world by their perceived levels of public sector corruption, scoring on a scale of 0 (highly corrupt) to 100 (very clean). Bank secrecy may facilitate money laundering and attract offenders to disguise their money. Thus, we include data from the Financial Secrecy Index. The Secrecy Score for each jurisdiction is calculated from 20 Secrecy Indicators that can be grouped around four broad dimensions of secrecy: ownership registration, legal entity transparency, the integrity of the tax and financial regulation, and international standards and cooperation (Financial Secrecy Index 2022). Meanwhile, to measure the magnitude of nine aspects of government attitude, we use the dataset from the United States Department of State's Bureau for International Narcotics and Law Enforcement Affairs Money Laundering and Financial Crimes Country Database (US INSCR) by indexing several variables discussing both countries' implemented provisions on AML-CFT and restrictions of financial transaction mechanisms.

The availability of regulations and provisions are summarized numerically as an Indexed Score in the following table;

**Table 3. Government Attitude (GA) variable's Comparative Table<sup>1</sup>**

Country	Limiting Factor						Restriction			GA Indexed Score
	Criminalization of Money Laundering	Freezing and Confiscation	Reporting Requirements for Financial Institutions	Customer Due Diligence (CDD)	Supervision and Regulation of Financial Institutions	National and International Cooperation	Shell Banks	Correspondent Banking	Alternative Remittance Systems (ARS)	
Australia	Y	Y	Y	Y	Y	Y	N	Y	Y	8
Brunei Darussalam	Y	Y	Y	Y	Y	Y	Y	N	Partial**	7,5
Canada	Y	Y	Y	Y	Y	Y	N/A*	N/A*	N/A*	6
Chile	Y	Y	Y	Y	Y	Partial**	N/A*	N	N	5,5
China	Y	Y	N	Y	Partial**	Partial**	Y	Y	N/A*	6
Hong Kong SAR	Y	Y	Y	Y	Y	Partial**	Y	Y	N/A*	7,5
Indonesia	Y	Y	Y	Y	Partial**	Y	Y	Y	Partial**	8
Japan	Y	Y	N	Partial**	Partial**	Y	Partial**	Partial**	Partial**	5,5
Malaysia	Y	N	N	Partial**	Partial**	Y	Partial**	Partial**	Partial**	4,5
Mexico	Y	N	N	Y	Partial**	Y	N	N	Y	4,5
New Zealand	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Papua New Guinea	Y	N	N	N**	Partial**	Y	N**	N**	Partial**	3
Peru	Y	Y	Y	Y	Y	Partial**	N	N	N	5,5
Philippines	Y	Y	N	Partial**	Partial**	Partial**	Partial**	Partial**	Partial**	5
Russia	Y	Y	Y	Y	Y	Partial**	N	Y	Y	7,5

<sup>1</sup> Extracted from United States INSCR (2016) and clustered to the aforementioned parameters.

Singapore	Y	Y	Y	Y	Y	Partial**	N	N	Partial**	6
South Korea	Y	Y	Y	N	Partial**	Partial**	Partial**	Partial**	Partial**	5,5
Taiwan (Chinese Taipei)	Y	Y	N	Partial**	Partial**	Partial**	Partial**	Partial**	Partial**	5
Thailand	Y	N	N	Partial**	Partial**	Partial**	Partial**	Partial**	Partial**	4
United States	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Vietnam	Y	Y	Y	Y	Y	Partial**	Partial**	Partial**	Partial**	7

As for the Graph approach, Author tabulated the data for the Graph model into the columns of Source (*Country i*), Target (*Country j*), and Weight (% of Grand Total of Trade flow). An example of *Indonesia-centric* Graph is exhibited below;

**Table 4. Graph Approach data table**

Source ( <i>Country i</i> )	Target ( <i>Country j</i> )	Weight (% SUM Trade flow)
IDN.1	AUS	0.08%
IDN.1	BRN	0.22%
IDN.1	CAN	0.20%
IDN.1	CHL	0.03%
IDN.1	CHN	0.47%
IDN.1	HKG	0.20%
IDN.1	JPN	0.34%
IDN.1	KOR	0.14%
IDN.1	MEX	0.30%
IDN.1	NZL	0.11%
IDN.1	PER	0.07%
IDN.1	PHL	0.36%
IDN.1	PNG	0.89%
IDN.1	RUS	0.16%
IDN.1	SGP	0.07%
IDN.1	THA	0.12%
IDN.1	TWN	0.04%
IDN.1	USA	0.11%

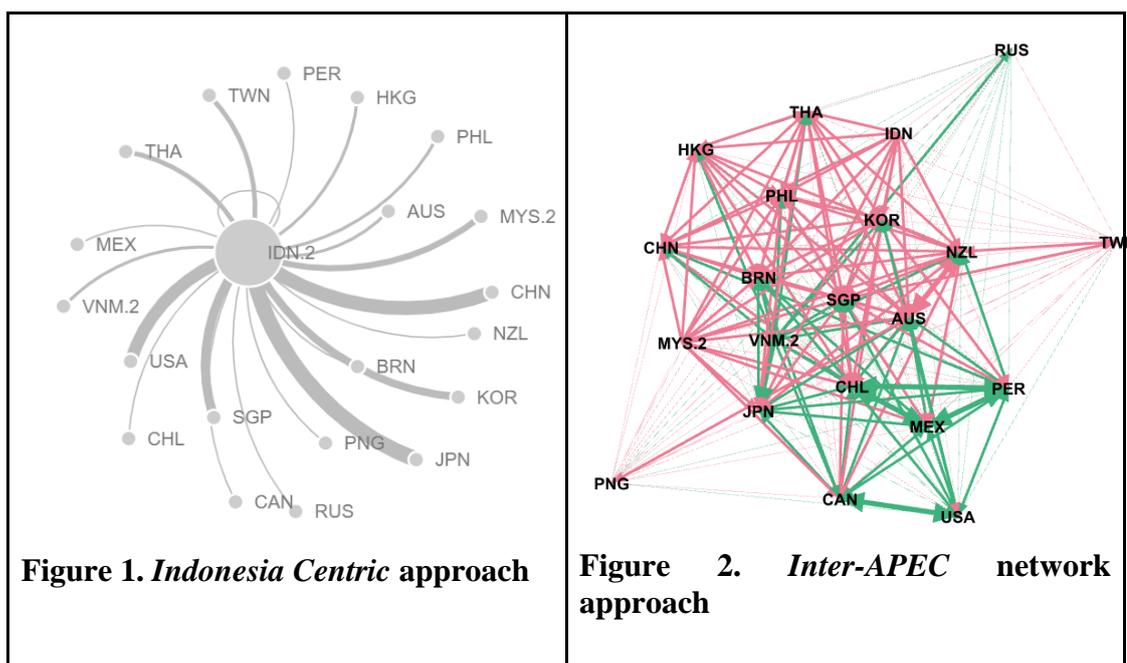
## Result and Discussion

### d. Graph Centroid Differentiation

We use the graph centroid approach and volume of commercial trades data to test the assumption that what is significant for legal trade also holds for money laundering flows. The Indonesia Centric graph approach (Figure 1) depicts Indonesia as the ‘hub’/focal point of the network model because all other APEC countries must be ‘directly connected’ with Indonesia. The network demonstrates that several countries have a higher degree of connectivity with Indonesia represented by thicker lines, namely, the United States (USA), Japan (JPN), China (CHN), and Singapore (SGP). It reveals that these three countries have a large trade volume with Indonesia following the international trade flow assumption. We assume these trade relations reflect money laundering activities between countries where illegitimate funds are poured into the mainstream areas utilizing trade activities (Hataley 2020). Thus, we presume that Indonesia has significant money laundering connections with the United States, Japan, China, and Singapore, where Indonesia may receive or send larger amounts of dirty money to or from those countries.

From the second Graph approach in Figure 2 we can notice how the network is constituted differently from Figure 1, that all the country *nodes* are ‘dispersed’ along the network with their *edges* lines visibly going outward or inward. This observation also shows higher degrees of connectivity and centrality in several country *nodes*, such as Singapore (SGP), Australia (AUS), New Zealand (NZL), and Chile (CHL). Those countries act as localized hubs due to their connection with almost all APEC countries. Referring to the international trade flow assumption and their position within the network, we can infer that those countries may have significant traffic of laundered funds inbound and outbound to their counterparts APEC countries. Meanwhile, the figure displays that several countries are positioned quite distant, such as Russia (RUS), Taiwan (TWN), and Papua New Guinea (PGN). We presume those three countries have the least money laundering relations in APEC countries.

The following Graph networks are achieved using open-source *Gephi* 0.10.1 with ‘*ForceAtlas2*’ layout algorithm.



### e. Walker Gravity Model

Following Walker’s equation, the *gravity* (attractiveness inverse to distance) of money laundering among APEC country members can be computed as in the following table.

**Table 5. Observed Indonesia Centric Gravity indexes.**

Country	GNI per capita (in ,0000 USD)	CPI	Government Attitude index	SWIFT	Secrecy Score	Distance Cap. (in km)	Count of conflict	<i>Distance<sub>ij</sub> Index</i>	Gravity Index	Rank
	<i>GNP/capita</i>	<i>CR<sub>j</sub></i>	<i>GA<sub>j</sub></i>	<i>SWIFT<sub>j</sub></i>	<i>BS<sub>j</sub></i>		<i>CF<sub>j</sub></i>	<i>D<sub>ij</sub></i>		
Australia	46.140	79	8	1	318	5.388	1	4,50	1064,30	8
Brunei Darussalam	60.420	58	7,5	1	28	1.527	1	3,15	282,92	15
Canada	45.900	82	6	1	349	15.653	0	6,56	796,95	9
Chile	22.680	66	5,5	1	161	15.606	1	6,06	208,27	17
China	13.420	40	6	1	578	5.200	9	4,36	540,80	11
<b>Hong Kong SAR***</b>	<b>58.660</b>	<b>77</b>	<b>7,5</b>	<b>1</b>	<b>927</b>	<b>3.252</b>	<b>0</b>	<b>4,30</b>	<b>3910,44</b>	<b>3</b>
Indonesia	10.160	37	8	1	170	0	8	1,00	539,50	12
Japan	42.010	72	5,5	1	765	5.772	0	4,33	2306,67	4
Malaysia	24.840	49	4,5	1	296	1.182	5	2,06	1125,64	7
Mexico	18.810	30	4,5	1	139	16.859	1	6,68	128,26	19
New Zealand	38.650	90	9	1	230	7.718	0	4,77	637,68	10
Papua New Guinea	4.100	28	3	1	470	4.461	1	4,45	133,41	18
Peru	11.520	35	5,5	1	89	17.942	2	6,79	52,00	21
Philippines	8.560	35	5	1	162	2.782	3	4,25	105,34	20
Russia	23.460	29	7,5	1	270	9.302	14	5,92	319,21	14
<b>Singapore*</b>	<b>83.960</b>	<b>84</b>	<b>6</b>	<b>1</b>	<b>1167</b>	<b>894</b>	<b>0</b>	<b>2,96</b>	<b>10197,17</b>	<b>1</b>
South Korea	39.720	53	5,5	1	499	5.278	0	4,42	1402,33	5
Taiwan (Chinese Taipei)	48.487	61	5	1	482	3.807	1	5,35	1373,04	6
Thailand	15.840	35	4	1	380	2.312	5	4,19	443,07	13
<b>United States**</b>	<b>58.870</b>	<b>74</b>	<b>9</b>	<b>1</b>	<b>1951</b>	<b>16.363</b>	<b>6</b>	<b>6,54</b>	<b>5325,30</b>	<b>2</b>
Viet Nam	7.780	33	9	1	375	3.015	5	4,28	209,04	16

Table 5 above presents the result of the gravity model for comparing money laundering flows in APEC countries. To estimate the degree of APEC countries' attractiveness of Indonesia's money laundering flow, we retrieve the physical distance in kilometers and cultural distance (common currency, colonial background, common religion, and common language) between Indonesia and APEC countries. Despite being an ending node on the edges, we compute 1 (one) in Indonesia's distance index column since we cannot have 0 (zero) as the denominator in a fraction.

The table also demonstrates that the results are as theoretically expected. Validating Ferwerda (Ferwerda et al. 2020, 9) and our hypothesis, the greater countries' wealth and the closer they are, the higher the degree of a country's money laundering attractiveness. Singapore, the United States, and Hong Kong SAR are Indonesia's three top money laundering flows destinations. Six out of the top ten countries are in Asia. The other four countries that are not geographically and culturally close to Indonesia have a significant GNI per capita and high secrecy score that may outweigh the cost of the distance. Another insight is that Indonesia, which scores 539,50 points and ranks 19th, apparently is not a favorite money laundering destination for domestic and international money launderers due to its high corruption level and unattractive banking regime. This result is in line with the National Risk Assessment 2022, where Singapore and the United States are the two countries with the highest risk of outward money laundering from Indonesia, followed by India (non-APEC country), China, Thailand, Malaysia, Hong Kong SAR, Australia, Japan, and Taiwan.

However, by comparing Figure 1 (graph centroid differentiation) to the result of the gravity model, it can be presumed that a *naive* approach using a single predictor (e.g., commercial trade volume) is insufficient to gauge the overall gravity/attracting force of money laundering. Hence the Author proposed the Walker gravity model, where gravity is a function of composited multi-variables from a wide perspective divided with the geo-economic-socio distance.

**Table 6. Observed Inter-APEC Countries Gravity indexes.**

Country	GNI per capita (in ,000 USD)	CPI	Government Attitude index	SWIFT	Secrecy Score	Distance Cap. (in km)	Count of conflict	Distance <sub>ij</sub> Index	Gravity Index	Rank
	GNP/capita		CR <sub>i</sub>						GA <sub>i</sub>	
Australia	46140	79	8	1	318	8558	1	0,30	15964,44	4
Brunei Darussalam	60420	58	7,5	1	28	7083	1	0,75	1188,26	17
Canada	45900	82	6	1	349	9830	0	0,55	9505,47	8
<b>Chile</b>	<b>22680</b>	<b>66</b>	<b>5,5</b>	<b>1</b>	<b>161</b>	<b>12573</b>	<b>1</b>	<b>0,95</b>	<b>1328,57</b>	15
China	13420	40	6	1	578	7039	9	0,58	4065,33	10
Hong Kong SAR***	58660	77	7,5	1	927	6623	0	0,35	48042,54	<b>3</b>
Indonesia	10160	37	8	1	170	6753	8	0,74	729,05	<b>19</b>
Japan	42010	72	5,5	1	765	7747	0	0,90	11097,64	7
Malaysia	24840	49	4,5	1	296	7152	5	0,91	2548,15	12
Mexico	18810	30	4,5	1	139	10240	1	0,47	1822,97	14
New Zealand	38650	90	9	1	230	9074	0	1,02	2982,11	11
Papua New Guinea	4100	28	3	1	470	7259	1	0,93	638,37	20
Peru	11520	35	5,5	1	89	11159	2	0,30	1176,96	18
Philippines	8560	35	5	1	162	5776	3	1,73	258,78	21
Russia	23460	29	7,5	1	270	9119	14	0,15	12598,02	6
Singapore**	83960	84	6	1	1167	8062	0	0,38	79430,58	<b>2</b>
South Korea	39720	53	5,5	1	499	7505	0	0,42	14757,87	5
Taiwan (Chinese Taipei)	48487	61	5	1	482	6530	1	1,21	6070,87	9
<b>Thailand</b>	<b>15840</b>	<b>35</b>	<b>4</b>	<b>1</b>	<b>380</b>	<b>6425</b>	<b>5</b>	<b>0,85</b>	<b>2184,06</b>	13
<b>United States*</b>	<b>58870</b>	<b>74</b>	<b>9</b>	<b>1</b>	<b>1951</b>	<b>9933</b>	<b>6</b>	<b>0,36</b>	<b>96743,03</b>	<b>1</b>
Viet Nam	7780	33	9	1	375	6582	5	0,69	1296,67	16

Table 6 compares the money laundering attractiveness of APEC countries. From the CEPII dataset, we obtain the physical distance in kilometers between the capital cities in each APEC country and dummy variables for countries that use a common currency, have a colonial background, common religion, and common language. We use a border dummy to control the distance between neighboring countries (whether they are contiguous or not). Then, we add the average commercial trade between APEC countries. As shown on table 5, the same three countries have the highest attractiveness score. However, the United States ranks first, followed by Singapore and Hong Kong SAR. There are differences with the Graph centroid of the inter-APEC network where Singapore, Australia, New Zealand, and Chile are the prominent hubs of the network. The Graph network only considers the centralities and how the countries are connected to determine the significance of a *node* country. It differs in the Walker model where gravity is a function of all sums inverse the distance.

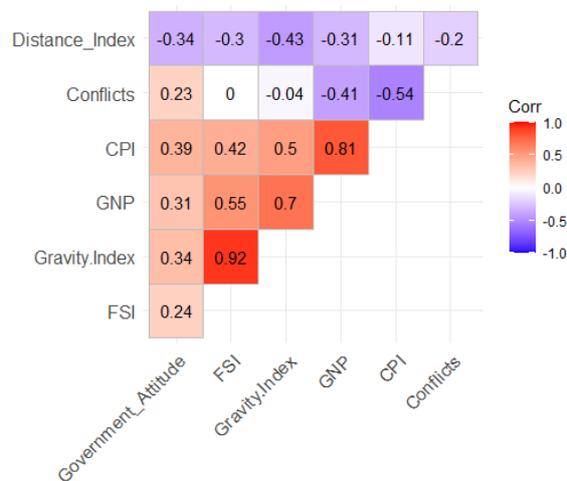
**Table 7. Gravity measurement comparison; Inter-APEC and Indonesia Centric**

Country	Gravity Index Inter-APEC	Rank	Gravity Index Indonesia Centric	Rank
	CFj		CFj	
Australia	1064,30	8	15964,44	4
Brunei				
Darussalam	282,92	15	1188,26	17
Canada	796,95	9	9505,47	8
Chile	208,27	17	1328,57	15
China	540,80	11	4065,33	10
<b>Hong Kong SAR</b>	<b>3910,44</b>	<b>3</b>	48042,54	<b>3</b>
<b>Indonesia</b>	539,50	<b>12</b>	729,05	<b>19</b>
Japan	2306,67	4	11097,64	7
Malaysia	1125,64	7	2548,15	12
Mexico	128,26	19	1822,97	14
New Zealand	637,68	10	2982,11	11
Papua New Guinea	133,41	18	638,37	20
Peru	52,00	21	1176,96	18
Philippines	105,34	20	258,78	21
Russia	319,21	14	12598,02	6
<b>Singapore</b>	<b>10197,17</b>	<b>1</b>	79430,58	<b>2</b>
South Korea	1402,33	5	14757,87	5
Taiwan (Chinese Taipei)	1373,04	6	6070,87	9
Thailand	443,07	13	<b>2184,06</b>	13
<b>United States</b>	<b>5325,30</b>	<b>2</b>	<b>96743,03</b>	<b>1</b>
Viet Nam	209,04	16	1296,67	16

Table 7 displays the money laundering attractiveness results ranking using the gravity model. Columns 1 and 2 (left) show the attractiveness of money laundering flows in APEC countries, while columns 3 and 4 (right) reveal the gravity of money laundering from Indonesia's dirty money flows. Overall, certain economic powerhouses are more attractive to money laundering destinations. GNI per capita, which serves as the economical mass in our models, has a positive and significant coefficient for the destination country in both models. This means countries with higher GNI per capita receive more 'dirty money' from Indonesia and other APEC countries. This finding provides stakeholders and regulators a better understanding of the money laundering risk of Indonesia's neighboring countries and develop appropriate actions, for instance, implementing appropriate monitoring for accounts and transactions from and to those countries, as well as enhanced due diligence based on the risks presented by those countries.

#### f. Correlation Analysis

The following correlation analyses represented the interactions between variables used by the Gravity model. Results are produced using R programming language within R-Studio IDE with 'stats' and 'ggcorrplot' packages. Strongly correlated variables are marked with asterisks (\*, \*\*, or \*\*\*) a more detailed view of the table is available on **Table 6** of the **Appendix** section.

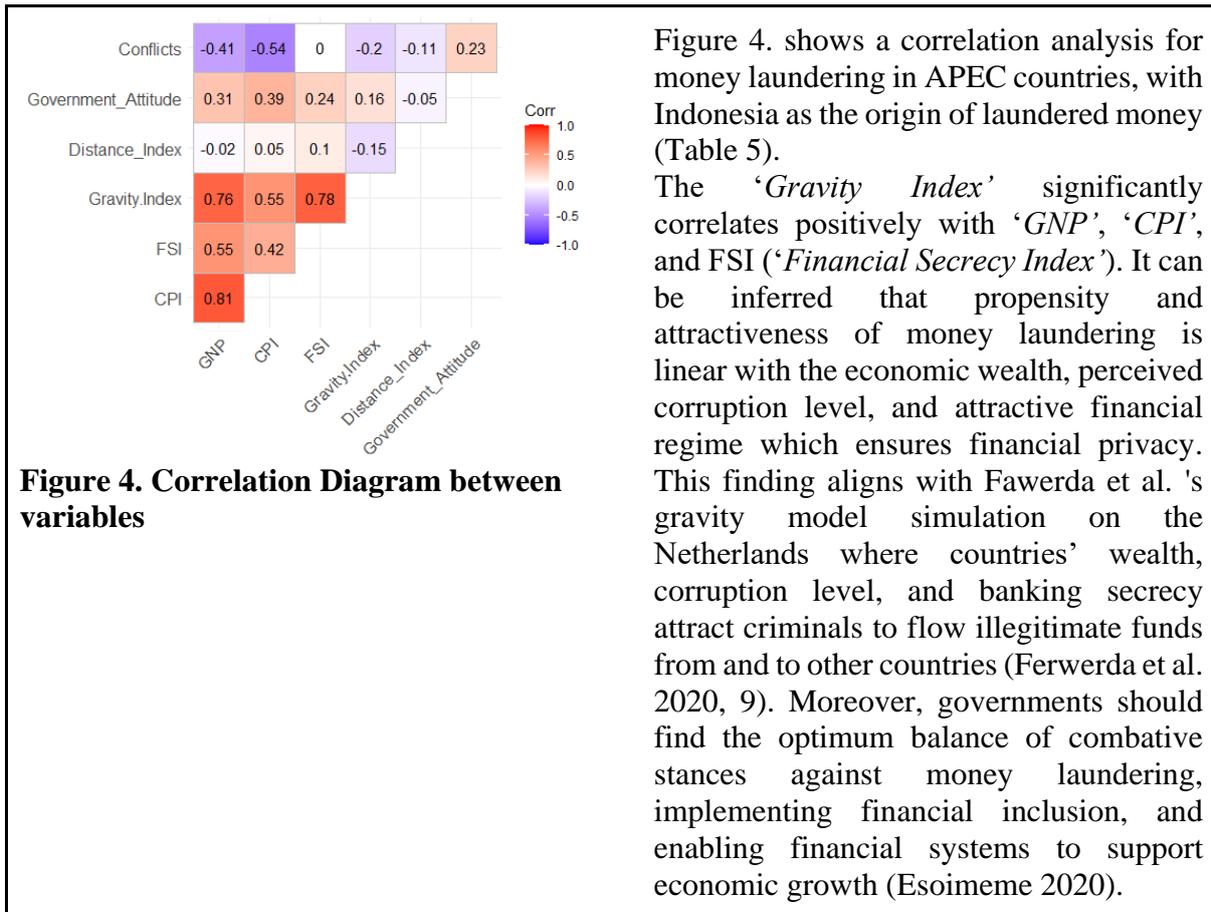


**Figure 3. Correlation Diagram between variables**

Correlation Analysis for in-between APEC countries displays that several parameters correlate and react to the corresponding parameters (Table 5).

The ‘Gravity Index’ correlates strongly linearly with FSI (‘Financial Secrecy Index’) and ‘GNP’. It can be inferred that the propensity and attractiveness of money laundering go hand-in-hand with how strongly the authority applies financial secrecy. A study by the UNODC Global Programme Against Money Laundering confirms that jurisdictions that offer high levels of secrecy and various financial mechanisms and institutions providing anonymity for the beneficial owners are highly appealing to criminals (Blum et al., 7). In addition, money laundering risk can also be found in regions with higher commercial & trade flow as it enables money launderers to disguise the proceeds of crime through trade transactions (trade-based money laundering).

Gaining access to information for investigation purposes in countries with high levels of financial secrecy may not be simple. Thus, bank secrecy and privacy issues have concerned regulators and law enforcement agencies. Prior to requesting information, it is important to review applicable privacy laws to understand any limitations. We suppose that the exchange of information among FIUs should occur as informally and as rapidly as possible and with no excessive formal prerequisites, while guaranteeing privacy and confidentiality of the shared data. Furthermore, to prevent trade-based money laundering, financial service providers should develop suspicious indicators and knowledge of their business to monitor, prevent and manage risks associated with any unusual activity.



### Conclusion

Gravity model simulations show that the United States, Singapore, and Hong Kong SAR consistently become the most attractive countries among APEC members for money laundering. Not only economically wealthy and financially secretive, but Singapore and Hong Kong SAR also attract money launderers because of their geographical and cultural distance, that is relatively close and/or similar to other APEC countries, including Indonesia. On the other hand, the United States is not geographically and culturally proximate to Indonesia or other APEC countries (relatively), but money launderers may as well prioritize US’ general economic flourishes and attractive banking regime as crucial to their operations.

From the correlation analysis, it can be concluded that GNI per capita and financial secrecy are the most significant variables in determining the degree of money laundering attractiveness. Physical distance deters flows of dirty money where it is seen as a transaction cost. However, our models display that bank secrecy may outweigh the cost caused by physical and cultural distance in money laundering.

A limitation of our simulations is that it does not distinguish between domestic money laundering, international investment of dirty money, and money flowing through. Another limitation is the unavailability of necessary datasets. This paper does not use a data set that reflects the number of money laundering cases in APEC countries and data for suspicious transactions to and from APEC countries. We, therefore, must assume that variables such as countries’ wealth, corruption level, government attitude, SWIFT membership, financial secrecy, and physical and cultural distance are sufficient to determine the level of attractiveness from and to Indonesia and other APEC countries.

Our simulations are based on a theoretical model and several assumptions. Once more necessary data becomes available, this data can be incorporated into this model to improve the estimations and test the assumption. The results of our simulations must be seen as preliminary.

We hope this paper can better understand the factors contributing to money laundering attractiveness in Indonesia and its neighboring countries and develop appropriate regulatory policies.

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## Appendix

Table 8. Correlation Matrix *Inter-APEC Countries*

	GNP	CPI	Government Attitude	FSI	Conflicts	Distance Index	Gravity Index
GNP	1	<b>0.81***</b>	0.31	<b>0.55**</b>	-0.41	-0.31	<b>0.70***</b>
CPI	<b>0.81***</b>	1	0.39	0.42	<b>-0.54*</b>	-0.11	<b>0.50*</b>
Government Attitude	0.31	0.39	1	0.24	0.23	-0.34	0.34
FSI	<b>0.55**</b>	0.42	0.24	1	0	-0.3	<b>0.92***</b>
Conflicts	-0.41	<b>-0.54*</b>	0.23	0	1	-0.2	-0.04
Distance Index	-0.31	-0.11	-0.34	-0.3	-0.2	1	-0.43
Gravity Index	<b>0.70***</b>	<b>0.50*</b>	0.34	<b>0.92***</b>	-0.04	-0.43	1

Table 9. Correlation Matrix *Indonesia Centric Countries*

	GNP	CPI	Government Attitude	FSI	Conflicts	Distance Index	Gravity Index
GNP	1	<b>0.81***</b>	0.31	<b>0.55**</b>	-0.41	-0.02	<b>0.76***</b>
CPI	<b>0.81***</b>	1	0.39	0.42	<b>-0.54*</b>	0.05	<b>0.55*</b>
Government Attitude	0.31	0.39	1	0.24	0.23	-0.05	0.16
FSI	<b>0.55**</b>	0.42	0.24	1	0	0.1	<b>0.78***</b>
Conflicts	-0.41	<b>-0.54*</b>	0.23	0	1	-0.11	-0.2
Distance Index	-0.02	0.05	-0.05	0.1	-0.11	1	-0.15
Gravity Index	<b>0.76***</b>	<b>0.55*</b>	0.16	<b>0.78***</b>	-0.2	-0.15	1