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**MEASURING THE MONEY LAUNDERING RISK FROM  
INDIVIDUAL CUSTOMERS AND ITS DETERMINANTS -  
THE CASE OF VIETNAMESE COMMERCIAL BANKS**

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## ABSTRACT

The Vietnamese banking operation system is one of the most significant field in the economy of Vietnam that is strongly reinforced in the monitoring mission and also rapidly strengthened the power of development through implementing the merge and acquisition in the banking system. Thence, Vietnam has received much attentions of many international organizations, extremely attached a significant amount of foreign direct investments (FDI) from the other developing and developed countries with the high positions in global finance industry and especially achieved some agreements for the participation of many worldwide communities, including APEC, TPP, FTA and etc. Nevertheless, before lots of great valuable opportunities, there always exists the appearance of dangerous risk that is extremely growing up day by day in Vietnam commercial banking system, and definitely one of the considerable financial risks should be mentioned is money laundering risk. Currently, the money laundering risk is still a popularly first-rate problem and becoming more complicated that Vietnamese government frequently make an incessant attempt for generating the appropriately useful management cause of its negative results in some of different aspects of the economy and society in Vietnam.

This paper is applied the framework Christopher Price 2008<sup>1</sup> and HSBC Money Laundering Risk Procedures 2016<sup>2</sup>; with the purpose of estimating the risk contribution for each individual customer in Vietnamese banking system, mainly through the information from the survey in South East region in Vietnam in general and Ho Chi Minh city in specific. Based on the collected data from the survey, the Money Laundering Risk Score (MLRS) is calculated for each customer who is using the services and products of Vietnamese commercial banks by the enhanced measurement model of Christopher Price. After that, this thesis continuously considers some factors that could impact to MLRS such as age, gender, academic level, group of salary, purpose of using account, source of funds and the total number of accounts in banking system of all observations of this paper. Using the ordinary least squares, ordinary logistic regression and stepwise method, the regression can be employed for MLR of all valid observations in four distinct categories of customers: Very High Risk Level, High Risk Level (HRL), Medium Risk Level (MRL) and Low Risk Level (LRL). For the group of 76-100 risk score is belongs to the Very High Risk Level and High Risk Level with the scale from 51 to 75, consisted of customers with large amount of cash and wire transactions, the occupation related to the government organizations and also with the length of using services in the banking system under one year. The group of respondents, who have a number of transactions in cash and wire with relative amounts, worked for some domestic or foreign organizations as well as were customers of Vietnamese commercial banks for over one year to less than five years that is considered as MRL group with the risk score of 41- 80. The last LRL is the lowest level of money laundering risk of customers with the small amount of cash and wire payments, normal occupations and long relationships. Consequently, with the result of the regression model, this paper probably generates an appropriate estimation of the money laundering risk for current Vietnamese conditions and since then proposes some recommendations that probably useful and practical for Vietnamese commercial banking system.

➤ **Key words: Money laundering risk score contribution, Money laundering risk determinants, Individual customers, Christopher Price Framework, Vietnamese commercial banks.**

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<sup>1</sup> Money laundering risk measurement for customer was discussed in Christopher Price (2008). Customer Risk Assessment. Metavante Project – Risk and Compliance Solutions.

<sup>2</sup> HSBC Vietnam (2016). Knowledge bite of money laundering risk from customer. HSBC Money Laundering Risk Procedures.

## INTRODUCTION

One of the risks in the financial-banking industry, especially in a field of banking business, is the risk of money laundering. It is always considered as the important issues, which have to be closely managed and controlled strictly. Moreover, for taking the opportunity to participate in the Trans-Pacific Partnership (TPP), the free-trade agreement (FTA) and especially becoming a member of APEC will bring many great benefits for Vietnam. Vietnam will have the better chance to approach the modern developing models and to infiltrate into powerful financial markets such as America, Australia, Canada, Singapore and etc. and similar to other developing countries, to liberalize trade in the areas of service industry, to develop the national economy, to step up more export as well as create more advantage conditions to expand and attract foreign investments. However, in comparison with the financial strength of Vietnamese banking system with other members in the same area in specific as well as in the world in general, there are still many limitations in banking. For example, the capital ratio is quite low, cash flow is not logical and many inadequacies in the process of dealing with bad debt as well as the capability for risk management is not really effective.

Therefore, Vietnam will be able to become the country and a place where the latent risk of money laundering is likely to emerge as international crime. When Vietnam starts to join and integrate transnational financial markets, the balance of international payments and fund remittance be reduced, the laws on control and traffic restriction, exemption for tariffs or the extension of international labor term and residency sources from other countries in the world to Vietnam. Inherently, the risk of money laundering is one of the most important issues in most countries in the world because it has a strong negative influence on all aspects of social and economic life. And, more importantly, it influences the defense and security of these countries, whether they're powerful financial countries or those that are in the process of recovery and development. According to the International Monetary Fund (IMF), the value of global money laundering activities within a year would account for 2-5% of global GDP, with the value of USD 1-2 trillion annually. Also, according to the UNODC report, in 2010, the money laundering rate was USD 1.6 trillion and had an impact on global GDP of 2.7%. (*Filippo and Maria, 2017*)<sup>3</sup>

Through hypotheses and problems are mentioned above, there are a number of different research articles and applications that emphasize the importance of estimating the risk of each country's money laundering and controlling the badly impact affected by money laundering. First of all, the detrimental effects of money laundering on developing countries are increasing in crime and corruption, undermining the financial system, reducing foreign investment, the economy and the private sector is weakened, damaging both the economy and the privatization process, so it is necessary to enhance the effectiveness of anti-money laundering so that to improve anti-crime and corruption, strengthen a consolidation of financial institutions and contribute to stimulate economic development. (*Brent L. Bartlett, 2012*)<sup>4</sup>

In general, the quantification of money laundering risks is not always very urgent and worthwhile, but in the modern industrial and developing financial economic times; identifying and establishing compatible procedures and techniques are probably promptly and easily described or classified to share to the international anti-money laundering community, but the standard measurement and management of money laundering risk is so delicate to accomplish and utilize, especially when the platforms and methods employed by financial criminals are changing so rapidly and modern day by day and becoming more complicated. (*Nardo, 2009*)<sup>5</sup>

Recently, the global data of the tendency for financial crime is more internationally widen with the attempt of generating an accurate estimation, however, even though a number of largely varied measurements have been sacrificed, none of them can be thoroughly demonstrated. Moreover, the quantitative consequences that have been corrected and developed by anti-money laundering regulations have not yet to be absolutely answered (*Biagioli, 2008*)<sup>6</sup> and also no extensively approved estimate methodology has yet been completed (*Fleming, 2013*)<sup>7</sup>

In summary, Vietnam in general and the Finance – Banking sector in particular are now working harder to continue implementing and completing the plan on prevention of money laundering organized by FATF. In addition, Vietnam was also promulgated by the National Assembly a number of anti-money laundering laws passed on 18/06/2012 and officially take effect

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<sup>3</sup> Filippo Reganati and Maria Oliva (2017). The determinant of money laundering: Evidence from Italian Regions.

<sup>4</sup> The largely important effect on some of different sectors of society and economy was discussed in Brent L. Bartlett (2012). The Negative Effects of Money Laundering On Economic Development.

<sup>5</sup> The method of measuring needed to be improved and innovated by Nardo, M. (2009). Building synergies between theory and practice countering financial crime on systemic approach.

<sup>6</sup> Biagioli, A. (2008). Finance crime as a threat to the wealth of nations: a cost-effectiveness approach.

<sup>7</sup> Fleming, M.H. (2013). FSA's scale and impact of financial crime project (phase 1): critical analysis.

from 01/01/2013 in order to protect the country's political security and socio-economic situation to be always safe and potentially developed. However, in order to ensure that objectives are accomplished as well as the relevance and usefulness of the provisions and terms of the Law on money laundering in Vietnam are maximized, it is necessary to have more research basis papers for assessing the situation and the current state of the money laundering risk in Vietnam in order to be able to continuously issue the guidelines and recommendations that are consistent with the Vietnamese legal system and reality as well as to proceed with international successful rules. This study will attempt to measure the risk of money laundering among clients in the commercial banking system of Vietnam and provide an overview of the risk of money laundering and the causes leading to that risk; with the purpose of giving some recommendations for the Vietnamese banks to choose appropriate methods to ensure that the Bank's operating system taking place in much safer way.

To identify preferred research areas about the Money laundering risk and its determinants as well as suitable such recommendations to be made, the general aims need to be clarified throughout this research:

- (1) Calculating the money laundering risk from customers who are the members of Vietnamese commercial banks
- (2) Analyzing the related complement determinants and its estimated impact on the money laundering risk
- (3) Reassess some of feasible solutions and recommendations for modeling money laundering risk in Vietnam

For completing the potential purposes above, the paper shapes three research questions:

- Question 1: What is the suitable measurement of money laundering risk from customers in Vietnam?
- Question 2: How do the determinants of customer profile effect on the money laundering risk?
- Question 3: What is the possible management for the money laundering risk in Vietnamese commercial banks?

In detail, this study probably supports Vietnamese banks to monitor some important indicators affecting to their money laundering risk situation; and thereby they could improve their performance, increase their profits as well as guarantee for their customer assets; through making a decision for an efficient management of money laundering risk and applying appropriate governance policies. This paper also suggests some specific solutions for Vietnamese commercial banks in order to choose some good approaches to manage the MLR for each group of customers.

## LITERATURE REVIEW

- *The framework for money laundering risk framework*

The mission for preventing the money laundering risk, specific in the ability of monitoring and detecting the financial suspicious activities from the customers including individuals or organizations has been received much attention of many financial institutions or commercial banks; cause of its extremely negative effect to their profits and investment funds as well as the prompt progress from financial behaviors and technologies of criminals. To manage efficiently the money laundering risk, almost commercial banks need to prior to control carefully from the customer profile and frequent transactions or payments, such an important and difficult problem for establishing the appropriate model that probably quantifying money laundering risk for each customer in the large number of multiple targets in the most accurate manner. Moreover, it is not simple for the financial institutions or commercial banks to explore the best procedures for approaching or actually classifying the sensibility of all basic information, which was provided by any existing and also new prospective clients, in order to divide each group of customers into the adequate risk categories. There are few studies presented about the models for approximately quantifying the money laundering risks with some types of approaches.

The FATF GUIDANCE 2013<sup>8</sup> in Risk assessment for money laundering risk, this study mainly pointed out the general principles for the money laundering risk assessment for all countries over the world. Based on the conditions of each country, the development of government policies and supervisors, the power of law enforcement and relevant authorities, as well as the purpose and scope for risk assessment, the adequate methodology was selected with different groups of observations and required information. This paper was intended to support each country to classify, assess and clearly understand about money laundering risk sector through the assessment process divided into three stages, comprising of identification, analysis and evaluation.

The first identification stage of the risk assessment process was in the context of detecting the foremost list of the potential risks and risk factors, including political factors, economic and social indicators as well as geographical factors, technological factors and legislative factors, specially the effectiveness of operations from competent authorities that could be occurred for the countries following the incredible threats or vulnerabilities; the mission of this stage is considered as a comprehensive outlook to support the other stages; but was not effective because of the exist of some new and previously excavated risks. For the analysis stage which was the most important stage of the risk assessment process, the purpose of this stage was achieving the complete estimation for each of the risks with the importance from the combined result of threat and vulnerability, the analysis stage was undertaken following the type and purpose of risk assessment for each country and basically depended on the valid information and database. The last part is evaluation that the risk analysis was implemented totally again to determine the priorities for supporting to develop their strategy and procedure more practical and efficiently. In summary, this guidance of FATF provide valuable and advisable input to help many competent authorities in general could enhance their national anti-money laundering risk policies and lots of financial institutes or banks in particular to select an appropriate measurement based on each type and degree for mitigating and controlling the money laundering risk, however, the scope of guidance is for global, it therefor may not be a useful reference for all countries in the world and there still not any evidence for its application by quantitative statistics.

The next study from Vandana Pramod, Jinghua Li and Ping Gao, 2012<sup>9</sup> discussed the different framework of for preventing the money laundering risk in commercial banks which were COSO and COBIT. Two of them were mentioned as an internal risk control system following one of the most popularly used frameworks in banks is Basel II generated by Basel Committee in June 2004 that would be an international standard to prevent money laundering risk with a guidance for “what to do” measurements and controlling actions should take place. The framework of COSO was described as a control system to collecting information security for commercial banks or financial institutes with five basic elements; including controlling environment indicator that concentrated on the ethical value, structure and operating culture of organizations, as well as human resources and the other relevant departments of audit, board of directors and authorities; the risk assessment for risk identification process, the style and ways to achieve objectives in managing risks, the control activates, the information and communication that related the method for efficiently communicating to collect full and well quantitate information and the last components of monitoring for the on going monitoring planning, appropriate evaluations and reports for organizations. After that, the COBIT framework was created as an update version of COSO which was mainly focused on the technologies of the full process of organization’s operation that separated in four domains, that is, delivery and support, monitoring and further. The objective of the combined frameworks of COSO and COBIT is

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<sup>8</sup> The FATF Guidance (2013) with the title of National money laundering and terrorist financing risk assessment presented about the approach for the money laundering risk measurement from customer’s profile.

<sup>9</sup> Vandana Pramod, Jinghua Li and Ping Gao (2012). A framework for preventing money laundering in banks.

providing the reasonable guidance for financial organizations to achieve the goals of controlling the money laundering risk from the modern information system by implementing the rules of these frameworks. Finally, this paper supported commercial banks and financial institutes an intelligent system to manage customer's information and monitoring the significantly suspicious transactions or payments in order to detect the money laundering risk. However, due to the differences of the human intervention, the situations, regions and regulations of each country as well as the development of technologies, the results and effectiveness of the mapped framework of COSO and COBIT might be affected and changed. Moreover, the banks and organizations would not have an efficient management if using the mapped framework or following the requirements of Basel II with the traditional approaches and methods.

The work paper of Mauro Salvo, 2016<sup>10</sup> also presented about the risk- based approach which was another way to monitor the influence of money laundering risk in the financial stability evidenced through the exchange-rate and currency market in Brazil as a theoretical framework, including four stages of identifying the potential risk in the currency market, sizing and categorizing the risk level and predicting for the damage of the risk, selecting the measurement for mitigating MLR and finally controlling and evaluating the risk events. Because of the lack of full statistics, the model in this paper could not be completed, the risk based approach was also recommended as a method for increasing the effectiveness for the fully collecting necessary information and elements, that are, the performance of foreign currency in Brazil, the value of Brazilian currency, the regulations of the operation of Brazilian exchange market, the situations of money laundering level of this country and also the transactions as well as locations of clients. This paper gave a general judgment about Brazilian currency market and how the financial institutes got the better risk management that could prevent the criminal citizens and organizations for enhancing the economic development in this country. Once again, this paper was also not proven in the realistic case and probably adequate for the currency market in some countries with the same positions like Brazil.

Christopher Price (2008) estimated about the money laundering risk through the table of score contribution with three main types of customer profiles comprised of geography, customers and products and services. Consequently, the customer risk assessment study was taken the initiative from Christopher Price to give the researcher an overview about the process of measuring the risk from customer with an assumed example and illustration, especially in individual customers that mainly based on the identification, verification techniques and also the assessments from customers against globally suspicious payments and transactions, financial criminals and a necessary database of politically exposed person (PEPs), also following the requirement of segmented products and services and detailed customer acceptance processes to confirm the proximate risk level for each client type. Thence, this research proceed estimating the risk point of money laundering activities from customer with the important acceptance of three essential characteristics of geography, customers and products and services proposed by financials and commercial banks that have been mentioned in several papers as *FATF Report, 2012*<sup>11</sup>; *Wolfsberg, 2006*<sup>12</sup>; *Fassil and Hasan, 2011*<sup>13</sup>; *Lexis Nexis, 2012*<sup>14</sup>; *National Money Laundering – Risk assessment 2015*<sup>15</sup> and also *HSBC Vietnam Money Laundering Procedures 2016*<sup>16</sup>, through defining and classifying the type of each customer, distinctive geographies and offered services respectively.

The relative score contribution of measuring the money laundering risk of banking customers is described in the table 3 below as the estimated value applied from possible risk factor results with its relative weights. The average weight of each risk factor is determined by potential risk management decisions.

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<sup>10</sup> Another risk-based approach for estimating the money laundering risks in the currency and exchange rate market was declared in the paper of Mauro Salvo (2016). Money laundering as a threat to financial stability: a risk-based approach.

<sup>11</sup> FATF (2012). Specific risk factors in laundering the proceeds of corruption, assistance to reporting institutions.

<sup>12</sup> The Wolfsberg group (2006). Wolfsberg statement, Guidance on a risk based approach for managing money laundering risks.

<sup>13</sup> Fassil Fanta and Hasan M Mohsin (2011). Anti-money laundering regulation and crime: a two-period model of money-in-the-Utility-Function.

<sup>14</sup> Lexis Nexis UK (2012). Anti-money laundering - Bank's management of high money-laundering risk situations.

<sup>15</sup> Department of the Treasury W.D.C (2015). National money laundering risk assessment.

<sup>16</sup> HSBC Vietnam (2016). Knowledge bite of money laundering risk from customer. HSBC Money Laundering Risk Procedures.

Table 3: The relative score contribution of measuring the money laundering risk from Christopher Price 2008

Risk Factor	Relative Risk Factor Weight	Possible Results	Result Score Contribution
Country of Domicile	10%	Result 1 – United States Non HIFCA/HIDTA	25
	10%	Result 2 – FATF Members/Nations Other than Result 3 and 4	50
	10%	Result 3 – Nations Formerly on NCCT List within Past 3 years	75
	10%	Result 4 – Nations Sponsoring Terror, Drug Trafficking, and Weak AML Regimes, Offshore Tax Havens, U.S. HIFCA/HIDTA	100
Cash Activity Volume	40%	Result 1 (10 – 100 USD)	25
	40%	Result 2 (101 – 1000 USD)	50
	40%	Result 3 (1001 – 10000 USD)	75
	40%	Result 4 (10001– 100000 USD)	100
Wire Activity Volume	40%	Result 1 (10 – 100 USD)	25
	40%	Result 2 (101 – 1000 USD)	50
	40%	Result 3 (1001 – 10000 USD)	75
	40%	Result 4 (10001– 100000 USD)	100
Length of Relationship	10%	Result 1 (> 5 years)	25
	10%	Result 2 (3 - 5 years)	50
	10%	Result 3 (1- 3 years)	75
	10%	Result 4 (0 – 11 months)	100
PEP (Signer) – Dominant Risk Item	Automatic High risk	Result 1 - Yes	Automatic High risk
	0%	Result 2 - No	0
Total Risk Score			

In the table 3, the collected data from each observation should be applied following the measure indicator of Christopher framework and the distinct money laundering risk score could be generated for each customer.

Table 4: The risk score attribution scale of measuring the money laundering risk form Christopher Price 2008

Risk score attribution	Score Range
Very High	76-100
High Risk	51-75
Medium Risk	26-50
Low Risk	0-25

In the table 4, after calculating the money laundering risk score, based on the scale of the risk attribution, each customer should be divided into each appropriate category in order to support for the analysis process of the determinants of money laundering risk.

The above risk factors in Christopher Price framework is considered following:

- Country of Domicile factor – the purpose of this factor is investigating the geographic regions of banking customers, the branch of banks frequently provided products and services for customer as well as the jurisdiction regime of this areas.
  - United States, Non HIFCA/HIDTA: the customers that have permanent address in United States and out of the list of countries in High intensity financial crime areas (HIFCAs) regulated by United States Department of the Treasury – Financial Crimes and Enforcement Network High intensity drug trafficking areas (HIDTAs) appointed by Drug Enforcement Administration.
  - FATF Members: including the group of customers in a list of FATF countries, such as: Argentina, Australia, Belgium, Brazil, Canada, China, Finland, Greece, India, Ireland, Japan, Malaysia, Mexico, New Zealand, South Africa, Turkey, United Kingdom and etc.
  - Non-Cooperative Countries or Territories (NCCTs) regulated in black list of FATF and OECD: the customers are identified in relatively high risk level when belong to these countries over 3 years: Iran, North Korea, Algeria, Ecuador, Indonesia and Myanmar.
  - The customer is considered high risk level in the list of countries from Nations Sponsoring Terror, Drug Trafficking, and Weak AML Regimes, Offshore Tax Havens, U.S. HIFCA/HIDTA regulated by FATF, United States Department of the Treasury – Financial Crimes and Enforcement Network, Drug Enforcement Administration, Office of National Drug and Money Laundering Control Policy and The Office of National Drug Control Policy from White House.
- Cash Activity Volume – quantified reply on the total amount of money that the customer use in cash quarterly affecting to customer activities and provided services from banks.
- Wire Activity Volume - quantified reply on the total amount of money that the customer use by transfer method quarterly affecting to customer activities and provided services from banks.
- Length of Relationship – the estimated value for the period of time that customer started using the banking products and services
- PEPs - with the full definition of politically exposed person is directly defined by the Financial Action Task Force (FATF) as “an individual who is or has been entrusted with a prominent public function”. With their social position and strong power in the national political system, it is recognized that the money laundering risk for PEPs is significantly high, related to some of predicate offences, comprising of including smuggling, corruption and bribery and probably terrorist financing activities.

Nevertheless, the measurement of Christopher Price (2008) probably based on the estimation of the subjective identifications and the hypothetical evidences are just mostly suitable for both individual or organization respondents who belong to all sectors related to finance and banking, stay in various areas in many different countries. So this paper would not be completely applied when the detailed example has not adapted and also been demonstrated in the realistic situations in case of each of country or respondent has their own characteristics and even the necessary information not completely collected. For these observations and presentations, in this paper, the hypothetical information has been adjusted following the HSBC money laundering risk assessment in Vietnam published in 2016 to assure the utility of the respondent’s data is appropriate for the money laundering risk measurement of Vietnamese citizens. It was noted in HSBC procedures about quantifying the factors relevant to money laundering risk from customer that including the country risk factor, product risk, account risk and also occupation risk factors; it seemed to be similar with the framework of Christopher Price; however, emphasizing the importance of customer’s occupation types affecting to the level of money laundering risk with the estimated scale of three categories of Standard, Medium and High risk level with relative scores. The statistics has been collected the questionnaire but it is available for more various groups of the respondents who are customers of Vietnamese banking system, and without graphical illustrations; so as to make our research appropriate to the realistic conditions in Vietnam concerning money laundering risk.

The relative score contribution of money laundering risk of banking customers is presented in the table 5 below as the estimated value that has been adjusted following Vietnam conditions, also applied from possible risk factor results based on the Vietnamese HSBC money laundering risk assessment with the addition risk factor of occupation type and its relative weight to make an appropriate risk measurement for Vietnamese citizens; in generally the other factors is constant. The average weight of each risk factor is determined by potential risk management decisions.

*Table 5: The adjusted relative score contribution risk from Christopher Price 2008 and HSBC Vietnam procedure 2016 of measuring the money laundering*

Risk Factor	Relative Risk Factor Weight	Possible Results	Result Score Contribution
Occupation Type	10%	Result 1 – Domestic private companies	25
	10%	Result 2 – Joint-stock/ 100% capital investment foreign organizations	50
	10%	Result 3 – Domestic Government companies	75
	10%	Result 4 – International Government/ Non – Government Organizations	100
Cash Activity Volume	40%	Result 1 (10 – 100 USD)	25
	40%	Result 2 (101 – 1000 USD)	50
	40%	Result 3 (1001 – 10000 USD)	75
	40%	Result 4 (10001– 100000 USD)	100
Wire Activity Volume	40%	Result 1 (10 – 100 USD)	25
	40%	Result 2 (101 – 1000 USD)	50
	40%	Result 3 (1001 – 10000 USD)	75
	40%	Result 4 (10001– 100000 USD)	100
Length of Relationship	10%	Result 1 (> 5 years)	25
	10%	Result 2 (3 - 5 years)	50
	10%	Result 3 (1- 3 years)	75
	10%	Result 4 (0 – 11 months)	100
PEP (Signer) – Dominant Risk Item	Automatic High risk	Result 1 - Yes	
	0%	Result 2 - No	
Total Risk Score			

The table 5 shows the measurement for the money laundering risk score from customers is appropriately adjusted based on the measure indicator of Christopher framework and HSBC Vietnam money laundering procedures with the relative weights to estimate the comparatively accurate score of each banking customer following Vietnamese situations.

In the conditions of the other factors are constant,

- The Occupation Type is replaced for Country of Domicile factor – the purpose of this factor is concentrate on the occupation sector of each individual which has an effect on the money laundering purpose and ability.

*Table 6: The risk score attribution scale form Christopher Price 2008 and HSBC Vietnam procedure 2016 of measuring the money laundering*

Risk score attribution	Score Range
Very High	76-100
High Risk	51-75
Medium Risk	26-50
Low Risk	0-25

In the table 6, after calculating the money laundering risk score from the adjusted measurement, based on the scale of the risk attribution, each customer should be divided again into four risk-level categories including Very High, High, Medium and Low risk that is more suitable for Vietnam money laundering risk position compared to the other developed countries, such as: United States, Euro zone, South Africa and some of countries belongs to FATF or relevant anti-money laundering international organizations.

As a matter of the fact that there are still not any practical evidences or assumptions completely appropriate to the realistic situation. Hence, bringing the real statistics to the calculation of money laundering risk for customer is still a fully challenging and difficult issue which has not been conducted in any previous papers. In this paper, the main objective is presenting a new outlook that money laundering risk from customer would be recognized apparently based on the real-life data from a survey with four risk levels of Very High, High, Medium and Low, also exploring the potential existence of money laundering risk in the Vietnamese banking system.

- ***Empirical evidences for determinants of money laundering risk***

After selecting the appropriate measurement for quantifying the money laundering risk score for banking customers in Vietnam, this paper persists on making a discussion and an analysis about the valid determinants that have possible impacts on the money laundering risk provided from many relevant evidence sources. Besides, the OLS method for the regression, this paper tries to apply more several methods, including: forward selection, backward elimination and stepwise feature selection based on Bank Secrecy act/Anti-Money laundering program<sup>17</sup>.

These models have each own function and approach, but the main purposes of determining more concretely what variables are actually useful and available as well as the quantity of data collecting is probably verified in the most trustful way; since then, the specifically reliable variables could be chosen to run into the before selected model. Besides, some of factors that have been mentioned and used in SAS paper for customer-rating model, including: customer relationship with banking service, geographical factor, account features, high-risk customer like PEPs, customers are non-resident or working for money service business, alert history in banking system, expected product usage and payment or transactional activities that seemed to be coincident with FATF guidance, 2013. These model procedures for selecting appropriate variables are well mathematical and widely applied for many financial firms and organizations. Nevertheless, to collect some better factors, the other should concentrate on captivating the regulatory expectations following the position of each country; because the results would continuously change when developing different risk rating models for national citizen.

The first Vietnamese research of Chat Le Nguyen, 2014<sup>18</sup> for this paper discussed the situation of money laundering risk in Vietnam is mainly depended on the effectiveness of anti-money laundering risk regime with numerous domestic factors of GDP, inflation rate, high criminal rate, the low power of economy, the reasonable banking management system, efficient risk measurement and loose legal system in tax as well, which are lack of some standards to adapt the international regime. Besides, the money laundering risk also had the quite influence from citizen behavior indicators, with the low educational degree of the population, it was simple for criminals to approach and implement laundering money and also about the average income was not satisfied the demand of workers; it therefore leads them to undertake the criminal activities, specially related to money laundering.

For another study was belongs to the author Loan Thi Nguyen, 2016<sup>19</sup> that once again focused on the function of Vietnamese anti-money laundering regulations, this paper was considered as the overview about the procedures of money laundering risk in Vietnam and generate the appropriate solutions, but emphasize the method to recognize the MLR some of suspicious transactions and activities of customers which is evidenced in statistics by surveying some of commercial banks in Vietnam; comprising of all the transactions with large amount of investing planning or large amount in cash without original source, the international payments of currency and exchange rate, the transactions without any economic benefits for customers, the observed customers in the investigating or litigious process and in the international black lists of international anti-money laundering organizations, and the attitude of customers when providing personal information or transactions. This paper proposed the solutions for preventing money laundering risk in Vietnam that government should enhance the regulations following the international frameworks with supplementing some provisions about the monitoring all suspicious transactions with large amount in cash of banking system as

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<sup>17</sup> Evidenced from SAS Institute (2015). AML Customer Risk Rating – Modernize customer risk rating models to meet risk governance regulatory expectations.

<sup>18</sup> Chat LE NGUYEN (2014). The international anti-money laundering regime and its adoption by Vietnam.

<sup>19</sup> Loan THI NGUYEN (2016). Phòng chống rửa tiền qua hệ thống ngân hàng Việt Nam.

well as the requirement of annually reporting of all commercial banks in Vietnam.

The work paper of Santha and Mahendhiran, 2007<sup>20</sup> discussed about the external factors in some developing countries that had an effect on the money laundering risk including national technology related to the development of international technological system, the quality of citizen capital with the connection with knowledge of employees, the effectiveness of the legal framework that related to the legal and regulatory system of each national economy, the ethical behavior of firms and individuals and the qualification of innovation was from the development of new banking products and services. In details, the technology development and the qualification of innovation factors had negative results to money laundering risk that meant the high technological environment and the strong development of new products that improved as a protecting tool would prevent the approach of money laundering criminals; moreover, the citizen capital, the effectiveness of the legal framework and the ethical behavior of national subject factors had positive effects on MLR that implied the citizen capital, legal framework and also ethical behaviors of citizens in the developing countries were still in low level and easy to be infiltrated by criminal activities compared to the developed countries.

These indicators were again presented in the study of Neha Parashar and his student group, 2008<sup>21</sup> with the similar purpose of affecting to the money laundering risk and also similar variables, including technology, innovation and ethical behavior of firms with the similar characteristic results with the Santha and Mahendhiran paper; and specially the addition of business and financial sophistication factors, macroeconomic stability, higher education and training of human, and national auditing and reporting standards. From the positive results of business sophistication, macroeconomic stability, education of citizens in developing countries, and auditing and reporting standards proved that the financial market and standards became more complex and effective, the money laundering risk would decrease. The last factor odd business sophistication had the positive effect with MLR because if the operation of firms was complicated and the useful management could not be applied, it was easy to support for the money laundering risk.

The another paper from Muhammad, 2014<sup>22</sup> also gave the general evidence about the effectiveness of anti-money laundering regulations and discussed the determinants of money laundering risks belongs to individuals closely related to banking sector which were the customer record keeping factor with all of the provided secrecy information from customer about profile, location, method for transactions, the number of transactions and payments, as well as the funding source; with the next suspicious transaction reporting factor was one of the most necessary element for commercial banks to prevent money laundering risk that including process with four stages of checking account, asking customers about missing information, monitoring the previous transactions and evaluating the risk level of customer to recognize the suspicious transitions; and the last employee trainee factor was the process for enhancing employee's knowledge, skills, behaviors as well as the ability to recognize the suspicious customers and transactions. In summary, the customer record keeping and suspicious transaction reporting had the positive impact and the negative result was caused the employee training indicator.

Following the money laundering risk paper of Fillippo and Maria, 2017<sup>23</sup>, the authors continuously pointed out some of external determinants had the significant impact on money laundering risk with the evidence from Italy, comprising of national money laundering risk and conviction rate, shadow economy, the education rate, the development of technology, GDP growth, corruption rate, gaming and gambling and incidence of mafia. The only two factors with the positive results for money laundering risk were conviction rate and education rate that seemed to be similar with the results of Muhammad paper needed to be carefully increased by relevant authorities as an efficient approach to prevent the money laundering risks. The other factors in this paper had the negative results that would also be a useful reference for governance organs to improve the Italian financial market as well as for the further research papers in Italy about money laundering risk.

The another guidance for managing money laundering risk from the Wolfsberg group, 2006<sup>24</sup> group mentioned again the three main categories commonly used to measure money laundering risk, including: country risk with the determination of the statement of customer's country whether it belongs to the list of high money laundering risk locations or not that regulated by FATF and some international anti-money laundering organizations like World bank, the Organization for Economic Co-operation and Development ("OECD"), and also the Egmont Group of Financial intelligence units; for customer risk that this guidance

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<sup>20</sup> Santha Vaithilingam and Mahendhiran Nair (2007). Factors affecting money laundering: lesson for developing countries.

<sup>21</sup> Bajrang, Pavitra, Ritika, Piyush, Puneet and Neha (2008). Factors affecting money laundering: A Lesson for developing countries.121-123

<sup>22</sup> Muhammad Usman Kemal (2014). Anti-money laundering regulations and its effectiveness. 421-425.

<sup>23</sup> Filippa Reganati and Maria Oliva (2017). The Determinant of money laundering: Evidence from Italian regions. 5-8.

<sup>24</sup> The Wolfsberg group. Wolfsberg statement – Guidance on a Risk based approach for managing money laundering risks, 3-6.

concentrated on the significant level of customer's assets frequently used for making transactions and payments with financial institutes with some different types of high-risk customers, such as: high value customers, the manufactures of armament, financial dealers and intermediaries, unregulated charity or nonprofit organizations, and also the disclosed account generated from customers to their accountants, lawyers or relatives in some financial institutes or banks, and the other service factors basically related to the international banking services for both individual or organization customers or the trading and delivery activities of metal as well as the length of relationship between customers and banks. Moreover, the training and education of employees in banks and financial institutes is one of the most important elements to prevent money laundering risk in the financial market with more attached external factors, comprising of the level of regulations and laws, the effectiveness of anti-money laundering regime, national financial complexity and also the power jurisdiction as well as the knowledgeable standards of regulatory authorities and lawful enforcements.

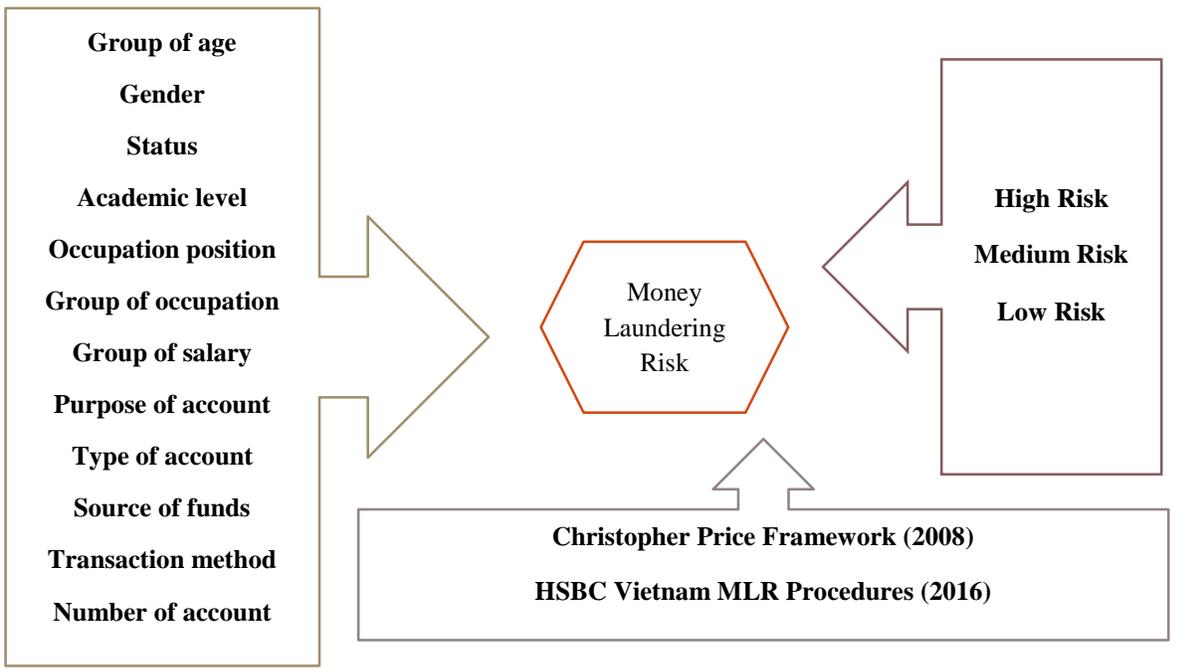
The essential report from FATF in 2012 about the special elements for money laundering risk which was considered as a supportive guidance with a relatively clear full lists of the determinants of money laundering risk, especially customer risk factors related to money laundering from Peps, including the position of them in the political system, the purpose of using account in banking system and the business relationship with some of economic factors involved, such as extractive industries, national GDP growth rate, the absorption from governance activities with huge infrastructure projects, human health activities and also human capital. Each of relevant factors was evidenced by realistic case studies in different countries. Similarly, as mentioned in FATF guidance in 2013 related to the national money laundering risk assessment, the indicators affecting to the money laundering risk was apparently pointed out with the division into five groups of political, economic, social, technological, environmental and geographical, and legislative factors. Specially, in the economic factors with the composition for individual and organization in financial services that also described some factors of banking products, services and transactions with a list of elements from the mandatory information of products, a large amount transactions in cash and wire transfers as well as the appearance of high risk or non-resident observations, the customer factors that were relevant to types of clients, the alert for high risk indicators from customer, nature of occupation relationships and the regulatory applied to banking customers, and also the geographic factors for the cross-border payments of funds, the main geographical area of customer or non-residents whether needed to be monitoring the money laundering risk or not.

Based on literature review above, the determinants of money laundering risk are basically divided into two groups as internal and external indicators. The internal determinants are mainly presented for. On the other hand, the external determinants are focused on the development of technologies, GDP growth rate, business and financial sophistication factors, macroeconomic stability, higher education and training of human, and national auditing and reporting standards, and etc. Almost all of above studies frequently discussed about the determinants for both individual and organization customers and also depended on the adequate situation of each mentioned country. In addition, the internal factors of money laundering risk from customers are probably simply changing and adjusting that to be more correlative with the risk measurement. Therefore, this thesis just only concentrates on the relationship between the internal indicators, including: customer's group of income, age, gender, occupation, marital status, academic level, source of funds, purpose of using service, methods of transactions, the number of accounts in Vietnamese banking system and etc., and money laundering risk without the control of external indicators because of its lack of full database and large vulnerability in marketable statistics. These determinate relationships are probably appropriate and relevant to the context of Vietnam throughout this paper.

## DATA AND RESEARCH METHODOLOGY

- **Conceptual Framework**

Following the literature review, the Christopher Price (2008) measurement combined with the HSBC Vietnam risk procedures 2016 mentioned in literature review for MLR is selected with four main elements, comprising of occupation type, cash volume, wire volume and length of using banking services. This paper also examines the internal determinants of MLR including group of age, gender, marital status, education level, position and sector of occupation, group of income, type of account, purpose of using account, source of funds, level of assets, transaction method. The dependent and independent variables are presented and illustrated in the conceptual framework sector as in figure 2 below:



*Figure 3: Conceptual framework for money laundering risk*

- **Data description:**

The further descriptive information of this paper statistics from the collective respondents is shown in the two table below:

*Table 7: The description of qualitative variables<sup>25</sup>*

Qualitative variables		Percentage (%)
<b>Illustration</b>	<b>Symbol</b>	
<b>THE GROUP OF AGE</b>	<b>AGEGROUP</b>	
Under 18		0
18 - 45		70,4
46 - 55		23,2
56 - 65		5,4
66-75		1
Over 75		0
<b>GENDER</b>	<b>GENDER</b>	

<sup>25</sup> Source from the collective statistics of this paper

Male		36,5
Female		63,5
<b>STATUS</b>	<b>STATUS</b>	
Single		53,2
Married		45,3
Divorced		1,5
Different status		0
<b>ACADEMIC LEVEL</b>	<b>ACALEVEL</b>	
Universalizing		0,5
High school diploma		6,9
Junior college		28,1
Associate's Degree		7,4
Bachelor's degree		46,8
Master/ PHD degree		10,3
Different academic level		0
<b>EMPLOYMENT MODEL</b>	<b>EMPL.MODEL</b>	
Domestic private company		45,8
Joint-venture foreign company		15,3
100% investment capital foreign company		19,2
Domestic state-owned company		13,3
Domestic non-profit government organization		3,4
International non-profit government organization		2,0
Different employment model		1,0
<b>OCCUPATION POSITION</b>	<b>POSITION</b>	
Intern/ Trainee/ Part-time employee		4,4
Full-time employee		53,7
Chief department		26,1
Senior Manager		11,8
Director		3,0
Member of board of directors		1,0
Different occupation position		0
<b>THE GROUP OF JOB</b>	<b>JOBGROUP</b>	
The sector of Communist Party, Government, Union and relevant organs or authorities		5,9
The sector of law and control		6,9
The sector of economy, finance & banking, financial application, accounting, insurance, remittance and commercial investment		36,0
The sector of medical, science and education		12,8
The sector of agriculture, forestry and fishery		7,4
The sector of servicing, technology and engineering		26,6
The sector of art, culture and entertainment		4,4
Different sector		0
<b>THE GROUP OF SALARY</b>	<b>SALGROUP</b>	
Less than or equal VND 5 million		12,3
Over 5 to VND 10 million		38,4
Over 10 to VND 18 million		26,6

Over 18 to VND 32 million		16,3
Over 32 to VND 52 million		3,4
Over 52 to VND 80 million		3,0
Over VND 80 million		0
<b>THE TYPES OF BANKING ACCOUNT</b>	<b>ACCTYPE</b>	
Credit account		1,5
Domestic/ International payment account		57,1
Savings account		30,0
Business account		4,4
Foreign investment account		6,9
<b>THE PURPOSE OF USING ACCOUNT</b>	<b>PURPOSE</b>	
Receiving salary		40,4
Savings		25,1
Business and Investment		15,8
Personal and credit card payment		17,7
Money transfer for abroad student		1,0
Receiving funds oversea from relatives		0
Different purpose of using account		0
<b>SOURCE OF FUNDS</b>	<b>SOF</b>	
Basic salary, commission and allowance		63,1
Retirement pension		3,0
Family allowance		2,0
Personal savings		22,2
Profits from business and investment		9,9
Compensation from insurance/ inheritance		0
Different source of funds		0
<b>METHOD OF TRANSACTIONS</b>	<b>METHOD</b>	
Cash deposit		30,5
Funds from the third party		3,9
Domestic transactions		58,1
International transactions		7,4
Different method of transactions		0
<b>MONEY LAUNDERING RISK CATEGORIES</b>	<b>MLRC</b>	
LOW		7,9
MEDIUM		71,4
HIGH		20,7
VERY HIGH		0

Table 8: The description of quantitative variables<sup>26</sup>

Quantitative variables		Minimum	Maximum	Mean
Illustration	Symbol			
Total assets (VND)	<b>TTLASSET</b>	20,000,000	1,800,000,000	209,000,000
Total quarter net income (VND)	<b>NETINCOME</b>	5,000,000	207,000,000	28,912,808
The period time of starting using banking services (YEARS)	<b>LENGTH</b>	1,0	20,0	5,872
The probability of net income using for banks in cash (%)	<b>PROCASH</b>	0,0	1,0	0,43
The total amount of money using for banks in cash (VND)	<b>CASHAMOUNT</b>	0,0	160,800,000	12,934,261
The total transactions in cash (Times)	<b>CASHTRANS</b>	0,0	12,0	3,00
The probability of net income using for banking services and products in wire (%)	<b>PROWIRE</b>	0,0	1,0	0,573
The total amount of money using for banks in wire (VND)	<b>WIREAMOUNT</b>	0,0	140,000,000	15,647,512
The total transactions in wire (Times)	<b>WIRETRANS</b>	0,0	15,0	3,0
The total accounts in banking system. (Times)	<b>NOACC</b>	1,0	6,0	3,0
The money laundering risk score of respondents. (Score)	<b>MLRS</b>	25,0	70,0	44,0

- **Variables selection**

Besides the cross-section regression techniques were applied to analyze and determine the appropriate determinants for the regression model of money laundering risk., this paper also employed the stepwise regression including forward selection with the addition and backward elimination with the subtraction of the independent explanatory variables following some of previous specified criterion to select again the most actually useful variables that supporting for identifying more undetectable influences as well as making the model more practical and effective.

To accomplish this objective, this paper tries to run many stepwise models for almost all the collected independent variables to choose the residual variables with the considerable frequency in stepwise models with the significance of 10%. All of further stages of running stepwise models is presented below:

- **Forward selection**

Forward selection is one of the simplest approaches to build the model successful through nominating the variables by using STATA software. This approach starts for null model without any variables and then one additional variable is applied one at a time for this previous installed model; subsequently, this method is executed for all independent variables step by step. At each step, the variables are tested for conformity in the model by the significance level of p-value; and in this paper, the highest significance level is accepted for not over 10%. For the predicted variables will be selected with the p-value level of 10% from the lowest ones until all remaining variables are statistically significant.

**Stepwise, pe (.1): regress MLRS AGEGROUP GENDER STATUS ACALEVEL POSITION JOBGROUP SALGROUP ACCTYPE PURPOSE SOF METHOD NOACC**

Figure 5: Forward selection model of independent determinants

<sup>26</sup> Source from the collective statistics of this paper

- **Backward elimination**

With the forward selection, as a matter of the fact that one new addition may distribute one or more of the already or non-significant variables; therefore, an alternative method is explored that is backward elimination similar to the forward selection procedure but in the converse approach and also run by STATA. This method starts again in a fit model with all of necessary variables and continuously reduced model by eliminating some of inappropriate variables that are not significant or over than the chosen critical level of 10% step by step with the same rule for all of reserved independent variables are significant to the model.

**Stepwise, pr (.1): regress MLRS AGEGROUP GENDER STATUS ACALEVEL POSITION JOBGROUP SALGROUP ACCTYPE PURPOSE SOF METHOD NOACC**

---

*Figure 6: Backward elimination model of independent determinants*

- **Stepwise regression**

Stepwise regression is considered as a combination of forward selection and backward elimination. This approach simultaneously applies add and remove variables for one process in the same time and also tests again the similar variables selected in the forward selection and back ward elimination with the same significant level of 10%. At each stage, the significance is set up for each forward or backward method to confirm these variables should be added or eliminated and the variations may be done how accurately and appropriately.

**Stepwise, pe (.1) pr (): regress MLRS AGEGROUP GENDER STATUS ACALEVEL POSITION JOBGROUP SALGROUP ACCTYPE PURPOSE SOF METHOD NOACC**

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*Figure 7: Stepwise model of all independent determinants with the 10% significance of forward selection*

**Stepwise, pe () pr (.1): regress MLRS AGEGROUP GENDER STATUS ACALEVEL POSITION JOBGROUP SALGROUP ACCTYPE PURPOSE SOF METHOD NOACC**

---

*Figure 8: Stepwise model of all independent determinants with the 10% significance of backward elimination*

**Where:**

- ✓ **MLRS:** presents for the MLR score of respondent
- ✓ **ACEGROUP:** presents for the age group of respondent
- ✓ **ACALEVEL:** is the academic level of respondent
- ✓ **ACCTYPES:** is the account types of respondent
- ✓ **GENDER:** presents the gender of respondent
- ✓ **JOBGROUP:** presents for the sectors of customer's respondent
- ✓ **METHOD:** is the method of transactions using by respondent
- ✓ **NOACC:** presents the total accounts in banking system of respondent
- ✓ **PURPOSE:** expose the purpose of using banking account of respondent
- ✓ **POSTIONS:** presents the occupation position of respondent
- ✓ **SALGROUP:** presents for group of monthly salary of respondent
- ✓ **STATUS:** is the marital status of respondent
- ✓ **SOF:** is the source of funds used for banking service of respondent

- **Correlation matrix of independent variables**

Correlation matrix is another method run in STATA with a purpose of testing the direction and strength from the relationship of the independent variables together that probably contributes to consult and select again some of useful variables to make the model be run in the most accurate way. This method estimates with some of hypothesis of no assumption of causality and a linear association between the variables. The result of the correlation from two variables can be positive or negative with the scale of -1 to +1, including the weak relationship from 0.1- 0.3, the moderate is between 0.4 to 0.7 and with the scale from 0.8 – 1.0 is for the strong correlation; especially the extreme values of -1 and +1 present the perfect linear relationship that means these variables are coincide and can not be run in the general model.

In this paper, the correlation matrix is applied for all independent variables; and after estimating some of effective variables from the selection stage, the correlation matrix can be run again for those selected ones.

**Correlate AGEGROUP GENDER STATUS ACALEVEL POSITION JOBGROUP SALGROUP  
ACCTYPE PURPOSE SOF METHOD NOACC**

Figure 9: Correlation matrix of all independent determinants

▪ **Liner Regression model**

Following the stepwise method, this study also run the regression by STATA and SPSS software with the application of multiple linear regression models to determine the relationship between money laundering risk and its determinants. The general regression model for money laundering risk is presented below:

$$\begin{aligned} \text{MLRS} = & \beta_1 + \beta_2 \text{AGEGROUP} + \beta_3 \text{GENDER} + \beta_4 \text{STATUS} + \beta_5 \text{ACALEVEL} + \beta_6 \text{POSITION} \\ & + \beta_7 \text{JOBGROUP} + \beta_8 \text{SALGROUP} + \beta_9 \text{ACCTYPE} + \beta_{10} \text{PURPOSE} + \beta_{11} \text{SOF} \\ & + \beta_{12} \text{METHOD} + \beta_{13} \text{NOACC} + \mu_i \end{aligned}$$

Figure 10: Regression model of MLR and its determinants

▪ **Logistic regression model**

After using the liner regression from general model of money laundering risk, this paper also applied the logistic regression model because of its concordance in statistics for covering all of the cases of categorical dependent variable that was homological with the categories of Very High, High, Medium and Low MLR customer in this paper.

The logistic regression was widely applied in many various fields, including medical, education, machine learning, social sciences and etc. The function of this method is to estimate the probability for many different predictors or independent variables with the purpose of generating more accurate conclusions about the effected value and significance to the dependent variable. The evolved percentage of the different independent variables as well as risk factors would change the probability of a given outcome with respectively specific percentage. The logistic regression was divided into two fields of multinomial logistic regression where the independent risk factors analyzed with more than two different outcome categories and ordinal logistic regression that the variables evaluated in the ordered multiple categories.<sup>27</sup>

○ **Multinomial Regression**

Multinomial regression approach is a different form of liner regression method applied in RStudio software executed when the nominal value of a dependent indicator is identified with more than two levels. This method is used for describing the collective data and also analyze the relationship between one dependent variable and one or many consecutive independent predictors with the assumption of the nominal variable that has no intrinsic ordering. In the multinomial model, it is assumed that the log-odds off each response following the formula shown below:

$$n_{ij} = \log \frac{\pi_{ij}}{\pi_{ij}} = \alpha_j + x_j \beta_j$$

Figure 11: Multinomial regression model formula of all independent determinants

Where  $\alpha_j$  is constant and  $\beta_j$  is a vector of regression coefficients for  $j = 1, 2, \dots$  and  $J-1$  category. This model is considered as a logistic regression model with the different form of liner regression model, except that the probability distribution is multinomial based on each category of the observations for the  $J-1$  level instead of binomial or less. The  $J-1$  multinomial logistic equation contrast each off categories  $1, 2, \dots, J-1$  of the ordinal  $J$  category, whereas the single logistic regression is in a contrast between successes and failures. If  $J = 2$ , the multinomial logistic regression model reduces the liner regression or the usual logistic regression model.

<sup>27</sup> Business Analytics (2016). How to use multinomial and ordinal logistic regression in R.

○ **Ordinal Regression**

Ordinal logistic regression or the proportional odds model is considered as another extension of binomial logistic regression that is also used to predict the interaction of the ordered multiple categories or levels from the dependent variable and one or more independent factors. This model helps to cover and observe more faithfully with a natural order in the variable categories in general model. The ordinal logistic regression models the cumulative probability  $P(\gamma = j, X_j)$  as the logistic function with the given  $X \in R^{n \times p}$  input data and  $Y \in N^n$  target values. For simplicity, it is assumed that  $\gamma$  is a non-decreasing vector, that is,  $\gamma_1 \leq \gamma_2 \leq \dots$ . Where  $\omega, \theta$  are vectors to be estimated from the data and  $\phi(t) = \frac{1}{1 + \exp(-t)}$

$$P(\gamma = j, X_j) = \phi(\theta_j + \omega^T X_i) = \frac{1}{1 + \exp(\omega^T X_i - \theta_j)}$$

---

*Figure 12: Ordinal regression model formula of all independent determinants*

▪ **Model evaluation**

To generate the most accurate effected value of independent factors to the dependent variable as well as evaluate the usefulness of the general model from the multinomial and ordinal logistic regression, this paper would base on two measuring indicators including accuracy score and F1 score.

“The function of accuracy score is to compute the accuracy for the estimated value scale from 0 to 1 with both the fraction and count that represents the correct percentage predictions for each independent variable with the condition of the total set of predicted variables closely match with the table of true variables.

With the measuring indicator of F1 score that is used for estimating the precision as the ability of classifying all of the positively useful samples and not for trying to change the negative elements to the positive ones. The F1 score is also perceived as an average exponent of the precision and recall with the similar score from 0 to 1, when the best value of independent factors is achieved that means the F1 score value is nearly 1 and conversely.”<sup>28</sup>

During the process of surveying and collecting data, there are many difficulties was formed, such as the willingness of respondents for providing information because of the individual elementary, the uncompleted diversification in the group of age of respondents as well as the application of Christopher measurement in the Vietnamese situations. Therefore, this study tried to modify the most appropriate model to be ore specific and detailed for respondents with the purpose of creating more favorable conditions for the progression of surveying.

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<sup>28</sup> Scikit learn (2016). Model evaluation: quantifying the quality of predictions.

## RESULTS AND DISCUSSION

▪ **Variable selection result:**

Before analyzing the impact of some factors to the money laundering risk, this paper alternately applied for all determinants in three approaches of forward selection, backward elimination and stepwise regression to determine the most efficient variables for the general regression of money laundering risk.

The impact of following independent variables from forward selection is shown in table 9:

**Table 9: Regression results of the impact of independent variables of forward selection step by step with the 10% significance**

Independent Variables	Model forward selection step by step										
	AGEGROUP	***	***	***	**	**	**	**	**	***	***
GENDER	***	***	***	***	***	***	***	***	***	***	***
STATUS											
ACALEVEL			*					*			
POSITION											
JOBGROUP											
SALGROUP			**					**			
ACCTYPE											
PURPOSE	**	**	**	**	**	**	**	**	**	**	**
SOF	***	***	***	***	***	***	***	***	***	***	***
METHOD											
NOACC	**	**	*	**	**	**	**	*	**	**	**

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The impact of following independent variables from backward elimination is presented in table 10:

**Table 10: Regression results of the impact of independent variables from stepwise backward elimination**

Independent Variables	Model backward selection step by step										
	AGEGROUP	**	***	***	***	***	***	***	**	**	**
GENDER	***	***	***	***	***	***	***	***	***	***	***
STATUS											
ACALEVEL	*	**	*					*	*	*	*
POSITION											
JOBGROUP											
SALGROUP	**	**	**					**	**	**	**
ACCTYPE											
PURPOSE	**	**	**	*	**	**	**	**	**	**	**
SOF	***	***	***	***	***	***	***	***	***	***	***
METHOD											
NOACC	*	*	*	**	**	**	**	*	*	*	*

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The impact of following independent variables from the stepwise regression is presented in table 11:

**Table 11: Regression results of the impact of independent variables from stepwise regression**

Independent Variables	Model 17	Model 18
AGEGROUP	***	**
GENDER	***	***
STATUS		
ACALEVEL		*
POSITION		
JOBGROUP		
SALGROUP		**
ACCTYPE		
PURPOSE	**	**
SOF	***	***
METHOD		
NOACC	**	*

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Based on the results of three approaches of stepwise regression analysis shown in table 9, 10 and 11 for the respondents in the categories of High, Medium and Low Risk Level, it is easy to evaluate the determinants of money laundering risk, comprising *of the respondent's group of age, gender, academic level, the group of salary, purpose of using account, source of funds and their method of transactions* in Vietnamese banking system.

▪ **Correlation result:**

The correlation matrix of seven selected independent variables in three methods of forward selection, backward elimination and stepwise regression is shown in table 12:

**Table 12: Correlation matrix results of selected independent variables**

	AGEGROUP	GENDER	ACALEVEL	SALGROUP	PURPOSE	SOF	NOACC
AGEGROUP	1.0000						
GENDER	-0.1724	1.0000					
ACALEVEL	-0.1116	0.1189	1.0000				
SALGROUP	0.0153	0.2031	0.4986	1.0000			
PURPOSE	-0.0561	0.1167	0.2433	0.2885	1.0000		
SOF	0.1324	0.0295	0.0285	0.3777	0.3741	1.0000	
NOACC	0.1886	0.0289	0.0844	0.3075	0.2258	0.3062	1.0000

After running all of the stages of forward selection, backward elimination and stepwise regression, from the general results of the similar largest frequencies of all independent variables combined with the correlation matrix of these variables, the seven essential variables which were the most efficient and believable indicators selected to run the general regression model with money laundering risk with all of the correlation results under 0.5 that was considered as an inappreciable correlation, comprising of the group of age, gender, academic level, the group of salary, purpose of using account, source of funds and the number of accounts.

▪ **Liner Regression result:**

The liner regression result of the selected independent variables to money laundering risk is clearly shown in table 13 with the significance relatively:

**Table 13: Liner regression results for the impact of independent variables to Money Laundering Risk**

<b>Independent variables</b>	<b>Money Laundering Risk</b>
<b>AGEGROUP</b>	.1394148 **
<b>GENDER</b>	.2193232 ***
<b>ACALEVEL</b>	-.0564223 *
<b>SALGROUP</b>	-.0764511 **
<b>PURPOSE</b>	.0662384 **
<b>SOF</b>	.0816889 ***
<b>NOACC</b>	.0439465 *
<b>The number of observations</b>	203
<b>Breusch-pagan-godfrey Test</b>	Yes
<b>White Test</b>	Yes
<b>Durbin-waston Test</b>	Yes

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Following the results of general regression analysis for money laundering risk shown in table 10 for all respondents, the determinants of money laundering risk are identified to be actually related to the respondent's group of age, gender, academic level, the group of salary, purpose of using account, source of funds and their method of transactions and definitely the model of this paper could be rewrite:

$$\text{MLRS} = .7206 + .1394 \text{ AGEGROUP} + .2193 \text{ GENDER} + (-.0564) \text{ ACALEVEL} + (-.0764) \text{ SALGROUP} + .0662 \text{ PURPOSE} + .0817 \text{ SOF} + .0439 \text{ NOACC}$$

The positive correlation between the respondent's group of age (AGEGROUP) and MLR indicated that the higher level of age group the respondents are, the higher money laundering risk occurred in the financial market. Besides, the total accounts of respondents in banking system probably raise the risk of money laundering activities through the positive result of the account variable (NOACC) and MLR. The negative correlation between money laundering risk with the respondent's group of salary (SALGROUP) and academic level (ACLEVEL) implied that the lower amount of money the respondents earn and lower academic level they were, the higher degree money laundering risk could occur that mentioned and evidenced in some previous papers of Sathan and Mahendhiran, Muhammaz and Wolfberg. Besides, the factors of the gender (GENDER), source of funds (SOF) and the purpose of using accounts (PURPOSE) of respondents would also have the impact on money laundering risk.

- **Multinomial logistic regression model result:**

The multinomial logistic regression result with the accuracy score for the selected independent variables to money laundering risk is clearly presented in table 14 with estimated value relatively:

**Table 14: Multinomial regression results for the accuracy score of independent variables to Money Laundering Risk**

<b>Independent variables</b>	<b>Accuracy score</b>
<b>AGEGROUP</b>	0.1554388
<b>GENDER</b>	0.6254571
<b>ACALEVEL</b>	- 0.2088213
<b>SALGROUP</b>	-0.4026925
<b>PURPOSE</b>	0.4204958
<b>SOF</b>	0.2239123
<b>NOACC</b>	0.3345657
<b>The number of observations</b>	203

Following the summary output of multinomial regression of independent variables to money laundering risk with respective coefficient values, some of identification could be presented in detailed with the arithmetic way.

A one-unit increase in changing the group of age if being in the older status of respondent increase the log odds of MLR by 0.16

A one-unit increase in changing the gender, compared man to women, the log odds of MLR will increase by 0.63

On the other hand, a one-unit increase in the growth of the academic levels from respondents if moving from lower to higher education decline the log odds of MLR by 0.20

Moreover, the growth in the salary groups of respondents increase one unit if moving from low to high salary will reduce the log odds of MLR by 0.40

A changing in varying the purposes of using account of respondents will raise the log odds of MLR by 0.42

The transmit among the categories of source of funds of respondents from usual salary and savings to business or investment profits will multiple the log odds of MLR by 0.22

A one-unit enhance in the number of accounts of respondents if moving from “few” to “numerous” increase the log odds of MLR by 0.34

- **Ordinal logistic regression model result:**

The ordinal logistic regression result with the accuracy score for the selected independent variables to money laundering risk is clearly presented in table 15 with value calculated relatively:

**Table 15: Ordinal regression results for the accuracy score of independent variables to Money Laundering Risk**

<b>Independent variables</b>	<b>Accuracy score</b>
<b>AGEGROUP</b>	0.2828000
<b>GENDER</b>	0.7119974
<b>ACALEVEL</b>	- 0.4651749
<b>SALGROUP</b>	-0.2652104
<b>PURPOSE</b>	0.0128210
<b>SOF</b>	0.1053981
<b>NOACC</b>	1.6483444
<b>The number of observations</b>	203

Following the summary output of ordinal regression of independent variables to money laundering risk with respective coefficient values, some of identification could be presented in detailed with the arithmetic way.

The modification in the group of age from young to old, the odds of MLR of Low, Medium, High and Very High level is 0.28 greater.

A changing in the gender of respondents, compared man to women, the odds of MLR if moving from Low to High is 0.71 times greater.

In contrast, a one-unit increase in the growth of the academic levels from respondents if moving from lower to higher education decreases the odds of MLR by 0.47 times.

Moreover, the growth in the salary groups of respondents if moving from lower to higher salary will reduce the odds of MLR by 0.403 times.

A changing in the purposes of using account of respondents if moving from receiving salary from the employment to making business and investment activities will raise the odds of MLR by 0.01 times.

The commutation in source of funds of respondents moving from basic savings and salary to the profits from business and investment activities, the log odds of MLR from lower to higher risk level multiples 0.11 times.

A one-unit promotion in changing the number of accounts of respondents if moving from “few” to “numerous” increases the odds of MLR by 1.65 times.

## CONCLUSION AND FURTHER RESEARCH

### ▪ *Conclusion and Recommendations*

The objective of this paper is to apply the Christopher Price framework (2008) for measuring the money laundering risk for Vietnamese customers and examine the positive determinants of money laundering risk with the purpose of to generating some of useful method to control and prevent the money laundering risk in the Vietnamese realistic situation. To achieve the proposed goals, the detailed questions are developed and evidenced. Therefore, based on the result of this thesis, the affirmative explanation for the money laundering risk and its determinants would be presented in detailed in this section.

For the measurement of Christopher Price (2008), the estimation about the money laundering risk score that applying in the developed version with the additional element of occupation types of customers from HSBC money laundering risk procedures (2016) for the practical situation of Vietnam’s citizens in the South East region, allowed several new generalizations which could be different from the considerations in some previous papers but seem reasonable in the current situation of Vietnam.

This paper had also analyzed the effects of the appropriate factors that selected from many previous studies, the money laundering regulations in Vietnam as well as the application form of many Vietnamese credit institutes to money laundering risk. The general model was run for 290 Vietnamese banking customers and collected some of positive results from the seven important independent variables, including group of age, gender, academic level, the group of salary, purpose of using account, source of funds and their method of transactions with the numerous model application of forward selection, backward elimination, stepwise, liner and logistic regression.

The higher respondent’s group of age would lead to the higher money laundering risk occurred in the financial market; when the customers became older, they would have more experience and knowledge about the financial and banking market to implement some of criminal activities, especially money laundering risk. Based on the statistics of World Bank, in 2015, Vietnam was one of the countries that had a the rapidest growth rate by 14% in the changing of labor force that was becoming older and older; as well as from the prediction of United Nations, in some next years, Vietnam would approach the 18% probability of old citizens in the total population structure that caused many influences on the development of risk controlling mechanism in the Vietnamese society and economy in general and on financial banking market in specific<sup>29</sup>. The negative relationship between money laundering risk and the respondent’s group of salary as well as the academic level indicated that the lower amount of money the respondents earn and lower academic level they were, the higher degree money laundering risk was that has been

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<sup>29</sup> Vietnamese Ministry of labour – invalids and social affairs (2016). Việt Nam đang có tốc độ già hóa dân số rất nhanh.

mentioned and evidenced in some previous papers of the Wolfsberg, 2006 group, Sathan and Mahendhiran, 2007, Muhammad, 2014 and Filippo and Maria, 2017.

This result would make sense with the Vietnam situation. As a matter of fact, Vietnam is still a developing country, especially the banking system and regulations have not been completed and assured, as well as the conditions of education and social life are still remarkably low. Therefore, the money laundering risk in this country is still high with the more and more complicated tendency that is declared with the statistics of 71,4% Medium and even 20,7% High risk level for 203 Vietnamese observations in this paper<sup>30</sup>. Besides, the variables of gender, source of funds and purpose of using accounts may also influence on money laundering risk.

On the other hand, following the result of this thesis, compared to the probability of women, men had a higher tendency of implementing the money laundering activities. The more total accounts in the banking system the respondents had, the higher money laundering risk level they were, if the customers have lots of accounts in many different commercial banks and get acquainted with using the banking services and products, it was easier for them to execute the money laundering activities through their wide network in making transactions and payments. Besides, the source of funds and purpose of using account simultaneously had a positive effect on the money laundering risk; the difference among these factors is for the high risk customer was evaluated by the source of funds mainly from the financial profits with the purpose of doing business and investment activities. In contrast, the low and medium risk level was belong to the group of customers that basically depended on saving and receiving salary purpose with the source of funds from personal income and savings.

Following the general evaluation above about the determinants of money laundering risk of Vietnamese customers combined the current situation of Vietnam, it probably considered that the degree of latent money laundering risk is still high and not completely control in the financial market. Therefore, the Vietnamese financial institutions, especially commercial banking system that would seriously generate some practical monitoring policies and solutions, as well as carefully implement almost all of control standards following the regulations and articles of the Government, State Bank of Vietnam and FATF organization to prevent the money laundering risk from each group of individual customer.<sup>31</sup>

With the high risk level group of customers, the policy of accepting and recognizing customer would be closely checked when opening the accounts regarding to the amount of funds that customers use for banking products and services and the original source of this funds with all relevant legitimate evidences collected; depending on each group of customer' salary and academic level would lead to the ability for executing the money laundering activities. The customers of this groups must be constantly monitored in all the transactions, especially in international payments; and definitely if any suspicious transactions with large amount of money explored, the alter needs to be reported and the customer due diligence process would be implemented for all previous information of customers. Besides, for the group of medium and low risk customers, only the knowing customer process is simply applied, the necessary information from customer is collected one time when opening account with the source of funds and purpose of using this account as well as the transactions and payments of these customers would be checked and reviewed annually. If the suspicious abruptly appeared and any information about their occupation, salary group, source of funds and etc., the risk level would be estimated again following their current position and the appropriate risk managing procedure is also selected and applied<sup>32</sup>.

Furthermore, the Vietnamese commercial banks and financial institutions should also extend more training project for the employees in the relevant department to update and catch up with the latest tendency of anti-money laundering standards of the international organizations and the national government before the changing of the complicated money laundering behaviors of the criminals, especially frequently strengthen and maintain the ability of the anti-money laundering risk in the mainly internal audit and control department to assure the customer due diligence process is seriously and carefully implemented in order to prevent the money laundering risk for the financial market in specific and in Vietnam in general with the best way.

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<sup>30</sup> Source from the collective statistics of this paper

<sup>31</sup> Huyen, T.T and Mai, N.T (2015). Quản lý rủi ro về phòng chống rửa tiền.

<sup>32</sup> Basel Committee on Banking Supervision (2014). Sound management of risks related to money laundering and financing of terrorism.

- *Limitations and further directions*

Besides the new contribution this thesis to the research of measuring the money laundering risk, there are still some limitations to the paper. In the survey, the respondents provided their personal information based on the estimation from their experience and interaction with the banking sector, their quarter net come, the percentage of using money as well as the total transactions implemented quarterly in both cash and wire and etc. that leads to the survey process is not completed in time and the invalid variable data is sometimes appeared. However, based on the author's best knowledge, there have not been any better ways to collect these factors yet. Moreover, because of the novelty of the measurement money laundering risk for customer in over the world in general and in Vietnam in specific, there are not many comparison and general identifications about this issues to support for this paper.

This paper with the aims to probably establish the more useful model of calculating the money laundering risk for each customer including national citizens as well as the foreigners, especially for more effected risk factors from the foreigners. Moreover, this model could be applied to other different types of financial institutions instead of Vietnamese commercial banks. The situation of Vietnam's economy is still potential, especially in financial market and the money laundering risk is now occurring in the larger frequency with lots of differently complicated approach. Therefore, this paper expects to become one of the usable references for the higher development of measuring the money laundering risk in order to make the research business of money laundering risk become more varied and relevant as well as support for the policy and procedure generation of in monitoring the money laundering risk of many Vietnamese commercial banks as well as financial institutions.



## LIST OF REFERENCES

- Ajmal Raza (2008). Prevalence of money laundering and its compliance in “Commercial banks of Lahore, Pakistan”. *Journal of Economics and Development*, Vol. 17, No.2, August 2015.
- Amedeo Argentiero, Michele Bagella and Francesco Busato (2008). Money laundering in a two-sector model: using theory for measurement. *Eur J Law Econ*, Vol. 26, 341-359.
- Angela Samantha Maitland Irwin, Kim-Kwang Raymond Choo and Lin Liu (2012). Modelling of money laundering and terrorism financing typologies. *Journal of Money Laundering Control*, Vol. 15, No. 3, 316-335.
- Anti-Money Laundering Compliance Unit Department of Justice and Equality. What is money laundering? Retrieved 19 May, 2017, from <http://www.antimoneylaundering.gov.ie/website/aml/amlcuweb.nsf/page/definitions-en>
- APG. Annual Report 2011-2012, 2015-2016. Retrieved 20 May, 2017, from
- Arnoldo R. Camacho (2013). Modelling the Risk profiles of Clients in the fight against Money laundering and Terrorist Financing. *International Journal of Business and Economics*, Vol. 12, No. 2, 97-120.
- Bajrang, Pavitra, Ritika, Piyush, Puneet and Neha Parashar (2008). Factors affecting money laundering: A Lesson for developing countries. *Symbiosis Centre for Management and HRD*, Vol. 3, No.2.
- Basel Committee on Banking Supervision (2014). Sound management of risks related to money laundering and financing of terrorism. Retrieved 15 Jun, 2017 from <http://www.bis.org/publ/bcbs275.htm>
- Biagioli, A. (2008). Finance crime as a threat to the wealth of nations: a cost-effectiveness approach. *Journal of Money Laundering Control*, Vol. 11, No.1, 88.
- Brent L. Bartlett (2012). The Negative Effects of Money Laundering On Economic Development. The Asian Development Bank Regional Technical Assistance Project, No.5967.
- Business Analytics (2016). How to use multinomial and ordinal logistic regression in R. Retrieved 2 Jun, 2017, from <https://www.analyticsvidhya.com/blog/2016/02/multinomial-ordinal-logistic-regression>
- CDC Investment work. Responsible investing – Business Integrity, Anti-money laundering. Retrieved 18 May, 2017 from <http://www.cdcgroup.com/How-we-do-it/Responsible-Investing/Business-integrity/AML/>
- Chat LE NGUYEN (2013). The growing threat of money laundering to Vietnam – The necessary of intensive countermeasures. *Journal of Money Laundering Control*, Vol. 16, No. 4, 321-332.
- Chat LE NGUYEN (2014). The international anti-money laundering regime and its adoption by Vietnam. *Asian Journal of International Law*, Vol. 4, 197-225.
- Christopher Price (2008). Customer Risk Assessment. Metavante Project – Risk and Compliance Solutions. Retrieved 10 May, 2017 from
- Department of the Treasury W.D.C (2015). National money laundering risk assessment. Executive summary, Threats, 2-3.
- Drug Enforcement Administration. High Intensity Drug Trafficking Areas (HIDTAs). Retrieved 31 May, 2017, from <https://www.dea.gov/ops/hidta.shtml>
- Elias Gotz and Michael Jossion (2009). Political factors affecting AML/CFT efforts in post-communist Eurasia – The case of Georgia. *Journal of Money Laundering Control*, Vol. 12, No. 1, 59-73.
- Fassil Fanta and Hasan M Mohsin (2011). Anti-money laundering regulation and crime: a two-period model of money-in-the-Utility-Function. *Journal of Economic Cooperation and Development*, 32, 3, 1-20.
- Filippo Reganati and Maria Oliva (2017). The determinant of money laundering: Evidence from Italian Regions. VGTU Press, contemporary issues in Business, Management and Education.
- Financial Action Task Force (2016). Anti-money laundering and counter-terrorist -financing measures - United States. The FATF Plenary meeting.
- Financial Action Task Force Guidance (2012). Specific risk factors in laundering the proceeds of corruption, assistance to reporting institutions. Retrieved 25 May, 2017, from <http://www.fatf-gafi.org/publications/corruption/documents/specificriskfactorsinthelaundryingofproceedsofcorruption-assistancetoreportinginstitutions.html>

Financial Action Task Force Guidance (2013). National money laundering and terrorist financing risk assessment. Retrieved 25 May, 2017, from

<http://www.fatf-gafi.org/documents/documents/nationalmoneylaunderingandterroristfinancingriskassessment.html>

Financial Action Task Force Guidance (2013). Politically exposed persons (recommendations 12 and 22).

Financial Action Task Force Guidance (2016). Annual Report 2015 – 2016. Retrieved 20 May, 2017, from <http://www.fatf-gafi.org/publications/fatfgeneral/documents/annual-report-2015-2016>

Financial Action Task Force. About the Non-Cooperative Countries and Territories (NCCT) Initiative. Retrieved 31 May, 2017, from

Financial Action Task Force. FATF Members and Observers - The 37 Members of the FATF. Retrieved 31 May, 2017, from

Fleming, M.H. (2013). FSA's scale and impact of financial crime project (phase 1): critical analysis. Occasional Paper series 36, August 2013. Financial Service Authority. Retrieved 16 May, 2017 from <http://www.fsa.gov.uk/pubs/other/critical>

HSBC Vietnam (2016). Knowledge bite of money laundering risk from customer. HSBC Money Laundering Risk Procedures.

<http://www.molisa.gov.vn/vi/Pages/chitiettin>

<https://www.lexisnexis.de/whitepaper/uk-aml-whitepaper.pdf>

Huyen, T.T and Mai, N.T (2015). Ngăn chặn rửa tiền và tài trợ khủng bố. Retrieved 19 May, 2017, from <http://tapchitaichinh.vn/viet-nam-chong-rua-tien,-tai-tro-khung-bo/ngan-chan-rua-tien-va-tai-tro-khung-bo-61030.html>

Huyen, T.T and Mai, N.T (2015). Quản lý rủi ro về phòng chống rửa tiền. Retrieved 20 May, 2017, from <http://tapchitaichinh.vn/viet-nam-chong-rua-tien,-tai-tro-khung-bo/quan-ly-rui-ro-ve-phong-chong-rua-tien-64441.html>

Idown, Abiola and Obasan, Kehinde A. (2012). Anti-money laundering policy and its effects on bank performance in Nigeria. Business Intelligence Journal, Vol. 5, No. 2.

Lexis Nexis UK (2012). Anti-money laundering - Bank's management of high money-laundering risk situations. Retrieved 22 June, 2017 from

Lixin Yan, Lishan Ai and Jun Tang (2011). Risk-based AML regulation on internet payment services in China. Journal of Money Laundering Control, Vol. 14, No.1, 93-101.

Loan THI NGUYEN (2016). Phòng chống rửa tiền qua hệ thống ngân hàng Việt Nam. Scientific journal of Open university of Ho Chi Minh, Vol. 4, No. 49.

Loan, T.H (2016). Phòng chống rửa tiền qua hệ thống Ngân hàng Việt Nam. Tạp chí khoa học Đại học Mở TP.HCM, 4 (49).

Man, L.T and Giang, N.T (2015). Phòng chống rửa tiền: Những vấn đề còn nan giải. Journal of Development and Contextualization, Vol.25, No. 35.

Mauro Salvo (2016). Money laundering as a threat to financial stability: a risk-based approach. SSRN Site Subscription Links. Retrieved 3 June, 2017 from [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2788735](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2788735)

Muhammad Usman Kemal (2014). Anti-money laundering regulations and its effectiveness. Journal of Money Laundering Control, Vol. 17, No. 4, 416-427.

Nardo, M. (2009). Building synergies between theory and practice countering financial crime on systemic approach. Journal of Financial Crime, Vol. 13, No. 3.

Ninh, L.P and Ha, V.T.T (2013). Những thách thức đối với lĩnh vực tài chính – ngân hàng khi tham gia TPP. Retrieved 19 May, 2017, from

<http://tapchitaichinh.vn/nghien-cuu-trao-doi/nghien-cuu-dieu-tra/nhung-thach-thuc-doi-voi-linh-vuc-tai-chinh-ngan-hang-khi-tham-gia-tpp-26748.html>

Normah Omar, Zulaikha Amirs and Roshayani Arshad (2014). Money laundering – FATF special recommendations VIII: a review of evaluation report. Procedia – Social and Behavioral Sciences, 145, 211-215.

Normah Omar, Zulaikha Amirs Johari, Roshayani Arshad (2014). Money laundering – FATF special recommendations VIII: a review of evaluation report. Procedia – Social and Behavioral Sciences, 145, 211-225.

Paul Allan Schott (2006). Reference Guide to Anti-Money Laundering and Combating the Financing of Terrorism. The World Bank.

PWC (2016). Global economic crime survey. Retrieved 21 May, 2017, from

<https://www.pwc.com/gx/en/services/advisory/forensics/economic-crime-survey.html>

Ricardo Azevedo Araujo (2008). Assessing the efficiency of the anti-money laundering regulation: an incentive-based approach. *Journal of Money Laundering Control*, Vol. 11, No. 1, 67-75.

SAS Institute (2015). AML Customer Risk Rating – Modernize customer risk rating models to meet risk governance regulatory expectations. Retrieved 10 Jun, 2017 from [https://www.sas.com/en\\_us/whitepapers/aml-customer-risk-rating-107824.html](https://www.sas.com/en_us/whitepapers/aml-customer-risk-rating-107824.html)

Scikit learn (2016). Model evaluation: quantifying the quality of predictions. Retrieved 2 Jun, 2017, from [http://scikit-learn.org/stable/modules/model\\_evaluation.html](http://scikit-learn.org/stable/modules/model_evaluation.html)

Svetlana Nikoloska, Ivica Simonovski (2012). Role of banks as entity in the system for prevention of money laundering in the Macedonia. *Procedia – Social and Behavioral Sciences*, 44, 453-459.

Svetlana Nikoloska, Ivica Simonovski (2012). Role of banks as entity in the system for prevention of money laundering in Macedonia. *Procedia – Social and Behavioral Sciences*, 44, 453-459.

The Wolfsberg group (2006). Wolfsberg statement, Guidance on a risk based approach for managing money laundering risks. *Wolfsberg Risk- Based Approach Guidance*.

United States Department of the treasury – Financial Crimes and Enforcement Network. HIFCA. Retrieved 31 May, 2017, from <https://www.fincen.gov/hifca>

Vandana Pramod, Jinghua Li and Ping Gao (2012). A framework for preventing money laundering in banks. *Journal of Information Management & Computer Security*, Vol. 20, No. 3, 170-183.

Vietnamese Ministry of labour – invalids and social affairs (2016). Việt Nam đang có tốc độ già hóa dân số rất nhanh. Retrieved 10 Jun, 2017, from <http://sldtbxh.baclieu.gov.vn/lctac/default.aspx?Source=/tintuc&Category=&ItemID=409&Mode=1>