The Velocity of Money and the Stock Market. A Comparative Forward and Backward Analysis

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Abstract

This study applied the panel autoregressive distributed lag (ARDL) model to examine the forward and backward relationships between the velocity of money and the traded stocks in samples of economies varies in term of the level of money supply relative to nominal GDP and the level of economic development during the period 2000-2019.

The empirical findings show differentiated mutual relationships and degrees of response between the velocity of money and the value of traded stocks for each level of money supply relative to GDP and each level of economic development. For developed economics, the value of traded stocks highly and positively responds to the velocity of money and the velocity of money encourages the value of traded stocks. The degree of the positive response of the value of traded stocks to the velocity of money is

relatively low in developing economies, and the value of traded stocks discourages the velocity of money in these economies. The response of the value of traded stocks to the velocity of money is negative in economies with high levels of money supply relative to their nominal GDP; the velocity of money negatively affects the value of traded stocks. As long as the level of the money supply is lying beneath the level of nominal GDP, the value of traded stocks responds positively and highly to the velocity of money. Finally, the effect of the velocity of money on the traded stocks is much stronger than the effect of traded stocks on the velocity of money.

Keywords: Stocks, velocity of money, money supply, economic development.

JEL: D53, E31, E44, E51, O12.

1. Introduction

The successful interactions between the real and monetary sectors are crucial for achieving sustainable economic growth. The ideal mutual relationship states that each sector should support the other one to ensure sustainable economic growth. On one hand, the transactions in the real sector support and encourage real investment, which, in turn, stimulates the monetary sector to finance the increasing investment spending. On the other hand, an active and efficient financial system supports the real sector with multiple ways

and instruments to finance the investment spending (Baumol and Blinder, 2003). However, the empirical experiments don't necessarily match with this ideal mutual relationship. Empirically, several causality relationships are expected, one-sided positive relationship, one-sided negative relationship, interdependence relationship, and no causal relationship (Mujeri and Mujeri, 2020). The velocity of money is one indicator regarding the performance and the stability of the real sector. High levels of risk or uncertainty about the real sector are usually associated with low rates of velocity of money, and as the real sector becomes more stable and trusted, the velocity of money starts to increase (Friedman, 1984). There is a causality relationship between the velocity of money and business cycles where the unbalanced velocity of money may cause inflation or recession (Alikhanov and Taylor 2015; LEÃO, 2005; Komijani and Nazarian, 2004); thus, a balanced velocity of money is considered a key tool to ensure the stability of the price level and rapid and sustained economic growth in any economy (Akinlo, 2012), where the velocity of money is considered the link that connects the money supply and the real economy (Yua, 2013). In other words, both the money supply and the velocity of money are responsible for the spending status in the economy and energizing the real sector (Gentle and Jones, 2015). This makes the velocity of money of potential impact on the stock market, which is in a mutual relationship with the performance of the real sector (Westerhoff, 2011).

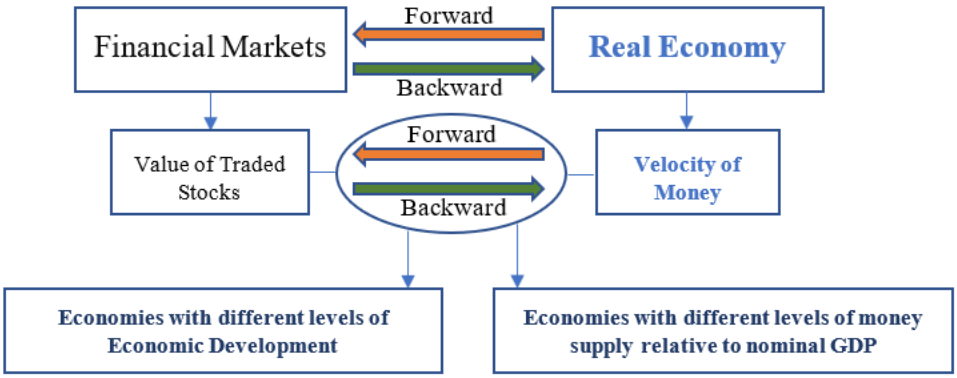
1.1. Study Problem

While both the money supply and the velocity of money are responsible for the spending status in the economy and energizing the real sector; however, the money supply is under the direct control of the monetary authority while the velocity of money is not. In other words, the monetary authorities are able to affect the velocity of money just through indirect channels. In this context, determining the different economic circumstances that may alter the mutual relationship between the velocity of money and the value of traded stocks enable for identifying these indirect channels.

1.2. Study Objectives and Layout

This study tries to examine the forward and backward relationships between the velocity of money, one of the tools that stimulate the real sector, and the value of traded stocks, one of the performance indicators on the financial system, under different levels of money supply and economic development. Figure (1) illustrates the study layout.

Figure (1): The Study Layout



1.3. Study Hypotheses

- The mutual relationships between the value of traded stocks and the velocity of money differ according to the level of money supply relative to the level of nominal GDP.
- The mutual relationships between the value of traded stocks and the velocity of money differ according to the level of economic development.
- The forward impact of the velocity of money to the value of the traded stocks is stronger than the backward impact of the relationship.

1.4. Study Methodology

This study applied the panel autoregressive distributed lag (ARDL) model, Akaike info criterion (AIC), on panel data in

their logarithm forms to determine the mutual elasticity and relationship between the velocity of money and the value of traded stocks.

1.5. The scope of the study

This study examines the mutual relationships between the value of traded stocks and the velocity of money in two categories of economies during the period 2000-2019. The first category includes two sample economies, and each sample includes 8 economies classified due to the level of money supply relative to nominal GDP. The second category includes two sample economies, and each sample includes 9 economies classified due to the level of economic development.

1.6. Sources of Data

Data are collected from the World Development Indicators of the World Bank.

1.7. Research Plan

Section (1): Introduction.

Section (2): Literature Review.

Section (3): The Development of Velocity of Money and Value of Traded Stocks in the Sample Countries.

Section (4): Econometric Analysis and Empirical Findings.

Section (5): Concluding Remarks and Recommendations.

2. Literature Review

There are multiple number of literatures that empirically examined the determinants and factors that affect the velocity of money.

The study of Mohamed (2020) isolated the effect of institutional factors and applied cointegration and error correction methods to examine the relationship between the velocity of money and a number of economic variables in Sudan during the period 1969-2016. The study argued that economic growth, trade openness, and government deficit stimulate the velocity of money, while inflation and investment spending discourage the velocity of money. The study of Sharma and Syarifuddin (2019) applied ARDL model on monthly data for the period 2000-2017 to identify the determinants of the velocity of money in Indonesia in the long and short run. The study debated that tax proceeds, industrial output, and short-term interest rates affect the velocity of money in the long run while demand for money affects the velocity of money in the short run. The study of Nunes et al. (2018) applied cointegration autoregression test on time series data for the period 1891-1998 to determine the behavior of the velocity of money and examine the effect of macroeconomic variables and institutional factors on the velocity of money in the Portuguese economy. The study found that institutional factors have significant long-run effects on the velocity of money, and macroeconomic variables such as levels of income, interest rates, and inflation rates scientifically affect the velocity of money as

well. Moreover, the effect of institutional factors on the velocity of money follows a U shape trend with a late turning point. The study of Aruna (2016) applied ARDL model to examine the effect of financial development, represented by the financial development index, on the velocity of money in Sierra Leone through the period 1970-2013. The study argued that the financial development in Sierra Leone did not affect the velocity of money, indicating that poor financial development efforts have been in place through the considered period. The study of Nampewo and Opolot (2016) applied ARDL model to examine the effect of financial innovations on the velocity of money in Uganda during the period 2000-2013. The study illustrated financial development has had a negative impact on the velocity of money in the short run and turned into a positive impact in the long run. The study of Ng'imor (2015) utilized the ARDL and the stepwise regression analysis to determine factors that affect the velocity of money in Kenya through the period 1998-2012. The study determined real GDP with a positive effect on the velocity of money while the real exchange rate and the growth of the financial sector negatively affect the velocity of money. The study of Okafor (2013) utilized the Vector Autoregressive model to identify main determinants of income velocity of money in Nigeria during the period 1985-2012 and argued that the growth of income and interest rate positively affect the velocity of money while there is a negative relationship between stock

market capitalization and the velocity of money. The study of Akinlo (2012) used multivariate co-integration and error correction modeling approach to examine the effect of financial development on the velocity of money in Nigeria through the period 1986-2010 and argued that exchange rate devaluation negatively affects the velocity of money; in contrary, per capita income stimulates the velocity of money. In addition, the relationship between financial development and the velocity of broad money is a long-run relationship. The study of Sudo (2011) investigated the factors that stand behind the decline in the velocity of money during the period 1990-2010 in Japan and argued that the discount factor and liquidity requirement determined by the households are the main influencers to the velocity of money. The study of Rami (2010) applied the ARDL model to examine the determinants of the velocity of money in India through the period 1972-2004. The study determined institutional factors such as the population of the banking system and the level of monetization as main influencers of the velocity of money. The study of Zhao and Wang (2006) applied ordinary regression analysis to examine the sectoral effect on the velocity of money through the period 1979-2003. The study argued that the relative weights of different productive sectors affect the velocity of money and that the decrease in the velocity of money in China is attributed to the decreases in the relative weight of the agriculture sector.

Despite there are several pieces of literature that cover the factors affecting the velocity of money; however, I found just one literature that covers the backward effect of the velocity of money on different variables in the economy. The study of Warburton (2013) applied the Newey–West estimator and logit estimator to determine factors managed to stimulate the economy during the period 1957-2011. The study argued that the velocity of money is one crucial factor to encourage economic growth during recession periods when financial and real markets fail in doing so.

What is new with this study?

This study tries to examine the forward and backward relationships between the value of traded stocks and the velocity of money and, unlike the majority of literature that focused on one country only, the scope of this study expands to include several economies and the analysis of panel data, not just time-series data of a certain economy. Moreover, the relationships between the velocity of money and the value of traded stocks will be examined with different levels of money supply and economic development.

3. The Development of Velocity of Money and Value of Traded Stocks in the Sample Countries

3.1. Countries with Different Levels of Money Supply Relative to Nominal GDP

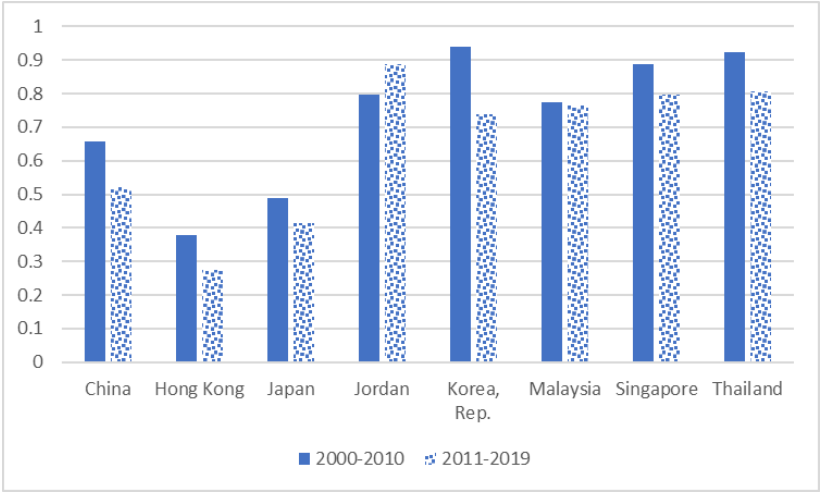
This category is classified into two country samples. The first sample includes countries with levels of money supply exceed

their nominal GDP (high liquidly sample), while the second sample includes countries with money supply equals to 70% or less of their nominal GDP (low liquidity sample).

3.1.1. High Liquidity Countries Sample

This sample contains 8 countries, namely China, Hong Kong, Japan, Jordon, Korea, Malaysia, Singapore, and Thailand. The development of the velocity of money of these countries through the two sub-periods 2000-2010 and 2011-2019 is represented by figure (2).

Figure (2): Development of the Velocity of Money in the High Liquidity Countries Sample



Source: Author's calculations based on World Bank, World Development Indicators Data Base.

Figure (2) illustrates the development of the average velocity of money of the high liquid countries. The velocity of money of all

countries in the sample did not exceed or even reach number one. Besides, the second sub-period witnessed relative retreatment in the velocity of money for all countries in the sample except Jordan.

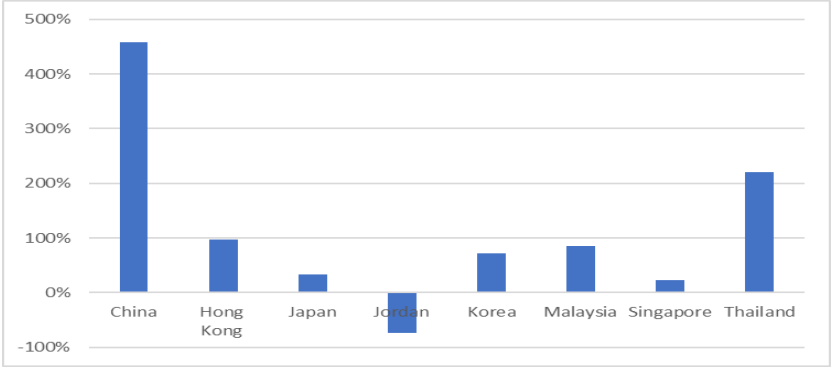
The development of the value of traded stocks in the high liquidity countries sample is represented by table (1) and figure (3). The value of traded stocks has been rapidly grown for all the countries in the sample except Jordan.

Table (1): The Development of the Average Value of Traded Stocks in High Liquidity Countries Sample (Billion US$)

Period	China	Hong Kong	Japan	Jordan	Korea	Malaysia	Singapore	Thailand
2000-2010	2755	830	3861	11	1036	68	176	97
2011-2019	15357	1633	5174	3	1775	126	217	312

Source: World Bank, World Development Indicators Data Base.

Figure (3): Growth Rates of the Value of Traded Stocks in the High Liquidity Countries Sample

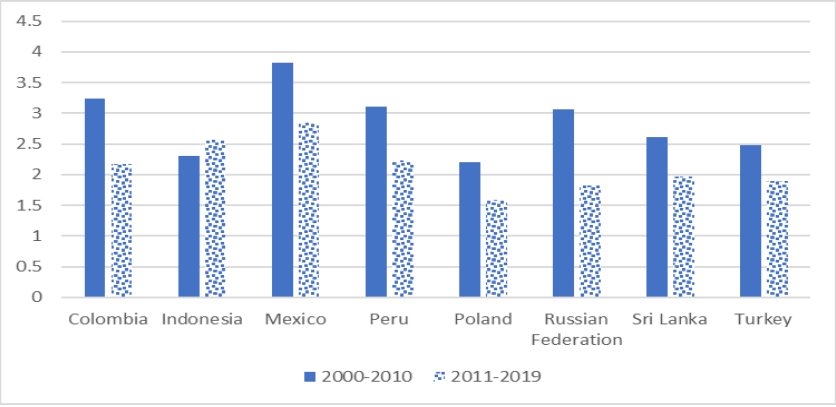


Source: Author's calculations based on World Bank, World Development Indicators Data Base.

3.1.2. Low Liquidity Countries Sample

This sample contains 8 countries, namely Colombia, Indonesia, Mexico, Peru, Poland, Russian Federation, Sri Lanka, and Turkey. The development of the velocity of money of these countries through the two sub-periods 2000-2010 and 2011-2019 is represented by figure (4).

Figure (4): Development of the Velocity of Money in the Low Liquidity Countries Sample



Source: Author's calculations based on World Bank, World Development Indicators Data Base.

Figure (4) illustrates the development of the average velocity of money of the low liquid countries. The velocity of money of all countries in the sample is very high: however, the second sub-period witnessed relative retreatment in the velocity of money for all countries in the sample except Indonesia.

The development of the value of traded stocks in the low liquidity countries sample is represented by table (2) and figure

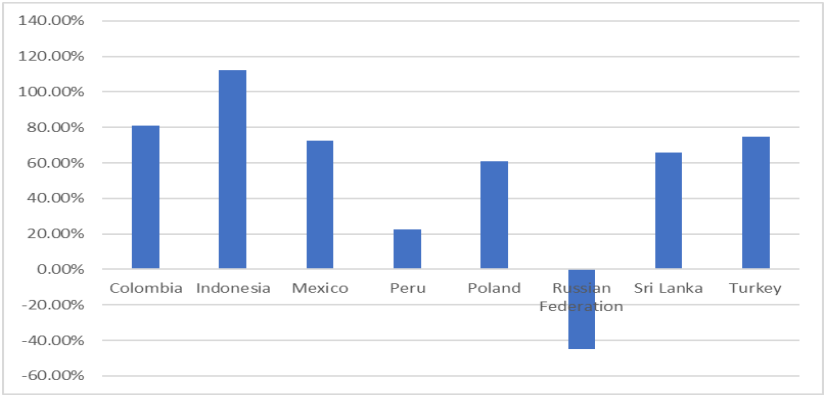
(5). The value of traded stocks has been significantly grown for all the countries in the sample except Russian Federation.

Table (2): The Development of the Average Value of Traded Stocks in Low Liquidity Countries Sample (Billion US$)

Period	Colombia	Indonesia	Mexico	Peru	Poland	Russian Federation	Sri Lanka	Turkey
2000-2010	9.9	45.4	65.3	2.8	37	407	1.1	203
2011-2019	17.9	96.4	112.7	3.4	59.5	224.5	1.8	354.5

Source: World Bank, World Development Indicators Data Base.

Figure (5): Growth Rates of the Value of Traded Stocks in the Low Liquidity Countries Sample



Source: Author's calculations based on World Bank, World Development Indicators Data Base.

3.2. Countries with Different Levels of Economic Development

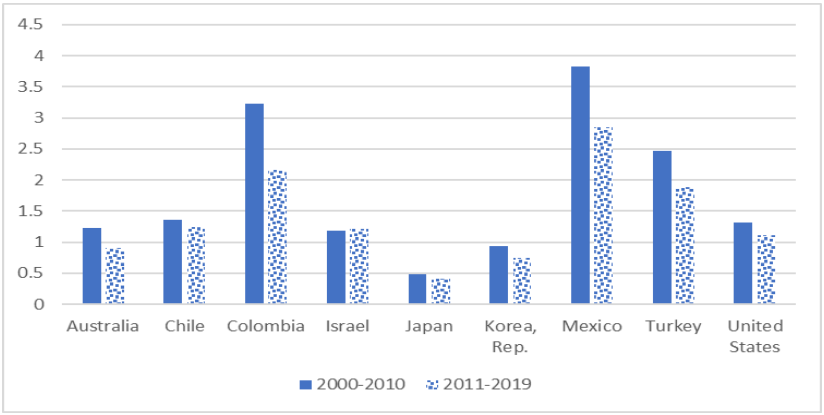
This category is classified into two country samples. The first sample includes countries with advanced levels of economic development (OECD countries sample), while the second sample

includes countries with relatively modest levels of economic development (developing countries sample).

3.2.1. The Developed Countries Sample

This sample contains 9 of the OECD member countries, namely Australia, Chile, Colombia, Israel, Japan, Korea, Mexico, Turkey, and the United States. The development of the velocity of money of these countries through the two sub-periods 2000-2010 and 2011-2019 is represented by figure (6).

Figure (6): Development of the Velocity of Money in the Developed Countries Sample



Source: Author's calculations based on World Bank, World Development Indicators Data Base.

Figure (6) illustrates the development of the average velocity of money of the developed countries. The velocity of money significantly varies between the sample countries and ranging from

0.5 to 3.7. In addition, the velocity of money tended to diminish in the second sub-period for all countries in the sample except Israel.

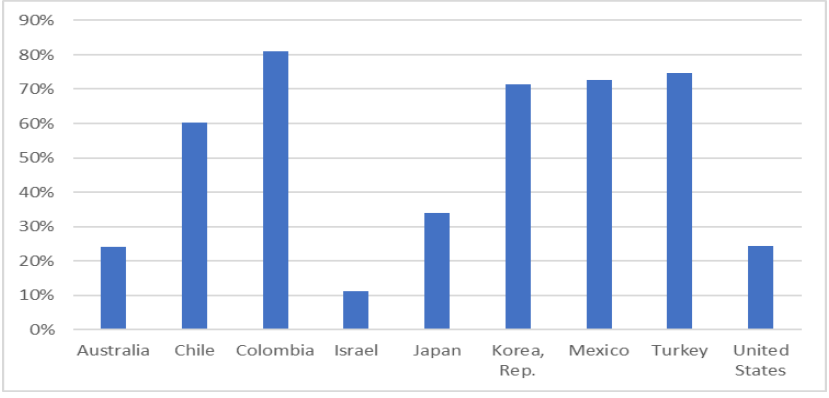
The development of the value of traded stocks in the developed countries sample is represented by table (3) and figure (7). The value of traded stocks has been significantly grown for all the countries in the sample.

Table (3): The Development of the Average Value of Traded Stocks in the Developed Countries Sample (Billion US$)

Period	Australia	Chile	Colombia	Israel	Japan	Korea,	Mexico	Turkey	United States
2000-2010	670	23	10	54	3861	1036	65	203	29061
2011-2019	832	36	18	60	5174	1775	113	354	36122

Source: World Bank, World Development Indicators Data Base.

Figure (7): Growth Rates of the Value of Traded Stocks in the Developed Countries Sample

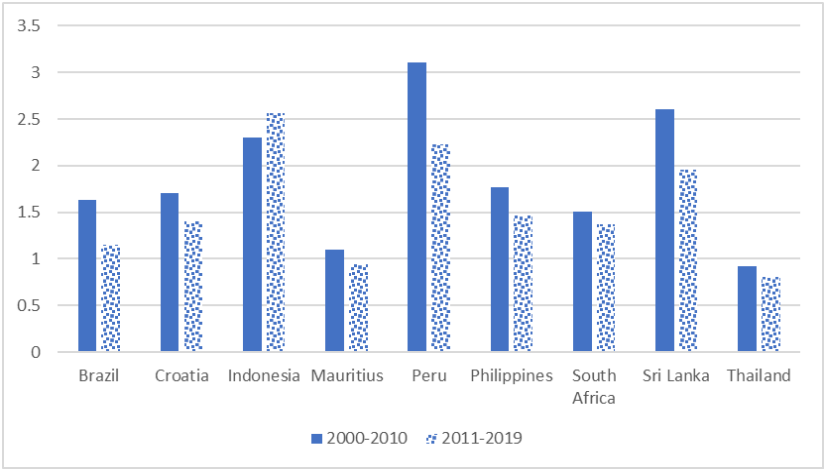


Source: Author's calculations based on World Bank, World Development Indicators Data Base.

3.2.2. The Developing Countries Sample

This sample contains 9 countries, namely Brazil, Croatia, Indonesia, Mauritius, Peru, Philippines, South Africa, Sri Lanka, and Thailand. The development of the velocity of money of these countries through the two sub-periods 2000-2010 and 2011-2019 is represented by figure (8).

Figure (8): Development of the Velocity of Money in the Developing Countries Sample



Source: Author's calculations based on World Bank, World Development Indicators Data Base.

Figure (8) illustrates the development of the average velocity of money of the developing countries. The velocity of money of the sample countries varies in the range 0.7 and 3.1 and the second sub-period witnessed relative retreatment in the velocity of money for all countries in the sample except Indonesia.

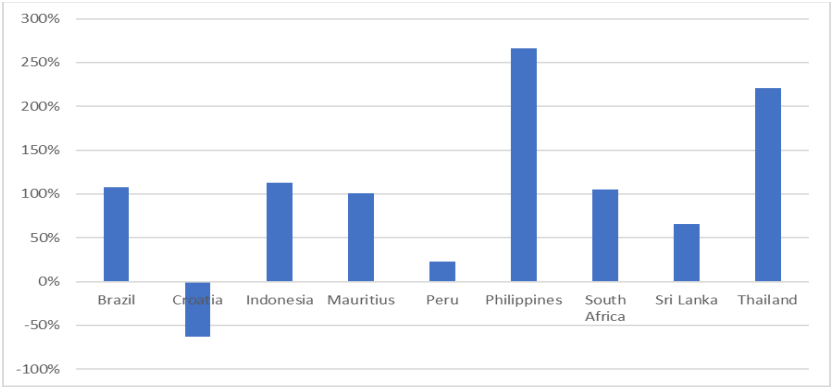
The development of the value of traded stocks in the developing countries sample is represented by table (4) and figure (9). The value of traded stocks has been significantly grown for all the countries in the sample except Croatia.

Table (4): The Development of the Average Value of Traded Stocks in the Developing Countries Sample (Billion US$)

Period	Brazil	Croatia	Indonesia	Mauritius	Peru	Philippines	South Africa	Sri Lanka	Thailand
2000-2010	333.1	1.3	45.4	0.2	2.8	9.6	138.8	1.1	97.1
2011-2019	690.3	0.5	96.4	0.4	3.4	35.2	284.1	1.8	311.6

Source: World Bank, World Development Indicators Data Base.

Figure (9): Growth Rates of the Value of Traded Stocks in the Developing Countries Sample



Source: Author's calculations based on World Bank, World Development Indicators Data Base.

4. Econometric Analysis and Empirical Findings

This section examines the mutual relationship between the value of traded stocks and the velocity of money in the previously mentioned two categories of economies by applying the panel autoregressive distributed lag (ARDL) model, Akaike info criterion (AIC).

4.1. Specifying the Model

The generalized autoregressive distributed lag (ARDL) model has been built based on the following function:

$$y_{nt} = f(y_{n,t-k}, x_{nt}, x_{n,t-v})$$

Where *y* and x are the total value of traded stocks and the velocity of money, reciprocally, *k* represents the lags of the dependent variables, *v* represents the lags of the independent variables or the regressors.

The generalized model is represented as follows:

$$lny_{nt} = \sum_{k=1}^{K} \Theta_n lny_{n,t-k} + \sum_{v=0}^{V} \beta_{n,t-v}\, lnx_{n,t-v} + \varphi_n + \varepsilon_{nt}$$

Where Θ represents the coefficients of the lagged dependent variables, β represents the coefficients of the independent variables, φ represents the unit-specific fixed effect, and ε represents the error term.

The error correction model or the re-parameterized ARDL model is represented as follows:

$$\Delta lny_{nt} = \underbrace{\theta_n(lny_{n,t-1} - \psi_n lnx_{nt})}_{\text{Error Correction Term}} + \sum_{k=1}^{K-1} \xi_{nt} \Delta lny_{n,t-k} + \sum_{v=0}^{V-1} \beta'_{nt}\, ln\Delta x_{n,t-v} + \varphi_n - \varepsilon_{nt}$$

Where θ is the coefficient of the error correction term and it indicates the speed of correcting the short-term deviations, ψ represents the long-run relationships vector, ξ and $\beta'$are the short-term dynamic coefficients.

4.2. Stationarity Test

Augmented Dickey–Fuller and Phillips–Perron tests have been used to examine the stationarity of the model variables. The test revealed that all the model variables are stationary, whether at level or the first difference, see appendix (1).

4.3. The Empirical Findings Regarding the Level of Money Supply relative to GDP

The outcomes of the ARDL models indicate that the model is valid where, the coefficients of the error correction terms are negative and statistically significant at a 1% significance. Then, causal long-run relationships are running from the regressors to the dependent variables, see appendices (2), (3), (4), and (5).

4.3.1. Countries with Levels of Money Supply higher than Nominal GDP

For countries with high levels of money supply relative to their nominal GDP, the velocity of money is found with a negative impact on the value of traded stocks, where the coefficient of the velocity of money is -3.22 and it is statistically significant at a 1% significance level. In other words, the response of the value of traded stocks to changes in the velocity of money is elastic and negative, see appendix (2). On the other hand, the response of the velocity of money to changes in the value of traded stocks is inelastic and negative, see appendix (3).

4.3.2. Countries with Levels of Money Supply less than Nominal GDP

For countries with low levels of money supply relative to their nominal GDP, the velocity of money positively affects the value of traded stocks, where the coefficient of the velocity of money is 7.2 and it is statistically significant at a 1% significance level. This indicates that the response of the value of traded stocks to changes in the velocity of money is elastic and positive, see appendix (4). On the other side, the response of the velocity of money to changes in the value of traded stocks is inelastic and negative, see appendix (5).

4.4. The Empirical Findings Regarding the Level of Economic Development

The outcomes of the ARDL models indicate that the model is valid where, the coefficients of the error correction terms are negative and statistically significant at a 1% significance level. Then, causal long-run relationships are running from the regressors to the dependent variables, see appendices (6), (7), (8), and (9).

4.4.1. Sample of OECD Countries

The velocity of money supports the stock market in countries with advanced levels of development where the response of the value of traded stocks is elastic and positive to the velocity of money. The coefficient of the value of traded stocks is 14.8 and it is statistically significant at a 1% significance level, see appendix (6). Moreover, the thriving stock trade increases the velocity of money; however, the response of the velocity of money to changes in the value of traded stocks is inelastic, see appendix (7).

4.4.2. Sample of Countries with Modest Levels of Development

For countries with relatively modest and low levels of development, the response of stock market to the velocity of money is positive, where the coefficient of the value of traded stocks is 6.65 and it is statistically significant at a 1% significance level, see appendix (8). In contrary, the effect of the value of traded stocks on the velocity of money is negative and the response of the velocity of money is inelastic, where the

coefficient of the velocity of money is -0.066 and it is statistically significant at a 1% significance level.

5. Concluding Remarks and Recommendations

The empirical findings of the study illustrate that the mutual effect of the value of traded stocks and the velocity of money depends on both the level of money supply relative to nominal GDP and the level of economic development.

As long as the level of money supply exceeds the level of nominal GDP the mutual relationship between the value of traded stocks and the velocity of money is negative, and as the level of money supply falls beneath the level of GDP the effect of the velocity of money on the value of traded stocks became positive; however, the velocity of money negatively affects the value of traded stocks. On the other side, the velocity of money and the value of traded stocks encourage and support each other in the developed countries. For developing countries, the value of traded stocks supports the velocity of money; however, the opposite is not true, where the value of traded stocks negatively affects the velocity of money.

The response or elasticity of the value of traded stocks increases with the improvement in the level of economic development; this may be attributed to the high marginal propensity to save in the developed countries relative to the developed ones.

Countries with high levels of money supply relative to their nominal GDP are experiencing a long-run negative impact running from the velocity of money to the value of traded stocks. This may be attributed to two main reasons; the accompanied high inflation rates increase the discount rates and decrease the prices of traded stocks. In addition, high inflation rates encourage the rates of consumption spending rather than the rates of investment spending.

In all cases, it can be said that the effect of the velocity of money on the traded stocks is much stronger than the effect of traded stocks on the velocity of money. The empirical findings of the study have been summarized in table (5).

Table (5): Summary of the Empirical Findings of the Study

The Level of Money Supply to Nominal GDP				
Classification	Dependent Variable	Independent Variable	Elasticity	Coefficient
High levels of money supply relative to GDP	The value of traded stocks	The velocity of money	Elastic	-3.22
	The velocity of money	The value of traded stocks	Inelastic	-0.08
Low Levels of Money Supply relative to GDP	The value of traded stocks	The velocity of money	Elastic	7.2
	The velocity of money	The value of traded stocks	Inelastic	-0.24
The Level of Economic Development				
Classification	Dependent Variable	Independent Variable	Elasticity	Coefficient

High Levels of Development (OECD)	The value of traded stocks	The velocity of money	Elastic	14.8
	The velocity of money	The value of traded stocks	Inelastic	0.04
Modest and low levels of Development	The value of traded stocks	The velocity of money	Elastic	6.6
	The velocity of money	The value of traded stocks	Inelastic	-0.06

The above findings confirm the validity of the three hypotheses of the study.

The empirical findings illustrate that developing countries can make benefit from the high elasticity of the traded stocks to changes in the velocity of money through increasing the efficiency of different markets. In this regard, government regulations have to be directed to reduce different market externalities that impede the efficient performance of markets. On the other side, governments have to stop financing their activities and procurements through open market operations, which increase the pool of money supply and induce inflation.

Appendices

Appendix (1)

Unit Root Test (Stationarity Test)

Sample of Countries with Rates of Money Supply Exceed 100% of Nominal GDP					
Variable	Stationarity Status	Augmented Dickey–Fuller		Phillips–Perron	
		Statistic	Probability	Statistic	Probability
The Value of Traded Stocks	Level	21.16	0.1724	19.1868	0.2591
	First Level	58.4964	0	91.8357	0
The Velocity of Money	Level	5.81997	0.9899	27.9487	0.0321
	First Level	67.7032	0	317.713	0
Sample of Countries with Rates of Money Supply 50% or Less of Nominal GDP					
Variable	Stationarity Status	Augmented Dickey–Fuller		Phillips–Perron	
		Statistic	Probability	Statistic	Probability
The Value of Traded Stocks	Level	31.7237	0.0109	16.0415	0.4501
	First Level	59.8352	0	74.3969	0
The Velocity of Money	Level	9.94564	0.8695	30.9384	0.0137
	First Level	39.5811	0	98.7088	0
Sample of OECD Countries					
Variable	Stationarity Status	Augmented Dickey–Fuller		Phillips–Perron	
		Statistic	Probability	Statistic	Probability
The Value of Traded Stocks	Level	34.5279	0.0108	19.6225	0.3545
	First Level	56.6902	0	88.7975	0
The Velocity of Money	Level	9.71447	0.9408	39.2185	0.0027
	First Level	63.3167	0	310.944	0
Sample of Countries with Different Levels of Development					
Variable	Stationarity Status	Augmented Dickey–Fuller		Phillips–Perron	
		Statistic	Probability	Statistic	Probability
The Value of Traded Stocks	Level	54.0591	0.0158	36.2653	0.3634
	First Level	118.286	0	163.090	0

The Velocity of Money	Level	20.1744	0.9710	63.8630	0.0014
	First Level	111.640	0	282.943	0

Appendix (2)

Dependent Variable: D(Y)
Method: ARDL
Sample: 2001 2019
Included observations: 152
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): X
Fixed regressors: C
Number of models evaluated: 1
Selected Model: ARDL(1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
X	-3.226366	0.787707	-4.095897	0.0001
Short Run Equation				
COINTEQ01	-0.264581	0.038813	-6.816770	0.0000
D(X)	0.095996	0.559677	0.171520	0.8641
C	6.721500	1.047395	6.417352	0.0000

Mean dependent var	0.081839	S.D. dependent var	0.408287
S.E. of regression	0.381371	Akaike info criterion	0.851455
Sum squared resid	19.63487	Schwarz criterion	1.331951
Log likelihood	-43.11637	Hannan-Quinn criter.	1.046567

Appendix (3)

Dependent Variable: D(Y)
Method: ARDL
Sample: 2001 2019
Included observations: 152
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): X
Fixed regressors: C
Number of models evaluated: 1
Selected Model: ARDL(1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
X	-0.082856	0.013550	-6.115016	0.0000
Short Run Equation				
COINTEQ01	-0.329017	0.076202	-4.317717	0.0000
D(X)	0.023969	0.017382	1.378944	0.1702
C	0.612295	0.161752	3.785385	0.0002
Mean dependent var	-0.014215	S.D. dependent var		0.064674
S.E. of regression	0.047882	Akaike info criterion		-2.953362
Sum squared resid	0.309516	Schwarz criterion		-2.472866
Log likelihood	261.2690	Hannan-Quinn criter.		-2.758250

Appendix (4)

Dependent Variable: D(Y)
Method: ARDL
Sample: 2001 2019
Included observations: 152
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): X
Fixed regressors: C
Number of models evaluated: 1
Selected Model: ARDL(1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
X	7.211908	0.970838	7.428539	0.0000
Short Run Equation				
COINTEQ01	-0.145866	0.062718	-2.325762	0.0215
D(X)	-0.182398	0.483646	-0.377132	0.7067
C	2.621025	1.153665	2.271912	0.0247

Mean dependent var	0.069661	S.D. dependent var	0.451766
S.E. of regression	0.424541	Akaike info criterion	1.105144
Sum squared resid	24.33169	Schwarz criterion	1.585640
Log likelihood	-63.41153	Hannan-Quinn criter.	1.300257

Appendix (5)

Dependent Variable: D(Y)
Method: ARDL
Sample: 2001 2019
Included observations: 152
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): X
Fixed regressors: C
Number of models evaluated: 1
Selected Model: ARDL(1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
X	-0.246512	0.032594	-7.563224	0.0000
Short Run Equation				
COINTEQ01	-0.157575	0.051473	-3.061288	0.0027
D(X)	0.050419	0.024587	2.050623	0.0422
C	1.066117	0.376128	2.834455	0.0053

Mean dependent var	-0.025250	S.D. dependent var	0.065855
S.E. of regression	0.054827	Akaike info criterion	-2.890318
Sum squared resid	0.405815	Schwarz criterion	-2.409822
Log likelihood	256.2254	Hannan-Quinn criter.	-2.695205

Appendix (6)

Dependent Variable: D(Y)
Method: ARDL
Sample: 2001 2019
Included observations: 171
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): X
Fixed regressors: C
Number of models evaluated: 1
Selected Model: ARDL(1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
X	14.84256	4.279949	3.467928	0.0007
Short Run Equation				
COINTEQ01	-0.035263	0.035849	-0.983640	0.3269
D(X)	0.397360	0.471509	0.842741	0.4007
C	0.859545	0.779751	1.102332	0.2721
Mean dependent var	0.057079	S.D. dependent var		0.324837
S.E. of regression	0.293471	Akaike info criterion		0.466928
Sum squared resid	13.09106	Schwarz criterion		0.963610
Log likelihood	-14.02351	Hannan-Quinn criter.		0.668311

Appendix (7)

Dependent Variable: D(Y)
Method: ARDL
Sample: 2001 2019
Included observations: 171
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): Y
Fixed regressors: C
Number of models evaluated: 1
Selected Model: ARDL(1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
X	0.047745	0.013459	3.547474	0.0005
Short Run Equation				
COINTEQ01	-0.252607	0.107428	-2.351411	0.0200
D(X)	0.031526	0.019463	1.619743	0.1074
C	-0.281360	0.111666	-2.519644	0.0128
Mean dependent var	-0.024223	S.D. dependent var		0.078159
S.E. of regression	0.053948	Akaike info criterion		-2.849178
Sum squared resid	0.442376	Schwarz criterion		-2.352496
Log likelihood	284.4260	Hannan-Quinn criter.		-2.647795

Appendix (8)

Dependent Variable: D(Y)
Method: ARDL
Sample: 2001 2019
Included observations: 171
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): X
Fixed regressors: C
Number of models evaluated: 1
Selected Model: ARDL(1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
X	6.655373	1.066504	6.240366	0.0000
Short Run Equation				
COINTEQ01	-0.124079	0.028690	-4.324872	0.0000
D(X)	-0.358143	0.373680	-0.958423	0.3387
C	2.662937	0.546077	4.876489	0.0000

Mean dependent var	0.076515	S.D. dependent var	0.437790
S.E. of regression	0.423394	Akaike info criterion	1.118870
Sum squared resid	51.62753	Schwarz criterion	1.704474
Log likelihood	-138.2079	Hannan-Quinn criter.	1.352208

Appendix (9)

Dependent Variable: D(Y)
Method: ARDL
Sample: 2001 2019
Included observations: 171
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): X
Fixed regressors: C
Number of models evaluated: 1
Selected Model: ARDL(1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
X	-0.066892	0.011703	-5.715986	0.0000
Short Run Equation				
COINTEQ01	-0.225836	0.035937	-6.284271	0.0000
D(X)	0.020062	0.007177	2.795459	0.0055
C	0.384216	0.056479	6.802786	0.0000

Mean dependent var	-0.018689	S.D. dependent var	0.058279
S.E. of regression	0.051545	Akaike info criterion	-2.901396
Sum squared resid	0.765174	Schwarz criterion	-2.315793
Log likelihood	545.2374	Hannan-Quinn criter.	-2.668058

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