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NARDL Model of Shadow Economy, Interest Rate Volatility, Economic Growth and Financial Inclusion: Comparative Study of Western Europe and Developing Asia

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ABSTRACT

Past literature concluded several times that Macroeconomic factors have both positive and negative impacts on Finical Inclusion. For a clear understanding of low levels of financial inclusion in developing countries, literature needs further investigations of financial inclusion relationships with the shadow economy, interest rate volatility, and economic growth. The objective of the current study is to investigate macroeconomic variables' impact on financial inclusion by using annual data from 1990 -2017 for Western Europe and developing Asia. Further, the study has also drawn a comparison between Western Europe and emerging Asia in the context of which one is more affected by interest rate volatility, shadow economy, and economic growth in terms of financial inclusion. This study has adopted the nonlinear cointegration technique NARDL, which shows nonlinearity in the model and depicts the asymmetric impact of underlying variables on financial inclusion. The study`s results show that all underlying variables significantly impact financial inclusion; the growth relationship is positive, and the shadow economy and interest rate volatility establish a negative connection. These nations must devise economic market reforms to develop a reliable governance system. Future research can be done using different proxies for the same variables, and a comparison of results can be drawn under other measurement criteria.

JEL Classification: E02, E26, E4, G2, G39, O11

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1. INTRODUCTION

Over the past few decades, economic policymakers are becoming increasingly concerned about macroeconomic stability. The main reason behind this is that macroeconomic stability provides a cushion for absorbing any shocks resulting from wide fluctuations in any economy. Financial inclusion becomes particularly essential for developing or emerging economies, which have been anticipated to be a key player in the development of economic growth globally (Hajilee, Stringer, & Metghalchi, 2017). The most fundamental to this macroeconomic stability is the financial sector as a stable and well-developed financial market leads to more significant investment opportunities, enhanced capital formation, allocation of resources effectively, and, in return, a higher degree of positive economic growth (Acemoglu, Johnson, & Robinson, 2005).

A considerable amount of literature has been produced on financial inclusion. Although there is no one widely accepted definition, the idea of access to financial tools is found common. Developing countries use financial inclusion as a supply-side strategy to cultivate their markets. Financial inclusion is made more operative by utilizing funds and properties previously neglected and restructured to operate as investments. There are many ways to fulfill this objective, including mobile phones as the primary source, availability of affordable financial services, more significant credit resources, and having saving tools that are safe and reliable (Hajilee, Stringer, & Metghalchi, 2017). Financial inclusion has been defined in several ways, but the easy availability of financial services for everyone in a state is widely accepted. Financial inclusion is mainly set as the availability of affordable financial services and greater accessibility to credit and saving instruments to the public. (Ahamed et al., 2021; Leon and Zins, 2020).

Several empirical studies that are done have focused on financial inclusion determinants in different economies (Van der Werff et al., 2013; Turégano and Herrero, 2018; Sethi and Acharya, 2018), but there is no empirical evidence that investigates the effect of interest rate volatility on financial inclusion and provides comparable results between developed and developing economies. Similarly, the Interest rate is a factor that significantly and directly impacts banking segment output and monetary movement. The research shows extensive literature on interest rate variation and its impact on various economic interdependent factors. For instance, the connection between interest rates and several critical financial actors, for example, stock prices or banks' stock earnings, has been significantly inspected by (Merton 1973, Long 1974, Stone 1974, Benink &Wolff 2000, Kasman et al. 2011, Alam & Uddin 2009, Joseph & Vezos 2006, Ballester et al. 2011, Jawaid & Ul Haq 2012 & Tripathi & Ghosh 2012). The scholars mentioned above emphasized the direct effect of interest rate instability on banks' stock yields.

A recent study by (Younas, Qureshi, & Al-Faryan 2022) has suggested that future research should analyze the shadow economy's impact on financial inclusion. The shadow economy, underground economy, or black economy are other names for the informal economy. All economic operations concealed from regulatory authorities due to financial rewards are considered part of the shadow economy (Medina and Schneider, 2019). Concerning previous literature on financial inclusion, many researchers have focused on examining the impact of financial inclusion and its part on the different economic states, specifically in nations having a big shadow economy (Mehrotra & Yetman 2015, Mbutor &Uba 2013, Aduda & Kalunda 2012 and Sahay et al. 2015). Further research has also investigated the relationship between the shadow economy and economic development (Berrittella 2015, Elgin and Schneider 2016, Markellos et al. 2016). Earlier research on financial inclusion tried to see the result of factors such as shady economy, human capital, and merchandise ingenuousness, plus additional vital factors that influence financial inclusion and fiscal expansion.

In developed countries, the financial system is a broader range in contrast to countries that are in the developing phase. Studies showed that 81% of grownups residing in advanced nations have access to personal bank

accounts in comparison to only 28% in countries that are in the developing phase. The results of studies and experiences show that 50 % of the world's young people do not have bank accounts (Zulfiqar et al., 2016). It is considered that the financial inclusion rate of developed and developing countries is not the same, and there is a big gap between them. To draw more broad economic implications related to financial inclusion country-wise, comparative analysis will be very fruitful, as suggested by Liu, D., Zhang, Y., Hafeez, M., & Ullah, S. (2022). Multiple studies Specifically emphasize drawing a comparison between developed and developing economies in terms of economic growth would expand future research on which economy affects financial inclusion more and whether there is any gap between developed and developing economies.)Mose, N., &Thomi, J. (2021) by Ozil, P. K. also (2021, October).

It is crucial to see which economy could be affected more due to interest rate volatility. Working more on these factors could reflect results of domestic presence, like the figure of grown-ups who use banking services for deposits and loans and its impact on financial stability (Morgan& Pontines, July 2014). Existing rational literature related to two critical variables of economy named financial inclusion and unregistered economic activities, also known as the shadow economy, devastatingly exhibits symmetric results. But due to some factors, the connection is considered asymmetric (Hajilee, Stringer, & Metghalchi, 2017). Therefore, the current study applied a procedure that does not consider symmetry but alternatively permits the statistics to present a clearer picture. After considering the vast amount of literature related to the current study, it is observed that various studies focused on financial inclusion, its factors, and the effect of interest rate variation on diverse fiscal variables. According to the previous research, no realistic investigation has been conducted linked to the comparative asymmetric influence of econometric variables on financial inclusion, particularly for developed and developing nations.

Theoretically, the economy's variation in supply and demand forces results in instability. This may occur due to a change in financial inclusion. As investors might perceive actual stable spending, an unexpected contribution of additional assets positively changes the financial system. It increases the level of savings, which makes some changes, such as the interest rate for lending. These fluctuations can be seen very easily. Long-run economic growth is contingent upon deposits and borrowings (Acemoglu, Johnson, & Robinson, 2010). A boost of financial inclusion will help on one side with the help of a stable growth rate through investment in productive capacity. A sustainable economic impact of financial inclusion will result in more hardly achievable goals. On the other hand, with the help of easily measurable conventional recourses, the long-run impact is indistinct by not early recognizing a disaggregated timeline. This research contributes to the literature by providing information to reduce this misconception. The help of nonlinear and asymmetric cointegration creates the opportunity for nonlinearity in the specification model, showing a clear picture of financial inclusion in the growing economy.

By drawing a comparison between developed and developing economies, this study will help developing economies understand the need for substantial financial inclusion. Developed economies are usually taken as a standard that globally affects economic dynamics. The center of attention to emerging economies is essential because they are the heart of the economy (Hanson, 2012). Economic growth, which can be defined as raising stock, investing in human capital, and advancing technology, is the dependent variable in this study. It refers to the rise in a population's standard of living (Hoinaru et al., 2020). Countries' economic growth is estimated as an increase in potential GDP (Boţa-Avram et al., 2018; Hoinaru et al., 2020). Economies with healthy financial inclusion must have the ability to grow as a percentage of GDP, increase the likelihood of trade among high and low-income states and possess a high amount of resources and operate globally too. People have the proper lifestyle in developed countries (World Bank, 2016). Advanced nations are currently working on building a solid financial system that positively affects financial inclusion and economic growth by increasing the availability of banking services and capturing a more significant part of resources.

Multiple studies ((Makina and Walle, 2019 Dahiya and Kumar 202,0 Singh and Stakic 202,1, Liu, D., Xie, Y., Hafeez, M., & Usman, A. (2022) results show that financial inclusions play a vital role in increasing economic growth, the but its reverse relationship is still unknown. Another view is that in less developed economies where the growth rate is low, people are not supported by their financial system due to a lack of financial resources and services. Therefore, the current study filled this gap and measured the impact of growth on financial inclusion.

Based on the literature support, this study further contributes to financial inclusion as one of the central determinants of economic development. The ambiguity would lead to incorrect results and any unknown event, and asymmetry impact brings an adverse change in the financial system, decreasing economic development and growth. Economic uncertainties, primarily interest rates, are one of them. The presence of an unregistered economy could have several irregular impacts on developed and emerging markets. Therefore, it is necessary to draw comparative results among advanced and developing economies to check which one is more affected.

The results of this study practically contribute as these countries should introduce financial market development, provide the right to use financial services and products, change the law accordingly in the country and benefit the country with better financial opportunities. Research considers that the accomplishment of these events of economic policymakers makes greater financial inclusion, financial solid market growth, and enormous economic growth in developing countries. Results propose that such countries work on law and order concerning their financial market inclusion and interest rate policies.

The current study aims to measure the impact of interest rate volatility, shadow economy, and economic growth on financial inclusion and comparisons of developing Asia economies (Pakistan, Bangladesh, Vietnam, Philippines) with developed economies (Austria, Belgium, France, Denmark). The rest of the article includes a literature review methodology and results in discussion as former countries have lower financial market inclusion and later have active financial inclusion. The results of the analysis are given in the Appendix. Conclusion with policy recommendation limitations and future directions are given at the end of the paper.

2. LITERATURE REVIEW

Financial inclusion is one of the most critical areas of financial literacy. On the other hand, a single definition of financial inclusion is not present. All sources refer to it as access to a financial tool. Developing economies' growth depends on the supply-side policy named financial inclusion. Unaccounted investment sources, which are part of the economy, are expertly gathered through financial inclusion. Smartphone banking, in other words, is an easy, convenient banking service in terms of affordability, more significant credit range, and reliable deposit tools are channels that support financial inclusion mechanisms (Malhotra& Yetman, 2015, World Bank, 2014). Financial inclusion is usually known as obtaining financial support from an official financial institution, but there are different types like government institutions and private. A comprehensive monetary system creates support for absent individuals. It incorporates them into the financial system by generating benefits for all individuals, producing an unbiased diffusion of development opportunities (Zulfiqar et al., 2016, Turégano and Herrero, 2018; Sethi and Acharya, 2018).

According to (Mhlanga, 2021), financial inclusion is also about ensuring that financial institutions and financial markets are sustainable and that there is enough competitive pressure to maintain various affordable products and services. Financial inclusion focuses on all players in economic markets. Irrespective of providing credit availability, it provides a platform to financially excluded people by providing financial assistance. According to Amrita 2020 tested model in 41 countries, information and communication technology also plays a crucial role in the development of financial inclusion.

Economic development cannot be measured comprehensively in an economy if a larger size of inhabitants is monetarily not enjoying the benefits of credit and other facilities. The goal of inclusive economic growth cannot be achieved without direct and continuous participation of the excluded and marginalized (Medina and Schneider, 2017). The research results indicate that financial inclusion in economic developments is contingent on firms' reach towards credit instead of a family unit (Chauvet & jacalin, 2017). Organization progress is positively interrelated with the company's access to mortgage and finance. It also depends on financial inclusion captured at the segment level (Chauvet & jacalin, 2017). A solid and adequate financial system depends on economic growth, which attracts foreign investors and helps economic development, leading to a range of financial services and increased financial inclusion. Changes in current policies can facilitate financial services (Cicchiello et al., 2021).

South Asian countries' statistics show a comparatively higher deposit rate of 32 percent, but this money is not part of the financial system because easy means of saving are approached. Overall, only 21 percent of grownups in Asia save in financial organizations, and 300 million Asian adults save money externally instead of contacting financial institutions, demonstrating the total world population (Zulfiqar et al., 2016). According to Abubakar et al. (2020), financial inclusion is one of the variables promoting growth in emerging nations. They claim that if financial inclusion increased more quickly than population growth, Nigeria's economic growth would be significantly accelerated. Ouechtati (2020) empirically studies the impact of financial inclusion on poverty and income inequality using a sample of 53 developing nations from 2004 to 2017. By expanding credit availability and access to deposit accounts at commercial banks, the author finds proof that financial inclusion helps to reduce poverty and income disparity. In 116 developing nations in the continents of Asia, Africa, Latin America, and the Caribbean, Omar and Inaba (2020) discover comparable findings.

The Shadow economy is a vital part of literature that suggests that the shadow economy's relationship with economic development provides more understanding of the determinants of the shadow economy. In several countries, the shadow economy has hindered the administrations in many states, specifically in the evolving republics where around 75% of the manufacturing is unregistered (matched to only approximately 10% in advanced nations). Providing commoners and businesses to fly beneath the radar, the shadow economy weakens traditional organizations and reduces the capability of management to bring together the proceeds required to offer commodities. Therefore, market participants prefer to be not part of the current economy (Koufopoulou, P., Williams, C. C., Vozikis, A., &Souliotis, K2019). Due to this, the impact of underground activities s a hot topic of research. There are no obvious advantages of an informal sector, so energy to increase financial inclusion would lead to positive consequences, such as decreased credit uncertainties and borrowing costs (Berdiev & Saunoris, 201 6, Huynh and Nguyen, 2020). However, the shadow economy could also positively impact, with positive social protection and creating different job opportunities, low usage, savings in the authorized market, etc. Possible constructive margins of the shadow economy are visible when management is dishonest, when public funds are not utilized wisely, and the people who are making and implementing policies are not making the right decisions. (Zaman & Goschina, 2015, (Koufopoulou et al., 2019).

In six Balkan nations between 2006 to 2017, Affandi and Malik (2020) looked at how the Shadow economy and financial institutions' outreach affected financial inclusion. The authors looked at how the Shadow economy and outreach of financial institutions affected financial inclusion and utilized the NARDL model, a nonlinear cointegration technique, to discover unequal impacts. The findings revealed that financial inclusion is significantly harmed by the Shadow economy, whereas financial institutions' outreach was very beneficial in the Caribbean.

Ishioro (2020) used an OLS and error correction technique, supplemented by cointegration and unit root tests, to investigate the short- and long-term effects of the Shadow economy and financial market inclusion on the economic growth of Nigeria. From 1990 to 2017, annual time series data were used to conduct the study. The OLS findings demonstrated that the Shadow economy facilitates financial market inclusion in Nigeria; nevertheless, in the near run, the development of the financial market can only be statistically explained by one historical lagged value of the Shadow economy.

Hajilee & Niroomand (2017) have investigated that with a more sophisticated financial inclusion structure, a state could take advantage of the more traditional economic and monetary system and decrease poverty and, in due course, higher long-run economic growth. While other studies concluded that the impact of financial inclusion on development increased when firms had more access to credit instead of households (Beck, Rioja, & Valev, 2012, Younas, Z. I., Qureshi, A., & Al-Farhan, M. A. S2022), different sized sectors faced ‘‘financing gap financial inclusion is a way to reduce this gap (GPFI, 2011). Financial inclusion lessens liquidity constraints and boosts investment. Sectorial level allocation of credit across firms significantly influences the industry's industrial arrangement, rivalry, or level of informality, especially in developing economies (Beck, Demirguc-Kunt, & Maksimovic, 2005). Long-run economic growth and minimization of deprivation of resources reduction of monetary and financial stability are widely discussed as economic outcomes of financial inclusion (Mehrotra & Yetman, 2015). The literature depicts that the degree of financial inclusion predicts the effects of fiscal expansion on economic development. Abdmoulah and Jelili (2013) show that the non-linear function among 26 economies and financial growth can be clarified by the availability to finance, which is tapped by the figure of branches. While other studies concluded that the impact of financial inclusion on growth increased when firms had more access to credit instead of households (Beck, Rioja, & Valev, 2012)

Interest rate variation/volatility is essential for concerned parties as economic development organizations and decision-makers. Existing literature and financial concepts mainly focused on the interest rate, international finance, and bond market dynamics and their further development. Standard deviation or variation in mortgage rates is the center of attention regarding different hedging techniques used to minimize the associated risk (Markellos &Psychoyios, 2018). The impact of interest rates on banks' stock yields has a topic of debate for banking institutions, governing establishments, educational groups, and stockholders. Subsequently, the bankruptcy of several banks has been exclusively responsible for the adverse effects of unstable interest rates (Kasman et al., 2011).

The economic growth of any state imitates its ability to recreate merchandise and amenities. The most obvious explanation of economic growth is the rise in that republic's Gross Domestic Product (GDP). Nominal GDP is accustomed to inflation figures to replicate real GDP. Interest rate is critical; increasing and decreasing instability is closely linked with inflation rates. The high and low trend also affects monetary growth (high GDP), which h linked with financial development. The corporate sector is susceptible to precisely forecast interest rate movements. Numerous preceding research save supposed that data set based on time series trend have static nature, and the fact of non-stationary has been ignored (Saymeh &Orabi, 2013, Ishioro, 2020).

According to previous studies, financial inclusion provides broader channels to financial services, while on the other hand, lack of access to financial services shows slow economic growth.in this case, individuals and small businesses utilize their informal savings and earnings. In those economies with greater GDP, their financial inclusion is also high because these countries have high financial literacy in banking services like saving and investment. Studies also show that countries with high corruption and unstable economic policies lack financial inclusion (Urueña& Perez, 2022).

In conclusion, plenty of literature on financial inclusion, shadow economy, and economic growth is available, but all studies assume symmetric association. Moreover, there is a motive to consider that the association is

expected to be asymmetric there, for current research will apply a technique that does not assume symmetry but, as an alternative, allows the data to disclose its more natural shape.

As the literature indicates that financial inclusion is one of the significant elements of the economic system, which helps the economy circulate money toward economic growth and development. Based on the preceding research grounds, the purpose of the study is to draw comparative research between developed and emerging economies to investigate the influence of interest variability on the shadow economy and economic growth on financial inclusion. Besides this, the current study investigated the long-term impact of the interest rate volatility, shadow economy, and economic development on financial inclusion for developed and developing states from 1990–2017.

3. METHODOLOGY

The study investigates the sensitivity of interest rate volatility towards financial inclusion among developed and developing Asian economies. Keeping this in view, the population consists of Western Europe and Asia. Western Europe consists of developed economies, and Asia is growing.

From the population of developed economies, Denmark, Austria, Belgium, and France are selected due to high financial market inclusion, as several studies show that developed economies have a high level of financial inclusion (Sarma & Pais, 2008). Demirgüç- Kunt, Klapper 2013 established that seven countries, namely India, China, Pakistan, Indonesia, Bangladesh, Vietnam, and the Philippines, comprise 92% of the 1.5 billion people in Developing Asia, are not registered with banks. Therefore, Pakistan, Bangladesh, Vietnam, and the Philippines are taken from developing Asia. Further, these economies have low financial market inclusion. (Sarma &Pais, 2008).

For analysis, the long-run relationship is assessed using Pesaran et al. (J Appl Econ, 2001) restricted technique to cointegration and nonlinear error-correction modeling and Shin et al. (2014) nonlinear cointegration estimation method (NARDAL). This technique develops nonlinearity into a model that enables the researcher to check the asymmetric impact of interest rate variability on financial inclusion.

Econometric model and estimation method

This study follows shin et al. (2014) to build the financial inclusion model. The long-run description of the financial inclusion model in this section is supported by the literature reviewed in the previous section as in Eq. (1) for each variable. Further County wise and variable-wise analysis is conducted

$$\boldsymbol{fi} = \boldsymbol{c} + \boldsymbol{Yt} + \boldsymbol{Ut} \quad \text{Eq (1)}$$

$$\boldsymbol{fi} = \boldsymbol{c} + \boldsymbol{SEt} + \boldsymbol{Ut}$$

$$\boldsymbol{fi} = \boldsymbol{c} + \boldsymbol{VR} + \boldsymbol{U}$$

Where FIt financial inclusion for each country I and j is defined as bank deposits to GDP, YT is GDP per capita; SEt is the Shadow Economy measured as labor force participation rate represented by the percentage of the economically active total population between the ages of 15 and 6itVRt is a measure of the variability of real interest rate (R). Based on existing literature, more outstanding economic transactions and development generate more favorable entrepreneurial opportunities. Therefore, the research considered growth coefficient (b) positive. Similarly, a shadow economy negatively affects the financial system and its development. Accordingly, this research assumes the coefficient (c) of the shadow economy is negative. The literature presents a classic relationship of interest rate in the long term, which impacts the decisions of entrepreneurs (Mishkin 1977, Mishkin 2007). Investors' perception is directly influenced by interest rate variation. The interest rate plays a chief role in financial market growth and inclusion. Therefore, the current study estimated

the coefficient of interest rate volatility measure (d) to be negative. The estimated coefficients of Eq. (1) illustrate the long-run effect.

$$\Delta FIt = C + \rho FIt - 1 + \theta^{+} Yt_{-1} + \theta^{-} Yt_{-1} + \sum_{i=1}^{P-1} \varphi \Delta FIt - i + \sum_{i=0}^{q} \pi i^{+} \Delta Y +_{t-i} + \sum_{i=0}^{q} \pi i^{-} \Delta Y -_{t-i} + \mu t \qquad Eq\ (2)$$

The long-run coefficients:

The long-run coefficient of VR+t is calculated by dividing the negative of the coefficient of VR+t,θ+ by the coefficient of financial inclusion t-1, ρ, and the long-run coefficient of VR- t by dividing the opposite of the coefficient of VR-t, θ- by the coefficient of Financial inclusion-1ρ (-θ+ / ρ) and (-θ- / ρ) are the long-run coefficients of VRt+ and VR-, respectively. The summation symbol Σ implies that NARDL considers including differenced variables into the model up to some lags. For example, in the case of ΔFIt-1, NARDL believes the inclusion of its first lagged term up to the maximum lag you choose, if appropriate. And in the case of ΔVR-t, it considers the inclusion of its zero lag (ΔVR-t itself) up to the maximum lag you choose, if appropriate.

Asymmetric Cointegration test: A long-run relationship or cointegration is present if the joint null hypothesis, ρ =θ+ = θ- =zero, is rejected. The critical value is the same crucial value for ARDL.

The Wald test F-statistics used in this procedure reflect the integration orders of the variables. At the same time, the upper-bound critical value is appropriate for variables with integrated order one or I (1) and order zero or I (0). Considering this factor, most macro variables are either I (1) or I (0). Meanwhile, the long-run effects are achievable by normalized θ1 − θ4 on θ0 (Bahmani-Oskooee and Fariditavana 2016). Shin et al. (2014) emphasized building the partial sum variables and including them in Eq. (2) and calling it a Nonlinear Autoregressive Distributed Lag model (NLARDL). Their 2014 estimation technique is based on the Pesaran et al. (2001) bounds testing approach.

Concerning Eq. (2), it is significant that the presence of a symmetric effect is one of the main hypotheses. The reason behind this is that there is always a chance of enormous fluctuations in the public and investors' prospects over time, particularly in terms of interest rate variation, economic environment unknown changes, and shadow economy effects. To calculate the possible asymmetric impact of econometric variables on financial inclusion NARDL technique divide the interest rate series into two parts 1) partial sum of positive change in rate denoted by VRt+ and 2) partial sum of a positive shift in interest rate indicated by VR- and include both as different repressors in the model, and the model becomes:

$$FIt = C + \beta 1\ VRtp + \beta 2\ VRtN + Ut \qquad \text{Eq (3)}$$

Testing Symmetry: If the long-run coefficients (-θ+ / ρ) and (-θ- / ρ) are not the same, then there is an asymmetry in the long run. So, test the null hypothesis of (-θ+ / ρ) = (-θ- / ρ). If the null is rejected, then there is a long-run asymmetry in the model.

4. RESULTS & DISCUSSION

In this research, the researcher has investigated the impact of interest rate volatility, shadow economy, and economic growth on the financial inclusion of Western Europe countries with high financial inclusion and developing Asia countries with low financial inclusion. For comparison purposes, Firstly results of Western Europe countries Denmark Austria Belgium, and France have been discussed. The discussion moves toward

developing Asia countries, including Pakistan, Bangladesh, and Vietnam Philippines. Firstly, descriptive statistics have been analyzed to examine the maximum, minimum, standard deviation, and mean values of the variables used in the current sample. Secondly, the unit root test has been applied to check the stationarity of the variables used in the study.

Table 1. Results of Unit Root Test of Financial Inclusion for Each Country.

Sr. No	Country	ADF at level 1(1) (Value)
1	Denmark	-2.72773
2	Austria	-3.536198
3	Belgium	-3.530368
4	France	-5.615517
5	Pakistan	-4.172396
6	Bangladesh	-3.903932
7	Vietnam	-2.858686
8	Philippine	-2.981388

As in this NARDL approach is used and for this purpose, data must be stationary at level 1(0), and 1st difference 1(1) NARDL does not include data series which are inactive at 2nd level. The model is applied through EViews. NARDL assumes data is nonlinear, generating two positive partial and negative partial sum series.

Table 2. Results of Unit Root Test of Economic Growth for Each Country.

Sr. No	Country	ADF at level 1(0) (Value)
1	Denmark	-4.129704
2	Austria	-4.537339
3	Belgium	-3.93869
4	France	-4.723555
5	Pakistan	-3.640799
6	Bangladesh	-4.927439
7	Vietnam	-2.841931
8	Philippine	-4.114168

A nonlinear Error correction model is applied to check the long-run relationship. Further cointegration test is applied. Wald test coefficient restriction. Specify the restriction c (2) =c (3) =c (4) =0. This Wald test performs the joint null hypothesis of the coefficient of financial inclusion (-1), which is the second coefficient in the list (hence the notation c (2)), and the coefficient of VR_p, which is c (3), and the coefficient of VR_n which is c (4). This joint null hypothesis acts as the null hypothesis of no cointegration. The value of Wald test F-statistics is compared with (Pesaran et al. 2001) critical upper bound limit to draw the results.

Table 3. Results of Unit Root Test of Shadow Economy for Each Country.

Sr. No	Country	ADF at level 1(0) (Value)
1	Denmark	-5.688351
2	Austria	-2.41891
3	Belgium	-5.922954
4	France	-5.415857
5	Pakistan	-2.317881
6	Bangladesh	-2.637009
7	Vietnam	-2.921962
8	Philippine	-1.977001

In the last step, hypotheses of asymmetry are measured. Both positive and negative change has a long-run positive effect on financial inclusion. An asymmetry test tests if the coefficient is equal or not. If they are similar, there is no asymmetry; if they are not, there is evidence of asymmetry.

Table 4. Results of Unit Root Test of Interest Rate Volatility for Each Country.

Z	Country	ADF at level 1(0) (Value)
1	Denmark	-12.71892
2	Austria	-5.946064
3	Belgium	-4.813748
4	France	-4.392813
5	Pakistan	-5.171426
6	Bangladesh	-5.490372
7	Vietnam	-4.423389
8	Philippine	-4.45592

After the calculation of the long-run coefficient for VR_p and VR_n by –c (3)/c (2) and –c (4)/c (2), respectively. If the null hypothesis of equality is rejected as the p-value is less than 0.05, then the Wald test indicates an asymmetry in the long run.

5. RESULT DISCUSSION

According to the results (see appendix table 5), coefficients of economic growth show a positive relationship in Denmark, Austria, Belgium, and France. As economic growth increases, it will increase financial inclusion as a positive coefficient has more impact than a negative at the same time, developing countries Pakistan, Bangladesh, Vietnam, and the Philippines also show a positive relationship with economic growth. This is also in line with literature as economic activity increase will lead to the development of economic institutions and people have more access to finances. (Denizer, Iyigun, & Owen, 2002, Hajilee et al. (2017,Kabakova, O.,

&Plaksenkov, E. 2018)). It means that if a country is growing and moving towards economic growth, people trust financial services.

Variable of the shadow economy (see Appendix 6) shows a negative relationship in all developed countries. The negative coefficient of the shadow economy also results in a more excellent value, which means the shadow economy negatively affects financial inclusion among all nations. Denmark has a relatively higher impact of shadow economy on financial inclusion, which shows weak law enforcement and poor performance of the economic institution as well. Similarly, the effect of the shadow economy negative coefficient is also more significant in Pakistan, Bangladesh, Vietnam, and the Philippines, which is also a sign of considerable decreases in financial inclusion. Rational investors avoided opportunity costs and used illegal ways to avoid tax payments. These results align with the literature (Straub, 2005; Dabla-Norris et al., 2008; Blackburn et al., 2012; Bose et al., 2012; Capasso and Jappelli, 2013, Hajilee et al., 2017, Ajide, F. M. 2021). According to literature that the economic structure is one category of an organization that impacts the comparative expenses and incentives of joining the unauthorized system, which, ultimately, influences the existence of the shadow economy (Straub 2005, DablaNorris et al. 2008, Blackburn et al. 2012, Bose et al., 2012, Capasso & Jappelli, 2013, Hajilee et al. 2017, Ajide, F. M. 2021).

Interest rate volatility also shows a negative relationship (see appendix table 7) in all economies; in Austria, Interest rate volatility impacts financial inclusion more than other variables. It means higher interest rate volatility will decrease financial inclusion. Literature also predicts a negative relationship as people move towards informal ways when borrowing is higher and returns are low. (Acemoglu & Robinson 2010). As supported by literature, people avoid using financial services due to increased borrowing costs and low returns. And in Asia saving rate is higher but informal ways of savings are used (Zulfiqar, Chaudhary, & Aslam, 2016). Similarly, in Asia, the results are the same. The negative impact of interest rates on financial inclusion is also in line with the literature (Denier, Iyigun, & Owen, 2002, Hajilee et al. (2017, Kabakova, O., &Plaksenkov, E. 2018, Ajide, F. M., 2021).

Further, all countries (Appendix table 8) and variables are cointegrated at 1% and 5 % significance levels. This validates the results of coefficients. Lastly, hypothesis four related to asymmetry is accepted only in the case of France and Belgium's economic growth. According to literature, symmetric effects exist, but changes in investor perception of the shadow economy and financial market uncertainty will lead to the asymmetry effect (Kim, D. W., Yu, J. S., & Hassan, M. K. 2018, Hajilee, M., & Niroomand, F. 2021). But (appendix table 9) shows It is rejected in Denmark, Austria Belgium in Asian economies; in the long run, it is only accepted in the case of Vietnam and the Philippines and left in the case of Pakistan and Bangladesh.

Comparison of Western Europe and Developing Asia Results

Looking at the results of both regions in Western Europe, the country's economic growth coefficients have higher values than developing Asia. Economic growth is a critical element of this region that positively affects financial inclusion, and a decrease in economic growth directly hits financial inclusion. Another reason for the higher value of coefficients might be a higher rate of economic growth in Western Europe or a higher level of financial inclusion, which is affected by economic growth increase or decrease. Interest rate volatility is another crucial factor that plays its role in strengthening the financial system, which increases or decreases financial inclusion. France reports higher coefficient values in developing Asia, specifically in Bangladesh and Western Europe. Other than these countries, both regions report change figures between 1 and 2. 99 percent. This shows that interest rate volatility should be minimized in both areas so that it will not negatively affect financial inclusion irrespective of a strong economy or high level of financial inclusion. The Shadow economy is one of the most crucial elements of any economy. But countries with a higher level of shadow economy will have more negative effects on economic development. The current study results of developed economy and

developing shows Denmark and Bangladesh's shadow economy coefficients have a higher value. Other than these Western Europe countries, Austria, Belgium France has relatively higher values which means this region is affected by the shadow economy more than developing Asia countries, irrespective of being a developed nation or having a high level of financial inclusion. While in developing Asia, this effect is less reason might be a low level of financial inclusion.

6. CONCLUSION

Financial inclusion is the most critical and powerful accelerator of the economy's progress. The imbalance in the economy and the limited usage of the banking sector in the economies are the main factors that slow down the growth in the economy. The current study analyses the relationship between financial inclusion and macroeconomic variables.

In the current study, the impact of macro-economic variables is measured on financial inclusion Countries with a high level of financial inclusion in western Europe and low financial inclusion in developing Asia are selected as the sample. Macro-economic variables include interest rate volatility, shadow economy, and economic growth. The analysis is performed by using data from 1990-2017. Nonlinear Autoregressive distributed lag model incorporates non-linearity in data as past research assumes a linear relationship. Further cointegration bound testing approach critical values of (Pesaran et al. 2001) are compared with Wald test F-statistics. The asymmetry effect is also measured through Wald test F statistics. The results of the current study explain the relationship between economic growth and financial inclusion, which is positive in terms of direction. In both regions, economic growth significantly brings a change in financial inclusion. In the case of Western Europe, the value of change is more significant than in developing Asia. These results align with the literature (Urueña& Perez, 2022). Secondly, interest rate volatility results are essential in all countries. It shows a negative relationship with financial inclusion. An increase in interest rate volatility brings a decrease in financial inclusion. These results are also supported by existing literature, as mentioned above. The Shadow economy y is also significant and accepted in all countries. It also shows a negative relationship. It means one of the reasons for the low level of financial inclusion in developing countries is the shadow economy (Affandi& Malik, 2020). Lastly, in the long run, asymmetry effects prevail. It is rejected in most countries except France, Vietnam, and the Philippines. According to the results, strange events significantly affect financial inclusion, a vital part of the financial system. These events negatively affect the financial system, create hurdles for decision-makers, and negatively influence economic progress. These results are essential to understanding the low level of financial inclusion in developing countries and a decreasing trend in financial inclusion in developed countries.

The study results imply that developed and developing economies should take specific measures to decrease economic uncertainties, especially concerning interest rates. These nations must devise financial market reforms to establish a reliable governance system. Enable access to financial services and products, and revised rules and regulations should be implemented to overcome the shadow economy impact and deliver adequate financial assistance to the public. Applying these measures by economic policy decision-makers will bring positive change in financial inclusion and improve economic development and higher financial progress in developing states. Research advises that Denmark, Bangladesh, and France must be vigilant in implementing regulations linked with economy and interest rate guidelines. Every research has some limitations, leading to future investigation trends. In the current study only, the long-run relationship is established, while the short-run relationship is equally important in the long run. Future research can also incorporate short-run analysis. Further, different proxies can be used to measure the variables, but this research used one broker. Future research can be done by using other representatives for the same variables, and a comparison of results can be

drawn under different measurement criteria. The reverse relationship between financial inclusion on economic variables can also be tested in future research.

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Appendix

Nonlinear Autoregressive distributed lag Model

This model is used to determine the long-term relationship between underlying variables. A further specialty of this model is that it incorporates non-linearity in data, which helps it depict a clearer picture. For analysis after performing the unit root test partial sum of positives and negatives are drawn through EViews from 1990 to 2017. Details results are given below

Table 5. Impact of Economic Growth on Financial Inclusion Results for All Countries1990-2017.

S.No	Country Name	Variable Name	C	Coeffi.	C LPOS	C LNEG
			12.2395			
1	Denmark	FI_DEN (-1)		-0.26302		
		Y_DEN_P (-1)		0.857983	3.2	
		Y_DEN_N (-1)		-0.659971		2.5
2	Austria		54.6168			
		FI_AUS(-1)		-0.627543		
		Y_AUS_P(-1)		0.26072	0.41	
		Y_AUS_N(-1)		-0.3533072		0.56
3	Belgium		41.5387			
		FI_BEL (-1)		-0.569626		
		Y_BEL_P (-1)		1.668584	2.96	
		Y_BEL_N (-1)		-2.944665		5.25
4	France		18.1417			
		FI_FRA (-1)		-0.340123		
		Y_FRA_P (-1)		0.469327	1.35	
		Y_FRA_N (-1)		0.32605		0.92
5	Pakistan		10.7135			
		FI_PAK (-1)		-0.495696		
		Y_PAK_P (-1)		0.689442	1.38	
		Y_PAK_N (-1)		-0.626528		1.26
6	Bangladesh		2.51852			
		FI_BANG (-1)		-0.020815		
		Y_BANG_P (-1)		0.0148695	0.71	
		Y_BANG_N (-1)		-0.00926		0.44
7	Vietnam		-1.2104			
		FI_VIET (-1)		-0.49389		
		Y_VIET_P (-1)		0.238009	0.48	
		Y_VIET_N (-1)		-0.139707		0.47
8	Philippine		5.37206			
		FI_PHIL (-1)		-0.200078		
		Y_PHIL_P (-1)		0.559799	2.75	
		Y_PHIL_N (-1)		-0.038689		0.15

Note*: Selection method: Uni-directional. Step wise Regression-value=0.05.-c(3)/c(2)=-c(4)/c(2)

Table 6. Impact of Shadow Economy on Financial Inclusion Results for All Countries 1990-2017.

S.No	Country Name	Variable Name	C	Coe ffi.	C LPOS	C LNEG
			23.54703			
1	Denmark	FI_DEN (-1)		-0.43622		
		SE_DEN_P (-1)		1.453444	3.33	
		SE_DEN_N (-1)		-0.474609		1.08
2	Austria		6.068909			
		FI_AUS(-1)		-0.154152		
		SE_AUS_P(-1)		0.148594	0.93	
		SE_AUS_N(-1)		-0.066068		0.42
3	Belgium		3.694447			
		FI_BEL (-1)		-0.22562		
		SE_BEL_P (-1)		0.367828	1.63	
		SE_BEL_N (-1)		-0.306613		1.36
4	France		22.2702			
		FI_FRA (-1)		-0.355759		
		SE_FRA_P (-1)		0.631375	1.8	
		SE_FRA_N (-1)		-0.4415693		0.25
5	Pakistan		15.00231			
		FI_PAK (-1)		-0.474607		
		SE_PAK_P (-1)		0.223875	0.46	
		SE_PAK_N (-1)		-0.470441		0.99
6	Bangladesh		2.972718			
		FI_BANG (-1)		-0.042934		
		SE_BANG_P (- 1)		0.1058356	2.5	
		SE_BANG_N (-1)		-0.2320306		5.7
7	Vietnam		4.878024			
		FI_VIET (-1)		-0.965587		
		SE_VIET_P (-1)		0.4596431	0.28	
		SE_VIET_N (-1)		-0.251663		0.26
8	Philippine		21.36539			
		FI_PHIL (-1)		-0.433576		
		SE_PHIL_P (-1)		0.87019	2.1	
		SE_PHIL_N (-1)		-0.211959		2

Note*:Selection method: Uni-directional. Stepwise Regression-value = 0.05.- c (3)/c(2)= -c(4)/c(2)

Table 7. Impact of Interest Rate Volatility on Financial Inclusion Results for All Countries 1990-2017.

S.No	Country Name	Variable Name	C	Coeffi.	C LPOS	C LNEG
1	Denmark	FI_DEN (-1)	16.16839	-0.344224		
		VR_DEN_P (-1)		0.633592	1.84	
		VR_DEN_N (-1)		-0.359616		1.04
2	Austria		22.77031			
		FI_AUS(-1)		-0.227162		
		VR_AUS_P(-1)		0.282978	1.27	
		VR_AUS_N(-1)		-0.297787		1.31
3	Belgium		-21.9056			
		FI_BEL (-1)		-0.380969		
		VR_BEL_P (-1)		0.400978	1.05	
		VR_BEL_N (-1)		-0.376841		0.97
4	France		50.3083			
		FI_FRA (-1)		-0.1103697		
		VR_FRA_P (- 1)		0.4769616	4.2	
		VR_FRA_N (-1)		-0.317685		2.8
5	Pakistan		21.84055			
		FI_PAK (-1)		-0.287668		
		VR_PAK_P (-1)		0.2902442	1.008	
		VR_PAK_N (-1)		-0.2931461		1.019
6	Bangladesh		4.534985			
		FI_BANG (-1)		-0.102528		
		VR_BANG_P (-1)		0.657394	6.5	
		VR_BANG_N (-1)		-0.719648		7.1
7	Vietnam		0.826403			
		FI_VIET (-1)		-0.227075		
		VR_VIET_P (-1)		0.282485	1.24	
		VR_VIET_N (-1)		-0.680522		2.99
8	Philippine		6.14717			
		FI_PHIL (-1)		-0.113795		
		VR_PHIL_P (-1)		0.1925781	1.6	
		VR_PHIL_N (-1)		-0.1979558		1.7

Note*: Selection method: Uni-directional. Stepwise Regression-value=0.05.-c(3)/c(2)=-c(4)/c

Table 8. Co-integration Results for all countries.

S.No	Country Name	Variable Name	Wald test s tat	Upper bound Critical Value	
				5%(1)	1%(1)
1	Denmark	VR	8.7534	5.73	7.84
		SE	9.45178	5.73	7.84
		Y	7.9745	5.73	7.84
2	Austria	VR	6.186439	5.73	7.84
		SE	6.003451	5.73	7.84
		Y	9.305844	5.73	7.84
3	Belgium	VR	8.427667	5.73	7.84
		SE	5.868274	5.73	7.84
		Y	6.369782	5.73	7.84
4	France	VR	9.892928	5.73	7.84
		SE	8.373619	5.73	7.84
		Y	6.452369	5.73	7.84
5	Pakistan	VR	16.22072	5.73	7.84
		SE	8.391177	5.73	7.84
		Y	9.643909	5.73	7.84
6	Bangladesh	VR	5.949453	5.73	7.84
		SE	7.221081	5.73	7.84
		Y	9.028435	5.73	7.84
7	Vietnam	VR	10.18639	5.73	7.84
		SE	9.301239	5.73	7.84
		Y	34.8471	5.73	7.84
8	Philippine	VR	7.94827	5.73	7.84
		SE	12.57193	5.73	7.84
		Y	9.605258	5.73	7.84

Table 9. Results of Asymmetry Presence in Long Run

S.No	Country Name	Variable Name	Wald Test F-stat (P value)	P value should less than 0.05
1	Denmark	VR	0.4171	> Not present
		SE	0.1286	> Not present
		Y	0.1357	> Not present
2	Austria	VR	0.4171	> Not present
		SE	0.1286	> Not present
		Y	0.1357	> Not present
3	Belgium	VR	0.4914	> Not present
		SE	0.8119	> Not present
		Y	0.0001	>present
4	France	VR	0.0006	>present

		SE	0.005	>present
		Y	0.0009	>present
5	Pakistan	VR	0.1419	> Not present
		SE	0.5274	> Not present
		Y	0.4194	> Not present
6	Bangladesh	VR	0.8305	> Not present
		SE	0.7405	> Not present
		Y	0.8109	> Not present
7	Vietnam	VR	0.0001	< present
		SE	0.0052	< present
		Y	0.0001	< present
8	Philippine	VR	0.8556	> Not present
		SE	0.0067	< present
		Y	0.0011	< present

Data were collected for the following variables.

Variable	Definition
R	Real interest rate
VR	Volatility measure of real interest rate (R).
FI	The total value of demand, time, and saving deposits at domestic deposit money banks as a share of GDP. This measure shows how many people are financially included.
SE	Shadow economy size. It is calculated as the labor force Contribution rate, which is the active participation of individuals between 15-64 Hajilee et al. 2017.
Y	economic growth as GDP per capita