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Remittances and Output Volatility: The Role of Financial Development

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Abstract:
This paper examines the impact of remittances on output volatility through the channel of financial development using data for 158 countries from 1971 to 2017. We estimate the role of financial development by looking at multiple features of financial institutions, such as depth, access and efficiency. We used multiple indicators as a proxy of financial development in the remittance-output volatility nexus and employed System Generalized Method of Moments (GMM) and Fixed Effects Instrumental Variable (FE-IV) models. Our findings are robust across specifications. We find a significant positive impact of all indicators of financial development on the remittance-output volatility relationship. The findings suggest that multifaceted financial development is needed for the effective management of output volatility through remittance inflows.

Keywords: Output volatility, remittances, financial development, remittance-output volatility nexus.

JEL Classification: C33, F24.

Remittances and Output Volatility: The Role of Financial Development

1. Introduction

Economic history is replete with output volatility shocks. Events including the British South Sea bubble in 1720, the oil price shock in 1973 and the Great Depression in the 1930s induced significant macroeconomic fluctuations. After the mid-1980s, we had observed a persistent decline in economic fluctuations in the US and other developed economies in the form of steady growth rates. That is, until the financial crisis of 2008 introduced a macroeconomic disturbance globally characterized by low economic growth rates. Therefore, it seems that periods of economic stability are outliers and world economies tend to face the frequent challenge of output instability. But stability in output growth is crucially necessary for a stable and competitive economy. It affects economic growth, poverty and the welfare of nations more generally. Thus, stable output growth remains a fundamental policy objectives worldwide.

The role of the financial sector in these output volatility shocks was evident during the recent global financial crisis of 2007-2008. This crisis reportedly caused the failure of the financial system in general and its financial institutions in particular. These institutions have been playing a substantive role in the provision of financial services. Widespread loan defaults in the US mortgage industry infected capital in financial institutions and left them with highly illiquid assets. As a result, the failure of US financial institutions led to a recession in the US as well as the emergence of the global financial crisis, negatively affecting world economies.

The failure of financial institutions during the crisis motivates us to investigate if the development of financial institutions now play a role in the well-established impact of remittances on output volatility. Financial development, being the progression of financial institutions and markets, is a multidimensional process. Banks are the most important and largest institutions in the financial system. Apart from them, other nonbank institutions (insurance companies, mutual funds, etc.) are also critical entities in the financial sector. Similarly, the features of these banks and non-bank financial institutes have also advanced over time. The important and emerging features of this evolution are access and efficiency (Cihak *et*

al., 2012). Svirydzenka (2016) defines financial development as a combination of the depth, access, and efficiency of the financial system.

Financial access is the ability to access financial services. Financial access measures the commitment to outreach activities in the banking sector. Financial access enables resource constrained entities to solve issues related to resource availability, mobilization and allocation. An increase in financial accessibility can theoretically provide affordable and easy access to financial services to low-income groups. These groups often lack access to financial services offered by the formal financial system because of non-affordability. A developed financial sector is of limited use if it is not accessible to a sufficiently large fraction of the population. Financial access is often identified as a contributor to inclusive growth because.

The efficiency feature of financial development evaluates the ability of institutions to provide financial services at a low cost. This ability is viewed in accordance with sustainable revenues and the level of activity in the capital market (Svirydzenka, 2016). If the sector is inefficient, its contribution to economic growth would be limited despite being sizeable and wide reaching. Financial efficiency is the core of the high-performing financial sector. Improvement in it boosts financial profits and reduces financial risks. It is measured through the efficiency ratio. This ratio suggests that the financial sector requires fewer expenses to generate greater revenues, thereby ensuring consistent productivity and growth.

In this study, we analyze how the efficiency features of financial development, along with traditional depth features, mediate the remittance-output volatility relationship. Financial depth can mediate the volatility of output growth when remittance flows improve credit availability in the financial sector. When the inflows are steady, they decrease the altruistic, saving, and insurance needs of recipient families. This reduction in turn can hamper the development of the financial sector (Aggarwal *et al.*, 2011). Similarly, greater financial accessibility can help magnify the impact of remittances on output volatility through the provision of financial systems to a higher proportion of the population. Moreover, when surplus remittances move from recipient savers to that of productive investors, it helps organize the financial system and thereby can affect output volatility differently. Therefore, studying the multiple dimensions of financial development can help economists and policymakers realize the role of remittances through the channel of finance.

Output volatility is affected by multiple factors (Beck *et al.*, 2000). Factors such as institutional quality, structural changes, risk-sharing mechanisms and political stability play a crucial role in determining output stability. Moreover, the extent of integration with the outside world and exposure to external shocks also induce growth volatility (Beck *et al.*, 2000; Majeed & Noreen, 2018).

Remittances, as the second largest source of capital inflows, is transformational toward the achievement of sustainable output growth (Chami *et al.*, 2007; Ahamada & Coulibaly, 2011; Chami *et al.*, 2012; Adeniyi *et al.*, 2019). Remittances predominantly stabilize recipient economies in two ways. First, they help to provide the necessities of life and improve living standards of many households, due to being person-to-person transfers from migrants to relatives back home. Second, on a macro level, these inflows fuel economic growth. This growth takes place through the channel of investment in human and physical capital and financing new businesses. Consequently, remittances can potentially lead to stable and elevated growth.

Remittances also improve the social safety net and induce stable output growth (Chami *et al.*, 2012). As remittance income permits the recipients to consume more, they are crucial in helping families move up from subsistence consumption. This increase in consumption generates short-term economic growth which in turn can lead to long-run stable growth through industrial expansion (Chami *et al.*, 2012). However, remittances can also reduce economic growth through the remittance trap. This trap increases dependence on payments, and makes economic growth conditional on the continued incidence of these flows (Chami *et al.*, 2018).

Studies such as Chami *et al.* (2007), Craigwell *et al.* (2008), Bugamelli (2011), Chami *et al.* (2012), Bouoiyour *et al.* (2014) and Jidoud (2015) investigate the impact of remittances on output volatility. On the other hand, studies such as Beck *et al.* (2000), Cermeno (2012), and Majeed & Noreen (2018) analyze the impact of financial development on output volatility.

However, there are very few studies that analyze the role of financial development as a mediator of the remittance-output volatility nexus. Studies such as Ahamada & Coulibaly (2011) and Adeniyi *et al.* (2019) are the only studies that look at the confounding role of financial development in this realm. However, the findings of these studies are inconclusive. Moreover, another weakness in these studies is that they

have used conventional indicators of financial development (domestic credit provided by banks and credit to the financial sector), thereby ignoring its multidimensional and complex nature. These indicators are actually just one feature (depth) of financial development (Cihak *et al.*, 2012; Svirydzenka, 2016). Therefore, the studies did not consider the other two characteristics (access and efficiency) of financial development, thus leaving a gap in the literature.

Our study provides a better understanding of the multidimensional impact of financial development on the remittance-output volatility relationship. The present study focuses on financial depth, access, and efficiency as potential mediators in the remittance-output volatility nexus. There are only two other studies, Ahamada & Coulibaly (2011) and Adeniyi *et al.* (2019), that have used common measures of financial depth as an indicator of financial development, though both have shortcomings and neglect to use the standard determinants of output volatility. For instance, the well-established roles of real and monetary sector uncertainty as potential determinants of output volatility are ignored in both of them. Furthermore, Ahamada & Coulibaly (2011) covered 109 developing economies for the period 1975-2007, whereas Adeniyi *et al.* (2019) used data from 71 countries for the period 1996-2012. Therefore, both studies use smaller samples over a relatively shorter time period as compared to our analysis. In addition, these studies did not include country-specific characteristics in their analyses.

Since financial depth, access, and efficiency are the features of a financial system needed to represent a complete picture of the sector, their roles should be analyzed in the remittance-output domain. It is worth considering what direct and mediating roles these different indicators play on output volatility. Our empirical analysis provides new insights in particular regarding the mediating roles of key features of financial development. Moreover, this study covers a large sample of 158 countries for the 1971-2017 time period, thereby providing fresh evidence related to both the direct and mediating roles of financial development. In addition, we control for country-specific effects, as well as estimating a System GMM model.

This study attempts to answer three crucial questions: First, do remittance inflows help decrease output volatility? Second, does the impact of financial development vary depending upon its features (and method of measurement)? Third, what are the interactive impacts of

remittances and financial development and are these impacts on output volatility deteriorating or augmenting?

We used two measures of each of the characteristics of financial development: for financial depth, domestic credit to the private sector by banks and credit provided by the financial sector was used. Similarly, for financial access, bank branches per 100,000 adults and ATM per 1,000 km^2, and for financial efficiency, bank lending-deposit spread and bank return on assets were used. In addition, this study was conducted for a sample of 158 countries over a forty-six year period. Furthermore, we also employed System GMM to manage endogeneity and FE-IV to control for unobserved country-specific characteristics.

We find that the impact of remittances on output volatility is negative and significant, indicating that inflows stabilize output growth. This shows that output volatility decreases as remittances flow into an economy. Furthermore, the results indicate that output volatility responds differently to the various features and measures of financial development. For instance, the depth characteristic of financial development increases output volatility, as both of its measures have a positive impact.

However, the role of access in financial development is inconclusive: one of the measures (bank branches) enhances output volatility, whereas the other (ATM) helps reduce output fluctuations. Furthermore, the efficiency of financial development is a stabilizer of output growth. Since both measures mitigate output volatility, the efficiency of financial institutions is an important contributor to output stability. Furthermore, most importantly, the interactive impacts of these features and their measures are positive and statically significant. Last, the main findings suggest that when remittance inflows affect output volatility through the development of different facets of the financial system, it magnifies output fluctuations despite its direct volatility reducing/enhancing impact.

The remainder of the study is organized as follows: Section 2 presents a review of the relevant literature. Section 3 incorporates a discussion of the data, methodology and statistical analysis. Furthermore, Section 4 reports on the empirical results and interpretation. Finally, Section 5 concludes the study and suggests some policy implications.

2. Literature Review

Output volatility remains one of the central concerns of policymakers worldwide. The literature on minimizing output fluctuations has evolved over time, and there is sufficient theoretical and empirical evidence available in this regard. In this section, first, we will present early theories of the business cycle. In the second subsection, we will focus on the theoretical and empirical literature on remittances' role in output volatility. The third subsection will discuss theoretical arguments and empirical evidence related to the impact of financial development on the volatility of output growth. Finally, in the last subsection, we will present a brief review of the available literature on the collective role of remittances and financial development on fluctuations in output growth.

2.1. Early theories of the business cycle

To understand early theories pertaining to business cycles, we must look at different schools of economic thought: According to the Keynesian school of thought, it is the demand side factors that induce business cycle fluctuations; as an alternative to the Keynesian school, real business cycle (or RBC) theorists suggested that it is technological shocks that initiate business cycle fluctuations. These shocks are generally the result of events like bad weather, tight rules and regulations, innovations, and changes in input prices; neo-classical theorists suggest that it is the structural change between sectors that induces business cycle uncertainty, an uncertainty that has resulted from a decrease in unemployment. Consequently, reductions in economic agents' income and a rise in aggregate demand shocks occur; according to monetarist theorists, it is fluctuations in the interest rate that induce variability in long-term investment and hence variability in the business cycle. Likewise, another monetary theory of 'crisis of overproduction' given by Karl Marx recognized that inadequate purchasing power decreases aggregate demand and overloaded inventories, thereby inducing contraction in output growth.

2.2. Empirics of Remittances and Output Volatility

The theoretical arguments regarding remittances and output volatility can be traced back to the following theories. First, the theory of moral hazard advocates that remittance inflows amplify growth volatility. Remittances could in theory function as disincentives for recipients to work as they make less effort in seeking employment and prefer leisure over labor. In this way, productivity decreases, increasing uncertainty in

output growth. Alternately, it can be argued within the context of this theory that recipients of remittances often prefer to work, but they demand better work incentives by raising their reservation wage. This rise in wages theoretically can result in workers dropping out of the labor force and results in upward pressure on commodity prices. With the rise in prices, exports can become less competitive, and the output of the country fluctuates. Third, according to the Dutch Disease effect, remittances appreciate the real exchange rate causing reallocation of resources from the traded to the non-traded sectors. This process of reallocation of resources induces volatile growth rates. Fourth, remittances can deteriorate the quality of governance. It is argued that access to remittances enables recipients to be indifferent about a government role in the general welfare and in the fulfilment of their needs, so the dependency on government decreases. As a result, the government can become inefficient. Moreover, tolerance toward corruption and incompetence also increases as recipients view it as less costly to bear; consequently, institutional and governance quality deteriorates. This deterioration leads the economy toward a rise in social conflict on the incidence of even slight internal or external uncertainty leading to volatile growth rates (Abdih *et al.*, 2008; Chami *et al.*, 2012). Lastly, it is possible that as remittance flows increase, positive technological shocks result in demands for wage increases. This augments the income effect and, as a consequence, increases output volatility.

On the other hand, however, there is literature that highlights a favorable effect of remittances on output volatility. The most widely promoted theory in this regard is the altruistic motive. According to this theory, as remittances increase, the recipient's consumption constraints are removed. This increase in consumption covers the basic necessities of life and improves living standards; as a result, output growth stabilizes. Second, according to the theory of insurance, increasing the incidence of remittances provides insurance against economic risk, which in turn helps stabilize output growth. Additionally, this insurance also improves the investment portfolio of the country. It provides an increased opportunity to diversify investments in both human and physical capital, thereby inducing stability in output growth. Third, with an increase in inflows, short-run economic growth transforms into industrial expanded long-run growth and hence stabilizes output.

On the empirical front, the role of remittances is debatable, as studies have documented both positive and negative impacts. Initial studies on the relationship analyzes output volatility predominantly through the lens of economic uncertainty. The first strand of the literature

suggests that output volatility diminishes as a result of remittances. This is supported by studies such as Ahamada & Coulibaly (2011), Chami *et al*. (2012), Bettin *et al*. (2012), Jidoud (2015) and Adeniyi *et al*. (2019), as all of them pointed to remittances as output volatility stabilizers. The authors argue that when inflows are specifically for consumption and investment purposes, it smooths out both. Thus, stable consumption and investment as components of a national income accounting identity reduce output volatility.

In contrast, the second strand of literature reports augmented effects of remittances on volatile output growth. A study such as Bugamelli & Paterno (2011) argue for the positive impact of remittances on output volatility. The authors justified this augmented impact through the Dutch Disease effect. As remittances remove consumption constraints, this can potentially reduce the labor supply of recipients which in turn causes output to fluctuate more (Bugamelli & Paterno, 2011).

2.3. Empirics of Financial Development and Output Volatility

Similar to remittances, there are various transmission channels from financial development to output volatility. First, it is argued that with an increase in financial development, there are fewer liquidity constraint in financial markets. This removal of constraints provides favorable incentives for investment in profitable long-term projects, which in turn improves the investment profile of a country. Moreover, financial development also eases the transfer of funds, thereby decreasing the chances of delayed or cancelled investment projects. Consequently, fluctuations in the business cycle diminish, and output growth stabilizes. Second, with the development of the financial sector, growth prospects also flourish through the allocation of risk to riskier yet fruitful investment ventures. It might happen that in an attempt to diversify the portfolio, investors invest in riskier yet more profitable investment projects. As a result, total factor productivity increases, which in turn stimulates stable growth.

However, there are also transmission channels through which financial development enhances output volatility. First, as the financial sector develops, it exposes the economy to dynamic shocks. Therefore, output volatility increases through financial institutions. Second, with financial development, access to loanable funds increases. This increased access raises investment in short-run riskier projects, thereby enhancing volatility in output growth.

The empirical literature of financial development and output volatility can be grouped as follows: The first strand of literature suggests a mixed effect of financial development on output volatility, depending upon which of its measures is used in the analysis. Studies such as Bernanke & Gertler (1989) focus on financial accelerators, and Gertler (1992) focuses on the capacity building aspect of financial development as output volatility enhancement. Easterly *et al*. (2000) separated the financial sector into capital and equity markets and found that the capital market is relatively less vulnerable to output volatility. Bacchetta and Caminal (2000) focused on the role of credit market imperfections and advocated mixed results. Easterly *et al.* (2001), while focusing on financial depth, pointed out that financial development reduces output volatility up to a certain point, whereas private credit measures increase volatility. Cermeno *et al.* (2012) explored the impact of the nature and level of financial deepening as the volatility reducing factor in the Mexican economy. Similarly, Majeed and Noreen (2018) have used financial sector depth, efficiency, stability and access measures of financial development, providing mixed results.

The second strand of literature points out that it is the nature of a shock through which the impact of financial development on output volatility can be determined. Bacchetta & Caminal (2000) advocate that the development of the financial sector causes a reallocation of capital from one firm to another, which introduces additional unanticipated productivity shocks in the economy. Similarly, Beck *et al.* (2000) go one step further in the analysis and point to volatility of the real (terms of trade) and the monetary (inflation) sectors and that of policy (government expenditure) uncertainty as the channels through which the financial sector affects (either positive or negative) volatility of output growth.

2.4. Empirics of Tripartite (Financial Development in Remittance-Output Volatility Nexus)

The theoretical argument regarding the tripartite relationship among financial development, remittances, and output volatility is traced as financial development increases, which enhances the absorptive capacity of the economy. With this enhanced capacity, when remittance inflows increase, financial development channels excess funds from savers to investors; as a result, financial constraints lessen and the number of long-term investment projects increase. These long-run investments ensure stable growth paths, thereby decreasing output volatility.

On the empirical front, the literature is limited and there have been only two studies on this. Ahamada & Coulibaly (2011) analyzed the influence of financial development in the relationship of remittances-output volatility. The findings of the study suggest that remittances' impact on growth volatility is nonlinear. It is the level of financial development that determines how much remittances help to stabilize output volatility. Likewise, another recent study by Adeniyi *et al.* (2019) concluded that both remittances, as well as financial development individually, dampen output uncertainty. However, the mediating role of financial development is mixed. For instance, it is advocated that the impact of banking sector credit is positive but insignificant, whereas the effect of credit on the private sector is negative and significant, concluding overall inconclusive results.

In sum, the theoretical literature illustrates the negative and positive impacts of remittances on output volatility. Similar is the case with financial development. The empirical literature predominantly emphasizes the negative effect of remittances. However, there is no dominant impact of financial development, and its mediating role in the remittance-output nexus is inconclusive.

3. Data and Methodology

The literature provides evidence about a number of factors that collectively determine output volatility. For instance, trade openness is investigated by Easterly *et al.* (2001), Bekaert *et al.* (2002), Wacziarg & Welch, (2003), Kose *et al.* (2006) and Haddad *et al.* (2013). Likewise, terms of trade shocks are focused on by Beck *et al.* (2000), Ceechetti *et al.* (2005) and Rumler & Scharler (2011). Several studies also investigated country size as an important determinant. A large country size reflects a large resource base, which helps diminish output volatility (Mobarak, 2005; Furceri & Karras, 2007; Chami *et al.,* 2012). The share of government consumption in GDP is an essential input to ensure stable economic growth (Rodrik, 1998; Chami *et al.*, 2012). Another potential input to output volatility is institutional quality (Acemoglu & Zilibotti, 1997; Acemoglu *et al.,* 2003). Therefore, there are a variety of possible determinants of output volatility; hence, the output production function in the general form can be expressed as follows:

$$OV = f(inputs|volatility) \quad (1)$$

Where OV is output volatility and inputs to volatility are the numbers of factors determining the uncertainty in output growth.

A closer analysis of the possible determinants of output volatility shows that most of them are interlinked and can be generalized and grouped into a uniform set of possible inputs. For instance, trade openness can be viewed as an external factor affecting output volatility. Loayza *et al.* (2007) and Chami *et al.* (2012) also pointed out trade as an external shock affecting the growth rate. Similarly, the terms of trade can be viewed as real sector volatility since it induces unanticipated shocks in the production function. Studies such as Beck *et al.* (2000) and Majeed & Noreen (2018) proxy terms of trade volatility as a shock to the real sector. As monetary shocks affect banks' supply of loanable funds and inflation uncertainty alters the motives for money demand affecting aggregate supply, the literature also finds that inflation volatility can be grouped under monetary sector volatility.

Variables such as country size, finance, institutional environment/quality and government consumption can collectively be perceived as internal country-specific characteristics. Furthermore, few studies have pointed to government expenditure as an additional fiscal policy shock (Wang *et al.,* 2007). Surprisingly, the impact of this shock can be felt either through real or monetary shock (Beck *et al.,* 2000). For instance, when a shock occurs through finance, its effect can be felt via real sector volatility. In contrast, if the incidence of the shock is due to financing in bonds or by inflation tax, then it can be observed via monetary sector volatility (Beck *et al.,* 2000).

Following the above discussion, the simplest model of output volatility can be written as:

$$OV = f(E, R, M, I) \tag{2}$$

where E, R, M and I represent vectors of external factors, real sector shock, monetary sector volatility and internal factors (country-specific characteristics), respectively.

The literature identifies several variables under each vector. However, studies have used different variables because of the reliability of the measure, data availability and other limitations.

Our empirical investigation included *VTOT* (volatility of terms of trade) as the variable associated with the real sector vector, *VINF* (volatility of inflation) for the vector related to the monetary sector, *TO* (trade openness) representing the external shock vector, and internal vector restricted to POP (population) growth as follows:

$$OV = f(VTOT, VINF, |, POP) \tag{3}$$

Remittances are an important determinant of output volatility being countercyclical and the most stable form of external capital flow. The effects of these inflows are ambiguous in the literature. It is assumed that since remittance flows are exogenous, they induce uncertainty in the economy, similar to terms of trade. On the other hand, remittances are output stabilizers due to their altruistic motives and countercyclical nature (Chami *et al.*, 2005).

The effect of financial development is also extensively mentioned in the output volatility literature. The literature highlighted the negative impact of financial development through the channel of improvement in the availability of funds. Financial development is known to alter the absorptive capacities of economies. Well-developed and well-functioning financial markets enable the provision of excess funds (including possibly remittances) to economic agents who are in need of finance. Therefore, financial development helps smooth out investment constraints and increases production with a resultant reduction in output volatility (Ahamada & Coulibaly, 2011; Adeniyi *et al.*, 2019). Given the importance of financial development, studies still use the common indicators of financial depth to capture the impact. However, the diversity of the concept and its unexplored dimensions demands investigation of the impact in a broader way.

This study explores the potential determinants of output volatility by focusing on remittances and financial development. Therefore, we extend equation (3) as follows:

$$OV = f(VTOT, VINF, |, POP, PR, FD) \tag{4}$$

where *PR* is personal remittances and *FD* is financial development.

To analyze the mediating role of financial development in the remittance-output volatility nexus, the interaction term of remittances and financial development has been introduced in equation 4 as follows:

$$OV = f(VTOT, VINF, |, POP, PR, FD, PR \quad FD) \ldots\ldots (E) \tag{5}$$

Econometrically, the model incorporating remittances' impact (alone) can be written as follows:

$$LOV \quad = \alpha_0 + \alpha_1 LOV_{-1} + \alpha_2 PR \quad + \alpha_3 VTOT \quad + \alpha_4 VINF \quad + \alpha_5 LPOP \quad + \alpha_6 \quad + \nu_t + \mu_t + u \tag{6a}$$

where *PR* is personal remittances.

Similarly, the regression models containing six distinct indictors of financial development (alone) can be represented as follows:

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 DCB \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6a}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 DCF \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6b}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 BB \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6c}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 ATM \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6d}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 BS \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6e}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 BA \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6f}$$

where t = year, ranging from 1971 to 2017, i = country index ranging from 1, 2,….158, *LOV* is the natural log of output volatility, *DCB* is credit to private sector by banks, DCF is a credit provided by the financial sector, *BB* is bank branches per 100,000 adults, *ATM* is ATM per 1,000 km^2, *BS* is bank lending-deposit spread and *BA* is bank return on asset. Among control variables, *LPOP* is the log of population growth, while the rest of the terms are summarized in Appendix: Table 1A.

For the mediating role of financial development in the remittance output volatility nexus, the following econometric models are estimated using interaction terms:

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 DCB + \gamma_4 PR\ DCB + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7a)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 DCF + \gamma_4 PR\ DCF + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7b)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 BB + \gamma_4 PR\ BB + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7c)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 ATM + \gamma_4 PR\ ATM + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7d)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 BS + \gamma_4 PR\ BS + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7e)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 BA + \gamma_4 PR\ BA + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7f)$$

where *PR*DCB* is the interaction of remittances with credit to the private sector by banks, *PR*DCF* is the interaction of remittances with credit provided by the financial sector, *PR*BB* is the interaction of remittances with bank branches per 100,000 adults, *PR*ATM* is the interaction of remittances with *ATM* per 1,000 km^2, and *PR*BS* is the interaction of personal remittances with bank lending-deposit spread. Finally, *PR*BA* represents the interaction effect of remittances with bank return on assets.

3.1. Econometric Methodology

Our study covers 158 countries over the period of 1971-2017 using data from the World Bank (2018) and International Financial Statistics (2018). The sample of the study is restricted because of data limitations. We have used a System GMM model and FE-IV model in our analysis. The System GMM technique was proposed by Arellano and Bover (1995) and Blundell and Bond (1998). The technique combines the standard moment conditions of first differences with the additional moment conditions that are derived from the equation in levels. In standard moment conditions,

the lagged values are used as instruments. However, the additional moment conditions are based on an assumption concerning the correlation between the dependent variable (x and the country-specific effect($\eta|i$). The system GMM assumes that the difference of x is uncorrelated with the individual effects but is correlated with η_i. In System GMM, the additional moment conditions are represented at levels as follows:

$$E[\Delta y|i(t-1)\mu \ ] = 0 \text{where, } \mu \ = \eta_i + \nu \quad (8)$$

$$E[\Delta x|\mu \ ] = 0 \quad (9)$$

The use of a System GMM estimator enables us to control the effects of time-invariant country-specific characteristics and endogeneity issues due to lagged dependent variables. Table 1A illustrates the definition and sources of variables used in the analysis.

3.2. Descriptive Statistics

Table 1 presents the descriptive statistics of the variables used in this study.

Table 1: Descriptive Statistics

Variables	Obs.	Mean	Median	Std. Dev.	Minimum	Maximum
Dependent Variable						
Output Volatility	1071	212.87	75.22	385.66	4.95 (Bangladesh)	3941.37 (United Arab Emirates)
Focused Variable						
Personal Remittances	1071	5.21	2.11	7.32	0.008 (Bulgaria)	90.74 (Poland)
Different Measures of Financial Development						
Domestic Credit to Private Sector by Banks	1071	46.62	36.29	38.38	1.42 (Norway)	201.29 (Sudan)
Domestic Credit by Financial Sector	1071	62.69	49.51	56.39	-31.77 (Malta)	267.66 (Sudan)
Different Measures of Financial Inclusion						
Bank Branches per 100,000 adults	1071	16.36	11.46	18.85	0.58 (Ghana)	258.32 (Bahrain)
Automated Teller Machines (ATMs) per 1,000 km2	1071	46.88	8.66	168.59	0.03 (Zambia)	3395.13 (Netherlands)
Different Measures of Financial Efficiency						
Bank Lending-Deposit Spread	1071	7.40	5.96	6.36	1.56 (Cuba)	37.12 (Lesotho)
Bank Return on Assets	1071	1.59	1.59	1.28	-0.74 (Namibia)	4.88 (Azerbaijan)

Variables	Obs.	Mean	Median	Std. Dev.	Minimum	Maximum
Control Variables						
Terms of Trade Volatility	1347	11.75	8.79	12.58	1.07 (Australia)	209.912 (Canada)
Inflation Volatility	1347	8.28	6.91	6.75	0.14 (China)	307.94 (New Caledonia)
Population Growth	1347	1.50	1.34	1.27	-0.41 (West Bank and Gaza)	7.844 (Faroe Islands)
Trade Openness	1347	83.20	78.67	33.99	11.43 (Seychelles)	417.64 (Somalia)

3.3. Correlation Matrix

Correlation is a statistical technique that is used to explain the direction and strength of the linear relationships between two variables. To identify multicollinearity, a correlation matrix is used. Tables 2 and 3 report a correlation matrix for personal remittances and various proxies of financial development, respectively. Remittances have a negative correlation with output volatility. Furthermore, all the indicators of financial development have a positive correlation with output volatility except bank lending spread and bank return on assets. Domestic credit to the private sector has the highest correlation, with a value of 0.39.

Table 2: Correlation Matrix for Personal Remittances

Variables	OV	PR	VTOT	VINF	POP	TO
OV	1					
PR	-0.172	1				
VTOT	-0.079	0.024	1			
VINF	-0.077	0.083	0.025	1		
POP	-0.117	-0.022	0.147	0.021	1	
TO	0.271	0.073	-0.063	-0.055	-0.152	1

Table 3: Correlation Matrix of Financial Development

Vari.	OV	DCB	DCF	BB	ATM	BS	BA	VTOT	VINF	POP	TO
OV	1										
DCB	0.39	1									
DCF	0.30	0.85	1								
BB	0.19	0.42	0.37	1							
ATM	0.20	0.30	0.22	0.01	1						
BS	-0.23	-0.40	-0.36	-0.25	-0.17	1					
BA	-0.16	-0.32	-0.31	-0.17	-0.25	0.24	1				
VTOT	0.01	-0.23	-0.25	-0.12	-0.08	0.09	0.05	1			
VINF	-0.16	-0.28	-0.24	-0.15	-0.11	0.28	0.17	0.01	1		
POP	0.26	-0.02	-0.21	-0.25	-0.02	0.10	0.22	0.15	0.10	1	
TO	0.25	0.19	0.03	0.02	0.54	-0.12	0.03	-0.03	-0.15	0.02	1

4. Empirical Results

4.1. Pre-Estimation Analysis

In the initial step of the analysis, the pre-estimation tests related to multicollinearity, heteroscedasticity and autocorrelation are employed. Table 4 reports the findings of these tests. The result of the variance inflation factor (VIF) concludes that there is unlikely to be a problem of multicollinearity. However, the result of the Breusch–Pagan test shows that there is the problem of heteroskedasticity in the remittances-output volatility nexus. This problem is addressed using the System GMM technique. Similarly, there is also the problem of autocorrelation, as the value of Wooldridge's test is less than 0.1.

Table 4: Pre-estimation tests

Dependent Variable: Volatility of Output	
VIF	1.16
Breusch–Pagan Test	0.235
Wooldridge's Test	0.000

Source: Authors' calculations.

4.2. Results of Fixed and Random Effects

Table 5 presents the regression results obtained from fixed and random effects estimation. Remittances contribute negatively to output volatility, implying that they help mitigate output fluctuations. The estimated value suggests that a 1 percent increase in remittances brings about an approximately 0.003 percent decrease in output volatility. This decrease is consistent with the findings of Chami *et al.* (2007), Adeniyi *et al*. (2019) and Bugamelli & Paterno (2011), who argued that remittances stabilize output volatility. Here, the countercyclical impact of remittances is dominant. This negative impact is supported by the altruistic and insurance theory of remittances. The inflows loosen budget constraints for migrants' families and resultantly induce smooth consumption. Moreover, remitted amounts might also be used to ensure against economic risk. Furthermore, remittances may in some cases be helping to diversify investment portfolios with the objective of hedged against economic jeopardization, thereby diminishing output volatility (Chami *et al.*, 2007; Chami *et al.*, 2012).

The effect of output volatility lag shows that a 1 percent increase in previous year volatility enhances current growth volatility by 0.756

percent. The result suggests that current volatility has a lagged effect. Here, the magnitude of the effect is quite large and statistically significant, indicating that volatility in previous years is one of the most crucial determinants of current volatility.

The estimates of terms of trade uncertainty show that a one percent rise in it enhances output volatility by 0.001 percent. This rise is consistent with the findings of Beck *et al.* (2000) and Majeed & Noreen (2018). This shock arises mostly due to international shocks. The terms of trade volatility occur through fluctuations in the relative prices of imports and exports resulting in volatile growth.

The impact of trade is positive and significant at the 1 percent level of significance. This positive effect is in accordance with the results obtained by Easterly *et al.* (2001), Bugamelli & Paterno (2009) and Adeniyi *et al*. (2019). With openness to trade, a country's exposure to external shocks increases. More integrated trade intends the economy to specialize and produce the product of the comparative advantage, thereby increasing exposure to external product-specific shocks. Furthermore, financial vulnerability may also increase because trade openness induces additional uncertainty in the economy.

Population growth also affects output volatility and is the most common proxy for an economy's size. The results of random effects estimation suggest that output volatility diminishes with a higher population. This result is in line with the result drawn by Furceri & Poplawski (2008). With increases in population growth, endowment, and resource base in the country, output growth is consequently sustained. Moreover, a large country size enables feasible output diversification, which in turn diminishes output volatility vulnerability.

The Hausman test indicates that a fixed effect is appropriate and chosen over a random effect.

Table 5: Fixed and Random Effects Estimates of Remittances

Dependent Variable: Volatility of Output		
Variables	**FE**	**RE**
Volatility of Output $_{t-1}$	0.756***	0.948***
	(0.010)	(0.005)
Remittances	-0.003*	-0.003***
	(0.002)	(0.001)
Volatility of Inflation	0.004**	-0.0001
	(0.001)	(0.001)
Volatility of Terms of Trade	0.001***	0.001***
	(0.0005)	(0.003)
Trade	0.002***	0.001***
	(0.0002)	(0.0001)
Population	0.019	-0.042***
	(0.016)	(0.008)
Constant	0.981	0.184
	(0.055)	(0.026)
Adjusted R-square	0.931	0.933
F-Probability	0.000	0.000
No. of Observation	3656	3656
Hausman/Wald Statistics	404.64	51102.90
	(0.000)	(0.000)

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

Table 6 reports the results of various measures of financial development on output volatility by employing fixed effects. The results show that domestic credit to banks, credit provided by the financial sector and bank branches per 100,000 adults have positive signs, suggesting that an increase in them augments output volatility. The impact of bank branches is slightly stronger (0.005) than that of credit to banks (0.001) and credit to the financial sector (0.001). However, ATM per 1,000 km^2, bank lending spread, and bank return on assets decrease output volatility. Among these, the effect of bank return on assets is stronger (0.014) than the magnitude of ATM and bank lending spread (0.0003 and 0.004, respectively).

The positive effects of domestic credit on banks, the financial sector and bank branches on volatility is important. There could be multiple reasons behind this: First, with a rise in these indicators, the availability of finance improves. This excess finance encourages investment in short-term riskier projects, which in turn enhance growth volatility (Easterly *et al.*, 2001). Second, as these measures increase, the economy is exposed to dynamic shocks, thereby increasing output volatility through the channel of financial institutional development (Easterly *et al.*, 2001; Adeniyi *et al.*, 2019; Majeed & Noreen, 2018).

On the other hand, the negative impact of ATMs and bank return on assets is also important. This could be because the development of these indicators represents the movement of excess funds from savers to the borrower. This movement resultantly removes financial (consumption and investment) constraints, and consequently, output volatility decreases. Particularly, with an increase in access to financial services, investment and consumption constraints are removed. As a result, the number of income-generating activities increases, and growth prospects improve, enabling output volatility to decline. Similarly, a rise in the number of ATMs enables an efficient payment mechanism, which in turn strengthens the resources of financial institutes, thereby diminishing output volatility. An increase in the spread between lending and savings rates would tend to reduce volatility by reducing lending possibly to less productive projects. Last, a rise in bank return on assets can encourage savers to save more, leading to stable output growth through the channel of increased availability of funds for investment. These findings are in accordance with the negative impact of financial development on output volatility reported by Ahamada & Coulibaly (2011).

Table 6: Fixed Effects Estimates of Financial Development

Variables	Dependent Variable: Volatility of Output					
	Domestic Credit to Private Sector by Banks	Domestic Credit to Private Sector by Banks	Bank Branch per 100,000 adults	ATMs per 1,000 km²	Bank Lending-Deposit Spread	Bank Return on Assets
Volatility of Output $_{t-1}$	0.771***	0.770***	0.676***	0.670***	0.744***	0.717***
	(0.009)	(0.009)	(0.017)	(0.018)	(0.012)	(0.013)
Volatility of Inflation	0.001	0.001	0.005	-0.005**	0.001	-0.003***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Volatility of Terms of Trade	0.002***	0.001***	0.004***	0.004***	0.001***	0.002***
	(0.004)	(0.004)	(0.001)	(0.001)	(0.0004)	(0.001)
Trade	0.0002*	0.0002*	0.001*	0.001***	0.00002*	0.001***
	(0.0003)	(0.0003)	(0.0007)	(0.0007)	(0.0003)	(0.0005)
Population	-0.002	-0.004	-0.024	-0.021	0.006	0.007
	(0.014)	(0.014)	(0.028)	(0.027)	(0.018)	(0.020)
Financial Development	0.001***	0.001*	0.005***	-0.0003*	-.004***	-0.014***
	(0.0004)	(0.0002)	(0.003)	(0.0001)	(0.001)	(0.008)
Constant	0.919	0.935	1.184	1.277	1.077	1.147
	(0.051)	(0.051)	(0.107)	(0.106)	(0.061)	(0.071)
Adjusted R-square	0.938	0.938	0.942	0.936	0.927	0.938
F- Probability	0.000	0.000	0.000	0.000	0.000	0.000
No. of Observations	4002	3979	1823	1708	2917	2672
Hausman Test	408.56	416.87	280.23	274.68	357.93	362.29
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

RE estimates of different measures of financial development are presented in Table 7. Similar to FE, RE is also consistent, indicating that increases in credit to the financial sector, bank and bank branches augment output volatility. However, the impact of ATM, bank lending spread and bank return on assets is volatility decreasing, thereby helping to stabilize output volatility.

Table 7: Random Effects Estimates of Financial Development

Variables	Dependent Variable: Volatility of Output					
	Domestic Credit to Private Sector by Banks	Domestic Credit to Private Sector by Banks	Bank Branch per 100,000 adults	ATMs per 1,000 km²	Bank Lending-Deposit Spread	Bank Return on Assets
Volatility of Output $_{t-1}$	0.941***	0.943***	0.943***	0.946***	0.948***	0.941***
	(0.005)	(0.005)	(0.007)	(0.007)	(0.005)	(0.005)
Volatility of Inflation	-0.0003	-0.001	0.001	-0.0008	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Volatility of Terms of Trade	0.001***	0.001***	0.002***	0.001***	0.001***	0.001***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.0003)	(0.0001)
Trade	0.0003***	.0004***	0.0003*	0.001***	0.001***	0.0004***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0002)
Population	-0.017***	-0.020**	-.024***	-.035***	-.031***	-0.022***
	(0.008)	(0.009)	(0.012)	(0.128)	(0.009)	(0.009)
Financial Development	0.001***	0.001***	0.003***	-0.0001*	-0.003**	-0.015***
	(0.0002)	(0.0001)	(0.001)	(.00003)	(0.001)	(0.006)
Constant	0.164	0.167	0.136	0.181	0.195	0.156
	(0.025)	(0.025)	(0.036)	(0.042)	(0.031)	(0.031)
Adjusted R-square	0.939	0.939	0.945	0.945	0.929	0.941
No. of Observations	4002	3979	1823	1708	2917	2672
Wald Statistics	47727.29	46200.58	54273.56	26689.63	26338.35	20736.71
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

4.3. Results of System GMM

This study includes instruments in specified models and employs the System GMM approach to solve the problem of endogeneity. We have taken lagged values of explanatory variables and time dummies as exogenous instruments. Moreover, instruments of remittances such as latitude distance (Desousa & Duval, 2010), unemployment (Aggarwal *et al.*, 2011) and instruments of financial development, capital account openness (Majeed & Norren, 2018) and urban population (Beck *et al.*, 2000) are incorporated as external instruments.

Latitude is often used as a proxy of the bilateral distance between remittance sending and receiving economies. It is a time-invariant variable. The latitudinal distance between migrants' home and host economy impacts the flows through different channels. First, when the distance is viewed as a proxy of the cost migrants expend in sending the remittances amount back to their home economy, the flows decline. However, the inflows rise, first, when they are sent to loosen consumption and investment constraints of the dependent (recipient) families back in the home economy. Second, remittance flows also increase when the cost of migration is high. This increase in remittance inflows is to cover the cost migrants' families endure in the process of moving migrants abroad.

Remittance flows are also correlated with unemployment. This association can be explained as follows: when unemployment in the home country increases, people tend to migrate across the border in search of a job. This search, in turn, reduces consumption and investment constraints in the home economy in the form of remittance transfer. Hence, remittance inflows in the home economy can consequently rise.

Capital account openness is one of the instruments of financial development. The more open the overall capital account is, the greater the chances of financial development. As the liberalization of capital accounts increases, it welcomes foreign investors and the use of financial institutions, leading to an increase in the development of the financial sector.

The urban population is also correlated with financial development. As the urban population increases, their demand for finance for motives (transitory, precautionary and speculative) of holding cash also rises. This increase in demand consequently enhances the supply of financial intermediates, thereby leading to financial development.

The results presented in Table 8 report the impact of remittances on output volatility using System GMM. The estimates indicate that remittances have a negative and statistically significant impact on volatility. This implies that output volatility decreases by 0.034 percent as a result of a 1 percent rise in remittances. This finding is consistent with results drawn by Bugamelli & Paterno (2011) and Chami *et al.* (2012). The decline in output volatility implies that remittances provide an extra source of finance. The probability of the Hansen test confirms that the instruments are valid. Moreover, the value of AR (2) is insignificant, indicating that the error term is uncorrelated and that the issue of serial correlation does not exist.

Table 8: System GMM estimates of remittances

Dependent Variable: Volatility of Output	
Variables	**Coefficient**
Volatility of Output $_{t-1}$	0.507***
	(0.135)
Remittances	-0.034***
	(0.015)
Volatility of Inflation	0.013
	(0.021)
Volatility of Terms of Trade	0.028
	(0.018)
Trade	0.014***
	(0.005)
Population	-0.737***
	(0.194)
Constant	0.679
	(0.872)
Adjusted R-square	1395
No. of Instruments	78
AR (1) Pr > z	0.365
AR (2) Pr > z	0.344
Hansen Test Prob > Chi	0.646

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

Table 9 below reports the results of System GMM for various indicators of financial development. The coefficient reflects that output volatility magnifies by 0.193, 0.017 and 0.123 percent as a result of a 1 percent rise in credit to the financial sector, credit provided by banks and bank branches per 100,000 adults, respectively. However, output volatility diminishes by 0.002, 0.044 and 0.085 percent as a result of a 1 percent rise in ATM, bank lending spread and bank return on assets. These impacts are consistent yet much stronger, as the size of the coefficients is relatively large compared to the estimates of FE and RE. In addition, the probability values of the Hansen test and AR (2) signify that instruments are valid and that the issue of serial correlation does not arise.

Table 9: System GMM Estimates of Financial Development

Variables	Dependent Variable: Volatility of Output					
	Domestic Credit to Private Sector by Banks	Domestic Credit to Private Sector by Banks	Bank Branch per 100,000 adults	ATMs per 1,000 km²	Bank Lending-Deposit Spread	Bank Return on Assets
Volatility of Output $_{t-1}$	0.689***	0.568***	0.311***	0.955***	0.923***	0.841***
	(0.026)	(0.030)	(0.032)	(0.021)	(0.022)	(0.041)
Volatility of Inflation	0.009***	-0.099***	-0.016	-0.066***	0.004	-0.020
	(0.003)	(0.014)	(0.014)	(0.013)	(0.001)	(0.021)
Volatility of Terms of Trade	0.031***	0.476***	0.009***	0.033***	0.032***	0.051***
	(0.009)	(0.012)	(0.005)	(0.014)	(0.009)	(0.015)
Trade	-0.001	-0.001	0.001	0.005***	0.0004	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0004)	(0.001)
Population	0.036	0.258***	0.386***	-0.098***	-.203***	-0.671***
	(0.061)	(0.073)	(0.149)	(0.056)	(0.048)	(0.156)
Financial Development	0.193***	0.017***	0.123***	-0.002***	-.044***	-0.085***
	(0.001)	(0.001)	(0.012)	(0.001)	(0.011)	(0.051)
Constant	0.008	0.875	0.993	0.086	0.238	0.405
	(0.132)	(0.226)	(0.254)	(0.239)	(0.159)	(0.381)
No. of Observations	1504	1523	1203	1023	1117	1485
AR (1) Pr > z	0.002	0.369	0.016	0.000	0.017	0.571
AR (2) Pr > z	0.112	0.492	0.902	0.472	0.105	0.829
Hansen Test- Prob > Chi =	0.629	0.581	0.999	0.229	0.454	0.194

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

Table 10 below illustrates the impact on output volatility incorporating the interaction terms. The coefficients of interaction show that a 1 percent rise in remittances interacted with credit by banks, credit to the financial sector and bank branches causes output volatility to increase by 0.001, 0.0017 and 0.008 percent, respectively. Similarly, output volatility increases by 0.001, 0.006 and 0.035 percent because of a 1 percent rise in the interaction of remittances with ATM, bank lending spread and bank return on assets, respectively.

Table 10 illustrates that the coefficients on the interaction terms are much smaller in size than the coefficient on remittances. This small size shows that remittances' impact is negative, yet its impact is not overcome by the positive impact of financial development. In other words, financial development indicators not only enhance output volatility but also suppress the impact of remittances. In other words, economies are directly vulnerable to the volatility-enhancing effects of financial development and

indirectly vulnerable to the augmented impact of financial development on the remittance-output volatility nexus.

By comparing the coefficient of indicators of financial development and remittances, it can be observed that the negative coefficient on remittances is fairly large in size in comparison to the relatively small positive/negative coefficients on the financial sector variables. This comparison tells us that because the coefficients on the indicators of financial development are small, they are dominated by the larger, negative coefficient on remittances.

Furthermore, insignificant values (0.250, 0.446, 0.104, 0.189, 0.336 and 0.106) of AR (2) reflect no problem of serial correlation. The probability value of the Hansen test is greater than 0.1 in all the models (0.633, 0.962, 0.955, 0.334, 0.605, 0.263), indicating that the instruments are valid.

Table 10: System GMM with Interaction Terms

Variables	**Dependent Variable: Volatility of Output**					
	Domestic Credit to Private Sector by Banks	**Domestic Credit to Private Sector by Banks**	**Bank Branch per 100,000 adults**	**ATMs per 1,000 km²**	**Bank Lending-Deposit Spread**	**Bank Return on Assets**
Volatility of Output $_{t-1}$	0.573***	0.485***	0.488***	0.882***	0.781***	0.829***
	(0.031)	(0.037)	(0.058)	(0.032)	(0.039)	(0.032)
Volatility of Inflation	0.025***	-.068***	-0.040**	-.063***	0.017	-0.033**
	(0.006)	(0.016)	(0.019)	(0.011)	(0.013)	(0.013)
Volatility Terms of Trade	0.026**	0.043***	0.045**	0.028**	0.014**	0.021***
	(0.010)	(0.014)	(0.021)	(0.011)	(0.008)	(0.008)
Trade	-0.001	-0.002**	-0.001	0.0003	-0.001	0.001**
	(0.001)	(0.001)	(0.002)	(0.0008)	(0.001)	(0.0005)
Population	-0.074	-0.043	0.171	-.163***	-.888***	-0.263**
	(0.071)	(0.089)	(0.117)	(0.041)	(0.116)	(0.128)
Remittances	-0.106***	-.137***	-0.107*	-0.025**	-0.075**	-0.051**
	(0.037)	(0.039)	(0.058)	(0.011)	(0.034)	(0.024)
Financial Development	0.019***	0.015***	0.075***	-0.002**	-0.028	-0.164**
	(0.002)	(0.002)	(0.013)	(0.001)	(0.018)	(0.075)
Remittances* Financial Development	0.001**	0.0017**	0.008**	0.001**	0.006**	0.035**
	(0.0007)	(0.0006)	(0.003)	(0.0003)	(0.003)	(0.016)
Constant	0.670	1.584	0.927	0.884	1.060	0.941
	(0.261)	(0.293)	(0.565)	(0.281)	(0.324)	(0.267)
No. of Observations	1393	1409	1094	936	855	1023
AR (1) Pr > z	0.002	0.358	0.085	0.000	0.000	0.000
AR (2) Pr > z	0.250	0.446	0.104	0.189	0.336	0.106
Hansen Test- Prob > Chi	0.633	0.962	0.955	0.334	0.605	0.263

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

4.4. Fixed Effect Instrumental Variable

IV-FE is employed to overcome the issue of correlation between the error term and independent variables while capturing unobserved country-specific effects. The estimated results are reported in Table 11. The main results are consistent with previously employed estimation techniques. For instance, the results of interaction terms are output volatility enhancing thereby destabilizing output growth. In the diagnostic analysis, the statistics of the Wu-Hausman test for endogeneity reveal that the treated endogenous variables and their variation can be treated as exogenous since the null hypothesis of exogeneity is accepted.

Table 11: IV-FE with Interaction Terms

Variables	Dependent Variable: Volatility of Output					
	Domestic Credit to Private Sector by Banks	Domestic Credit to Private Sector by Banks	Bank Branch per 100,000 adults	ATMs per 1,000 km²	Bank Lending-Deposit Spread	Bank Return on Assets
Volatility of Output $_{t-1}$	0.711***	0.709***	0.658***	0.660***	0.617***	0.710***
	(0.016)	(0.016)	(0.212)	(0.019)	(0.029)	(0.015)
Volatility of Inflation	0.003	0.003	0.009**	0.006**	0.002	0.004*
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Volatility of Terms of	0.002*	0.002*	0.006**	0.004**	0.002	0.002***
Trade	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Trade	0.001**	0.002**	0.002**	0.001**	0.001*	0.0004
	(0.0005)	(0.001)	(0.001)	(0.0008)	(0.001)	(0.0005)
Population	-0.003	-0.002	-0.053	-0.002	0.057	0.015
	(0.032)	(0.031)	(0.045)	(0.031)	(0.046)	(0.022)
Remittances	-0.013**	-0.011**	-0.022	-0.0003	-0.022**	-0.005
	(0.005)	(0.005)	(0.012)	(0.006)	(0.011)	(0.004)
Financial Development	0.00003	-0.0001	0.003	-0.002**	-0.032**	-0.048**
	(0.0007)	(0.0005)	(0.004)	(0.0007)	(0.012)	(0.022)
Remittances* Financial	0.0002**	0.0001*	0.001**	0.0003**	0.001*	0.002**
Development	(0.0001)	(0.0001)	(0.0008)	(0.0002)	(0.001)	(0.001)
Constant	0.759	0.760	0.856	0.880	1.107	0.813
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. of Observations	1654	1649	1096	1381	990	1070
R-Square	0.948	0.948	0.953	0.956	0.949	0.947
Wu-Hausman Stats	0.512	0.453	0.631	0.600	0.527	0.509

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

5. Conclusion

Output volatility is one of the macroeconomic channels faced in the path toward achieving stable output growth. There is a chain of financial and economic hazards that arise because of volatile output. Therefore,

understanding output volatility is critically important. The financial crisis of 2008 led to the failure of financial institutions that initially spilled over to the US economy and later to the majority of the world economies. Since the financial crisis induced an unexpected global economic slowdown, we are motivated to analyze what impact the development of the financial sector in terms of depth, access and efficiency may have on volatile output growth.

Remittances are the second largest and the most stable source of foreign capital flows, and their effects on output growth and the financial sector motivate us to investigate this study. This study examines the mediating impact of several indicators of financial development on the remittance-output volatility relationship using large panel data of 158 countries from the long period of 1971-2017. The output volatility is computed from five years moving the standard deviation of the cyclical component in per capita GDP constant 2010 US$. For remittances, the personal remittance variable is used. However, financial development is proxied using two measures in each of three features of financial development. For instance, financial depth is proxied by domestic credit provided by banks and credit to the financial sector, financial access is represented by bank branches per 100,000 adults and ATM per 1,000 km^2, and financial efficiency is represented by bank lending deposit spread and bank return on assets.

The role of the financial sector as a mediator in the remittance-output volatility nexus remains relatively neglected in the literature. Moreover, the recent empirics regarding remittances impact and the direct and mediating role of financial development for a large sample are also missing in the literature. To the best of our knowledge, this study is one of the first attempt of its kind to fill these gaps. The literature used common indicators of financial development for the mediating role, presenting an incomplete picture (Ahamada & Coulibaly, 2011; Adeniyi *et al.,* 2019). Moreover, they ignored the standard determinants of output volatility given by Beck *et al.* (2000) and have the limited number of estimation techniques employed. This study incorporates less explored indicators of financial depth along with unexplored measures of financial access and efficiency incorporating the multiple dimensional nature of financial development. Moreover, advanced System GMM and FE-IV techniques are also employed to address the econometric issues and reaffirm the findings.

The findings obtained from both employed specifications are robust and consistent. The results can be summarized as follows. The individual (direct) impact of remittances on volatility is negative and statically significant. This implies that remittance inflows act as a stabilizer for output volatility. Second, the direct impact of financial development is inconclusive since different measures have dissimilar impacts on output volatility. For instance, credit to the financial sector and credit provided by bank and bank branches increase output volatility. On the other hand, ATM per 1,000 km^2, bank lending-deposit spread, bank return on assets helps diminish output fluctuations. Third, the interaction effects of remittances with different measures of financial development have positive and significant impacts on output volatility. This implies that the negative (direct) impact of remittances on volatility is partly cancelled out.

The empirical findings of this study suggest the following policy recommendations. First, since remittances play an important role in diminishing output fluctuations, it may be encouraged by providing ease to the process of receiving remittance amounts so that stability in output can be achieved. Second, as few measures of financial development elevate output volatility while others deteriorate it, countries may execute control and consequently adopt specific reforms in the process of financial sector development. Third, as the findings suggest that the direct impacts of remittances are partly undone by the positive interaction effect, policymakers should ensure that such policies are formulated that minimize the meditating role of financial development in the remittance-output volatility relationship. Furthermore, policymakers may try to mitigate present output fluctuations as much as possible since output volatility has a strong and significant lag effect.

This study is open to the possibility of future research in the following areas: First, this study used several features and indicates of financial development one by one. The index of financial development can be generated by incorporating different proxies, so that the overall impact can be analyzed. Second, the possibility of getting effect by neighboring economies' shocks increases greatly as the economies are more integrated and globalized now. Therefore, further research can be done on isolating the spillover effects of neighboring shocks and then analyzing the impact on output fluctuations.

References

Abdih, Y., Dagher, J., Chami, R., & Montiel, P. (2008). Remittances and Institutions: Are Remittances a Curse?. *International Monetary Fund*, 8-29.

Acemoglu, D., & Zilibotti, F. (1997). Was Prometheus Unbound by Chance? Risk, Diversification, & Growth. *Journal of Political Economy*, *105*(4), 709–751.

Acemoglu, D., Johnson, S., Robinson, J., & Thaicharoen, Y. (2003). Institutional Causes, Macroeconomic Symptoms: Volatility, Crises and Growth. *Journal of Monetary Economics*, *50*(1), 49-123.

Acosta, P.A., Baerg, N.G., & Mandelman, F.S. (2009). Financial Development, Remittances, and Real Exchange Rate Appreciation. *Federal Reserve Bank of Atlanta*, *Economic Review 94* (1), 1–12.

Adeniyi, O., Ajide, K., & Raheem, I. (2019). Remittances and Output Growth Volatility: Does Financial Development Dampen or Magnify the Effects?. *Empirical Economics*, *56*(3), 865-882.

Aggarwal, R., Demirguc-Kunt, A., & Peria, M. (2011). Do Remittances Promote Financial Development?. *Journal of Development Economics, 96*, 255–264.

Ahamada, I., & Coulibaly, D. (2011). How Does Financial Development Influence the Impact of Remittances on Growth Volatility?. *Economic Modeling*, *28*(6), 2748-2760.

Arellano, M. & Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error-Components Models. *Journal of Econometrics*, 68, 29-51.

Bacchetta, P., & Caminal, R. (2000). Do Capital Market Imperfections Exacerbate Output Fluctuations?. *European Economic Review*, *44*(3), 449-468.

Beck, T., Levine, R., & Loayza, N. (2000). Finance and the Sources of Growth. *Journal of Financial Economics*, *58*(1), 261–300.

Beine, M., Lodigiani, E., & Vermeulen, R. (2012). Remittances and Financial Openness. *Regional Science & Urban Economics*, *42*(5), 844-857.

Bekaert, G., Harvey, C., & Lundblad, C. (2002). *Growth Volatility and Equity Market Liberalization* (Working Paper No.12). Duke University.

Bernanke, B., & Gertler, M. (1989). Agency Costs, Net Worth, and Business Fluctuations. *American Economic Review*, *79*(1), 14–31.

Bettin, G., Lucchetti, R., & Zazzaro, A. (2012). Financial Development & Remittances: Micro-Econometric Evidence. *Economics Letters*, *115*(2), 184-186.

Blundell, R. & Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics*, 87,115-143.

Bouoiyour, J., Miftah, A., & Selmi, R. (2014). *Do Financial Flows Raise or Reduce Economic Growth Volatility? Some Lessons from Moroccan Case* (MPRA Paper No. 57258). University Library of Munich, Germany.

Bugamelli, M., & Paterno, F. (2011). Output Growth Volatility and Remittances. *Economica*, *78*(311), 480-500.

Bugamelli, M. (2009). Output Growth Volatility and Remittances. *Economica*, *77*(441), 330-340.

Cecchetti, S. G., Genberg, H., & Wadhwani, S. (2005). *Asset Prices in a Flexible Inflation Targeting Framework* (Working Paper No. 8970). National Bureau of Economic Research.

Cermeno, R., Garcia, R., & Gonzalez-Vega, C. (2012). *Financial Development and Growth Volatility: Time Series Evidence for Mexico & the United States* (Working Paper No. 544). CIDE.

Chami, R., Hakura, D. S., & Montiel, P. (2012). Do Worker Remittances Reduce Output Volatility in Developing Countries?. *Journal of Globalization and Development*, *3*(1), 854-923.

Chami, R., Fullenkamp, C., & Jahjah, S. (2005). Are Immigrant Remittance Flows a Source of Capital for Development?. *IMF Staff papers*, *52*(1), 55-81.

Chami, R., Barajas, A., Cosimano, T., Fullenkamp, C., Gapen, M., & Montiel, P. (2007). Macroeconomic Consequences of Remittances. *IMF Staff papers*, *72*, 259-270.

Chami, R., Ernst, E., Fullenkamp, C., & Oeking, A. (2018). Is There a Remittances Trap?. *Finance and Development*, *55*(3).

Chowdhury, M. (2011). Remittances Flow and Financial Development in Bangladesh. *Economic Modelling*, *28*(6), 2600-2608.

Cihak, M., Demirgüç-Kunt, A., Feyen, E., & Levine, R. (2012). *Benchmarking Financial Systems around the World* (Working Paper No. 6175). World Bank, Washington, DC.

Coulibaly, D. (2009). Remittances, Financing Constraints and Growth Volatility: Do Remittances Dampen or Magnify Shocks?. *Economic Modelling, 32*, 193-212.

Craigwell, R., Jackman, M., & Moore, W. (2008). Economic Volatility and Remittances. *International Journal of Development Issues*, *9*(1), 25-42.

Desousa, J., and Duval, L. (2010). Geographic Distance and Remittances in Romania: Out of Sight, Out of Mind?. *Economie Internationale*, (1), 81-97.

Easterly, W., Islam, R., & Stiglitz, J. E. (2001). Shaken & Stirred: Explaining Growth Volatility. *Annual World Bank Conference on Development Economics*, 2000, 191-211.

Furceri, D., & Karras, G. (2007). Country Size and Business Cycle Volatility: Scale Really Matters. *Journal of the Japanese and International Economies*, *21*(4), 424-434.

Furceri, D., & Poplawski Ribeiro, M. (2008). *Government Consumption Volatility and Country Size* (Working Paper No. 17). Centre D'tudes Prospectives et D'Informations Internationales.

Gupta, S., Pattillo, C. A., & Wagh, S. (2009). Effect of Remittances on Poverty and Financial Development in Sub-Saharan Africa. *World Development*, *37*(1), 104-115.

Haddad, M., Lim, J., Pancaro, C., & Saborowski, C. (2013). Trade Openness Reduces Growth Volatility When Countries are Well Diversified. *Canadian Journal of Economics*, *46*(2), 765-790.

Hakura, D.S. (2009). Output Volatility in Emerging Market and Developing Countries: What Explains the Great Moderation of 1970–2003? *Czech Journal of Economic & Finance*, *59*(3), 229–254.

Jidoud, A. (2015). Remittances and Macroeconomic Volatility in African Countries. *International Monetary Fund,* 15-49.

Kose, M. A., Prasad, E. S., & Terrones, M. E. (2006). How Do Trade and Financial Integration Affect the Relationship Between Growth and Volatility?. *Journal of International Economics*, *69*(1), 176–202.

Loayza, N. V., Ranciere, R., Serven, L., & Ventura, J. (2007). Macroeconomic Volatility and Welfare in Developing Countries: An Introduction. *The World Bank Economic Review*, *21*(3), 343-357.

Majeed, M. T., & Noreen, A. (2018). Financial Development and Output Volatility: A Cross-Sectional Panel Data Analysis. *Lahore Journal of Economics*, *23*(1), 97-141.

Mobarak, A.M. (2005). Democracy, Volatility and Development. *Review of Economics and Statistics 87*(2), 348-361.

Rodrik, D. (1998). Why Do More Open Economies Have Bigger Governments?. *Journal of Political Economy*, *106*(5), 997 –1032.

Rumler, F., & Scharler, J. (2011). Labor Market Institutions and Macroeconomic Volatility in a Panel of OECD Countries. *Scottish Journal of Political Economy*, *58*(3), 396-413.

Svirydzenka, K. (2016). Introducing New Broad-based Index of Financial Development. *International Monetary Fund*, *16*(5).

Wacziarg, R., & Welch, K. H. (2003). Trade Liberalization and Growth: New Evidence. *National Bureau of Economic Research*, *73*, 726-730.

Wang, P., & Wen, Y. (2013). *Financial Development and Long-run Volatility Trends* (Working Paper No.54). FRB of St. Louis.

Appendix

Table 1A: Summary of Variables

Variables	Label by	Measured in	Sources
Dependent Variable			
Output Volatility	OV	Five years SD of cyclical component of GDP per capita constant 2010 US Dollars	Author's Calculation
Focused Variables			
Personal Remittances	PR	Percentage of GDP	WDI (2018)
Different Measures of Financial Depth			
Domestic credit to private sector by banks	DCB	Percentage of GDP	WDI (2018)
Domestic credit provided by financial sector	DCF	Percentage of GDP	WDI (2018)
Different Measures of Financial Access			
Bank branches per 100,000 adults	BB	Number	WDI (2018)
Automated Teller Machines (ATMs) per 1,000 km2	ATM	Number	FAS (2018)
Different Measures of Financial Efficiency			
Bank Lending-Deposit Spread	BS	Rate	IFS (2018)
Bank Return on Assets	BA	Percentage	Bankscope, Bureau van Dijk (BvD)
Control Variables			
First Lag of Output Volatility	OV(-1)	First lag of five years SD of cyclical component of GDP per capita constant 2010 US Dollars	Author's Calculation
Volatility of Terms of Trade	VTOT	Five years SD of Terms of Trade	Author's Calculation
Volatility of Inflation	VINF	Five years SD of inflation, consumer price index (2010 = 100)	Author's Calculation
Population Growth	POP	Annual Percentage	WDI (2018)
Trade Openness	TO	Percentage of GDP	WDI (2018)