



ORIGINAL CONTRIBUTION

Terms of Trade Volatility, Financial Integration and Macroeconomic Fluctuations: A Global Panel Analysis

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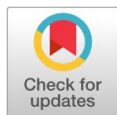
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Abstract— This study examines the relationship between terms of trade volatility, financial integration and macroeconomic fluctuations for 99 developed and developing economies over the period 1991-2021. The primary aim of the study is to explore the effects of terms of trade volatility on macroeconomic volatility, measured as output volatility, consumption volatility, and investment volatility. Additionally, the study assesses the moderating role of financial integration between terms of trade volatility and macroeconomic volatility. To achieve the objective, this study employed a dynamic panel generalized method of moments approach. The results provide substantial evidence that terms of trade volatility significantly increases macroeconomic volatility. However, the analysis also highlights that the greater international financial integration reduces the negative effect of terms of trade volatility on macroeconomic volatility. This suggests that financially integrated countries are better equipped to withstand terms of trade shocks, thereby minimizing their impact on macroeconomic volatility. The findings have important policy implications for global economies. Policymakers should therefore prioritize enhancing financial integration to cushion the effects of external shocks on economies. It is worth mentioning that by diversifying the exports and augmenting financial markets, countries can mitigate terms of trade volatility and enhance macroeconomic stability. Furthermore, by building up deeper financial integration and resilience-building mechanisms, economies could respond more efficiently to global economic shocks like terms of trade volatility.

Index Terms— Terms of trade volatility, Macroeconomic volatility, Dynamic panel GMM, Financial integration, Global panel analysis

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Introduction

Macroeconomic Fluctuations (MF) remain a central concern for policymakers and researchers alike. They are a manifestation of the instability of both domestic and external shocks, which weaken the stability of the global economy. The 2007-2008 Global Financial Crisis (GFC) likely reignited the discussion on studying the policies aimed at enhancing resilience to MF (Elgin, 2025). It also highlighted prominence of Financial Integration (FI) in cross-border transmission of economic shocks (Belke & Keil, 2016; Dedola & Lombardo, 2012). The term macroeconomic fluctuations refer to the fluctuation of the level of economic activities, output, employment, and inflation as well as balance of payment (Agénor et al., 2000). MF are an inseparable part of the economies and they influence all aspects of life including individual lives and stability of the world economies. The outcomes of turbulent macroeconomic environment become more and more significant. This is because of the fact that, an unsure macroeconomic climate gives way to low rates of investment which in turn impact negatively on poverty, income inequality and levels of

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education (Gavin & Hausmann, 1998). Empirical research has revealed the existence of a strong negative association between Output Volatility (VOutput) and enduring growth. Countries having greater exposure to macroeconomic instability are growing more slowly, making it sound that instability is an a priori negative factor on welfare and growth. Consequently, the potential pay-off in terms of welfare and growth in case of lowering instability is large. In an open-economy model, Macroeconomic Volatility (MV) is an issue of utmost concern (Loayza et al., 2007). Countries that have low output volatility have higher growth levels in the long run (Wang & Wen, 2011). Therefore, it is important to know the potential strategies of mitigating the liabilities associated with this volatility. The fear of uncertainty about future returns that come with high output volatility discourages the investment hence, slowing down the economic growth (Ahmed & Suardi, 2009).

Despite the many potential causes of MV, there is a growing corpus of work that suggests external factors, namely Terms of Trade Volatility (VTOT) (Avom et al., 2021) and Financial Integration (FI), are important causes of MV (Evans & Hnatkovska, 2007). The current study operationalizes MF in the form of MV through Output Volatility (VOutput), Consumption Volatility (VCONS), and Investment Volatility (VINVS). VTOT is defined as changes in a nation's export and import relative pricing (Silver, 2007). Variations in the TOT consistently raise concerns among policymakers across developed and developing countries. A country's output and trade balance may change because of significant trade variations (Backus et al., 1992). VTOT have powerful real effects. A positive TOT shock (rising export prices) raises real national income and purchasing power, spurring higher consumption and investment, and often lowering sovereign borrowing costs by improving debt-servicing capacity. Conversely, a decline in export prices reduces income, forces real exchange-rate depreciation, and can increase financial stress (Monterroso & Vilán, 2025).

Despite the extensive literature regarding the effects of TOT, FI, and MV, the research has not provided clear direction on measuring TOT shocks as an impetus for a nation's foremost macroeconomic indicators, despite the fact that they are frequently regarded as a significant contribution to business cycle fluctuations. The predictions of business cycle models suggest that TOT shocks are culpable for 30 and 50 percent of the volatility in output (Kose, 2002; Mendoza, 1995). This is a theoretical proposition that may be derived from the predictions of business cycle models. Nevertheless, according to empirical findings provided by Schmitt-Grohé and Uribe (2018), TOT shocks are accountable for approximately ten percent of the variability in output. The literature is limited in offering definitive results from a comprehensive approach about the significant role of TOT on macroeconomic instability. Besides VTOT, other factors such as financial integration also emerged as the key driver of macroeconomic instability. In the past couple of decades, world economies have also become much more financially interlinked. Outward and inward capital flows toward emerging markets have grown enormously since 1980 (Kose et al., 2003) when countries liberalized cross-border investments. From a theoretical perspective, this deeper interlinkage holds two possible, but opposite effects on volatility. First, the accessibility of world capital can provide insurance and risk sharing: capital-scarce economies can borrow abroad and smooth consumption, and risk-sharing arrangements may dampen domestic shocks (Kose et al., 2006). Foreign direct investment inflows, for instance, may finance new industries, lowering reliance on any specific commodity. Second, FI can promote specialization through comparative advantages, increasing exposure to sector-specific shocks, and may subject countries to reversal of capital flow surprises. Without vigorous domestic markets, a volatile boom–bust cycle may be created by sudden stops (Kose et al., 2006). This theory is ambiguous. Financial openness might lower volatility via smoothing, or increase it by channeling global shocks into domestic economies.

Empirical findings are equally mixed. Some research suggests that opening up financially has been stabilizing on average. Bekaert et al. (2002) demonstrate that equity market liberalizations and capital account openness are connected with a reduction in output and consumption volatility. Hausmann and Gavin (1996) reported that financial liberalization and VOutput in developing nations do not significantly correlate. Kose et al. (2003) found that FI by itself has little impact on VOutput. Hence, by studying, we have found mixed results on the relationship between VTOT and MV and between FI and MV. Besides this, the literature offers only fragmented insights into what moderates the transmission from TOT movements to macroeconomic volatility. Since economic stability is most important to long-term growth and policy formation, knowledge about all the transmissions that influence TOT volatility on macroeconomic fluctuations is crucial for policymakers and economies to hedge against volatility in order to ensure stability and for welfare maximization. This work adds three contributions to the existing literature; first, it captures the role of international FI as a moderating factor in the relationship between VTOT and MV. The study uses 'Total Foreign Direct Investment (TFDI) assets and liabilities' as a comprehensive measure, rather than relying on conventional, narrower proxies for FI. Second, much of the existing research focuses on either developed or developing countries, limiting the generalizability of findings. By constructing a large panel dataset of 99 developed and developing countries, this study provides a global perspective on the direct and indirect relationship between VTOT and MV. Third, the study investigates the direct and indirect effects of VTOT on VOutput, VCONS, and VINVS. This augments knowledge regarding the transmission of VTOT and clarifies the differentiated effects on sub components of aggregate demand, especially the elastic components. Hence, the main research question is whether FI increases or decreases the negative impacts of VTOT on MV. The dynamic between VTOT, FI and MF is of special interest to policymakers who want to use these variables to stabilize the economy.

Literature Review

The literature has widely discussed the association between VTOT, FI, and MV. The impacts of VTOT and FI on macroeconomic variables have been examined using different data sets and methods. As a result, the literature is inconclusive concerning the impact that VTOT and FI have on MV. The following discussion covers the most relevant aspects of this relationship. This has entailed analysis of the effect of VTOT on MV preceding the

analysis of the relationship that FI has with MV. The first research that tested the linkage between TOT shocks and the business cycle variations was by Mendoza (1995) who discovered that TOT shocks explain 37 per cent of the volatility in output when applied to import prices, and 56 per cent when applied to domestic prices. The author observed that TOT shocks in the developing nations are more, enduring and less pro-cyclical than in the G7 and more volatile because of pro-cyclical utilization of imported capital goods and exporting of commodities. As a result, developing countries experience elevated MV. Using a similar framework to Mendoza, Kose (2002) estimates that TOT shocks account for about 88% volatility in the business cycle. These factors explain 90% of Investment Volatility (VINVS) and the main reasons for the changes in the other variables. The relationship between VTOT and MV has been studied, mainly how external shocks affect the economy's stability. Avom et al. (2021) pointed out that VTOT highly influences Growth Volatility (GV), especially in African countries. However, institutional quality and financial development alleviate the negative effects of VTOT on GV. Drawing on the same context, Alimi and Aflouk (2017) noted the effects of heterogeneity based on the economic structures whereby commodity exporters have greater output volatility as compared to exporters of manufactured goods.

For specific country analysis, Rodríguez et al. (2018) explain that for Peru, external shocks to the TOT outweigh the impact of domestic productivity on economic fluctuations and have long-run effects on public investment and expenditures. Kpodar et al. (2019) claimed that with the greater financial system's depth, particularly the banking system when compared to the stock market, the economy can be insulated from the transmission of Terms of Trade (TOT) shocks. In Sub-Saharan Africa (SSA), employing instrumental variables (2SLS), Yaya (2025) shows that growth volatility is exacerbated by TOT shocks and discretionary policies. Nonetheless, the fiscal rules support in minimizing adverse effects. In contrast, fixed exchange rate regimes are likely to make growth more volatile, this brings up the need for selective fiscal policies as well as exchange rate frameworks to strengthen resilience. Shahzad and Miao (2025) examined the link between TOT components, labor, capital and investment, in U.S. In a similar vein Shaheen (2025) explores the effect of export diversification and TOT shocks on the labor markets of Emerging and Developing Economies (EMDEs). The period 2000 to 2023 has been analyzed by Marquetti et al. (2025) in the context of profit rates, exchange rates, and TOT in the Brazilian economy to determine the relationship that these three factors have with one another. In addition, Kweka (2024) studies the relationship between VTOT and tax revenue in SSA, showing that the tax-to-GDP ratio benefits from changes in terms of trade, while its volatility has indirect negative impacts. In SSA, tax revenue is often negatively impacted by informal economic activity. Consequently, fluctuations in TOT hinder the expansion of GDP per capita and tax base in Sub-Saharan Africa. To lower the risks of a declining tax base in SSA, the findings suggest that hedging the risks associated with VTOT, expanding agricultural production, and speeding up the formalization of informal sectors are all necessary.

The empirical studies carried out thus far also examined the effects of TOT and VTOT on output and growth at the level over the short and long terms. There is still conflicting and equivocal evidence, with some research supporting the positive link between TOT and economic growth (Basu & McLeod, 1991; Blattman et al., 2003, 2004, 2007; Bleaney & Greenaway, 2001; Deaton, 1999; Ding & Field, 2005; Eicher et al., 2008; Grimes, 2006; Kaneko, 2000; Kehoe & Ruhl, 2008; Kose & Riezman, 2001; Mendoza, 1997; Rodríguez et al., 2018; Schmitt-Grohé & Uribe, 2018; Singh, 2023). There are studies that point to the opposite effect of TOT on economic output and growth (Hadass & Williamson, 2003; Turnovsky & Chattopadhyay, 2003). Furthermore, research shows that VTOT causes economic unpredictability, lowers investment motivation, and changes spending and saving patterns, which in turn negatively impacts a country's external balances (Broda, 2004; Mendoza, 1997). Increased VTOT, or volatility of terms of trade, also makes fixed capital investment difficult due to the uncertainty over potential returns (Servén, 2003). Lastly, a drop in the TOT is associated with capital flight, a decrease in Foreign Direct Investment (FDI), and declines in infrastructure investment, all of which negatively impact economic development in the long run (Aghion et al., 2009). Harberger (1950) and Laursen and Metzler (1950) argue that a decline in the TOT negatively impacts the current account balance through a reduction in savings. Contrarily, Obstfeld (1982) argues HLM (Harberger-Laursen-Metzler) effect posits a sustained decline in TOT that would improve the current account balance by increasing savings. We also found that the impact of TOT shocks on growth fluctuations varies with the estimation techniques employed in the literature. While calibrated dynamic business-cycle models (Kose & Riezman, 2001; Mendoza, 1995) find VTOT to have a significant effect on growth fluctuations, SVAR models (Schmitt-Grohé & Uribe, 2018) find the effect to be minimal. The difference in findings is striking; the latter finds the effect to be in the range of 10 to 15 percent. Studies conducted using DSGE models have concluded that Terms of Trade (TOT) shocks are of little relevance when explaining the business cycle. To summarize, the literature demonstrates that VTOT is of considerable importance for macroeconomic stability, with the effects being different for each economy. Although high VTOT typically works to impede growth, a country's ability to withstand and legally pursue growth at a high level, having strong financial systems, fiscal policies, and institutional frameworks, can help to offset the negative effects of VTOT.

Similarly, a considerable amount of literature has examined the relationship between FI and MV and has provided insights into the relationship's intricate dynamics. According to traditional theories of international macroeconomics, FI is a discretionary macroeconomic policy that stabilizes macroeconomic volatility; production risk insurance reduces excessive output volatility (Kalemli-Ozcan et al., 2003). Others disagreed, arguing that FI raises output variability through production efficiency. Because of the capital shortage and reliance on foreign capital for domestic production, it affects output. However, as FI promotes income risk sharing among nations, the second body of study focuses on the consumption smoothing effects of FI. Access to international financial assets will enable domestic inhabitants to diversify their portfolios (Baxter & Crucini, 1995; Buch et al., 2005; Rogoff, 1995; Sutherland, 1996). According to the imperfect markets assumption, a recent body of literature claimed that there is a non-linear relationship. They projected a U-shaped relationship using an analytical model, demonstrating that output and consumption volatility rise with increased financial integration; however, the volatility decreases as integration rises (Evans & Hnatkovska, 2007).

Empirical findings show mixed results. For instance, Makoto (2020) suggests that financial integration (FI) has no impact the Consumption Volatility (VCONS) while adversely affecting the volatility of output. In a study, Hausmann and Gavin (1996) analyzed the causes of output volatility in developing countries from 1970 to 1992, and found a strong positive relationship between the volatility of output and the volatility of capital flows. Examining output volatility, Easterly (2000) showed that the domestic financial sector's development lowers the volatility. In contrast, they also noted that increased Trade Openness (TO) is connected to greater output volatility, particularly in developing nations. They concluded that capital flows, as well as financial openness; do not meaningfully affect output volatility. Dada et al. (2025) claim that the impact of financial globalization on the instability of macroeconomic variables is considerable. While examining the effects of FI over time, Mujahid and Alam (2014) analyzed the phenomenon for a steadier relationship. They found that while largely affecting VOutput, in long run, FI primarily constrains both VOutput and VCONS in short run. Carp (2014) posits that capital volatility resulting from financial globalization might slow down economic growth. In addition, Mirdala and Svrčeková (2014) observe that the FI contributes to instability on the macroeconomic level. Because capital flows in developing economies are more sensitive than in developed ones, this effect is more noticeable there. Financial integration lowers macroeconomic volatility more successfully in industrialized nations than in Asian nations, claim Yadav et al. (2019). According to their findings, macroeconomic volatility possesses a favorable association with inflation but has an unfavorable relationship with financial openness, trade openness, and broad money. Nonetheless, financial liberalization has a negligible effect. Using a DSGE model, Ghazouani et al. (2019) found that more financial integration typically lowers volatility in the short run. However, following monetary policy shocks, financial integration tends to reduce consumption volatility and nominal and real interest volatility while simultaneously increasing production and nominal exchange rate volatility. However, Guru and Yadav (2021) discovered that while financial openness largely increases productivity in less developed nations, it also considerably increases capital accumulation and productivity in developing nations. Furthermore, they found that in more open countries, the negative consequences of currency crises on capital accumulation and growth are more noticeable. Thus, a comprehensive analysis of key literature indicates that the impact of FI on macroeconomic variables also remains indeterminate.

Data and Methodology

Data and variables

For model evaluation, we used a sample of 99 countries, both developed and developing, covering the years 1999 to 2021. The countries and time-periods are chosen based on the systematic and thorough availability of data for the various variables. Macroeconomic variables are taken from the 'World Development Indicators', as it contains a broad array of recognized international indicators and data. The FI variables used in the study came from the dataset of (Lane & Milesi-Ferretti, 2025). This dataset is a revised version of the 'External Wealth of Nations Mark II' database (Lane & Milesi-Ferretti, 2007), with extensions in (Lane & Milesi-Ferretti, 2018), 'The External Wealth of Nations Revisited (IMF Economic Review)'. Such data sources underpin solid analysis of FI across various economies. In this context, Indicators employed to proxy macroeconomic fluctuations include VOutput, VCONS, and VINVS. Therefore, the principal explanatory variable is VTOT, while, among others, Interest Rate Volatility (VIR) is a control variable. Volatility of these variables is measured by the rolling window standard deviation of Voutput, VCONS, VINVS, VTOT, and VIR. Many studies utilize this framework because it rationally captures the intricate characteristics of volatility (Arezki et al., 2014; Kose et al., 2003; Marioli et al., 2024). In addition, in line with the established norms in the literature, we incorporate a range of control variables, which include GDP Per Capita (GDPPC), Trade Openness (TO), Population (POP), Agricultural Value Added (AVA), Manufacturing Value Added (MVA), and Interest Rates Volatility (VIR). Descriptive statistics of the variables used are provided in the appendix, Table IV.

Model and estimation methodology

The conceptual framework of the study is outlined in Figure 1. It is crucial to understand all the possible channels and important factors that affect the transmission of VTOT on MV. Hence, by taking into account the moderating effect of FI between VTOT, and MV, the study may be capable of providing insight into the potential effects of influence.

Hence, the study adopts linear models as per Avom et al. (2021). We estimate the following three equations to achieve the objective.

$$VOutput_{it} = \alpha_1 VOutput_{i,t-1} + \beta_1 VTOT_{i,t} + \gamma_1 FI_{i,t} + \delta_1 (FI_{i,t} * VTOT_{i,t}) + AX_{i,t} + u_{1i} + \tau_{1t} + \varepsilon_{1(i,t)} \quad (1)$$

$$VCONS_{it} = \alpha_2 VCONS_{i,t-1} + \beta_2 VTOT_{i,t} + \gamma_2 FI_{i,t} + \delta_2 (FI_{i,t} * VTOT_{i,t}) + A'X_{i,t} + u_{2i} + \tau_{2t} + \varepsilon'_{2(i,t)} \quad (2)$$

$$VINVS_{it} = \alpha_3 VINVS_{i,t-1} + \beta_3 VTOT_{i,t} + \gamma_3 FI_{i,t} + \delta_3 (FI_{i,t} * VTOT_{i,t}) + A''X_{i,t} + u_{3i} + \tau_{3t} + \varepsilon''_{3(i,t)} \quad (3)$$

Where VOutput_{it} stands for output volatility of country *i* in year *t*, VCONS_{it} stands for consumption volatility, and VINVS_{it} stands for investment volatility. VTOT is a term of trade volatility. FI stands for financial integration. Control variables, represented by the vector *X*, include GDPPC, TO, VIR, POP, AVA, and MVA. We have incorporated the lagged dependent variables in order to account for catching-up effects α_1 VOutput

$i, t-1$, α_2 VCONS $i, t-1$, and α_3 VINVS $i, t-1$. Furthermore, τ_{1t} , τ_{2t} , τ_{3t} , and u_{1i} , u_{2i} , and u_{3i} and represent time and country fixed effects, respectively. Whereas, $\varepsilon_{1(i,t)}$, $\varepsilon'_{2(i,t)}$, $\varepsilon''_{3(i,t)}$ are the error terms of three equations. The inclusion of a lag-dependent variable on the right side of the equation invalidates standard static panel regression (Nickell, 1981). To address the issue of dynamic panel bias, we employ the System GMM estimator, an enhancement of the earlier Difference GMM (Arellano & Bond, 1991), as developed by Arellano and Bover (1995) and Blundell and Bond (1998). Endogeneity issues associated with explanatory variables can be addressed through System GMM estimation. Endogeneity is minimized by employing the lags of the independent variables as instruments. A valid System GMM estimate is contingent upon several conditions.

The purpose of the over-identification test, or the Hansen test, is to assess the validity of the instruments and determine whether they are correlated with the instruments or with the error term. The Hansen test is also preferred because it is more robust to heteroscedasticity and to autocorrelated errors than the Sargan over-identification test (Roodman, 2009). The Hansen test is mostly too vulnerable to instrument proliferation, which creates more interest in the "collapse" command. Arellano and Bond's AR (2) autocorrelation test aims to determine the first-order correlation of the residuals in levels and examine the second-order serial correlation of the errors in differences. This correlation was created by the development of the GMM system estimator, which results in first-order correlation in the error terms of the initial differences. The evaluation of the Hansen test about the quality of the selected instruments and the absence of second-order autocorrelation in the errors of the AR (2) difference equation shows the validity of the GMM system estimator. The use of the GMM system involves two-step estimation and the implementation of dmeijer's finite-sample corrected standard errors. As stated by Cameron et al. (2010), the two-step System GMM estimation, in comparison to the one-step estimation, has been shown to provide better asymptotic efficiency. In theory, standard errors for idiosyncratic error terms generated from two-step estimation account for serial correlation and heteroskedasticity. Bond et al. (2001) argue that standard errors will be biased downward even with two-step estimation due to sample size. To address the gap between theory and practice, Windmeijer (2000) suggests applying finite sample adjustments to the standard errors in two-step estimation.

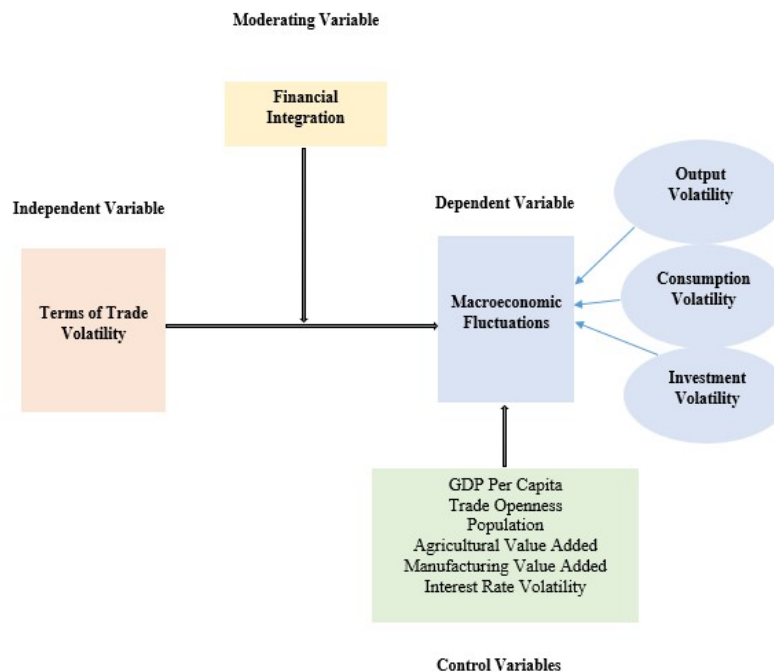


Fig. 1 Conceptual framework

Empirical Results and Discussion

Unit root tests

When analyzing panel data, it is important to examine the sequence of variable integration in order to decide which estimating technique to use. In the panel, we implemented unit root tests, specifically Im-Pesaran-Shin (IPS) and the Fisher-type (ADF and PP) tests, as documented in Table I. The integration order results show the importance of applying multiple tests to counter bias and confirm the reliability of the results. The outcome across the unit root tests shows that nearly all the variables are stationary at the level. The exceptions being Financial Integration (FI), Population (POP), and Manufacturing Value Added (MVA), which are first differenced stationary.

Table I
Unit root tests

Variables	IPS	FADF	FPP	Order of Integration
VTOT _{it}	-8.919*** (0.000)	1057.777*** (0.000)	539.428*** (0.000)	I(0)
VOutput _{it}	-4.054*** (0.000)	317.389*** (0.000)	327.406*** (0.000)	I(0)
VCONS _{it}	-3.851*** (0.000)	2310.037*** (0.000)	652.626*** (0.000)	I(0)
VINVS _{it}	-26.702*** (0.000)	964.807*** (0.000)	233.186*** (0.000)	I(0)
FI _{it}	-2.96*** (0.000)	717.288*** (0.000)	946.107*** (0.000)	I(1)
GDPPC _{it}	-6.850*** (0.000)	365.024*** (0.000)	1735.045*** (0.000)	1(0)
TO _{it}	-1.99*** (0.000)	374.547*** (0.000)	411.679*** (0.000)	I(0)
POP _{it}	-13.223*** (0.000)	614.932*** (0.000)	455.886*** (0.000)	1(1)
AVA _{it}	-5.990*** (0.000)	484.960*** (0.000)	924.264*** (0.000)	I(0)
MVA _{it}	24.687*** (0.000)	376.890*** (0.000)	461.701*** (0.000)	I(1)
VIR _{it}	-7.4521*** (0.000)	409.522*** (0.000)	784.062*** (0.000)	I(0)

The null hypothesis for the Im–Pesaran–Shin (IPS), Fisher-ADF, and Fisher-PP tests is that the series contains a unit root. Rejection of the null at conventional levels (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.10$ implies stationarity. Estimated coefficients are reported with p -values in parentheses. The results indicate that variables are of mixed order of integration, with some stationary at levels I(0) and others becoming stationary after first differencing I(1). P values are given in parentheses.

Dynamic system GMM outcomes

Table II presents the outcomes of the impact of VTOT on MF measured as VOutput, VCONS, and VINVS. The dynamic panel SGMM estimation provides compelling evidence that VTOT significantly affects the MV. In all three models, the evidence of strong persistence in macroeconomic volatility is confirmed by the significant and positive coefficients on lagged dependent variables VOutput, VCONS, and VINVS. These findings suggest volatility is not only transitory; rather, it comprises structural inertia. Table II demonstrates that, regardless of the used specification, the term associated with the VTOT is positive and statistically significant in three models. Hence, the positive VTOT coefficient that is also statistically significant in column 1 shows that VTOT elevates VOutput. It is consistent with Avom et al. (2021) findings, which suggest VTOT continues to be the most important growth volatility determinant. Columns 2 and 3 also describe the significant effects of VTOT on VCONS and VINVS, respectively, with significant coefficients. Furthermore, financial integration has a statistically significant negative coefficient in all specifications and highlights its stabilization function. Hence, financial integration tends to reduce volatility through the provision of international risk sharing, smoothing consumption, and foreign finance accessibility in the face of adverse shocks, as highlighted by Obstfeld (1992) and Kose et al. (2009). From the control variables, GDPPC corresponds to with lower volatility; the variable is negative and statistically significant in all three models. It proposes macro volatility in three aspects: output, consumption, and investment volatility decline at a greater income level. This has been consistent with other findings that with higher wealth, output volatility becomes lower in both advanced and developing countries (Avom et al., 2021; Kpodar et al., 2019). In all specifications, trade openness has been found to contribute to higher macroeconomic volatility, consistent with (Avom et al., 2021). Therefore, with regard to population, there is a significant negative relationship with VOutput, VCONS, and VINVS in all specifications. This conforms to the findings of Furceri and Karras (2007) and Karras (2006) that larger nations experience lower volatility in their cycles. Larger nations are said to experience lower shocks and volatility (Head, 1995), and that is not unexpected. Agricultural value added has a positive contribution, likely because the sector is more prone to value and climatic changes. The positive contribution of Agricultural Value Added (AVA) indicates that export-oriented nations are more economically volatile, which is consistent with findings by Avom et al. (2021). MVA reduces the volatility of output, consumption, and investment. This is aligned with the findings of Moro (2015) and Elhiraika et al. (2014). Interest rate volatility is positively correlated with all proxies for macroeconomic volatility. This depicts the destabilizing influence of monetary uncertainty. This correlates with Clarida (2001), where the authors explain that policy uncertainty, especially in the context of countries with weak independence of central banks or inconsistent monetary policies, translates to economic instability. The results of the diagnostic tests also validate the reliability of the

model, where there is no evidence of second-order autocorrelation AR (2), and the Hansen *J*-test *p*-values are in the reasonable range, confirming the used instruments are legitimate. The results suggest that VTOT is a significant source of MV, although the impact can be reduced with a higher level of FI.

Table II
Effect of VTOT on VOutput, VCONS, and VINVS

Variables	Model 1 VOutput	Model 2 VCONS	Model 3 VINVS
VOutput _{it}	0.790** (0.303)		
VCONS _{it}		0.619*** (0.027)	
VINVS _{it}			0.735*** (0.040)
VTOT _{it}	0.053** (0.024)	0.032*** (0.006)	0.076*** (0.019)
FI _{it}	-0.020*** (0.0007)	-0.026*** (0.003)	-0.034*** (0.003)
GDPPC _{it}	-0.011** (0.005)	-0.014** (0.007)	-0.012** (0.005)
TO _{it}	0.0113*** (0.004)	0.0147* (0.0087)	0.013*** (0.002)
POP _{it}	-0.104** (0.042)	-0.184*** (0.005)	-0.175*** (0.008)
AVA _{it}	0.072*** (0.005)	0.085*** (0.029)	0.088*** (0.020)
MVA _{it}	-0.075*** (0.004)	-0.072*** (0.0047)	-0.077*** (0.003)
VIR _{it}	0.013** (0.006)	0.015** (0.007)	0.021*** (0.008)
C	0.057** (0.027)	-0.050*** (0.007)	-0.065*** (0.009)
Observations	1,644	1,643	1,643
Number of Country ID	99	99	99
Instruments	54	55	53
AR (1) <i>p</i> -value	0.000	0.001	0.000
AR (2) <i>p</i> -value	0.393	0.273	0.426
Hansen <i>p</i> -value	0.215	0.190	0.124

Notes: *, **, and *** demonstrate significance at the 10%, 5%, and 1% levels, respectively. Robust standard errors are enclosed in parentheses. The Hansen test, AR(2), and AR(1) reported *p*-values evaluate the validity of the instrument and serial correlation.

Table III shows SGMM results while considering the moderating effect of FI between VTOT and MV. When we added the moderating effect of FI or its interaction term, the effect of VTOT on MV remained unchanged in all the specifications within the three models. The results portray VTOT as a significant source of MV, regardless of the volatility metric used. This shows VTOT has significant effect on MV. The impact is most pronounced on the investment volatility. Furthermore, the negative statistically significant interaction terms suggest that FI mitigates the adverse effect of VTOT on MV in all specifications. This reflects the ability of global capital market access to help economies smooth out VTOT-induced output, consumption, and investment risk. Global financial market integration allows countries to cope with the destabilizing effect of external price shocks. This is consistent with the international risk-sharing theory (Kose et al., 2009; Obstfeld, 1992). Our findings support the proposition that FI enhances resilience; this is likely contingent on the presence of robust macro-financial institutions. The decrease in volatility associated with GDPPC is in line with the notion that wealthier countries possess well-developed institutions and market structures that absorb and mitigate shocks. POP and MVA also seem to lower volatility across all three columns on varying specifications. On the other hand, TO, AVA, and VIR stand out as factors contributing to elevated macroeconomic volatility. Additionally, the lower panel of Table III provides diagnostic tests that show that autocorrelation is not an issue, as indicated by AR (2). Furthermore, the Hansen test demonstrates the accuracy of the instruments as it is impossible to reject the null hypothesis.

Table III
Moderating effect of FI between VTOT and VOutput, VCONS, and VINVS

Variables	Model 1 VOutput	Model 2 VCONS	Model 3 VINVS
VOutput _{it}	0.807** (0.312)		
VCONS _{it}		0.609*** (0.174)	
VINVS _{it}			0.867*** (0.227)
VTOT _{it}	0.035*** (0.013)	0.165*** (0.038)	0.043** (0.019)
FI _{it}	-0.0109*** (0.002)	-0.023** (0.010)	-0.046*** (0.008)
FI _{it} * VTOT _{it}	-0.048*** (0.009)	-0.014** (0.006)	-0.051** (0.020)
GDPPC _{it}	-0.012** (0.005)	-0.011*** (0.004)	-0.078*** (0.009)
TO _{it}	0.045*** (0.009)	0.480*** (0.015)	0.014*** (0.001)
POP _{it}	-0.065** (0.026)	-0.045** (0.022)	-0.0052* (0.003)
AVA _{it}	0.042** (0.019)	0.005*** (0.001)	0.025* (0.014)
MVA _{it}	-0.079*** (0.027)	-0.053** (0.023)	-0.033*** (0.0026)
VIR _{it}	0.075*** (0.017)	0.033*** (0.007)	0.014*** (0.001)
C	0.0691*** (0.017)	0.026** (0.012)	0.072*** (0.010)
Observations	1,644	1,643	1,643
Number of Country_ID	99	99	99
Instruments	56	32	49
AR (1) (<i>p</i> - value)	0.000	0.067	0.057
AR (2) (<i>p</i> - value)	0.251	0.397	0.268
Hansen (<i>p</i> - value)	0.186	0.294	0.241

Notes: *, **, and *** demonstrate significance at the 10%, 5%, and 1% levels, respectively. Robust standard errors are enclosed in parentheses. The Hansen test, AR(2), and AR(1) reported *p*-values evaluate the validity of the instrument and serial correlation.

Conclusion

The GFC reinvigorated the discussion of policies to increase resilience to MF. This brings up the issue of FI. Greater FI may make economic shocks worse or less severe. The idea that greater FI may actually worsen the effects of economic shocks stems from the fact that foreign capital flows, especially short-term ones, exhibit notable pro-cyclical behavior. However, through international risk-sharing and intertemporal replacements, increased financial integration can assist a nation in stabilizing its internal investment and consumer spending, therefore lessening the impact of shocks. In order to get broader generalizations of the results, this study first focuses on global panel analysis. Second, this study analyzes the moderating effect of international financial integration between VTOT and MV. The study looks at the possibility that FI could be more resilient against VTOT. Hence, this research explores the association between VTOT, FI and MF across 99 countries, encompassing developed and developing economies from 1991 to 2021. Based on the dynamic system GMM estimation technique, the findings suggest that the VTOT increases MV. More importantly, the study underlines the moderating role of FI, which lessens the negative consequences of TOT volatility to MV. Hence, results are also robust because a wide range of MV determining variables such as GDPPC, TO, POP, AVA, MVA, and VIR have been included. The implications of our study are interesting to policymakers. From the policy angle, the results show that strengthening financial integration should become a policy priority. The policies that promote the integration of financial markets, diversification of export markets, and stabilization of volatile TOT should be able to remove adverse impacts of VTOT on MV, therefore increasing the degree of economic stability. The research supports the view that MV can be triggered by VTOT. This work provides some useful insights; however, there are some limitations to the work. One possible limitation of this work is the use of panel data. While this approach helps to generalize in a larger way, it might miss the considerable

heterogeneity in and across different regions. Future work may enhance the analysis by reconfiguring the data at regional, even country-level, and evaluating the extent to which countries and by extension, regions respond differently to VTOT. Furthermore, future studies could investigate the sectoral transmission of VTOT by evaluating specific sectors, e.g. agriculture and manufacturing, to better to understand sectoral heterogeneity.

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Appendix

Table IV
Descriptive statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
VTOT _{it}	0.277	0.076	0.230	1.450
VOutput _{it}	0.0295	0.062	0.005	1.533
VCONS _{it}	3.777	0.291	0.312	3.852
VINVS _{it}	0.337	0.041	0.0131	0.443
Flit	18.203	5.738	-1.930	32.721
GDPPC _{it} (log, constant USD)	8.699	2.052	-1.332	24.264
TO _{it} (% of GDP)	92.796	58.572	9.036	442.62
POP _{it} (growth rate %)	1.285	1.526	-5.280	19.360
AVA _{it} (% of GDP)	8.697	8.371	0.013	57.239
MVA _{it} (% of GDP)	13.068	6.833	0.397	49.879
VIR _{it}	3.316	3.972	0.0001	20.183