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Financial Development, Financial Instability, and Fiscal Policy Volatility: International Evidence*

By **Ma Yong and Lv Lin***

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Abstract

This paper investigates the effects of financial development and financial instability on fiscal policy volatility using system GMM estimator based on panel data of 96 countries from 1990 to 2019. We find that higher levels of financial development are associated with lower fiscal policy volatility, but an increase in financial instability would lead to greater volatility in fiscal policy. We also find that the harmful effect of financial instability on fiscal policy conduct would be alleviated in the normal phase of the financial cycle but would be magnified during expansionary, recessionary and crisis periods. This paper extends the existing literature by highlighting the role of finance in fiscal policy volatility, where a large and stable financial system is conducive to the smooth conduct of fiscal policy.

JEL Classification: H39, E62, E63
Keywords: Financial development; Financial instability; Financial cycle; Fiscal policy volatility

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1. Introduction

Despite the emerging literature on the economic, political and institutional determinants of fiscal policy volatility, few, if any, have discussed the potential role of financial factors such as financial development, financial instability and financial cycles in affecting fiscal policy volatility. However, the conduct of fiscal policy is surely related to financial factors and there are various channels through which finance may influence fiscal policy behavior. For example, fiscal deficits need to be financed by financial resources, whose availability largely depends on the level of financial development. Another example is the impact of financial cycle. Typically, during the upward phase of the financial cycle, we can see an expansion of the business cycle, which is usually accompanied by increased government revenue and expenditures. In contrast, during the downward phase of the financial cycle, especially in times of financial instability, the business cycle enters into a phase of uncertainty, which usually leads to an increase in fiscal policy volatility.

Given the lack of studies on the role of finance in fiscal policy volatility, this paper attempts to partially fill in this gap by examining the impact of financial development, financial instability and financial cycle on fiscal policy volatility using a large dataset covering around 96 countries over the period 1990–2019. This paper contributes to the existing literature in the following aspects:

First, in contrast to the majority of the literature that focuses primarily on the economic and institutional determinants of fiscal policy volatility, our paper highlights the important role of finance in determining fiscal policy volatility. In particular, we have identified two main channels that finance may play a role in affecting fiscal policy volatility: (i) financial development channel; and (ii) financial instability channel. While the first channel has a smoothing effect on fiscal policy volatility, the latter channel has the opposite effect. These results imply that a large and stable financial system is conducive to the smooth conduct of fiscal policy. This conclusion is proved to be valid across various robustness checks. Besides the impact of financial development and financial instability, we also find that economic growth, inflation rate, public debt, fiscal crisis, banking crisis, population, trade openness, financial openness, and IMF-supported programs are also important determinants of fiscal policy volatility. These findings add new evidences to the previous literature on the various determinants of fiscal policy volatility (e.g., Agnello and Souza, 2014; Cevik and Teksoz, 2014).

Second, by examining the interaction effects of financial development and financial instability on fiscal policy volatility, we find that the volatility effect of financial instability on fiscal policy decreases at higher levels of financial development. This means that, as a country becomes more financially developed, the magnifying effect of financial instability on fiscal policy volatility would be smaller. Moreover, by comparing the behavior of government revenue with that of government spending, we find that the marginal effect of financial development on reducing the impact of financial instability on government revenue is more pronounced than that on government spending, suggesting that government revenue policy may benefit more from a large and well-developed financial system in that the policy behavior of government revenue would be better stabilized than that of government spending at higher levels of financial development. These results cast interesting new insights into the recent burgeoning literature on the two-way inter-connections between finance and fiscal policies (Bénétrix and Lane, 2010; Lane, 2011; Obstfeld, 2013; Aghion et al., 2014; Yépez, 2018).

Third, our estimation strategy differs from the previous literature in that we do not use non-overlapping multi-year averages of the proxy variables as our main estimation strategy. In the previous studies on financial macroeconomics, data are usually averaged over 3-year non-overlapping periods to smooth out the cyclical effects of the variables before estimation. The main problem with this method is that non-overlapping time-averaged variables are typically not valid instruments when the reverse-causation problem arises due to time-aggregation, as argued by Ahmed (1998). Moreover, there are two additional reasons why we do not use non-overlapping averages as our main estimation strategy. First, the use of non-overlapping multi-year averages will suffer a significant loss of observations that can be used for estimation, and some important information contained in the time variations of the data will have to be disregarded, both of which will impair the identification of parameters in the estimation. Second, to have a deep understanding of the effects of finance on fiscal policy volatility, not only the long-term effects are worth investigating, but also its short-term effects. However, the use of non-overlapping multi-year averages inevitably ignores the latter. Thus, in this paper we use rolling averages as our main estimation strategy. Nevertheless, the results with non-overlapping averages are also reported as a robustness check.

Fourth, we explore the medium- and long- term effects of financial development and financial instability using the method of local projection. We find that the effects of financial development and financial instability on fiscal policy volatility is enhanced in the medium term but weakened in the long term. In particular, the results from the local projection method show that financial development and financial instability exhibit the strongest effects on fiscal policy volatility in the second or third year after a shock is realized. When the amplifying effects become the strongest, the volatility of government revenue, budget balance and government spending would grow by 0.4%, 0.3% and 0.2%, respectively.

Fifth, we find that the effect of financial instability on fiscal policy volatility also depends on financial cycle, where the harmful effect of financial instability on fiscal policy conduct would be alleviated in the normal phase of the financial cycle, but would be further magnified during expansionary, recessionary and crisis periods. These results suggest that, on the one hand, policymakers should be extremely careful about the instability effect of financial bubble, financial bust and financial crisis on fiscal policy conduct; on the other hand, policymakers may enjoy a more discretionary conduct of fiscal policy when the financial cycle is in the normal phase. Overall, these findings provide interesting new insights into recent literature on the role of financial cycle in affecting fiscal and macroeconomic outcomes (e.g., Borio, 2014; Bénétrix and Lane, 2017) and how fiscal policy should be conducted in different economic and financial conditions (e.g., Hutchison et al., 2010; DeLong and Summers, 2012; Fetai, 2013; Ferraresi et al., 2015; Leeper et al., 2017).

Finally, we investigate the transmission channel through which financial development and financial instability affect fiscal policy volatility. We find that on the one hand, a more market-based financial system tends to have higher financial development and lower financial instability (greater financial stability); on the other hand, fiscal policy exhibits lower volatility in a more market-based financial system. These results suggest that financial development and financial stability contribute to a smoother conduct of fiscal policy by promoting financial marketization.

The rest of the paper is organized as follows. Section 2 gives a brief introduction of the data and variables. Section 3 discusses the model and estimation strategy. Section 4 reports the baseline result and conducts robustness checks. Section 5 provides some further discussions. The final section concludes and discusses some policy implications.

2. Data and variables

Our dataset is composed of annual cross-country data from 96 countries for the period 1990 to 2019, including 39 high income and 57 low and middle income. A detailed list of the countries included in our analysis is provided in Table A1 in the Appendix. The choice of our sample is due to data availability. Unless indicated otherwise, all macroeconomic data are sourced from the World Bank's *World Development Indicators* (WDI) and the IMF's *International Financial Statistics* (IFS). For institutional variables, the main sources are the Cross National Time Series Data Archive (CNTS), the Database of Political Institutions (DPI), and the Polity IV dataset. A detailed description of the data sources is presented in Table A2 in the Appendix. In what follows, we briefly discuss the specific variables used as proxies in the regression analysis.

2.1. Fiscal policy volatility

The traditional approach to measuring fiscal policy volatility is calculating the multi-year standard deviation of a fiscal policy variable such as budget balance, government revenue, or government spending. This approach, however, is frequently criticized by economists for that it does not isolate the exogenous components of fiscal policy changes. To distinguish fiscal policy volatility from adaptability to sudden changes of economic conditions, we follow the previous literature (e.g., Woo, 2011; Agnello and Souza, 2014; Cevik and Teksoz, 2014) and extract the discretionary component of fiscal policy by estimating fiscal policy rules for each country. Specifically, to construct measures of discretionary fiscal policy, we estimate the following equation for each country in our sample:

$$F_t = c + \alpha_1 F_{t-1} + \alpha_2 GAP_t + \alpha_3 Z + \xi_t^F \quad (1)$$

where F_t denotes the fiscal policy variable; GAP_t denotes output gap; Z_t is a set of controls including a time trend, inflation and its squared term; c is a constant; and ξ_t^F denotes the discretionary component of fiscal policy. According to Eq. (1), fiscal policy can be decomposed into three components: persistence, discretion, and volatility. Excluding discretion and persistence, the remaining residual (ξ_t^F) corresponds to the fiscal policy volatility. As for the fiscal policy variable, we employ three frequently used proxies, including government budget balance/GDP, government revenue/GDP, and government spending/GDP.

We estimate Eq. (1) by using ordinary least squares method. After obtaining the discretionary component of fiscal policy (ξ_t^F) implied by Eq. (1), we get rid of the time-varying trend in the residuals using Hodrick-Prescott (HP) filter, and define fiscal policy volatility as the standard deviation of the HP-detrended cyclical value of the residual (ξ_t^F) for consecutive, overlapping, three-year periods, from 1990 to 2019. Then the country-specific volatility of the cyclical component, denoted by $Vol_{i,t}^F$, can be interpreted as a quantitative estimate of the fiscal policy volatility for a given period, as in Fatas and Mihov (2006).

2.2. Financial development and financial instability

There are two frequently used measures of financial development in the literature. The first one is private sector credit to GDP ratio (denoted by *Financial development*), which refers to the ratio to GDP of the credit provided to the private sector by banks and other financial institutions, excluding credit issued to the public sector. Another one is the M2 to GDP ratio (denoted by *M2*), which refers to the ratio of broad money (money and quasi money) to GDP.

According to Levine et al. (2000) and Beck et al. (2000), compared with the M2 to GDP ratio, the private sector credit to GDP ratio is a more appropriate measure of financial development, because it measures the most important activity of the financial sector and has a significant impact on the economy. Therefore, we use the private sector credit to GDP ratio as our main measure of financial development in this paper.

To measure financial instability, the traditional approach is to calculate the standard deviation of the financial development variable considered. This approach has the benefit of being easily computable, but it also neglects the persistence and trend inherent in the evolution of the financial development variable. Another approach is the flexible approach suggested by Guillaumont-Jeanneney and Kpodar (2011), where financial instability is defined as the volatility of the residuals obtained by the following regression for each country:

$$FD_t = \theta_1 + \theta_2 FD_{t-1} + \theta_3 T_t + \xi_t^{FD} \quad (2)$$

where FD_t denotes the financial development variable considered (i.e., private sector credit to GDP ratio), T_t is a time trend, and ξ_t^{FD} is the residual. As in Guillaumont-Jeanneney and Kpodar (2011), Eq. (2) is estimated using ordinary least squares method. Then, similar to the calculation of the fiscal policy volatility, financial instability (denoted by *Financial instability*) is defined as the standard deviation of the HP-detrended cyclical component of the residuals (ξ_t^{FD}) for consecutive, overlapping, three-year periods from 1990 to 2019.

As one can see, the second approach would be superior to the traditional one in that it excludes the persistence and trend of the financial development variable from the calculation of financial instability and thereby reduces the "noises" associated with the financial instability indicator. For this reason, throughout the paper we shall use the indicator obtained by the second approach as our main measure of financial instability. As for the indicator obtained by the first approach, it will be used as an alternative proxy for financial instability in the robustness analysis.

2.3. Control variables

Following the previous literature (e.g., Fatas and Mihov, 2003, 2006; Agnello and Souza, 2014; Cevik and Teksoz, 2014; Furceri et al., 2016), we include a variety of control variables that are likely to have an impact on fiscal policy volatility. First, we use two frequently cited variables, i.e., GDP growth rate (*Growth*) and inflation rate (*Inflation*), to control for the general macroeconomic conditions of an economy. Second, we control for public debt ratio (*Public debt*) and fiscal crisis (*Fiscal crisis*), of which the first is calculated as the ratio of government debt to GDP, while the latter is a dummy variable which equals to 1 if a country experiences a fiscal crisis. Similarly, we also control for banking crisis (*Banking crisis*), which is a dummy variable that takes the value of 1 if a country experiences a banking crisis for a given year. Third, we control for the effect of country size using the logarithm of total population (*Population*). Fourth, we include trade openness (*Trade openness*) and financial openness (*Financial openness*) to control for a country's exposure to external real-sector and financial shocks. As is common in the literature, trade openness is measured by the ratio of exports plus imports to GDP, while financial openness is proxied by the KAOPEN index (also known as "Ito-Chinn index") developed and updated by Chinn and Ito (2006). Finally, as some studies documented that an IMF-supported program tends to reduce fiscal policy volatility (e.g., Cevik and Teksoz, 2014; Papi et al., 2015; Balima and Sy, 2021), we also include a dummy variable (*IMF program*) that takes the value of 1 if a country implements an IMF-supported program for a given year. In

addition to these commonly used controls, in the robustness test (see Section 4.2.6), we further control for government institutions, political stability and demographic characteristics by including additional control variables such as polity scale (*Polity scale*), government crisis (*Government crisis*), cabinet changes (*Cabinet changes*), political constraints (*Political constraint*), political system (*Political system*), and old-age dependency ratio (*Age dependency)*. A more detailed explanation of the variables is presented in Table A2 in the Appendix. Table 1 reports the summary statistics of the data.

Table 1 Descriptive statistics

Variable	Mean	Min	Max	Std. Dev.	Obs
Budget balance	2.179	-6.855	11.321	4.009	2841
Government revenue	27.782	2.764	65.537	12.781	2845
Government spending	29.880	7.096	67.128	12.576	2843
Output gap	-0.005	-3.030	2.970	1.296	2871
Budget balance volatility	1.390	0.026	3.877	1.048	2544
Government revenue volatility	1.262	0.010	3.585	1.016	2548
Government spending volatility	1.476	0.010	4.185	1.148	2546
Financial development	3.555	0.574	5.133	0.982	2827
Financial instability	2.319	0.002	6.533	1.866	2539
Financial volatility	2.719	0.000	8.032	2.272	2636
Growth	3.607	-4.534	11.845	3.459	2866
Inflation	5.853	-9.419	19.848	6.459	2862
Squared inflation	56.891	0.000	208.357	74.707	2862
Public debt	3.859	2.250	5.571	0.683	2828
Fiscal crisis	0.295	0	1	0.456	2880
Banking crisis	0.098	0	1	0.298	2688
Population	15.920	11.043	21.065	1.998	2880
Trade openness	4.246	2.886	5.596	0.537	2833
Financial openness	0.311	-1.924	2.322	1.573	2823
IMF program	0.286	0	1	0.452	2880
Policy scale	4.029	-10	10	6.430	2524
Government crisis	0.134	0	5	0.410	2878
Cabinet changes	0.420	0	5	0.566	2866
Political constraints	0.115	0	1	0.262	2791

Political system	0.846	0	2	0.960	2819
Age dependency	2.261	0.212	3.523	0.642	2880
Expansion	0.233	0	1	0.423	2827
Recession	0.224	0	1	0.417	2827
Normal	0.544	0	1	0.498	2827

To minimize the influence of outliers on estimation results, all quantitative variables are winsorized based on the interquartile range (i.e., IQR)[1] since most of their distributions are either left-skewed or right-skewed (Verardi and Vermandele, 2018). Meanwhile, we take the logarithm of the private sector credit to GDP ratio, public debt ratio, population, trade openness and age dependency to further eliminate outliers. In summary statistics, the underlying variables for which the volatility of fiscal policy is computed include the ratios of budget balance to GDP, government revenue to GDP, government spending to GDP, output gap and inflation as well as its squared term. The average of budget balance is 2.179%, signifying that most countries in the sample have fiscal surpluses. The ratios of government revenue to GDP and government spending to GDP average at 27.782% with a standard deviation of 12.781% and 29.880% with a standard deviation of 12.576%, respectively. The mean of the output gap is negative, implying a relatively low economic growth for most countries over the observation period. As for the dependent variables, the descriptive statistics show that the variables denoting fiscal policy volatility exhibit similar distributions, with their means between 1.2 and 1.5 and their standard deviations around 1. Turning to financial variables, the mean of financial development is 3.555, smaller than the average level of financial development in advanced economies (4.534) and emerging economies (3.763), indicating that less developed countries tend to have less developed financial systems.

As for control variables, the distributions of the public debt ratio, population, trade openness and age dependency are more concentrated, with standard deviations less than 1 after excluding extreme values. The minimums of GDP growth and inflation are less than 0, indicating that some countries in the sample had experienced an economic recession. The maximums of GDP growth (11.845%) and inflation (19.848%) also indicate that some countries in the sample might have gone through an economic expansion. Fiscal crisis is more frequent than banking crisis since the mean of fiscal crisis is greater than that of banking crisis. Similarly, we can tell from the mean of IMF program that the IMF-supported programs are conducted infrequently. The averaged polity scale is greater than 0, which is closer to the maximum value, implying that most sample countries are more inclined to democracy. The means of the government crisis, cabinet change and political constraint are nearer to their minimum values, suggesting that governments in most countries are stable over the sample period. The policy system is averaged at 0.846, which means that most countries abide by an assembly-elected presidential system. Finally, the means of financial expansion, recession and normality reflect that the sample countries have experienced financial bust and boom, but for the most of time financial markets have stayed within the normal ranges.

[1] Define *r_p25* and *r_p75* as the 25th and 75th percentiles respectively, and the upper adjacent value is calculated by *r_p75*+1.5*(*r_p75*- *r_p25*), while the lower adjacent value is computed as *r_p25*-1.5*(*r_p75*- *r_p25*).

A safe-haven asset tends to hold its value if stock markets experience extreme negative returns (Baur and McDermott, 2010). Safe-haven currencies are those that give hedging benefits in times of financial market volatility or financial distress (Habib and Stracca, 2012). Conventionally, the US dollar (USD), the Swiss franc (CHF), and the Japanese yen (JPY) have been safe-haven currencies.[2] Some market participants have argued that the renminbi (RMB), the Chinese currency, joined the group of safe-haven currencies after it was included in the Special Drawing Rights (SDR) basket as a global reserve currency in 2016, with the other components of the SDR being traditional safe-haven currencies (Aizenman et al., 2020). Although the RMB did indeed hold its value against the US dollar during the 2008 financial crisis, others dispute the RMB's status as a safe haven and assert that the RMB will not become a safe-haven currency until Chinese economic and broader institutional reforms are implemented because the RMB is not sufficiently liquid and not readily convertible. This paper investigates the role of the RMB as a safe-haven currency in the face of financial stress.

The most intuitive approach to evaluating the hedging benefits of currencies is based on the correlation (or covariance) between equity and currency markets (Dumas and Solnik, 1995; De Santis and Gerard, 1998). From this perspective, investors use foreign currencies to minimise the risk of a diversified portfolio and long those currencies that are more negatively correlated with international equity portfolio returns to minimise the overall portfolio volatility. Campbell et al. (2010) show that the US dollar, the euro, and the Swiss franc move against the international equity market. Thus, these currencies should be attractive to risk-minimising global equity investors despite their low average returns. However, there are two main limitations associated with the correlation approach. On the one hand, the correlation cannot capture the nonlinear response of a safe-haven currency to an extreme shock (Habib and Stracca, 2012; Fatum and Yamamoto, 2016; Fatum et al., 2017). On the other hand, the hedging benefits of the currency might not be fully captured by the correlation approach, as investors typically go beyond the mean-variance preference when they flee to safety (Chan et al., 2018).

By dealing with the above shortcomings, we attempt to contribute to the safe-haven currency literature as follows. First, we use a regime-switching approach, a nonlinear method, to derive currency coskewness and cokurtosis and measure the nonlinear response of safe-haven currencies to a global stock market shock. In the literature, Baur and McDermott (2010) provide an intuitive method to study whether gold is a safe haven with dummies measuring extreme downturns in the global stock market at different scales using a linear model. Following Baur and McDermott (2010), Ming et al. (2020) study whether gold is a safe haven against extreme downturns in the Chinese stock market, and Baur and Smales (2020) show that precious metals are ideal safe havens against uncertainty measured by geopolitical risk. Similarly, Habib and Stracca (2012) and Habib et al. (2020) investigate the drivers of safe-haven currency behaviour using a linear model and treat the VIX as the measure of market uncertainty.

Unlike the above linear models, Chan et al. (2018) measure a currency's hedging capacity with its coskewness with the global stock market (the covariance between the currency premium and equity volatility) using a multivariate regime-switching approach, which can better capture the joint distribution of asset returns empirically and theoretically (Ang and Bekaert, 2002; Guidolin and Timmermann, 2008;Branch and Evans, 2010) and situate the time-varying beta

[2] Conventional wisdom holds that "When foreign exchange investors felt panicky, they head to, or back to, old faithfuls: the Swiss franc, the US dollar and the Japanese yen." See "Dollar Stands Out as Safe Haven Currency", *Wall Street Journal*, December 9th, 2011.

method within the literature (Christiansen et al., 2011). We extend this approach to derive not only currency conditional coskewness but also cokurtosis, which refers to the stable performance of a currency (as measured by currency return) during times of financial stress (as measured by stock market volatility or skewness).Our time-varying coskewness and cokurtosis may contain more information in integrated global asset markets since they are driven by the joint distribution of currency and equity returns. Additionally, they are more intuitive than other measures based on extreme value theory and copulas as well as other (nonlinear) comovements used in the recent literature. Intuitively, a higher and positive currency coskewness means that when stock volatility increases, the currency risk premium also increases. Similarly, a lower and negative currency cokurtosis means that when the stock market has a higher possibility to crash, the currency risk premium tends to be higher. In contrast, Bekiros et al. (2017) study the nonlinear relationship between an asset and stock market using continuous wavelet approach and copula models, which are pure econometric models and less intuitive. Moreover, regime-switching-based estimates are typically determined with considerably more accuracy than estimates of the higher moments obtained directly from realised returns (Guidolin and Timmermann, 2008).

Second, currency conditional coskewness and cokurtosis have a strong economic foundation in the skewness and kurtosis preference of investors who consider the capacity of a currency to hedge volatility and crashesin the global stock market. The skewness and kurtosis preference are based on "prudence"[3](e.g., Kimball, 1990) and "temperance" (e.g., Denuit and Eeckhoudt, 2010), respectively, signifying that investors desire higher (positive) skewness and lower (negative) kurtosis (Rubinstein, 1973; Kraus and Litzenberger, 1983).An investor examines an asset's contribution to the skewness and kurtosis of a broadly diversified portfolio, referred to as coskewness and cokurtosis of that asset with the portfolio. The literature has provided supportive empirical evidence that coskewness and cokurtosis on stock, bond, and option markets are significant in determining expected returns (e.g., Harvey and Siddque, 2000; Dittmar, 2002; Vanden, 2006; Guidolin and Timmermann, 2008; Yang et al., 2010). In contrast, crash risk, captured by currency (idiosyncratic) skewness (Brunnermeier et al., 2008; Burnside et al., 2010) and the global foreign exchange volatility factor (Menkhoff et al., 2012),is not informative about the hedging properties of currencies from a broadly diversified portfolio point of view. Although the currency covariance with global equity volatility in Lustig et al. (2011) is conceptually similar to currency coskewness, we propose time-varying currency coskewness and cokurtosis, which are essentially risk factors. Chan et al. (2018) evaluate the hedging benefits of currency coskewness but not cokurtosis. In a recent paper, Opie and Riddiough (2020) find that currency returns are predictable, accounting for their hedge capacity against global factor returns from a broadly diversified portfolio point of view, but their research is conducted under a mean and variance framework.

Third, we evaluate the hedging capacity of onshore and offshore RMB using currency coskewness and cokurtosis and compare it with this capacity of the Japanese yen. On one hand, Japanese yen is found to be the safest currency (Fatum and Yamamoto, 2016) and possesses desirable hedging benefits in times of financial market volatility (Chan et al., 2018). On the other hand, though offshore RMB (CNH) is much less regulated and is de facto fully convertible because it is freely traded outside of mainland China, Fatum et al. (2017) find no evidence to

[3] Prudence suggests a precautionary saving motive, the propensity to prepare and safeguard oneself in the face of uncertainty. It is in contrast to risk aversion, which is how much one dislikes uncertainty and turns away from uncertainty if possible.

suggest that offshore RMB is a safe haven. Similarly, we find that onshore RMB (CNY) has positive coskewness with the global equity market in some periods, while offshore RMB (CNH) has positive coskewness with the emerging stock market. The patterns imply that the CNY can only hedge against global stock market volatility to some extent, while the CNH can only hedge against emerging stock market volatility. In contrast, the JPY has positive coskewness in all periods with a larger scale and is a better hedge in a volatile market, as it appreciates when equity volatility increases. Moreover, the cokurtosis of both onshore and offshore RMB with the equity market is positive, and thus neither can hedge against a stock market crash. In contrast, JPY cokurtosis is negative, suggesting even higher hedging effectiveness during a stock market crash.

Furthermore, we investigate whether the features of a currency as a safe haven are priced in its future excess return using predictive regressions. In general, we find that RMB coskewness with stock markets is not priced in the RMB's future excess return. In contrast, the counterpart of the JPY is priced, suggesting that prudent equity investors use the JPY rather than the RMB to hedge against global stock market volatility. Moreover, the conditional cokurtosis of the RMB and JPY with the equity market does not command a statisticallyor economically significant ex ante risk premium with the expected positive sign. By implication, temperate investors use neither the RMB nor the JPY to hedge against global stock market crashes. On the whole, the RMB is not yet a safe-haven currency, while the JPY exhibits the safe-haven property to some degree. These results are robust after controlling for currency beta (Lustig et al., 2014； Verdelhan, 2018), volatility factors (Lustig et al., 2011; Menkhoff et al., 2012), and crash risk (Brunnermeier et al., 2008; Burnside et al., 2010). For a further robustness check, we use the more intuitive method of Baur and McDermott (2010) and find similar results.

The rest of the paper is organised as follows. Section 2 describes the data and gives a preliminary analysis. Section 3 discusses the regime-switching models and derives their conditional moments. Section 4 presents the empirical results, and Section 5 checks the robustness of the main results. Section 6 concludes and offers final remarks.

3. Model and estimation strategy

3.1. Econometric model

To investigate the effects of financial development and financial stability on fiscal policy volatility, we estimate the following dynamic panel data model:

$$Vol_{i,t}^{F} = c + \beta_1 Vol_{i,t-1}^{F} + \beta_2 Finance_{i,t} + \beta_3 Instability_{i,t} + \gamma Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t} \quad (3)$$

where $Vol_{i,t}^{F}$ denotes fiscal policy volatility; $Finance_{i,t}$ denotes financial development; $Instability_{i,t}$ denotes financial instability; $Z_{i,t}$ denotes a set of control variables; υ_i and η_t are the unobservable country- and time-specific effects, respectively; and $\varepsilon_{i,t}$ is the stochastic error term.

3.2. Estimation strategy

To estimate the model given by Eq. (3), two major issues should be taken into account: the inclusion of the unobserved country-specific effects and the possibility that the model contains endogenous variables. The standard approach to estimating such a dynamic panel model with country-specific effects and endogenous variables is the generalized method of moments (GMM) estimator. There are two types of GMM estimators: the difference GMM estimator and the

system GMM estimator. The first-differenced GMM estimator introduced by Arellano and Bond (1991) uses the following moments:

$$E[(\varepsilon_{i,t} - \varepsilon_{i,t-1})\Omega_{i,t-j}] = 0, \quad j \geq 2 \tag{4}$$

where $\Omega_{i,t-j}$ denotes a set of lagged explanatory variables used as instruments for the first-differenced equation. Besides the moment conditions given by Eq. (4), Arellano and Bover (1995) and Blundell and Bond (1998) propose to use additional moments, where the lagged first differences of the variables are used as instruments for the level equation:

$$E[\varepsilon_{i,t}\Delta\Omega_{i,t-j}] = 0, \quad j \geq 1 \tag{5}$$

When both the moment conditions in (4) and (5) are used in estimation, it leads to a system GMM estimator with more efficient estimates, as shown by Arellano and Bover (1995) and Blundell and Bond (1998). Therefore, throughout the paper we will use the system GMM estimator as our main estimation strategy.

A potential problem with the GMM estimator is that, when a large number of instruments are available, numerous instruments can overfit endogenous variables and make the test for instrument validity misleading. To address this problem, we present results with a collapsed instrument matrix and ensure that the number of instruments used always stays substantially below the cross-section size of the panel, a criterion suggested by Roodman (2009) to avoid the problem of overfitting. We also use the finite sample corrected standard errors proposed in Windmeijer (2005).

Finally, to ensure the validity of the estimation results, two standard specification tests are employed: (1) Sargan test, which tests the overall validity of the instruments with the null hypothesis that all of the instruments are valid; (2) AR(2) test, which tests the second-order serial correlation of the error term with the null hypothesis that the error term is not serially correlated; (3) Wald Chi2 test or F test, which test the overall validity of the model with the null hypothesis that all coefficients are zero. To ensure adequate model specification, both the null hypotheses of the first two tests should not be rejected and the null hypothesis of the last one test should be rejected.

4. Empirical results

4.1. Baseline results

Our baseline regression results are reported in Table 2, where three fiscal policy volatility variables (i.e., budget balance volatility, government revenue volatility, and government spending volatility) are used as dependent variables and the private sector credit (% of GDP) is used as the proxy for financial development. Financial instability is defined as the standard deviation of the HP-detrended residuals obtained from estimating the model given by Eq. (2). Given the potential correlation between financial development and financial instability, we first incorporate financial development and financial instability separately into Eq. (3) as the major explanatory variable and then include the two variables simultaneously to see if the correlation would affect the results. All models in Table 2 are estimated by the system GMM method. The specification tests indicate that all models in Table 2 are well specified. Specifically, both the null hypotheses of the Sargan test and the AR(2) test cannot be rejected in all models, indicating that our instruments are valid and there is no second-order serial correlation in the estimation. The null hypothesis of the Wald Chi2 test is rejected, meaning that the regression is significant.

Table 2 Financial instability and fiscal policy volatility: baseline results

Independent variables	Dependent variable								
	Budget balance volatility			Government revenue volatility			Government spending volatility		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lagged dep.var.	0.757***	0.568***	0.737***	0.536***	0.689***	0.519***	0.788***	0.682***	0.705***
	(14.081)	(9.706)	(16.247)	(9.659)	(7.904)	(9.602)	(9.722)	(6.887)	(14.117)
Financial development	-1.538***		-1.534***	-1.180***		-1.235***	-0.844**		-0.809***
	(-2.821)		(-3.345)	(-2.840)		(-2.964)	(-2.067)		(-2.695)
Financial instability		0.045**	0.072**		0.055**	0.046***		0.075*	0.065**
		(2.240)	(2.156)		(2.057)	(2.626)		(1.782)	(2.148)
Growth	-0.128	0.014	-0.185**	-0.020	-0.016	-0.016	-0.305	-0.014	-0.082
	(-1.163)	(0.236)	(-2.203)	(-1.573)	(-0.889)	(-1.264)	(-1.562)	(-0.716)	(-1.251)
Inflation	0.005	0.022	-0.008	-0.026	0.069	-0.040	-0.122	-0.098	-0.003
	(0.384)	(0.696)	(-0.931)	(-0.832)	(1.243)	(-1.379)	(-1.360)	(-0.714)	(-0.332)
Public debt	-0.749*	0.760	-0.972***	-0.760**	0.712	-0.770**	-0.219	0.979	0.346
	(-1.870)	(1.605)	(-2.744)	(-2.155)	(1.049)	(-2.231)	(-0.597)	(0.912)	(1.375)
Fiscal crisis	1.303***	0.176	0.860**	1.170*	-1.232	1.090*	-0.487	-0.320	0.801
	(2.695)	(0.849)	(2.284)	(1.801)	(-0.859)	(1.785)	(-0.202)	(-0.658)	(1.188)
Banking crisis	-0.184	0.481**	-0.136	-0.993**	-1.347	-0.618	-1.207	0.366	-0.083
	(-0.339)	(1.969)	(-0.318)	(-2.160)	(-1.085)	(-1.454)	(-1.157)	(0.204)	(-0.139)
Population	-0.086	-1.551***	0.075	-0.481*	-1.552**	-0.561**	-0.529	-3.829*	-0.175
	(-0.261)	(-3.152)	(0.247)	(-1.934)	(-2.266)	(-2.476)	(-1.108)	(-1.762)	(-1.013)
Trade openness	-1.132	-5.774***	1.133	-1.352*	-4.900***	-1.188*	-4.840**	-6.143	-3.735**
	(-0.780)	(-3.647)	(1.126)	(-1.959)	(-2.860)	(-1.767)	(-2.127)	(-0.913)	(-2.436)
Financial openness	0.396*	-0.026	0.401**	0.203	0.550	0.160	0.189	0.344	-0.262
	(1.847)	(-0.274)	(2.127)	(0.720)	(1.038)	(0.790)	(0.352)	(0.379)	(-1.414)
IMF program	-3.968***	-0.280	-2.903***	-0.458	1.378	-0.531*	0.344	1.656	-2.844***
	(-2.927)	(-0.320)	(-2.683)	(-1.379)	(0.970)	(-1.666)	(0.325)	(0.711)	(-3.272)
Constant	15.672*	46.667***	4.629	20.928***	42.291***	21.742***	35.999**	84.031	21.651***
	(1.751)	(3.676)	(0.631)	(2.701)	(2.854)	(2.985)	(2.310)	(1.491)	(2.783)
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(2)	0.120	0.562	0.350	0.176	0.285	0.227	0.436	0.188	0.634
Sargan	0.743	0.146	0.456	0.197	0.114	0.149	0.797	0.732	0.254
Prob(Wald Chi2)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instruments	41	51	48	47	42	50	39	38	54
Observations	2167	2164	2164	2170	2167	2167	2169	2166	2166
Countries	96	96	96	96	96	96	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

Let us start with the effects of financial development and financial instability on budget balance volatility, as shown by models (1)-(3) in Table 2. From models (1)-(3) we can see that the coefficient of financial development is significantly negative at the 1% significance level, suggesting that higher financial development is associated with lower budget balance volatility. The coefficient of financial development in model (3) indicates that budget balance volatility would decrease by 1.534%, ceteris paribus, as the logarithm of private sector credit to GDP rises 1%. There are many reasons that have been documented in the existing literature to explain the correlation between financial development and fiscal policy volatility. The most intuitive one is that financial development releases financing constraint for the real economy, which fosters economic growth and fiscal policy stability (e.g., Gruss et al., 2020; Osei and Kim, 2020; Jalles, 2021; Mawejje and Odhiambo, 2022; Afonso and Carvalho, 2022). In contrast, the coefficient of financial instability is positive and statistically significant at the 5% significance level, which suggests that greater financial instability would lead to an increase in budget balance volatility. The coefficient of financial instability is estimated to be 0.072, meaning that all else being equal, a 1% increase in financial instability would result in an increase of 0.072% in budget balance volatility.

Models (4)-(9) in Table 2 report results of the repeated analysis for government revenue volatility and government spending volatility, from which we can see that both the two volatility variables are negatively correlated with financial development but positively correlated with financial instability. These results again confirm our previous conclusion that financial development is conducive to reducing fiscal policy volatility whereas financial instability has the opposite effect.

The results of Models (6) and (9) suggest that a 1% growth of (log) private sector credit to GDP would lead to a 1.235% decline in government revenue volatility and a 0.809% reduction in government spending volatility. Moreover, government revenue volatility is more impacted by financial development than government spending volatility. With the development of finance, policy authorities can adopt financial technologies and structural policies to provide new engines for the economy. In this context, financial development steps into digital transformation, and the policies of inclusive finance, industrial structure adjustment and tax refund are introduced. While the development of digitalization helps to reduce costs and improve efficiency, structural policies could facilitate industrial transformation and improve income redistribution. As a result, these policies contribute to boosting industrial optimization and improving private consumption. Although tax refund and reduction may disturb the stability of government revenue, the structural optimization would provide a new impetus for the stabilization of government revenue, which can partially explain why government revenue is more stable than government spending. Another reason is that inclusive policies require periodical cooperations of spending policy, which causes frequent adjustment of government spending policy and makes it more volatile than government revenue. Meanwhile, a 1% increase in financial instability will raise the volatility of government revenue and government spending by 0.046% and 0.065%, respectively. As financial instability brings about economic uncertainty and decreases households' income, the volatility of government revenue is exacerbated.

Turning to the results for control variables, economic growth and inflation rate are found to be negatively associated with fiscal policy volatility. We also find that larger population is negatively associated with fiscal policy volatility, which is consistent with Furceri et al. (2016). This can be attributed to the fact that smaller countries are typically exposed to more economic

shocks and thus their fiscal policies need to respond more frequently to these shocks for the purpose of economic stabilization. In addition, public debt ratio has a negative impact on fiscal policy volatility because government bond market broadens external financing channels for the fiscal authority, and the rapid expansion of bond market allows the government to tap into public debt and hence smooth the movements in fiscal accounts. As for the impact of fiscal crisis, it also has a negative impact on fiscal policy volatility. According to Medas et al. (2018), fiscal crisis refers to the following situations: (1) the defaulted amounts of sovereign debts are greater than 0.2% of GDP, or the defaulted amounts grow more than 10% in a year; (2) the country has recourse to large IMF financial support (more than 100% of quota); (3) the country is faced with very high inflation and steep increase in domestic arrears; (4) the country encounters loss of market access and high risk premium of sovereign debts. Based on this definition, one can see that fiscal crisis raises fiscal policy volatility because of the following reasons: (i) the growing defaulted amounts of sovereign debts would trigger a surge in risk aversion, which affects debt issuance and payment and thus leads to greater fiscal fluctuations; (ii)government's resort to large official financing usually stands for the country's inability to keep its financial obligation and to maintain a stable fiscal policy; (iii) high inflation would force the government to turn to seigniorage or accumulation of domestic arrears to finance the fiscal deficit, which could further induce immoderate fiscal policy. Banking crisis affects fiscal volatility in a similar manner. According to Laeven and Valencia (2020), when a country exhibits signs of financial distress and policy intervention measures to deal with significant losses in the banking system, we treat the country as being trapped in a banking crisis. Given the above definition, we can predict greater fiscal volatility during a banking crisis. This is mainly due to the fact that banking failure cuts off a government's availability of external financing and that intensive policy interventions would inevitably incur the adjustments of fiscal policy for coordination purposes.

Turning to the two openness indicators, financial openness is positively correlated with fiscal policy volatility, while trade openness has the opposite effect. Papi et al. (2015) find that the openness of current and capital account and financial liberalization could reduce the volatility of fiscal policy. As trade openness and financial openness increase, economic growth and household income would benefit from diversification of trade and financial channels, which enables government to maintain the stability of fiscal policy. However, Woo (2011) and Agnello and Sousa (2014) point out that trade and financial openness are explicitly associated with increased risks and shocks, where a higher level of openness may lead to greater fiscal policy volatility. Our results suggest that while trade openness mainly exhibits the growth enhancing effect, financial openness mainly exhibits the risk inducing effect.

Finally, we also find that the IMF-supported program is negatively correlated with all of the three fiscal volatility variables, indicating that IMF support is conductive to reducing fiscal policy volatility. IMF-supported programs typically provide upright phases and long-term loans for countries facing fiscal and financial crisis for the purpose of macroeconomic stabilization. In this way, the role of IMF bailout is reflected as improving credit availability, offsetting the bad signals and moral hazard effects, which helps to mitigate the volatility of fiscal policy (Papi et al., 2015; Balima and Sy, 2021).

To sum up, from the results in Table 2, we arrive at two main conclusions: (1) countries with more developed financial systems tend to have lower fiscal policy volatility; (2) financial instability has an amplifying effect on fiscal policy volatility. Meanwhile, in line with the previous literature, we also find that economic growth, inflation rate, public debt, fiscal crisis,

banking crisis, population, trade openness, financial openness, and IMF-supported programs are important determinants of fiscal policy volatility.

Thus, in contrast to the previous studies that focus primarily on the economic and institutional determinants of fiscal policy volatility, our results shed new light on the important role of finance in determining fiscal policy behavior. Specifically, we have identified two main channels that finance may play a role in determining fiscal policy volatility: (i) financial development channel; and (ii) financial instability channel. Interestingly, the first channel has a dampening effect on fiscal policy volatility while the latter has an amplifying effect on fiscal policy volatility. Taken together, it points to the conclusion that a large and stable financial system provides the best financial environment for the smooth conduct of fiscal policy.

4.2. Robustness checks

In this section, we propose four tests to check the robustness of our baseline findings. First, we address endogeneity issues by using instrumental variables, AMG estimator, CCEMG estimator and two-step system GMM. Second, we repeat the analysis using alternative measures of financial instability. Third, we re-estimate the regressions by accounting for long-term effects. Fourth, we allow for a set of additional controls in the regressions.

4.2.1 Reverse causality and instrumental variable (IV) estimation

The estimation methodology in this paper addresses unobserved period- and country-level effects as well as reverse and simultaneous causations to some degree by including the lagged dependent variable and using lagged observations of the independent variables as instruments. However, due to the deep connection between financial activities and fiscal policy, it is likely that financial development, financial instability and the error term are correlated. First, the discretion of fiscal policy affects the policy circumstance for financial development and financial instability. The volatility of fiscal policy stands for unclear policy stance, and further leads to the volatility of financial policy, which incurs insufficient credit expansion and impedes financial development. Meanwhile, fiscal policy also exerts impact on financial indicators. For example, discretionary fiscal policy might be detrimental to the stability of business conditions and household income, thus reducing overall demand for credit and depressing financial development eventually. Therefore, causality can run in the reverse direction. Second, there might be some other omitted determinants that can affect fiscal policy volatility, financial development and financial instability at the same time. Third, the indicators of interest, i.e. fiscal policy volatility, financial development and financial volatility, are likely to be measured with errors. To address these issues, we use the IV-2SLS approach, which isolates the exogenous element of variation in financial development and financial instability to identify the one-way effect on fiscal policy volatility.

According to the IV-2SLS method, instrumental variables are constructed to eliminate the endogeneity of Eq. (3). For the reverse causality, a country's level origin or legal system strongly influences its legal and regulatory environment governing financial transactions as well as the differences in country-level financial development. Since the legal system is independent of fiscal policy, it can be used as the instrumental variable to control for simultaneity bias (La Porta et al., 1998; Levine et al., 2000). Despite that, legal system, which usually is coded as dummy variable, is limited to identifying the differences between countries and inevitably disregards trends over time. To deal with this problem, we first group countries into "Civil law", "Common law", "Customary law", "Muslim law" and "mixed law", respectively, and assume similarities in financial development within the same group. Then, we average the financial development index of other countries within the group and calculate the standard deviation of HP-detrended

residuals in Eq. (2) using the averaged index of financial development as the dependent variable. Finally, we instrument financial development and financial instability using the dummy variable of legal system, the averaged financial development and the modified financial instability as well as their lagged observations.

For omitted variables and measurement errors, we build instrumental variables based on Lewbel (1997). On the one hand, we calculate the product of fiscal indicator's deviation from its average and financial development indicator's deviation from its average as the instrument for financial development. On the other hand, the product of fiscal indicator's deviation from its average and financial instability indicator's deviation from its average are constructed as the instrument for financial instability. Then, we test possible combinations of instruments and perform IV-2SLS estimations for budget balance volatility, government revenue volatility and government spending volatility respectively. The results are reported in Table 3.

Table 3 Robustness test: IV-2SLS estimation

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	0.566***	0.529***	0.540***
	(22.593)	(19.083)	(20.731)
Financial development	-0.242*	-0.164*	-0.275**
	(-1.868)	(-1.764)	(-2.090)
Financial instability	0.108***	0.076**	0.112***
	(2.706)	(2.125)	(2.912)
Growth	-0.007	0.003	-0.008
	(-1.030)	(0.500)	(-1.326)
Inflation	-0.011***	-0.003	-0.011**
	(-2.722)	(-0.815)	(-2.546)
Public debt	-0.036	-0.015	0.013
	(-0.651)	(-0.321)	(0.241)
Fiscal crisis	0.133**	0.055	0.078
	(2.539)	(1.219)	(1.530)
Banking crisis	0.141*	-0.006	0.144**
	(1.942)	(-0.087)	(2.073)
Population	0.165	-0.286	0.181
	(0.694)	(-1.217)	(0.752)
Trade openness	0.012	0.145	0.112
	(0.129)	(1.545)	(1.124)
Financial openness	-0.037	-0.037	-0.029
	(-1.215)	(-1.292)	(-0.944)
IMF program	-0.067	0.017	-0.077
	(-1.296)	(0.356)	(-1.502)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
Kleibergen-Paap rk LM	92.141***	67.798***	77.963***
	(0.000)	(0.000)	(0.000)
Anderson-Rubin Wald	16.60*	19.17**	13.47*
	(0.084)	(0.038)	(0.061)
Hansen	0.320	0.146	0.372
Prob(F-test)	0.000	0.000	0.000
Instruments	10	10	7
Observations	2164	1987	2166
Countries	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the Hansen and F tests are *p*-values.

Table 3 shows that fiscal policy volatility is negatively correlated to financial development and positively associated with financial instability. Anderson-Rubin Wald test is rejected, meaning that the instruments are highly correlated with the endogenous variables. Meanwhile, the Kleibergen-Paap rk LM statistics are 92.141, 67.798 and 77.963 for budget balance volatility, government revenue volatility and government spending volatility respectively, indicating that there is no underidentification problem. In summary, these results suggest that our main conclusions remain valid after accounting for potential endogeneity problem.

4.2.2 Cross-section dependence and common shock.

To rule out the effects of cross-section dependence and common shock, we re-estimate Eq. (3) using Augmented Mean Group estimator (AMG) and Common Correlated Effects Mean Group estimator (CCEMG). Then we conduct a Perasan test for residuals to see how cross-section dependence and common shock affects estimation results.

The results are presented in Tables A3-A4, from which we can see that for budget balance volatility, the *p*-value of cross-section dependence statistics is 0.061 for AMG estimator, meaning that the null hypothesis of weak cross-sectional dependence is rejected. Therefore, the AMG estimation is inefficient to control for cross-section dependence effects when the dependent variables is budget balance volatility. For government revenue volatility, the coefficient of financial instability is significantly positive, while the coefficient of financial development becomes insignificant. Meanwhile, the influence of financial development on government spending volatility turns to be significantly positive. These results imply that the AMG estimation cannot adequately solve the endogeneity problem of Eq. (3).

Under the estimation of CCEMG, the *p*-values of cross-section dependence statistics are 0.258 for budget balance, based on which we can infer that the cross-section dependence effect is eliminated using the CCEMG estimator. However, according to the *p*-values of the Wald test (0.877), the independent variables only explain a small fraction of the variations in budget balance volatility under the CCEMG estimation. Also, the problem of weak explanation of CCEMG occurs in the estimates of government revenue and government spending volatility.

Table 4 Robustness test: two-step system GMM estimation

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	0.701***	0.580***	0.703***
	(21.227)	(6.604)	(9.500)
Financial development	-0.981***	-0.764*	-0.747*
	(-3.846)	(-1.692)	(-1.901)
Financial instability	0.049**	0.041*	0.116**
	(1.977)	(1.744)	(2.086)
Growth	-0.156***	-0.016	-0.169**
	(-2.802)	(-1.621)	(-2.293)
Inflation	-0.011	-0.004	-0.020*
	(-1.557)	(-0.108)	(-1.909)
Public debt	-0.759***	-0.350	0.060
	(-3.311)	(-0.692)	(0.239)
Fiscal crisis	0.319**	1.882**	1.438**
	(2.156)	(2.051)	(2.065)
Banking crisis	0.363	-1.129*	-0.657
	(1.524)	(-1.906)	(-1.013)
Population	-0.118	-0.637	-0.113
	(-0.494)	(-1.529)	(-0.523)
Trade openness	0.427	-2.799**	-1.215

	(0.459)	(-2.161)	(-0.863)
Financial openness	0.266**	0.827*	-0.132
	(2.153)	(1.810)	(-0.392)
IMF program	-0.888*	-1.047**	-2.304***
	(-1.704)	(-2.005)	(-2.666)
Constant	7.578	25.886**	10.462*
	(1.152)	(2.225)	(1.690)
Time fixed Effect	Yes	Yes	Yes
Country fixed Effect	Yes	Yes	Yes
AR(2)	0.954	0.118	0.361
Sargan	0.392	0.142	0.236
Prob(Wald Chi2)	0.000	0.000	0.000
Cross-section dependence	0.222	0.122	0.227
Observations	2164	2167	2166
Countries	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sargan, Wald Chi2 and cross-section dependence tests are *p*-values.

To further address the problem of cross-section dependence and common shock, we experiment with the two-step system GMM estimator and test the cross-section dependence of residuals afterwards. Table 4 summarizes the results, from which we can see that there are significant correlations between financial variables and fiscal policy volatility. In particular, as financial system becomes more developed and less volatile, the volatility of fiscal policy would decrease. In addition, the *p*-values of cross-section dependence test are larger than 0.1, implying that the null hypothesis of weak cross-section dependence cannot be rejected under the two-step system GMM estimation and thus the estimation results in Table 4 are valid.

4.2.3 Alternative measure of financial instability

As a standard practice in the empirical literature, first we test whether our results are robust to alterative measure of financial instability, which is a main focus of the paper. As mentioned in Section 2.2, another widely used measure of financial instability in the literature is the standard deviation of the financial development variable. Thus, we use the standard deviation of the private sector credit to GDP ratio (denoted by *Financial volatility*) as an alternative measure of financial instability and repeat the regression analysis. The results are reported in Table 5. From Table 5 we can see that both the negative effect of financial development on fiscal policy volatility and the positive effect of financial instability on fiscal policy volatility remain statistically significant, suggesting that our main results remain valid under different measures of financial instability.

Table 5 Robustness test: alternative measure of financial instability

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	0.741***	0.597***	0.724***
	(16.989)	(10.717)	(7.293)
Financial development	-1.325***	-0.944***	-0.899***
	(-3.327)	(-2.835)	(-2.669)
Financial volatility	0.049**	0.031*	0.043*
	(1.982)	(1.758)	(1.762)
Growth	-0.225***	-0.017	-0.288***
	(-3.294)	(-1.448)	(-3.362)
Inflation	-0.010	-0.041	-0.084
	(-1.214)	(-1.552)	(-1.598)
Public debt	-1.057***	-0.339	-0.965**

	(-3.194)	(-1.418)	(-2.560)
Fiscal crisis	0.562*	0.334	-0.291
	(1.704)	(0.738)	(-1.389)
Banking crisis	-0.286	-0.657	-0.355
	(-0.765)	(-1.562)	(-1.048)
Population	-0.046	-0.759**	-0.431
	(-0.157)	(-2.501)	(-1.080)
Trade openness	0.802	-2.289***	0.118
	(0.828)	(-2.684)	(0.113)
Financial openness	0.316*	0.431	-0.317
	(1.882)	(1.583)	(-1.369)
IMF program	-1.960**	-0.180	0.358
	(-2.212)	(-0.521)	(0.480)
Constant	7.450	27.782***	14.830
	(1.018)	(3.131)	(1.502)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
AR(2)	0.674	0.764	0.868
Sargan	0.243	0.202	0.861
Prob(Wald Chi2)	0.000	0.000	0.000
Instruments	48	50	53
Observations	2165	2168	2167
Countries	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

The relationship between fiscal policy volatility and control variables also remains unchanged. The restraining effect on fiscal policy volatility is mainly driven by the high output growth, high public debt ratio, large-scale population, trade openness and IMF's support. Comparatively speaking, the intensifying effect on fiscal policy volatility is brought by fiscal crisis and financial openness.

4.2.4 Accounting for long-term effects

To further account for the long-term effects of financial development and financial instability on fiscal policy volatility, we check the robustness of our results by using non-overlapping averages, as in Beck and Levine (2004). To do so, we split our sample into two data sets including a three-year non-overlapping panel (1990-92, 1993-95, and so on) and a five-year non-overlapping panel (1990-94, 1995-99, and so on) and re-estimate the regressions. The results are presented in Table 6.

Table 6 Robustness test: accounting for long-term effects

Independent variables	Dependent variable					
	Budget balance volatility		Government revenue volatility		Government spending volatility	
	3-year (1)	5-year (2)	3-year (3)	5-year (4)	3-year (5)	5-year (6)
Lagged dep.var.	0.190***	-0.034	0.633*	0.238***	0.183***	0.105
	(2.657)	(-0.410)	(1.859)	(2.831)	(2.739)	(1.380)
Financial development	-1.596**	-0.921***	-1.239**	-0.351**	-0.814**	-0.422***
	(-2.019)	(-3.162)	(-2.421)	(-2.081)	(-2.512)	(-2.726)
Financial instability	0.355**	0.065*	0.324**	0.055*	0.267*	0.062*
	(2.042)	(1.656)	(2.240)	(1.675)	(1.675)	(1.658)
Growth	-0.149	-0.101*	-0.032	0.038	-0.141	-0.114**
	(-1.307)	(-1.875)	(-0.761)	(1.557)	(-1.541)	(-2.381)
Inflation	0.009	-0.012	-0.108	0.004	-0.061	-0.001
	(0.173)	(-0.822)	(-1.287)	(0.322)	(-1.213)	(-0.062)
Public debt	-0.681**	-0.783***	-0.244	-0.340**	-0.195	-0.199
	(-2.065)	(-3.321)	(-0.574)	(-2.217)	(-0.494)	(-1.357)

Fiscal crisis	0.284	-0.046	-0.375	0.476	0.186	0.324
	(0.449)	(-0.098)	(-0.495)	(1.085)	(0.391)	(0.712)
Banking crisis	-0.101	0.821***	-1.070	0.113	0.065	1.000**
	(-0.253)	(2.802)	(-0.825)	(0.283)	(0.182)	(2.194)
Population	-0.620***	-0.249	0.108	-0.246**	-0.431	-0.189
	(-2.632)	(-1.056)	(0.341)	(-2.052)	(-1.582)	(-1.380)
Trade openness	-1.741	1.177**	0.600	0.464	-1.918	0.142
	(-1.614)	(2.302)	(0.583)	(1.317)	(-1.512)	(0.342)
Financial openness	-0.431	0.176	-0.135	0.056	0.029	-0.011
	(-1.508)	(1.202)	(-0.270)	(0.481)	(0.121)	(-0.103)
IMF program	-0.230	0.255	0.350	-0.311	-0.001	-0.020
	(-0.463)	(0.340)	(0.825)	(-0.947)	(-0.001)	(-0.053)
Constant	27.043***	6.625	1.513	4.938*	20.409**	6.105*
	(2.675)	(1.232)	(0.169)	(1.845)	(2.251)	(1.866)
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
AR(2)	0.179	0.672	0.543	0.349	0.687	0.590
Sargan	0.786	0.249	0.896	0.113	0.479	0.149
Prob(Wald Chi2)	0.000	0.000	0.000	0.000	0.000	0.000
Instruments	45	35	34	54	39	49
Observations	711	361	712	362	713	361
Countries	96	96	96	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

From Table 6 we can see that, consistent with the previous results, the coefficient of the financial development variable is estimated to be significantly negative while that of the financial instability variable is estimated to be significantly positive, indicating that our main conclusions remain robust after accounting for the potential long-term effects of finance on fiscal policy volatility.

However, there are also some slight changes in the coefficients of control variables. First, the effect of fiscal crisis on the volatility of fiscal policy becomes insignificant after considering the longer-term effect. It indicates that fiscal crisis primarily leads to short-term disruption in the fiscal policy of many countries. This is probably because the official financing support and austerity measures can quickly offset the disturbing effects of fiscal crisis, which as defined in our paper is largely caused by credit event, domestic public debt default and loss of market confidence, in a relatively short time.

Second, the significance of the coefficient on IMF-supported programs is weakened in the medium and long run. In the existing literature, both the amplifying and depressing effects of IMF-supported programs on fiscal policy volatility are documented. On the one hand, some studies have provided supporting evidences that the IMF-supported stabilization program is a potential driver for fiscal policy volatility (e.g., Jorra, 2012; Cevik and Teksoz, 2014), which is largely attributed to the moral hazard problem and debt dilution when IMF fails to distinguish between liquidity and solvency crisis. On the other hand, the favorable aspect of the IMF-supported stabilization programs is also verified in Papi et al. (2015) and Balima and Sy (2021). They argue that the IMF-supported programs can improve credit availability and offset bad signals as well as moral hazard effects. Taking into account all these possibilities, our results suggest that the IMF-supported programs could help to smooth the conduct of fiscal policy in the short run, but the stabilization effect would probably be neutralized by the adverse effects over longer horizons.

Third, the combined effect of positives and negatives can also give an explanation for the similar changes in the coefficients of trade and financial openness. For one thing, Papi et al.

(2015) find that, as the trade openness and financial openness increase, economic growth and household income will benefit from diversification of trade and financial channels, which enables the government to maintain fiscal policy stability. For another thing, Woo (2011) and Agnello and Sousa (2014) point out that trade and financial openness are explicitly associated with increased risks and shocks, where a higher degree of openness may lead to greater fiscal policy volatility. In our study, the positive effects of trade openness benefit the economy in the short run, while the potential risks gradually emerge over the long term. By contrast, the risk factors brought by financial openness take the lead in the short term, while the economy-stimulating effect comes to standing out at longer horizons.

Comparing the long-term results with the baseline results in Table 2, we find that the absolute values of the coefficients for financial development and financial instability display an upward trend when the calculation window changes from overlapping to non-overlapping, and then the absolute values show a downward trend when the calculation window shifts from medium (3-year) to long term (5-year). Therefore, it is reasonable to assume that the effects of financial development and financial instability are strengthened in the medium term and begin to recede over the long term.

4.2.5 Different groups of countries

To test whether our main results vary with respect to different groups of countries, we classify the sample countries into advanced economies (AEs), emerging economies (EMs) and low-income countries (LICs) according to the country classification by World Bank and re-estimate the regressions for each group. The results for the AEs, EMs and LICs are reported in Tables 7-9, respectively. It is obvious that the negative relationship between financial development and fiscal policy volatility remains unaltered in all regressions in Tables 7-9. Meanwhile, the amplifying effect of financial instability on fiscal policy volatility still holds as before, as suggested by the significantly positive coefficient on the financial instability variable. Again, these results suggest that the main conclusions of the paper do not change with respect to different groups of countries.

Table 7 Robustness test: advanced economies

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	0.495***	0.510***	0.443***
	(4.928)	(5.354)	(3.701)
Financial development	-3.235***	-0.781***	-2.648***
	(-3.338)	(-3.107)	(-2.795)
Financial instability	0.070*	0.023*	0.067**
	(1.707)	(1.705)	(2.347)
Growth	-0.150**	0.015	-0.079
	(-2.050)	(0.901)	(-0.466)
Inflation	-0.047	0.064*	0.004
	(-0.821)	(1.921)	(0.158)
Public debt	-2.889***	-0.330	-1.531**
	(-3.707)	(-1.563)	(-2.445)
Fiscal crisis	-4.806*	-2.379**	0.433
	(-1.831)	(-2.050)	(0.258)
Banking crisis	0.586*	0.789**	1.326
	(1.955)	(2.147)	(1.247)
Population	1.021**	-0.321***	-0.011
	(2.298)	(-3.289)	(-0.047)
Trade openness	-1.838**	-0.425**	-2.340**
	(-2.104)	(-2.278)	(-2.455)

Financial openness	1.372***	0.613***	1.447**
	(3.690)	(2.756)	(2.254)
IMF program	5.566*	2.573**	4.178*
	(1.942)	(2.055)	(1.783)
Constant	15.760**	10.704***	25.704**
	(2.146)	(3.529)	(2.562)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
AR(2)	0.866	0.332	0.557
Sargan	0.689	0.848	0.100
Prob(Wald Chi2)	0.000	0.000	0.000
Instruments	54	66	51
Observations	582	582	583
Countries	25	25	25

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

Table 8 Robustness test: emerging economies

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	0.353	0.754***	0.434***
	(0.997)	(5.895)	(2.734)
Financial development	-3.445**	-1.003**	-3.186**
	(-2.273)	(-1.965)	(-2.079)
Financial instability	0.380*	0.105*	0.127**
	(1.829)	(1.810)	(2.135)
Growth	-0.125	-0.019	-0.080
	(-1.070)	(-0.642)	(-0.991)
Inflation	-0.161**	-0.004	-0.116*
	(-2.181)	(-0.120)	(-1.883)
Public debt	-1.104*	0.114	-0.392
	(-1.815)	(0.270)	(-0.853)
Fiscal crisis	-1.810	-2.811**	-0.384
	(-1.099)	(-2.365)	(-0.455)
Banking crisis	-0.028	0.069	-0.434
	(-0.026)	(0.088)	(-0.648)
Population	0.975	1.404**	-0.425
	(1.474)	(2.114)	(-0.940)
Trade openness	1.929	2.295**	1.520
	(1.349)	(1.993)	(1.257)
Financial openness	-0.405	0.432	-0.484
	(-0.909)	(1.413)	(-1.268)
IMF program	0.960	0.877	1.013
	(0.823)	(1.627)	(1.257)
Constant	-6.802	-31.274**	15.702
	(-0.530)	(-2.018)	(1.622)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
AR(2)	0.883	0.379	0.718
Sargan	0.812	0.884	0.387
Prob(Wald Chi2)	0.000	0.000	0.000
Instruments	43	52	46
Observations	317	320	318
Countries	14	14	14

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

Table 9 Robustness test: low-income countries

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	0.399	0.654***	0.498***
	(1.415)	(6.719)	(3.028)
Financial development	-3.633**	-1.516***	-3.283***
	(-2.259)	(-2.702)	(-3.054)
Financial instability	1.048**	0.270***	0.294**
	(2.006)	(2.604)	(2.002)
Growth	-0.206*	-0.020	0.064
	(-1.737)	(-0.912)	(0.909)
Inflation	-0.126*	-0.023	-0.004
	(-1.932)	(-0.985)	(-0.141)
Public debt	-0.082	-0.334	-0.084
	(-0.091)	(-0.930)	(-0.121)
Fiscal crisis	1.310	0.588	1.035*
	(1.498)	(1.173)	(1.710)
Banking crisis	3.802**	1.695**	2.788***
	(2.037)	(2.096)	(2.590)
Population	0.008	0.379	1.021
	(0.006)	(0.652)	(1.561)
Trade openness	-0.940	1.283*	0.149
	(-0.561)	(1.805)	(0.244)
Financial openness	-0.426	0.201	0.597
	(-0.486)	(0.971)	(1.446)
IMF program	-0.945	-0.616*	-0.643
	(-1.269)	(-1.645)	(-1.433)
Constant	13.756	-5.466	-9.392
	(0.640)	(-0.579)	(-0.901)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
AR(2)	0.380	0.336	0.844
Sargan	0.827	0.814	0.714
Prob(Wald Chi2)	0.000	0.000	0.000
Instruments	46	61	58
Observations	252	252	252
Countries	11	11	11

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

However, we do find some differences between different groups of countries. In particular, we find that the coefficients of financial instability are the largest in Table 9 and the smallest in Table 7, implying that financial instability has the strongest impact on fiscal policy volatility in the LICs, followed by EMs and AEs. Similar results are also obtained for the impact of financial development on fiscal policy volatility: the coefficients of financial development are larger in magnitude in Table 9 than those in Tables 7-8, suggesting that fiscal policy volatility in LICs decreases at a higher speed with the development of the financial system than in EMs and AEs. Obviously, these differences point to a more pronounced relationship between finance (both in terms of financial development and financial instability) and fiscal policy volatility in LICs. A

possible explanation for this difference is that less developed countries typically have more volatile business cycles due to less-developed financial systems as well as weaker economic institutions (Fatas and Mihov, 2003), which makes them resort more often to discretionary fiscal policy. In this context, financial development in less developed countries would have a more pronounced effect on smoothing business cycles and thus lowering fiscal policy volatility. At the same time, as business cycles in less developed countries depend more on financial development, an increase in financial instability will naturally have a larger weakening effect on economic stability, which leads to more volatile business cycles and thus more volatile fiscal policy.

4.2.6 Including further controls

To check the robustness of our results to potential omitted variables, we allow for a variety of further controls that may have an impact on fiscal policy volatility, including: (1) polity scale (*Polity scale*), which measures how democratic a country is; (2) government crisis (*Government crisis*), which indicates a country's government instability; (3) cabinet changes (*Cabinet changes*), which measures a country's political instability; (4) political constraints (*Political constraints*), which measures the percentage of veto players dropping from the government for a given year; (5) political system (*Political system*), which characterizes a country's political system; and (6) old-age dependency ratio (*Age dependency*), which accounts for a country's ageing process (potential burden on working-age population). The first five variables control for the quality of government institutions and political instability (Agnello and Souza, 2014), while the last variable further controls for a country's demographic characteristics (Woo, 2009). The regression results with these additional controls are reported in Table 10.

Table 10 Robustness test: adding further controls

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep. var.	0.771***	0.334***	0.701***
	(12.914)	(4.309)	(11.435)
Financial development	-1.263**	-1.081***	-0.625***
	(-2.259)	(-2.755)	(-2.955)
Financial instability	0.328**	0.034**	0.092**
	(2.173)	(2.076)	(2.101)
Polity scale	-0.046	-0.017	0.005
	(-0.810)	(-0.770)	(0.206)
Government crisis	0.182	0.026	-0.026
	(0.447)	(0.548)	(-0.297)
Cabinet changes	0.619*	0.077**	0.085*
	(1.909)	(2.128)	(1.689)
Political constraint	0.614	0.305*	0.077
	(0.636)	(1.805)	(0.797)
Political system	0.056	0.547	-0.311

	(0.100)	(1.436)	(-1.203)
Age dependency	0.087	0.228	-0.186
	(0.089)	(0.692)	(-0.804)
Constant	9.821	6.282	2.937
	(1.268)	(1.483)	(1.174)
Other controls	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
AR(2)	0.278	0.100	0.551
Sargan	0.726	0.396	0.617
Prob(Wald Chi2)	0.000	0.000	0.000
Instruments	58	71	83
Observations	1978	1981	1980
Countries	88	88	88

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

The results in Table 10 again confirm our main results that financial development is conducive to smoothing fiscal policy volatility while financial instability leads to greater fiscal policy volatility. Thus, the main results of the paper would not change after more country characteristics such as government institutions, political instability and demographic characteristics are controlled. As for the six additional control variables, we find that cabinet changes and political constraint have significantly positive impacts on government revenue volatility. In all other cases, the additional control variables are not statistically significant.

5. Further discussion

5.1. Interaction effects

In the previous analysis, we have treated the impact of financial development and financial instability on fiscal policy volatility independently. However, one might think of potential mechanisms that link financial development and financial instability, reinforcing or weakening each other's effect on fiscal policy volatility. Thus, it is interesting to see whether the effect of financial instability decreases or increases at higher levels of financial development. To see this, we can introduce an interaction term between financial development and financial instability in the regression equation:

$$Vol_{i,t}^{F} = c + \beta_1 Vol_{i,t-1}^{F} + \beta_2 Finance_{i,t} + \beta_3 Instability_{i,t} + \beta_4 Instability_{i,t} * Finance_{i,t} + \gamma Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t} \quad (6)$$

where $Finance_{i,t} * Instability_{i,t}$ is the interaction term of interest, and the coefficient β_4 captures the interaction effects between financial development and financial instability. All other variables in Eq. (6) are defined the same as before.

Table 11 reports the results. We find that the coefficient on the interaction term is significantly negative in all regressions, suggesting that the positive effect of financial instability on fiscal policy volatility is weakened as financial development increases. In other words, as a country

moves to a higher level of financial development, the volatility effect of financial instability on fiscal policy tends to be smaller.

Table 11 Interaction effects between financial development and financial instability

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	0.727***	0.709***	0.718***
	(16.263)	(14.169)	(10.051)
Financial development	-1.176**	-0.702**	-0.876**
	(-2.467)	(-2.222)	(-2.003)
Financial instability	0.440**	0.964**	0.775**
	(2.408)	(2.128)	(2.060)
*Financial development * Financial instability*	-0.093**	-0.231**	-0.185**
	(-2.110)	(-2.053)	(-2.003)
Growth	-0.117	-0.038*	-0.098
	(-1.537)	(-1.757)	(-1.323)
Inflation	0.001	0.011	0.001
	(0.099)	(0.457)	(0.121)
Public debt	-0.559	0.164	0.348
	(-1.339)	(0.578)	(1.150)
Fiscal crisis	0.506	-0.980	0.822
	(0.663)	(-0.824)	(0.966)
Banking crisis	-0.371	-1.435	-0.470
	(-0.445)	(-1.269)	(-0.422)
Population	0.168	-0.610	0.047
	(0.599)	(-1.578)	(0.190)
Trade openness	-0.508	-2.750**	-5.521**
	(-0.530)	(-2.304)	(-2.224)
Financial openness	0.288	0.554	0.084
	(1.328)	(1.562)	(0.306)
IMF program	-3.192**	-1.523	-3.627***
	(-2.437)	(-1.549)	(-2.781)
Constant	7.130	23.746**	26.242**
	(0.871)	(2.211)	(1.971)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
AR(2)	0.159	0.145	0.201
Sargan	0.663	0.366	0.765
Prob(Wald Chi2)	0.000	0.000	0.000
Instruments	50	46	51
Observations	2164	2167	2166
Countries	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

In order to calculate the marginal effect of financial instability on fiscal policy volatility and its significance for different levels of financial development, we conduct a linear restriction test of the sum of the coefficient β_3 and β_4 in Eq. (6) for different values of financial development. To facilitate interpretation, the marginal effect of financial instability on government budget balance volatility, government revenue volatility and government spending volatility in relation to financial development are plotted in Figs. 1, 2 and 3, respectively.

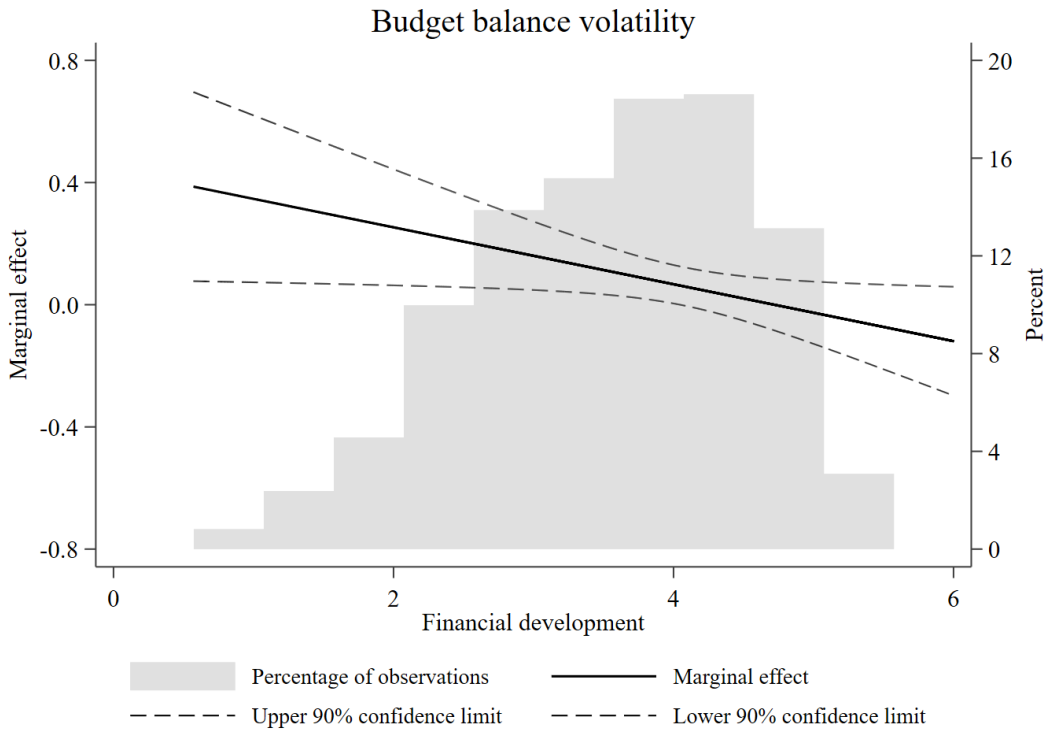


Fig. 1 Marginal effect of financial instability on budget balance volatility in relation to financial development

Notes: (1) This figure illustrates the marginal effect of financial instability on budget balance volatility at different levels of financial development; (2) financial development is measured by the logarithm of private sector credit to GDP ratio (%); (3) budget balance volatility is measured by the standard deviation of the HP-detrended residual for Eq. (1) in Section 2.1, using government budget balance as the dependent (fiscal policy) variable.

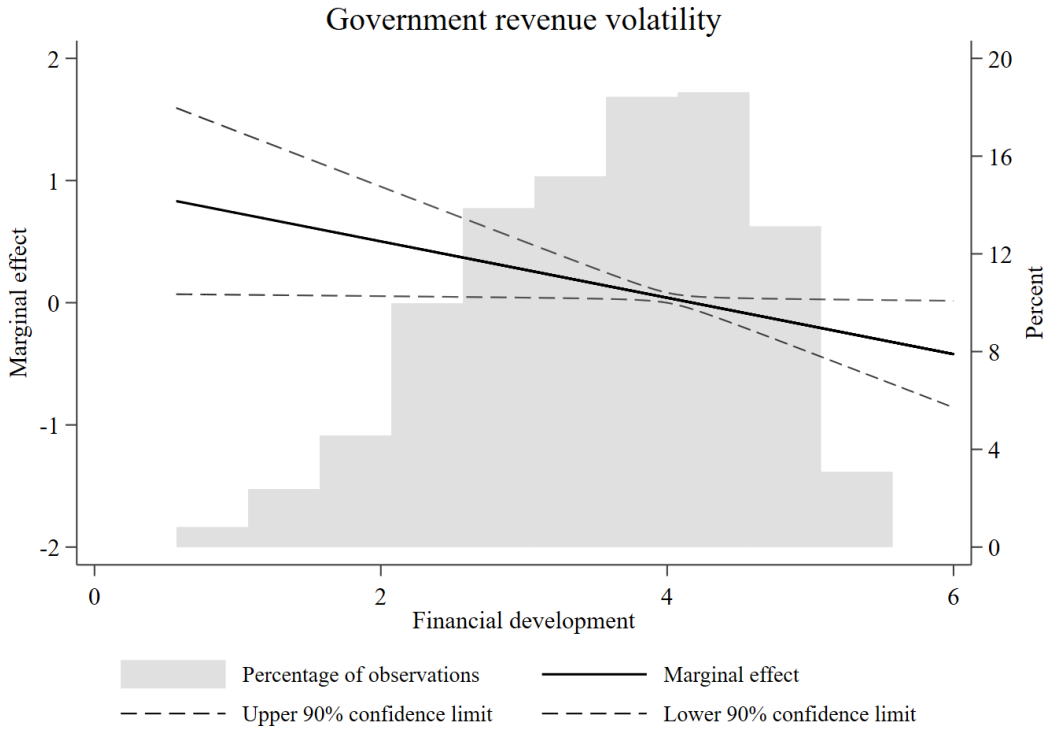


Fig. 2 Marginal effect of financial instability on government revenue volatility in relation to financial development

Notes: (1) This figure illustrates the marginal effect of financial instability on government revenue volatility at different levels of financial development; (2) financial development is measured by the logarithm of private sector credit to GDP ratio (%); (3) government revenue volatility is measured by the standard deviation of the HP-detrended residual for Eq. (1) in Section 2.1, using government revenue as the dependent (fiscal policy) variable.

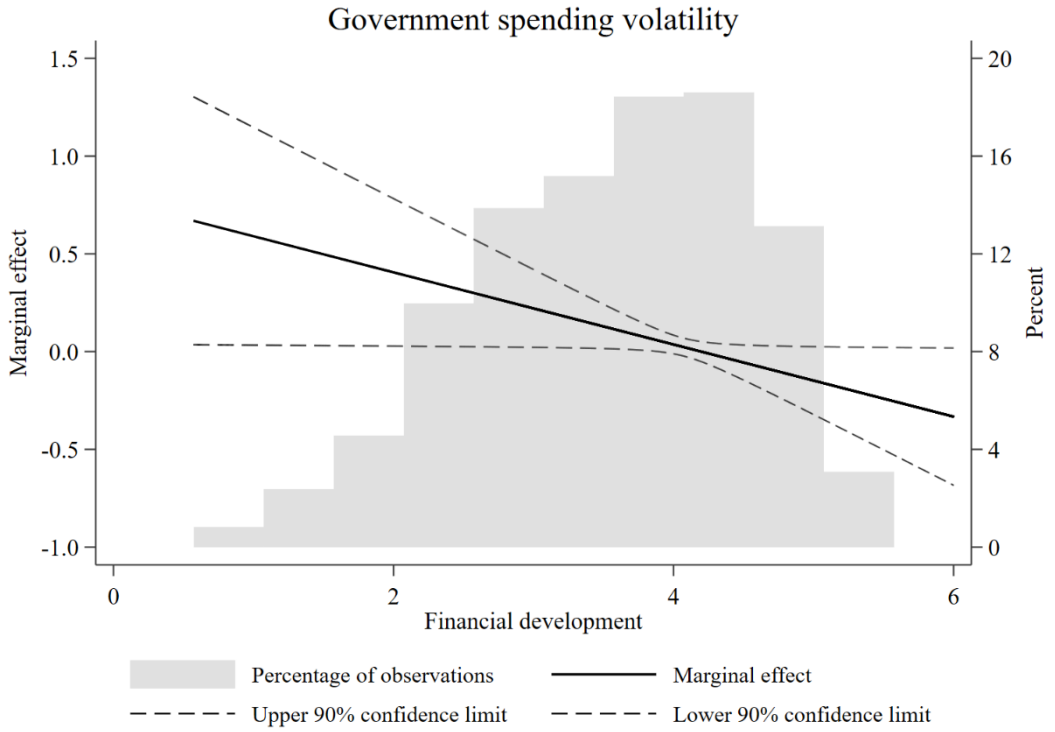


Fig.3 Marginal effect of financial instability on government spending volatility in relation to financial development

Notes: (1) This figure illustrates the marginal effect of financial instability on government spending volatility at different levels of financial development; (2) financial development is measured by the logarithm of private sector credit to GDP ratio (%); (3) government spending volatility is measured by the standard deviation of the HP-detrended residual for Eq. (1) in Section 2.1, using government spending as the dependent (fiscal policy) variable.

From the results in Figs. 1–3, we can see that except for a few exceptions for government revenue volatility at very high levels of financial development, the marginal effect of financial instability on fiscal policy volatility remains positive for all levels of financial development considered, and such positive relation weakens as financial development increases. These results suggest that financial instability is a source of fiscal policy volatility in countries with relatively less developed financial systems, and countries with more developed financial systems are less sensitive to the adverse effect of financial instability.

There are at least two interpretations for this finding. First, a larger financial system may have greater capacity to absorb shocks from financial instability, which weakens the impact of financial instability on fiscal policy volatility. Second, countries with more developed financial systems typically have more financial means to stabilize their fiscal policy behavior, which may partially offset the volatility effect of financial instability on fiscal policy.

5.2. The impact of financial cycle

Despite the growing body of literature on the sources of fiscal policy volatility, few, if any, have discussed how financial cycle may affect the effect of financial instability on fiscal policy volatility. As we have already shown that financial instability has a significant impact on fiscal

policy volatility, it would be interesting to further discuss how financial cycle may play a role in this relationship. For this purpose, in this subsection we attempt to investigate how the effect of financial instability on fiscal policy volatility varies across different phases of the financial cycle. To this end, first we follow the "peak-to-trough" approach suggested by Braun and Larrain (2005) and identify three typical phases of the financial cycle: expansion, recession and normal. Specifically, we identify the phases of financial cycle for each country according to the cyclical component of the private sector credit to GDP ratio. Denoting the level of the private sector credit to GDP ratio in country *i* and year *t* by $F_{i,t}$ and its cyclical component by $\hat{F}_{i,t}$ (calculated by Hodrick-Prescott filter) and its standard deviation by $\sigma(\hat{F})_{i,t}$, then the three representative phases of the financial cycle can be defined as follows:

(1) Financial expansion (*Expansion*). As in Braun and Larrain (2005), we identify a financial "peak" if $\hat{F}_{i,t} > \sigma(\hat{F})_{i,t}$, i.e., the cyclical component of $F_{i,t}$ is more than one standard deviation above the trend. Once a local "peak" is found, we look back until reaching a local "trough", which is defined as a time satisfying both $\hat{F}_{i,t} < \hat{F}_{i,t-1}$ and $\hat{F}_{i,t} < \hat{F}_{i,t+1}$, i.e., the cyclical component of $F_{i,t}$ is lower than both the previous and posterior years. Then, financial expansion (*Expansion*) is defined as a dummy variable which takes the value of 1 for years falling into the periods between the peak and trough, and 0 otherwise.

(2) Financial Recession (*Recession*). Likewise, a financial "trough" is identified as a year when the cyclical component of $F_{i,t}$ is more than one standard deviation below the trend, i.e., $\hat{F}_{i,t} < \sigma(\hat{F})_{i,t}$. Then we look back to find a local "peak", identified as a year when both $\hat{F}_{i,t} > \hat{F}_{i,t-1}$ and $\hat{F}_{i,t} > \hat{F}_{i,t+1}$ hold. Then, financial Recession (*Recession*) is defined as a dummy variable that takes the value of 1 for years between the peak and trough, and 0 otherwise.

(3) Normal period (*Normal*). Having identified both the expansionary and recessionary periods of the financial cycle, the left years that do not fall into these two phases are identified as "normal" periods, captured by a dummy variable "*Normal*" taking the value of 1 for a year belonging to the "normal" periods, and 0 otherwise.

After the four dummy variables for identifying financial cycle phases are constructed, we can interact them with the financial instability variable in the regressions to examine how the effect of financial instability on fiscal policy volatility may vary across different phases of the financial cycle. The estimation results for the three dependent variables (i.e., budget balance volatility, government revenue volatility, and government spending volatility) are reported in Tables 12, 13 and 14, respectively.

Table 12 Financial instability and budget balance volatility over the financial cycle

Independent variables	Dependent variable: *Budget balance volatility*			
	(1)	(2)	(3)	(4)
Lagged dep. var.	0.277***	0.438***	0.394***	0.642***
	(3.534)	(5.612)	(5.102)	(12.331)
Financial development	-1.034***	-0.524***	-1.327***	-2.367***
	(-2.881)	(-3.671)	(-5.049)	(-3.131)
Financial instability	0.044**	0.056*	0.060*	0.271***
	(2.387)	(1.739)	(1.685)	(2.714)
Financial instability Banking crisis*	0.078*			
	(1.775)			
*Financial instability*Expansion*		0.099*		

		(1.667)		
*Financial instability*Recession*			0.180*	
			(1.663)	
*Financial instability*Normal*				-0.169*
				(-1.718)
Banking crisis	0.283*	0.210**	0.367***	0.229
	(1.707)	(2.266)	(3.436)	(0.632)
Expansion		0.055		
		(0.336)		
Recession			-0.468	
			(-1.400)	
Normal				0.436
				(1.509)
Constant	6.138**	2.796*	-0.534	35.727**
	(2.520)	(1.680)	(-0.251)	(2.316)
Controls	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes
AR(2)	0.109	0.223	0.162	0.150
Sargan	0.102	0.126	0.210	0.523
Prob(Wald Chi2)	0.000	0.000	0.000	0.000
Instruments	60	114	88	76
Observations	2164	2164	2164	2164
Countries	96	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

Table 13 Financial instability and government revenue volatility over the financial cycle

Independent variables	Dependent variable: *Government revenue volatility*			
	(1)	(2)	(3)	(4)
Lagged dep. var.	0.210***	0.217***	0.485***	0.473***
	(2.600)	(3.405)	(7.531)	(8.632)
Financial development	-1.287***	-0.687***	-0.833***	-0.659**
	(-3.739)	(-3.655)	(-3.428)	(-1.987)
Financial instability	0.051***	0.032*	0.038**	0.077***
	(3.099)	(1.869)	(1.962)	(2.939)
Financial instability Banking crisis*	0.069*			
	(1.668)			
*Financial instability*Expansion*		0.060*		
		(1.656)		
*Financial instability*Recession*			0.071*	
			(1.652)	
*Financial instability*Normal*				-0.072*
				(-1.654)
Banking crisis	0.274*	0.184	0.291**	-0.595
	(1.853)	(1.356)	(2.025)	(-1.267)
Expansion		0.204*		
		(1.707)		
Recession			0.238*	
			(1.698)	
Normal				-0.231*

				(-1.650)
Constant	6.168**	19.566***	10.388**	8.038
	(2.352)	(3.715)	(2.066)	(1.561)
Controls	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes
AR(2)	0.104	0.153	0.123	0.400
Sargan	0.212	0.620	0.875	0.893
Prob(Wald Chi2)	0.000	0.000	0.000	0.000
Instruments	62	79	81	76
Observations	2167	2167	2167	2167
Countries	96	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

Table 14 Financial instability and government spending volatility over the financial cycle

Independent variables	Dependent variable: *Government spending volatility*			
	(1)	(2)	(3)	(4)
Lagged dep. var.	0.362***	0.068	0.704***	0.508***
	(4.272)	(0.894)	(8.387)	(8.993)
Financial development	-1.276***	-0.545***	-1.055***	-0.728**
	(-4.035)	(-2.903)	(-3.338)	(-2.249)
Financial instability	0.041**	0.051*	0.071*	0.068***
	(2.411)	(1.954)	(1.657)	(2.683)
Financial instability Banking crisis*	0.082*			
	(1.697)			
*Financial instability*Expansion*		0.089*		
		(1.655)		
*Financial instability*Recession*			0.103*	
			(1.649)	
*Financial instability*Normal*				-0.070*
				(-1.654)
Banking crisis	0.326*	0.369***	0.307	-0.751
	(1.730)	(3.971)	(1.614)	(-1.469)
Expansion		0.310*		
		(1.647)		
Recession			0.344*	
			(1.666)	
Normal				-0.168
				(-1.208)
Constant	3.239	-12.255***	-20.970***	9.504*
	(1.068)	(-2.656)	(-2.996)	(1.780)
Controls	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes
AR(2)	0.645	0.190	0.894	0.142
Sargan	0.573	0.529	0.983	0.507
Prob(Wald Chi2)	0.000	0.000	0.000	0.000

Instruments	78	75	80	94
Observations	2166	2166	2166	2166
Countries	96	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

From the results in Tables 12–14, we can see that for all of the three fiscal policy volatility variables, the coefficients of the interaction term between financial instability and expansion (*Financial instability* Expansion*) and that between financial instability and recession (*Financial instability* Recession*) are estimated to be significantly positive, while those on the interaction term between financial instability and normal (*Financial instability* Normal*) are estimated to be significantly negative. This suggests that the positive effect of financial instability on fiscal policy volatility would be magnified during expansionary or recessionary phases of the financial cycle, but would be weakened during normal phases of the financial cycle.

These results can be explained from two different perspectives. The first one is that fiscal policy is procyclical in many developing countries due to political distortions and incentives (Talvi and Végh, 2005; Alesina et al., 2008; Erbil, 2011; Bova et al., 2014). Therefore, fiscal policy will increase public spending and decrease tax in boom while reducing public spending and raising tax in bust, both of which would lead to greater volatility in government revenue, government spending and fiscal deficit eventually. The other perspective is that for the purpose of macroeconomic stability, the fiscal authority needs to be more responsive to financial instability during times of financial expansion or recession than it does during normal period. Financial expansion means more financing available for the private sector, which leads to higher economic growth as well as more government revenue and expenditure. Higher financial instability would prompt the fiscal authority to increase government revenue and reduce government spending to smooth economic fluctuations, both of which would lead to greater fiscal policy volatility. Similarly, financial recession stands for less financing supply for the private sector, which results in economic slowdown as well as less government revenue and expenditure. In this case, the fiscal authority would have to cut down government revenue and raise government spending to prevent economic recession, which makes the conduct of fiscal policy more volatile.

Meanwhile, the coefficient of the interaction term between financial instability and crisis (*Financial instability* Banking crisis*) is significantly positive for all of the three fiscal volatility variables, suggesting that the conduct of fiscal policy is more volatile during times of financial crisis. This might be interpreted that during financial crises, on the one hand government revenue tends to be more volatile due to crisis shock; on the other hand, the government needs to adjust its spending policy more aggressively to counteract the crisis shock, both of which lead to an increase in fiscal policy volatility.

To sum up, the results in Tables 12–14 suggest that the effect of financial instability on fiscal policy volatility also depends on the state of the financial cycle, where the positive effect of financial instability on fiscal policy volatility is more pronounced during expansionary, recessionary and banking crisis periods.

5.3 The medium-term effects

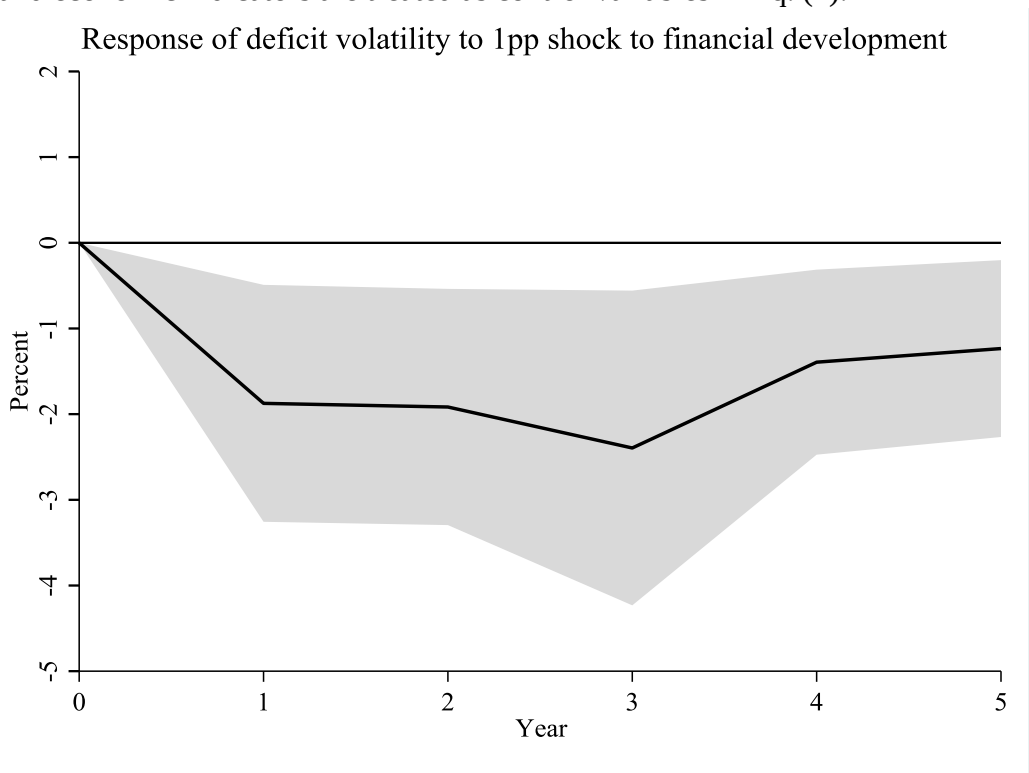
In this subsection we employ the local projection method proposed by Jordà (2005) to investigate the dynamic characteristics of the effects of financial development and financial

instability on fiscal policy volatility. According to Jordà (2005), the basic model of local projection method for panel data is as follows:

$$\Delta Vol^{F}_{j+i} = c + \sum_{\omega=1}^{3} \beta^{i}_{Vol,\omega} \Delta Vol^{F}_{j-\omega} + \sum_{\omega=1}^{3} \beta^{i}_{Fin,\omega} \Delta Finance_{j-\omega} + \sum_{\omega=1}^{3} \beta^{i}_{Ins,\omega} \Delta Instability_{j-\omega} + \gamma \Delta Z_{j+i} + \varepsilon \quad (7)$$

where *j* represents the benchmark year and *i* denotes the impulse response period. ΔVol^{F}_{j+i} is the change of fiscal policy volatility at $j+i$, representing the response of fiscal policy volatility to the financial shock, either financial development shock $\Delta Finance$ or financial instability shock $\Delta Instability$, which happens at $j-1$.

As in Jordà (2005), we explore the response of fiscal policy volatility in five years by setting *i* to range from 0 to 5 and focusing on the time-varying coefficients $\beta^{i}_{Fin,1}$ and $\beta^{i}_{Ins,1}$. The maximum number of lag periods ω is set as three periods, consistent with Jordà (2005). The lags of the dependent variable, independent variables with two and three lags and the difference of other financial and economic indicators are treated as control variables in Eq. (7).



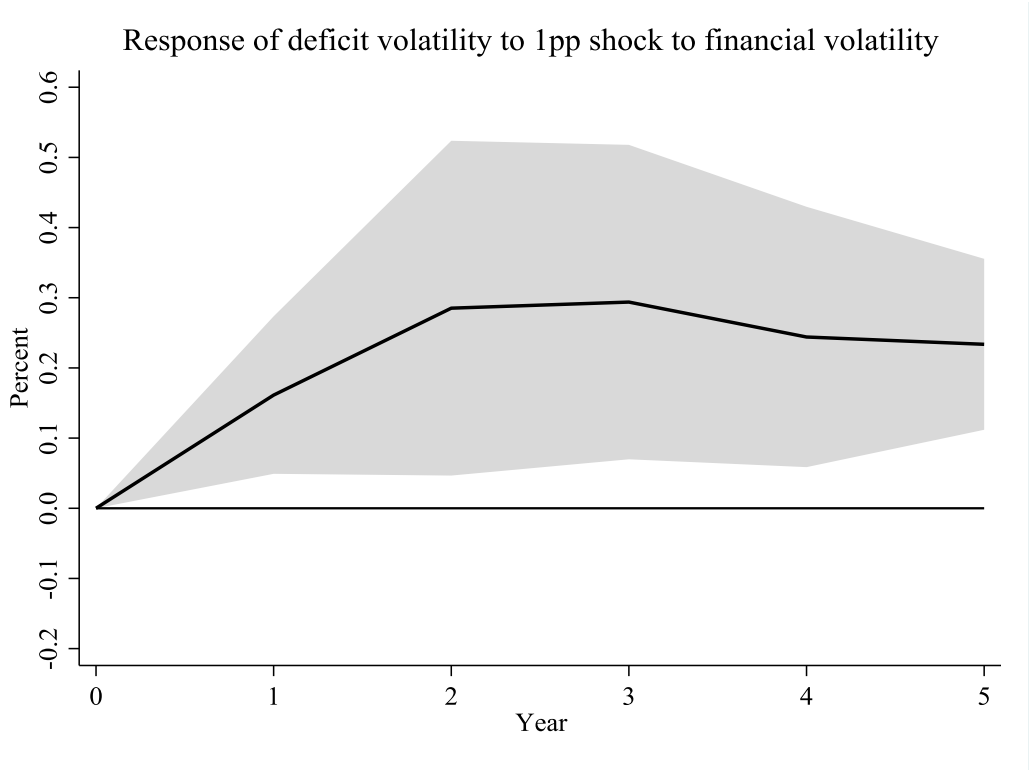


Fig.4 The response of budget balance volatility to 1 percent shock to financial development and financial volatility

Notes: (1) financial development is measured by the logarithm of private sector credit to GDP ratio (%); (2) government spending volatility is measured by the standard deviation of the HP-detrended residual for Eq. (1) in Section 2.1, using government spending as the dependent (fiscal policy) variable; (3) the grey area denotes the 90% confidence interval.

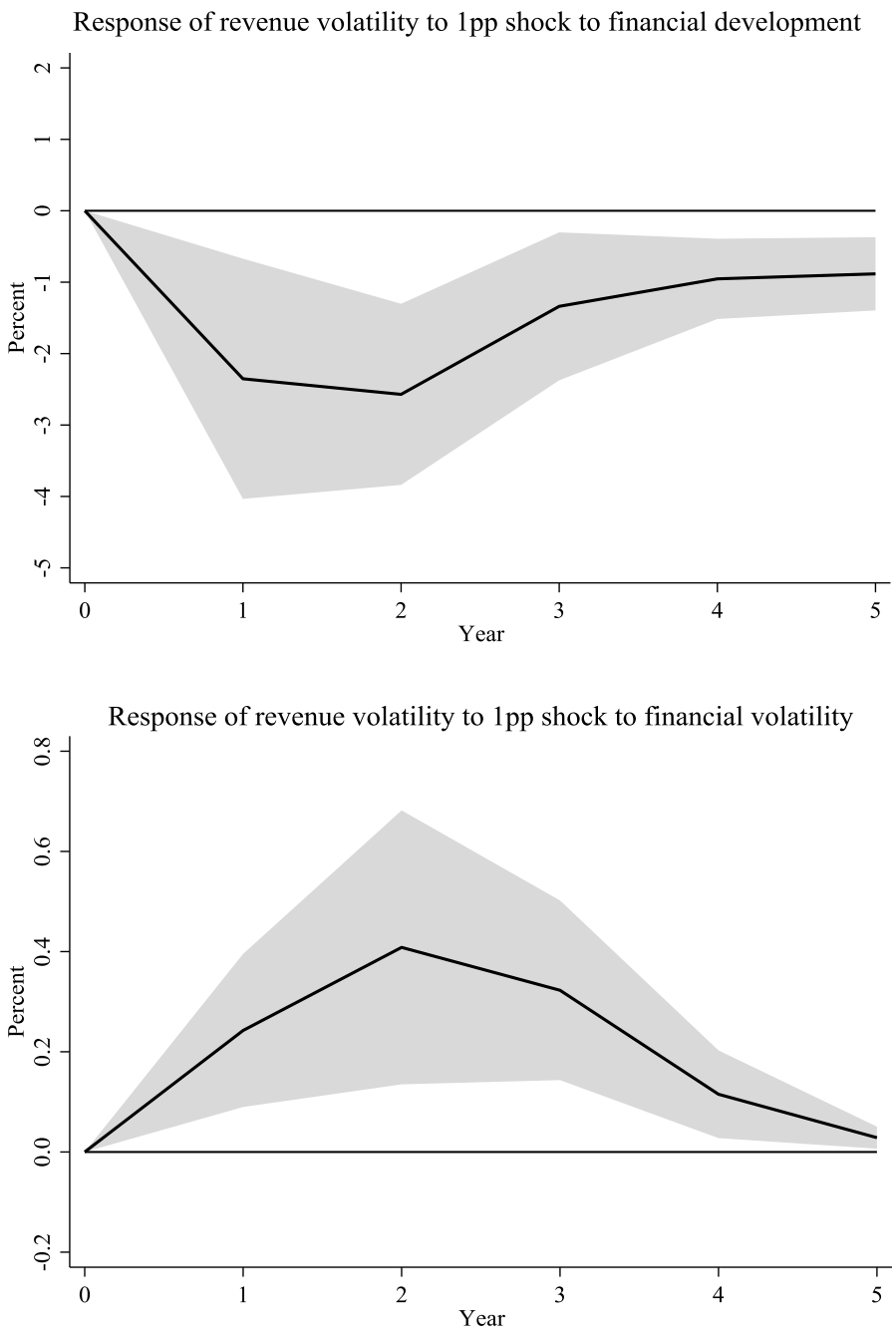


Fig.5 The response of government revenue volatility to 1 percent shock to financial development and financial volatility

Notes: (1) financial development is measured by the logarithm of private sector credit to GDP ratio (%); (2) government spending volatility is measured by the standard deviation of the HP-detrended residual for Eq. (1) in Section 2.1, using government spending as the dependent (fiscal policy) variable; (3) the grey area denotes the 90% confidence interval.

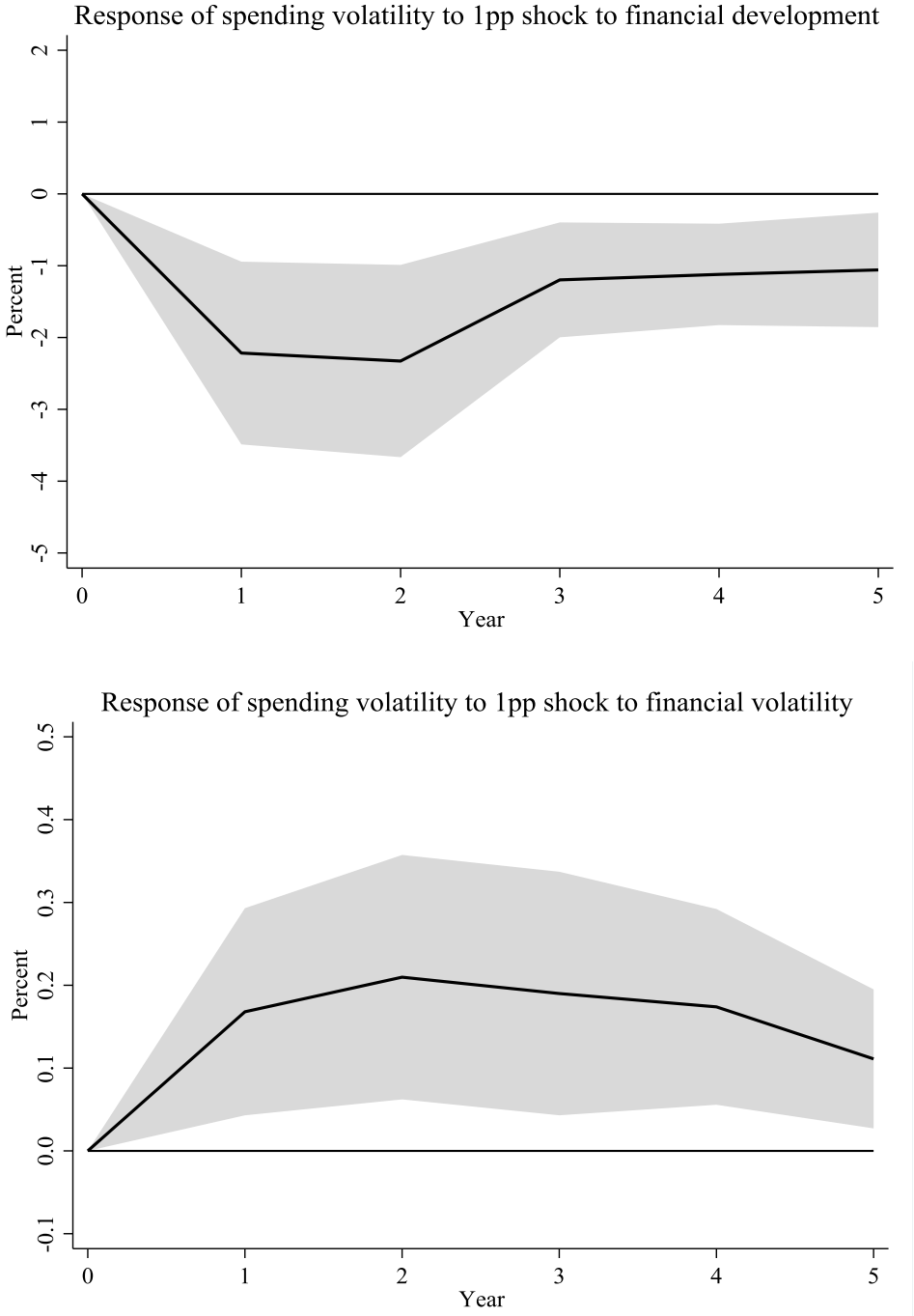


Fig.6 The response of government spending volatility to 1 percent shock to financial development and financial volatility

Notes: (1) financial development is measured by the logarithm of private sector credit to GDP ratio (%); (2) government spending volatility is measured by the standard deviation of the HP-detrended residual for Eq. (1) in Section 2.1, using government spending as the dependent (fiscal policy) variable; (3) the grey area denotes the 90% confidence interval.

The results are presented in Figures 4-6, from which we can see that the depressing effect of financial development on fiscal policy volatility gradually increase after the 1 % shock of financial development, and exhibits the strongest effect in the second or third year, after which the effect begins to reduce rapidly. The maximum decrease of fiscal policy volatility after a financial development shock is less than 3 percent on average. The effect of a financial instability shock shows similar dynamics, where the positive effect of financial instability on fiscal policy volatility displays an upward trend before the second or third year and then starts to fade away. When the effect become the strongest, the volatility of government revenue, budget balance and government spending grows by 0.4%, 0.3% and 0.2%, respectively.

5.4 The role of financial structure

The previous literature has documented that financial development is closely associated with the marketization of financial system (Toye, 2016; Ma, 2018; Chen et al., 2021; Ma and Yao, 2022). In this subsection, we proceed to explore the mediation role of financial structure in the relationship between financial development, financial instability and fiscal policy volatility using the following mediation model:

$$Vol_{i,t}^{F} = c + \theta_1 Vol_{i,t-1}^{F} + \theta_2 Finance + \theta_3 Instability + \theta_4 Structure_{i,t} + \mu Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t} \quad (8)$$

$$Structure_{i,t} = a + \alpha_1 Vol_{i,t-1}^{F} + \alpha_2 Finance_{i,t} + \alpha_3 Instability_{i,t} + \varphi Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t} \quad (9)$$

As is standard in literature (Ma, 2018; Chen et al., 2021), financial structure is measured as the stock market capitalization to GDP relative to private sector credit to GDP (denoted as *Financial structure*). The significance of the mediation effect depends on the significance of the coefficients α_2, α_3 and θ_4. More specifically, only if the null hypothesis is rejected (i.e., the coefficients (α_2, α_3 and θ_4) are significantly different from zero) can we conclude that financial structure plays a mediation role in the relationship between financial development, financial instability and fiscal policy. Furthermore, the significance of θ_2 and θ_3 denotes that financial development and financial instability have remarkable indirect and direct impact on the volatility of fiscal policy, otherwise they only have the indirect effect on fiscal policy volatility.

From the results in Table 15, we can see that higher financial development is associated with more market-based financial market and greater financial instability is associated with less market-based financial market. Meanwhile, more market-based financial system is associated with lower volatility of fiscal policy. To sum up, these results tend to suggest that higher financial development and more stable financial system would contribute to a smoother conduct of fiscal policy by promoting financial marketization.

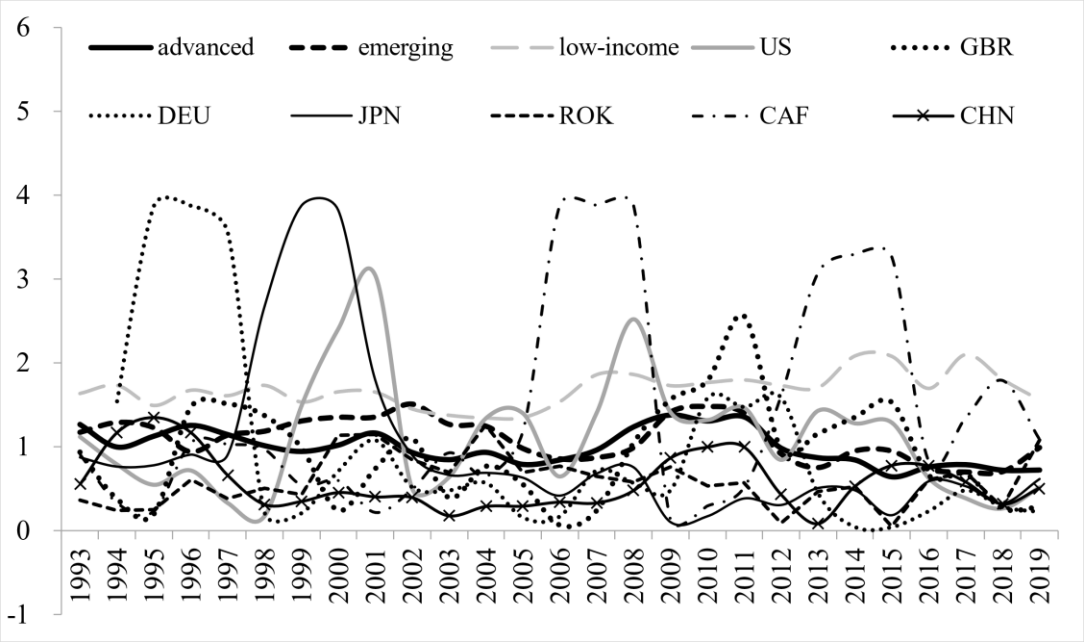


Fig.7 Budget balance volatility in the sample countries

Notes: (1) budget balance volatility is calculated as the standard deviation of the HP-detrended residuals of Eq. (1) when the dependent variable is the ratio of budget balance to GDP; (2) the time span is from 1993 to 2019 since the 1990-1992 samples become invalid for the calculation of residuals and rolling standard deviation; (3) we choose representative economies and countries to illustrate the volatility of budget balance in the sample, including advanced economies, emerging economies, low-income countries, the United States (US), the United Kingdom (GBR), Germany (DEU), Japan (JPN), Republic of Korea (ROK), Central Africa Republic (CAF) and China (CHN).

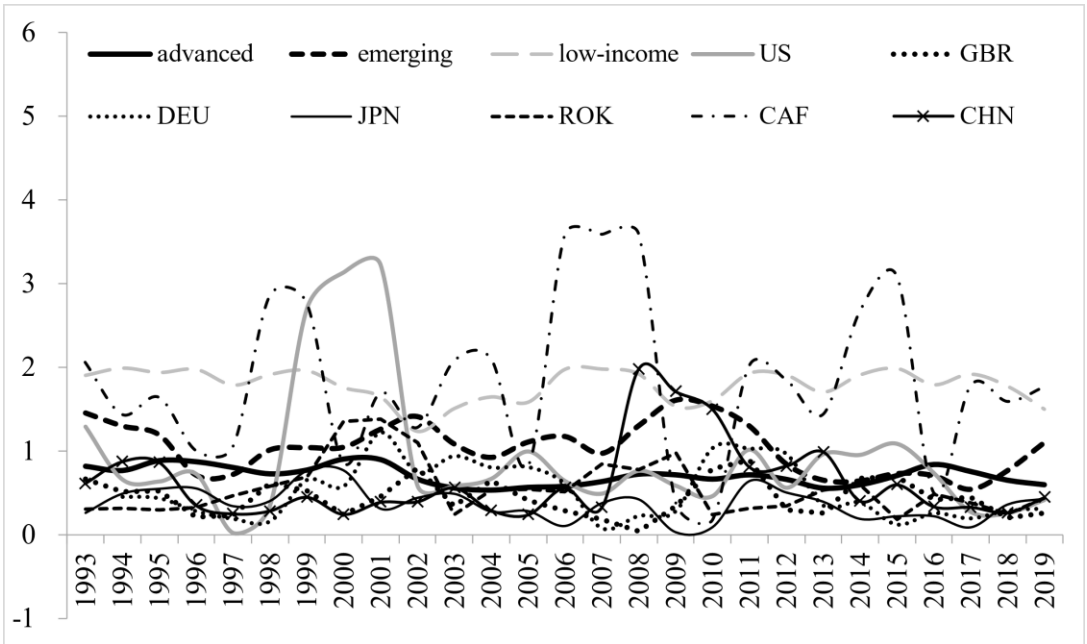


Fig.8 Government revenue volatility in the sample countries

Notes: (1) government revenue volatility is calculated as the standard deviation of the HP-detrended residuals of Eq. (1) when the dependent variable is the ratio of government revenue to GDP; (2) the time span is from 1993 to 2019 since the 1990-1992 samples become invalid for the calculation of residuals and rolling standard deviation; (3) we choose representative economies and countries to illustrate the volatility of budget balance in the sample, including advanced economies, emerging economies, low-income countries, the United States (US), the United Kingdom (GBR), Germany (DEU), Japan (JPN), Republic of Korea (ROK), Central Africa Republic (CAF) and China (CHN).

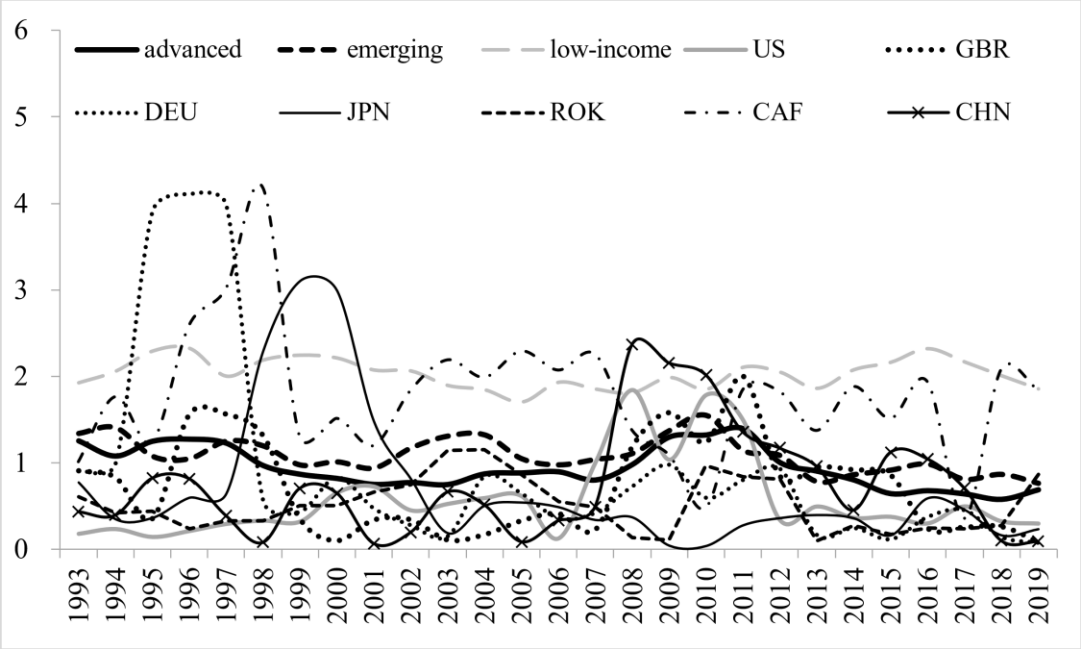


Fig.9 Government spending volatility in the sample countries

Notes: (1) government spending volatility is calculated as the standard deviation of the HP-detrended residuals of Eq. (1) when the dependent variable is the ratio of government spending to GDP; (2) the time span is from 1993 to 2019 since the 1990-1992 samples become invalid for the calculation of residuals and rolling standard deviation; (3) we choose representative economies and countries to illustrate the volatility of budget balance in the sample, including advanced economies, emerging economies, low-income countries, the United States (US), the United Kingdom (GBR), Germany (DEU), Japan (JPN), Republic of Korea (ROK), Central Africa Republic (CAF) and China (CHN).

Table 15 The mediation effect of financial structure

Independent variables	Dependent variable					
	Budget balance volatility		Government revenue volatility		Government spending volatility	
	Financial structure	Fiscal policy volatility	Financial structure	Fiscal policy volatility	Financial structure	Fiscal policy volatility
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged dep.var.	0.024	0.515***	0.070	0.274**	-0.010	0.767***
	(0.390)	(8.286)	(0.590)	(2.104)	(-0.206)	(15.858)
Financial development	1.586**	-0.931***	1.359*	-0.908***	0.467***	-0.501**
	(2.149)	(-2.867)	(1.820)	(-3.168)	(2.732)	(-1.987)
Financial instability	-0.081*	0.043*	-0.079*	0.048***	-0.035*	0.048**
	(-1.681)	(1.766)	(-1.660)	(2.955)	(-1.842)	(2.510)
Financial structure		-0.354*		-0.406*		-0.863***
		(-1.798)		(-1.840)		(-3.130)
Constant	-2.576	30.929***	-3.820	29.975***	-4.314	-3.502
	(-0.334)	(5.044)	(-0.484)	(4.421)	(-1.529)	(-0.564)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
AR(2)	0.477	0.597	0.526	0.154	0.550	0.323
Sargan	0.414	0.138	0.505	0.858	0.143	0.102
Prob(Wald Chi2)	0.000	0.000	0.000	0.000	0.000	0.000
Instruments	43	67	44	61	69	61
Observations	1414	1414	1417	1417	1416	1416
Countries	68	68	68	68	68	68

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the AR(2), Sagan and Wald tests are *p*-values.

The transmission mechanism can be explained as follows. Since financial development is measured by the financial intermediary credit to private sector, the indicator of financial development stands for the development of indirect financial market (mainly referring to banking market). By contrast, stock market capitalization captures the development of direct financial market. The more development of finance indicates the greater financing demand of the economy. Although banking market could satisfy most of capital demand, banks are subject to many constraints, including capital adequacy requirement, required reserve and credit structure constraints, which prevents credit from rapid growth and results in credit rationing. The development of stock market broadens financing channels for enterprises and governments, which improves the allocation efficiency of financial resources. In this context, as banking market develops, the growing demand for financing further promotes the development of stock market and financial marketization. With the promotion of financial marketization, financial system becomes more efficient, which impels the steady growth of economy and thus enhances the stability of fiscal policy. On the contrary, greater financial instability means that financing demands are more difficult to be satisfied, which is harmful for financial marketization and leads to higher fiscal policy volatility.

7. Concluding remarks

This paper investigates the effects of financial development and financial instability on fiscal policy volatility using system GMM estimator based on panel data of 96 countries from 1990 to 2019. We find that while an increase in financial development is conducive to reducing fiscal policy volatility, an increase in financial instability raises the volatility of fiscal policy. In addition, we also find that the effect of financial instability on fiscal policy volatility depends on the financial cycle, where the harmful effect of financial instability on fiscal policy conduct is alleviated in normal and recessionary phases of the financial cycle but magnified during expansionary and crisis periods.

The findings of the paper have both theoretical and policy implications. On the theoretical side, in contrast to the previous literature that focuses primarily on the economic and institutional determinants of fiscal policy volatility, our paper highlights the important role of finance in determining fiscal policy volatility, where a large and stable financial system is found to be helpful for smoothing fiscal policy volatility. From a policy perspective, this implies that policy reforms aimed at reducing fiscal policy volatility should also take into account the impact of financial factors. In particular, policy makers should be aware that it is essential to promote financial development and maintain financial stability for a smooth conduct of fiscal policy.

Besides promoting financial development and maintaining financial stability, our study also suggests that better developed government bond market and stock market, greater trade openness and smoother financial cycles can contribute to the stability of fiscal policy. In light of these results, we can draw the following policy implications:

First, as for government bond market, a nearly full-scale market making system would be prudently workable for generating or enhancing liquidity in high-end emerging markets and developed markets. In comparison, the governments of emerging, developing and least-developed countries should consider more about building a call market or a dealers' club market according to the phase of bond market before introducing a market making system (Endo, 2013). Also, constantly improving

the varieties of government bond traded could facilitate the development of diversified government bond market, which is beneficial for fulfilling the investment needs for government.

Second, the prosperity of stock market can be realized by implementing a relatively loose monetary policy for some well-developed stock markets. The growth of money supply and reduction in financing costs under loose monetary policy will boost the price of financial assets and stabilize the risk appetite of investors, which increases investor's participation in stock market eventually. In terms of underdeveloped stock market in developing countries, establishing the basic system of stock market and optimizing the industrial structure are the cornerstone of consolidating the steady development of the market. To be more specific, government should improve the information disclosure mechanism, expedite the build-up of circuit breaker mechanism and use comprehensive accounting indicators to strictly implement the delisting process to accelerate the reform of registration, trading and delisting system. Furthermore, encouraging the development of innovative high-tech enterprises is favorable for increasing return on capital and hence the expansion of stock market.

Third, the taxation of financial services under VAT may improve trade openness (Xu and Krever, 2016; López-Laborda and Peña, 2017, 2021). The financial VAT can reduce the price of traded goods relative to the price of non-traded goods, triggering an increase in tradable sector. Besides, the practical experience of European countries shows that the "option-to-tax" method is more efficient in improving trade openness than "separate taxes". Besides, the high economic growth and low domestic saving rate are the main drivers of trade openness in some low-income countries, while the two factors cannot act as the driver for openness in lower-middle income countries (Osei et al., 2019). For both low-income countries and lower-middle income countries, improving the gross capital formation is essential for trade openness, which means that the government should pay more attention to the construction of a multilevel capital market and encouraging the long-term capital to enter financial market.

Finally, in the aftermath of the global financial crisis, the researches of the BIS have pointed out that the implementation of countercyclical macroprudential policy is an effective way to tame the cyclical fluctuations of financial system in the long term. In practice, macroprudential policy is used to avoid credit booms and busts by imposing the requirements of capital adequacy, liquidity coverage, reserves and countercyclical capital buffer on commercial banks. In the short term, to control the leverage of the real economy and optimize the allocation of credit resources is inevitable indispensable to solving the problem of extreme financial volatility.

Appendix

Table A1 Countries included in the sample

High income (39)	Advanced (25)	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak, Spain, Sweden, Switzerland, United Kingdom, United States

	Emerging (4)	Chile, Poland, Saudi Arabia, United Arab Emirates
	Developing (10)	Antigua and Barbuda, Bahamas, Bahrain, Barbados, Kuwait, Oman, Panama, Romania, Seychelles, Trinidad and Tobago
Middle income (46)	Emerging (10)	Argentina, China, Colombia, India, Indonesia, Iran, Malaysia, Mexico, Philippines, Thailand
	Developing (25)	Algeria, Azerbaijan, Bolivia, Costa Rica, El Salvador, Fiji, Gabon, Ghana, Grenada, Honduras, Jordan, Kenya, Lebanon, Mongolia, Morocco, Namibia, Nigeria, Pakistan, Papua New Guinea, Paraguay, Sri Lanka, Suriname, Tunisia, Swaziland, Venezuela
	Least developed (11)	Bangladesh, Benin, Bhutan, Comoros, Djibouti, Equatorial Guinea, Lesotho, Samoa, Solomon Islands, Tanzania, Vanuatu
Low income (11)	Least developed (11)	Burkina Faso, Burundi, Central African Republic, Guinea, Guinea-Bissau, Madagascar, Mozambique, Niger, Rwanda, Sudan, Togo

Note: The sample countries are classified according to the income level and overall development. The countries are first classified into 39 high-income countries, 46 middle-income countries and 11 low-income countries according to the World Bank's classification of countries[4]. Under each income level, the countries are then split into advanced economies, emerging economies, developing countries and least developed countries based on the standard of IMF and the United Nation[5].

[4] High income: https://data.worldbank.org/income-level/high-income?view=chart;
Middle income: https://data.worldbank.org/income-level/middle-income;
Low income: https://data.worldbank.org/income-level/low-income

[5] IMF: https://www.imf.org/external/pubs/ft/fandd/2021/06/the-future-of-emerging-markets-duttagupta-and-pazarbasioglu.htm#:~:text=This%20approach%20identifies%20the%20following%20countries%20in%20the,Africa%2C%20Thailand%2C%20Turkey%2C%20and%20the%20United%20Arab%20Emirates.
The United Nation: https://www.un.org/development/desa/dpad/least-developed-country-category/ldcs-at-a-glance.html

Table A2 Definitions and sources of variables

Variable	Description	Source
Budget balance volatility	Standard deviation of the HP-detrended discretionary component of the general government budget deficit (% of GDP)	Authors' calculation
Government revenue volatility	Standard deviation of the HP-detrended discretionary component of the general government revenue (% of GDP)	Authors' calculation
Government spending volatility	Standard deviation of the HP-detrended discretionary component of the general government spending (% of GDP)	Authors' calculation
Financial development	Logarithm of domestic credit to private sector (% of GDP)	WDI*
Financial instability	Standard deviation of the HP-detrended discretionary component of the domestic credit to private sector (% of GDP)	Authors' calculation
Financial volatility	Standard deviation of private sector credit (% of GDP)	Authors' calculation
Growth	Annual percentage change of real GDP	WDI
Inflation	Annual percentage change in GDP deflator (%)	WDI
Public debt	Logarithm of government debt (% of GDP)	IMF**
Fiscal crisis	Binary variable (taking the value of 1 if a country experiences fiscal crisis)	Medas et al. (2018)***
Banking crisis	Binary variable (taking the value of 1 if a country experiences banking, currency or debt crisis)	IMF
Population	Logarithm of the population of a country	WDI
Trade openness	Logarithm of the ratio of exports and imports to GDP (%)	WDI
Financial openness	Capital account openness index (the Chinn-Ito Index)	Chinn-Ito website****
IMF program	Binary variable (taking the value of 1 if a country implements an IMF-supported program for a given year)	IMF
Policy scale	Discrete variable (ranging from -10 to +10)	Polity IV Database*****
Government crisis	Discrete variable (ranging from 0 to 5)	CNTS
Cabinet changes	Discrete variable (ranging from 0 to 5)	CNTS******
Political constraints	Percentage of veto players who drop from the government in a given year	DPI*******
Political system	Discrete variable (0 is given for a presidential system, 1 is given for an assembly-elected presidential system, and 2 is given for a parliamentary system)	DPI
Age dependency	Logarithm of the number of people aged 65 or over in percent of working-age population (aged 15-64)	WDI
Expansion	Binary variable (taking the value of 1 if a country is experiencing an expansionary period of financial cycle for a given year)	Authors' calculation
Recession	Binary variable (taking the value of 1 if a country is experiencing a recessionary period of financial cycle for a given year)	Authors' calculation
Normal	Binary variable (taking the value of 1 if a country is experiencing a normal period of financial cycle for a given year)	Authors' calculation

Notes: (1) * WDI denotes the World Bank's *World Development Indicators* database; (2) **Data are accessible at the website (http://www.imf.org/external/pubs/ft/wp/2010/data/wp10245.zip); (3) *** Data are available from the online appendix of Medas et al. (2018); (4) ****Data are available at the Chinn-Ito index website (http://web.pdx.edu/~ito/Chinn-Ito_website.htm); (5) ***** The Polity IV Database is available at http://www.cidcm.umd.edu/inscr/polity/index.htm; (6) ****** CNTS denotes the *Cross National Time Series Data Archive*; (7) ******* DPI denotes the *Database of Political Institutions*.

Table A3 Robustness test (Augmented Mean Group estimator)

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	0.182***	0.142***	0.142***
	(5.332)	(4.796)	(3.539)
Financial development	-0.280	0.128	0.647**
	(-0.799)	(0.450)	(2.030)
Financial instability	0.001	0.056**	0.004
	(0.018)	(2.171)	(0.105)
Growth	0.007	-0.005	0.011
	(0.621)	(-0.494)	(1.221)
Inflation	-0.014	-0.011	-0.004
	(-0.916)	(-1.282)	(-0.244)
Public debt	-0.137	-0.099	0.658***
	(-0.639)	(-0.534)	(2.898)
Fiscal crisis	0.133**	-0.020	-0.023
	(2.414)	(-0.372)	(-0.295)
Banking crisis	0.038	-0.062	-0.004
	(0.382)	(-0.772)	(-0.041)
Population	-5.833*	-4.554***	-7.139*
	(-1.749)	(-3.350)	(-1.836)
Trade openness	-0.248	0.114	0.216
	(-0.746)	(0.432)	(0.514)
Financial openness	-0.270	-0.302**	-0.144
	(-1.522)	(-2.326)	(-0.998)
IMF program	0.091*	-0.010	0.054
	(1.677)	(-0.172)	(1.214)
common dynamic process	1.003***	0.996***	0.883***
	(3.983)	(3.466)	(3.155)
Constant	96.013*	70.990***	106.780*
	(1.806)	(3.343)	(1.751)
Prob(Wald Chi2)	0.000	0.000	0.000
cross-section dependence	0.061	0.286	0.228
Observations	2134	2137	2136
Countries	93	93	93

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the Wald Chi2 and cross-section dependence tests are *p*-values.

Table A4 Robustness test (Common Correlated Effects Mean Group estimator)

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	-0.128	0.123	-0.007
	(-0.751)	(0.510)	(-0.047)
Financial development	-1.102	0.241	5.082*
	(-0.767)	(0.198)	(1.919)
Financial instability	0.246	-0.079	-0.242
	(1.176)	(-0.717)	(-1.122)
Growth	0.184*	-0.031	-0.038
	(1.646)	(-0.685)	(-0.979)
Inflation	0.071	-0.030	-0.131
	(1.230)	(-0.528)	(-0.947)
Public debt	-1.640	0.145	2.233
	(-0.685)	(0.170)	(1.095)
Fiscal crisis	0.004	-0.312	-0.646
	(0.018)	(-1.331)	(-1.605)
Banking crisis	0.311	-0.251	0.324
	(0.381)	(-0.850)	(0.465)
Population	38.026	-3.689	-26.414
	(1.366)	(-0.547)	(-0.692)
Trade openness	-6.454	1.311	2.675
	(-1.318)	(0.998)	(1.174)
Financial openness	0.106	-0.199	1.148
	(0.094)	(-0.293)	(1.295)
IMF program	0.167	0.366**	0.031
	(0.985)	(2.109)	(0.133)
Constant	-531.746	83.466	529.277
	(-1.052)	(0.756)	(0.753)
Prob(Wald Chi2)	0.877	0.481	0.230
cross-section dependence	0.258	0.664	0.674
Observations	2134	2137	2136
Countries	93	93	93

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the Wald Chi2 and cross-section dependence tests are *p*-values; (4) For brevity, the table omits the estimation results for coefficients of cross-section averaged regressors and the results are available upon requests.

Table A5 Tests for coefficient differences (budget balance and government revenue)

Independent variables	Panel A		Panel B		Panel C	
	Budget balance volatility	Government revenue volatility	Budget balance volatility	Government revenue volatility	Budget balance volatility	Government revenue volatility
Lagged dep.var.	0.680***	0.709***	0.682***	0.709***	0.563***	0.538***
	(43.549)	(47.602)	(43.430)	(47.097)	(31.005)	(28.976)
Financial development	-0.072***	-0.104***	-0.076***	-0.115***	0.139**	-0.013
	(-3.118)	(-4.889)	(-3.199)	(-5.289)	(2.420)	(-0.248)
Financial instability	0.015*	0.017**	0.014	0.020**	0.001	0.010
	(1.718)	(2.171)	(1.596)	(2.462)	(0.135)	(1.187)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	No	No	Yes	Yes	Yes	Yes
Country fixed effect	No	No	No	No	Yes	Yes
Prob(*F*-test)	0.000	0.000	0.000	0.000	0.000	0.000
Observations	2164	2167	2164	2167	2164	2167
Countries	96	96	96	96	96	96
Difference in coefficient (β_2)	0.032		0.040		0.152**	
Difference in coefficient (β_3)	-0.002		-0.006		-0.009	

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the F-test are *p*-values.

Table A6 Tests for coefficient differences (government revenue and government spending)

Independent variables	Panel A		Panel B		Panel C	
	Government revenue volatility	Government spending volatility	Government revenue volatility	Government spending volatility	Government revenue volatility	Government spending volatility
Lagged dep.var.	0.709***	0.706***	0.709***	0.706***	0.538***	0.550***
	(47.602)	(46.623)	(47.097)	(46.305)	(28.976)	(29.777)
Financial development	-0.104***	-0.087***	-0.115***	-0.091***	-0.013	0.109*
	(-4.889)	(-3.694)	(-5.289)	(-3.789)	(-0.248)	(1.911)
Financial instability	0.017**	0.009	0.020**	0.007	0.010	-0.009
	(2.171)	(1.051)	(2.462)	(0.804)	(1.187)	(-0.956)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	No	No	Yes	Yes	Yes	Yes
Country fixed effect	No	No	No	No	Yes	Yes
Prob(*F*-test)	0.000	0.000	0.000	0.000	0.000	0.000
Observations	2167	2166	2167	2166	2167	2166
Countries	96	96	96	96	96	96
Difference in coefficient (β_2)	-0.018		-0.024		-0.122*	
Difference in coefficient (β_3)	0.008		0.012		0.019*	

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the F-test are *p*-values.

Table A7 Tests for coefficient differences (budget balance and government spending)

Independent variables	Panel A		Panel B		Panel C	
	Budget balance volatility	Government spending volatility	Budget balance volatility	Government spending volatility	Budget balance volatility	Government spending volatility
Lagged dep.var.	0.680***	0.706***	0.682***	0.706***	0.563***	0.550***
	(43.549)	(46.623)	(43.430)	(46.305)	(31.005)	(29.777)
Financial development	-0.072***	-0.087***	-0.076***	-0.091***	0.139**	0.109*
	(-3.118)	(-3.694)	(-3.199)	(-3.789)	(2.420)	(1.911)
Financial instability	0.015*	0.009	0.014	0.007	0.001	-0.009
	(1.718)	(1.051)	(1.596)	(0.804)	(0.135)	(-0.956)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	No	No	Yes	Yes	Yes	Yes
Country fixed effect	No	No	No	No	Yes	Yes
Prob(*F*-test)	0.000	0.000	0.000	0.000	0.000	0.000
Observations	2164	2167	2164	2167	2164	2167
Countries	96	96	96	96	96	96
Difference in coefficient (β_2)	0.014		0.016		0.030	
Difference in coefficient (β_3)	0.006		0.007		0.011	

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the F-test are *p*-values.

Table A8 OLS regression: fixed effect

Independent variables	Dependent variable		
	Budget balance volatility	Government revenue volatility	Government spending volatility
	(1)	(2)	(3)
Lagged dep.var.	0.562***	0.537***	0.552***
	(31.160)	(29.179)	(30.077)
Financial development	0.094*	0.006	0.057
	(1.751)	(0.119)	(1.072)
Financial instability	0.008	0.010	-0.001
	(0.810)	(1.164)	(-0.104)
Growth	-0.005	0.001	-0.003
	(-0.889)	(0.190)	(-0.635)
Inflation	-0.005	-0.000	-0.002
	(-1.483)	(-0.131)	(-0.738)
Public debt	-0.017	-0.041	0.025
	(-0.425)	(-1.166)	(0.619)
Fiscal crisis	0.121**	0.069*	0.070
	(2.573)	(1.662)	(1.505)
Banking crisis	0.185***	0.004	0.194***
	(3.109)	(0.082)	(3.292)
Population	-0.013	-0.216*	-0.055
	(-0.096)	(-1.774)	(-0.399)
Trade openness	-0.030	0.153**	0.061
	(-0.360)	(2.099)	(0.747)
Financial openness	-0.044	-0.066***	-0.030
	(-1.515)	(-2.596)	(-1.037)
IMF program	-0.052	-0.002	-0.061
	(-1.054)	(-0.056)	(-1.251)
Constant	0.669	3.510*	0.981
	(0.307)	(1.824)	(0.454)
Time Effect	Yes	Yes	Yes
Country Effect	Yes	Yes	Yes
F-test	0.000	0.118	0.361
Observations	2164	2167	2166
Countries	96	96	96

Notes: (1) *,**,*** indicate statistically significant at the 10%, 5% and 1% level respectively; (2) The statistics given in the parentheses under the coefficients of explanatory variables are Z-values; (3) The statistics in the F-test are *p*-values.

Definitions and sources of variables

Growth. This variable is the annual percentage growth rate of GDP at market prices. Aggregates are based on constant 2015 U.S. dollars. The data are sourced from the World Bank Database (WDI).

Inflation. This variable is computed as the annual growth rate of the GDP deflator. The data are sourced from the World Bank Database (WDI).

Financial development. This variable is the logarithm of the private sector credit to GDP ratio. The raw data are sourced from the World Bank Database (WDI).

Public debt. This variable is the logarithm of the government debt to GDP ratio. The data are sourced from the working paper of IMF.

Fiscal crisis. This indicator is a dummy variable, which equals to 1 if a country experiences a fiscal crisis for a given year.

Banking crisis. This variable is a dummy variable, which takes the value 1 if a country experiences a banking, currency or debt crisis for a given year. The original information for the crisis episodes for each country is from IMF financial data.

Population. This variable is the logarithm of a country's population. The raw data are available at the World Bank Database (WDI).

Trade openness. This variable is calculated as the logarithm of the ratio of national trade (imports plus exports) to GDP. The raw data are sourced from the World Bank Database (WDI).

Financial openness. This variable is an index (Chinn-Ito Index) which measures a country's degree of capital account openness. The data are available at the Chinn-Ito index website (http://web.pdx.edu/~ito/Chinn-Ito_website.htm).

IMF program. This variable is a dummy variable, which takes the value 1 if a country implements an IMF-supported program for a given year.

Polity scale. This variable is Polity2 from Polity IV, which measures how democratic a country is. It subtracts the country's score on an 'autocracy' index from its score on a 'democracy' index and produces a polity scale ranging from -10 (strongly autocratic) to +10 (strongly democratic). The data are sourced from the Polity IV Database (http://www.cidcm.umd.edu/inscr/polity/index.htm).

Government crisis. This indicates the number of any rapidly developing situations that might cause the downfall of the present regime, excluding the situations of revolt. The data are sourced from the Cross National Time Series Data Archive (CNTS).

Cabinet changes. This annual frequency variable counts the number of times that a new premier is named and/or 50 per cent of cabinet posts are occupied by new ministers. The data are sourced from the Cross National Time Series Data Archive (CNTS).

Political constraints. This variable measures the percentage of veto players dropping from the government for a given year. The data are sourced from the Database of Political Institutions (DPI).

Political system. This variable characterizes the political system, a value of 0 is given for a presidential system, a value of 1 is given for an assembly-elected presidential system, a value of 2 is given for a parliamentary system. The data are sourced from the Database of Political Institutions (DPI).

Age dependency. This variable is calculated as the logarithm of the number of elderly people (aged 65 or above) as a percentage of working age (aged 15-64). The raw data are sourced from the World Bank Database (WDI).

Expansion. This variable is a dummy variable, which takes the value 1 if a country is experiencing an expansionary period of financial cycle for a given year. Methods used for characterizing the phases of the financial cycle can be found in the main text of the paper.

Recession. This variable is a dummy variable, which takes the value 1 if a country is experiencing a recessionary period of financial cycle for a given year. Methods used for characterizing the phases of the financial cycle can be found in the main text of the paper.

Normal. This variable is a dummy variable, which takes the value 1 if a country is experiencing a normal period of financial cycle for a given year. Methods used for characterizing the phases of the financial cycle can be found in the main text of the paper. Methods used for characterizing the phases of the financial cycle can be found in the main text of the paper.

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