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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Financial structure and macroeconomic volatility: a panel data analysis*

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Abstract

In 2015, the European Commission (EC) launched its action plan for the creation of a European Capital Markets Union. The EC aims to return the European economy to sustainable growth and to enhance its shock absorbing capacity by reducing the reliance on bank finance and stimulating financial deepening and cross-border integration of Europe's capital markets. Financial diversification and integrated European capital markets are expected to improve risk sharing among households, supporting economic stability. However, the economic literature reveals a lack of theoretical and empirical consensus on the superiority of either a bank-based or a market-based financial system in promoting growth or reducing macroeconomic volatility. This paper is the first to include bond markets in its financial structure indicators, besides stock markets and bank lending. Using panel data on 55 countries between 1975 and 2014 and three different measures of financial structure, we investigate the effect of the structure of the financial system on the volatility of output and investment growth as well as their cyclical components. We do not find evidence that market-based financial structures dampen volatility of output or overall investment. Increase of the stock market size relative to that of the banking sector has a significant positive effect on the business cycle volatility of investments.

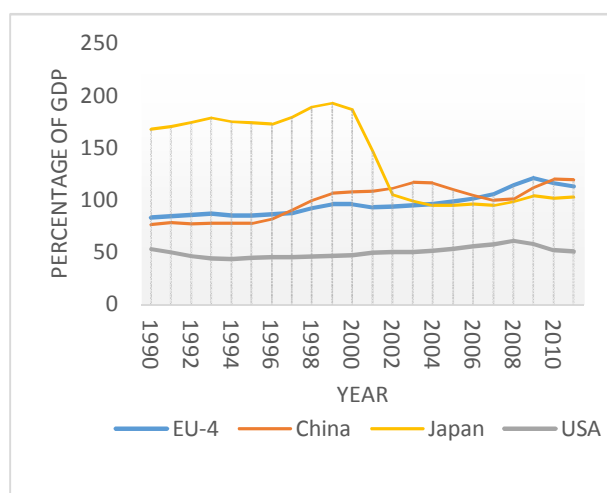
Keywords: financial development, financial system structure, macroeconomic volatility, market-based finance, bank-based finance, capital market integration, business cycle.

JEL classifications: G15, G18.

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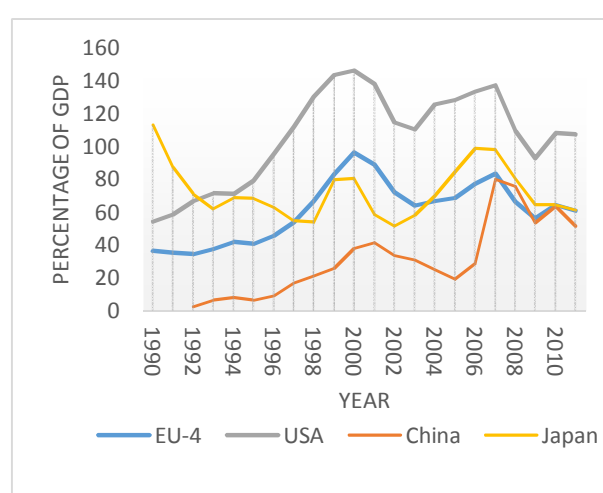
1. Introduction

In September 2015, the European Commission (EC) launched its action plan for the creation of a European Capital Markets Union (CMU). This flagship initiative of the Juncker Commission aims at creating a single European capital market for all EU member states (EC 2015). Since the 1990s, the European banking sector has grown significantly larger (relative to GDP) than those of other jurisdictions, particularly the United States (see Graph 1)². This has made the financial structures of the majority of European countries strongly bank-based, with bank lending playing a significantly larger role in corporate sector funding than market issuance of debt and equity securities (Langfield and Pagano, 2015). In addition, corporate bond and equity market capitalisation in the EU is relatively underdeveloped compared to other jurisdictions (see Graphs 2 and 3)².



Graph 1: Credit to the private sector by deposit money banks (percentage of GDP)

Source: World Bank, Financial Structure Database (June 2017).



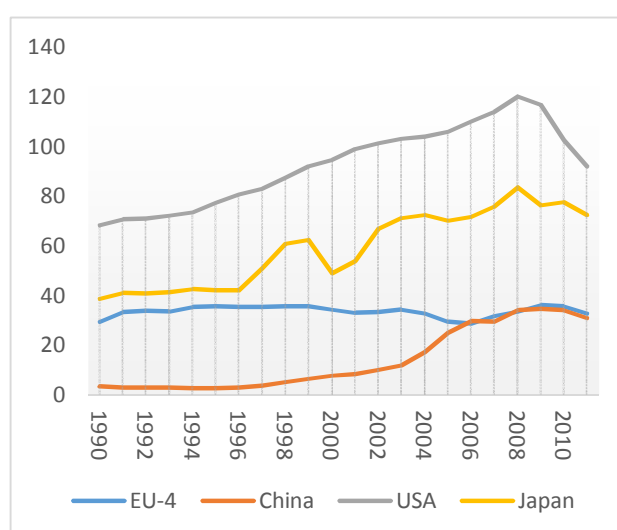
Graph 2: Stock market capitalization (percentage of GDP)

Source: World Bank, Financial Structure Database (June 2017).

The introduction of the CMU aims at stimulating the financial deepening and cross-border integration of domestic capital markets and removing the obstacles encountered by European businesses when attracting funds on capital markets, complementing banks as a source of financing (EC 2015). The EC asserts that the CMU will ensure greater diversification in the funding of the economy and reduce the cost of raising capital, particularly for small and medium-sized enterprises (SMEs). It should also enhance the flow of capital from investors to

² EU-4 shows the average annual values of Europe's four largest economies: Germany, United Kingdom, Italy and France

European investment projects, improving allocation of risk and capital across the EU (EC 2015). Moreover, financial diversification and integrated European capital markets should improve risk sharing among households, contributing to lower volatility of income and consumption and supporting economic stability (Anderson *et al.*, 2015). The CMU would also make Europe more resilient to shocks to the economy by enhancing its shock-absorbing capacity (EC 2015). Besides the envisaged effects for macroeconomic and financial stability, the EC believes that although banks will continue to play a vital role in the European economy a move to a more market-oriented European financial system is necessary in order to support a sustainable return to economic growth and job creation (EC 2015).



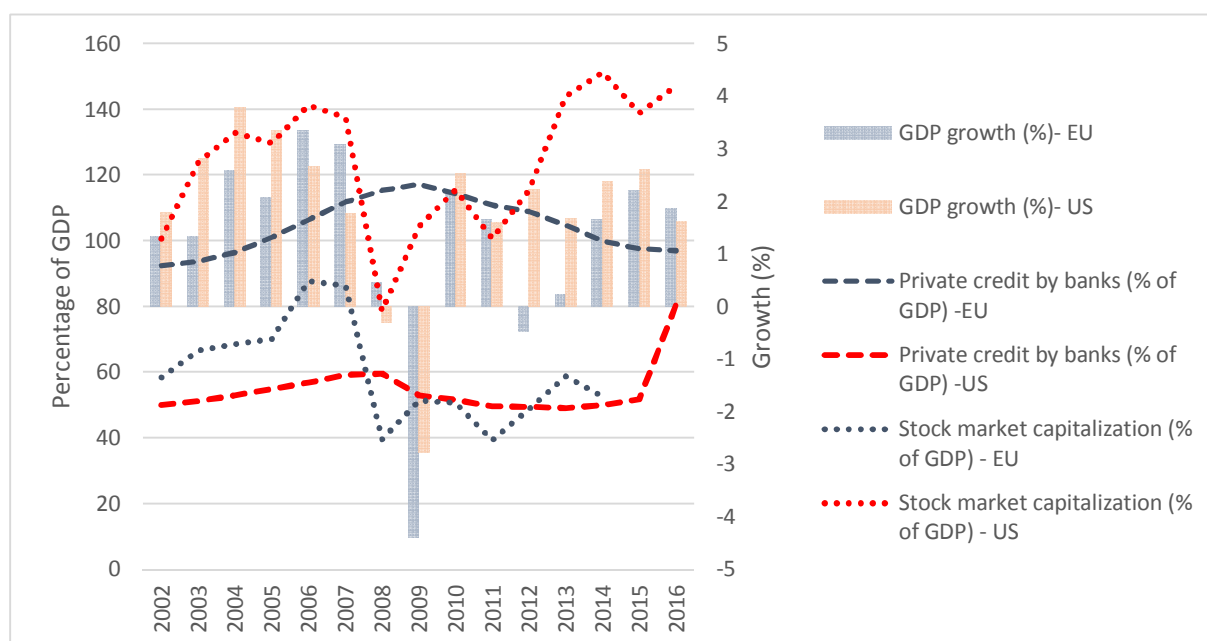
Graph 3: Private bond market capitalization (percentage GDP)

Source: World Bank, Financial Structure Database (June 2017).

The relative dominance of bank financing in the European financial system and the underdevelopment of European financial markets relative to those in the US may be a key factor explaining the difference in economic recovery in both areas after the financial crisis of 2007-2009. Since the crisis, EU growth has been lagging behind that of the US, which recovered faster from the worldwide economic meltdown (see Graph 4). The financial crisis impaired bank's lending abilities in both areas but the effect on the real economy in the EU exceeded that of the US, due to the heavy reliance on bank financing (Financial Times, November 2015). In a market-oriented financial system, participants in the financial system may be better able to substitute bank credit with market financing following a credit crunch, thus dampening the effect on the real economy (Bijlsma *et al.*, 2015). Crouzet (2014) finds that asymmetric shocks to bank's lending costs, such as the 2007-2009 financial crisis, have a

larger effect if an economy is initially bank-dependent, such as is the case in the majority economies in the Eurozone. In addition, European banks initially put off the necessary balance sheet restructuring and instead rolled over credit in order to postpone loss recognition, essentially turning into ‘zombie banks’ (Caballero, 2008). In contrast, their US counterparts were able to restructure much quicker, backed by the trouble asset relief program (Tarp), paving the way for a sustainable recovery (Financial Times, November 9, 2015).

Despite the difference in recovery between the market-oriented US and the relatively bank-oriented EU, there is no consistent empirical evidence available on the superiority of market-based financial systems in promoting growth and stability (Bijlsma *et al.*, 2015). Although several studies have investigated the impact of the structure of the financial system on economic growth, there seems to be neither empirical nor theoretical consensus on the superiority of bank-based or market-based financial systems. In addition, despite the importance of macroeconomic stability for foster growth (Ramey and Ramey, 1995) and income equality (Breen & García-Peñalosa, 2005), literature that examines the relationship



Graph 4: United States and EU GDP growth, banking sector and stock market size

Source: World Bank, World Development Indicators.

between financial structure and macroeconomic volatility is scarce and has primarily relied on financial structure indicators based on the relative size and activity of the stock markets to that of banks and does not include corporate bond markets.

We add to the small body of empirical studies in the structure-volatility nexus by investigating the effect of financial system structure on macroeconomic volatility. In addition, this study contributes to the existing body of literature by incorporating corporate bond market capitalisation into one of our financial structure indicators in order to create a more comprehensive measure of financial system structure. Using panel data of 55 countries between 1975 and 2014 and three alternative measures of financial system structure, we investigate the effect of financial structure on both the overall and the cyclical volatility of output and investment growth. The panel results show that more market-oriented financial structures are not associated with lower overall and business cycle volatility of output or overall investment growth volatility. Remarkably enough, we observe that an increase in the stock market size relative to that of the banking sector has a significant positive effect on business cycle volatility of investment growth.

Section 2 of our paper provides a review of the literature and Section 3 describes the data and methodology. Section 4 discusses the main empirical results for output growth and Section 5 does the same for investment growth. Section 6 presents our conclusions and Section 7 discusses the limitations of the present paper and offers suggestions for future research.

2. Literature review

2.1. Financial intermediaries development and macroeconomic volatility

Financial development refers to the depth and sophistication of a financial system (Phumiwasana, 2003). Financial development occurs when the entire financial system – consisting of capital markets and financial intermediaries – improves in its ability to ameliorate the effects of information, enforcement, and transactions costs and can better provide its functions (Levine, 2005). The link between financial development and macroeconomic volatility is rooted in the external financing needs of financially constrained firms, whose borrowing capacity is influenced by the existence of financial market imperfections (Wei & Kong, 2016). Shocks to the real economy are propagated and amplified through a “financial accelerator” that operates through the credit channel and arises due to information asymmetries between lenders and borrowers in the credit markets (Bernanke *et al.*, 1999; Gertler & Bernanke, 1995). According to the “balance sheet view”, a negative shock that causes a fall in firms’ net worth increases agency cost by worsening the potential conflict between lenders and borrowers. This leads to a higher external finance premium,

which magnifies the fluctuations in borrowing, spending and investment and therefore in real economic activity (Gertler & Bernanke, 1995; Kiyotaki & Moore, 1997). Similarly, the external financing premium is positively related to the dependency of borrowers on external financing. A shock that reduces a firm's current cash flow reduces the firm's ability to finance from retained earnings, increasing its dependency on external finance and consequently, the external finance premium (Wei & Kong, 2016). Due to the pro-cyclical nature of cash flows and the net worth of businesses, the external finance premium is countercyclical (external finance premium is lower, the higher the net worth of businesses is). An initial shock exogenous to the real economy is amplified by the existence of financial frictions, such as adverse selection and moral hazard problems, resulting in larger business cycle fluctuations (Dabla-Norris & Srivisal, 2013). In addition, an initial shock to the financial sector could affect the real economy by limiting the amount of funds that can be channelled from lenders to borrowers. This credit tightening causes borrowers to reduce their spending and hiring, which causes real economic activity to decline (Quadrini, 2011).

Well-developed financial intermediaries can help mitigate the effect of financial frictions, associated with asymmetric information problems, on macroeconomic volatility by lowering the cost of acquiring and verifying information. Banks develop expertise in acquiring information and can mobilise economies of scale in terms of screening and monitoring borrowers. This reduces both adverse selection and post-lending moral hazard problems. The associated fall in financial frictions will curb the financial accelerator effect and smoothen the business cycle (Da Silva, 2002). Aghion *et al.* (2000) argue that countries with poorly developed financial systems tend to be more volatile, as the demand for and supply of credit tends to be more cyclical. They find that deeper financial systems can reduce the volatility of investment and growth by alleviating liquidity constraints on firms and facilitate long-term investment. In addition, financial intermediaries could stabilise macroeconomic fluctuations by allowing better risk management. Acemoglu and Zilibotti (1997) find that the presence of indivisible projects limits the risk diversification of an economy. The inability to diversify idiosyncratic risk and the presence of risk-averse agents in the financial markets hamper the accumulation of capital and introduce uncertainty in the growth process. They argue that the development of financial intermediaries can facilitate greater risk diversification and thereby dampen economic growth fluctuations.

A large body of empirical studies has examined the link between financial intermediary development and macroeconomic volatility. Denizer *et al.* (2002) find that financial sector development is associated with lower volatility in output, consumption and investment

growth. They also find that banks play a particularly important role in reducing volatility in consumption and investment growth, suggesting that banks provide risk management and information processing services that are particularly important for consumption smoothing and reducing investment volatility. Similar results are presented by Da Silva (2002) who finds that financial system development, particularly that of the banking sector, is associated with lower volatility in the business cycle components of output, investment and consumption.

However, other studies have found a non-linear relationship between financial intermediary development and macroeconomic stability. Dabla-Norris and Srivisal (2013) find that financial sector depth reduces overall and business cycle volatility of output, consumption, and investment growth, but only up to a certain point. Once financial development exceeds this point, further deepening could amplify consumption and investment volatility. Similarly, Easterly *et al.* (2001) find a similar U-shaped relationship between financial sector development and growth volatility using panel data for 60 countries. Alatrash *et al.* (2014) also find a U-shaped relationship between financial sector size and GDP growth volatility in countries with high quality financial sector. The non-linear relationship could potentially be explained by increased risk taking by agents in countries with a well-developed financial sector and higher firm leverage (Alatrash *et al.*, 2014; Easterly *et al.*, 2001).

Other studies have shown that the effect of financial sector development can differ in terms of its impact on cyclical- and overall macroeconomic volatility. Wei and Kong (2016) find that financial intermediary development reduces short-term output volatility but has no significant effect on trend volatility of GDP. Mallick (2014) finds that financial intermediary development only affects business-cycle volatility and has no significant impact on the overall volatility of GDP growth. He finds that private credit dampens business-cycle volatility, particularly for middle-income countries, but has no effect on overall volatility of output.

The volatility of an economy is inevitably related to shocks and how an economy is able to absorb these shocks (Easterly *et al.*, 2000). Several studies have shown that the effect of financial intermediary development on macroeconomic volatility is not unambiguous and depends on the kind of shock that a country faces. Dabla-Norris and Srivisal (2013) find that deeper financial sectors might serve as shock absorbers mitigating the effect of external shocks on macroeconomic volatility. Bacchetta and Caminal (2000) argue that financial sector development could dampen the effects of productivity shocks on macroeconomic volatility. Beck *et al.* (2006) find that well-developed financial intermediaries can dampen the effect of real sector shocks by alleviating agency costs and cash-flow constraints. However, the impact of monetary shocks may be magnified in countries where businesses have limited access to

capital markets as an alternative source of external funding while no effect is found in countries with well-developed stock markets.

2.2. Capital market development and macroeconomic volatility

Although studies that examine the relationship between financial development and macroeconomic volatility are abundant, the majority of them have relied on proxies of financial development that capture the development of financial intermediaries relative to the size of the economy. However, these proxies only measure how well financial intermediaries function in terms of financing investment or spending of both businesses and households (Tharavanij, 2007). The financial development indicators used in the majority of these studies only measure the development of the “indirect financing channel” and do not capture the development of capital markets that may have an independent effect on economic growth and volatility. Development of capital markets as part of the overall financial system reduces financial frictions by improving disclosure and higher transparency in the financial system, reducing asymmetrical information and agency costs (Tharavanij, 2007). Furthermore, deep and liquid capital markets lower liquidity risk and enhance access to finance and investments through bond and equity issuance (Levine, 2005). In addition, capital markets offer diversification opportunities which would reduce idiosyncratic risk (Tharavanij, 2007).

Tharavanij (2007) illustrates the importance of incorporating measures of direct finance, even after controlling for the level of financial intermediation. He finds that countries with more developed capital markets have less volatile investment and output growth. Sahay *et al.* (2015) argue that the non-linear relationship between financial intermediation development and macroeconomic stability arises due to increasing financial stability risk. However, they also assert that this result does not hold for capital market development, which is found to reduce macroeconomic volatility. In contrast, Wei and Kong (2016), using data for 30 regions in China, find that financial market development has no significant effect on macroeconomic volatility. Mallick (2014) finds that stock market capitalisation reduces business-cycle volatility, but only in low-income countries.

2.3. Financial structure and macroeconomic volatility

Another relevant line of research has examined the relationship between the structure of a country’s financial system and its economic performance. Whereas financial development refers to the size and activity of the financial system as a whole, financial structure refers to

the infrastructure of finance providers and their relative importance in the provision of financial services in the economy (Phumiwasana, 2003; World Bank, 2013). Ideally, a measure of financial structure would encompass the size and activity in the entire financial system. However, the most common classification in the literature distinguishes between market-based or bank-based financial systems.

A vast body of literature has examined the relationship between the structure of a financial system and economic growth. This literature focuses on the relative merits of bank-based and market-based financing in providing services that induce economic growth (for an overview, see Allen & Gale, 2001; Levine, 2005). However, there is no theoretical consensus on the superiority of either system and some studies have disregarded the fruitfulness of the distinction between the two financial structures altogether. These studies suggest that it is the overall financial development that enhances long-term growth (Beck *et al.*, 2001; Levine, 2002; Levine & Zervos, 1998). Proponents of the bank-based view have argued that banks diminish adverse selection problems through the ex-ante screening of borrowers, and reduce moral hazard by monitoring firms' ex-post investment decisions by specialising in obtaining and processing information. The free-riders problem inherent in security markets may disincentivize individual market participants to engage in similar costly information-based activities. In addition, banks may be better at facilitating intertemporal smoothing of non-diversifiable risk (Allen & Gale, 1997). Proponents of the market-based view have argued that markets allow for better diversification of risk and have questioned the superiority of banks in reducing moral hazard problems. They have argued that there is a time-inconsistency in the threat of cutting credit in the face of default, which makes the threat improbable. Security markets are more credible due to the high renegotiation costs associated with renegotiating with many bond holders (Allen & Gale, 2000).

The importance of a country's financial structure could also be assessed to the degree that banks and markets enable efficient risk sharing and reducing financial frictions. As argued earlier, reducing financial frictions and risks inherent in the financial system enhances the resilience of the economy to macroeconomic shocks, with implications which beneficially affects macroeconomic stability. However, as in the structure-growth nexus, there is no clear theoretical consensus on the superiority of either system's stabilising effects. Both banks and markets allow channelling of funds from those with a surplus to those in need of financing. However, real and monetary shocks could be transmitted differently through the intermediated and non-intermediated channel. In response to a shock to the economy, banks are more likely to internalise short-term adjustment costs, due to relative rigidity of lending

and savings rates. In a deep and liquid capital markets, shocks have a more immediate effect on asset prices as the market adjusts and moves to a new equilibrium. Following this line of reasoning, banks can soften the immediate impact of a shock by absorbing the shock onto their balance sheets rather than immediately transmitting them to consumers in the short-run. However, banks can also contribute to fluctuations in economic activity by tightening credit and shifting to safer assets.

Due to the counter-cyclical nature of credit standards and the consequential procyclical nature of credit provision, banks can fuel a boom during upturns by expanding their credit provision and aggravate contraction during downturns by reducing it. Financial market participants may exhibit similar behaviour, but may exacerbate volatility even further by displaying herding behaviour. However, the presence of risk-seeking investors in the financial markets could reduce fluctuations in economic activity. These investors are willing to bear more risk for potentially higher returns, and will continue to provide funds during downturns. This in turn will alleviate the financial constraints that businesses have. During economic downturns, banks may be reluctant to write off or sell their assets at a loss, which would immediately impact their profits. Holding a large proportion of non-performing loans could impair the banking sector's ability to provide new credit, increasing financial constraints for businesses and contributing to a further slowdown (Phumiwasana, 2007).

On the subject of systemic risk, some have argued that the lack of transparency and limited disclosure in relationship banking (a common feature of bank-based financial systems) could lead to a collapse of credit provision in the event of a bank run (Rajan and Zingales, 2001). If one intermediary fails, healthy intermediaries may be unable to step in due to the firm-specific knowledge inherent in bank-firm relationships. In addition, depositors may be unable to distinguish between healthy and unhealthy banks, adding to contagion risk in the financial system. Fecht (2004) develops a theoretical model and shows that contagion risk is particularly high in moderately bank-based financial systems. When capital markets lack depth and liquidity, fire sales of a distressed bank's assets could cause asset prices to drop and impede the balance sheets of other intermediaries.

Finally, an issue that is closely related to the present study is the spare-tire concept, which refers to the idea that having a well-diversified financial system can have a stabilising effect on the economy. In a well-diversified financial system, banks and markets may act as substitutes if one finance channel gets clogged. According to this argument, development of capital markets would reduce macroeconomic volatility more than a bank-based financial system would do alone. Fiore and Uhlig (2015) find that when a financial crisis impairs the

banking sector's flexibility in the provision of credit, the scope for businesses to shift from bank to market financing can dampen the adverse real effect of a credit crunch by alleviating the credit constraints that businesses face. However, during normal times when banks can provide ample flexibility, substitutability of external financing sources has a less prominent effect on aggregate economic activity. Levine *et al.* (2016) find evidence that the ability of firms to substitute bank by capital market financing during a systemic banking crisis ameliorate the effects of the crisis on profits, employment and investment efficiency. Although this finding is consistent with the spare-tire view, Levine *et al.* (2016) find that financial intermediary and stock market development prior to the crisis have no significant effect on external finance substitutability. However, the services provided by banks and markets differ and may not be perfect substitutes (Phumiwasana, 2007). In addition, development of markets could impede the ability of the financial system to allow for intertemporal smoothing of risk, which could have a destabilising effect on the economy. When banks face competition from the market, individuals with excess funds may move to the capital market during an economic upturn, hampering the accumulation of reserves that could act as a buffer during a downturn (Allen & Gale, 1997).

The relatively scarce body of empirical literature in the structure-volatility nexus has not provided consistent evidence on the impact of financial structure on economic stability. Tharavanij (2007) finds that countries with relatively market-oriented financial systems exhibit lower output and investment growth volatility. Although he does not find a significant effect of the relative degree of market orientation on business cycle volatility, the signs are consistently negative. Yeh *et al.* (2013) find that market-based countries experience faster growth, but this is at the cost of greater macroeconomic fluctuations in the long run. A possible explanation for the positive relationship between market-oriented financial systems and macroeconomic volatility could be that banks – as coordinated coalitions of investors – have a comparative advantage over uncoordinated markets at reducing post-lending moral hazard, owing to superior monitoring activities. Stock markets can create disincentives for rigorous corporate control since investors can inexpensively sell their shares. Arguably, in more market-oriented financial systems, corporate performance may be monitored less stringently. This in turn can cause more unpredicted outcomes in production and thus increased volatility in economic growth (Boot & Thakor, 1997). Da Silva (2002) and Denizer *et al.* (2000) find no significant relationship between financial structure and business-cycle volatility. Phumiwasana (2003) finds that bank-based financial systems increase volatility among developed countries, but are associated with lower growth volatility in developing

countries. Wei and Kong (2016) show that the measure of financial structure used, matters when examining its effect on macroeconomic volatility. They find that a higher ratio of the turnover rate to financial development efficiency enhances both cyclical and trended volatility. However, when financial structure was measured by stock market capitalisation and financial development efficiency, higher degrees of market orientation did not have a significant impact on trended volatility, but were found to reduce cyclical volatility.

Other studies have examined the link between financial structure and output volatility at the industry level. For example, Raddatz (2006) examines the link between financial development and volatility at the industry level. He finds that financial intermediaries are more important than equity markets for reducing industry-level output volatility. As previously mentioned, financial development and macroeconomic volatility are linked through the existence of financial frictions which amplify shocks by financially constraining firms. Baum *et al.* (2011) examine how obstacles to external financing may vary across financial systems. They find that both the financial development and the financial structure of a country are important determinants of the financial constraints that firms face. They show that bank-based systems are more successful in alleviating financial constraints.

Some studies have examined the relationship between a country's financial structure and the probability and intensity of an economic downturn. Easterly *et al.* (2000) find that financial sector depth is associated with a higher probability of a downturn, while stock market depth reduces the likelihood of a downturn, possibly due to better risk diversification opportunities. These findings suggest that economies that rely more heavily on debt-finance are more vulnerable to economic downturns. Gambacorta *et al.* (2014) find that economies with bank-oriented financial systems are more resilient during "normal" downturns. Banks can draw on long-term relationships with their customers and are therefore more willing to continue extending credit during a downturn. However, market-oriented systems are found to be more resilient during a financial crisis when the banking sector's shock absorbing capacity is impaired. Langfield and Pagano (2015) examine this effect of financial structure in European countries on their stability and growth. They find that an increase in the banking sector relative to equity and private bond markets is associated with more systemic risk and hence lower stability.

3. Data and methodology

We use annual data of 55 countries between 1975 and 2014 (see Table A.1 in the appendix to this report). The annual data are transformed into eight sub-periods, each covering a five-year time span.³ For all variables except volatility, the annual data is transformed into five-year averages. Volatility measures are transformed by calculating the standard deviations within the respective five-year periods. Missing data points are replaced by averaging the available data points for a given time-span, under the condition that at least three data points are present for a given five-year period. If this condition is not met, the particular five-year observation in the panel is treated as missing. Tables A.2-4 in the appendix give an overview of the included variables, their sources, descriptive statistics and the correlation matrix.

We explain macroeconomic volatility by financial structure and financial development using a reduced-form equation:

$$\sigma_{it} = \beta_0 + \beta_1 * FS_{it} + \beta_2 * FD_{it} + \beta_3 * X_{it} + \varepsilon_{it} \quad (1)$$

The dependent variable, σ , measures volatility defined as the natural logarithm of the standard deviation of either output growth (based on real GDP per capita) or investment growth (based on gross fixed capital formation). Volatility of real GDP per capita growth is frequently used in the literature as a measure of macroeconomic volatility (*e.g.* Alatrash *et al.*, 2014; Dabla-Norris & Srivisal, 2013; Mallick, 2014; Tharavanij, 2007; Klomp & de Haan, 2009) In addition to this measure of growth cycles volatility, this paper also extracts the cyclical components from output and investment growth in order to measure *business cycle volatility* of GDP and investment growth. Cyclical variations are separated from the trend using the Christiano-Fitzgerald (CF) band-pass filter technique, which extracts cyclical fluctuations that last two to eight years.

FS and FD in Equation (1) are indicators of financial structure and financial system development, respectively. In order to capture the effect of financial structure on macroeconomic volatility, we use three different measures of financial structure. The first measure is structure/activity, which measures the activity of the stock market relative to that of banks. More specifically, following Levine (2002) it is defined as the ratio of total value traded to bank credit.⁴ This measure captures stock market activity relative to banking sector activity. The second measure of financial structure is structure/size, which – in line with Levine (2002) – is defined as the ratio of domestic stock market capitalisation to total bank

³ 1975-1979, 1980-1984, 1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009, 2010-2014.

⁴ Value traded is the ratio of stock market total value traded to GDP. Bank credit is the ratio of private credit by deposit money banks to GDP.

credit. The third measure introduced in this paper is structure-size, which is similar to the second measure, but it includes capitalisation of the private bond market in the numerator. This numerator is a more comprehensive indicator of the domestic capital market size, as it captures both the size of the domestic stock market and that of the domestic private bond market. Higher values of all three structure measures indicate a higher level of market orientation.

For financial system development, we also use three different measures. Finance-activity is a measure of the activity of stock markets and intermediaries and is defined as the sum of total value traded and private credit.⁵ The second measure for financial system development is finance-size, which captures the size of stock markets and financial intermediaries and is defined as the sum of stock market capitalisation and private credit. In order to develop a more comprehensive measure of financial system depth, we use finance-size including private bond market capitalisation as an alternative measure of financial system development. Both the financial development and the financial structure indicators enter the regression in natural logarithmic form.⁶

X_{it} denotes a set of control variables which may also affect macroeconomic volatility. Some studies have shown that developing countries tend to experience much more growth volatility than developed countries do (*e.g.* Easterly and Stiglitz, 2000). To control for the economy size, we include the natural logarithm of GDP per capita. Governments can influence a country's economy through fiscal policy measures, so the fiscal policy stance may affect macroeconomic fluctuations. In order to take account of this, we include the ratio of government consumption expenditure to GDP. Several studies have established an impact of both financial and trade openness on macroeconomic volatility (*e.g.* Kose 2009). The sum of foreign direct investment inflows and outflows (both in absolute terms) relative to GDP is used as a proxy for financial openness. Trade openness is proxied by the ratio of the sum of imports and exports to GDP. Both the financial openness and trade openness indicators enter the regression in natural logarithmic form. The standard deviation of changes in real effective exchange rates is included to control for the effect of exchange rate volatility on macroeconomic volatility. Exchange rate volatility may influence domestic production and consumption decisions, particularly in open economies. However, the impact of both

⁵ Private credit is the ratio of private credit by deposit money banks and other financial institutions to GDP and is used in order to capture not only the activity of banks but also that of other non-depository financial intermediaries.

⁶ Both the financial structure and financial development indicators are first calculated on an annual basis. Next we calculate the five-year average of each indicator to use in the regressions.

exchange rate volatility and openness on volatility are theoretically ambiguous: fewer trade barriers may increase exposure to shocks from abroad, but can also allow shocks to the domestic economy to be “exported” and thus reduce macroeconomic volatility. In addition, the effect of exchange rate flexibility on business cycle volatility may differ, depending on the origin of a shock (Da Silva, 2002; Tiryaki, 2003; Tharavanij, 2007). We include terms of trade volatility as a proxy for external shocks. Finally, we include the Polity Index, which captures the characteristics of a country’s political regime and its inflation rate.

In order to account for potential endogeneity of the explanatory variables of equation (1), which is indeed a reduced form model, we conduct instrumental variable (IV) estimations. More specifically, the financial development and structure indicators are instrumented by their first (five-year) lagged values. We performed a Wu-Hausman test to test whether the financial development and structure indicators are endogenous, but we also have theoretical arguments to expect endogeneity. In addition to applying instrumental variables in pooled OLS, we perform fixed effect estimations (IVFE) to check the robustness of our findings.

4. Estimation results of output growth volatility models

Table 1 shows the regression outcomes of the *output growth* volatility model. As measures of financial development and structure we apply, respectively, ‘finance-activity’ and ‘structure-activity’ (model 1), ‘finance-size’ and ‘structure-size’, both based on stock market capitalisation only (model 2), and finance-size and structure-size indicators, both based also on the private bond market (model 3). The Wu-Hausman test statistic is insignificant for all three models, suggesting that all financial structure and financial development measures can be treated as exogenous. For theoretical reasons, however, we apply instrumental variables throughout. The F-test statistic on the fixed effects in the IVFE estimations is insignificant in all three models’ estimations, so that the null hypothesis of absence of country-specific effects cannot be rejected. Hence, we consider the IV estimations as the appropriate ones and will not discuss the IVFE estimates in detail.

The financial structure indicator is found to have an insignificant effect on output growth volatility. Hence, moving towards a more market-oriented financial system does not significantly reduce GDP growth volatility, based on this approach. Our finding contradicts that of Tharavanij (2007),⁷ who observes a significant negative effect of financial structure on

⁷ We endeavoured to replicate the work of Tharavanij (2007), using an updated database. Our outcomes deviated from those of Tharavanij (2007), possibly due to changes in the data.

output growth volatility. In contrast, Yeh *et al.* (2013) find a significant positive effect. Our insignificant result is similar to that of Phumiwasana (2003).

Finance-activity and the bonds included finance-size indicator of financial development have a significant negative effect on output growth volatility. These outcomes suggest that enhancing the activity in the financial system may be beneficial in terms of fostering output growth stability. This finding is similar to that of Tharavanij (2007) who observes a negative impact of both financial-market and financial-sector activity on macroeconomic growth volatility. The impact of the stock-based finance-size indicator (Model 2) is insignificant. In contrast, Wei and Kong (2016) find that an increase in the stock market size has a negative effect on output growth, while any effect of financial intermediary development is insignificant. Similarly, Mallick (2014) find no significant effect of financial intermediary development.

Trade openness has a consistent and significant positive effect on output growth volatility in all three IV estimations, in line with Easterly *et al.* (2000), but contradicts the observations of Tharavanij (2007), Dabla-Norris and Srivisal (2013) and Mallick (2014). Terms of trade volatility has a significant positive effect on output growth volatility in two out of three IV estimations, like the observations of Mallick (2014) and Easterly *et al.* (2000), but contradictory to those of Tharavanij (2007). Interestingly, GDP per capita has a significant positive effect in all three IV estimations, suggesting that output volatility is higher in more developed countries. Inflation has a significant positive effect in two IV estimations. The measure of political regime, polity, is significantly negative in two models. This suggests that countries with more democratic political regimes are more stable in terms of output growth volatility. Similarly, Klomp and de Haan (2009) find that more democracy is associated with lower volatility in output growth. Finally, the effect of government consumption, financial openness and exchange rate volatility is found to be insignificant.

The (IVFE) outcomes in Table 1 show that our findings regarding the effect of financial structure on output growth volatility are consistent, even after controlling for country-fixed effects. But the effect of the finance-activity and the bond included finance-size indicator of financial development lose their significance in the IVFE estimations. This also holds for trade openness, terms of trade volatility, GDP per capita, inflation and the polity index. Note that fixed effects estimates ignore information in the explanatory variables, which are constant per country, so that only changes over time are used, which apparently provide less information than cross-country differences. As an additional robustness check, we apply

Table 1. Growth volatility model estimates (1975-2014)

	Model 1		Model 2		Model 3	
	IV	IVFE	IV	IVFE	IV	IVFE
Finance-activity	-0.307** (-2.22)	-1.298 (-1.18)				
Structure-activity	0.036 (0.85)	-0.108 (-0.59)				
Finance-size			-0.209 (-1.38)	-1.090 (-1.07)		
Structure-size			0.0436 (0.43)	-0.086 (-0.35)		
Finance-size (incl. bonds)					-0.265* (-1.67)	11.19 (0.45)
Structure-Size (incl. bonds)					0.127 (0.83)	-0.248 (-0.05)
Financial openness	0.012 (0.18)	0.395 (1.43)	-0.005 (-0.07)	0.245 (1.35)	0.051 (0.46)	0.181 (0.17)
Trade openness	0.235* (1.94)	0.606 (0.95)	0.285** (2.47)	0.549 (0.92)	0.351** (2.55)	3.487 (0.56)
GDP per capita (US\$)	0.178** (2.49)	0.730 (0.88)	0.165** (2.16)	0.630 (0.88)	0.176* (1.89)	-7.985 (-0.52)
Terms of trade volatility	1.889* (1.74)	3.663* (1.79)	2.262* (1.88)	3.618 (1.59)	2.515 (0.99)	-13.57 (-0.27)
Exchange rate volatility	-0.717 (-0.69)	-2.296 (-1.28)	-0.645 (-0.56)	-0.765 (-0.45)	-2.530 (-1.04)	-12.99 (-0.81)
Government consumption	-0.005 (-0.43)	0.007 (0.16)	-0.003 (-0.20)	0.005 (0.08)	-0.000 (-0.00)	-0.802 (-0.39)
Inflation	0.001*** (4.10)	0.0016 (0.50)	0.005 (0.66)	-0.005 (-0.29)	0.057*** (3.57)	0.436 (0.59)
Polity	-0.0264** (-2.45)	-0.059 (-1.51)	-0.021** (-2.08)	-0.013 (-0.30)	-0.0214 (-1.49)	1.162 (0.32)
Constant	-5.013*** (-7.40)	-8.275 (-1.44)	-5.638*** (-7.63)	-7.670* (-1.71)	-5.929*** (-5.46)	7.014 (0.23)
Number of observations	187	187	180	180	84	84
R-squared	0.147		0.143		0.250	
Number of country FE		53				34
Wu-Hausman test	1.714		1.610		1.729	
Prob > F	0.00***	0.00***	0.00***	0.00***	0.00**	0.00***
Prob > F _u		0.991		0.956		1.00
Corr(u _i , X _b)		-0.913		-0.854		-0.985

Notes: Robust z-statistic in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%; IV means instrumental variable estimation (instruments: first lagged value of financial development and financial structure variables), IVFE is short of fixed effects instrumental estimation (instruments: first lagged value of financial development and financial structure variables), Wu-Hausman tests on exogeneity of instrumented variables, Prob>F tests on joint significance of all explanatory variables except constant, Prob > F_u tests on joint significance of all cross-country individual effects, Corr(X_b,u_i) means correlation of the predicted value of the dependent variable (X_b) and individual fixed effects (u_i).

weighted regression with GDP per capita in order to assign higher weights to countries with more economic development. The previously reported outcomes are robust under this alternative estimation approach.

Table 2 shows the regression outcomes of the business cycle volatility of GDP growth model. As measures of financial development and structure we apply, respectively ‘finance-activity’ and ‘structure-activity’ (model 1) and ‘finance-size’ and ‘structure-size’, both based on stock market capitalisation only (model 2), and finance-size and structure-size indicators, both based also on private bond market capitalisation (model 3). The Wu-Hausman test statistic is insignificant for all three models 3, suggesting that all financial structure and financial development measures can be treated as exogenous. However, as above, we apply instrumental variable estimation throughout for theoretical reasons. The F-test statistic on the fixed effects in the IVFE estimations is insignificant in all three model estimations, indicating that country-specific effects have no significant impact on business cycle volatility of output growth. Hence, we again consider the IV estimations as the correct ones.

As is the case for total output growth volatility, the financial structure indicator has a consistent insignificant effect on business cycle volatility of output growth. So based on this approach, a higher degree of market-orientation in the financial system does not reduce cyclical fluctuations in output growth. This finding is consistent with those of Tharavanij (2007), Wei and Kong (2016) and da Silva (2002).

The finance-activity (model 1) and the stock-based finance-size (model 2) indicators of financial development have a significant negative effect on business cycle volatility of output growth, while the bonds included size indicator (model 3) is insignificant. This indicates that expansion of the activity as well as the size of the financial system may result in reduction of business cycle volatility of output growth. These findings are consistent with those of Wei and Kong (2016) and Mallick (2014). In contrast, Tharavanij (2007) observes a negative effect of stock market turnover (used as an absolute measure of stock market development) on cyclical output volatility, but observes no effect of financial intermediary development. The outcomes indicate that finance-activity has a significant negative effect on both overall and business cycle volatility of output growth, whereas the stock-based size structure indicator only impacts *business cycle* volatility of output growth and the bonds included size indicator only has a significant negative effect on *overall* output growth volatility.

Trade openness has a consistent and significant positive effect on business cycle volatility of output growth in IV estimations, in line with Mallick (2014). In contrast, Tharavanij (2007) finds that higher trade openness is associated with lower business cycle volatility of output, while da Silva (2002) and Wei and Kong (2016) observe no significant effect. These outcomes indicate that countries with more open economies are more vulnerable to external shocks, which may have a positive effect on business cycle volatility of output growth. GDP

Table 2. Business cycle volatility of output model estimates (1975-2014)

	Model 1		Model 2		Model 3	
	IV	IVFE	IV	IVFE	IV	IVFE
Finance-activity	-0.325*** (-2.63)	-1.202 (-1.29)				
Structure-activity	0.0394 (0.81)	-0.145 (-0.95)				
Finance-size			-0.252** (-2.05)	-1.233 (-1.44)		
Structure-size			0.064 (0.68)	-0.095 (-0.47)		
Finance-size (incl. bonds)					-0.170 (-1.23)	10.660 (0.46)
Structure-size (incl. bonds)					0.170 (1.30)	-0.927 (-0.20)
Financial openness	-0.013 (-0.20)	0.333 (1.43)	-0.030 (-0.46)	0.226 (1.49)	-0.003 (-0.03)	0.255 (0.25)
Trade openness	0.230* (1.93)	0.791 (1.47)	0.281*** (2.63)	0.802 (1.60)	0.349*** (3.05)	2.834 (0.48)
GDP per capita (US\$)	0.226*** (3.42)	0.638 (0.92)	0.210*** (2.98)	0.658 (1.10)	0.128 (1.39)	-6.884 (-0.48)
Terms of trade volatility	1.510 (1.52)	2.293 (1.33)	1.958* (1.80)	2.689 (1.41)	1.644 (0.78)	-16.300 (-0.35)
Exchange rate volatility	-0.311 (-0.36)	-2.348 (-1.55)	-0.034 (-0.04)	-1.015 (-0.71)	-0.329 (-0.17)	-10.640 (-0.71)
Government consumption	-0.005 (-0.44)	0.040 (0.84)	-0.002 (-0.15)	0.016 (0.37)	0.012 (0.08)	-0.077 (-0.18)
Inflation	0.000** (2.55)	0.0001 (0.26)	0.001 (0.13)	-0.010 (-0.67)	0.041*** (3.22)	0.362 (0.52)
Polity	-0.032*** (-2.98)	-0.056* (-1.71)	-0.026*** (-2.59)	-0.020 (-0.56)	-0.031** (-2.16)	1.114 (0.33)
Constant	-5.385*** (-9.86)	-8.701* (-1.79)	-5.844*** (-10.21)	-8.455** (-2.25)	-6.044*** (-6.83)	1.598 (0.06)
Number of observations	187	187	180	180	84	84
R-squared	0.183		0.177		0.245	
Number of country FE		53		53		35
Wu-Hausman test	1.758		1.628		0.139	
Prob > F	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
Prob > F _u		0.803		0.490		1.00
Corr(u _i , X _b)		-0.914		-0.880		-0.984

Notes: Robust z-statistic in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%; IV means instrumental variable estimation (instruments: first lagged value of financial development and financial structure variables), IVFE is short of fixed effects instrumental estimation (instruments: first lagged value of financial development and financial structure variables), Wu-Hausman tests on exogeneity of instrumented variables, Prob>F tests on joint significance of all explanatory variables except constant, Prob > F_u tests on joint significance of all cross-country individual effects, Corr(X_b,u_i) means correlation of predicted value of the dependent variable (X_b) and individual fixed effects (u_i).

per capita has a significant positive effect in two out of three estimations. These outcomes suggest that developed countries experience more business cycle fluctuations in output growth. Inflation has a significant positive effect in two out of three estimations. The polity measure has a consistent and significant negative sign across all estimations, telling us that

countries with more democratic regimes experience less business cycle fluctuations in output growth.

The fixed effect estimations (IVFE) reported in table 2 as a robustness check, show that our findings regarding the effect of financial structure are consistent after controlling for country-specific effects. However, the finance-activity and stock-based size indicators of financial development, as well as all other control variables lose their statistical significance when controlling for country-specific effects. It confirms that FE estimates are less appropriate. A second robustness test is weighing regressions with weights based on GDP per capita, which provides very similar results.

5. Estimation results of the investment growth volatility models

Table 3 shows the regression outcomes of the *investment growth* volatility model. As measures of financial development and structure we use, respectively ‘finance-activity’ and ‘structure-activity’ (model 1) and ‘finance-size’ and ‘structure-size’, both based on stock market capitalisation only (model 2), and finance-size and structure-size indicators based also on the private bond market (model 3). The Wu-Hausman test statistic is significant in all three models, so that the null hypothesis of exogeneity is rejected and the financial development and structure measures should be treated as endogenous. We apply instrumental variables throughout.⁸

Similar to the overall and business cycle volatility *output growth* volatility model’s estimations, the financial structure indicator in all three models has an insignificant effect on *investment growth* volatility. This finding is inconsistent with that of Tharavanij (2007), who observes a significant negative effect of financial structure on investment growth volatility. All three financial development indicators have a significant negative effect. This finding suggest that an increase in activity in the financial system as well as an explanation of the financial system size may result in reduced investment growth fluctuations, similar to our findings in the output growth models. Trade openness, terms of trade volatility and inflation have consistent significant positive effects. The polity index has a significant negative effect

⁸ The F-test statistic on the fixed effects in the IVFE estimations of all three models is insignificant, thus the null hypothesis of zero country-specific effects cannot be rejected. Hence we consider IV estimations as the appropriate ones.

Table 3. Investment growth volatility model estimates (1975-2014)

	Model 1		Model 2		Model 3	
	IV	IVFE	IV	IVFE	IV	IVFE
Finance-activity	-0.269** (-2.53)	-1.280 (-1.36)				
Structure-activity	-0.011 (-0.27)	-0.369 (-1.63)				
Finance-size			-0.191* (-1.69)	-2.71 (-1.31)		
Structure-size			0.072 (0.78)	-0.398 (-0.84)		
Finance-size (incl. bonds)					-0.313* (-1.90)	16.460 (0.45)
Structure-size (incl. bonds)					0.186 (0.96)	0.160 (0.03)
Financial openness	-0.040 (-0.60)	0.407 (1.58)	-0.057 (-0.86)	0.466 (1.29)	-0.095 (-0.76)	-0.381 (-0.24)
Trade openness	0.442*** (4.00)	0.381 (0.65)	0.554*** (4.94)	0.825 (0.97)	0.745*** (4.39)	3.148 (0.35)
GDP per capita (US\$)	-0.042 (-0.73)	1.000 (1.25)	-0.107* (-1.72)	1.725 (1.12)	0.025 (0.29)	-11.890 (-0.54)
Terms of trade volatility	2.967*** (2.88)	4.109** (1.97)	3.229*** (3.36)	6.608* (1.74)	5.112** (2.41)	-20.560 (-0.29)
Exchange rate volatility	-0.139 (-0.14)	-1.019 (-0.59)	-1.140 (-1.27)	1.767 (0.57)	-1.594 (-0.52)	-10.200 (-0.44)
Government consumption	-0.0144 (-1.16)	0.001 (0.03)	-0.007 (-0.58)	-0.044 (-0.49)	0.017 (0.89)	-0.931 (-0.31)
Inflation	0.001*** (3.89)	0.000 (0.38)	0.018** (2.14)	-0.032 (-0.84)	0.049** (2.01)	0.586 (0.55)
Polity	0.025*** (2.61)	-0.048 (-1.17)	0.037*** (3.67)	-0.019 (-0.29)	-0.008 (-0.43)	2.004 (0.38)
Constant	-2.812*** (-4.18)	-8.988 (-1.56)	-3.162*** (-4.61)	-9.871 (-1.19)	-4.887*** (-4.18)	17.290 (0.40)
Number of observations	178	178	170	170	84	84
R-squared	0.310		0.327		0.275	
Number of country FE		52		52		34
Wu-Hausman test	3.915**		8.437***		5.393***	
Prob > F	0.00***	0.00***	0.00***	0.00***	0.00**	0.00***
Prob > F _u		0.828		0.998		1.000
Corr(u _i , X _b)		-0.887		-0.934		-0.984

Notes: Robust z-statistic in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%; IV means instrumental variable estimation (instruments: first lagged value of financial development and financial structure variables), IVFE is short of fixed effects instrumental estimation (instruments: first lagged value of financial development and financial structure variables), Wu-Hausman tests on exogeneity of instrumented variables, Prob>F tests on joint significance of all explanatory variables except constant, Prob > F_u tests on joint significance of all cross-country individual effects, Corr(X_b,u_i) means correlation of predicted value of the dependent variable (X_b) and individual fixed effects (u_i).

in two IV estimations. These outcomes are in line with expectations. The other explanatory variables do not exhibit consistent or significant effects on investment growth volatility.⁹

Table 4 shows the regression outcomes of the *business cycle* volatility of the investment growth model with three measures of financial development and structure. In contrast to the overall investment growth volatility estimates, the stock-based structure-size indicator has a significant positive effect on cyclical volatility of investment growth. The structure-activity and bonds included structure-size indicator are insignificant, similar to the findings reported in Tables 1-3. Similar to our observations concerning the business cycle volatility of *output growth*, the finance-activity and the stock-based finance-size indicators of financial development have a significant negative effect on cyclical volatility of *investment growth*, while the coefficient of the bonds included finance-size indicator is insignificant. Denizer *et al.* (2002) and Da Silva (2002) observe a similar effect, although their financial development indicator only incorporates financial intermediary development. The effects of trade openness are significant and positive in all three IV estimations. Terms of trade volatility, inflation and GDP per capita have a significant positive effect in two estimations, while the effect of the polity indicator is significantly negative in all three estimations.

⁹ The fixed effect estimations outcomes (IVFE) show that the structure indicators lose their significance after controlling for country-specific effects, probably because fixed effects picks up the cross country effect and the structure changes relatively little over time. The financial development lose their significance. Terms of trade volatility remains significant in two out of three IVFE estimations while all other explanatory variables have an insignificant coefficient. Weighted average estimations do not change our findings.

Table 4. Business cycle volatility of investment growth model estimates (1975-2014)

	Model 1		Model 2		Model 3	
	IV	IVFE	IV	IVFE	IV	IVFE
Finance-activity	-0.363*** (-3.15)	-0.983 (-1.34)				
Structure-activity	0.0401 (0.84)	-0.170 (-0.97)				
Finance-size			-0.318*** (-2.61)	-1.327 (-1.04)		
Structure-size			0.156* (1.89)	-0.188 (-0.64)		
Finance-size (incl. bonds)					-0.170 (-1.23)	10.660 (0.46)
Structure-size (incl. bonds)					0.170 (1.30)	-0.927 (-0.20)
Financial openness	-0.049 (-0.80)	0.275 (1.37)	-0.064 (-1.01)	0.239 (1.07)	-0.003 (-0.03)	0.255 (0.25)
Trade openness	0.305*** (2.99)	0.892* (1.96)	0.375*** (4.22)	0.980* (1.86)	0.349*** (3.05)	2.834 (0.48)
GDP per capita (US\$)	0.224*** (3.35)	0.509 (0.82)	0.189*** (2.75)	0.694 (0.73)	0.128 (1.39)	-6.884 (-0.48)
Terms of trade volatility	1.819* (1.78)	2.777* (1.71)	2.187** (2.12)	4.293* (1.83)	1.644 (0.78)	-16.300 (-0.35)
Exchange rate volatility	-0.223 (-0.25)	-1.949 (-1.44)	-0.389 (-0.41)	-0.271 (-0.14)	-0.329 (-0.17)	-10.640 (-0.71)
Government consumption	-0.003 (-0.25)	0.001 (0.02)	0.004 (0.37)	-0.026 (-0.47)	0.007 (0.49)	-0.771 (-0.40)
Inflation	0.000** (2.06)	0.000 (0.18)	0.004 (0.69)	-0.017 (-0.73)	0.041*** (3.22)	0.362 (0.52)
Polity	-0.032*** (-3.10)	-0.069** (-2.14)	-0.027*** (-2.70)	-0.037 (-0.92)	-0.031** (-2.16)	1.114 (0.33)
Constant	-5.492*** (-9.74)	-8.536* (-1.90)	-5.763*** (-10.10)	-8.378 (-1.64)	-6.044*** (-6.83)	1.598 (0.06)
Number of observations	178	178	170	170	84	84
R-squared	0.238		0.243		0.245	
Number of country FE		52			52	34
Wu-Hausman test	3.054**		4.115**		0.139	
Prob > F	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
Prob > F _u		0.686		0.623		1.000
Corr(u _i , X _b)		-0.913		-0.905		-0.984

Notes: Robust z-statistic in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%; IV means instrumental variable estimation (instruments: first lagged value of financial development and financial structure variables), IVFE is short of fixed effects instrumental estimation (instruments: first lagged value of financial development and financial structure variables), Wu-Hausman tests on exogeneity of instrumented variables, Prob>F tests on joint significance of all explanatory variables except constant, Prob > F_u tests on joint significance of all cross-country individual effects, Corr(X_b,u_i) means correlation of predicted value of the dependent variable (X_b) and individual fixed effects (u_i).

6. Conclusion and implications

The Capital Market Union initiative of the European Commission is aimed at stimulating the financial deepening and cross-border integration of domestic capital markets and would

remove the obstacles that European businesses encounter in attracting funds on capital markets, complementing banks as a source of financing. In addition, the CMU would ensure greater diversification in the funding of the economy and reduce the cost of raising capital, particularly for small and medium-sized enterprises. It should enhance the flow of capital from investors to European investment projects, improving allocation of risk and capital across the EU (EC, 2015). Moreover, financial diversification and integrated European capital markets may improve risk sharing among households, contributing to lower volatility of income and consumption and supporting economic stability (Anderson *et al.*, 2015). This paper does not find evidence that moving towards a more market-oriented financial system is beneficial to fostering stability.

This paper investigates the impact of financial development and financial structure on macroeconomic volatility. We use panel data of 55 countries between 1975 and 2014, and distinguish between output and investment growth, as well as overall volatility and business cyclical volatility. We consider three different measures of financial development as well as financial system structure. It appears that the financial structure does not have a significant effect on overall *output volatility* nor on its cyclical components. This indicates that moving towards a more market-oriented financial system may reduce output volatility. We find that an increase in the stock market *size* relative to that of the banking sector may contribute to business cycle volatility of investments, while an increase in stock market *activity* relative to that in the banking sector has no effect on the *business cycle* volatility of *investments*. Financial structure is found to have no effect at all on overall investment growth volatility. These results suggest that moving towards a more market-oriented financial system may not be beneficial to promoting stability in investment growth. An increase in financial system activity may result in reduced *overall* volatility of *output growth*, while an increase in both the activity in – and the size of – the financial system may suppress *business cycle* volatility of output growth. In addition, we observe that an increase in either financial system activity or the size of the financial system may result in both reduced overall investment growth and business cycle volatility of investments.

7. Limitations and future research

This study examines the effect of financial structure on macroeconomic volatility by focusing on the degree of market-orientation in a country's financial system. We define financial structure as the capital market size, including stock and bond markets, relative to the banking

sector size. In reality, the financial system comprises other financial institutions and markets, such as venture capital and derivatives markets, pension funds, mutual funds, etc. These financial-system components may have different effects on macroeconomic volatility. Future research could focus on the different financial system components. We investigate whether financial structure affects macroeconomic volatility. Future research could focus on *how* financial structure impacts macroeconomic volatility. Other structural characteristics of a country's financial system, such as asset concentration, competition and the degree of foreign ownership in the banking sector may also have impact on macroeconomic volatility. Non-linearity in the relationship between the structure of the financial system and macroeconomic volatility may also warrant attention. We include bond market capitalisation as a measure of capital market development, but data on bond market capitalisation has only been available since 1990 and covers a relatively small number of countries. In addition, while value-traded serves as a measure for activity in the stock markets, no such activity measure is readily available for the bond markets. Further research could focus on the effect that bond markets have on macroeconomic volatility by not only considering the scale, but also the activity and efficiency of these markets. Some studies argue that macroeconomic volatility may be path dependent, where previous volatility could impact current volatility. In order to control for this possibility, lagged volatility could be included in the regressions. Finally, our estimation takes account of potential endogeneity issues of financial development and financial structure by using their first lagged value as instruments. Other instruments, including creditors' and shareholders' protections measures and legal origin, may be more suitable but where not at hand.

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STATISTICAL APPENDIX**Table A.1: List of countries used in the dataset**

Australia	Italy
Austria	Japan
Belgium	Latvia
Bolivia	Luxembourg
Brazil	Malaysia
Bulgaria	Mexico
Canada	Morocco
Chile	Netherlands
China	New Zealand
Colombia	Nigeria
Costa Rica	Norway
Croatia	Pakistan
Cyprus	Philippines
Czech Republic	Poland
Côte d'Ivoire	Portugal
Denmark	Russian Federation
Ecuador	Saudi Arabia
Finland	Singapore
France	South Africa
Georgia	Spain
Germany	Sweden
Ghana	Switzerland
Greece	Trinidad and Tobago
Hungary	United Kingdom
Iceland	United States
Iran, Islamic Rep.	Uruguay
Ireland	Venezuela
Israel	

Table A.2: Variable names, description and sources

Variable	Description	Source
<i>Dependent variables</i>		
Output growth volatility	Ln (Standard deviation of real GDP per capita growth)	World Development Indicators, World Bank
Output growth business cycle volatility	Ln (Standard deviation of the business cycle component of real GDP per capita growth)	World Development Indicators, World Bank
Investment volatility	Ln (Standard deviation of gross fixed capital formation growth)	World Development Indicators, World Bank
Investment growth business cycle volatility	Ln (Standard deviation of the business cycle component of gross fixed capital formation growth)	World Development Indicators, World Bank
<i>Explanatory variables</i>		
Structure-activity	Ln(stock market total value traded / private credit by deposit money banks)	Financial Structure Database, World Bank (June 2016)
Structure-size	Ln (stock market capitalisation / private credit by deposit money banks)	Financial Structure Database, World Bank (June 2016)
Structure-size (including bonds)	Ln ((stock market capitalisation + private bond market capitalisation) / private credit by deposit money banks)	Financial Structure Database, World Bank (June 2016)
Finance-activity	Ln (private credit by deposit money banks and other financial institutions + stock market total value traded)	Financial Structure Database, World Bank (June 2016)
Finance-size	Ln (private credit by deposit money banks and other financial institutions + stock market capitalisation)	Financial Structure Database, World Bank (June 2016)
Finance-size (including bonds)	Ln (private credit by deposit money banks and other financial institutions + stock market capitalisation + private bond market capitalisation)	Financial Structure Database, World Bank (June 2016)
Financial openness	Ln (FDI inflows + FDI outflows)/ GDP	World Development Indicators, World Bank
Trade openness	Ln (Imports + Exports)/ GDP	World Development Indicators, World Bank
GDP per capita	Ln (real GDP per capita in US\$ in 2010 prices)	World Development Indicators, World Bank
Terms of trade volatility	Standard deviation of changes in net barter terms of trade index	World Development Indicators, World Bank
Exchange rate volatility	Standard deviation of changes in the real effective exchange rate (based on CPI)	Own calculations World Development Indicators, World Bank
Government consumption	Government final consumption expenditure / GDP	World Development Indicators, World Bank
Inflation	Annual change (%) consumer prices	World Development Indicators, World Bank
Polity index	Index ranging between -10 (autocratic regimes) and +10 (democratic regimes).	Polity IV

Table A.3: Key descriptive statistics of the model variables

Variables	Abbreviations	Obs	Mean	Std. Dev	Min	Max
GDP per capita growth volatility	Gvol	417	0.027	0.035	0.003	0.588
GDP per capita business cycle volatility	Gbcvol	417	0.023	0.018	0.002	0.154
Investment growth volatility	Ivol	377	0.113	0.122	0.004	1.746
Investment growth business cycle volatility	Ibcvol	377	0.023	0.018	0.002	0.154
Structure-activity	FSactivity	327	0.375	0.642	0.0004	6.2670
Structure-size	FSsize	315	0.866	0.685	0.024	3.368
Structure-size (incl. bonds)	FSsizeB	144	1.413	0.883	0.113	4.623
Finance-activity	FAactivity	327	97.019	76.060	7.41	434.72
Finance-size	FAsize	315	123.541	83.046	10.064	375.618
Finance-size (incl. bonds)	FAsizeB	144	194.749	100.0273	26.066	433.612
Financial openness	Fopen	364	6.323	12.748	0.101	136.761
Trade openness	Topen	414	75.016	56.568	9.502	410.247
GDP per capita	GDPcap	417	21344.44	19449.28	289.738	104878.5
Terms of trade volatility	SD-DTOT	247	0.067	0.066	0.004	0.402
Exchange rate volatility	SD-DREER	416	21,343	19,473	289.7	104,879
Government consumption	Gov	415	16.96	4.911	7.029	38.68
Inflation	Inflation	409	24.662	149.102	-1.174	2414.346
Polity index	Polity	412	5.848	6.210	-10	10

Table A.4: Correlation matrix of the model variables

	Gvol	Gbcvol	Ivol	Ibcvol	FSactivity	FSSize	FSSizeB	FAactivity	FASize	FASizeB
Gvol	1.00									
Gbcvol	0.568	1.00								
Ivol	0.299	0.479	1.00							
Ibcvol	0.519	0.999	0.479	1.00						
FSactivity	-0.062	-0.076	-0.134	-0.102	1.00					
FSSize	-0.006	0.012	-0.002	0.026	0.477	1.00				
FSSizeB	-0.064	0.005	-0.028	0.006	0.621	0.862	1.00			
FAactivity	-0.120	-0.158	-0.198	-0.178	0.602	0.197	0.231	1.00		
FASize	-0.083	-0.119	-0.180	-0.139	0.389	0.388	0.355	0.885	1.00	
FASizeB	0.051	0.043	-0.024	0.043	0.424	0.322	0.391	0.884	0.959	1.00

	Gvol	Gbcvol	Ivol	Ibcvol	FAactivity	FSAactivity	FASize	FSSize	FASizeB	FSSizeB
Fopen	0.020	0.058	-0.015	0.057	0.036	0.099	-0.006	0.238	0.324	0.236
Topen	0.028	0.077	0.041	0.095	-0.007	0.189	0.054	0.138	0.316	0.219
GDPcap	-0.127	-0.254	-0.24	-0.253	0.212	0.018	0.066	0.577	0.571	0.515
DTot	0.278	0.319	0.395	0.363	-0.023	0.110	0.073	-0.345	-0.353	-0.166
Dreer	0.145	0.314	0.290	0.297	-0.084	0.061	0.009	-0.193	-0.181	-0.074
Gov	-0.088	-0.200	-0.196	-0.2200	0.010	-0.174	-0.073	-0.119	0.044	0.009
Inflation	0.028	0.014	0.141	0.014	-0.057	-0.080	-0.121	-0.120	-0.122	-0.440
Polity	-0.184	-0.392	-0.129	-0.425	-0.092	-0.116	0.083	0.176	0.187	0.081

	Fopen	Topen	GDPcap	DTot	Dreer	Gov	Inflation	Polity
Fopen	1.00							
Topen	0.549	1.00						
GDPcap	0.422	0.313	1.00					
DTot	-0.238	-0.277	-0.353	1.00				
Dreer	-0.148	-0.228	-0.314	0.507	1.00			
Gov	0.072	-0.022	0.380	-0.404	-0.305	1.00		
Inflation	-0.060	-0.084	-0.116	0.110	0.341	-0.072	1.00	
Polity	0.116	0.008	0.461	-0.338	-0.267	0.238	0.003	1.00

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