Central Bank Review 17 (2017) 47–54

Contents lists available at ScienceDirect

Central Bank Review

journal homepage: http://www.journals.elsevier.com/central-bank-review/

Financial development convergence: New evidence for the EU

Dilara Kılınç [a], Ünal Seven [b, *], Hakan Yetkiner [a]

[a] Department of Economics, Izmir University of Economics, 35330, Izmir, Turkey
[b] Structural Economic Research Department, Central Bank of the Republic of Turkey, Istiklal Cad. No:10, 06100 Ulus, Ankara, Turkey

ARTICLE INFO

Article history:
Received 21 March 2017
Received in revised form
8 May 2017
Accepted 9 May 2017
Available online 13 May 2017

JEL classification:
C23
E22
G20
O50

Keywords:
Financial integration
Convergence
EU countries
System GMM

ABSTRACT

This paper aims to investigate whether the banking and stock market measures among European Union countries have been subject to a convergence process in order to verify whether the transition from the European Monetary System to the Single Currency in the last five decades have led to the integration of financial markets. We show that banking and stock market measures tend to converge across the EU over time, and the process is even improved by controlling for the quality of country level institutions and a range of macroeconomic variables. We conclude that there is a degree of success in the financial integration process of EU countries and therefore recommend that the EU accelerates financial integration to completion rather than to slowing the process.

1. Introduction

The European Union (EU) Single Market project seeks to create a territory with no internal borders or regulatory obstacles to the free movement of goods and services, and the factors of production. The integration project is expected to stimulate competition and trade, cut prices, improve efficiency, and promote economic growth among members. The financial sector as one of the principal sectors of an economy plays a key role in the integration process of economies, given the positive impact of financial development on economic development.[1] Therefore, the creation of a single market for financial services has been a key aspect of European integration.[2] To this end, since the second half of the last century, a series of steps was taken to enhance the single market project, including the European Monetary System (EMS), the European Currency Unit (ECU), The Exchange Rate Mechanism, the Economic and Monetary Union (EMU), and the Single Currency Area.

A key issue is to understand the outcome of the steps taken towards financial integration in the last five decades. The primary aim of this study is to elucidate convergence in banking and stock market measures in the EU-15 countries.[3] We consider evidence on convergence in financial measures as a verification of the success of these steps taken from EMS to Single Currency in the last five decades for integration in financial markets. To this end, this work studies convergence in banking measures (the ratio of private credit by deposit money banks to GDP and the ratio of liquid liabilities to GDP) over the period 1963–2012, and in the stock market

* Corresponding author.
E-mail addresses: dilara.kilinc@ieu.edu.tr (D. Kılınç), unal.seven@tcmb.gov.tr (Ü. Seven), hakan.yetkiner@ieu.edu.tr (H. Yetkiner).

Peer review under responsibility of the Central Bank of the Republic of Turkey.

[1] A widespread movement toward financial development and the economic growth nexus emerged notably with the early work by Goldsmith (1969) and Shaw (1973) in the 1970s. Since then, there have been various studies investigating the relationship between financial development and economic growth. A large body of research concentrating on this relationship has shown that a well-functioning and market oriented financial sector contributes to improved economic outcomes (King and Levine, 1993a; 1993b; Levine and Zervos, 1996; Beck and Levine, 2004; Seven and Yetkiner, 2016).

[2] A detailed discussion on the history of European financial integration can be found in De Haan et al. (2009) and a one on legal dimension in Gortsos (2011). For empirical evidence, Tables 2 and 3 in Abiad et al. (2007) can be referred.

[3] The EU-15 countries are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom.

http://dx.doi.org/10.1016/j.cbrev.2017.05.002

measures (the ratio of stock market capitalization to GDP and the stock market turnover ratio) over the period 1988–2012. We also investigate the role of several control variables, which we believe may contribute to the explanation of the convergence in financial measures across the EU-15 countries. Our rationale for focusing solely on the EU-15 countries, rather than the EU-28, is twofold. Firstly, the EU-15 countries have relatively similar levels of economic development and less structural differences in fundamental economic and political institutions.[4] Secondly, since we differentiate between banks and stock markets, it is of great importance to choose only those countries that have both (well-developed) banking sectors and stock markets. Furthermore, not all the EU-28 countries had sufficient stock market data, especially the relatively new member states. Were data for EU-28 available, results would not perhaps change qualitatively but the degree of statistical significance would be lower due to greater variation and dissimilarities in fundamentals. This view, although speculative, is consistent with, for example, Borsi and Metiu (2015), who describe a clear separation between the new and old EU member states in the long run in (income) convergence performance.

There are three key points for specifically choosing convergence in financial sector development. Firstly, we motivate our research from the mutual interaction between income, the front-end of an array of activities in back-end sectors, and the financial sector, a back-end sector.[5] The literature presents a bidirectional relationship between financial development and economic growth, pointing to the supply-leading and demand-following hypotheses.[6] Furthermore, the issue of whether the financial sector development in one country is catching up with the levels achieved by the others is vital since bridging the financial development gap is likely to help reduce the income gap. Evidently, the EU project constitutes a natural climate for measuring convergence in back-end sectors, since "the project stimulates integration in back-end sectors as much as in the front-end" (Beyzatlar and Yetkiner, 2017). Therefore, we investigate whether such convergence has occurred in a sample of EU countries.

The second reason for focusing on the financial sector is the strong evidence of income convergence among EU-15 countries.[7] Studies such as Beugelsdijk and Eijffinger (2005), Crespo Cuaresma et al. (2013), Cavenaile and Dubois (2011) all show evidence of income convergence in EU-15. Crespo Cuaresma et al. (2013) also show that the length of EU membership has a significant positive effect, indicating the positive role of economic integration on income convergence.[8] A strong income convergence among EU-15 countries due to similarities in fundamentals suggest that a similar convergence may also be expected in financial measures, given the mutual interaction between the front-end income and the financial sector, a back-end sector. Hence, income convergence is likely to provide a solid background for testing the financial development convergence hypothesis. Moreover, there are several other studies in which economic integration is presumed to be a determinant of income convergence. For example, Kutan and Yigit (2007) investigate the impact of economic integration on convergence and productivity growth by using the stochastic endogenous growth approach. Abiad et al. (2007) show that economic integration accelerates capital movement from capital-rich to capital-scarce economies, which enhances income convergence. Borsi and Metiu (2015) also presume that economic integration is a cause of income convergence. In conclusion, the literature clearly supports the presumption of financial convergence among EU-15 countries, based on evidence on income convergence and economic integration.

The final reason for the choice of the financial sector is that, despite the clear indications of the financial development for the real economy in the literature, there has been little systematic empirical study indicating whether the financial measures across countries converge over time. In this respect, we also contribute to the small but growing literature on financial sector convergence. Among the very few studies, Murinde et al. (2004), using data for seven EU countries for the period of 1972–1996, investigate convergence in terms of the patterns of corporate financing by banks, bond markets, and stock markets to determine whether the economies are converging towards capital-market-oriented or a bank-oriented financial system. Their evidence suggests convergence on a variant of the capital market-oriented financial system, indicating the reliance on internal financing as well as direct financing through equity and bond markets, while bank debt is becoming relatively less important. Veysov and Stolbov (2011) investigate the existence of convergence for financial institutional characteristics for the dataset of 102 countries from 1980 to 2009. The authors conclude that there is a worldwide trend towards steady financial development, as well as the convergence of financial depth indicators; nevertheless, their study suggests that this speed of convergence is not sufficient to allow the developing world to catch up. Bianco et al. (1997) find that convergence in financial systems of the six EU countries is still limited. Different results are found by Antzoulatos et al. (2011), who test for the financial development convergence of 38 industrial and developing countries during the 1990–2005 period. Their results not only show no evidence of convergence, but also suggest that the differences in financial system of the sample countries are actually increasing over time. These differences are greater for stock market and private credit by banks compared to bond market and bank deposits. Bruno et al. (2012) study the issue of convergence of financial systems through the lens of asset allocation using data for the OECD countries. The authors find a strong evidence of convergence of shares and insurance products, but mixed results for debt securities and deposits, due to differences across countries in the weight of national public debts and in the role of banks. More recently, using data of a broad sample of countries for 1965–2009, Bahadir and Valev (2015) show that credit levels relative to GDP and other measures of banking tend to converge over time. The authors, however, do not test the same convergence hypothesis for the stock market development indicators, which is an equally important component of financial development.

Our main contribution is that in our investigation into whether

[4] Cavenaile and Dubois (2011) show that the 10 new entrants from Central and Eastern Europe and the 15 former members of the European Union have heterogeneous convergence process, supporting our country selection process. Borsi and Metiu (2015) can also be considered supporting our focus on EU-15.

[5] As first argued by Beyzatlar and Yetkiner (2017), any back-end sector having a high level of interaction with the front-end sector will also portray a convergence behavior.

[6] The supply-leading hypothesis suggests a causal relationship from financial development to economic growth, by which the mainstream literature is dominated (see, for example, McKinnon, 1973, King and Levine, 1993a, 1993b; Neusser and Kugler, 1998; Levine et al., 2000; among many others). On the other hand, the demand-following hypothesis asserts a causal relationship from economic growth to financial sector development. The hypothesis suggests the positive response of financial sector development to economic growth in such a way that an increasing demand for financial services might promote financial sector as the real economy grows (see, for example, Gurley and Shaw, 1967; Goldsmith, 1969; Jung, 1986; among others).

[7] Some seminal works in income convergence are Mankiw et al. (1992), Islam (1995), Caselli et al. (1996), Evans (1997), Hoeffler (2002) and Mathunjwa and Temple (2007).

[8] There are also a group of studies, including Kutan and Yigit (2004, 2005, 2007) and Brada et al. (2005), using different estimation methodologies, such as rolling cointegration or stochastic convergence, divulge the impact of integration on convergence in core EU members and new members for several real and nominal variables, including industrial output, prices, monetary aggregates and nominal and real interest rate spreads.

widely used measures of financial development exhibit convergence or divergence across the EU-15 countries over time, we specifically differentiate the two components of the financial sector, namely banking and stock markets. The investigation of convergence in stock market development measures will provide an insightful guide for measuring the success of the EU Single Market project for financial services. It is important to take this approach because (i) the EU-15 countries mostly have bank-oriented financial systems; (ii) there is a great deal of heterogeneity within the development levels of stock markets across the EU-15. For example, compared to the UK, considered as one of the most developed financial centers for capital markets (as well as credit markets), other members, such as Finland, Greece and Ireland, have relatively less developed capital markets. Therefore, it is important to examine the extend of the gains what these countries have made from the EU Single Market project for capital markets. Although there are studies mentioned above focusing on different groups of EU countries, there is only limited research on financial development convergence for the EU-15 countries. Therefore, focusing specifically on the EU-15 countries, rather than EU-7 or EU-28, is another contribution of this paper. We also contribute to the literature on the determinants of financial development by including several macroeconomic (real GDP per capita, inflation rate and trade openness) and institutional quality (corruption index) variables in the regressions.

The simple approach to detecting the convergence or divergence process over time is to plot annualized growth rates against initial levels of the variable of interest. Fig. 1 presents a scatter plot of the five-year span average growth rate of private credit by banks to GDP ratio against the earliest observation (in five-year span) for the same statistic for each EU-15 countries for the 1963–2012 period. The plot indicates a negative relationship between its initial value and the average growth rate of private credit by banks to GDP ratio, which suggests convergence in bank development measures across the EU-15 counties. It is interesting to note that UK is an outlier, which can be attributed to UK's exclusion from European Monetary Union. A similar result is seen for the ratio of liquid liabilities to GDP, which we omit for reasons of space.

In a similar manner, Fig. 2 plots the five-year span average growth rates of stock market capitalization to GDP ratio against the earliest observation (in five-year span) for the same statistic for each EU-15 countries for the 1988–2012 period. The plot shows that the average growth rate of stock market capitalization to GDP ratio is higher (lower) in countries with lower (higher) initial value,

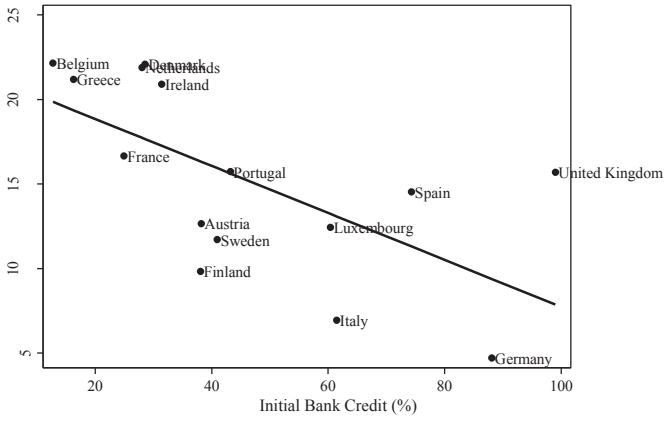

Fig. 1. Bank development convergence.
Source: The World Bank DataBank, Authors' Calculations.

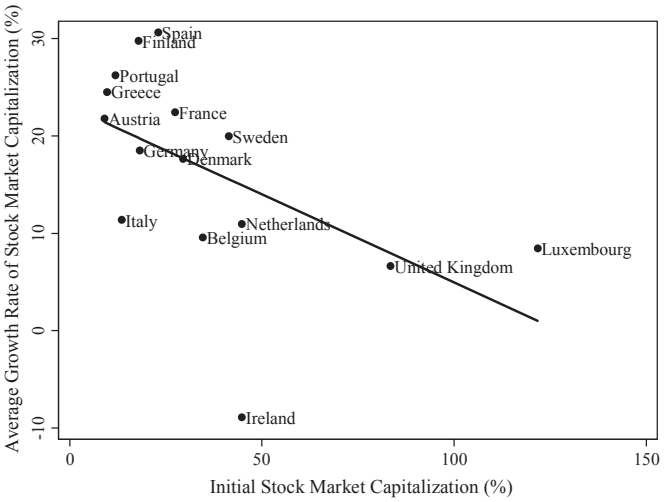

Fig. 2. Stock market development convergence.
Source: The World Bank DataBank, Authors' Calculations.

supporting the view that the EU-15 countries have a tendency to converge in stock market development measures. A similar result is found for the stock market turnover ratio, which we again omit.

Citing the descriptive evidence given above to support our financial development convergence hypothesis, and taking the income convergence theory as a basis for, this study formulates a dynamic panel convergence process, and employs System Generalized Method of Moments (GMM) methodology in order to empirically show the existence of convergence in financial measures across the EU-15 countries. Four types of financial development data are used in estimations: private credit by banks to GDP ratio, liquid liabilities to GDP ratio, stock market capitalization to GDP ratio and stock market turnover ratio. We acknowledge that further financial measures could be used to test the financial development convergence; in this case, however, it is presumed that the panel of countries are similar in fundamentals, and that there is evidence of convergence at the front end, i.e., income convergence. In addition, the variables in our analysis are those commonly employed in the literature, constituting, we believe, a representative, if somewhat limited, set of variables. The data is transformed into 5-year spans, covering the period 1963–2012 for bank development measures, and 1988–2012 for stock market development measures. Inspired by the income convergence literature, two types of convergence equations are estimated: the absolute (unconditional) convergence, and the conditional convergence. In the latter, various control variables, namely real GDP per capita, inflation rate, trade openness and corruption index are used. All estimates show strong evidence for convergence in financial development measures, and a higher (implicit) convergence rate when a control variable is used (although control variables are not necessarily statistically significant in every estimation). To overcome the possible endogeneity problems for explanatory variables, we use lagged differences and lagged levels of all endogenous variables as instruments in the levels equation, and in the first-differenced equation, respectively. All System GMM estimates on the convergence behavior of financial development can be considered consistent and robust, as the instrumental variables are valid and the coefficients of lagged financial measures are always negative and statistically significant. The organization of the paper is as follows: the next section presents the methodology, data and findings. The last section concludes the paper.

2. Methodology, data, and findings

2.1. Methodology

In order to estimate absolute and conditional convergence in financial development measures, we follow dynamic panel data methodology in the tradition of Islam (1995) and Caselli et al. (1996). In particular, we use the System GMM estimator, proposed by Arellano and Bover (1995) and Blundell and Bond (1998), to address the problems of potential endogeneity and unobserved country-specific effects in the data, as a two-step panel econometric analysis. This approach is used because the other estimation methods used in the convergence literature, such as Ordinary Least Squares (OLS) levels and Within Groups (WG) are not necessarily consistent or unbiased. The OLS levels estimations could be biased and inconsistent when unobserved time invariant country effects are omitted in a dynamic panel data model (Hsiao, 2014). Similarly, the WG estimations may be biased and inconsistent when unobserved country specific effects are taken into account with fixed time period (Nickell, 1981; Hsiao, 2014). Hence, OLS levels and WG estimations are regarded as upper and lower bounds, respectively (Bond et al., 2001; Hoeffler, 2002).[9] Consequently, rather than either method, System GMM is preferred as a robust technique, as it estimates unbiased and consistent results (Arellano and Bover, 1995; Blundell and Bond, 1998, 2000; Blundell et al., 2001).

The following dynamic panel equation is estimated in order to test financial development convergence:

$$FD_{i,t} = \beta \cdot FD_{i,t-1} + \gamma \cdot X_{i,t} + \mu_i + \phi_t + \varepsilon_{i,t} \quad (1)$$

where $FD_{i,t}$ on the LHS of the equation represents, alternatively, bank development measures and stock market development measures for country i in a 5-year time span of period t. On the RHS, β is the coefficient of previous 5-year span financial development variable. It is expected to be between 0 and 1, which implies that financial development grows more rapidly in countries/periods with a lower initial level of financial development. Moreover, smaller β implies a higher convergence rate, which is expected in conditional convergence estimations; $\beta = 1$ implies that differences in financial development across countries persist over time; and $\beta > 1$ provides evidence for divergence. μ_i and ϕ_t measure country specific effects and time specific effects, respectively. We also use several control variables with the potential to affect the financial development convergence, such as trade openness (*trade*), real GDP per capita (*gdpc*), inflation rate (*inflation*), and corruption index (*corruption*). Hence, $X_{i,t}$ and γ, respectively, are the vector of control variables and their corresponding coefficients. Finally, $\varepsilon_{i,t}$ is the transitory error term.

By construction, there is a problem of endogeneity due to the simultaneous presence of the country-specific effect (μ_i) and the lagged dependent variable. To show this problem of endogeneity, let us define $\mu_i + \phi_t + \varepsilon_{it} = u_{i,t}$. Then, we see that $E[u_{i,t} \mid FD_{i,t}] \neq 0$, since $FD_{i,t-1} = \beta \cdot FD_{i,t-2} + \gamma \cdot X_{i,t-1} + u_{i,t-1}$ and $u_{i,t-1}$ include μ_i, which is also in $u_{i,t}$. In other words, the strict exogeneity hypothesis that excludes feedback of error towards the explanatory variables is rejected as the lagged dependent variable is correlated with the error term. To overcome this problem and to control for the endogeneity of other explanatory variables, we employ the System GMM approach that composes a system which includes lagged differences and lagged levels of variables as instruments in the levels equation and the first-differenced equation, respectively.

[9] Though biased and inconsistent, we also run the WG regressions. The estimates are available upon request from authors.

Even after eliminating the country-specific effects from the regression by a first-difference transformation of Equation (1), the possibility remains that past shocks predict contemporary regressors. According to Arellano and Bond (1991), we can overcome this bias with the following two assumptions.

$$E[X_{i,t-s}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \ldots, n \quad (2)$$

$$E[FD_{i,t-s}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \ldots, n \quad (3)$$

Nevertheless, Blundell and Bond (1998) have shown that when the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for the regression equation expressed in first-differences. This is likely to lead to biased coefficients, and the problem is generally exacerbated in small samples. The solution by Blundell and Bond (1998) is to compose a system which includes lagged differences, and lagged levels of variables, as instruments in the levels equation and the first-differenced equation, respectively. We have additional moment conditions such that;

$$E[(FD_{i,t-s} - FD_{i,t-s-1})(\mu_i + \varepsilon_{i,t})] = 0 \text{ for } s = 1 \quad (4)$$

$$E[(X_{i,t-s} - X_{i,t-s-1})(\mu_i + \varepsilon_{i,t})] = 0 \text{ for } s = 1 \quad (5)$$

We use moment conditions given in the equations (2) (3) (4), and (5) to obtain the System GMM estimations. To ensure the validity of instruments, we use the standard Hansen (1982) test of over-identification, where the null hypothesis is that the instrumental variables are not correlated with the residual, and the serial correlation test, where the null hypothesis is that there is no second-order serial correlation in the error term. The Arellano-Bond test (Arellano and Bond, 1991) for autocorrelation has a null hypothesis that there is no autocorrelation. The tests for AR (1) process in first differences rejects the null hypothesis, since $\Delta\varepsilon_{i,t} = \varepsilon_{i,t} - \varepsilon_{i,t-1}$ and $\Delta\varepsilon_{i,t-1} = \varepsilon_{i,t-1} - \varepsilon_{i,t-2}$ both have $\varepsilon_{i,t-1}$. However, the test for AR (2) in first differences is more important as it detects autocorrelation in levels. Moreover, as a rule of thumb, the number of instruments should be less than or equal to the number of groups in order to avoid finite sample bias caused by overfitting.

2.2. Data

The variable selection to measure financial development is a major problem in empirical studies due to the diversity of financial services provided by financial systems and the differences among economies in terms of availability of financial intermediation. The empirical literature has employed several indicators for the measurement of financial development. In this respect, we first distinguish between the two components of financial sector (banks and stock markets), and then select four widely used indicators to measure the level of financial development in the two subsectors. We use the ratio of private credit by deposit money banks to GDP (*private*) and the ratio of liquid liabilities to GDP (*liquid*) alternatively as the proxies for bank development.[10] In order to measure stock market development, we employ the ratio of stock market capitalization to GDP (*marketcap*) and stock market turnover ratio (*turnover*) alternatively.[11] Each of these variables adds extra

[10] The ratio of private credit to GDP is one of the most widely used indicators of financial development (King and Levine, 1993a; Levine et al., 2000; Rioja and Valev, 2004). The ratio of liquid liabilities to GDP is used by Goldsmith (1969), King and Levine (1993b) as the size of the financial sector in relation to GDP.

[11] See Levine and Zervos (1998), Beck and Levine (2004), Demetriades and Rousseau (2011), and Demirguc-Kunt et al. (2013).

Table 1
Descriptive Statistics of 5-year span data.

Variables	Period	Obs.	Mean	Std. Dev.	Min.	Max.
Private credit by deposit money banks (% of GDP)	1963–2012	138	74.13	43.26	12.72	208.27
Liquid liabilities (% of GDP)	1963–2012	140	76.51	54.73	7.97	362.70
Stock market capitalization (% of GDP)	1988–2012	74	61.31	41.19	9.06	170.78
Stock market turnover ratio (%)	1988–2012	74	69.25	45.19	0.43	199.33
Trade (% of GDP)	1963–2012	149	75.54	49.40	20.58	333.23
GDP per capita (constant 2005 US$)	1963–2012	148	27,129	12,720	4963	81,442
Inflation rate (%)	1963–2012	145	5.24	4.43	−4.76	19.15
Corruption index	1963–2012	89	4.79	1.01	2	6

information, which contributes to the accuracy of measurement of financial development (Seven and Yetkiner, 2016). For instance, bank credit to the private sector reflects the extent of efficient resource allocation, as the private sector can utilize funds in a more efficient and productive manner as compared to the public sector. The ratio of liquid liabilities to GDP indicates the ability of the banking system to channel funds from savers to borrowers. A higher liquidity ratio means higher intensity in the banking system. In regard to stock market development, stock market capitalization is the product of share price and the number of shares outstanding for all stocks traded on the principal exchange(s) of a given country. It measures the overall size of stock market and reflects the importance of role of equity issues in the capital mobilization and resource allocation process. Stock market turnover ratio is the ratio of total value traded to market capitalization, and it is a measure of share liquidity. It measures the extent to which the stock market is active, i.e., liquid relative to its size. The changes in the degree of turnover reflect short-term fluctuations associated with the business cycle.

The sample is composed of 15 EU countries and covers the periods 1963–2012 and 1988–2012 respectively for the estimation of convergence in bank and stock market development measures. Following Islam (1995), we utilize 5-year time intervals to reduce serial correlation problem and to eliminate the cyclical component. Hence, we obtain 10 data (time) points for bank development measures, and 5 data points for stock market development measures for each 15 countries.[12] In all estimations, all series are in natural logarithm, except the corruption index and the inflation rate. The data for financial development measures, real GDP per capita (in US Dollars at 2005 constant prices), and inflation rate were extracted from the World Bank's Global Financial Development Database. The trade openness data were retrieved from the World Bank's World Development Indicators Database. The data for corruption index were compiled from International Country Risk Guide (ICRG) Database.

Table 1 presents the descriptive statistics for the variables in 5-year span panel data set. There are considerable variations in our variables across time. For example, private credit to GDP ratio ranges from a low of 12.72% up to 208.27%. Similarly, stock market capitalization to GDP ratio ranges from 9.06% to 170.78%. Moreover, as a control variable, GDP per capita also shows significant variation, ranging from 4963 to 81,442 US$.

2.3. Findings

The panel regression results of estimating Equation (1) by one-step System GMM estimator with 5-year span data of EU-15 countries in the periods 1963–2012 (for bank development measures) and 1988–2012 (for stock market development measures) are reported in Tables 2 and 3, respectively.[13] We report the results of one-step System GMM estimators as downward bias is possible in the asymptotic standard errors relating the two-step GMM estimators (Hoeffler, 2002; Blundell and Bond, 1998).[14] For estimations in Table 2, the LHS variable is, alternatively, the ratio of private credit to GDP and the ratio of liquid liabilities to GDP. For estimations in Table 3, the variable is alternatively the stock market capitalization to GDP ratio and stock market turnover ratio. In both tables, the second and the third rows present the estimated coefficient of the lagged dependent variable, $\widehat{\beta}$. This coefficient is expected to be between 0 and 1, implying $\widehat{\beta}-1$ to be between −1 and 0, which is evidence of financial development convergence. Since the derivation of β is unknown in Equation (1) because of the lack of theoretical formulation for financial development measures, it is not possible to calculate the implied convergence rate. Nevertheless, we can make a remark on the (implicit) speed of convergence: the smaller the $\widehat{\beta}$, the higher the $\widehat{\beta}-1$ in absolute value, and hence the higher the speed of convergence. Additionally, the macroeconomic control variables are expected to contribute to convergence in measures of bank development and stock market development. In this respect, we added control variables trade openness to GDP, real GDP per capita, inflation rate and corruption index incrementally in the regressions. We expect $\widehat{\beta}-1$ in absolute value to increase with the inclusion of control variables. In all System GMM estimations, each lagged dependent variable is assumed to be predetermined. We treat trade openness, inflation rate and corruption index as exogenous, whereas GDP per capita as endogenous.[15]

Table 2 presents the convergence estimates in bank development measures in unconditional and conditional terms. The coefficients of lagged *private* and lagged *liquid* are between 0 and 1, and statistically significant in all estimations, which provide strong evidence for unconditional and conditional convergence in banking measures. As expected, unconditional convergence regressions imply the highest $\widehat{\beta}$, 0.957 for *private*, and 0.845 for *liquid*, and hence the lowest speed of convergence (see columns (1) and (6) of Table 2). In columns (2)–(5) and (7)–(10) of Table 2, we test conditional convergence by adding control variables to the model. We continue to observe statistically significant evidence for convergence in banking measures. The inclusion of additional control variables increases the speed of convergence in banking measures, although not always they are statistically significant. This is because

[12] The time points for i) bank development measures: 1963–67, 1968–72, …, 2008–12; ii) stock market development measures: 1988–92, 1993–97, …, 2008–12.

[13] The command "xtabond2" is used in Stata (v.13) for Sytem GMM estimations, and the instrument matrix is collapsed with the command "collapse" available in Stata, as mentioned in Roodman (2009).

[14] For System GMM, the two-step is more efficient than one-step estimator; however, there is a possibility of a downward bias in the asymptotic standard errors especially for the small sample size. The two-step System GMM estimates are also available upon request from the corresponding author.

[15] The endogeneity issue between financial development and GDP per capita is overcome by the System GMM estimator.

Table 2
Convergence in Bank Development Measures (Dependent variable: bank credit, liquid liabilities).

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	0.333*	0.085	−2.537**	−3.080*	−4.825*	0.757**	0.281	−0.541	−5.578*	−4.982
	(0.167)	(0.194)	(1.174)	(1.774)	(2.639)	(0.342)	(0.184)	(1.162)	(3.090)	(8.751)
Private (−1)	0.957***	0.916***	0.912***	0.841***	0.774***	–	–	–	–	–
	(0.041)	(0.039)	(0.063)	(0.063)	(0.102)					
Liquid (−1)	–	–	–	–	–	0.845***	0.821***	0.766***	0.612***	0.573**
						(0.081)	(0.070)	(0.126)	(0.097)	(0.240)
Trade	–	0.097***	−0.085	−0.007	−0.263	–	0.136**	0.404***	0.027*	0.589**
		(0.036)	(0.091)	(0.005)	(0.185)		(0.058)	(0.164)	(0.016)	(0.300)
GDPC	–	–	0.332**	0.821***	0.862**	–	–	−0.009	0.738***	0.235
			(0.165)	(0.199)	(0.385)			(0.178)	(0.248)	(0.214)
Inflation	–	–	–	−0.227**	−0.014	–	–	–	−0.205*	0.175
				(0.102)	(0.020)				(0.115)	(0.151)
Corruption	–	–	–	–	−0.089**	–	–	–	–	−0.096***
					(0.046)					(0.034)
Hansen test	0.23	0.25	0.32	0.30	0.88	0.25	0.22	0.26	0.65	0.71
Difference-in-Hansen test	0.28	0.26	0.77	0.69	0.99	0.19	0.26	0.16	0.90	0.98
AR (2)	0.09	0.10	0.10	0.21	0.17	0.12	0.11	0.06	0.06	0.43
Observations	123	123	123	123	86	125	125	125	125	86
Groups	15	15	15	15	15	15	15	15	15	15
Instruments	12	13	13	14	14	14	13	14	13	14

Notes: All series (except inflation rate and corruption index) in the regressions are in their natural logs. "(-1)" denotes the lag of the corresponding variable. Heteroscedasticity-consistent standard errors are in parentheses. Windmeijer (2005) finite sample correction for standard errors is employed. The p-values are reported for Hansen, Difference-in-Hansen tests and Arellano-Bond test for AR (2). ***, ** and * denote the statistical significance at 1%, 5% and 10% levels, respectively. Time dummies for 10 data points are included in all regressions.

Table 3
Convergence in Stock Market Development Measures (Dependent variable: market capitalization, turnover ratio).

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	2.320***	1.404***	−6.373*	−14.082	19.194	1.284***	4.288***	−7.898	−10.393	−16.209
	(0.290)	(0.554)	(3.463)	(8.694)	(14.193)	(0.440)	(0.915)	(12.666)	(9.080)	(10.161)
Marketcap (−1)	0.442***	0.420***	0.396***	0.368**	0.324**	–	–	–	–	–
	(0.071)	(0.077)	(0.118)	(0.157)	(0.135)					
Turnover (−1)	–	–	–	–	–	0.724***	0.684***	0.411***	0.378***	0.298***
						(0.097)	(0.088)	(0.143)	(0.129)	(0.117)
Trade	–	−0.557	−0.462**	−0.271	−2.712***	–	−0.652***	−1.928***	−2.035***	−2.565***
		(1.008)	(0.215)	(0.382)	(1.102)		(0.186)	(0.595)	(0.588)	(0.894)
GDPC	–	–	1.552**	1.970*	3.402**	–	–	1.802	2.079**	2.933**
			(0.502)	(1.065)	(1.631)			(1.490)	(1.054)	(1.263)
Inflation	–	–	–	−0.194***	−1.725***	–	–	–	0.034	0.049
				(0.069)	(0.636)				(0.076)	(0.079)
Corruption	–	–	–	–	−0.071	–	–	–	–	−0.089
					(0.094)					(0.107)
Hansen test	0.25	0.16	0.13	0.15	0.26	0.56	0.28	0.11	0.27	0.19
Difference-in-Hansen test	0.15	0.82	0.70	0.34	0.93	0.13	0.15	0.20	0.93	0.33
AR (2)	0.06	0.06	0.11	0.15	0.27	0.53	0.19	0.16	0.17	0.55
Observations	59	59	59	59	59	59	59	59	59	59
Groups	15	15	15	15	15	15	15	15	15	15
Instruments	8	9	9	12	15	8	9	10	12	15

Notes: All series (except inflation rate and corruption index) in the regressions are in their natural logs. "(-1)" denotes the lag of the corresponding variable. Heteroscedasticity-consistent standard errors are in parentheses. Windmeijer (2005) finite sample correction for standard errors is employed. The p-values are reported for Hansen, Difference-in-Hansen tests and Arellano-Bond test for AR (2). ***, ** and * denote the statistical significance at 1%, 5% and 10% levels, respectively. Time dummies for 5 data points are included in all regressions.

including a variable, although insignificant itself, empowers the instrument set of GMM regression significantly (Hoeffler, 2002). Hence, we observe the highest convergence rate when all control variables are included in the regressions (see columns (5) and (10) of Table 2). The results show a positive and statistically significant relationship between trade openness and bank development measures in columns (2) and (7–10), indicating that the banking sector develops as trade to GDP ratio increases. The impact of income on the ratio of private credit to GDP is positive and statistically significant in columns (3–5) and (9) of Table 2, as expected. In regard to the impact of inflation rate, the estimates show that it is negative and statistically significant in columns (4) and (9). We also control for the impact of corruption index as an institutional quality measure on the convergence of bank development measures. The evidence suggests that the corruption index has an improving impact on bank development measures, and it increases the speed of conditional convergence (see columns (5) and (10) of Table 2).

The convergence estimations in stock market development measures in unconditional and conditional terms are reported in Table 3. The estimated coefficient of lagged *marketcap*, which is between 0 and 1 and statistically significant in all System GMM estimations, suggests that the ratio of stock market capitalization to GDP converges across the EU-15 countries over time. In a similar manner, there is evidence of convergence in *turnover* in both unconditional and conditional terms. $\widehat{\beta}$ again takes the highest value in unconditional convergence regressions, 0.442 for *marketcap*, and 0.724 for *turnover*, which imply the lowest speed of convergence (see columns (1) and (6) of Table 3). After controlling for trade

openness, real GDP per capita, inflation rate, and the corruption index, we see that the speed of convergence is higher than that of unconditional convergence, although not all of these are statistically significant (see columns (2)–(5) and (7)–(10) of Table 3). Trade openness is negative and statistically significant in columns (3), (5), and (7–10). Real GDP per capita is positive and statistically significant in all but column (8), suggesting that real GDP per capita increases the ratios for both the stock market capitalization to GDP and the stock market turnover ratio. The estimated coefficient of inflation is negative and statistically significant, cf., columns (4–5) of Table 3. Finally, the corruption index is not statistically significant in either estimation.

To test the validity of the instruments, we first use the standard Hansen test of over-identification, where the null hypothesis is that the instrumental variables are not correlated with the residual. We fail to reject the null hypothesis for all of the estimations, which suggests a lack of correlation between the instrumental variables and the error term. Then, we assess the results of Arellano-Bond test, of which the null hypothesis is no autocorrelation in the error term. In all estimations, the *p*-values by AR (2) indicate that there is no evidence for the second-order serial correlation in the first-differenced residuals. Finally, we find the additional moment conditions valid for all estimations, since the null hypothesis of Difference-in-Hansen test is not rejected. Additionally, the rule of thumb is satisfied, since the number of groups is larger than or equal to the number of instruments in all estimations. Hence, the overall performance of all System GMM estimations is robust and consistent in terms of the validity of instrument set and the expected signs and significance levels of the lagged dependent variable.

3. Concluding remarks and policy implications

In this study, the issue of convergence in financial measures across the EU-15 has been explored for the period 1963–2012 for bank development measures, and for 1988–2012 for stock market development measures. Our investigation of financial development variables across the EU-15 countries provides strong evidence for the existence of unconditional and conditional convergence in financial development measures; in particular, we present evidence for convergence in terms of bank private credit to GDP, liquid liabilities to GDP, stock market capitalization to GDP and stock market turnover ratios. Furthermore, the trade to GDP ratio, real GDP per capita, the inflation rate and corruption index were found to be statistically significant determinants of both banking and stock market development, whereas the corruption index, a measure for the quality of institutions, does not seem to affect stock market development.

Overall, the paper conjectures that the convergence in financial measures across EU-15 countries indicates the effectiveness of EU financial integration policies. The policy implications of our findings are as follows. First, while a certain degree of EU financial integration has been achieved, the recent financial and sovereign crises have raised doubts about the integration process. After these crises, public opinion has started to question the future of economic (and political) integration among member states, which have retrenched cross-border financing, posing a threat to the future of economic integration. Our analyses indicate that there is a degree of success in financial integration, which is reflected in convergence in several financial measures, and therefore it seems logical to accelerate rather than to slow financial integration to completion to prevent unbalanced financial risks among members of the Euro area. This can be achieved by promoting further initiatives that enhance financial risk-sharing across member states, such as the Banking Union and the Capital Markets Union, and at the same time, improving the overall regulatory and policy framework to reduce the incidence of crises.

While this paper was in progress, there was only the slightest indication of the possibility of UK's exit from the EU, the so-called Brexit. To the surprise of world, however, the nationwide plebiscite held in June 2016 resulted in the United Kingdom voting to leave the European Union. An ex-post analysis of Brexit has a very direct connection with the results of our analyses. UK was the only EU-15 to remain outside the Monetary Union since it was established. Hence, though having no differences in fundamentals for income or financial convergence, UK has not shown the will for full integration, and particularly in monetary terms, making Brexit possible. We argue that Brexit is the result of a natural laboratory experiment proving that a political and economic integration project cannot be successful without successfully completed financial integration.

Our analysis has concentrated on financial size and liquidity variables due to the data availability across countries and time: however, access, efficiency, and use of financial services may be more relevant to measuring the level of financial development. Hence, we leave future research to explore convergence in other measures of financial development. Similarly, it is important to understand whether recently joined member states have also experienced such convergence, to be able to undertake a wider exploration of the success of the EU Single Market for financial services. This is important not only because these countries have relatively less developed economic and political institutions, leading to higher heterogeneity in the region, but also because the EU project expressly seeks to achieve economic integration of all member states with the aim of stimulating economic growth. It is to be hoped that future data sets would allow us to investigate other aspects of financial development in order to present stronger evidence on the success of the Single Market.

References

Abiad, A., Leigh, D., Mody, A., 2007. International Finance and Income Convergence: Europe Is Different. IMF Working paper, WP/07/64.

Antzoulatos, A.A., Panopoulou, E., Tsoumas, C., 2011. Do financial systems converge? Rev. Int. Econ. 19 (1), 122–136.

Arellano, M., Bond, S., 1991. Some tests of specification for panel data: monte Carlo evidence and an application to employment equations. Rev. Econ. Stud. 58 (2), 277–297.

Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. J. Econ. 68 (1), 29–51.

Bahadir, B., Valev, N., 2015. Financial development convergence. J. Bank. Financ. 56, 61–71.

Beck, T., Levine, R., 2004. Stock markets, banks, and growth: panel evidence. J. Bank. Financ. 28 (3), 423–442.

Beugelsdijk, M., Eijffinger, S.C.W., 2005. The effectiveness of structural policy in the european union: an empirical analysis for the EU-15 in 1995-2001. J. Common Mark. Stud. 43 (1), 37–51.

Beyzatlar, M.A., Yetkiner, H., 2017. Convergence in transportation measures across the EU-1 (forthcoming). Transportation.

Bianco, M., Gerali, A., Massaro, R., 1997. Financial systems across "developed economies": convergence or path dependence? Res. Econ. 51 (3), 303–331.

Blundell, R., Bond, S., 1998. Initial conditions and Moment restrictions in dynamic panel data model. J. Econ. 87 (1), 115–143.

Blundell, R., Bond, S., 2000. GMM Estimation with persistent panel data: an application to production functions. Econ. Rev. 19 (3), 321–340.

Blundell, R., Bond, S., Windmeijer, F., 2001. Estimation in dynamic panel data models: improving on the performance of the standard GMM Estimator. In: Baltagi, B.H., Fomby, T.B., Carter Hill, R. (Eds.), Nonstationary Panels, Panel Cointegration, and Dynamic Panels, vol. 15. Emerald Group Publishing Limited, pp. 53–91.

Bond, S.R., Hoeffler, A., Temple, J.R., 2001. GMM Estimation of Empirical Growth Models. CEPR Discussion Paper No. 3048.

Borsi, M.T., Metiu, N., 2015. The evolution of economic convergence in the European Union. Empir. Econ. 48 (2), 657–681.

Brada, J.C., Kutan, A.M., Zhou, S., 2005. Real and monetary convergence between the European Union's core and recent member countries: a rolling cointegration approach. J. Bank. Financ. 29 (1), 249–270.

Bruno, G., De Bonis, R., Silvestrini, A., 2012. Do financial systems converge? New evidence from financial assets in OECD countries. J. Comp. Econ. 40 (1),

141–155.
Caselli, F., Esquivel, G., Lefort, F., 1996. Reopening the convergence debate: a new look at cross-country growth empirics. J. Econ. Growth 1 (3), 363–389.
Cavenaile, L., Dubois, D., 2011. An empirical analysis of income convergence in the European Union. Appl. Econ. Lett. 18 (17), 1705–1708.
Crespo Cuaresma, J., Hadettova, M., Labaj, M., 2013. Income convergence prospects in Europe: assessing the role of human capital dynamics. Econ. Syst. 37, 493–507.
Demetriades, P.O., Rousseau, P.L., 2011. Government, openness and finance: past and present. Manch. Sch. 79 (2), 98–115.
Demirguc-Kunt, A., Feyen, E., Levine, R., 2013. The evolving importance of banks and securities markets. World Bank Econ. Rev. 27 (3), 476–490.
Evans, P., 1997. How fast do economics converge? Rev. Econ. Stat. 79 (2), 219–225.
Goldsmith, R.W., 1969. Financial Structure and Development. Yale Univ. Press, New Haven, CT.
Gortsos, C.V.I., 2011. Economic aspects, the existing legal framework and the way ahead (chapter 18), pp.394–425. In: Jovanovich, M. (Ed.), Competition, Spatial Location of Economic Activity, and Financial Issues, International Handbook on the Economics of Integration, vol. II. Edward Elgar Publishing Limited, UK.
Gurley, J.G., Shaw, E.S., 1967. Financial structure and economic development. Econ. Dev. Cult. Change 15 (3), 257–268.
De Haan, J., Oosterloo, S. & Schoenmaker, D., 2009. European Financial Integration: Origins and History, chapter 2, pp. 33–60. In De Haan, Oosterloo, and Schoenmaker (Ed. 24.26.) European Financial Markets and Institutions, Cambridge University Press, New York.
Hansen, L.P., 1982. Large sample properties of generalized method of moments estimators. Econometrica 50 (4), 1029–1054.
Hoeffler, A., 2002. The augmented Solow model and the African growth debate. Oxf. Bull. Econ. Stat. 64 (2), 135–158.
Hsiao, C., 2014. Analysis of Panel Data. Cambridge University Press, Cambridge.
Islam, N., 1995. Growth empirics: a panel data approach. Q. J. Econ. 110 (4), 1127–1170.
Jung, W.S., 1986. Financial development and economic growth: international evidence. Econ. Dev. Cult. Change 34 (2), 333–346.
King, R.G., Levine, R., 1993a. Finance and growth: schumpeter might be right. Q. J. Econ. 108 (3), 717–737.
King, R.G., Levine, R., 1993b. Finance, entrepreneurship, and growth: theory and evidence. J. Monet. Econ. 32 (3), 513–542.
Kutan, A.M., Yigit, T.M., 2004. Nominal and real stochastic convergence of transition economies. J. Comp. Econ. 32 (1), 23–36.
Kutan, A.M., Yigit, T.M., 2005. Real and nominal stochastic convergence: are the new EU members ready to join the Euro zone? J. Comp. Econ. 33 (2), 387–400.
Kutan, A.M., Yigit, T.M., 2007. European integration, productivity growth and real convergence. Eur. Econ. Rev. 51, 1370–1395.
Levine, R., Zervos, S., 1996. Stock market development and long-run growth. World Bank Econ. Rev. 10 (2), 323–339.
Levine, R., Zervos, S., 1998. Stock markets, banks and economic growth. Am. Econ. Rev. 88, 537–558.
Levine, R., Loayza, N., Beck, T., 2000. Financial intermediation and growth: causality and causes. J. Monet. Econ. 46 (1), 31–77.
Mankiw, N.G., Romer, D., Weil, D.N., 1992. A contribution to the empirics of economic growth. Q. J. Econ. 107, 407–437.
Mathunjwa, J.S., Temple, J.R., 2007. Convergence Behaviour in Exogenous Growth Models. Bristol Economics Discussion Papers No: 06/590.
McKinnon, R.I., 1973. Money and Capital in Economic Development. Brookings Institution, Washington, DC.
Murinde, V., Agung, J., Mullineux, A., 2004. Patterns of corporate financing and financial system convergence in Europe. Rev. Int. Econ. 12 (4), 693–705.
Neusser, K., Kugler, M., 1998. Manufacturing growth and financial development: evidence from OECD countries. Rev. Econ. Stat. 80 (4), 638–646.
Nickell, S., 1981. Biases in dynamic models with fixed effects. Econometrica 49 (6), 1399–1416.
Rioja, F., Valev, N., 2004. Finance and the sources of growth at various stages of economic development. Econ. Inq. 42 (1), 127–140.
Roodman, D., 2009. A note on the theme of too many instruments. Oxf. Bull. Econ. Stat. 71 (1), 135–158.
Seven, U., Yetkiner, H., 2016. Financial intermediation and economic growth: does income matter? Econ. Syst. 40 (1), 39–58.
Shaw, E.S., 1973. Financial Deepening in Economic Development. Oxford University Press, Oxford.
The World Bank DataBank, http://databank.worldbank.org/data/home.aspx.
Veysov, A., Stolbov, M., 2011. Do Financial Systems Converge? a Comprehensive Panel Data Approach and New Evidence from a Dataset for 102 Countries. Available at SSRN: https://ssrn.com/abstract=2037395.
Windmeijer, F., 2005. A finite sample correction for the variance of linear efficient two-step GMM estimators. J. Econ. 126 (1), 25–51.