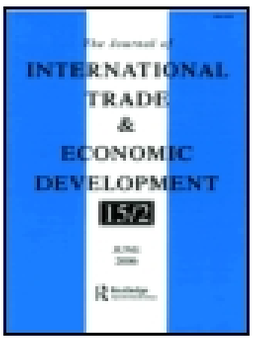

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Trade openness, foreign direct investment, and finance-growth nexus in the Eurozone countries

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ABSTRACT

The paper investigates causal relationships between trade openness, foreign direct investment, financial development, and economic growth in 19 Eurozone countries over the period 1988–2013. Using a panel vector error-correction model (VECM), the empirical results show that these variables are cointegrated. The study shows that a combination of opening the Eurozone countries for trade and fostering their financial and economic development have elevated inflows of foreign direct investment into the region in the long run. At the same time, increasing inflows of foreign direct investment in the short run have propelled economic growth, which in return has strengthened the role of financial development and international trade to sustain economic growth in the region through feedback effects. The empirical results have important policy implications for countries in the Eurozone, especially those who face challenges as a result of lack of confidence in their financial system and those who face a sovereign debt crisis.

KEYWORDS Trade openness; FDI; financial development; economic growth; Eurozone countries

JEL CODE L96, O32, O33, O43

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1. Introduction

Financial development[1] is considered to be one of the most important factors for economic growth, both in developed and developing countries (see, for instance, Adeniyi et al. 2015; Bayraktar 2014; Levine 2005; Pradhan, Arvin, and Bahmani 2015a; Rousseau and Wachtel 2002; Rousseau and Yilmazkuday 2009; Samargandi, Fidrmuc, and Ghosh 2015; Zhang, Wang, and Wang 2012). There are at least four ways in which financial development can increase economic growth: (a) through increasing the efficiency in intermediation between borrowers and lenders, (b) through improving the allocation of resources (via fund pooling, risk diversification, liquidity management, screening, and monitoring), (c) through increasing saving rates, and (d) through promoting the

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development of markets and instruments that enable risk sharing and facilitate economic growth (Aziz and Duenwald 2002; Goodhart 2004; Levine 1997; Yilmazkuday 2011).

Empirical evidence have shown that countries with robust and inclusive financial systems[2] that caters for a broad segment of the population are more prosperous than countries that restrict such access to a small segment of society's elites (Baltagi, Demetriades, and Law 2009). Consequently, instituting well-functioning financial markets and institutions[3] to attract savings and channelling them into productive investment projects are one of the main priorities of governments across the globe to stimulate and sustain economic growth (Law 2009).

There is a significant corpus since the seminal work of Schumpeter (1911) to determine how financial development spurs economic growth[4] (see, for instance, Bhattarai 2015; Christopoulos and Tsionas 2004; Greenwood and Scharfstein 2013; Herwartz and Walle 2014; Jedidia, Boujelbene, and Helali 2014; King and Levine 1993; Lee and Hsieh 2014; Pradhan et al. 2014a, 2014b). A second strand of studies have shown that trade openness and foreign direct investment (FDI) are important drivers for explaining the finance-growth nexus (see, for instance, Chen and Emile, 2013; Law, 2009; Otchere, Soumare, and Yourougou 2016).

The present study combines these two strands of literature by arguing that the inclusion of trade openness and foreign direct investment improves our understanding of the connection between finance and growth. The reason behind studying trade openness and FDI when discussing the relationship between financial development and economic growth are twofold. First, trade openness and FDI inflows have often been suggested as key drivers for economic growth (see, for example, Belloumi 2014; Tekin 2012). The impact of trade openness on economic growth can be positive and significant mainly due to the accumulation of physical capital and technology transfer. On the other hand, the positive impact of FDI inflows on economic growth can be due to increasing and augmenting the supply of funds for domestic investment. Most of the previous empirical studies have dealt with either the relationship between trade openness and economic growth (Awokuse 2007; Hsiao and Hsiao 2006), the relationship between FDI and economic growth (Cipollina et al. 2012; Durham 2004; Hazzer 2008; Herzer, Klasen, and Nowak-Lehmann 2008; Lipsey 2000; Pradhan, Arvin, and Norman 2014d), or the relationship between trade openness (and FDI) on economic growth (Pahlavani, Wilson, and Worthington 2005). Most studies conclude that both trade openness and FDI promote economic growth. However, these studies have failed to offer a conclusive result on the relationship in general and the direction of the causality in particular between trade openness, FDI, and economic growth. The growth enhancing effects stemming from trade openness and FDI inflows can vary from country to country and over time. Therefore, the first objective of the present study is to fill this gap in literature by investigating the influence of FDI on growth in a number of diverse countries covering an extended period of time. The results would add to the body of knowledge as policy makers can more acutely adjust policy incentives for FDI depending on the specific country.

Second, several studies have shown that trade openness and FDI inflows are important factors for financial development (Ang 2009; Choong, Yusop, and Soo 2004; Law 2009; Liu and Qiu 2014; Liu, Wang, and Wei 2001). The argument is that both trade openness and FDI inflows can improve the supply of external finance and limit the ability of industrial and financial incumbents to restrict competition through preventing entry of new firms. According to Baltagi, Demetriades, and Law (2009), both trade openness and FDI inflows are statistical significant determinants of banking sector development and that

opening up either trade or FDI without opening up the other could still generate gains in financial development. The majority of the past empirical studies have dealt with either the relationship between trade openness and financial development (Law 2009; Zhang, Zhu, and Lu 2015), the relationship between FDI and financial development (Adjasi et al., 2012; Azman-Saini, Law, and Ahmad 2010; Chen and Emile 2013 and Otchere, Soumare, and Yourougou 2016), or the relationship between trade openness (and FDI) on financial development (Choong 2012; Lee and Chang 2009). Most of these studies have concluded that both trade openness and FDI promote financial development. However, they have failed to offer a conclusive result on the direction of the causality between trade openness, FDI and financial sector development. The financial development effects from trade openness and FDI inflows vary from country to country and over time. Therefore, the second objective of the present study is to report on whether there is a difference in causality between economic growth trade openness, FDI and financial sector development over time in the various countries, and if so, whether the difference significant.

In general, there are three approaches that researchers can use to examine the impact of trade openness and FDI on finance-growth nexus, namely the cross sectional approach, the longitudinal approach, and the panel data approach. The cross-sectional approach considers number countries in one particular year, while the longitudinal approach studies individual countries over several years. Contrary to these approaches, the panel data approach studies a group of countries over a span of time. The latter approach provides more robust statistical estimators for the relationships between the variables (Baltagi 2005). The present study uses the third approach in examining the dynamics between trade openness, FDI, financial development and economic growth for countries in the Eurozone over the period 1988–2013. The contribution that the present study makes is that policymakers and government can implement policies, incentives and procedures that will be designed for the specific needs of a specific country to enhance economic growth by means of FDI. More effective and efficient actions in this regard could optimize economic growth for specific countries in the Eurozone, especially those that are negatively impacted by instability in their financial system, those who face contraction in their economic activity, and those who face increasing sovereign debt.

The empirical results of the present study indicate that the economic integration of countries within the Eurozone from 1988–2013 have resulted in increased flows of foreign direct investment (in turn largely influenced by economic growth, financial development, and trade openness) within the region in the long run. The short-run dynamics between trade openness, foreign direct investment, financial development and economic growth are a little more complex, with patterns of bi-directional relationships between a number of these variables.

This paper is organized as follows. In Section 2, a brief literature review is provided. In Section 3, the empirical model, methodology and data are discussed. In Section 4, the empirical results, in particular the long-term causal relationships between trade openness, FDI, financial sector development, and economic growth are explained. In Section 5, key implications of the empirical results and concluding remarks are given.

2. Literature review

There is an extensive body of literature examining the relationships between trade openness, FDI, financial sector development, and economic growth.[5] These studies can be classified into four strands studying, separately, financial development and economic

growth; trade openness[6] and economic growth; FDI and economic growth; and trade openness and financial development. A detailed summary of these four strands of literature describing the causal relationship between the above-mentioned variables is given below.

The first strand of literature is between financial development and economic growth. Several studies such as Asghar and Hussain (2014), Chaiechi (2012), Hsueh, Hu, and Tu (2013), and Pradhan et al. (2014c) have found the evidence in support of the supply-leading hypothesis (i.e. financial development leads to economic growth). In contrast, the studies by Asghar and Hussain (2014) and Kar, Nazlioglu, and Agir (2011) have found the evidence in support of demand-following hypothesis (i.e. economic growth leads to financial development). Similarly, the studies by Asghar and Hussain (2014), Pradhan et al. (2014b), and Wolde-Rufael (2009) support the evidence of feedback hypothesis (i.e. the bidirectional causality between financial development and economic growth).

The second strand of literature is between trade openness and economic growth. Studies by Abdelhafidh (2013), Gries, Kraft, and Meierrieks (2009), Hossain, Sanchez, and Yu (2011), Pistoresi and Rinaldi (2012), Pradhan, Arvin, and Norman (2014d) and Zhang (2001) found the evidence in support of the supply-leading hypothesis (i.e. trade or FDI lead to economic growth). In contrast, the studies by Lean and Tan (2011), Pistoresi and Rinaldi (2012), Pradhan, Arvin, and Norman (2014d), Shahbaz (2012), and Zhang (2001) all found the evidence in support of demand-following hypothesis (i.e. economic growth leads to trade or FDI). Similarly, the studies by Awokuse (2008), Hossain, Sanchez, and Yu (2011), Lee (2010), and Pistoresi and Rinaldi (2012) support the evidence of feedback hypothesis (i.e. the bidirectional causality between trade (or FDI) and economic growth).

The third strand of literature is between trade openness and financial development. Studies by Asghar and Hussain (2014),Chen and Emile (2013), Menyah, Nazlioglu, and Wolde-Rufael (2014), and Pradhan, Arvin, and Norman (2015b) all found the evidence in support of the supply-leading hypothesis (i.e. openness (trade or FDI) leads to financial development). In contrast, the studies by Asghar and Hussain (2014) and Menyah, Nazlioglu, and Wolde-Rufael (2014) all found the evidence in support of demand-following hypothesis (i.e., financial development leads to openness (trade or FDI)). Similarly, the studies by Asghar and Hussain (2014), Menyah, Nazlioglu, and Wolde-Rufael (2014) and Pradhan, Arvin, and Norman (2015b) support the evidence of feedback hypothesis (i.e. the bidirectional causality between financial development and openness (trade or FDI)).

The fourth strand of the literature investigates the direction of causality between economic growth and foreign direct investment. Studies by Abdelhafidh (2013), Lean and Tan (2011), Tang and Wang (2011) and Lee (2010) found results of a supply leading-hypothesis (unidirectional causality from foreign direct investment to economic growth). The opposite pattern of causality, from economic growth to FDI, is supported by findings of studies that suggested that FDI plays only a minor role in economic growth and that it is merely a by-product of economic growth (Lean and Tan (2011), Mah (2010) and Lee (2009)). Studies in which results suggest that there is a bi-directional causality between economic growth and foreign direct investment though a self-perpetuating cycle include those of Herzer (2012), Dash and Sharma (2011) and Ahmed, Cheng, and Messinis (2011).

Table 1 presents a summary of studies that have examined the causal nexus between financial development and economic growth; trade openness and economic growth; FDI and economic growth; and trade openness and financial development.

The present paper incorporates all four strands of literature into a single model and uses dynamic panel data approaches to examine the nature of the causal relationships

Table 1. Summary of studies on the causal connection between financial development and economic growth, openness and economic growth, openness and financial development, and economic growth and foreign direct investment.

Studies	Method	Country/Territory	Period	Hypotheses
A: Studies relating to financial development and economic growth				
Chaiechi (2012)	3	South Korea, Hong Kong, UK	1990–2006	SLH^{1}
Hsueh, Hu, and Tu (2013)	1	Ten Asian countries	1980–2007	SLH^{1}
Kar, Nazlioglu, and Agir (2011)	3	15 MENA countries	1980–2007	SLH^{1}, DFH^{1}
Menyah, Nazlioglu, and Wolde-Rufael (2014)	2	21 African countries	1965–2008	SLH^{1}, DFH^{1}
Pradhan et al. (2014a)	3	ASEAN countries	1961–2012	FBH^{1}
B: Studies relating to trade openness and economic growth				
Abdelhafidh (2013)	3	North African countries	1970–2007	SLH^{22}
Ang (2008)	3	Malaysia	1965–2004	DFH^{22}
Awokuse (2008)	3	Argentina, Colombia, Peru	1993–2002	FBH^{21}
Bahmani-Oskooee, Mohtadi, and Shabsigh (1991)	1	20 DCs	1951–1987	FBH^{21}
Gries, Kraft, and Meierrieks (2009)	3	16 SSACs	1960–2003	SLH^{21}
Hossain, Sanchez, and Yu (2011)	3	NICs	1971–2007	SLH^{21}, FBH^{21}
Konya (2006)	2	24 OECD countries	1960–1997	SLH^{21}, DFH^{21}, FBH^{21}
Lean and Tan (2011)	3	Malaysia	1970–2009	SLH^{22}, DFH^{22}
Lee (2010)	1	Japan and World	1977–2006	SLH^{22}, FBH^{22}
Riezman, Summers, and Whiteman (1996)	2	126 countries	1950–1990	SLH^{21}, DFH^{21}
Shahbaz (2012)	3	Pakistan	1971–2011	SLH^{21}, DFH^{21}
Van den Berg and Schmidt (1994)	1	16 LACs	1980–2007	SLH^{21}, FBH^{21}
Xu (1996)	1	32 DCs	1960–1990	SLH^{21}, FBH^{21}
Zhang (2001)	1	EALAC	1980–2007	SLH^{22}, DFH^{22}
C: Studies relating to trade openness and financial development				
Asghar and Hussain (2014)	3	15 DCs	1978–2012	SLH^{31}, DFH^{31}, FBH^{31}
Chen and Emile (2013)	3	China, Latin American countries	1982–2009	SLH^{31}
Lee and Chang (2009)	3	37 countries	1970–2002	FBH^{32}
Otchere, Soumare, and Yourougou (2016)	1	African countries	1996–2009	FBH^{32}
Pradhan, Arvin, and Norman (2015b)	3	India	1994–2011	SLH^{31}, FBH^{31}
D: Studies relating to economic growth and foreign direct investment				
Abdelhafidh (2013)	3	North African countries	1970–2007	SLH^{22}
Lean and Tan (2011)	3	Malaysia	1970–2009	SLH^{22}, DFH^{22}
Tang and Wang (2011)	2	Cambodia	1994–2006	SLH^{22}
Lee (2010)	1	Japan and World	1977–2006	SLH^{22}
Mah (2010)	1	China	1983–2001	DFH^{22}
Lee (2009)	1	Malaysia	1970–2000	DFH^{22}
Herzer (2012)	2	Germany	1980–2008	FBH^{22}
Dash and Sharma (2011)	3	India	1991–2006	FBH^{22}
Ahmed, Cheng, and Messinis (2011)	3	SSACs	1991–2001	FBH^{22}

Note 1: Supply-leading hypothesis: if unidirectional causality is present from financial development to economic growth; Demand-following hypothesis: if unidirectional causality form economic growth to financial development is present; Feedback hypothesis: if bidirectional causality between financial development and economic growth is present; Neutrality hypothesis: if no causality between financial development and economic growth is present.

Note 2: Bivariate Granger Causality; 2: Trivariate Granger Causality; 3: Multivariate Granger Causality; ASEAN: Association of South East Asian Nations; MENA: Middle East and North Africa; NACs: NACs: Northeast Asian Countries; EALAC: East Asia and Latin America Countries; LACs: Latin American Countries; DCs: Developing Countries; ACs: Asian Countries; and SSACs: Sub- Saharan African countries; and UK: United Kingdom.

Note 3: [1] is the link between financial development and growth, [21] is the link between trade openness and economic growth, [22] is the link between foreign direct investment and growth, [31] is the link between trade openness and financial development, and [32] is the link between foreign direct investment and financial development.

among trade openness, foreign direct investment, financial development, and economic growth in both the short and the long run.

3. Variables and empirical approach

The previous section highlights the extensive literature which examines separately the nexus between the four variables studied in the present study. The study will incorporate a more integrated framework that examines the short-run and long-run relationship between these variables. Our research framework and the hypotheses are presented in Figure 1.

The variables are defined more precisely as follows: Per capita economic growth rate is the percentage change in per capita gross domestic product [Variable: *PCG*]. The financial sector development indicator is constructed using six specific and different financial development indicators, namely (i) domestic credit to private sector (expressed as a percentage of GDP[7]), (ii) domestic credit provided by the financial sector (expressed as a percentage of GDP), (iv) domestic credit to private sector by banks (expressed as a percentage of GDP), (v) market equity capitalization of listed companies (expressed as

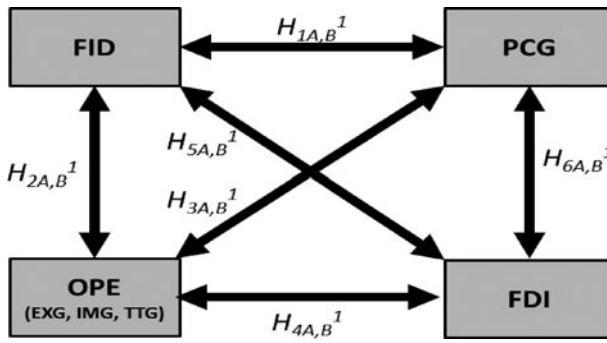

Figure 1. Hypotheses on the possible causal relationships.
Note 1: Our research framework tests the following hypotheses: H_{1A}^{0}: *Financial development does not Granger-cause per capita economic growth.* H_{1A}^{1}: *Financial development Granger-causes per capita economic growth.* H_{1B}^{0}: *Per capita economic growth does not Granger-cause financial development.* H_{1B}^{1}: *Per capita economic growth Granger-causes financial development.* H_{2A}^{0}: *Financial development does not Granger-cause trade openness.* H_{2A}^{1}: *Financial development Granger-causes trade openness.* H_{2B}^{0}: *Trade openness does not Granger-cause financial development.* H_{2B}^{1}: *Trade openness Granger-causes financial development.* H_{3A}^{0}: *Trade openness does not Granger-cause per capita economic growth.* H_{3A}^{1}: *Trade openness Granger-causes per capita economic growth.* H_{3B}^{0}: *Per capita economic growth does not Granger-cause Trade openness.* H_{3B}^{1}: *Per capita economic growth Granger-causes trade openness.* H_{4A}^{0}: *Foreign direct investment does not Granger-cause trade openness.* H_{4A}^{1}: *Foreign direct investment Granger-causes trade openness.* H_{4B}^{0}: *Trade openness does not Granger-cause foreign direct investment.* H_{4B}^{1}: *Trade openness Granger-causes foreign direct investment.* H_{5A}^{0}: *Financial development does not Granger-cause foreign direct investment.* H_{5A}^{1}: *Financial development Granger-causes foreign direct investment.* H_{5B}^{0}: *Foreign direct investment does not Granger-cause financial development.* H_{5B}^{1}: *Foreign direct investment Granger-causes financial development.* H_{6A}^{0}: *Per capita economic growth does not Granger-cause foreign direct investment.* H_{6A}^{1}: *Per capita economic growth Granger-causes foreign direct investment.* H_{6B}^{0}: *Foreign direct investment does not Granger-cause per capita economic growth.* H_{6B}^{1}: *Foreign direct investment Granger-causes per capita economic growth.*
Note 2: PCG is per capita economic growth, FID is financial development, OPE is trade openness, EXG is trade openness for exports-gross domestic product (GDP) ratio, IMG is trade openness for imports-GDP ratio, TTG is trade openness for total trade (imports plus exports)-GDP ratio, and FDI is foreign direct investment.
Note 3: H^0 denotes the null hypothesis; H^1 denotes the alternate hypothesis.

a percentage of GDP), (vi) value of traded stocks (expressed as a percentage of GDP), (vii) the equity turnover ratio (defined as the percentage change in the turnover of traded stocks). These variables are used to construct a composite index of financial sector development (variable: *FID*). Principal component analysis is used to construct this composite index.[8] Descriptive statistics on the components of this index are available from the authors upon request. The trade openness variable (*OPE*) is captured using three trade indicators: exports as a percentage of GDP [variable: *EXG*], imports as a percentage of GDP [variable: *IMG*], or total trade as a percentage of GDP [variable: *TTG*]. Descriptive statistics of the three trade indicators are not given here due to space constraints but are available from the authors. These statistics indicate that *IMG* is substantially higher compared to *EXG* and that this is true for the majority of these chosen countries. Moreover, there is variation within the particular trade indicators *EXG*, *IMG*, and *TTG*.[9] All the variables are expressed in natural logarithms in our empirical investigation.

Testing the causal relationships shown is Figure 1 will entail first assessing the properties of the data series; that is, whether the series are stationary or non-stationary. If the series are stationary, a standard Granger causality test will be undertaken. If the series are non-stationary, a vector error procedure will be used. This involves two-sub procedures: panel cointegration and panel Granger causality tests which will be undertaken to assess the short-term and long-term dynamics between *FID*, *OPE*, *FDI*, and *PCG*.

In the present study, we use the most common panel unit-root tests, namely the Levine, Lin and Chu (2002), Breitung (2000), Im, Pesaran and Shin (2003) and ADF Fisher-χ^2 tests (Maddala and Wu 1999). The null hypothesis in relation to the above-mentioned four unit root tests is that unit roots do exist in the series; that is, the variables are non-stationary.

If the unit root tests confirm that all variables are integrated of order one, this fulfils the condition of panel cointegration and panel Granger causality tests. In this case, a test to ascertain the long-run relationship among these four sets of variables will be conducted using testing procedures proposed in Pedroni (1999), a test that is widely used in the literature. To test the cointegration relationships among these variables for a panel of countries, the following regression equation is used[10]:

$$PCG_{it} = \alpha_{it} + \beta_{1i}FID_{it} + \beta_{2i}OPE_{it} + \beta_{3i}FDI_{it} + \theta_i t + \varepsilon_{it}, \tag{1}$$

where α_{it} and θ_i are the fixed effects for each country and deterministic trends respectively. The null hypothesis of no cointegration is examined based on seven different panel cointegration test statistics, which includes four individual panel statistics [panel v-statistic, panel ρ-statistic, panel t-statistic (non-parametric) and panel t-statistic (parametric)] and three group statistics [group ρ-statistic, group t-statistic (non-parametric) and group t-statistic (parametric)].

In the case of non-stationary series, error-correction models[11] (ECMs) are used to capture the short-run and long-run dynamics (causal relationship) between the variables. To test if financial sector development, trade openness, and *FDI* 'Granger-cause' economic growth in the short run and long run, the following ECM model is estimated:

$$\begin{aligned}\Delta PCG_{it} = \alpha_{1j} + \sum_{k=1}^{p}\beta_{1ik}\Delta PCG_{it-k} + \sum_{k=1}^{q}\lambda_{1ik}\Delta FID_{it-k} + \sum_{k=1}^{r}\mu_{1ik}\Delta OPE_{it-k} \\ + \sum_{k=1}^{s}\eta_{1ik}\Delta FDI_{it-k} + \delta_{1i}ECT_{it-1} + \varepsilon_{1it}.\end{aligned} \tag{2}$$

To test if economic growth, trade openness and *FDI* 'Granger-cause' financial sector development in the short run and long run, the following ECM model is estimated:

$$\Delta FID_{it} = \alpha_{2j} + \sum_{k=1}^{p} \beta_{2ik} \Delta FID_{it-k} + \sum_{k=1}^{q} \lambda_{2ik} \Delta PCG_{it-k} + \sum_{k=1}^{r} \mu_{2ik} \Delta OPE_{it-k} + \sum_{k=1}^{s} \eta_{2ik} \Delta FDI_{it-k} + \delta_{2i} ECT_{it-1} + \varepsilon_{2it}. \quad (3)$$

To test if economic growth, financial sector development and *FDI* 'Granger-cause' trade openness in the short run and long run, the following ECM model is estimated:

$$\Delta OPE_{it} = \alpha_{3j} + \sum_{k=1}^{p} \beta_{3ik} \Delta OPE_{it-k} + \sum_{k=1}^{q} \lambda_{3ik} \Delta FID_{it-k} + \sum_{k=1}^{r} \mu_{3ik} \Delta PCG_{it-k} + \sum_{k=1}^{s} \eta_{3ik} \Delta FDI_{it-k} + \delta_{3i} ECT_{it-1} + \varepsilon_{3it}. \quad (4)$$

Finally, to test if economic growth, financial sector development and trade openness 'Granger-cause' *FDI* in the short run and long run, the following ECM model is estimated:

$$\Delta FDI_{it} = \alpha_{4j} + \sum_{k=1}^{p} \beta_{4ik} \Delta FDI_{it-k} + \sum_{k=1}^{q} \lambda_{4ik} \Delta OPE_{it-k} + \sum_{k=1}^{r} \mu_{4ik} \Delta FID_{it-k} + \sum_{k=1}^{s} \eta_{4ik} \Delta PCG_{it-k} + \delta_{4i} ECT_{it-1} + \varepsilon_{4it}. \quad (5)$$

where p, q, r and s are the lag lengths for the differenced variables of the respective equations and can be determined by the Engle-Granger approach. The error-correction terms (ECTs) are derived from the long-run equilibrium properties depicted in these equations. The ECTs capture long-run dynamics, while differenced variables represent short-run dynamics between the variables.

For the short-run Granger causal relationships, if the null hypothesis $\lambda_{1ik} = 0$ (or $\lambda_{2ik} = 0$) is rejected, there is Granger causality running from *FID* to *PCG* (or *PCG* to *FID*). Similarly, if the joint null hypothesis $\mu_{1ik} = 0$ (or $\mu_{2ik} = 0$) is rejected, then there is Granger causality from *OPE* to *PCG* (or *FID*). An analogous statement may be made for the η coefficients. For long-run Granger causality, the null hypothesis ($\delta_{1i} = 0$, $\delta_{2i} = 0$, $\delta_{3i} = 0$ and $\delta_{4i} = 0$) needs to be rejected. The above tests can be performed through a Wald test.[12]

We also compute the generalized impulse response functions (GIRFs) for each of the variables, which can trace the effect of a one-off shock in on variable on the other endogenous variables. The GIRF is found to be invariant to the order of the variables in the VECM framework and is a reasonable tool to assess the general validity of the analysis.

In this study, we used the annual data ranging from 1988 to 2013 for 19 *Eurozone*[13] (E-19) countries from the *World Development Indicators* of the World Bank. The countries comprise Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain. These 19 countries were selected for their promising outlooks for investment and future growth within the Eurozone.

Panel data analysis is the most appropriate estimation technique, given the 26-year span of the data. The descriptive statistics and the correlations for our variables are not shown here due to space constraints. The results, which are available from the authors, show significant variability in the variables over the present sample.

4. Results

Table 2 provides the results of the panel unit root tests for each variable. It can be seen that the level values of all series studied here (*PCG*, *FID*, *EXG*, *IMG*, *TTG*, and *FDI*) are non-stationary and they are stationary at the first difference. This implies that all variables are integrated of order one, henceforth denoted by I (1).

Since the unit root tests confirm that all variables are I (1), panel cointegration and panel Granger causality tests can be used to test the relationships between the four variables. The results of the panel cointegration test are shown in Table 3. It can be seen that out of seven statistics we found most of the statistics that are significant at 1% level. Therefore, the null hypothesis of no cointegration can be rejected.

In order to check the robustness of the above results, we use an alternative panel cointegration test to gather additional evidence on the presence of cointegration. Thus, we use the Larsson–Lyhagen–Lothgren (LLL) test developed by Larsson, Lyhagen, and Lothgren (2001). The results of the LLL test which are reported in Table 4 validate our earlier cointegration results.

Since the results of Granger causality tests depend on the lag structure, a comment on the lag specification in our VECM estimation is in order. We choose a combination of lags that minimizes the Akaike Information Criterion (AIC) and the Schwartz–Bayes Information Criterion (SBIC). These criteria are widely used in econometric studies and are commonly accepted. A table detailing the lag specifications is available from the authors on request.

The results of panel Granger causality test are shown in Table 5. It can be seen that when ΔFDI is treated as dependent variable, the lagged ECT_{-1} is statistically significant

Table 2. Panel unit root test statistics.

	Test Statistics											
	Levine, Lin and Chu			Breitung			Im, Pesaran and Shin			ADF- Fischer χ^2		
Variables	LD	FD	IN	LD	FD	IN	LD	FD	IN	LD	FD	IN
PCG	−0.81	−13.0*	I [1]	0.97	−5.66*	I [1]	−0.91	−7.06*	I [1]	38.74	143.9*	I [1]
FID	1.25	−3.82**	I [1]	0.45	−4.19*	I [1]	1.17	−2.03**	I [1]	33.6	62.75*	I [1]
FDI	0.64	−6.83*	I [1]	−0.95	−6.52*	I [1]	−1.03	−6.09*	I [1]	36.8	129.2*	I [1]
EXG	3.17	−9.11*	I [1]	−0.58	−7.99*	I [1]	−1.32	−3.89*	I [1]	40.8	88.1*	I [1]
IMG	3.58	−8.10*	I [1]	2.64	−6.56*	I [1]	0.08	−3.33*	I [1]	28.4	78.2*	I [1]
TTG	8.61	−9.34*	I [1]	−1.02	−8.58*	I [1]	−0.50	−4.07*	I [1]	23.8	91.5*	I [1]

Note 1: PCG is per capita economic growth, FID is financial development, FDI is foreign direct investment, EXG is trade openness for exports-gross domestic product (GDP) ratio, IMG is trade openness for imports-GDP ratio, and TTG is trade openness for total trade (imports plus exports)-GDP ratio.
Note 2: LD stands for level data, FD stands for first difference data, LLC stands for Levine-Lin-Chu test, IPS stands for Im-Pesaran-Shin test, ADF stands for ADF-Fischer Chi-square test, and PP stands for PP-Fischer Chi-square test.
Note 3: * and ** denote statistical significance at the 1% and 5% levels, respectively.
Note 4: I [1] denotes integrated of order one, which is placed in the column IN (which denotes inference).

Table 3. Panel cointegration test statistics.

	Specifications		
Test Statistics	*Specification 1*	*Specification 2*	*Specification 3*
Panel v-statistic	2.13** [0.02]	1.20*** [0.10]	2.07** [0.02]
Panel ρ-statistic	−2.10** [0.02]	−1.50*** [0.10]	−1.88** [0.03]
Panel PP-statistic	−6.96* [0.00]	−4.95* [0.00]	−6.07* [0.00]
Panel ADF-statistic	−7.17* [0.00]	−5.16* [0.00]	−6.30* [0.00]
Group ρ-statistic	−4.16* [0.01]	−4.10* [0.01]	−4.30* [0.01]
Group PP-statistic	−11.3* [0.00]	−9.67* [0.00]	−10.1* [0.00]
Group ADF-statistic	−8.22* [0.00]	−7.16* [0.00]	−7.78* [0.00]

Note 1: Specification 1 considers the causal nexus between *PCG*, *FID, FDI* and *EXG*; Specification 2 considers the causal nexus between *PCG, FID, FDI* and *IMG*; and Specification 3 considers the causal nexus between *PCG, FID, FDI* and *TTG*.
Note 2: PCG is per capita economic growth, FID is financial development, FDI is foreign direct investment, EXG is trade openness for exports-gross domestic product (GDP) ratio, IMG is trade openness for imports-GDP ratio, and TTG is trade openness for total trade (imports plus exports)-GDP ratio.
Note 3: *, **, and *** denote statistical significance at the 1%, 5%, and 10% levels, respectively.
Note 4: Lag length selection is based on SIC statistics.

Table 4. Panel cointegration test statistics based on the LLL test.

	Likelihood Ratio		
Hypotheses	*Specification 1*	*Specification 2*	*Specification 3*
R = 0	253.7*	210.7*	208.5*
R ≤ 1	82.82*	90.36*	79.60*
R ≤ 2	45.57*	50.38*	45.44*
R ≤ 3	35.63	38.20	36.03

Note 1: Specification 1 considers the causal nexus between *PCG*, *FID, FDI* and *EXG*; Specification 2 considers the causal nexus between *PCG, FID, FDI* and *IMG*; and Specification 3 considers the causal nexus between *PCG, FID, FDI* and *TTG*.
Note 2: PCG is per capita economic growth, FID is financial development, FDI is foreign direct investment, EXG is trade openness for exports-gross domestic product (GDP) ratio, IMG is trade openness for imports-GDP ratio, and TTG is trade openness for total trade (imports plus exports)-GDP ratio.
Note 3: LLL denotes the Larsson-Lyhagen-Lothgren test (Larsson, Lyhagen, and Lothgren 2001).
Note 4: * denotes statistical significance at the 1% level.

at the 1% level. This implies that trade openness, financial development, and per capita economic growth Grange-Cause foreign direct investment in the long run. When ΔPCG, ΔFID, or ΔOPE is used as the dependent variable, the ECT_{-1} term is not statistically significant. That implies there are no long-run Granger causal relationships among these variables in these three cases. The estimated lagged ECTs (specifications 1-3) all carry negative signs. This indicates that the change in the level of foreign direct investment rapidly responds to any deviation in the long-run equilibrium (or short-run disequilibrium) for the t-1 period. In other words, the effect of an instantaneous shock to the level of financial development, per capita economic growth, and trade openness on foreign direct investment inflows will be completely adjusted in the long run. The return to equilibrium, however, occurs at different rates: 18% under specification 1, 16% under specification 2, and 17% under specification 3. However, the statistical insignificance of the ECTs suggests that per capita economic growth, trade openness, or financial development do not respond to deviations from the long-run equilibrium. The long-term dynamics between *FID, PCG, OPE* and *FDI* can be summarized in Figure 2.

Table 5. Granger causality test results.

Specifications/ Dependent Variables	Independent Variables				Lagged Error-Correction
Specification 1: VECM with PCG, FID, FDI, and EXG					
	ΔPCG	ΔFID	ΔFDI	ΔEXG	ECT_{-1}
ΔPCG	------	18.0*	4.86**	4.09**	−0.01
	[----]	[0.01]	[0.05]	[0.10]	(−0.91)
ΔFID	15.3*	------	0.99	4.51*	−0.01
	[0.01]	[----]	[0.60]	[0.05]	(−0.74)
ΔFDI	5.17**	1.27	------	2.06	−0.18*
	[0.05]	[0.52]	[----]	[0.35]	(−13.6)
ΔEXG	12.4*	10.6*	1.87	------	−0.01
	[0.01]	[0.01]	[0.39]	[----]	(−0.13)
Specification2: VECM with PCG, FID, FDI, and IMG					
	ΔPCG	ΔFID	ΔFDI	ΔIMG	ECT_{-1}
ΔPCG	------	15.7*	4.63**	0.52	−0.01
	[----]	[0.01]	[0.05]	[0.77]	(−0.85)
ΔFID	13.9*	------	0.72	3.91***	−0.01
	[0.05]	[----]	[0.49]	[0.10]	(−0.52)
ΔFDI	3.32***	1.43	------	0.79	−0.16*
	[0.10]	[0.49]	[----]	[0.67]	(−13.6)
ΔIMG	4.76**	21.9*	2.04	------	−0.01
	[0.05]	[0.01]	[0.36]	[----]	(−0.03)
Specification3: VECM with PCG, FID, FDI, and TTG					
	ΔPCG	ΔFID	ΔFDI	ΔTTG	ECT_{-1}
ΔPCG	------	17.2*	4.69**	1.67	−0.01
	[----]	[0.01]	[0.05]	[0.43]	(−0.87)
ΔFID	14.9*	------	0.86	4.81**	−0.01
	[0.01]	[----]	[0.65]	[0.05]	(−0.63)
ΔFDI	4.25**	1.38	------	1.48	−0.17*
	[0.05]	[0.50]	[----]	[0.47]	(−13.6)
ΔTTG	7.46*	17.9*	2.10	------	−0.01
	[0.01]	[0.01]	[0.35]	[----]	(−0.14)

Note 1: PCG is per capita economic growth, FID is financial development, FDI is foreign direct investment, EXG is trade openness for exports-gross domestic product (GDP) ratio, IMG is trade openness for imports-GDP ratio, and TTG is trade openness for total trade (imports plus exports)-GDP ratio.
Note 2: VECM: vector error-correction model; and ECT_{-1}: lagged error-correction term.
Note 3: Values in square brackets represent probabilities for *F*-statistics.
Note 4: Values in parentheses represent *t*-statistics.
Note 5: The basis for determination of long-run causality lies in the significance of the lagged ECT coefficients.
Note 6: *, **, and *** denote statistical significance at the 1%, 5%, and 10% levels, respectively.

In the short run, we find the existence of bidirectional Granger causality between financial development and per capita economic growth ($FID \leftrightarrow PCG$),[14] foreign direct investment and per capita economic growth ($FDI \leftrightarrow PCG$),[15] trade openness and per capita economic growth ($EXG \leftrightarrow PCG$),[16] and between financial development and trade openness ($FID \leftrightarrow OPE$[17]).[18] Additionally, there is an evidence of unidirectional causality from per capita economic growth to trade openness [($PCG \rightarrow IMG$)[19] and ($PCG \rightarrow TTG$)[20]]. The short-run dynamics between *FID, PGC, FDI* and *OPE* (*EXG, IMG*, or *TTG*) are shown in Figures 3–5.

Overall, the short-run Granger causality test results suggest that trade openness plays a more important role than *FDI* in enhancing per capita economic growth in the Euro-zone countries. This is because trade openness (as measured by *EXG)* has causal links to *PCG* both directly and indirectly through its link with *FID*. Moreover, no matter which

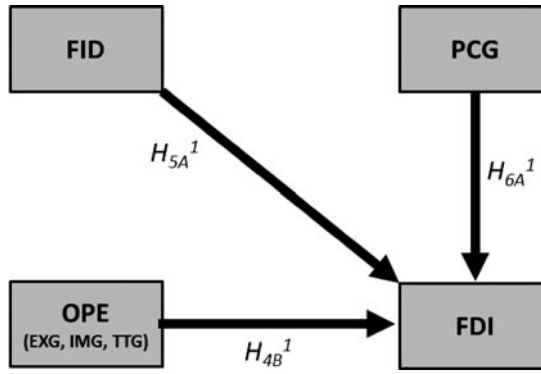

Figure 2. Long-term dynamics between FID, PCG, OPE (EXG, IMG, TTG) and FDI.

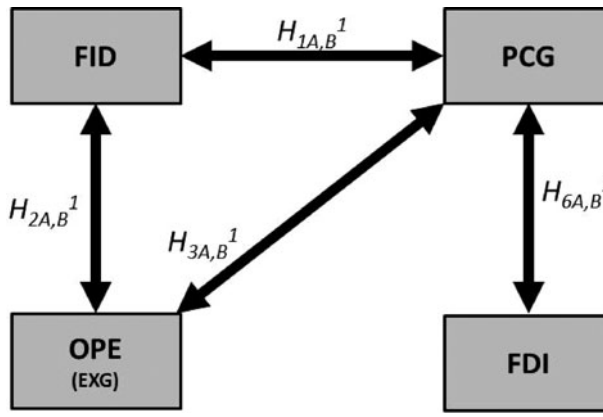

Figure 3. Short-term dynamics between FID, PCG, OPE (EXG) and FDI.

measure of trade openness we use, there is a bidirectional causality between *OPE* and *PCG* through *FID*. Hence, for these countries, trade openness appears to be a key driver of the 'finance-growth nexus' in the short run. This supports the view of Rajan and Zingales (2003) which are of the opinion that policymakers and development institutions should promote trade openness to mute interest groups' resistance to financial development and to generate economic growth. The defining requirement is that financial development always (or at least when an economy is highly open) leads to economic growth (see, *inter alia*, Herwartz and Walle 2014). By contrast, *FDI* has a direct bi-directional causal link with *PCG*, but there are no indirect effects since *FDI* is not causally linked to either *OPE* or *FID* in the short run. This bi-directional causal link ensures that FDI and economic growth drive each other in the developmental process. However, this link may adversely be affected if there is lack of financial development (Alfaro et al. 2004) and trade openness (Herwartz and Walle 2014; Iamsiraroj and Ulubasoglu 2015) in the economy.

The GIRFs were computed for each of the variables and are presented in Figures 6 to 8. Our discussion of the impulse response functions centres on the responses of per capita

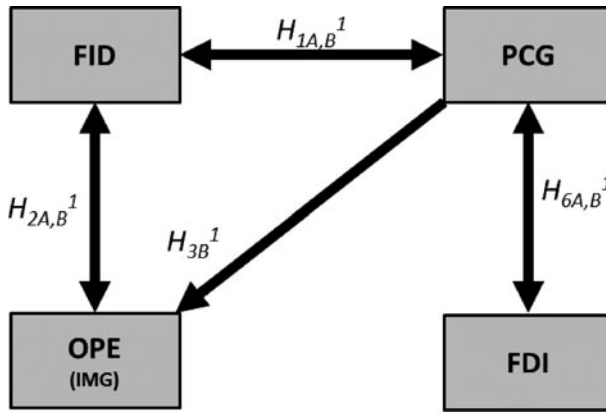

Figure 4. Short-term dynamics between FID, PCG, OPE (IMG) and FDI.

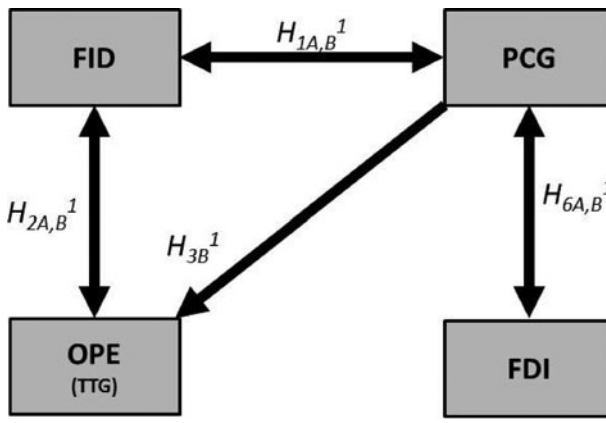

Figure 5. Short-term dynamics between FID, PCG, OPE (TTG) and FDI.

economic growth, financial development, trade openness,[21] and foreign direct investment to their own and other shocks. In particular, the GIRFs indicate how long and to what extent trade openness and foreign direct investment react to changes in finance-growth nexus in the panel of the nineteen Eurozone countries. For comparative analysis, we account the GRIFs to one-standard-error confidence bands (roughly equal to 95% confidence bands).

Figure 6 shows the responses of all the variables to a one standard deviation shock in other variables. In each case, the stock market activity variable is found to display an initial cyclical response to an exogenous shock, albeit in varying degrees. However, the responses of all the variables to exogenous shocks stabilize in approximately 10 years. In Figures 7 and 8, the responses of all variables to an exogenous shock are found to be highly uniform, thereby suggesting that, for finance-growth nexus, the responses of trade openness and foreign direct investment are similar.

In summary, the empirical results show that in the *long run*, financial development, trade openness, and increasing prospects of economic growth in the Eurozone are key sources of foreign direct investment in the region. The *short-run* dynamics between the

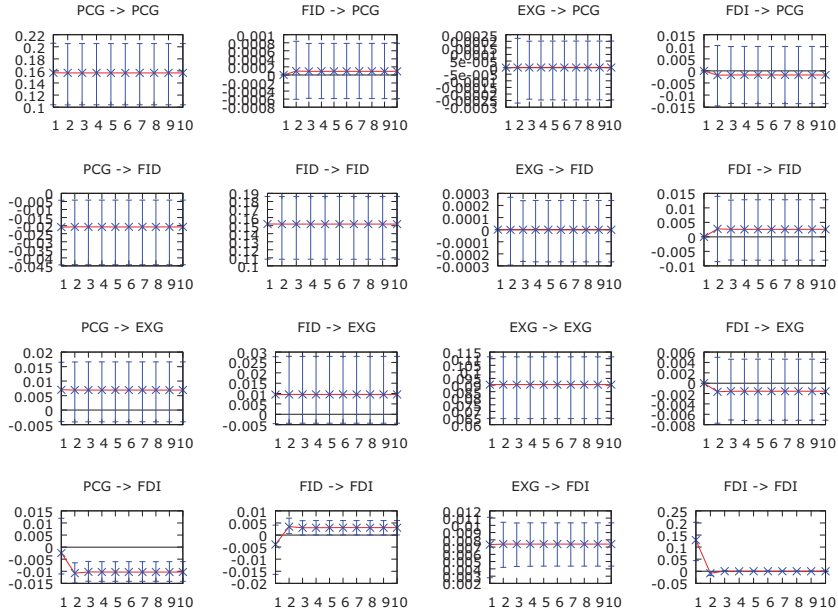

Figure 6. Plot of generalized impulse response functions for the Granger causal relations between per capita economic growth, financial development, trade openness (intensity of exports), and FDI in the nineteen Eurozone countries.
Note: PCG is per capita economic growth, FID is financial development, EXG is trade openness for exports-gross domestic product (GDP) ratio, and FDI is foreign direct investment.

four variables are a little more complex because there are patterns of bi-directional relationships between the following variable: financial development and trade openness (for all three variables – *IMG*, *EXG*, or *TTG*); financial development and economic growth; *FDI* and economic growth; and, trade openness (*EXG*) and economic growth.

Tables 6–8 present a comparative analysis of our findings and the findings of earlier key studies in the literature which have examined the financial development-economic growth nexus, foreign direct investment-economic growth nexus, and trade openness-economic growth nexus, all separately.

5. Conclusions and policy implications

The long-term and short-term dynamics between trade openness, financial sector development, foreign direct investment, and economic growth using the robust empirical framework in this paper suggests that careful implementation of policies pertaining to trade liberalization, financial development, foreign direct investment, and economic growth are necessary for the sustained prosperity of the Eurozone region. These policies and strategies are especially important for countries in the Eurozone that are adversely impacted by lack of confidence in their financial system, and those who face economic uncertainty and sovereign debt crisis. The countries in this predicament include Greece, Portugal, Italy, Ireland, Spain, and Cyprus.

Our empirical results provide evidence that greater economic integration of countries within the Eurozone from 1988 to 2013 in terms of trade, financial development, and

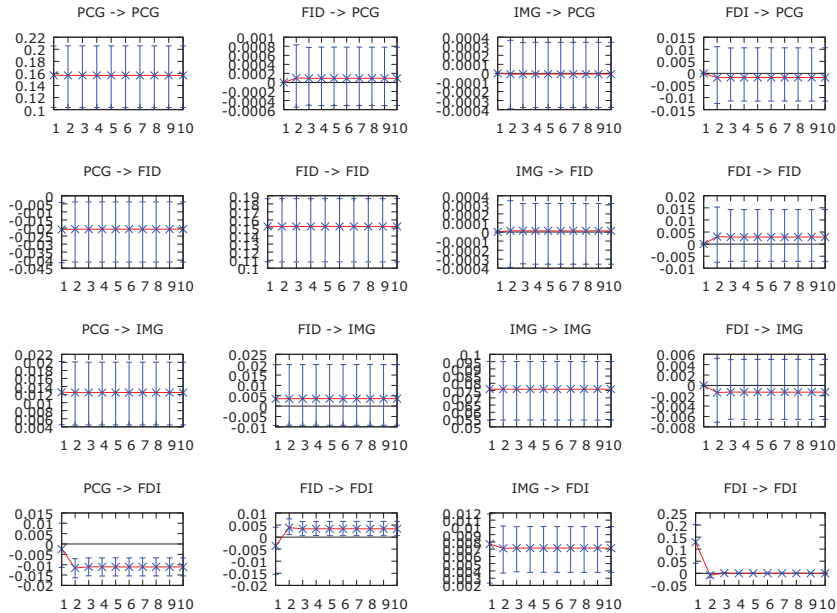

Figure 7. Plot of generalized impulse response functions for the Granger causal relations between per capita economic growth, financial development, trade openness (intensity of imports), and FDI in the nineteen Eurozone countries.
Note: PCG is per capita economic growth, FID is financial development, IMG is trade openness for imports-GDP ratio, and FDI is foreign direct investment.

growth prospects resulted in increased inflow of foreign direct investment within the region in the long run. Increase in foreign direct investment likely resulted in upgrading of physical infrastructure such as roads, ports, information and communication technology, science and technology endeavours, as well as improvements in human capital in the Eurozone region. Relaxation of trade rules in Europe over the sample period also acted as a catalyst in the free flow of FDIs into the region.

The drawbacks of unfettered flows of FDIs in the region, especially in countries with limited productive sectors, likely resulted in several negative spill-over impacts, which include: upward pressure on prices and wages; industries losing their global competitiveness; and increasing current account deficits (Constancio 2013). Slowdown in the global economy and exposure of European banks to the US subprime crisis triggered further panic on the health of the banking sector, sending many of these economies into recession (Constantcio 2013).

As economies in the Eurozone became more integrated, the financial and economic uncertainties in these selected countries reverberated to all other economies in the region even though many of the economies had stronger banking systems and globally competitive industries. During the height of the financial and economic crisis in the Eurozone, FDI inflows declined significantly. A study by UNCTAD shows that FDI inflows into Europe from 2012 to 2014 declined from USD 401 billion to USD 289 billion; while FDI inflows into Asia increased from USD 401 billion to USD 465 billion (UNCTAD 2015). Eurozone was less attractive for investors as compared to Asia, where income levels and productivity in Asia were on an upward trend over the last two decades.

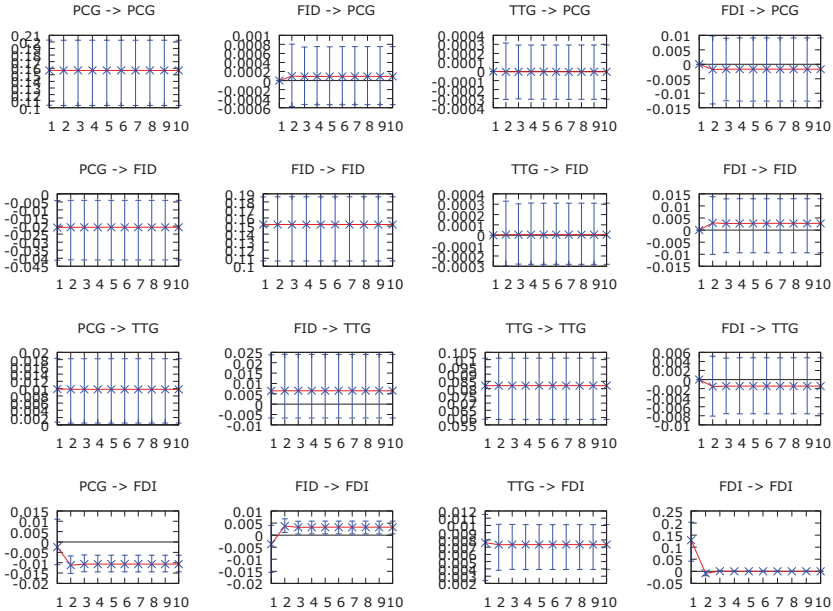

Figure 8. Plot of generalized impulse response functions for the Granger causal relations between per capita economic growth, financial development, trade openness (intensity of total trade), and FDI in the nineteen Eurozone countries.
Note: PCG is per capita economic growth, FID is financial development, TTG is trade openness for total trade (imports plus exports)-GDP ratio, and FDI is foreign direct investment.

The empirical analysis and the discussion presented above suggests that short-term development of Eurozone countries depend on inflow of high quality FDIs that enhance global competitiveness of firms and create high income jobs in the region. Furthermore, for FDI flows to persist in the long term, reforms in the financial system, strategies to stimulate economic growth, and policies to increase international trade should be given careful attention. These initiatives are discussed below.

Among the key initiatives to ensure greater financial stability and development within the region is improving the financial governance in individual member countries. Schoenmaker (2011) shows that Eurozone member countries have suffered from 'financial trilemma' – where financial stability, financial integration, and national financial policies often did not synchronize. In the context of Europe, under a centrally managed currency, the governance of national policies and financial regulations of local institutions were the responsibilities of the national governments in the Eurozone. Many of the countries did not have adequate financial measures and instruments to curb the rapid inflow of capital, which made its way into unproductive sectors, causing systemic risks to the banking sector and the financial system in these countries.

To mitigate this risk, more effective and sophisticated financial instruments are needed to ensure regulators and banks undertake and pass stress tests on the financial health of banks and financial institutions on a regular basis. These include measuring the non-performing loans (NPLs) of banks and risk profile of banks that are likely to breach the prescribed NPL threshold. Banks that are likely to breach the NPL threshold or are under financial stress should be put under a major restructuring plan to get

Table 6. Comparing our findings with those of previous studies on the link between financial development and economic growth.

Countries	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Our Findings
Austria	DFH						SLH				
Belgium	DFH, FBH	SLH									
Cyprus											
Estonia											
Finland	SLH						SLH				
France	DFH										
Germany	DFH										
Greece	FBH		DFH								
Ireland	DFH										
Italy	DFH, SLH										
Latvia											
Lithuania											
Luxembourg											
Malta											
Netherland	FBH										
Portugal											
Slovakia											
Slovenia											
Spain	DFH, SLH						SLH				
Panel				FBH	FBH	SLH		SLH	SLH	FBH	
EU – as a group											FBH[a,b,c]

Note 1: SLH: supply-leading hypothesis, indicating the presence of unidirectional causality from financial development to economic growth; DFH: Demand-following hypothesis, indicating the presence of unidirectional causality from economic growth to financial development; FBH: Feedback hypothesis, indicating the presence of bidirectional causality between financial development and economic growth; and NLH: Neutrality hypothesis, indicating the absence of Granger causality between financial development and economic growth.
Note 2: S1: Peia and Roszbach (2015); S2: Nieuwerburgh, Buelens, and Cuyvers (2006); S3: Dritsaki and Dritsaki-Bargiota (2005); S4: Pradhan et al. (2014C); S5: Lee and Chang (2009); S6: Calderon and Liu (2003); S7: Panopoulou (2009); S8: Bangake and Eggoh (2011); S9: Wu, Hou, and Cheng (2010); and S10: Chow and Fung (2011).
Note 3: 'a' denotes using exports-gross domestic product (GDP) ratio, 'b' denotes using imports-GDP ratio, and 'c' denotes using total trade-GDP ratio.
Note 4: We use trade and foreign direct investment simultaneously as additional variables in our study.

them back on an optimal performance trajectory. The restructuring plan should also include provisions to smoothly wind down the operations of banks through carefully orchestrated mergers and acquisition plans with stronger financial institutions within the Eurozone.

Competitiveness of the Eurozone countries in attracting high quality FDIs is not only dependent on financial stability in member countries in the region, but also the ability of the member countries in stimulating economic growth through raising the productivity of local firms and the labour force. Intense competitions from major industrial hubs in the Asia-Pacific region and other developing countries over the years have eroded the competitiveness of firms in many of the Eurozone countries. This is clearly evidenced by the shift of global FDI flows from Eurozone countries to the Asia-Pacific region as reported in UNCTAD (2015) and discussed above. To regain their competitive edge, strategies to raise the scientific and technological endeavours of firms in the Eurozone region should be intensified. Strong investment in research and development activities and support for small and medium-size enterprises to adopt the new scientific and technological discoveries will go a long way in raising the productivity and innovative capacity of industries in the Eurozone region.

Table 7. Comparing our findings with those of previous studies on the link between foreign direct investment and economic growth.

Countries	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Our Findings
Austria											
Belgium											
Cyprus											
Estonia									DFH		
Finland											
France										DFH	
Germany		FBH									
Greece											
Ireland											
Italy											
Latvia									DFH		
Lithuania									FBH		
Luxembourg											
Malta											
Netherland										DFH	
Portugal											
Slovakia									FBH		
Slovenia									DFH		
Spain											
Panel	FBH		DFH	SLH	SLH	SLH	SLH	SLH			
EU – as a group											FBH[a,b,c]

Note 1: SLH: supply-leading hypothesis, indicating the presence of unidirectional causality from foreign direct investment to economic growth; DFH: Demand-following hypothesis, indicating the presence of unidirectional causality from economic growth to foreign direct investment; FBH: Feedback hypothesis, indicating the presence of bidirectional causality between foreign direct investment and economic growth; and NLH: Neutrality hypothesis, indicating the absence of Granger causality between foreign direct investment and economic growth.
Note 2: S1: Herzer, Klasen, and Nowak-Lehmann (2008); S2: Herzer (2012); S3: Choe (2003); S4: Ahmed, Cheng, and Messinis (2011); S5: Pradhan, Arvin, and Norman (2014d); S6: Moudatsou and Kyrkilis (2011); S7: Moudatsou (2003); S8: Apergis, Lyroudi, and Vamvakidis (2008); S9: Varamini and Kalash (2010); and S10: Qi (2007).
Note 3: 'a' denotes using exports-gross domestic product (GDP) ratio, 'b' denotes using imports-GDP ratio, and 'c' denotes using total trade-GDP ratio.
Note 4: We use trade and financial development simultaneously as additional variables in our study.

Cross-border collaborations between countries within the region should also be encouraged, where countries with a strong competitive edge such as Germany, could assist ailing industries within the Eurozone to keep pace with rapid technological developments that are transforming industries around the globe. A case in point is German policy-makers and industries assisting firms in the Eurozone adopting the *Industry 4.0 Framework* to cope with converging technological and industrial platforms. This new framework, also known as 'Smart Manufacturing Industry' incorporate state-of-the-art innovations in cyber-physical systems, embedded systems, internet of things (IoT), internet of People (IoP), and cloud computing that enable industries to increase their productivity and pursue economies of scale and scope (MacDougall 2014).

The *Industry 4.0 Framework* is being led by the German Government to transform the local manufacturing industry into a globally competitive industry which could facilitate among other things: seamless communication between machines, devices and people via IoT and IoP; use of virtual world for better access to and transparency of information; machines undertaking tasks that are extremely complex, dangerous and hazardous; and development of intelligent machines that make decisions autonomously (Hermann,

Table 8. Comparing our findings with those of previous studies on the link between trade openness and economic growth.

Countries	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Our Findings
Austria											
Belgium										SLH[a,b]	
Cyprus											
Estonia											
Finland									FBH[a]		
France											
Germany						SLH[a]					
Greece											
Ireland											
Italy							SLH[a,b]			SLH[a,b]	
Latvia											
Lithuania											
Luxembourg											
Malta										SLH[a,b]	
Netherland											
Portugal								DFH[a]		[,b]	
Slovakia											
Slovenia											
Spain											
Panel	FBH[a]	SLH[a]	SLH[a]	SLH[a]	SLH[c]						
EU – as a group											FBH[a], DFH[b, c]

Note 1: SLH: supply-leading hypothesis, indicating the presence of unidirectional causality from trade openness to economic growth; DFH: Demand-following hypothesis, indicating the presence of unidirectional causality from economic growth to trade openness; FBH: Feedback hypothesis, indicating the presence of bidirectional causality between trade openness and economic growth; and NLH: Neutrality hypothesis, indicating the absence of Granger causality between trade openness and economic growth.
Note 2: S1: Konya (2006); S2: Weber (2011); S3: Anwar and Sampath (2000); S4: Riezman, Summers, and Whiteman (1996); and S5: Naveed and Shabbir (2006); S6: Marin (1992); S7: Pistoresi and Rinaldi (2012); S8: Oxley (1993); S9: Hatemi-J and Irandoust (2000); and S10: Riezman et al. (1996).
Note 3: 'a' denotes using exports-gross domestic product (GDP) ratio, 'b' denotes using imports-GDP ratio, and 'c' denotes using total trade-GDP ratio.
Note 4: We use financial development and foreign direct investment simultaneously as additional variables in our study.

Pentek, and Otto 2016). Greater diffusion of *Industry 4.0 Framework* across the Eurozone countries will enhance global competitiveness of the industries in the region.

The above initiatives can be further coupled with extending and deepening trade within the Eurozone through the following initiatives: greater investment in talent development within the region; attracting the best talent and firms from other regions to relocate in the Eurozone and use it as a 'test bed' for new path-breaking discoveries that will spur new sources of growth and industries; ensuring the regulations are business friendly, including competitive tax policies and favourable union-employer partnership and cooperation; and intensifying free trade agreements and outward foreign investments in high growth regions such as ASEAN and the Asia-Pacific region. The latter initiative will enhance the reach of firms from the Eurozone to vital global supply chain, resources, talent and markets in these highly dynamic regions of the world, where income levels and innovations are increasing at a fast pace. The economic linkages with regions that are vibrant and dynamic will become an important vehicle for knowledge and technology transfer, improving productivity and competitiveness of firms in the Eurozone. It has will open new employment opportunities and contribute to further inflows of foreign direct investment to the region.

In summary, increasing trade, financial sector development, and economic growth will likely result in increased investment in physical, human, and knowledge capital across the Eurozone in the long run through additional foreign direct investment inflows. It is easy to conjecture such elevated inflows will act as a catalyst for sustained economic prosperity in years to come if appropriate financial regulations, economic growth strategies, and international trade policies are in place at the central and national levels in the Eurozone.

Notes

1. Financial development refers to a process that marks improvements in the quantity, quality, and efficiency of financial intermediary services (Chaiechi 2012). A country's financial system includes the banking sector, stock markets, insurance markets, bond markets, and derivative markets. In this paper, the financial sector development is represented by developments in the banking sector and the stock market.
2. A robust financial system helps channel savings into productive investment; enables firms and individuals to undertake inter-temporal optimization of the assets and investments; assist in mitigate risks and provide adequate capital for the functioning of an efficient dynamic economy.
3. The composition of finance matters for long-term growth (Cournède, Denk, and Hoeller 2015).
4. Patrick (1966) posits two alternative hypotheses for the possible causal relationships between financial development and economic growth: supply-leading (the causality runs from financial development to economic growth only), and demand-following (the causality runs from economic growth to financial development).
5. Note that economic growth has also been linked to a number of other variables (e.g. broadband penetration, degree of urbanization, transportation intensity, etc.) which we do not study in this paper (see, for instance, Arvin and Pradhan 2014 and Arvin, Pradhan, and Neville 2015 for discussion). That is, the intent of our paper is not to look at *all* the variables that have been linked to economic growth.
6. Trade openness in some of these studies includes both trade and foreign direct investment inflows.
7. All the monetary variables in our analysis, including gross domestic product, are measured in *real* US dollars. Gross domestic product hereafter is denoted by GDP.
8. See, for instance, Pradhan et al. (2014a, 2014c) for a detailed explanation of this procedure.
9. A macroeconomic profile of these countries based on human development index, GDP, exports, imports, foreign direct investment, banking sector size, stock market size, and population size is available from the authors. According to Eurostat in Eurozone, the average annual GDP growth rate over the period 2002-2012 was approximately 0.95% in real terms, but there were years of high growth and years of stagnation or recession. In particular, the growth rate of GDP was approximately 3.2% in 2006, -4.5% in 2009, -0.28% in 2013, and 0.87% in 2014. In addition, over this period, Slovakia (4.55%) and Latvia (4.16%) had the highest GDP growth rate, while Greece, Italy and Portugal have the lowest GDP growth rate with an average rate of -0.06%, 0.00% and 0.05% respectively. The trends of foreign direct investment, trade openness and financial development also show similar variations within the Eurozone countries (see, for instance, Pegkas 2015; Wild, 2015).
10. Similar regression equations may be written for each of the other variables acting as the dependent variables. These are not shown for the sake of brevity.
11. The ECM framework is appealing because it allows for the determination of the direction of causation among trade openness, foreign direct investment, financial development, and per capita economic growth. While providing estimates on both short-run and long-run causal patterns (see, for instance, Awokuse 2005).
12. Dolado and Lütkepohl (1996) provide a detailed discussion of this test.
13. Eurozone is a subset of those European Union member states that have fully incorporated the *euro* as their common national currency.
14. This is consistent with the findings of Asghar and Hussain (2014), Iyare and Moore (2011), Pradhan, Arvin, and Bahmani (2015a), and Pradhan et al. (2014a, 2014b).
15. This is in line with the findings of Lee (2010), Lee and Tan (2006), Lu et al. (2009), and Nasser (2010).

16. This is consistent with the findings of Pradhan et al. (2015b) and Tang and Ravin (2013).
17. *OPE* is used for *EXG, IMG*, or *TTG* – as commented earlier.
18. This is similar with the findings of Asghar and Hussain (2014), Lee and Chang (2009), and Pradhan et al. (2015a).
19. This is consistent with the findings of Pistoresi and Rinaldi (2012) and Shahbaz (2012).
20. This is congruent with the findings of Awokuse (2006) and Pradhan et al. (2015b).
21. In common with the rest of this paper, trade openness is considered at three levels: exports, imports and total trade.

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