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Determinants of the link between financial and economic development: Evidence from a functional coefficient model

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ABSTRACT

Noting that "one size does not fit all" in the case of the finance–development (FD) relationship, a growing body of literature has recently focused on uncovering economic conditions under which financial development could be beneficial (detrimental) to economic development. We look into these conditions by means of a flexible semiparametric approach that allows the long-run FD link to depend on measurable economic factors. Using annual data for 73 economies spanning the period 1975–2011, we find that the impact of finance on economic development is generally stronger in high-income than low-income economies. However, allowing for intra-group variations reveals the importance of other factor variables in explaining the FD link. For instance, increasing financial development strengthens the FD link while increasing government size weakens it. Moreover, the FD link could even be negative if low- and lower-middle-income economies have very large governments or are extremely open to international trade.

1. Introduction

The importance of services and instruments of the financial system to the real economic sector has been recognized in the literature at least since Schumpeter (1911). However, there are economists who argue that finance does not matter to economic development. According to this view, either the financial system passively responds to the demand arising from the real sector and not vice versa (Robinson, 1952), or there is not at all a meaningful relationship between financial and economic development (Lucas, 1988). The intensive research on the link between financial and economic development in the last two decades has documented mixed results.[1]

Empirical studies on the relationship between financial and economic development mostly follow either of the following two research directions. The first group of studies attempt to test whether financial development matters for economic development—independent of an eventual reverse causal impact (e.g. King and Levine, 1993; Levine et al., 2000). While such studies try to immunize estimations of the impact of finance on development from potential biases induced by reverse causation from economic to financial development, they generally neither test the presence nor estimate the strength of this reverse causation. Often using cointegration and Granger causality tests, the second group of studies, however, explicitly examine the direction of causality between financial and economic development (e.g. Ang and McKibbin, 2007; Demetriades and Hussein, 1996). As an extension of the first research avenue, a growing body of literature has recently attempted to investigate underlying measurable economic conditions (henceforth factors) which might determine *the impact of finance on economic development* (henceforth the finance–development (FD) nexus/link/relationship).[2] These studies raise a question of substantive policy relevance: under what conditions is financial development

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[1] For instance, a significantly positive impact of financial development on economic development is documented in Christopoulos and Tsionas (2004), King and Levine (1993) and Levine et al. (2000). However, there are also studies which report that it is economic development which leads to financial development (Ang and McKibbin, 2007). In addition, a few studies have diagnosed a negligible impact of finance on economic development (Andersen and Tarp, 2003). See Levine (2005) and Ang (2008a) for extensive surveys of the theoretical and empirical literature on the relationship between financial and economic development.

[2] The two groups of studies use the phrase "FD nexus/link/relationship" with slightly different meanings. In the first group, as in this study, it means "the impact of finance on economic development". In the second group, however, it more broadly refers to "the (causal) relationship between financial and economic development". Similarly, the term "growth" is often used in the literature together with, or instead of, "development" even when it does not refer to the "rate of change" of income. In particular, studies focusing on the long-run FD relationship (e.g. Christopoulos and Tsionas, 2004; Demetriades and Hussein, 1996) use the level of real GDP per capita to measure economic "growth" or "development". It should be noted, however, that empirically distinguishing between "growth effects" and "level effects" of growth determinants is both complicated and less important as we are eventually concerned with improvements in welfare levels (Temple, 2000). Nevertheless, since the dependent variable in this study is GDP per capita, we prefer to use the term "development" instead of "growth". We thank an anonymous referee for encouraging us to deviate from the literature in this regard.

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beneficial (detrimental) to economic development, i.e., are there complementary policies that should be in place for a positive FD relationship? (Yilmazkuday, 2011). This question has been addressed either by estimating the FD relationship for different economies grouped according to certain economic criteria (Rioja and Valev, 2004), or by applying threshold regressions (Ketteni et al., 2007; Yilmazkuday, 2011). To date, the levels of economic and financial development, government size, inflation and openness to trade have been suggested to have an impact on the FD nexus (Rioja and Valev, 2004; Rousseau and Wachtel, 2002; Rousseau and Yilmazkuday, 2009; Yilmazkuday, 2011). However, contrasting evidence has emerged with regard to the direction and strength of the factors' impact on the FD nexus. For instance, three studies have associated the highest positive FD nexus with three distinct stages of economic development: low (Huang and Lin, 2009), medium (Yilmazkuday, 2011) and high (Deidda and Fattouh, 2002). Moreover, existing studies have not uncovered economic conditions which could lead to a negative FD relationship as observed by Xu (2000).

The aim of this study is to re-examine if, and to what extent, the impact of finance on economic development depends on the level of economic development, financial development, government size, trade openness, financial openness and the rate of inflation of an economy. To this end, we start with common dynamic OLS models (Saikkonnen, 1991; Stock and Watson, 1993) regressing GDP per capita on financial development and other control variables. Subsequently, we employ a functional coefficient model (Cai et al., 2000; Herwartz and Xu, 2009). In this model, the parameter attached to financial development, which is our measure of the FD nexus, is allowed to depend on one of the above-mentioned potential factor variables. This approach has two important advantages over rival methods like threshold regressions or the use of interaction terms. First, using the global factor invariance test of Herwartz and Xu (2009), it is possible to formally test whether the factors under consideration significantly determine the FD nexus. Second, this approach yields clearer pictures of the sign and magnitude of the considered factor's impact on the FD nexus. Although a somewhat similar analysis is possible with threshold regressions, for example as in Yilmazkuday (2011), this however comes at a cost of estimating the FD nexus on a rolling window of a small segment of the available data. Moreover, threshold regressions impose a rather strong linear FD relationship within estimation windows. The functional coefficient modeling approach, on the other hand, utilizes full sample information and relaxes the linearity assumption in the spirit of nonparametric kernel estimation.

In addition to the use of a flexible semiparametric approach, the present study differs from related works in three further aspects. Firstly, most studies, including Ketteni et al. (2007), Rioja and Valev (2004) and Yilmazkuday (2011), convert annual time series to five-year averages to immunize empirical results against the effects of business cycle fluctuations. The problems of averaging data, however, have not gone unnoticed in the literature. For example, Ang (2008a) argues that averaging may induce a new type of correlation between time-averaged variables which could markedly differ from the correlation between non-averaged series. Besides, averaging obviously entails a significant (80%) reduction of the sample (Baltagi et al., 2009). In this study, we employ (non-averaged) annual data for 73 economies spanning the period 1975–2011. Secondly, recent studies have shown that financial openness has a significantly positive impact on both economic development (Bekaert et al., 2011) and financial development (Baltagi et al., 2009). This suggests a positive effect of financial openness on the FD nexus. However, financial openness may replace financial development in terms of key growth-promoting roles, for instance, the provision of risk diversification (Obstfeld, 1994). As a consequence, financial openness might also exert a negative impact on the FD link. In light of conflicting economic reasoning, thus, we empirically assess the net impact of financial openness on the FD link. Thirdly, to allow for heterogeneous impacts of the factors on the FD nexus across income groups, we estimate distinct semiparametric models for low-, lower-middle-, upper-middle- and high-income economies.

To preview some results, the average FD link is found to be positive and to increase across income groups. Yet, there are significant variations within each income group. For instance, increasing financial development appears to strengthen the FD nexus while increasing government size generally weakens it. On the other hand, a negative FD nexus is diagnosed in low-income and lower-middle-income economies if the government size is very large or if these economies are highly open to international trade. Finally, the average FD nexus initially increases with the average level of financial openness, reaches a maximum in the lower-middle financial openness category and substantially declines thereafter. In sum, the FD nexus is found to depend on the levels of economic development, financial development, government size, trade openness and financial openness, but not on the rate of inflation.

Section 2 reviews briefly the literature on the factors behind the FD relationship. Section 3 describes the data and sketches both the parametric and functional coefficient models. Section 4 discusses empirical results. Section 5 concludes. Some technical issues of functional coefficient modeling are addressed in Appendix A, and lists of economies in each income group are provided in Appendix B.

2. Literature review

In this section, we briefly review the theoretical and empirical literature on the factors underlying the FD relationship. Several factors have been suggested in the literature to affect this relationship. We discuss each potential determinant in turn.

2.1. Level of economic development

The debate on the possible dependence of the FD link on the level of economic development can be traced back to Patrick (1966) who conjectures that finance leads to economic development at earlier stages of economic development while economic development induces financial development at later stages. The view that financial development is more beneficial to less developed economies is also shared by Fry (1995) and McKinnon (1973). However, Deidda (2006) and Greenwood and Jovanovic (1990) argue that minimum size requirements or huge startup and maintenance costs necessitate a certain critical level of economic development before financial development may foster economic development. In view of these conflicting conjectures, it is not uncommon to find studies estimating the FD nexus for distinct samples of high-income and low-income economies. The results are mixed, however. A cross-sectional study by De Gregorio and Guidotti (1995) shows that the FD link is stronger in low-income economies in comparison with high-income economies. These findings are supported by recent evidence from panel data based threshold analysis in Huang and Lin (2009). On the contrary, based on economy-specific Granger causality tests, Xu (2000) reports a weaker, and for some economies a negative, causality from financial to economic development in low-income economies. Similarly, Deidda and Fattouh (2002) and Hassan et al. (2011) have obtained a significantly positive FD nexus for high-income economies and a negligible FD relationship for low-income economies. On the other hand, Yilmazkuday (2011) finds that economies need to have a per capita income of $665 (in constant 1995 U.S. dollars) in order to benefit from financial development and the benefits start declining once the income level reaches $1636.

2.2. Level of financial development

Rioja and Valev (2004) have examined if the level of financial development impacts on the FD relationship. They find that a certain threshold level of financial development is required for a meaningful FD nexus. This is attributed to economies of scale that financial

intermediaries could enjoy in agglomerating savings and financing high-return investments. Yet, they have also diagnosed the FD nexus to be smaller in economies with a very high level of financial development than in economies with a medium level of financial development. This is supposed to imply the existence of diminishing marginal returns to i mprovements in the financial sector. However, Ketteni et al. (2007) have questioned the robustness of the findings in Rioja and Valev (2004) arguing that the likely nonlinear relationship between economic development and other growth determinants, i.e. initial income and human capital, have been ignored in Rioja and Valev (2004).

2.3. Level of inflation

A few studies have also shown that financial development leads to economic development only when the level of inflation is low (Huang et al., 2010; Rousseau and Wachtel, 2002; Rousseau and Yilmazkuday, 2009; Yilmazkuday, 2011). This is argued to be a result of the growth-damaging effects of inflation. Inflation is believed to have a negative impact on economic development because it is usually associated with increased variations in relative prices, which in turn are considered to impact adversely on long-term investments (Temple, 2000; Yilmazkuday, 2011).

2.4. Government size

A potential determinant of the FD link that has not attracted much attention yet is government size. Yilmazkuday (2011) finds that low-income economies benefit from financial development when they have large governments. This indicates that certain types of government expenditures (like on securing property rights, national defense and the legal system) are important for a growth-enhancing financial system. Meanwhile, high-income economies are found to achieve a comparably strong FD link only if they are characterized by relatively small government sizes. These results are attributed to the possibility that the private sector might be crowded out by the government.

2.5. Degree of openness to international trade

Yilmazkuday (2011) has also considered trade openness as a possible factor to affect the FD relationship. He finds that trade openness strengthens the FD link in low-income economies, but its effect is minimal in high-income economies. He argues that increased access to low-cost intermediate inputs, large and high-income markets, and technologies benefits open low-income economies. However, the FD link in high-income economies is less affected by trade openness as those economies have their own large domestic markets. Instead, higher financial development coupled with high trade and financial openness might lead to higher vulnerability to international shocks.

In sum, there appears to be a broad consensus that the FD relationship is factor dependent. However, the empirical evidence has been often inconclusive in terms of both the sign and magnitude of the effects of each factor on the FD relationship. In reexamining this issue, we conjecture that considering the middle-income categories might solve some of the contradictory results and uncover new important dependencies. We also use a data-driven semiparametric approach that does not impose a linear relationship between finance and economic development within estimation windows. Moreover, as argued before, we introduce financial openness as a new potential determinant of the link between financial and economic development.

3. Data and methodology

3.1. Data

To investigate factors that determine the FD nexus, we construct panel data sets comprising 73 economies for the period 1975–2011. The economies are selected with regard to data availability for a sufficiently long time period. As a broad concept involving improvements in the quality and quantity of various financial intermediary services, measuring financial development is difficult. We use the arguably most common measure, namely, credit by deposit money banks and other financial institutions to the non-financial private sector as a percentage of GDP (PRV). This measure excludes credit to public institutions and credit issued by the central bank. As a result, it measures the activity of financial intermediaries in channeling savings to investors. Consequently, it is argued to be more closely associated with the impact of financial development on investment and economic development than other measures like the percentage of monetary aggregates M2 or M3 in GDP (De Gregorio and Guidotti, 1995; Levine et al., 2000). Following standard practice in the FD nexus literature (e.g. Apergis et al., 2007; Christopoulos and Tsionas, 2004; Demetriades and Hussein, 1996), economic development is measured in terms of real GDP per capita (GDPPC). As a consequence, our estimation results should be interpreted as level—and not growth—effects of financial development on economic development. Government size is approximated in terms of government consumption expenditure as a percentage of GDP (GOV).[3] Due to several missing values in the data for inflation implied by the Consumer Price Index, we instead use the growth rate of the GDP deflator (INF). Trade openness is measured as the percentage of imports plus exports in GDP (OPEN). Finally, we employ Chinn and Ito's (2008) financial openness measure, which they call KAOPEN ('KA' stands for capital account). KAOPEN is derived as the first principal component of the reverse of four dummy variables that indicate major restrictions on cross-border capital transactions as reported in the Annual Report on Exchange Arrangements and Exchange Restrictions of the IMF.

Regarding data sources, PRV is obtained from the April 2013 update of the *Financial Development and Structure Dataset* of Beck et al. (2000)[4] while KAOPEN is taken from the April 2013 update of the *Chinn-Ito Index* (Chinn and Ito, 2008)[5]. The remaining time series are drawn from World Development Indicators.[6]

To get deeper insights into each factor's effects on the FD link across stages of economic development, we categorize the 73 economies into four income groups by their latest (2011) income level according to the World Bank's contemporary classification criteria.[7] In particular, economies whose latest real per capita GDP (in constant 2000 US Dollar) fall in the ranges less than 1025, 1026–4035, 4036–12275, and over 12476 are classified as low-income (15 economies), lower-middle-income (18), upper-middle-income (15) and high-income (25), respectively.[8] The list of economies included in each sample is provided in Appendix B. The low-income category includes 11 Sub-Saharan African economies plus India, Nepal, Pakistan and Papua New Guinea while the high-income group adds Bahamas, Cyprus and Singapore to 22 OECD economies. The remaining 14 Latin American economies

[3] Considering government investment would likely provide valuable insights on the impact of government expenditure on the FD nexus. However, this is not possible due to lack of data.

[4] Available at http://www.go.worldbank.org/X23UD9QUX0.

[5] Available at http://www.web.pdx.edu/~ito/Chinn-Ito_website.htm.

[6] Available at http://www.data.worldbank.org. Accessed on May 6, 2013.

[7] Available at http://www.data.worldbank.org/about/country-classifications/a-short-history.

[8] The debate on the FD relationship mainly concerns the question if financial development fosters economic development in a given economy. Therefore, studies on the FD nexus often measure economic development by either the level or growth rate of GDP—and not Gross National Income (GNI)—per capita. Accordingly, to study the FD nexus across stages of economic development, we classify economies based on their GDP per capita. However, the World Bank classifies economies based on their GNI per capita. Noting that economy-specific quotes of GNI per capita and GDP per capita may differ markedly, there are 18 economies which we group differently from the World Bank. However, if we classified economies into two, with low- and lower-middle-income economies in the first and upper-middle- and high-income economies in the second group, we would classify only five economies differently than the World Bank.

considered in this study are evenly divided into lower (7)- and upper (7)-middle-income economies.

As an alternative means of classifying sample information, we categorize economies into four groups with respect to their average level of KAOPEN. Additionally, we subdivide each cross section into two subperiods, 1975–1989 and 1990–2011 to test recent findings by Rousseau and Wachtel (2011) that the FD nexus is weakening over time.

Table 1 shows some descriptive statistics of the data covering the full-sample period. It provides the means, minimum and maximum values and standard deviations for the different cross sections. It can be seen that the data set is characterized by considerable variations within/between cross sections. The mean of the financial development measure PRV increases with the stage of economic development. Similarly, both average PRV and average per capita income (GDPPC) increase across stages of financial openness. The table also documents how economies in a certain category of financial openness are distributed over the income groups. In particular, each income group takes the largest share of economies in the corresponding financial openness category. For instance, low-income economies predominate the low-KAOPEN category.

3.2. Methodology

3.2.1. The parametric model: dynamic OLS

To uncover economic conditions behind the FD relationship, we mainly rely on the functional coefficient modeling approach (Cai et al., 2000; Herwartz and Xu, 2009). As we will show later, this semiparametric method is essentially a weighted parametric regression, with the weights depending on the local position of a particular observation with respect to a certain factor variable. However, we first consider parametric FD nexus estimates so that we can later easily analyze how functional estimates deviate from those of the benchmark parametric model. The discussion of parametric results also facilitates comparability of our findings with related studies. As we classify economies with regard to their income level (financial openness), differences in the parametric FD link estimates could also hint at the impact of economic development (financial openness) on the FD link. In particular, performing parametric regressions across stages of financial openness appears to be the most feasible way of investigating the impact of financial openness on the FD nexus as the measure KAOPEN—being an index derived from four dummy variables—has poor scale properties which make it difficult to treat it as a factor in functional coefficient modeling. We employ a standard panel dynamic OLS (DOLS) approach, where we regress GDP per capita on financial development and a few control variables (Ang, 2008b; Apergis et al., 2007; Christopoulos and Tsionas, 2004). A key feature of the DOLS regression is that the explanatory variables in levels are augmented with the lags and leads of their first differences (Saikkonnen, 1991; Stock and Watson, 1993). The augmentation by leads, in addition to lags, is instrumental in allowing the regressors to be endogenous. Consequently, the DOLS estimator has attracted several applications in the FD literature, where it is often difficult to rule out a potential reverse causality from economic to financial development. Formally, the model reads as

$$y_{it} = x_{it}'\beta + z_{it}'\gamma + u_{it}, \quad t = 1, \ldots, T, \quad i = 1, \ldots, N, \tag{1}$$

Table 1
Summary statistics, 1975–2011.

Variable	Mean	Max	Min	Std	Co.Var.	Mean	Max	Min	Std	Co.Var.
	World, 73 economies									
GDPPC	8304.5	41904.2	128.3	9684.4	1.17					
PRV	50.1	288.1	1.4	44.5	0.89					
GOV	16.1	43.4	3.2	6.0	0.37					
OPEN	76.4	460.5	6.3	49.7	0.65					
KAOPEN	19.8	12338.7	−26.6	279.0	14.07					
INF	0.2	2.4	−1.9	1.5	7.35					
	Low-income economies, 15					Low-KAOPEN economies, 18 (10, 4, 3, 1)				
GDPPC	392.4	1091.2	128.3	191.9	0.49	2160.1	21809.3	128.3	4234.6	1.96
PRV	18.2	51.1	1.4	9.3	0.51	27.1	149.8	1.4	24.1	0.89
GOV	14.3	39.8	4.8	6.5	0.46	13.9	39.8	3.2	6.1	0.44
OPEN	60.4	209.9	6.3	37.4	0.62	64.2	209.9	6.3	38.5	0.60
KAOPEN	11.7	159.3	−12.3	15.9	1.36	14.1	159.3	−12.3	18.8	1.33
INF	−0.9	1.4	−1.9	0.6	−0.72	−1.1	2.2	−1.9	0.6	−0.52
	Lower-middle-income economies, 18					Lower-middle-KAOPEN economies, 18 (5, 8, 2, 3)				
GDPPC	1560.2	3825.1	373.5	643.9	0.41	4016.2	38185.3	143.6	6809.2	1.70
PRV	33.7	165.8	1.5	28.6	0.85	42.0	288.1	2.5	42.9	1.02
GOV	13.9	38.5	5.0	4.9	0.35	14.8	33.6	5.7	4.7	0.32
OPEN	73.5	202.8	23.7	33.5	0.46	85.2	202.8	26.6	36.5	0.43
KAOPEN	47.7	12338.7	−23.5	560.3	11.75	8.4	77.3	−20.8	8.9	1.05
INF	−0.3	2.4	−1.9	1.3	−4.34	−0.4	2.4	−1.9	1.0	−2.34
	Upper-middle-income economies, 15					Upper-middle-KAOPEN economies, 18 (0, 6, 8, 4)				
GDPPC	5140.6	16181.6	785.9	2813.8	0.55	5828.4	22859.1	785.9	5202.6	0.89
PRV	40.5	193.5	2.5	32.1	0.79	43.3	211.1	2.1	35.3	0.82
GOV	14.9	35.2	3.2	5.6	0.37	15.6	43.4	5.0	6.3	0.40
OPEN	86.2	220.4	9.1	41.8	0.49	72.0	220.4	16.5	35.4	0.49
KAOPEN	15.8	139.7	−26.6	21.9	1.38	51.6	12338.7	−26.6	560.5	10.87
INF	0.2	2.4	−1.9	1.5	6.65	0.5	2.4	−1.9	1.5	2.83
	High-income economies, 25					High-KAOPEN economies, 19 (0, 0, 2, 17)				
GDPPC	19806.1	41904.2	2595.1	7756.1	0.39	20534.0	41904.2	4450.5	8081.8	0.39
PRV	86.9	288.1	13.6	48.1	0.55	86.2	262.8	3.7	47.1	0.55
GOV	19.5	43.4	8.2	4.9	0.25	20.0	35.2	8.2	4.6	0.23
OPEN	82.1	460.5	15.9	65.3	0.80	83.6	460.5	15.9	73.2	0.88
KAOPEN	7.1	390.7	−7.6	19.0	2.67	6.0	106.8	−21.0	11.4	1.90
INF	1.2	2.4	−1.9	1.4	1.15	1.8	2.4	−1.9	1.0	0.55

Notes: Full definitions of the variables and data sources are given in the text. Except GDPPC and KAOPEN, all variables are measured as percentage values. Max, min, std and Co.Var. represent maximum, minimum, standard deviation and coefficient of variation (i.e. std/mean), respectively. Entries next to the number of economies in each financial openness category denote, respectively, the number of low-income, lower-middle-income, upper-middle-income and high-income economies that belong to the corresponding financial openness category.

where $y_{it} = GDPPC_{it}$, $x_{it} = (PRV_{it}, GOV_{it}, OPEN_{it}, INF_{it})'$, and z_{it} collects fixed effects and lags and leads of first differences of the explanatory variables and $u_{it} \sim iid(0,\sigma_u^2)$ is the error term.[9] Accordingly, $\beta = \left(\beta_1, \beta_2, \beta_3, \beta_4'\right)$ while γ contains the parameters attached to the fixed effects and short-run dynamics. To allow for heterogeneous (economy-specific) intercepts[10] and short-run coefficients, we partial out z_{it}' from Eq. (1). To this end, we denote matrices collecting observations in y_{it}, $\mathbf{x}_{it}$ and z_{it} for economy i by Y_i, $\mathbf{X}_i$ and $\mathbf{Z}_i$, respectively, and henceforth consider the partial system

$$\widetilde{y}_{it} = \widetilde{x}_{it}'\beta + \widetilde{u}_{it}, \tag{2}$$

where $\widetilde{y}_{it}, \widetilde{x}_{it}$ and $\widetilde{u}_{it}$ are typical elements of, respectively, $\widetilde{Y}_i = M_i Y_i$, $\widetilde{X}_i = M_i X_i$ and $\widetilde{u}_i = M_i u_i$; $M_i = I - Z_i\left(Z_i'Z_i\right)^{-1}Z_i'$; and I denotes the $(T \times T)$ identity matrix. Applying OLS estimation in Eq. (2) yields DOLS estimates of the long run impacts of the explanatory variables on GDP per capita.

3.2.2. The semiparametric model

We now briefly outline the functional coefficient model that allows the long-run parameters in Eq. (1) to depend on economic factors. Issues of estimation and inference within the functional coefficient model are deferred to Appendix A. We begin by denoting a factor variable, for instance, the degree of trade openness, by ω_{it}. The full list of factors that we actually employ is provided in Section 4.2. As we are interested in the factor dependence of the long-run parameters, we presume that all the short-run parameters and the deterministic terms collected in γ are factor invariant. Thus, we generalize Eq. (2) towards a functional coefficient model, which reads as

$$\widetilde{y}_{it} = \widetilde{x}_{it}'\beta(\omega_{it}) + \widetilde{u}_{it}, \quad \omega_{it} = \{\sigma_t(\widetilde{\omega})\}^{-1}(\widetilde{\omega}_{it} - \overline{\omega}_t), \tag{3}$$

where $\overline{\omega}_t = N^{-1}\sum_{i=1}^{N}\widetilde{\omega}_{it}$ and $\sigma_t(\widetilde{\omega})$ are the time-specific cross-sectional mean and standard deviation of the factor observations $\widetilde{\omega}_{it}$, respectively. Eq. (3) allows the relation between economic development and its long-run determinants to depend on the measurable economic factor ω_{it}.

As outlined in Appendix A, kernel-based estimates of the semiparametric model can be interpreted as weighted pooled regression estimates, where the weights attached to particular observations $\{\widetilde{y}_{it}, \widetilde{x}_{it}\}$ depend on the time local position of the factor in the cross section of time series. As we are interested only in the functional dependence of the FD nexus, our discussion is restricted to $\hat{\beta}_1(\omega_{it})$. Respective functional estimates $\hat{\beta}_1(\omega_{it})$ can be displayed graphically. Since we have standardized the factor, ω_{it} takes values between -2 and 2 for about 95% of the data points, say. Thus, exploring how $\hat{\beta}_1$ responds to changes in ω_{it} could proceed by means of the following grid:

$$\hat{\beta}_1(\omega), \quad \omega = -2 + 0.1\kappa, \kappa = 0, 1, 2, \ldots, 40. \tag{4}$$

Hence, estimates $\hat{\beta}_1(\omega)$ reflect the effect of attaching relatively high kernel weights to economies which are above ($\omega > 0$), close to ($\omega = 0$) or below ($\omega < 0$) the factor's average time path. It is worthwhile noting here that a particular factor enters estimation as a regressor explaining economic development and as a factor behind the impact of all the regressors on GDP per capita. Therefore, our method is somehow similar to parametric regressions that include an interaction term between financial development and the factor variable. However, the latter approach, unlike ours, assumes a constant impact of the factor on the FD nexus. As it will turn out later, this assumption is quite restrictive.

4. Empirical results

4.1. Parametric estimates

Results from estimating the parametric model in Eq. (2) are documented in Table 2. Results from the full-period samples (Panel 1) demonstrate a statistically and economically significant positive long-run impact of financial development on economic development. This positive impact is in line with much of the empirical finance and development literature (see Levine, 2005, for a broad survey). Furthermore, the estimated coefficients are the larger the higher is the income level of the subsamples. In particular, the FD estimate (i.e. the coefficient attached to PRV) for high-income economies is almost three times larger than that for low-income economies. This underpins the dependence of the FD nexus on the income level. However, the estimated FD nexus shows little increment from upper-middle-income to high-income economies, suggesting the presence of a threshold level of income above which finance may not have an increasing impact on economic development.

The right hand side of Table 2 indicates that economies with the smallest or largest degree of financial openness benefit the least from financial development. On the contrary, economies with moderate levels of financial openness display the strongest impact of financial development on economic development. The negative impact of very high financial openness on the FD nexus could be explained by noting that both financial development and financial openness might serve the same beneficial roles to economic development. For example, providing risk diversification and hence increasing the probability of investment in high-risk, high expected-return projects is generally considered as an important function ascribed to both financial development (Greenwood and Jovanovic, 1990; Levine, 2005) and financial openness (Bekaert et al., 2011; Obstfeld, 1994).

On the other hand, dividing the samples into two periods (Panels 2 and 3 of Table 2) reveals that, in contrast to the findings in Rousseau and Wachtel (2011), not all cross sections are characterized by a weaker FD nexus in the recent than the earlier period. It is only in lower-middle income, high-income, and high-financial openness economies that we find the FD link to weaken over time. The result in high-income economies might be explained by noting that the financial development occurring outside the banking sector, which is not be captured by PRV, makes up a large and growing share of the overall financial development in those economies.

Table 2 also documents some model diagnostics with respect to the presence of serial correlation and unit roots in the residuals as well as poolability tests. In most cross sections, we obtain satisfactory results for all the three diagnostic tests. Specifically, in all cross sections, the null hypothesis of a panel unit root using the diagnostics of Levin et al. (2002) and Breitung (2000) is rejected. Thus, at the panel level the performed DOLS regression does not suffer from spurious dependence. Poolability test results also indicate that the pooled regression estimates are not systematically different from mean group estimates for most cross sections. Thus, after allowing for fixed effects and cross-section-specific transitory dynamics, pooling is not overly restrictive to uncover the long-run determinants of per capita income. Mitigating this overall evidence slightly, however, results from high-financial openness economies show a failure to satisfy the poolability restrictions, in both the full-period and the first sub-period. Therefore, a fair degree of caution should be given in interpreting the corresponding FD estimates. Finally, at the 5% level of significance, the null hypothesis of no first order serial correlation is rejected for about 67% of the economies, a large proportion of which are middle-income economies. Nevertheless, we refrain from model respecification for two reasons. First, serial correlation diagnostics improve if we use more than one lag of the first differences in the

[9] Estimation results are qualitatively unaffected by consideration of higher lag and lead orders.

[10] Essentially, we are estimating a fixed effects model. Generally favoring the fixed effects model over the random effects model, Hausman (1978) test results that are not reported here for space considerations suggest rejection of the null hypothesis in all but upper-middle-income and upper-KAOPEN economies.

Table 2
Parametric regression results.

Variables	Cross sections								
	Low income	Lower-middle	Upper-middle	High income	Low KAOPEN	Lower-middle	Upper-middle	High KAOPEN	World
Panel 1: 1975–2011									
PRV	0.099*	0.133*	0.266*	0.268*	0.139*	0.360*	0.204*	0.167*	0.229*
	(0.023)	(0.020)	(0.034)	(0.018)	(0.021)	(0.024)	(0.026)	(0.014)	(0.012)
GOV	0.077*	−0.329*	−0.162*	−0.093	−0.054	−0.030	−0.301*	−0.541*	−0.125*
	(0.040)	(0.057)	(0.082)	(0.098)	(0.045)	(0.059)	(0.062)	(0.114)	(0.030)
OPEN	0.263*	0.381*	0.223*	0.480*	0.204*	0.168*	0.312*	0.658*	0.283*
	(0.051)	(0.035)	(0.057)	(0.044)	(0.045)	(0.042)	(0.040)	(0.048)	(0.024)
INF	−0.161	−0.048	−0.264*	−0.559*	−0.463*	−0.451*	−0.063	−0.675*	−0.137*
	(0.169)	(0.022)	(0.099)	(0.087)	(0.151)	(0.206)	(0.026)	(0.094)	(0.029)
Serial corr.	46.667	55.556	80.000	80.000	44.444	66.667	77.778	78.947	67.123
Poolability	8.415	4.794	7.637	7.813	0.660	2.671	7.263	10.788*	7.073
Levin–Lin–Chu	−2.778*	−3.040*	−3.693*	−2.932*	−3.499*	−3.164*	−3.824*	−3.366*	−4.494*
Breitung	−3.460*	−4.008*	−2.851*	−4.398*	−3.911*	−3.646*	−3.693*	−4.145*	−5.520*
Observations	510	612	510	850	612	612	612	646	2482
Panel 2: 1975–1989									
PRV	0.030	0.167*	−0.050	0.283*	0.009	0.281*	0.073	0.190*	0.164*
	(0.038)	(0.040)	(0.067)	(0.031)	(0.030)	(0.040)	(0.053)	(0.022)	(0.020)
GOV	0.194*	−0.283*	−0.059	−0.066	0.122*	−0.005	−0.076	−0.801*	−0.057
	(0.046)	(0.096)	(0.095)	(0.148)	(0.052)	(0.094)	(0.103)	(0.152)	(0.047)
OPEN	0.128*	0.252*	0.349*	0.479*	0.175*	0.242*	0.353*	0.597*	0.275*
	(0.061)	(0.059)	(0.074)	(0.081)	(0.043)	(0.073)	(0.069)	(0.084)	(0.034)
INF	−0.218	−0.091*	−0.445*	−0.293*	−0.536*	−0.345	−0.110*	−0.497*	−0.145*
	(0.205)	(0.028)	(0.130)	(0.107)	(0.211)	(0.227)	(0.034)	(0.166)	(0.037)
Serial corr.	20.000	33.333	33.333	24.000	22.222	33.333	38.889	15.789	27.397
Poolability	4.597	1.885	2.356	13.993*	3.564	1.860	5.898	17.719*	10.556*
Levin–Lin–Chu	−2.118*	−2.266*	−2.673*	−2.601*	−2.236*	−2.416*	−2.445*	−2.223*	−2.948*
Breitung	−2.640*	−2.088*	−2.919*	−2.790*	−2.172*	−2.476*	−2.694*	−2.179*	−3.081*
Observations	195	234	195	325	234	234	234	247	949
Panel 3: 1990–2011									
PRV	0.147*	0.137*	0.332*	0.250*	0.169*	0.318*	0.261*	0.174*	0.234*
	(0.024)	(0.019)	(0.041)	(0.023)	(0.027)	(0.025)	(0.035)	(0.024)	(0.015)
GOV	−0.066	−0.280*	−0.017	−0.235*	−0.112*	−0.013	−0.314*	−0.348*	−0.123*
	(0.048)	(0.052)	(0.088)	(0.092)	(0.059)	(0.049)	(0.078)	(0.122)	(0.035)
OPEN	0.290*	0.444*	0.063	0.417*	0.212*	0.162*	0.364*	0.544*	0.289*
	(0.058)	(0.040)	(0.085)	(0.048)	(0.060)	(0.054)	(0.062)	(0.054)	(0.031)
INF	−0.242	−0.024	−0.310*	−0.689*	−0.437*	−0.526*	0.031	−0.421*	−0.075*
	(0.166)	(0.021)	(0.111)	(0.156)	(0.143)	(0.227)	(0.029)	(0.074)	(0.030)
Serial corr.	53.333	27.778	53.333	60.000	38.889	44.444	50.000	63.158	49.315
Poolability	6.268	4.410	9.018	4.691	1.834	1.568	12.679*	5.405	8.337
Levin–Lin–Chu	−3.254*	−3.023*	−3.402*	−3.350*	−3.245*	−3.265*	−3.154*	−2.905*	−3.876*
Breitung	−3.391*	−3.862*	−3.582*	−3.535*	−3.715*	−4.290*	−2.530*	−3.895*	−5.080*
Observations	315	378	315	525	378	378	378	399	1533

Notes: The dependent variable is GDPPC. The model includes a constant, and contemporaneous as well as one lag and lead of the first differences of the explanatory variables. Apart from INF, which enters the regression as log(1 + (INF/100)), all variables are in logarithmic form. The values provided in parentheses are estimated White (heteroskedasticity-robust) standard errors. The asterisk (*) denotes significance at the 5% level. Reported numbers of the serial correlation tests of Breusch (1978) and Godfrey (1978) represent percentages of economy specific regressions where tests indicate rejections of the null hypothesis of no first order serial correlation with 5% significance. Entries corresponding to Levin–Lin–Chu and Breitung are obtained by applying homogeneous panel unit root tests of Levin et al. (2002) and Breitung (2000), respectively, on the pooled residuals. Both tests have a null hypothesis that the residuals contain unit roots. The null hypothesis of the employed poolability test is that reported long-run parameter estimates are not systematically different from mean group estimates. The total number of observations reported for each sub sample refers to the data set after the first-differenced lags and leads are partialled out, and hence is less than what we could have in static regressions.

DOLS regression while higher order transitory dynamics leave the evaluation of the FD link qualitatively unaffected. Similarly, excluding data beyond the onset of the recent financial crises (2007–2011) could substantially reduce the number of economy-specific regressions with residual serial correlations, but would yield results that are qualitatively similar to those reported here. Second, eventual residual correlation does not invalidate consistency of the long-run DOLS parameter estimates.

4.2. Functional coefficient estimates

The parametric results documented in Section 4.1 have demonstrated that the FD link depends on the level of income and financial openness. In this section, we employ more flexible semiparametric tools to examine the dependence of the FD nexus with respect to four further factors. Potential factor variables are mainly selected in light of the related literature (Rioja and Valev, 2004; Yilmazkuday, 2011). They include the level of the government size (GOV), financial development (PRV), openness to international trade (OPEN), and inflation (INF).

To test if the FD nexus is dependent on a particular factor, we apply the factor based bootstrap approach proposed in Herwartz and Xu (2009). A brief discussion of the tests is provided in Appendix A. We first look at the global factor-invariance test results and then discuss the factor-dependent FD nexus with respect to local parametric estimation. The conventional 5% significance level is used to decide if a given factor has a statistically significant impact on the FD nexus.

The global factor-invariance test results documented in the upper panel of Table 3 show that the null hypothesis of a constant FD nexus can be rejected if we use government size, financial development or

Table 3
Global factor invariance test results.

Factor	Period	Low income	Lower middle	Upper middle	High income	World
p-Values						
GOV	1975–2011	0.001	0.000	0.000	0.000	0.000
	1975–1989	0.614	0.000	0.040	0.000	0.166
	1990–2011	0.000	0.049	0.000	0.000	0.000
PRV	1975–2011	0.010	0.000	0.012	0.000	0.000
	1975–1989	0.000	0.013	0.284	0.000	0.000
	1990–2011	0.723	0.000	0.000	0.036	0.000
OPEN	1975–2011	0.000	0.000	0.000	0.000	0.000
	1975–1989	0.000	0.000	0.000	0.000	0.000
	1990–2011	0.000	0.000	0.000	0.000	0.000
INF	1975–2011	0.153	0.151	0.001	0.035	0.000
	1975–1989	0.312	0.681	0.371	0.481	0.046
	1990–2011	0.128	0.170	0.000	0.016	0.000
Residual sum of squares						
GOV	1975–2011	8.358	10.182	14.594	12.119	53.996
	1975–1989	4.022	4.977	6.644	4.900	25.738
	1990–2011	3.860	5.034	7.342	6.343	27.457
PRV	1975–2011	8.477	10.459	17.319	13.622	52.148
	1975–1989	3.281	5.251	7.144	5.512	24.505
	1990–2011	4.511	4.827	8.699	7.049	26.854
OPEN	1975–2011	7.665	10.250	14.455	12.686	50.660
	1975–1989	3.435	4.746	5.391	5.905	23.546
	1990–2011	3.945	4.724	8.147	6.400	26.297
INF	1975–2011	8.563	10.767	16.665	14.160	53.477
	1975–1989	3.917	5.636	7.144	7.101	25.333
	1990–2011	4.353	5.060	8.642	6.854	27.521

Notes: Apart from INF, which entered as $\log(1 + (\mathrm{INF}/100))$, all variables are used in logarithmic forms. Reported numbers in the upper panel are (bootstrap) *p*-values and those in the lower panel are the respective residual sums of squares of the functional coefficient model. The null hypothesis of the global factor invariance test (Herwartz and Xu, 2009) is that the FD nexus is invariant with respect to the factor under consideration. As performing the test on Eq. (2) amounts to testing the overall dependence of the four long-run variables on the factor under consideration, testing here is performed after partialing out all the long-run variables except PRV from the pooled regression. The number of bootstrap replications is 1000.

trade openness as a factor variable. As it turns out, inflation fails to be a significant determinant of the FD link in low- and lower-middle income economies. Moreover, our unreported results that are available upon request indicate that the FD nexus does not show a clear dependence on inflation, even in upper-middle- and high-income economies. Consequently, we will not treat inflation as a factor in the ensuing discussions of the local FD nexus dependencies.

The lower panel of Table 3 reports the residual sum of squares (RSS)[11] of the functional coefficient model, which might give insights on the relative importance of the factors under consideration. The results generally suggest that openness and government expenditure are important determinants of the FD nexus. Complementing the global factor invariance test results, largest RSSs—and hence least impacts—are obtained when inflation is used as a factor behind the FD relationship in all the considered cross sections except the comprehensive sample.

4.2.1. Government size

Fig. 1 depicts the estimated functional FD nexus obtained by employing government size as a factor variable. The functional estimates displayed in Fig. 1 show that in low-income and high-income economies the FD link weakens with increasing government size. More importantly, we obtain a negative FD nexus in low- and lower-middle-income economies with large government sizes. This result supports the conjecture by Xu (2000) that a high degree of government regulation could be the reason for the negative FD nexus he found in low income economies. In upper-middle-income economies, a medium government size appears to be favorable for a stronger FD relationship while economies with very small or very large governments tend to lose the growth-promoting effects of financial development. This is in accordance with findings in Yilmazkuday (2011). These results likely underscore the importance of certain types of government expenditure like on securing property rights, national defense and the legal system that facilitate the efficient functioning of the financial sector. Yet, the fact that the FD nexus becomes low when the size of the government is large hints at the prevalence of excessive government regulations in such economies. In high-income (OECD) economies, governments are relatively larger (see Table 1), and strong legal systems that enforce property rights and financial contracts are already in place. As a result, additional government consumption mainly crowds out the private sector. This may reduce the efficiency in the utilization of the funds channeled to the private sector (PRV), and, hence, weaken the FD link. In line with this reasoning, functional estimates in the fourth column of Fig. 1 show that in high-income economies small governments are associated with a very strong FD link and increasing government size weakens the FD relationship. Additionally, the second and the third rows of Fig. 1 illustrate that the functional dependence of the FD nexus on the government size remains largely similar in the two subperiods. If any, large government sizes in upper-middle-income economies are associated with a negative FD nexus in the first period, casting additional doubt on the benefit of having large governments even in those economies.

4.2.2. Financial development

The estimated functional dependence of the FD nexus with respect to the level of financial development is depicted in Fig. 2. It can be seen that low-income economies with high level of financial development show a relatively strong FD relationship. Except in upper-middle-income economies, there is a generally increasing FD nexus for additional degrees of financial development, most likely because the scale of the growth-enhancing functions of the financial sector (Levine, 2005) increases as the financial system develops. For example, the financial sector has to reach a certain threshold of development before it could agglomerate savings that are large enough to finance indivisible, high return, investments (Rioja and Valev, 2004). The functioning of risk diversification and high-return project identification (Rioja and Valev, 2004) also requires a relatively high level of financial development.

Our unreported results that are available upon request show that the hump-shaped relationship between the level of financial development and the FD nexus in upper-middle-income economies displayed in Fig. 2 could not be observed if we restricted the data to 2006. Therefore, we interpret this finding as an indication that the recent financial crisis might have led to the commencement of diminishing marginal returns to financial development in those economies. Finally, splitting full-period cross sections into two obtains that most of the functional relations discussed above prevail in both subperiods.

4.2.3. Openness to trade

The results depicted in Fig. 3 indicate that the impact of trade openness on the FD nexus varies across stages of economic development. In low- and lower-middle-income economies, a moderate level of trade openness stimulates the FD nexus, but extreme openness could lead to a negative FD relationship. Except the negative FD link, the hump-shaped relationship between trade openness and the FD nexus corroborates the results reported in Yilmazkuday (2011). The negative FD nexus might highlight the failure of domestic firms in extremely open low- and lower-middle-income economies to withstand foreign

[11] Using the sum of squared prediction errors from a leave-one-out cross validation estimation obtains results that are qualitatively similar to those reported here and are available upon request.

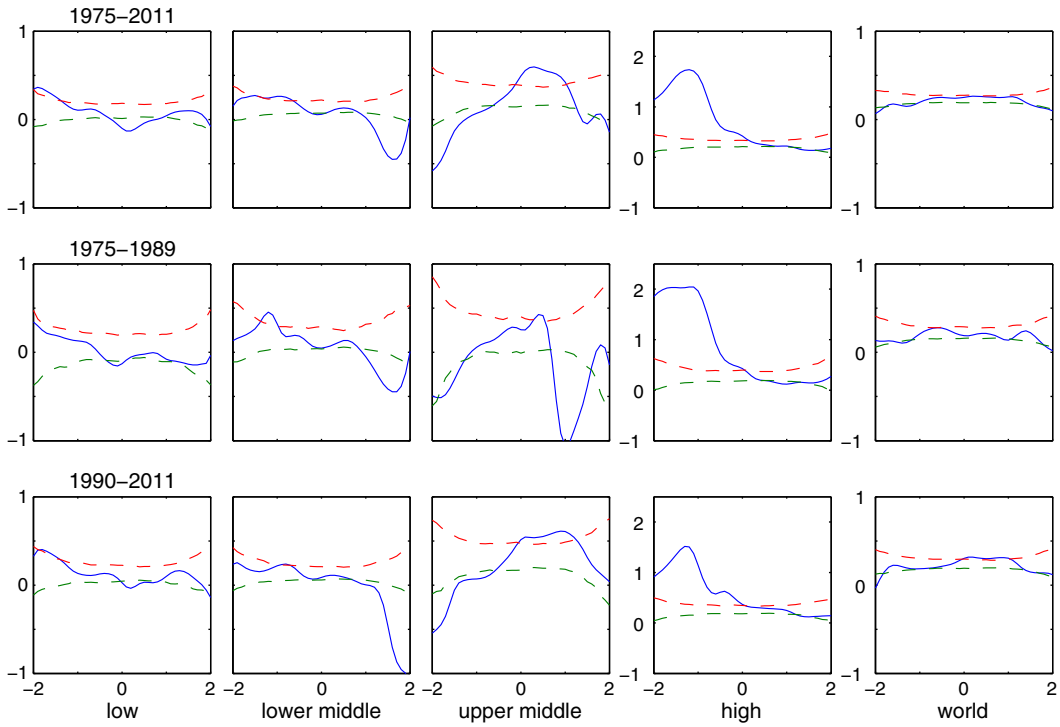

Fig. 1. Functional coefficient model estimates of the FD nexus conditional on the level of government size (GOV). The figures show estimated long-run effects $\hat{\beta}_1(\omega)$, with $\hat{\beta}_1$ on the vertical and ω on the horizontal axes. The solid line shows the point estimates and the two dashed lines are the 95% confidence intervals of the model excluding functional dependence. Hence, at a given value of ω, say -1, if $\hat{\beta}_1$ lies out of the two dashed lines, then we say that the FD nexus is locally dependent on the factor under consideration, in this case GOV. The vertical axes for the graphs in the columns 1, 2, 3 and 5 are of similar scale (i.e., between -1 and 1) while those of column 5 are scaled differently, between -1 and 2.5.

competition. In contrast, upper-middle-income economies show a marked FD link when they are highly open to trade. This might be because of the better utilization of credits by firms in those economies when they are given access to broader international markets and/or when they face strong competition of foreign firms. However, we do not observe any clear pattern for the impact of openness on the FD

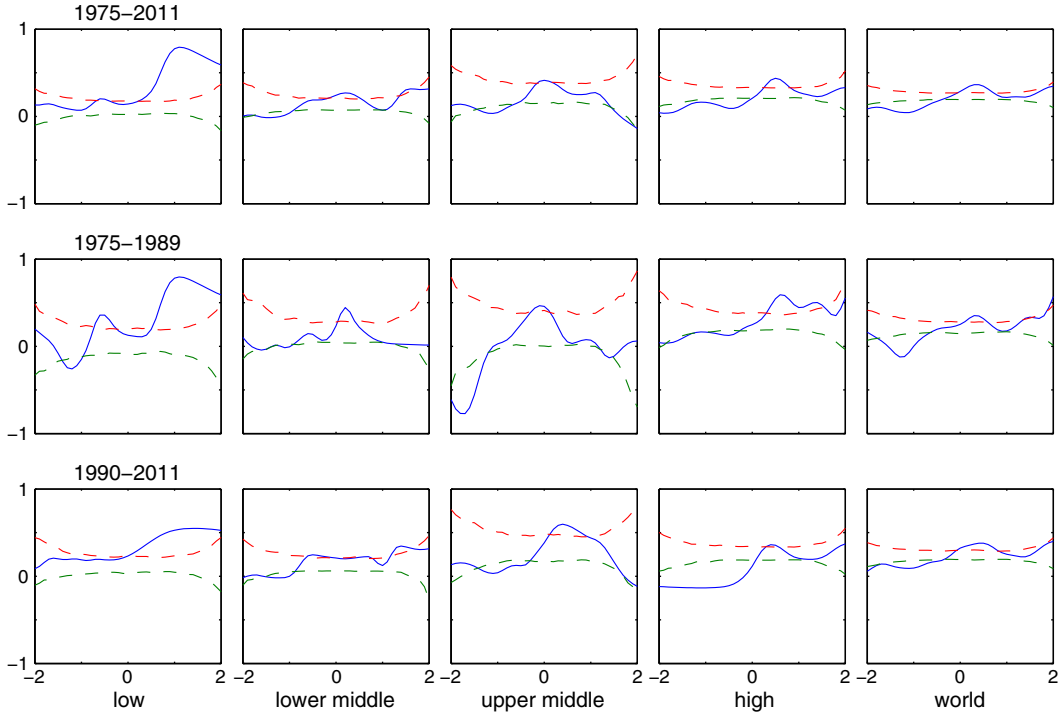

Fig. 2. Functional coefficient model estimates of the FD nexus conditional on the level financial development (PRV). For further notes, see Fig. 1.

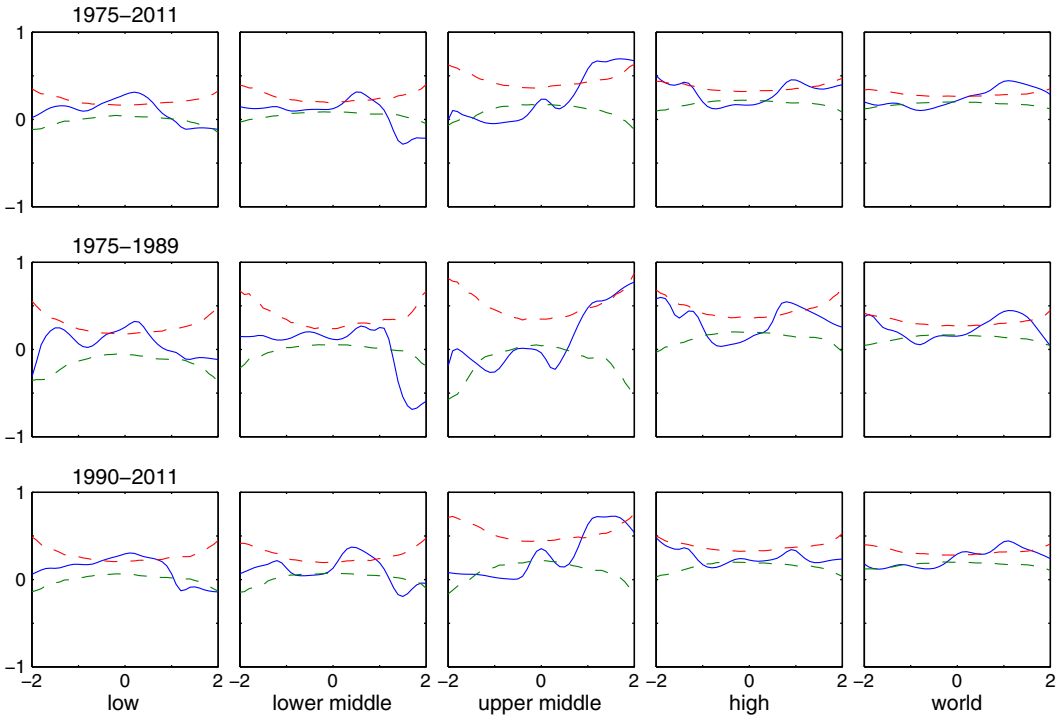

Fig. 3. Functional coefficient model estimates of the FD nexus conditional on the levels of trade openness (OPEN). For further notes, see Fig. 1.

nexus in high-income economies. Furthermore, subperiod estimation results are qualitatively similar to the full-period estimates.

5. Conclusions

We investigate economic factors underlying the FD nexus by means of semiparametric functional coefficient models on a data set comprising 73 economies over the period 1975–2011. We find that the FD link is dependent on an economy's level of economic and financial development, government size, trade openness and financial openness. However, the dependence of the FD link on the level of inflation is weak. Moreover, the effects of the economic factors on the FD link are diagnosed to be variant across distinct stages of economic development.

We find the average FD link to be positive and to increase across income groups. In particular, low-income economies obtain the least benefit from financial development while high-income economies enjoy almost three times as much benefit. Similarly, financial development has a generally positive effect on the FD nexus, with the strongest FD link observed in low-income economies with a high level financial development. There are also cases where financial development could have an adverse effect on economic development. This is observed in low- and lower-middle-income economies when they have very large governments or are extremely open to international trade. The impact of openness to trade on the FD relationship varies between lower-middle- and upper-middle-income economies. Upper-middle-income economies show a pronounced FD nexus when they are highly open to international trade. Yet, only a moderate level of trade openness is beneficial to lower-middle-income economies and being extremely open is found to induce a negative FD relationship. Finally, increasing financial openness strengthens the FD nexus to some extent, but very high levels of financial openness significantly weaken the FD nexus.

These results have three important policy implications. First, given that larger growth-promoting benefits of financial development are reaped as economies develop their financial and real sectors, low- and middle-income economies should continue developing their financial sector. In other words, they should not be discouraged by the smaller benefits they are currently obtaining from financial development. Regarding public policy tools for developing the financial sector, the burgeoning literature lists several policy and non-policy factors affecting the development of an economy's financial sector (see for example, Baltagi et al., 2009; Demetriades and Andrianova, 2005; Yongfu, 2005). Perhaps a potential policy candidate, which many studies have found to induce financial development, is financial liberalization. Yet, it should be emphasized that financial liberalization might turn out to be growth-retarding unless efforts are made to improve the quality of institutions, in general, and to closely supervise financial institutions, in particular (Ahmed, 2013). Second, the clear evidence on the negative impact of government size on the FD nexus implies the importance of less government involvements both in the financial and real sectors. However, the positive role of basic government expenditures like on protecting property rights and enforcing contracts on the FD link should not be undermined. Third, owing to the fact that trade promotes overall macroeconomic efficiency, policies encouraging an economy's openness to international trade are likely to increase the benefit from financial development. However, the negative FD nexus we found in highly open low- and lower-middle-income economies highlights the need to protect domestic firms from excessive external competition and, by extension, from loss of valuable financial resources through the ensuing bankruptcy of firms.

As argued this study provides a first view at the dependence of the FD nexus on financial openness. It appears worthwhile to address in future research if more sophisticated, continuous measures of financial openness offer further insights into the joint importance of financial development and financial openness for the long-run linkage between financial and economic development. As a second direction of future work one may consider to trace back the diagnosed factor dependence that characterizes the FD nexus to institutional settings across economies. Similar to the heterogeneity of government expenditures (e.g. compensation of government employees or expenditures related to securing property rights), other factor variables are also highly

aggregated measures that eventually hide important cross-section-specific characteristics of the FD nexus. For example, the employed measure of trade openness ignores the composition of goods exported by a particular economy. As a result, uncovering particular institutions that foster the FD nexus is of high importance for issues in development policy.

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Appendix A. Semiparametric modeling

A.1. Estimation

We apply a semiparametric estimator of $\beta(\omega)$ similar to the Nadaraya–Watson estimator (Nadaraya, 1964; Watson, 1964) which is given by

$$\beta(\omega) = X^{-1}(\omega)Y(\omega), \tag{5}$$

where $X(\omega) = \sum_{i=1}^{N}\sum_{t=1}^{T}\widetilde{x}_{it}\widetilde{x}'_{it}K_h(\omega_{it}-\omega)$ and $Y(\omega) = \sum_{i=1}^{N}\sum_{t=1}^{T}\widetilde{x}_{it}\widetilde{y}_{it}K_h(\omega_{it}-\omega)$, $K_h(\cdot) = K(\cdot/h)/h$, with $K(\cdot)$ being a kernel function and h the bandwidth parameter. In this study, $K_h(\cdot)$ is the Gaussian kernel, $K(\cdot/h) = (2\pi)^{-1/2}exp(-0.5(\cdot/h)^2)$. To select the bandwidth h, we apply Scott's (1992) rule of thumb, $h = 1.06\hat{\sigma}_\omega(NT)^{-1/5}$, where $\hat{\sigma}_\omega$ is the estimated standard deviation of the factor observations. Note that $\hat{\sigma}_\omega$ approximately equals to unity as we standardize the factors.

A.2. Inference

For inferential purposes, we follow the factor-based bootstrap approach of Herwartz and Xu (2009) that contrasts the factor invariant coefficient model with the factor dependent model. Herwartz and Xu (2009) suggest two types of tests for factor dependence, global and local. The global test is a bootstrap approximation of an F-statistic and contrasts the residual sum of squares under the factor dependent model to that under invariant coefficients. The local test on the other hand examines the factor dependence for a given value of the factor. Confidence intervals under the null of a factor invariant FD nexus are constructed using bootstrap FD nexus estimates $\hat{\beta}^*(\omega)$ obtained by means of pseudo samples ω^*_{it} of factors that are drawn with replacement from the given factor variables ω_{it} keeping other variables unchanged. This bootstrap re-sampling scheme destroys any systematic relationship between the model parameters and ω^*_{it}. For any local point ω, if an estimate $\hat{\beta}_1(\omega)$ lies outside its 95% confidence interval (based on 1000 bootstrap replications), then we reject the null hypothesis of constant FD nexus at 5% level of significance.

Appendix B. List of economies included in each sample

B.1. Low-income economies (15)

Burkina Faso, Burundi, Cameroon, Cote d'Ivoire, Ghana, India, Kenya, Lesotho, Madagascar, Nepal, Pakistan, Papua New Guinea, Senegal, Sudan, Togo.

B.2. Lower middle income economies (18)

Algeria, Bolivia, Ecuador, Egypt, El Salvador, Fiji, Guatemala, Honduras, Jordan, Morocco, Paraguay, Peru, Philippines, South Africa, Sri Lanka, Swaziland, Syrian Arab Republic, Thailand.

B.3. Upper middle income economies (15)

Botswana, Costa Rica, Dominican Republic, Gabon, Malaysia, Malta, Mauritius, Mexico, Portugal, Saudi Arabia, St. Vincent and the Grenadines, Trinidad and Tobago, Turkey, Uruguay, Venezuela.

B.4. High-income economies (25)

Australia, Austria, Bahamas, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, United Kingdom, United States of America.

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