Openness and the finance-growth nexus

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Abstract

Ragan and Zingales (2003) hypothesize that openness—trade and financial—is a crucial determinant of financial development. The main policy implication emerging from this hypothesis is that openness should be promoted as a means of facilitating economic growth through financial development. While subsequent research confirms that openness affects financial development, we study whether finance continues to be growth promoting as economies become increasingly open—a key implicit assumption behind the policy recommendation. Using data from 78 economies for the period 1981–2006, we find that very high levels of financial openness generally erode the growth-promoting role of financial development while high trade openness strengthens it. These worldwide findings by and large hold for subsamples of Sub-Saharan African, Latin American and OECD economies. Notable exceptions are the invariance of the finance-growth (FG) nexus on trade openness in OECD economies and the positive effect of financial openness on the FG link in Latin American economies.

Keywords: Openness; finance-growth nexus; financial development; economic growth; functional coefficient model.

JEL Classification: C14, C23, O16, G28

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1 Introduction

Rajan and Zingales (2003) hypothesize that both trade and financial openness are crucial for financial development. They argue that financial development is opposed by incumbent industrialists and financiers who are wary of the ensuing competition and, hence, erosion of their rents. However, trade openness, together with financial openness, could mute industrial and financial incumbents' resistance to financial development for two important reasons. On the one hand, incumbents who are doing well in an open economy environment may not oppose financial development as they may see domestic competition less pressing. On the other hand, firms that are struggling to survive foreign competition likely need to increase their investment, and, as a result, they may push for more financial development so as to get better access to external credit. In this sense, openness could be considered as an important determinant of financial development. In partial support for this hypothesis, Baltagi et al. (2009) find that opening up either the trade or the capital accounts—but not necessarily both—could induce financial development. Using a new data set on *de jure* measures of openness and financial development, Hauner et al. (2013) also document strong evidence that trade liberalization is a leading indicator of domestic financial liberalization. However, they find little support for the view that capital account liberalization leads to financial development.

Obviously, the main reason why some economists are trying to investigate determinants of financial development is that they believe financial development fosters economic growth. This conviction is clearly reflected in the following opening sentences of Rajan and Zingales' (2003) paper: "*There is a growing body of evidence indicating that the development of a country's financial sector greatly facilitates its economic growth…Why then do so many countries still have underdeveloped financial sectors?*" Accordingly, the main policy implication of the Ragan and Zingales hypothesis is that policy makers and development institutions should promote openness to mute interest groups' resistance to financial development and to generate economic growth. This line of reasoning, however, is based on the implicit assumption that financial development always—or at least even when an economy is highly open—leads to economic growth. Contradicting this assumption, recent studies have consistently established that the impact of finance on growth depends on a number of institutional and economic conditions prevailing in an economy, including trade and financial openness (see, for example, Rioja and Valev, 2004; Yilmazkuday, 2011; Law et al., 2013; Herwartz and Walle, 2014).[1] Therefore, examining if finance continues to foster economic growth as economies become increasingly open can be an indirect, yet a very relevant, approach to testing (the implication of) the Rajan and Zingales hypothesis. If, for example, the evidence suggests the opposite, then the hypothesis or the respective empirical evidence can not be used to advocate openness as a means of promoting economic growth.

The aim of this paper is to empirically examine whether and how *the impact of financial development on economic growth* (henceforth the finance-growth (FG) link/nexus/relationship) depends on trade and financial openness.[2] To this end, we follow a functional coefficient

[1] These works, including the current study, could also be seen as part of the broad research effort towards relaxing the standard, yet restrictive, assumption that all economies grow alike (e.g. Durlauf and Johnson, 1995; Bos et al., 2010).

[2] In the finance and growth literature, the phrase "FG nexus/link/relationship" has been used to refer to

modeling approach where the long-run FG nexus is allowed to depend on a factor variable, in this case, a particular measure of openness. Specifically, our study improves on previous attempts to examine the impact of trade openness (Yilmazkuday, 2011; Herwartz and Walle, 2014) and financial openness (Herwartz and Walle, 2014) on the FG nexus in at least three ways. First and foremost, we employ a continuous financial openness measure, namely, the percentage of the economy's aggregate foreign assets and liabilities in GDP (Lane and Milesi-Ferretti, 2007). Due to its smoothness, this measure, unlike the one used in Herwartz and Walle (2014), can be treated as a factor in the semiparametric estimation. Second, as a robustness check, we utilize disaggregated openness measures. In this regard, the financial openness measure is divided into two indicators: foreign assets and foreign liabilities. Similarly, the trade openness measure is disaggregated so that it distinguishes between imports and exports, on the one hand, and between goods exports (imports) and services exports (imports), on the other. Third, taking advantage of the smoothness of the new financial openness measure, we pursue a new empirical strategy of estimating a bivariate factor model, with trade openness and financial openness as the first and the second factors. This method helps to investigate whether financial development is beneficial when an economy has simultaneously high levels of trade and financial openness. Moreover, this approach allows us to identify which of the two openness types (trade and financial) is the most influential factor in determining the FG nexus.

In Section 2, we provide a brief review of the theoretical and empirical literature on the impact of openness on the FG relationship. The survey predicts a positive role of trade openness on the FG link in economies that have benefited more from international trade, and a negative one in economies whose firms suffered from increased international competition. The main channel here is that, the more the funds agglomerated by financial intermediaries are efficiently utilized by firms, the larger is the impact of financial intermediary activities on economic growth. With respect to financial openness, two main channels are highlighted. The first channel, which we call the "substitution" channel, builds on the fact that financial openness and financial development could play the same growth-promoting roles, e.g. risk diversification. Hence, as financial globalization intensifies, (domestic) financial development will likely become less important to economic development. A further negative effect of financial openness on the FG relationship is predicted by the "volatility" channel. This channel emphasizes that because financial integration improves international risk sharing, it leads to intensified specialization, which in turn induces vulnerability to industry-specific shocks, and hence, might negatively affect the efficient utilization of resources channeled by the financial sector.

In Section 3, we describe the data and sketch the empirical methodology. Our data set covers 78 economies over the period 1981–2006. We estimate both parametric and semiparametric models. The former model is estimated by means of dynamic OLS (DOLS) and fully modified OLS (FMOLS) estimators. The DOLS model is later generalized into a

two slightly different concepts. Some studies (including this paper) use it to narrowly mean "the impact of finance on growth". These studies often estimate the growth models controlling for the potential endogeneity of financial development. However, they typically do not test the presence of a reverse causality from growth to finance. Other studies, however, explicitly examine the direction of causality between finance and growth. Hence, the phrase "FG nexus/link/relationship" in such studies means "the (causal) relationship between finance and growth".

semi-parametric functional coefficient model where the parameter measuring the impact of financial development on economic growth is represented as a function of trade and financial openness.

Section 4 discusses empirical parametric and semiparametric FG nexus estimates. Our results show that the impact of trade openness on the FG relationship varies across stages of economic development. While high trade openness enhances the FG nexus in upper-middle-income economies, it exerts a negative impact on the FG link in low- and lower-middle-income economies. These results support the hypothesis that the impact of openness on the FG nexus depends positively on the success of the economies in international trade. With respect to financial openness, we find that very high levels of financial openness erode the growth-promoting role of financial development. This effect is distinctly stronger in high-income economies. Given that these economies have deeper financial systems that could better absorb international shocks, and that industrialized economies are indeed reaping the fruits of risk sharing due to financial integration (Kose et al., 2009), our results hint at the predominance of the "substitution" channel in high-income economies. The bivariate functional estimates indicate that trade openness is a more influential factor than financial openness. As a consequence, it is only in upper-middle-income economies that simultaneously opening the trade and capital accounts is found to significantly enhance the FG nexus. Therefore, our results offer only a partial support to the suggestion emerging from the Ragan and Zingales hypothesis that opening up both trade and capital accounts is a crucial means of fostering growth-promoting financial development.

Section 5 concludes with a short summary of the main results and potential research topics for the future. Some technical issues of functional coefficient modeling are addressed in Appendix A.

2 Review of the literature

Noting that studies on the impact of openness on the FG nexus have treated trade and financial openness as two independent factors, we separately review the literature on the dependence of the FG link first on trade and subsequently on financial openness.

2.1 Trade openness and the FG nexus

The effect of trade openness on the FG relationship seems to emanate from the impact of international trade on the overall macroeconomic performance of an economy. Therefore, as trade openness could have positive and negative effects on economic growth, it could also have contrasting effects on the FG nexus. On the one hand, trade openness may lead to enhanced macroeconomic efficiency by providing access to new raw materials and products, low-cost intermediate goods, larger markets and latest technologies (Yanikkaya, 2003). The increased efficiency—both at the firm and the aggregate level—likely leads to efficient utilization of funds channeled by domestic financial intermediaries. Hence, openness could strengthen the positive impact of financial development on economic growth. On the other hand, openness might weaken the FG link if international trade stifles domestic infant industries (Young, 1991). Openness could also induce macroeconomic instability (Rodrik, 1992) and increase vulnerabilities to international shocks (Yilmazkuday, 2011) and, hence, could negatively impact on the FG nexus. Therefore, the possible effect of trade openness on the FG nexus is not clear at the outset. Rather, it seems to depend on how well an economy performs in international trade, i.e., the FG relationship is likely to be stronger in economies which perform relatively better in international trade.

On the empirical side, Yilmazkuday (2011) has tested the dependence of the FG nexus on trade openness by means of threshold regressions. He finds that trade openness strengthens the FG 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 better technologies benefits open low-income economies. However, according to Yilmazkuday (2011), the FG nexus 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.

Another study that has examined the impact of trade openness on the FG nexus is that of Herwartz and Walle (2014). Using a functional coefficient modeling approach, Herwartz and Walle (2014) find significant variations in the results across the four income groups they have considered. While a moderate level of trade openness stimulates the FG nexus in low- and lower-middle-income economies, extreme openness is associated with a negative FG relationship in those economies. They attribute the evidence of a negative FG nexus to the failure of domestic firms in extremely open low- and lower-middle-income economies to withstand foreign competition. In contrast, upper-middle-income economies show a marked FG nexus when they are highly open to trade. This is ascribed to the enhanced utilization of credits by firms in those economies when they are given access to a broader international market and/or when they face strong competition from foreign firms. However, Herwartz and Walle (2014) do not observe any clear pattern for the impact of openness on the FG nexus in high-income economies.

2.2 Financial openness and the FG nexus

Financial openness could affect the FG nexus through two main channels. The first channel concerns the possibility that both financial openness and financial development could play the same growth-promoting roles (Herwartz and Walle, 2014). For instance, the finance and growth literature repeatedly mentions risk diversification as a crucial growth-promoting function of financial intermediaries (e.g. see the review by Levine, 2005). Similarly, studies on financial openness highlight risk diversification as an important benefit economies could reap by opening their capital accounts (Obstfeld, 1994; Bekaert et al., 2011). In fact, while a well-developed domestic financial sector allows risk sharing among agents within an economy, financial openness could additionally facilitate international risk sharing (Kose et al., 2009). Therefore, according to the "substitution" channel, financial globalization could reduce the FG nexus by serving as a "substitute" for financial development in its crucial roles in economic development.

The second channel, which we call the "volatility" channel, is based on the argument that financial openness might lead to pronounced macroeconomic fluctuations. More financial openness could cause more volatility in at least two ways. First, sudden changes in the direction of capital flows, which are not uncommon in international capital markets, could trigger boom-bust cycles in developing economies with shallow financial sectors (Aghion et al., 1999). Second, financial openness could induce volatility by facilitating specialization. We have mentioned above that financial openness offers risk sharing opportunities at the international level. As Kalemli-Ozcan et al. (2003) show, the presence of risk sharing mechanisms provides a fertile ground for more specialization to take place. Although more specialization might imply more efficiency, it might also mean more vulnerability to industry-specific shocks. Since resources channeled by the financial sector are likely to be used less efficiently in a volatile macroeconomic environment, volatility might weaken the FG nexus. Empirical evidence on the negative impact of macroeconomic volatility on the FG nexus is documented in, for instance, Arcand et al. (2012). Therefore, the "volatility" channel also predicts a negative relationship between the FG nexus and the degree of financial openness of an economy.

Empirically, Herwartz and Walle (2014) try to assess the impact of financial openness on the FG nexus. They find that economies with the highest level of financial openness benefit the least from financial development. Moreover, the weakest FG link in those economies is observed during the recent period, 1990–2005. They attribute the negative impact of very high financial openness on the FG nexus to the fact that both financial development and financial openness might serve the same beneficial roles to economic development. However, they employ a measure of financial openness with poor scale properties, which precludes the use of financial openness as a factor in the functional coefficient modeling. As a result, their conclusion is based on standard parametric regression results on data divided into four stages of financial openness.

2.3 The joint impact of trade and financial openness on the FG nexus

From the arguments stated above on the individual impacts of trade and financial openness on the FG relationship, it is apparent that both factors might work together in strengthening/weakening the FG nexus. Specifically, in light of the fact that both trade openness and financial openness encourage increased specialization, they could undermine the FG nexus by inducing volatility. The hypothesis by Rajan and Zingales (2003) requires that simultaneous opening of both capital and current accounts are necessary for financial development to take place. Hence, investigating the impact of simultaneously high (low) trade and financial openness may be a more direct way of testing the validity of the Rajan and Zingales hypothesis. However, we are not aware of an empirical study which examines the joint impact of trade and financial openness on the FG relationship.

To summarize, although there have been ample reasons to expect that trade and financial openness could affect the FG nexus, very few studies have so far tried to empirically test this proposition. However, there is a fair degree of consensus among the existing studies that, in most cases, financial development could have a little or negligible impact on economic growth when economies have a higher degree of trade or financial openness. This has a direct implication to the major policy recommendation emerging from the hypothesis in Rajan and Zingales (2003) that openness should be promoted as a means of facilitating economic growth through financial development. In other words, while openness might be good for financial development, financial development might have little growth-enhancing role when economies are very open. In this paper, we provide more comprehensive evidence on the impact of openness on the FG nexus using a wide range of trade and financial openness measures. In particular, this study differs from previous studies on the issue in three aspects. First, we employ a continuous financial openness measure that lends itself to be treated as a factor in the semiparametric estimation. Second, we utilize more disaggregated measures of trade openness that distinguish between goods export (import) and services export (import). Third, we apply a bivariate functional estimation with trade openness and financial openness as factors so that we can see their simultaneous impact on the FG nexus.

Based on the above discussion and the proposed empirical strategies, we expect to obtain the following four main results. First, as the economic benefit from trade liberalization differs from economy to economy, we expect well-performing economies to experience stronger FG links. Second, as trade enhances efficiency not only through exports but also through the import of goods and services that otherwise are too costly to produce domestically (Yanikkaya, 2003), we expect the impact of trade openness on the FG nexus to be independent of the type of openness measure. Third, because it can largely substitute financial development in its role in facilitating growth and can lead to macroeconomic volatility, we expect financial openness to substantially weaken the FG link. Fourth, in light of the fact that the efficient utilization of funds by firms is more crucial for the FG nexus than the competitive nature of financial openness to financial development, we expect trade openness to have a stronger impact in determining the FG nexus than financial openness.

3 Data and methodology

3.1 Data

Our panel data set spans the period 1981–2006 and comprises 78 economies whose selection is dictated by data availability for all variables for a sufficiently long time period.[3] We measure financial development using credit by deposit money banks and other financial institutions to the non-financial private sector as a percentage of GDP (PRV). PRV is arguably the most suitable measure of financial development as it excludes credit to public institutions and credit issued by the central bank. Therefore, it measures the role of financial intermediaries in channeling the society's savings to investors, and hence, can reflect the impact of financial development on economic growth in a better way than do other measures like the percentage of monetary aggregates M2 or M3 in GDP (De Gregorio and Guidotti, 1995; Levine, 2005). Although the latter measures are sometimes used in empirical studies, they clearly do not measure the role of the financial sector in channeling funds to investors—a key function of financial intermediaries. Another potential measure is the ratio of commercial bank assets to commercial bank plus central bank assets. Beck et al.

[3] In light of the severity of the recent financial crisis, it would be interesting to investigate how including data from 2007 onwards would change the results obtained from the data under consideration. However, lack of data for the period after 2006, especially for the financial openness indicator, prevents us from performing this comparison.

(2007) mention two reasons why this measure might miss substantial cross-country variation in financial development. First, in many countries central banks do not directly participate in the allocation of credit although they may influence banks to lend to favored sectors or firms. Second, the measure focuses narrowly on commercial banks, which are not the only financial intermediary institutions. Furthermore, it is worthwhile noting that PRV is the one which is found to exert a robust, positive impact on GDP per capita (Levine, Loayza, and Beck (2000) and Beck, Levine, and Loayza (2000)). A major limitation of PRV, however, is that it does not measure developments outside the banking sector. This fact should be taken into account in discussing estimation results, especially for high-income economies, where development in the financial market accounts for a large and growing share of the overall financial sector development.

In accordance with standard practice in the FG nexus literature (e.g., Demetriades and Hussein, 1996; Christopoulos and Tsionas, 2004; Apergis et al., 2007), we measure economic development by means of real GDP per capita (GDPPC). Consequently, our estimation results should be interpreted as level—and not growth—effects of financial development on economic development. Government size is measured by government consumption expenditure as a percentage of GDP (GOV). The growth rate of the GDP deflator is used to measure inflation (INF) as there are several missing values in the data for the Consumer Price Index.

Trade openness is approximated in terms of the percentage of imports plus exports in GDP (OPEN). When trade openness is used as a factor in the functional coefficient model, we check for sensitivity of results by employing the following alternative trade openness measures: the volumes of imports (IMP), exports (EXP), goods imports (GIMP), services imports (SIMP), goods exports (GEXP), or services exports (SEXP), all taken as a percentage of GDP. To measure financial openness, we employ the financial globalization indicator (FOPEN) suggested in Lane and Milesi-Ferretti (2007). FOPEN is derived as the volume of an economy's foreign assets plus liabilities as a percentage of GDP. The robustness checks in this case are done by utilizing the percentages of foreign assets (FA) or foreign liabilities (FL) in GDP as alternative measures of financial openness.

PRV is drawn from the November 2010 update of the *Financial Development and Structure Dataset* of Beck et al. (2000)[4] while FOPEN is taken from the updated and extended database of Lane and Milesi-Ferretti (2007).[5] The remaining series are obtained from the World Bank's World Development Indicators.

As the impact of openness on the FG nexus may vary across stages of economic development, we categorize the 78 economies into four according to the World Bank's contemporary classification criteria, based on their latest (2006) GDP per capita.[6] Specifically, economies whose latest real per capita GDP (in constant 2000 US Dollar) falls in the ranges less than 905, 906–3595, 3596–11115, and over 11115 are classified as low-income (17 economies), lower-middle-income (17), upper-middle-income (20) and high-income (24), respectively. The list of economies included in each sample is provided in Appendix B.[7]

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

[5] Available at `http://www.philiplane.org/EWN.html`

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

[7] Since GDPPC of an economy changes over time, the choice of year for classification might be crucial for the results we are going to discuss in Section 4. To examine if this is the case, we have undertaken a

Table 1: Summary statistics, 1981–2006

Variable	Mean	Max	Min	Std	Co.Var.	Variable	Mean	Max	Min	Std	Co.Var.
	World (78 economies)										
GDPPC	7810.4	41245.8	102.2	9550.8	1.22	IMP	42.0	204.5	3.0	26.3	0.63
PRV	51.0	269.8	1.4	41.1	0.81	EXP	37.6	234.4	3.2	25.0	0.67
GOV	16.1	43.0	3.2	6.2	0.39	GIMP	32.3	182.5	3.4	22.3	0.69
INF	10.5	390.7	-23.5	19.6	1.86	SIMP	9.9	47.0	0.7	6.6	0.67
OPEN	79.6	438.9	6.3	49.2	0.62	GEXP	27.0	197.9	0.9	20.8	0.77
FOPEN	169.2	2381.4	7.5	178.4	1.05	SEXP	10.7	66.3	0.1	10.6	0.99
						FA	65.0	1189.9	1.5	95.8	0.39
						FL	104.2	1191.5	6.0	90.8	0.87
	Low income (17)										
GDPPC	361.0	976.1	102.2	189.1	0.52	IMP	34.7	147.7	3.0	26.1	0.75
PRV	16.6	41.2	1.4	9.2	0.55	EXP	23.5	82.1	3.2	13.4	0.57
GOV	13.6	43.0	4.8	6.3	0.46	GIMP	27.4	134.1	3.4	24.3	0.89
INF	14.1	165.7	-8.2	20.8	1.48	SIMP	8.9	35.4	1.1	5.5	0.61
OPEN	58.2	187.7	6.3	34.5	0.59	GEXP	18.7	75.1	0.9	12.8	0.68
FOPEN	118.6	628.2	7.5	74.9	0.63	SEXP	5.3	22.7	0.1	3.5	0.67
						FA	20.4	83.0	1.5	14.1	0.66
						FL	98.2	561.8	6.0	65.8	0.67
	Lower middle (17)										
GDPPC	1498.1	3561.3	407.7	637.4	0.43	IMP	43.0	105.8	13.0	19.4	0.45
PRV	35.9	166.0	4.8	27.1	0.76	EXP	35.7	100.9	11.5	15.6	0.44
GOV	13.7	37.2	3.2	6.1	0.44	GIMP	32.9	87.6	9.8	15.3	0.47
INF	9.3	102.8	-23.5	10.5	1.12	SIMP	9.5	31.5	1.9	5.7	0.60
OPEN	78.8	202.8	24.9	33.8	0.43	GEXP	25.3	92.8	5.0	14.2	0.56
FOPEN	113.5	340.0	32.3	55.5	0.49	SEXP	10.5	47.7	0.5	9.4	0.89
						FA	37.2	260.0	2.4	35.1	0.42
						FL	76.3	238.6	23.7	34.5	0.45
	Upper middle (20)										
GDPPC	4733.4	15413.9	1213.8	2059.2	0.44	IMP	51.1	106.9	9.4	23.9	0.47
PRV	42.9	155.3	6.5	27.1	0.63	EXP	48.8	121.3	8.2	21.5	0.44
GOV	16.7	38.8	5.0	6.0	0.36	GIMP	38.5	84.5	8.0	19.3	0.50
INF	13.0	139.7	-20.8	21.0	1.62	SIMP	13.1	35.9	0.7	7.3	0.56
OPEN	100.0	220.4	21.1	43.4	0.43	GEXP	32.2	106.3	2.1	19.0	0.59
FOPEN	168.6	1324.5	26.1	153.7	0.91	SEXP	16.4	66.3	0.8	14.4	0.88
						FA	64.6	604.0	4.2	75.5	0.33
						FL	104.1	720.5	11.2	87.1	0.84
	High income (24)										
GDPPC	20122.3	41245.8	3510.0	8097.5	0.40	IMP	38.9	204.5	6.9	30.2	0.78
PRV	92.8	269.8	22.0	38.9	0.42	EXP	39.6	234.4	7.2	33.2	0.84
GOV	19.2	41.5	8.2	5.0	0.26	GIMP	30.2	182.5	4.9	25.7	0.85
INF	6.7	390.7	-4.8	21.5	3.21	SIMP	8.2	47.0	1.4	6.3	0.77
OPEN	78.5	438.9	16.0	63.2	0.80	GEXP	29.6	197.9	4.1	27.7	0.94
FOPEN	245.0	2381.4	33.0	260.6	1.06	SEXP	9.9	50.8	1.2	8.7	0.88
						FA	116.8	1189.9	7.7	139.5	0.28
						FL	128.2	1191.5	16.9	124.2	0.97

Note: Full definitions of the variables and data sources are given in the text. Except GDPPC, 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.

Table 1 documents descriptive statistics. The summary includes the means, the minimum

robustness check by setting the number of economies in each group the same as in this study. Namely, after ranking economies according to their GDPPC in a particular year, we considered the bottom 17, the next 17, the next 20 and the top 24 economies as low-income, lower-middle income, upper-middle income and high-income economies, respectively. Then re-classifying economies every year according to their contemporary level of GDPPC, we reproduced Figures 1–3. The results, which are available upon request, are similar to those presented in this paper. This is most likely because of the small number of between-group transitions experienced by the economies in the 26 years under study.

and maximum values, the standard deviations and the coefficients of variation for different income categories. In addition to the fact that the data set is characterized by considerable variations within and between cross sections, a number of distinctive features of the data are worth emphasizing. First, as expected, the mean of the financial development measure PRV increases with economic development. Second, the average degree of trade openness (measured by OPEN) initially increases with income, reaches a maximum (for upper-middle-income economies) and then declines. In contrast, the mean level of financial openness (FOPEN) shows a marginal decrease initially, but then increases markedly as economies develop. In particular, high-income economies are twice as much financially open as low-income economies. Disaggregating the openness measures OPEN and FOPEN reveals some interesting features. For instance, while OPEN is more or less evenly divided into IMP and EXP, FOPEN's component FL is much higher than FA in all income groups. Besides, high-income economies are about six times as much open as low-income economies in terms of FA. Further decomposing the trade openness measures, we find that the volume of trade in goods (GIMP and GEXP) is about three times that of trade in services (SIMP and SEXP). Given that low-income economies are highly dependent on concessional debts to run their economies, it is clear that the amount of debts does not reflect capital account openness in those economies.[8] Hence, the (disaggregated) foreign-assets-based indicator of financial openness (FA) seems to be a more reasonable measure in this case.

3.2 Methodology

3.2.1 The parametric model: dynamic OLS

Before we embark on examining the dependence of the FG nexus on openness by means of a functional coefficient modeling approach, we begin our analysis by estimating a typical parametric FG regression model. Obtaining parametric FG nexus estimates first will help us later to analyze the extent to which the functional estimates deviate from those of the benchmark parametric model. Of the parametric models frequently used in the FG literature, we employ the dynamic OLS (DOLS) model, where the explanatory variables in levels are augmented with the lags and leads of their first differences (Saikkonnen, 1991; Stock and Watson, 1993). As a robustness check, we will also provide estimation results using the Fully Modified OLS (FMOLS) estimator of Phillips and Hansen (1990). The asymptotic properties of the panel versions of both estimators can be found in Kao and Chiang (2000). The DOLS estimator has recently attracted several applications in the FG research (see, for example, Ang, 2008; Apergis et al., 2007). This increasing interest may be ascribed to the fact that DOLS estimation yields unbiased parameter estimates even in the presence of endogenous explanatory variables—a desirable property for studies on the FG nexus where the existence of a reverse causality from growth to finance is more the rule than the exception. The DOLS regression in our case reads as

$$y_{it} = \boldsymbol{x}'_{it}\boldsymbol{\beta} + \boldsymbol{z}'_{it}\boldsymbol{\gamma} + u_{it}, \quad t = 1, ..., T, \quad i = 1, ..., N, \tag{1}$$

[8] For example, 73.4% of the external debt in all low-income economies in 2006 constitute concessional debt (World Development Indicators online accessed on August 29, 2012).

where y_{it} represent GDP per capita; $\boldsymbol{x}_{it}$ is a vector of explanatory variables comprising PRV, GOV, OPEN, INF and FOPEN; $\boldsymbol{z}_{it}$ includes the fixed effect, and contemporaneous, one lag and one lead of the first differences of the right-hand side variables $\boldsymbol{x}_{it}$; $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$, respectively, are vectors of long-run and short-run parameters; and $u_{it} \sim (0, \sigma_u^2)$ is the error term. To allow the short-run coefficients to be economy-specific, we partial out $\boldsymbol{z}_{it}$ from (1). Let Y_i, $\boldsymbol{X}_i$ and $\boldsymbol{Z}_i$ denote, respectively, matrices collecting observations in y_{it}, $\boldsymbol{x}_{it}$ and $\boldsymbol{z}_{it}$ for economy i and $\boldsymbol{M}_i = (I - \boldsymbol{Z}_i(\boldsymbol{Z}_i'\boldsymbol{Z}_i)^{-1}\boldsymbol{Z}_i')$, where I is a $(T \times T)$ identity matrix. Then, the considered partial system is

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

where $\widetilde{y}_{it}$, $\widetilde{\boldsymbol{x}}_{it}$ and $\tilde{u}_{it}$ are elements of, respectively, $\widetilde{\boldsymbol{Y}_i} = \boldsymbol{M}_i\boldsymbol{Y}_i$, $\widetilde{\boldsymbol{X}_i} = \boldsymbol{M}_i\boldsymbol{X}_i$, $\tilde{u}_i = \boldsymbol{M}_i u_i$.

3.2.2 The semiparametric model

In this section, we first briefly outline a one-dimensional functional coefficient model similar to the one suggested by Cai et al. (2000) and Cai et al. (2009). This model is used to assess the dependence of the long-run FG nexus on alternative measures of trade and financial openness, with only one factor considered at a time. Moreover, we sketch a bivariate factor dependent model that allows us to examine the simultaneous impact of trade and financial openness on the FG nexus. Estimation and inferential methods within the functional coefficient model are taken from Herwartz and Xu (2009) and are briefly reviewed in Appendix A along with further references.

The panel DOLS estimator (and similarly the panel FM OLS estimator, Kao and Chiang, 2000) that can be retrieved from the model in (1) is normally distributed as the sample dimensions $T \to \infty$ followed by $N \to \infty$. For detailed treatments of asymptotic properties of panel estimators under integrated variables the reader is referred to Phillips and Moon (1999) or Kao and Chiang (2000). A crucial condition underlying panel data analysis is that the parameter vector $\boldsymbol{\beta}$ in (1) is invariant over both data dimensions such that each sample observation carries informational content for this parameter vector. In light of panel heterogeneity covering economies at various levels of economic development it is, however, not unlikely that the long run relation in (1) is subject to variation over both the cross section and the time dimension. Empirical assessments of panel DOLS regressions should, at least, allow a diagnostic contrasting of the homogeneous model against a more general specification allowing parameter heterogeneity. Subsample-specific analysis as provided in Table 2, or performing explicit tests for structural breaks might be followed in this direction. While such approaches are silent on the potential source of parameter variation, the class of functional coefficient models formalizes a more structural approach in the sense that parameter variation is related to a particular economic measure (henceforth 'the factor'). As a particular merit for the panel context, the functional model— with a suitable factor at hand— allows for variation of $\boldsymbol{\beta}$ over both the cross sectional and the time dimension.

Denoting a measurable factor, for instance, trade openness (OPEN), by ω, a functional coefficient representation of (2) is

$$\tilde{y}_{it} = \widetilde{\boldsymbol{x}}_{it}'\boldsymbol{\beta}(\omega) + \tilde{u}_{it}, \tag{3}$$

where $\boldsymbol{\beta}(\omega)$ indicates that the long run parameters of the regression model in (1) obey a local interpretation. To estimate the nonlinear model in (3) kernel-based weighted regression estimators can be applied. Thus, for the evaluation of $\boldsymbol{\beta}(\omega)$, observations corresponding to a factor observation ω_{it} will get more or less weight depending on the distance $\omega - \omega_{it}$. While the model in (3) appears restricted to a univariate factor variable, the consideration of higher dimensional factor variables, bivariate say, is straightforward. In this work we employ bivariate factor variables comprising measures of OPEN and FOPEN such that the bivariate kernels are used to weight observations according to distances $\omega - (\omega_{it}^{(1)}, \omega_{it}^{(2)})'$, where the superscripts 1 and 2 represent trade (OPEN) and financial openness (FOPEN), respectively. To improve upon the interpretation of the functional estimates, we refrain from using raw factor quotes but arrive at factor observations ω_{it}, $\omega_{it}^{(1)}$ and $\omega_{it}^{(2)}$ after standardizing observed factor quotes $\tilde{\omega}_{it}$, $\tilde{\omega}_{it}^{(1)}$ and $\tilde{\omega}_{it}^{(2)}$ as follows:

$$\omega_{it} = \frac{(\tilde{\omega}_{it} - \bar{\omega}_t)}{\sigma_t(\tilde{\omega})},$$
$$\text{with} \quad \bar{\omega}_t = 1/N \sum_{i=1}^{N} \tilde{\omega}_{it} \quad \text{and} \quad \sigma_t(\tilde{\omega}) = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} (\tilde{\omega}_{it} - \bar{\omega}_t)^2}. \tag{4}$$

Thus, for a local assessment of the long run relation in (1) we use an economy's time varying position within the global trend of the factor variable. By construction, the factor variable in (4) is stationary even if the raw quotes of the factor are integrated of order one.

The functional estimates are essentially weighted regression estimates, where the weights assigned to a particular observation reflect the time local position of the factor in the cross section of time series. As the question of interest in this paper is the impact of openness on the FG nexus, we discuss only $\hat{\beta}_1(\omega)$. For a one-dimensional factor model, functional estimates $\hat{\beta}_1(\omega_{it})$ can be displayed in a two-dimensional graph. Given that our factors are standardized, ω_{it} should lie between -2 and 2 for about 97% of the observations. Hence, the following grid can be used to analyze how $\hat{\beta}_1$ responds to changes in ω_{it}:

$$\hat{\beta}_1(\omega), \omega = -2 + 0.1\kappa, \kappa = 0, 1, 2, ..., 40. \tag{5}$$

In this case, the functional FG nexus estimates $\hat{\beta}_1(\omega)$ demonstrate the effect of attaching relatively high kernel weights to economies that are above ($\omega > 0$), close to ($\omega = 0$) or below ($\omega < 0$) the average trend of the factor variable. Similarly, estimates from the bivariate functional coefficient model are displayed in a three-dimensional graph applying the grid in (5) for both factors. Note that the common panel regression model in (1) is 'nested' within the functional model in (3) if the factor ω lacks any influence on the parameter vector. The factor-based bootstrap introduced by Herwartz and Xu (2009) targets at mimicking the parameter estimate evolving under the restrictive null hypothesis $\boldsymbol{\beta}(\omega) = \boldsymbol{\beta}$.

Table 2: Parametric regression results

	DOLS					FMOLS				
Variables	low	lower	upper	high	world	low	lower	upper	high	world
PRV	**0.113**	**0.215**	**0.289**	**0.104**	**0.216**	**0.113**	**0.193**	**0.275**	**0.083**	**0.206**
	(0.027)	(0.046)	(0.040)	(0.029)	(0.018)	(0.025)	(0.036)	(0.038)	(0.031)	(0.017
GOV	-0.091	**-0.140**	**-0.217**	**-0.361**	**-0.206**	-0.054	**-0.205**	**-0.339**	-0.136	**-0.235**
	(0.051)	(0.062)	(0.080)	(0.108)	(0.036)	(0.048)	(0.056)	(0.074)	(0.090)	(0.032)
OPEN	**0.160**	**0.217**	**0.287**	**-0.220**	**0.110**	**0.204**	**0.197**	**0.147**	-0.071	**0.082**
	(0.045)	(0.065)	(0.067)	(0.082)	(0.031)	(0.039)	(0.050)	(0.067)	(0.076)	(0.027)
FOPEN	-0.024	0.031	**0.261**	**0.276**	**0.162**	-0.019	**0.119**	**0.271**	**0.275**	**0.191**
	(0.026)	(0.059)	(0.033)	(0.023)	(0.015)	(0.027)	(0.043)	(0.036)	(0.023))	(0.014
INF	**0.429**	-0.517	0.177	-0.077	0.006	0.100	**-0.300**	-0.232	**-0.205**	**-0.221**
	(0.104)	(0.291)	(0.139)	(0.085)	(0.068)	(0.091)	(0.134)	(0.119)	(0.080)	(0.054)
Serial corr.	82.353	76.471	65.000	70.833	73.077					
Poolability	9.472	6.621	4.522	9.741	5.677					
HS	**-3.987**	**-3.528**	**-4.020**	**-3.522**	**-4.437**					
DH	**-4.194**	**-3.801**	**-3.821**	**-3.882**	**-4.417**					
Observations	391	391	460	552	1794					

Notes: The dependent variable is GDPPC. Entries on the left hand side panel of the table refer to the panel DOLS model results while those on the right are from a panel FMOLS model. Both models include a constant. The DOLS model additionally includes a constant and contemporaneous as well as one lag and lead of the first differences of all 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 standard errors. Rejections of the null hypothesis at the 5% level of significance are indicated by boldface numbers. 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. The null hypothesis of the employed poolability test is that reported long-run parameter estimates are not systematically different from mean group estimates. Entries corresponding to *HS* and *DH* are obtained by applying homogeneous panel unit root tests suggested, respectively, in Herwartz and Siedenburg (2008) and Demetrescu and Hanck (2012) on the pooled residuals. For both tests, the null hypothesis is that the residuals contain unit roots. 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, are less than what we could have in static regressions.

4 Empirical results

4.1 Parametric estimates

Table 2 documents estimation results using data from the four income groups and the full sample. The first notable result is that the FG nexus estimates from the panel DOLS model, which are presented in the left hand side panel of the table, are very similar to their FMOLS counterparts, which are documented on the right hand side panel. In light of this similarity, our discussion will focus only on the panel DOLS results. The evidence clearly shows that financial development has a statistically and economically significant positive long-run impact on economic development in all cross sections. This is a widely documented result in the FG literature (see Levine, 2005, for a broad survey). The estimated FG coefficient initially increases with income but finally declines with high-income economies exhibiting the weakest FG link of all income groups. This dependence of the FG nexus on the income level is also diagnosed, for example, in Yilmazkuday (2011) and Herwartz and Walle (2014). A noticeable difference from the parametric results documented in Herwartz and Walle (2014) is that high-income economies in the current study exhibit a weaker FG link. This could be explained by noting that these economies have a very high degree of financial openness (see Table 1), which was not included as an explanatory variable in Herwartz and Walle (2014). Indeed, by categorizing economies according to their degree of financial openness, Herwartz and Walle (2014) find that economies with the highest level of financial openness benefit the least from financial development.[9]

Table 2 also documents some model diagnostics: serial correlation and unit roots tests for the residuals, and poolability tests. Except for serial correlation, we obtain satisfactory results for the two diagnostic tests. In particular, the null hypothesis of a panel unit root is rejected using both unit root tests (Herwartz and Siedenburg, 2008; Demetrescu and Hanck, 2012) indicating that the panel DOLS estimation does not suffer from spurious dependence. For all cross sections, we cannot reject the null hypothesis that the pooled regression estimates are not systematically different from mean group estimates. Thus, after taking into account fixed effects and economy-specific transitory dynamics, pooling is not overly restrictive to quantify the long-run determinants of per capita income. However, the null hypothesis of no first order serial correlation is rejected in most of the economies. Still, we do not respecify the model for four reasons. First, using more than one lag of the first differences in the DOLS regressions would significantly reduce the number of economy-specific regressions with residual serial correlation, but would leave the evaluation of the FG link qualitatively unaffected. Second, residual correlation does not affect the consistency of the estimators. Third, both the DOLS and FMOLS estimators are known to correct for potential biases that might arise from the serially correlated errors. Fourth, using heteroskedasticity and autocorrelation consistent (HAC) standard errors leaves the significance of the parameter estimates unchanged.

[9]To be precise, excluding FOPEN from the model increases the coefficient attached to PRV in high-income economies to 0.236. However, as our aim is to see the impact of PRV on GDPPC after taking into account FOPEN's impact on GDPPC, we proceed by including FOPEN as an explanatory variable.

4.2 Functional coefficient estimates

In this section, results obtained from the functional coefficient model in (3) are discussed.[10] As stated in Appendix A, we employ the factor-based bootstrap approach proposed in Herwartz and Xu (2009) to examine the dependence of the FG relationship on trade and/or financial openness. Accordingly, we first discuss the global factor-invariance test results and then analyze the local dependence of the FG nexus on openness. Throughout, we use the conventional 5% significance level to decide if a given openness measure has a statistically significant impact on the FG link.

Table 3 documents the global factor-invariance test results. It can be seen that, with the exception of low-income economies, the null hypothesis of a factor-invariant FG nexus can be rejected if OPEN is used as factor variable. Even in low-income economies, a constant FG link can be rejected at the 10% level of significance. Measuring trade openness by means of IMP, instead of OPEN, obtains qualitatively similar results. Moreover, although using EXP leads to rejection of the null hypothesis only in upper-middle-income economies and the full sample, using SEXP offers the same conclusions as using IMP or OPEN. All in all, our results suggest that trade openness has a significant impact on the FG nexus. This is consistent with our expectation that trade openness affects the FG nexus, and this effect is observable independent of the openness measure employed. On the other hand, measuring financial openness by FOPEN, we find a significant dependence of the FG link on financial openness in high-income economies and the full sample. However, employing more disaggregated measures reveals a significant impact of financial openness on the FG nexus even in middle-income economies. In low-income economies, however, no financial openness measure significantly affects the FG link, perhaps because these economies are the least open in terms of FA.[11] Finally, a significant dependence of the FG nexus on the bivariate factors is observed only in the two middle-income categories. Results obtained by resampling only one of the two factors in the bivariate functional model reveal that, in line with our expectation, it is trade openness—and not financial openness—that is strongly driving the bivariate factor dependence evidence.

4.2.1 Trade openness

Figure 1 displays the estimated functional FG nexus obtained by employing OPEN, and the disaggregated measures EXP, IMP, GIMP, SIMP, GEXP and SEXP as factor variables. One important finding from the graphs in the first two rows is that, in line with our expectation, using either of import- or export-based openness measures provides very similar results. This is consistent with the international trade theory that trade promotes efficiency not only through exports but also through the import of goods and services that otherwise are too costly to produce domestically (Yanikkaya, 2003). Thus, we prefer to discuss only the evidence obtained by using the most aggregated trade openness measure, OPEN, as depicted in the first row of Figure 1. These results are similar to Herwartz and Walle (2014). Here, we can see that the impact of trade openness on the FG nexus depends on the level of economic development. Specifically, low- and lower-middle-income economies experience

[10]All computations are done in MATLAB 2013a.

[11]FL is less relevant for the analysis in low-income economies as it mainly comprises concessional debts.

Table 3: Global factor invariance test results

Factors	low income	lower middle	upper middle	high income	world
OPEN	0.058	0.003	0.000	0.042	0.000
EXP	0.078	0.185	0.000	0.112	0.000
GEXP	0.009	0.185	0.000	0.182	0.000
SEXP	0.081	0.000	0.000	0.000	0.000
IMP	0.158	0.000	0.000	0.028	0.000
GIMP	0.081	0.000	0.000	0.000	0.000
SIMP	0.020	0.000	0.000	0.006	0.000
FOPEN	0.083	0.233	0.052	0.000	0.000
FA	0.746	0.022	0.522	0.000	0.001
FL	0.154	0.744	0.001	0.000	0.001
OPEN*, FOPEN	0.203	0.008	0.000	0.975	0.000
OPEN, FOPEN*	0.979	0.899	0.884	0.999	1.000
OPEN*, FOPEN*	0.551	0.006	0.000	0.980	0.174

Notes: All variables are used in logarithmic forms. Reported numbers are (bootstrap) p-values. The null hypothesis of the global factor invariance test (Herwartz and Xu, 2009) is that the FG nexus is invariant with respect to the openness measure(s) under consideration. In the bottom three rows, resampling is conducted only for the factor indicated by the asterisk. For instance, (OPEN*, FOPEN) indicates that only OPEN is resampled while (OPEN*, FOPEN*) implies that both factors are resampled. Accordingly, these tests measure the partial and joint factor invariance of the FG nexus, respectively. Throughout, the number of bootstrap replications is 5000.

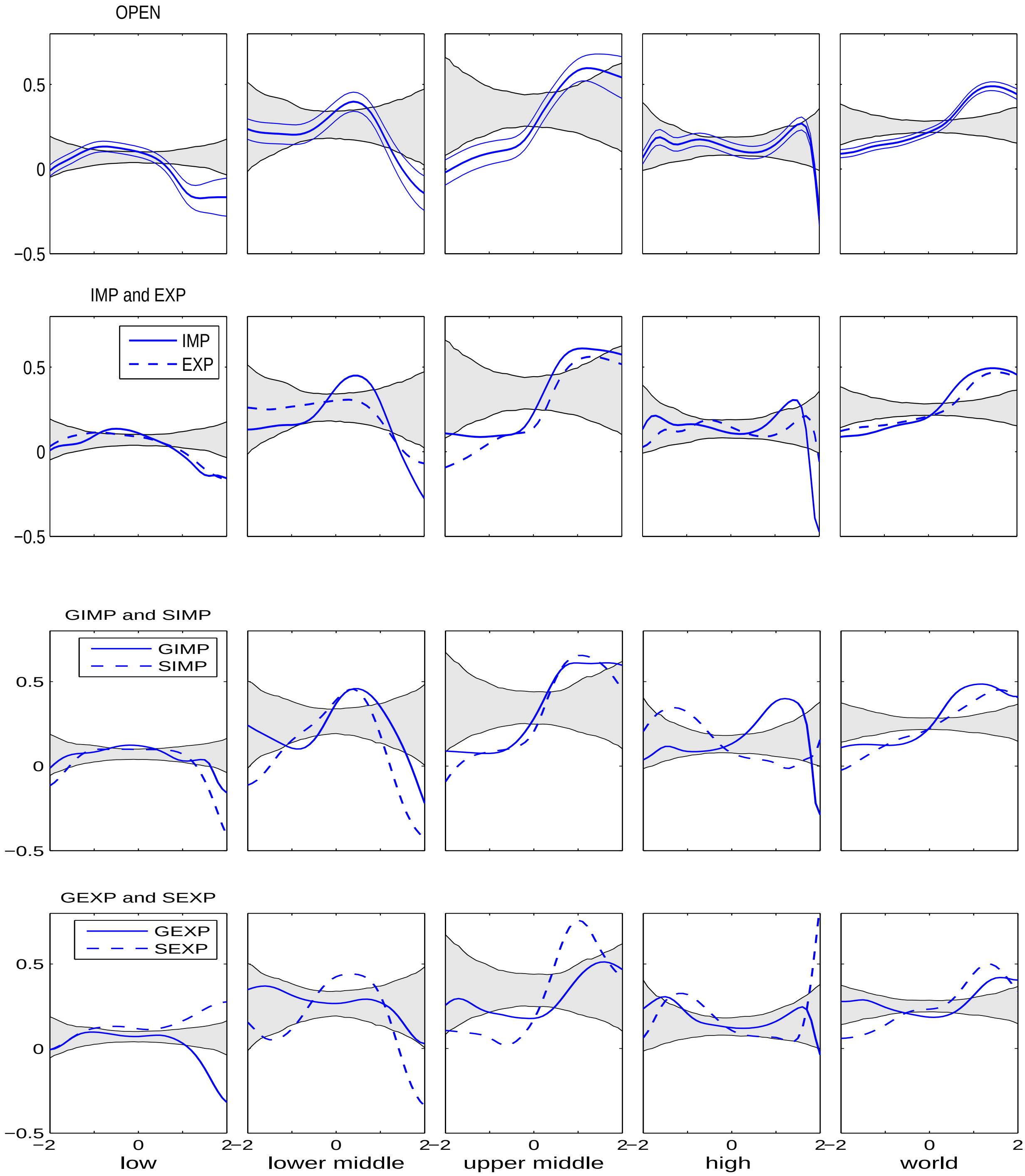

Figure 1: Functional coefficient model estimates of the FG nexus conditional on the level of trade openness. The figures show estimated long-run effects $\hat{\beta}_1(\omega)$, with $\hat{\beta}_1$ on the vertical and ω on the horizontal axes. In the first row, the functional estimates are bounded by ± 2 standard error confidence bands. The shaded areas indicate the 95% bootstrap confidence intervals of the model *excluding* functional dependence on OPEN. Hence, at a given value of ω, if $\hat{\beta}_1$ lies out of the shaded area, then we say that the FG nexus is locally dependent on OPEN. From the second to the fourth row, the effect of two different openness measures on the FG nexus are depicted in one figure. For the sake of clarity, the ± 2 standard error confidence bands are not provided. Similarly, instead of presenting two shaded regions for two factors, we take confidence intervals from the figures in the first row (using OPEN as a factor) and apply them for the figures in the remaining rows.

a stronger FG nexus if they are moderately open, but extreme openness could result in a negative FG relationship. A similar hump-shaped relationship between trade openness and the FG nexus is also documented in Yilmazkuday (2011) as a worldwide evidence. The negative FG relationship might be explained by noting that firms in low- and lower-middle-income economies are not strong enough to withstand the fierce competition from foreign companies (Young, 1991). Moreover, it could also be a consequence of open economies' increased vulnerability to macroeconomic shocks as argued in Rodrik (1992).

On the contrary, high trade openness increases the FG nexus in upper-middle-income economies. This might indicate the fact that firms in those economies are strong enough to withstand foreign competition. Furthermore, it might imply that those firms are able to efficiently utilize the obtained credit when they get access to larger markets and/or when they face strong competition of foreign firms (Yanikkaya, 2003). In high-income economies, however, trade openness does not appear to affect the FG nexus for a wide range of openness levels. When openness becomes extremely high, a likely negative impact is observed. The negative impact becomes even clearer when we measure openness by IMP—and not by EXP—possibly implying that a higher degree of imports might indicate poor performance of domestic firms facing international competition.

A further decomposition of the trade openness measures into goods and services imports (exports) obtains the functional estimates displayed in the third and fourth rows of Figure 1. Interestingly, the estimates demonstrate a fair degree of similarity to the results presented in the first and second rows of Figure 1 and corroborate the foregoing discussions. However, one peculiarity is worth mentioning here. If openness is measured by the volume of services exports as a percentage of GDP (SEXP), then even low-income and high-income economies are characterized by an increasing FG nexus. This is in line with the argument by Konan and Maskus (2006) that openness in services trade results in a more profound upgrading of economy-wide efficiency than openness in goods trade as financial, communications, and professional services are essential intermediate inputs into production in all sectors.

4.2.2 Financial openness

Figure 2 depicts the estimated functional dependence of the FG nexus on three alternative measures of financial openness. Again, the functional relations obtained by using the comprehensive measure, FOPEN, remain qualitatively unaffected by disaggregation of FOPEN into FA and FL. Basing the ensuing discussion on the first row of Figure 2, we find that financial openness has a clearly negative impact on the FG nexus at all levels of economic development. In particular, the functional estimates demonstrate that high-income economies could have a very high FG nexus if they are characterized by very low financial openness and the nexus declines as economies open up their capital accounts. This substantiates our conjecture in Section 4.1 that high-income economies exhibit the lowest FG nexus, most likely, because of the very high financial openness in those economies. This result is in line with the predictions of the "substitution" and "volatility" channels discussed in Section 2.2. In view of the fact that high-income economies have deeper financial systems that could better absorb international shocks, and that industrialized economies are indeed reaping the fruits of risk sharing due to financial integration (Kose et al., 2009), it seems that the "substitution" channel is stronger in these economies. Note that this channel

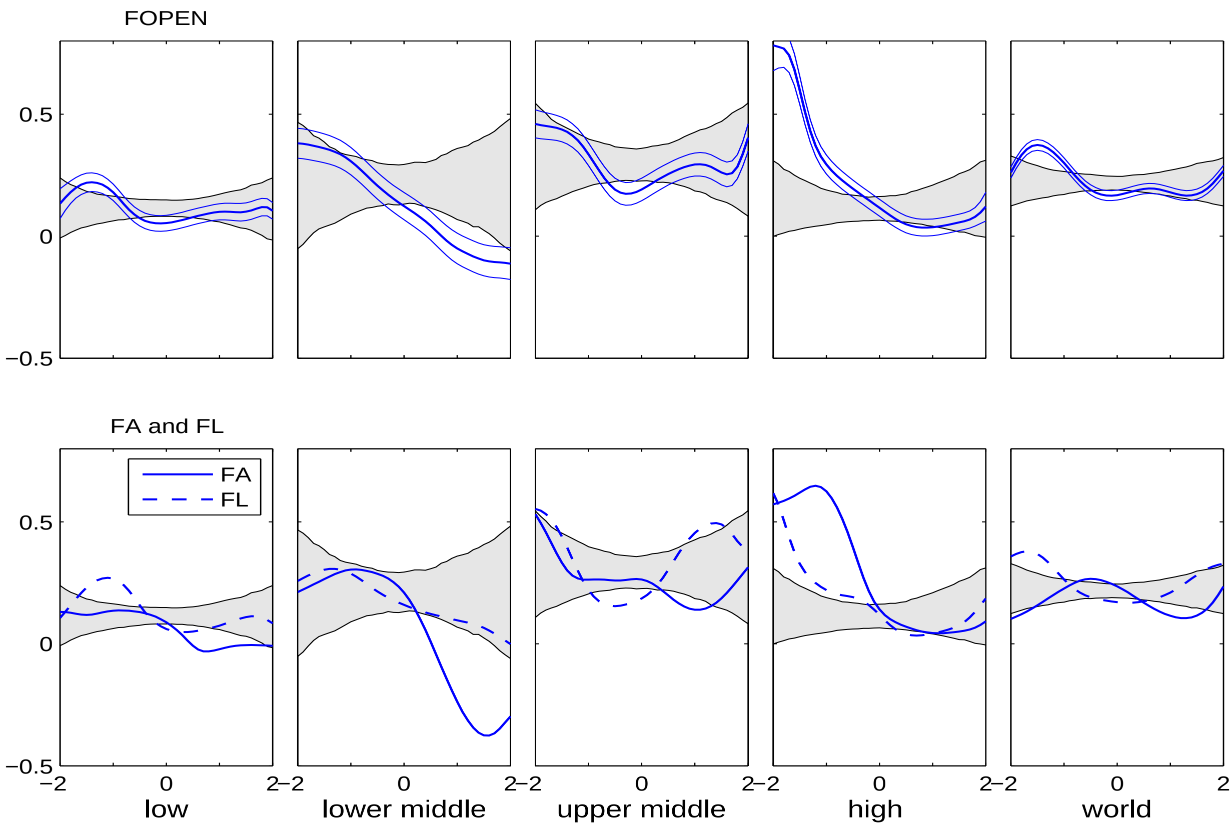

Figure 2: Functional coefficient model estimates of the FG nexus conditional on the level of financial openness measured as the volume of an economy's foreign assets (FA) and foreign liabilities (FL) as a percentage of GDP and the sum of FA and FL (FOPEN). For further notes, see Figure 1.

emphasizes the potential overlap between the roles that financial development and financial openness could play in economic development. For instance, like financial development, financial openness is believed to help agents diversify intertemporal or cross-sectional risks, and consequently increase the likelihood that high-risk, high-expected-return projects are not left out unfunded (Obstfeld, 1994; Bekaert et al., 2011).

Financial openness also shows a significantly negative impact on the FG relationship in lower-middle-income economies.[12] Given the relatively low levels of financial development and financial openness in these economies, it is unlikely that financial openness is 'competing' financial development and the "substitution" channel is driving these results. Rather, it appears that the increased vulnerability to international shocks that accompanies greater financial integration is weakening the FG nexus to the extent that it alters the positive FG relationship into a negative one. The fact that a similarly negative FG nexus is observed in low- and lower-middle-income economies when they are open to international trade is another indicator of the predominance of the volatility channel in such economies.

Our results are in contrast to the main policy implication of the Rajan and Zingales

[12] We focus only on FA, as it is the one with a statistically significant impact on the FG nexus according to the global factor invariance test results reported in Table 3.

(2003) hypothesis that economies benefit—in terms of economic growth—by opening up their capital accounts as this helps them to develop their domestic financial sector. While our study does not examine whether financial openness promotes financial development, it clearly shows that financial development is of little significance to economic development in states of very high financial openness. Nevertheless, our results should not be interpreted as implying a negative or negligible consequence of financial openness on economic development. In this regard, we have seen from the parametric regression results provided in Section 4.1 that financial openness has a significantly positive impact on economic growth in upper-middle and high-income economies. What our findings indicate, however, is that opening up capital accounts does not likely have a beneficial impact on economic growth if the benefit is expected to be delivered through enhanced growth-promoting financial development as advocated by Rajan and Zingales (2003).

4.2.3 Simultaneous trade and financial openness

One of the main features of the Rajan and Zingales (2003) hypothesis is that a simultaneous opening up of the trade and capital accounts is necessary for financial development to transpire. Baltagi et al. (2009) note that this view is in sharp contrast to most of the previous literature (e.g. McKinnon, 1991) that promotes a sequential approach where trade liberalization should come before financial liberalization. Accordingly, testing the validity of the main policy implication of the Rajan and Zingales hypothesis could more directly proceed by examining the impact of a simultaneous increase in trade and financial openness on the FG link. To this end, we have estimated a bivariate functional coefficient model in (3) and the results are depicted in Figure 3. Closer examination of the bivariate functional estimates reveals that overall patterns are, by and large, dominated by a single factor, namely, financial openness in high-income economies and trade openness in the remaining cross sections. The fact that trade openness dominates the bivariate factor results in most of the cross sections corroborates the global factor invariance test results documented in Table 3. It is worthwhile noting here that the univariate factor model results have shown that high trade openness enhances the FG nexus in upper-middle-income economies. Consequently, the fact that trade openness is a more influential factor than financial openness implies that a simultaneous increase in trade and financial openness strengthens the FG link in those economies. Hence, the Rajan and Zingales hypothesis may be used to promote openness as a means of achieving finance-induced growth in those economies provided that openness truly triggers financial development. But for the remaining cross sections, a high level of financial and trade openness is associated with a negligible, and at times a negative, FG nexus, most likely, because of the reasons conjectured in Section 4.2.1 for low- and lower-middle-income economies and in Section 4.2.2 for high-income economies.

5 Conclusions

In this paper, we examined the dependence of the FG nexus on various aspects of trade and financial openness. Our findings, which are fairly robust to a range of alternative and disaggregated openness measures, indicate that the impact of financial

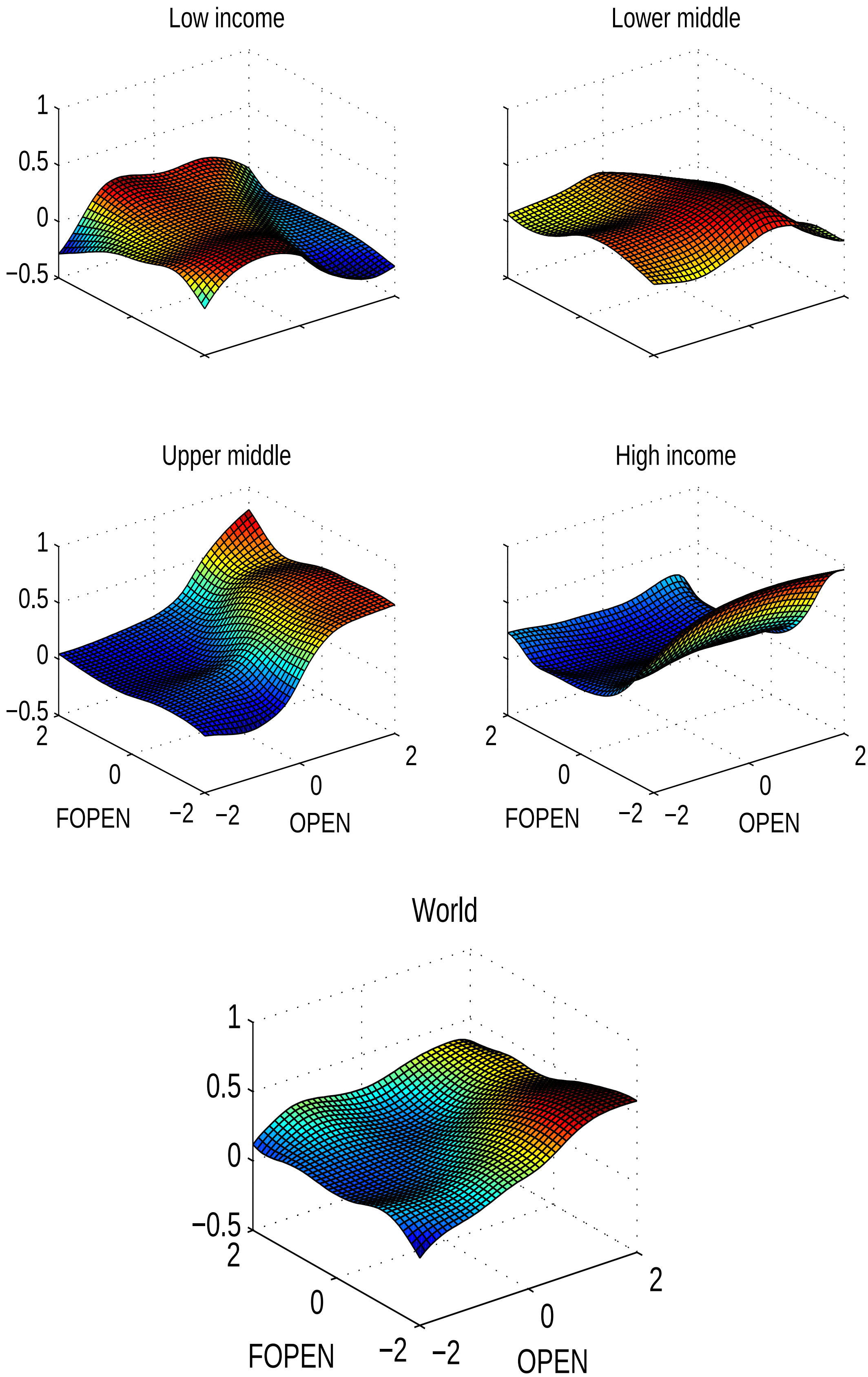

Figure 3: Functional coefficient model estimates of the FG nexus conditional on the level of trade openness (OPEN) and financial openness (FOPEN). The figures show estimated long-run effects $\hat{\beta}_1(\omega)$, with $\hat{\beta}_1$ on the vertical ($Z-$) axes and the factors $\omega^{(1)}$ and $\omega^{(2)}$ on the $X-$ and $Y-$axes respectively.

development on economic growth significantly depends on the degree of an economy's trade and financial openness. Most importantly, although financial openness might promote financial development as argued by Rajan and Zingales (2003), it is associated with an exceedingly diminishing impact of financial development on economic growth. The evidence on the impact of trade openness on the FG link is, however, mixed. Higher trade openness strengthens the FG link in upper-middle-income economies, but it has a weakening effect in low- and lower-middle-income economies. Finally, it is only in upper-middle-income economies that we find a significantly positive FG nexus in states of simultaneously high trade and financial openness. Therefore, our findings offer only limited support to the main policy implication emerging from the Ragan and Zingales hypothesis that opening up trade and capital accounts fosters economic growth by facilitating financial development.

This study demonstrates that, if the goal is to achieve a high level of finance-induced growth, theories or empirical findings showing that openness promotes financial development are not sufficient to suggest policies in favor of financial and trade openness. This highlights the need to coordinate the research direction that examines the determinants of financial development with the one that investigates factor dependence in the FG nexus. In this perspective, the research on the impact of government size and institutions on the level of financial development should be augmented by investigations of the impacts of these factors on the FG nexus. This is of immediate interest for future research.

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Appendix

A Semiparametric modeling

A.1 Estimation

Estimation and inference within stationary functional coefficient models is addressed in Cai et al. (2000). Cai et al. (2009) discuss functional estimation of regressions involving stochastically trending variables with stationary factors. In this study the functional parameters $\boldsymbol{\beta}(\omega)$ are estimated in a semiparametric fashion using the so-called the Nadaraya-Watson estimator (Nadaraya, 1964; Watson, 1964). This estimator is given by

$$\hat{\boldsymbol{\beta}}(\omega) = \frac{\sum_{i=1}^{N}\sum_{t=1}^{T}\tilde{x}_{it}\tilde{y}_{it}K_h(\omega_{it}-\omega)}{\sum_{i=1}^{N}\sum_{t=1}^{T}\tilde{x}_{it}\tilde{x}'_{it}K_h(\omega_{it}-\omega)}, \tag{6}$$

for a one-dimensional model, and

$$\hat{\boldsymbol{\beta}}(\omega^{(1)},\omega^{(2)}) = \frac{\sum_{i=1}^{N}\sum_{t=1}^{T}\tilde{x}_{it}\tilde{y}_{it}K_h(\omega_{it}^{(1)}-\omega^{(1)})K_h(\omega_{it}^{(2)}-\omega^{(2)})}{\sum_{i=1}^{N}\sum_{t=1}^{T}\tilde{x}_{it}\tilde{x}'_{it}K_h(\omega_{it}^{(1)}-\omega^{(1)})K_h(\omega_{it}^{(2)}-\omega^{(2)})}, \tag{7}$$

for a bivariate functional model.

For equations (6)–(7), $K_h(\cdot) = K(\cdot/h)/h$, $K(.)$ is a kernel function and h the bandwidth parameter. We employ the Gaussian kernel, $K(\cdot/h) = (2\pi)^{-1/2}\exp(-0.5(\cdot/h)^2)$. Regarding the bandwidth parameter h, we apply 1.8 times Scott's (1992) rule of thumb, i.e. $h = 1.8\hat{\sigma}_\omega(NT)^{-1/5}$ for a one-dimensional factor model and $h = 1.8\hat{\sigma}_\omega(NT)^{-1/6}$ for a bivariate factor dependent model, where $\hat{\sigma}_\omega$ is the estimated standard deviation of the factor observations. Note that, given that the factors are standardized, $\hat{\sigma}_\omega$ approximately equals to one.

A.2 Inference

Inference in the functional coefficient models closely follows the factor-based bootstrap approach of Herwartz and Xu (2009), which is less affected by the adverse effects of under- or oversmoothing of the functional estimates than wild or residual-based bootstrap approaches. The factor-based bootstrap is employed to test the factor-invariant case, $\boldsymbol{\beta}(\omega)=\boldsymbol{\beta}$, against a model which entails factor-dependent coefficients. Moreover, the factor dependence will be examined locally for a given value of the factor ω. To this end, bootstrap long-run parameter estimates $\hat{\boldsymbol{\beta}}^*(\omega)$ will be 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 resampling scheme destroys any systematic relationship between ω_{it}^* and the model parameters. Therefore, at any local point ω, if an estimate $\hat{\beta}_1(\omega)$ lies outside its 95% bootstrap confidence interval, then we reject the null hypothesis of a factor invariant FG nexus at location ω with 5% significance.

B List of economies included in each sample

B.1 Low-income economies

Cameroon, Cote d'Ivoire, Ghana, India, Kenya, Lesotho, Madagascar, Malawi, Nepal, Niger, Pakistan, Papua New Guinea, Senegal, Sierra Leone, Sudan, Togo.

B.2 Lower-middle-income economies

Dominican Republic, Ecuador, Egypt, El Salvador, Fiji, Guatemala, Honduras, Indonesia, Jordan, Paraguay, Philippines, South Africa, Sri Lanka, Swaziland, Syrian Arab Republic, Thailand, Vanuatu.

B.3 Upper-middle-income economies

Botswana, Chile, Costa Rica, Dominica, Gabon, Grenada, Malaysia, Malta, Mauritius, Mexico, Panama, Saudi Arabia, Seychelles, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, Turkey, Uruguay, Venezuela.

B.4 High-income economies

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