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RE-EXAMINING THE FINANCIAL DEVELOPMENT-OPENNESS NEXUS: NONPARAMETRIC EVIDENCE FOR DEVELOPING COUNTRIES

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This paper re-examines the nexus between financial development and openness in developing countries. Specifically, we test whether both financial and trade openness explain financial development and its variations across 44 developing economies. Questioning the functional specifications in previous studies, we propose a fully nonparametric modelling approach to validate the simultaneous openness hypothesis. Our findings from the parametric approach suggest that both openness dimensions positively impact financial development, providing a loose support for the simultaneous openness hypothesis. The results based on the nonparametric approach suggest a negative effect of closed economies (economies with relatively closed trade and capital accounts) on financial development, supporting the strong version of the simultaneous openness hypothesis. Correct model specification test results support the nonparametric model relative to the parametric model as appropriate for the sampled data. Our conclusion is therefore based on the nonparametric finding, which supports the simultaneous openness hypothesis for the selected developing countries.

JEL classification codes: C23, C51, F13, G29

Key words: financial development, financial openness, trade openness, nonparametric analysis, developing countries

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I. Introduction

There are two strands in the literature on the role of trade openness and capital account openness (financial openness) in financial development. One strand of the literature, especially the work by Rajan and Zingales (2003), argues that for financial development to take place, a country needs liberalization in both the trade and capital accounts; this is the "simultaneous" hypothesis on financial development. Having one of the openness dimensions without the other will mean that interest groups, especially industrial and financial incumbents as argued by Rajan and Zingales, will not be convinced to push for financial development. This simultaneity hypothesis proposed by Rajan and Zingales is in sharp contrast to the sequencing literature (e.g. McKinnnon, 1991) that argues that trade liberalisation should precede financial liberalisation. Though the argument put forward by Rajan and Zingales in support of their hypothesis is very interesting and intuitive, their paper lacks sound and robust empirical analysis to assess the validity of their hypothesis due to lack of data, aim of the paper and econometric methodology as argued in Baltagi et al. (2009).

Providing further empirical evidence on the openness hypotheses appears to be important in itself, helping to understand financial development. Furthermore, the policy implications depend on which of the two hypotheses is supported by the data. Baltagi et al. (2009) tested the openness hypothesis by proposing a model that incorporate the time series dimension that was not accounted for in Rajan and Zingales (2003). Using a dynamic panel GMM approach, Baltagi et al. (2009) find partial evidence to support the Rajan and Zingales hypothesis. Their study finds evidence for both openness dimensions and that "relatively closed economies stand to benefit most from opening up their trade and/or capital accounts". Irrespective of this, the authors indicate that banking sector financial development in relatively closed economies can still gain from opening up trade or capital accounts without the other.

Another strand of the research on financial development tends to focus on the political economy dimension rather than the openness hypothesis. Previous research in this area includes Clague et al. (1996), Pagano and Volpin (2005), Beck et al. (2000), Girma and Shortland (2008), and Huang (2009, 2010) among others. Assessing the role of political economy factors on financial development, Girma and Shortland (2008) examine the effect of a country's democratic characteristics and regime change on financial development for a panel of developed and developing countries. The empirical evidence from their study indicates that both regime stability and democracy promotes financial development in the studied countries. Huang (2010) also finds empirical evidence of a positive effect of institutional development on financial development for a panel of 90 countries, which is particularly strong for lower income countries, at least in the short run, while democratic transformation is usually followed by an increase in financial development.

One very important issue that is not addressed in the empirical literature is specification bias and the consequences of this for the estimates. All the studies specify a priori a functional relation between financial development and the respective regressors in the model, but whether the assumed functional specification is the "true/correct" specification that the data generating process (DGP) supports is often not tested. However, the econometric literature is clear on the fact that having the wrong specification implies that the expected value will not converge to the true value asymptotically. This has serious implication on the estimated parameters and their inferences. Secondly, if the "true" functional relation between financial development and say per capita GDP is quadratic but we specify it as linear, we get completely different implications. Additionally, we aim to examine the potential heterogeneity of financial development across developing countries and whether the observed heterogeneity can be explained by the level of income, trade openness, quality of institutions and financial openness.

The importance of getting the "true" functional specifications in empirical work cannot be over emphasized. We therefore propose to apply a data driven approach that relaxes the a priori functional specification assumption as usually done in the empirical literature to re-examine the openness hypothesis albeit using the model implemented in Baltagi et al. (2009). Our approach, unlike the parametric approach used by Baltagi et al. (2009), allow for all forms of interaction between the regressors in the model, not just the interaction between the two openness variables (trade and capital account). We propose a fully nonparametric approach that is more flexible in modelling the functional relations based on the DGP, which will help determine the "true" relation between financial development and its determinants and help assess the openness hypothesis in a manner that is free from possible functional specification bias. Besides, our approach will help validate whether the log-linear functional form usually applied by most of the previous researchers is appropriate, especially on developing countries' data. In this study, we focus on banking sector financial development, hence financial development refers to banking sector financial development.

The results from our study show that the popular log-linear specification usually applied in the empirical literature in this area of research may not be appropriate based on the non-parametric correct model specification test and the cross-validation scores (CVS) from the countries studied. We also find both openness variables to negatively impact financial development at low levels of both financial and trade openness. Also, the linear specification tends to be appropriate for some of the regressors. Additionally, both differences in the level of income and trade tend to be the likely factors responsible for the differences in financial development across the sampled developing countries. Moreover, consistent with the finding in Baltagi et al. (2009), our results also show that having one of the openness dimensions without the other still promotes financial development in our parametric model, whereas in the nonparametric model, we find a full support for the simultaneous openness hypothesis. Therefore our findings tend to provide a strong support for the Rajan and Zingales' hypothesis, since the nonparametric model is the appropriate model for our data.

The rest of paper is organised as follows. Section II provides details on the empirical model, while the data and results of the study are presented in section III. The summary and conclusion of the study is presented in section IV.

II. The model

A. Model specification

In order to assess the relationship between financial development and both capital and trade openness, we follow the model developed by Baltagi et al. (2009) and specify the baseline equation as:

$$\ln FD_{it} = \beta_0 + \beta_1 \ln FD_{it-1} + \beta_2 \ln Y_{it-1} + \beta_3 \ln TO_{it-1} + \beta_4 \ln FO_{it-1} + \beta_5 \ln Polity_{it-1} + \beta_6 (\ln TO_{it-1} \times \ln FO_{it-1}) + \mu_i + \eta_t + \varepsilon_{it}, \tag{1}$$

where FD is an indicator for financial development, Y is GDP per capita used as a proxy for income, TO is trade openness, FO is financial openness, $Polity$ represent quality of institutions, μ_i is country fixed effects, η_i is time fixed effects and ε_{it} is the random error term. All the variables are expressed in natural logarithms.

Equation (1) assumes a log-linear specification, which could be wrong and hence impose a functional misspecification bias on the model estimates. In order to account for possible misspecification bias in equation (1) and other forms of non-linearity not captured by the interaction term, we also model financial development more flexibly via a nonparametric model, expressed as:

$$\ln FD_{it} = m(X_{it}^{c}, X^{d}) + \varepsilon_{it}\ , \qquad (2)$$

where X_{it}^{c} is vector of all the continuous regressors, which include lagged financial development, income, trade openness, financial openness and quality of institutions; X^{d} is a vector of all the discrete regressors, which include both the time and country fixed effects; and m is a smooth function that is twice differentiable and additive. The key difference between the nonparametric model as expressed in equation (2) and a fully parametric model (1) is that the nonparametric model does not restrict the relationship a priori. Rather, it allows the DGP to determine the functional relation with more flexibility in the functional specification, incorporating all forms of non-linearity and interactions among the regressors. The expressions presented in equation (1) and (2) above pose two difficult estimation challenges: (a) the dynamic panel data bias (Nickell bias) and (b) the endogeneity problem, especially the institutional quality and GDP variables. Given that we have a long panel, we do not think the bias due to the correlation between the lagged dependent variable and the fixed effects is strong, since previous studies suggest that the Nickel bias is only serious in short panels (Cameron and Trivadi, 2005; Roodman, 2009). The second problem is however serious and needs to be corrected due to the fact that both GDP and institutions are endogenous in the models specified above. Both variables depend on the level of financial development and financial development depends on both variables. We therefore cannot rule out interdependence between these variables and hence feedback effects. The interdependency is evident from growth theories and empirics that link finance, institutions and growth (e.g., McKinnon 1973, Chinn and Ito 2006). We address this by adopting instrumental variable style as suggested and implemented in Ordás Criado et al. (2011), where we use lags of each of the regressors as valid instruments for their respective level.[1] This implies that the vector X_{it}^{c} in equation (2) now becomes $X_{it}^{c}(\ln FD_{it-3}, \ln Y_{it-2}, \ln TO_{it-2}, \ln FO_{it-2}, \ln Polity_{it-2})$ to control for the endogeneity problem. A similar approach is adopted for the fully parametric model presented in equation (1).

In testing the simultaneous openness hypothesis, we apply the following procedure as proposed in Baltagi et al. (2009), based on three key scenarios for

[1] The applied instrumental variable approach adopted for the kernel estimator might not be a proper dynamic and endogeneity corrected kernel estimator for panel data, but it serves as a first attempt to handle this issue of endogeneity in a nonparametric dynamic panel setting in this field of research. This approach follows that of Ordás Criado et al. (2011). There are few recently developed nonparametric dynamic panel estimators such as those proposed by Su and Lu (2013) and Henderson et al. (2013) but we argue that our approach is a reasonable first attempt in estimating a dynamic nonparametric panel for financial development and openness.

our testing objective. There is partial support for the simultaneous openness hypothesis if the partial effects of each of the openness variables at low levels of both trade and capital account openness is positive but become negative as each of the openness levels increases to a high level. The implication is that economies that are closed to both trade and capital account stand to benefit in terms of larger impact on financial development from opening up both relative to opening either trade or capital account.

For full support of the simultaneous openness hypothesis, the partial effects of each of the openness variables at low levels of the other is negative, implying that having one of the openness dimensions without the other will not result in a positive effect on financial development. Conversely, the effect at high levels of each of the openness variables will result in a positive marginal effect on financial development.

For a loose version of the simultaneous openness hypothesis, more of either trade or capital account openness should increase financial development. If this is satisfied, it implies the marginal effect of each type of openness on financial development is positive, with either the interaction term being positive or insignificant (zero).

B. Estimation methodology

Our estimation strategy follows two steps. In the first step we estimate equation (1) using fully parametric econometric methods appropriate for dynamic panel analysis. We then estimate equation (2) using a nonparametric approach to assess if there is an influence of functional form misspecification for the fully parametric results. For the fully parametric model, we apply three different estimators, fixed effect estimator (FE), corrected least squares dummy variable (LSDVC) estimator and the Arellano and Bond GMM estimator. Both LSDVC and GMM estimators were designed purposely to handle dynamic panels to correct for Nickel bias, especially in panels with short time periods, where the bias is severe. In panels with time period above 30 years, the bias created by the correlation between the lagged dependent variable and fixed effects is small (Judson and Owen, 1999). In such instances, the FE estimator performs well relative to both the GMM and LSDVC. The Arellano and Bond GMM estimator differences the model to get rid of the fixed effects, while LSDVC uses asymptotic expansion techniques to approximate and correct the small sample bias of the LSDV estimator for dynamic panels with short time periods.

The model presented in equation (2) is estimated using a kernel based nonparametric approach, specifically a local-linear kernel approach with mixed regressors proposed by Racine and Li (2004). The choice of this estimator relative to other kernel approaches such as the local constant kernel estimator is due to its ability to achieve the same rate of convergence as in a "truly" specified parametric model if the DGP is indeed linear, and to correct for boundary bias, which is not the case for the other kernel based estimators, especially the local constant estimator (Li and Racine 2007). For detailed derivation of the local-linear kernel estimator with mixed regressors, see Gyimah-Brempong and Racine (2010), Ordás Criado et al. (2011), and Karimu and Brännlund (2012).

The estimation strategy is in three steps. In the first step the optimal bandwidth is determined for the local-linear kernel estimator implemented in estimating $m(.)$, by using a least square cross-validation approach. In the second step, we implement the optimal bandwidth found in the first step to estimate equation (2), and in the final step we obtain the partial regression plot and partial gradient plots for each of the regressors, adopting a "wild" bootstrap method to construct heteroskedastic consistent standard errors for the confidence bands for the partial regression and partial gradient plots. The estimation of equation (2) is done using the local linear kernel[2] estimator proposed by Li and Racine (2007) to handle panel data with both continuous and discrete variables. We apply two product kernels, one for the continuous regressors and the other for the discrete regressors in the model. In this paper, the Gaussian kernel is chosen for the continuous regressors and Aitchison and Aitken (1976) is the product kernel implemented for the discrete regressors.

C. Nonparametric correct specification test

We propose to test the popular log-linear specification usually applied in the empirical literature (the FE for time periods above 30 years) by applying the J_n test. This is a nonparametric consistent specification test for a parametric model, where the null hypothesis is that a parametric model is correctly specified and stated below. The test has been utilized in various papers using nonparametric estimations, e.g, Gyimah-Brempong and Racine (2010), Li and Racine (2007), and Karimu and Brännlund (2012). We refer the reader to those papers for details on the testing procedure.

[2] There exist several kernel estimators and they include the local constant kernel estimator, local linear kernel estimator and local polynomial kernel estimator. See Fan and Gijbels (1996) for an in-depth treatment of local linear and polynomial kernel estimators.

III. Data and results

A. Data description and sources

We utilize an annual panel dataset consisting of 44 developing countries over the period 1975-2010 obtained from different sources (see Appendix, subsections C and D, for descriptive statistics, correlation matrix and sampled countries). Since we consider only banking sector financial development (FD), we use the indicator on private sector credit provided by the banking sector expressed as a percentage of GDP and sourced from the World Development Indicators (WDI) of the World Bank. According to Rajan and Zingales (2003), private sector credit measures "the ease with which any entrepreneur or company with a sound project can obtain finance". It is defined in the WDI to include financial resources provided to the private sector by other depository corporations (deposit taking corporations except central banks), such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. Importantly, since it excludes credit granted by the banking sector to the public sector, it is the most preferred measure of financial development of the banking sector (Beck et al. 2003). Other indicators of financial development which we do not consider in this paper include among others bank assets, liquid liabilities and stock market capitalization as a percentage of GDP.

Regarding financial openness, we include two alternative measures of capital account openness similar to the ones used in Baltagi et al. (2009). The first *de facto* or price-based measure proxies for financial globalization (Lane and Milesi-Ferretti 2006) and is defined as the volume of a country's external assets and liabilities. Specifically, we utilize WDI data on net foreign assets (NFA) defined as the sum of foreign assets held by monetary authorities and deposit money banks, less their foreign liabilities (share of GDP). This indicator is considered a reasonable and useful measure that adequately tracks the historical trend of a country's financial openness (Baltagi et al. 2009). The second measure of financial openness is the *de jure* capital account openness index (KAOPEN) developed by Chinn and Ito (2006). The KAOPEN index (first component) is constructed from a principal component of four International Monetary Fund (IMF) binary dummy variables that codify the tabulation of restrictions to cross-border capital transactions/controls as reported in the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). These indicator binary variables measures the existence of multiple exchange rates, restrictions on current account and capital account transactions, and a variable that indicates a requirement for the surrender of export proceeds. One key advantage of the KAOPEN index is that it measures the extent and intensity of capital controls (Chinn and Ito 2006). Higher values of KAOPEN imply greater financial openness.

Trade openness on the other hand is measured as the sum of exports and imports of goods and services (% of GDP) and is also sourced from the WDI. This variable measures the extent of actual exposure to trade interactions and accounts for the effective level of integration (Kim et al. 2010). Other control variables in our model include data on real GDP per capita, measured in 2005 constant prices (WDI) and institutional quality data obtained from the International Country Risk Guide (ICRG). The ICGR rating index comprises 22 variables measuring political, financial and economic risk in each country. We use the composite index of these three indices with scores ranging from 0 to 100 (or 1) to classify very low (80 to 100) and very high risk (0 to 49.9). A higher score or index implies better institutional quality. A better institutional quality would create an environment that ensures respect for and security of contracts and property rights.

B. Results

We first present the parametric results and provide some discussion on the results and later present the nonparametric results, which we discuss, the results and assess the influence of functional forms on the results.

Parametric results

In Table 1, we present the results from FE, LSDVC and the GMM estimators in order to compare the estimates and robustness of the direction of association of financial development and its covariates. In all cases we do not find significant interaction effect between trade openness and financial openness. The sign however is consistently negative at any of the conventional levels. Both trade openness and financial openness are positive and significant at the 5% level for both the FE[3] and GMM model's estimates, whereas only financial openness is insignificant in the LSDVC model. This finding suggests that both trade and financial openness are important in financial

[3] In the FE model only lagged financial development enters the model as endogenous, where the third lag is used as a valid instrument based on the xtivreg approach in Stata, where it is computed as $(z'y)^{-1}z'y$, while the other variables enter as exogenous based on their respective second lags.

development in developing countries and provide a loose support to the Rajan and Zingales hypothesis. Moreover, our results are qualitatively in line with the finding by Baltagi et al. (2009). The interaction term between trade openness and financial openness is not significant, unlike Baltagi et al. (2009) where it was significant. The differences in the statistical significance of the interaction could be explained by many factors including differences in countries' composition and in time period.

Table 1. Parametric regression results from different panel estimators (all variables are in logs)

Regressors	FE	FE	LSDVC	Diff. GMM
Lagged Financial Development	0.560***	0.559***	0.843***	0.787***
	(0.020)	(0.020)	(0.013)	(0.073)
Income (lagged)	0.266***	0.269 ***	0.140***	0.094*
	(0.045)	(0.046)	(0.029)	(0.051)
Trade Openness (lagged)	0.225***	0.373 *	0.130	0.203*
	(0.035)	(0.147)	(0.154)	(0.110)
Financial Openness (lagged)	0.245***	0.198**	0.091**	0.101**
	(0.046)	(0.064)	(0.043)	(0.046)
Quality of Institution (lagged)	0.029	0.029	-0.020	-0.010
	(0.027)	(0.027)	(0.024)	(0.021)
Trade*Finance (lagged)		-0.152	-0.020	-0.078
		(0.148)	(0.156)	(0.106)
Time dummies	yes	yes	Yes	No
Observations	1486	1486	1,486	1,440
Number of countries	44	44	44	44
Sample period	1975-2010	1975-2010	1975-2010	1975-2010
Number of instruments				38
AR2 test (p-value)				-0.75
				[0.453]
Sargan test (p-value)				29.07
				[0.616]
Adjusted R-square	0.49	0.49		
Jn- Test	13.023***	13.007***		
	[0.000]	[0.000]		

Notes: Significance codes: *** 0.001 ** 0.01 * 0.05, *Jn*-Test is the nonparametric correct specification test with the Null of correct specification for the parametric model, values in parenthesis are the robust standard errors, while values in the square brackets are the p-values. AR2 is second order serial correlation test. Sargan test is the test for over-identification of restrictions. We use the second lag of previous financial development, income, trade openness, financial openness and quality of institution as instruments in the estimation for all models, while lagged financial development variable is the only variable considered as endogenous variable in the GMM model, we also did not include time dummies in GMM model due to too many instruments when included. Individual effects are included in the analysis but not reported for FE and LSDVC.

The estimated income coefficient is significant and positively associated with financial development across the different estimators, which is consistent with the finance and growth literature. Quality of institutions on the other hand is insignificant across all estimators and at any of the conventional significance levels.

Given the relatively long time period of 36 years in our panel, results based on the FE are preferred due to the fact that the time period is above the 30 year threshold, where FE tends to outperform both LSDVC and GMM. We have also utilized instrumental variable approach (IV) in the estimation to handle potential endogeneity problems. The adjusted R-square of the FE model is 0.49, which is lower than the value from the nonparametric model (0.98) reported in Table 2 below.

Nonparametric results

In general, we can infer the relationship of each of the regressors with financial development by looking at the optimal bandwidth values. The judging rule is that regressors with a large bandwidth value will be linear and those with a small bandwidth value will be nonlinear. The results on the optimal bandwidth are reported in Table 2, which shows that all the regressors are linear except income and trade openness. However for easy interpretation on whether a regressor is linear or non-linear, we rely on both the partial regression and gradient plots, which are discussed below.

Table 2. Nonparametric panel regression results with optimal bandwidth

Regressor	Optimal Bandwidth
Lagged Financial Development	1540624
Income(lagged)	0.6544
Trade Openness(lagged)	0.8068
Financial Openness(lagged)	620800
Quality of Institution(lagged)	3.7234
Time dummies	0.4897
Country effect	0.0018
Regression Type: Local-Linear	
Bandwidth Selection Method: Least Squares Cross-Validation	
Cross-Validation Score: 0.04583	
Adjusted R-square: 0.98	

Note: we use the second lag of income, trade openness, financial openness, quality of institutions as instruments for their respective level to control for endogeneity.

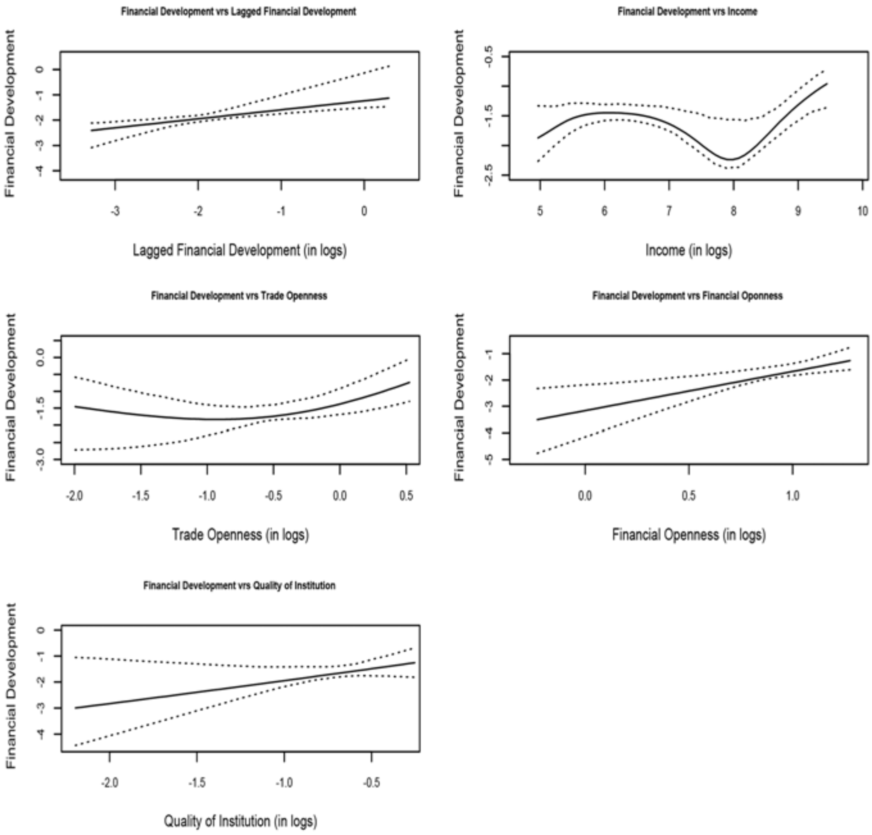
The results as reported in Figure 1 show the partial regression. Figure 1 can be interpreted as follows: the solid lines are the partial regression lines and show the relationship between the dependent variable (financial development) and each of the regressors, while the dotted lines are the 95% confidence band constructed using a "wild" bootstrap approach that is robust to heteroskedasticity. A positively sloped regression line along its entire domain of the regressor implies a positive linear relationship, while if the reverse is true it implies a negative relationship. However, a regression line that is positive in certain domain of the regressor and negative in others reflects a non-linear relationship with the dependent variable.

The nonparametric results indicate no departure from linearity in the case of previous financial development, financial openness and quality of institutions and are therefore consistent with the linear specification usually applied in the empirical literature on financial development. In terms of the direction of the relationship, we find positive effects of previous financial development, financial openness and quality of institutions on financial development from the partial regression plot, which is consistent with the finding in Chinn and Ito (2006), Girma and Shortland (2008), Baltagi et al. (2009), based on fully parametric approach.

However, we find evidence of non-linear relationship between financial development and trade openness as well as with income. The estimated partial regression line for trade openness has a negative slope for countries with low trade openness but turns positive for countries with relatively high trade openness. The income variable in general behaves similarly to trade openness in the sense that countries with low incomes tend to be associated with low level of financial development relative to countries with high income.

We further quantify the relationships as presented in Figure 1 by taking the respective gradients of the partial regression lines (the gradient plot is in Appendix A). The idea is to calculate the gradients across the entire domain of each of the regressors, which are translated directly as elasticities. Consistent with the partial regression plot, the estimated elasticities for previous financial development, financial openness and quality of institutions are constant across their respective domains and are 0.35, 1.44 and 0.91, respectively. Using nonparametric significance test for each of the variables in the model, the results indicate each of the variables is significant at the 5% level of significance, as reported in Table 3. The magnitude of the elasticities for previous financial development, financial openness and quality of institutions also mean that they are significant in economic terms, especially institutional quality and financial openness, which are approximately unitary elastic.

Figure 1. Partial regressions plots for lagged financial development, income, trade openness, financial openness and quality of institutions



Note: Income, trade openness, financial openness and institutions are lagged (second lag) to control for endogeneity.

The estimated income elasticity based on the gradient estimate on the other hand is non-linear, and varies from –0.95 to 0.81, with the negative elasticity range associated with a low per capita income level, while the positive range associated with high per capita income level. This implies that, in general, low incomes have negative effects on financial development, while high incomes tend to have positive effects on financial development. The implication is that countries with low per capita income tend to have low financial development relative to countries with high per capita income. The estimated elasticity for trade openness also varies across its domain and range from –0.36 to 0.96 as trade openness increases. The

Table 3. Nonparametric t-values for the various regressors

Regressor	P-value:
Lagged Financial Development	0.000 ***
Income (lagged)	0.000 ***
Trade Openness(lagged)	0.000 ***
Financial Openness(lagged)	0.010025 *
Quality of Institution(lagged)	0.001 **
Time dummies	0.000 ***
Country effect	0.000 ***

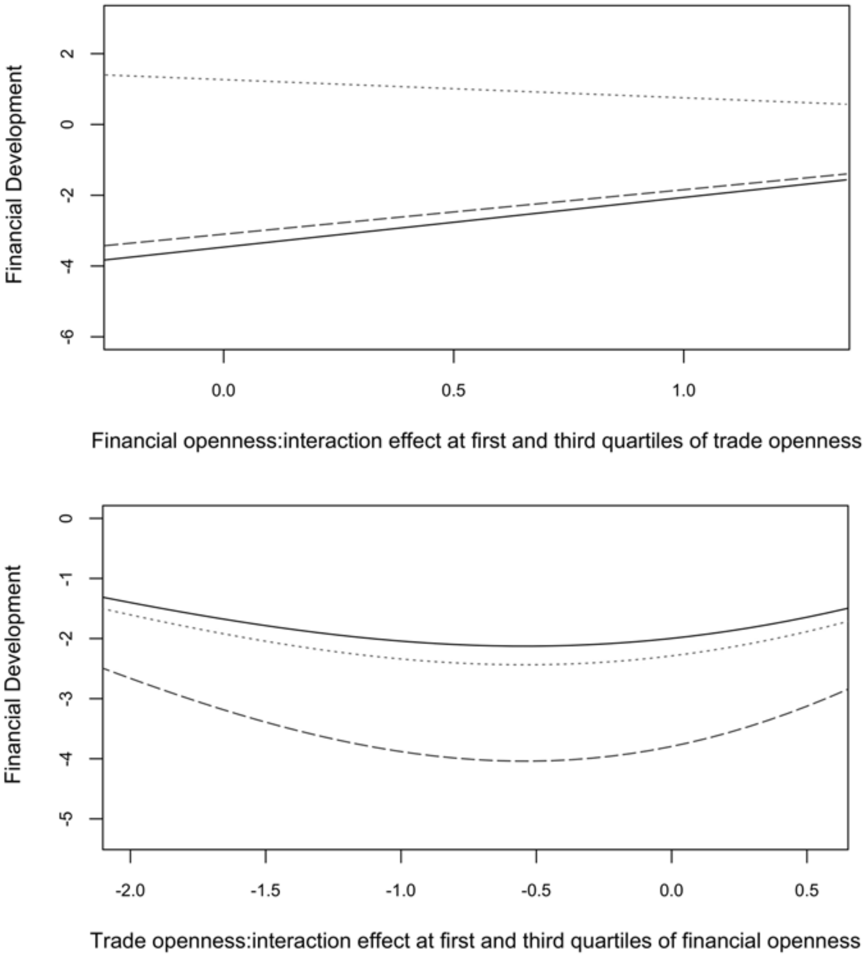
Note: *** 0.001 ** 0.01 * 0.05 denote significance codes

implication of this is that both low per capita income level and trade openness tend to discourage financial development while the reverse is true for high levels of both trade openness and per capita income. The results show both openness variables (trade and financial) are significant in our model, indicating the need of both for financial development.

In order to assess the influence of each of the openness variable on the effect of the other on financial development, thus the interaction effects, we plot the partial regression of financial openness at different levels (first and third quartiles) of trade openness and also the partial regression of trade openness at different levels of financial openness. This approach makes the effect of interaction between trade and financial openness on financial development clear. This exercise is presented in Figure 2 and indicates that at the first quartile of trade openness, financial openness has a negative relationship with financial development, but this negative relationship turns positive at the third quartile of trade openness. The negative interaction effect at the first quartile of trade openness is consistent with the finding in Baltagi et al. (2009), while the positive effect at the third quartile is contrary to the finding. The difference in the interaction of the openness effects on financial development reveals information that was hitherto masked by the parametric interaction effect as in Baltagi et al. This implies that at low level of trade openness the effect of financial openness on financial development is negative, lending support for the strong version of the simultaneous openness hypothesis.

On the other hand, we find that at a lower level of financial openness (first quartile), for levels of trade openness below –0.5 in log scale, trade openness tends to have a similar negative effect in terms of pattern of financial development, while the slope is approximately zero above –0.5. A similar pattern is shown by the interaction effect at the third quartile, except that the slope becomes positive at trade openness levels above –0.5 in the log scale. Again we find a switch of the interaction effect from negative to positive which was masked in the parametric model. However the effect of trade openness at a higher level of financial openness (third quartile) is higher in absolute terms (relatively steep slope) than that at lower level of financial openness (first quartile). The slope of the first quartile interaction line is less dramatic

Figure 2. Partial regression plots of the interaction effect of trade and financial openness on financial development



Note: solid line represent the partial regression line for trade and financial openness, while the red dotted and blue dash lines are the interaction effects evaluated at the first and third quartiles of trade and financial openness, respectively.

relative to that of the third quartile interaction line in the plot for trade openness. The implication is that the effect of trade openness on financial development at low levels of financial openness tends to be negative at low levels of trade openness but turns to zero at higher levels of trade openness, thus providing support for the strong version of the simultaneous openness hypothesis.

The evidence from both interaction effects suggests support for the simultaneous openness hypothesis since the effect of trade openness (capital account openness) on financial development at low levels of capital account openness (trade openness) is negative but as the levels of both openness variables increase, their effect on financial development becomes positive, which is line with the strong simultaneous openness hypothesis.

The preferred fully parametric model (FE) was subjected to a non-parametric correct model specification test to determine if the assumed specification was appropriate. The test conclusively rejected the fully parametric specifications at the 1% significance level (the result is reported in Table 1). The implication is that the assumed parametric specification is not able to completely handle all the non-linearity in the DGP, so possible functional misspecification bias cannot be ruled out.

C. Robustness checks

We also undertook a robustness analyses to assess how sensitive out main results are to the choice of proxy for financial openness. In this regard we used the capital account openness index KAOPEN developed by Chinn and Ito (2002, 2006). The results show no significant difference for one of our variables of interest (capital account openness) in terms of pattern and direction but differences arise with respect to trade openness (the gradient plots are in Appendix B), which tends to have negative effect on financial development for countries that have high levels of trade openness. In general, there are some differences especially on covariates such as income and lagged financial development and trade openness, which could be driven by measurement errors in the construction of the KAOPEN index, which is based on a summary of dummy variables that does not take into account variability of the underlying economic variables that they represent. Therefore the results from the new measure for capital account openness have to be interpreted with caution. This suggests that the measure used to proxy capital account openness influences the conclusion and therefore is not robust to variables that are likely constructed with some level of measurement errors.

V. Summary and conclusion

We examine the simultaneous openness hypothesis for a panel of developing countries covering the period 1975-2010. Unlike previous studies, we apply a flexible fully nonparametric approach that relaxes functional specification and is therefore robust to functional specification bias. Furthermore, the approach allow for all forms of interaction between the regressors in the estimation process and is therefore appropriate in accounting for all forms of non-linearities. We also controlled for potential feedback effects by using lags of each of the regressors as valid instruments for their current level.

Findings from the study show that both financial and trade openness significantly influence financial development and that having low levels of both openness variables tends to have a negative effect on financial development, whereas having high levels of both openness variables tends to have a positive effect on financial development for the selected developing countries. This therefore provides support for the strong version of the simultaneous openness hypothesis. Moreover, the study reveals that both income and trade openness are non-linear and therefore specifying the relationship as linear is likely to result in specification bias for the case of developing countries. Additionally, both elasticities tend to vary across their respective domain, with both low trade openness and income per capita having a negative effect on financial development, while higher levels of both tend to have positive effect on financial development. This finding reveals that the effect of both trade openness and income on financial development is country-specific. Consequently, countries that are more open to trade and at a high income per capita level tends to develop their financial sectors more relative to those with both low trade and income. This finding is consistent with Huang and Temple (2005) and to some extent the long-run estimates in Kim et al. (2010) for low and middle-income countries. Kim et al. (2010) provided evidence that the level of economic development affects the trade openness-financial development link in a non-linear form. Their study indicates that in low and middle-income countries trade openness tends to have positive long-run effect on financial development, while in high-income countries it has a negative long-run effect. Though our finding is consistent with Kim et al.'s, our approach provides more flexibility in the estimation, which allows the income effect to be country-specific, while Kim et al. only allow group specific income effects and therefore miss out the within group dynamic effects, especially the negative effect of both income and trade openness at low levels of trade and income.

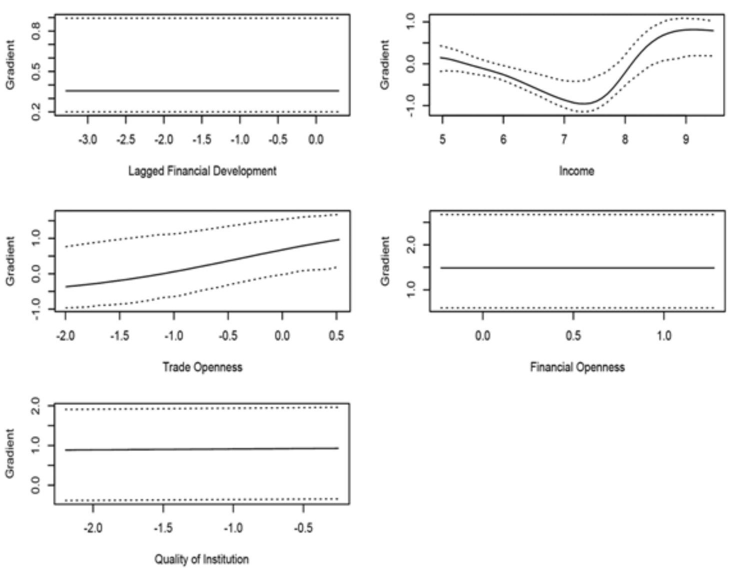
Furthermore, the findings indicate that previous financial development, financial openness and quality of institutions do not depart from linearity, which is in line with the linear assumption regarding the functional specification for most of the previous studies. Both previous financial development and the quality of institutions tend to have significant positive effect on financial development. However, the effects appear not to vary across countries within our sample.

The implication from all this is that income per capita and trade openness and the interaction between trade openness and capital account openness are the factors that are most likely to account for the differences in financial development in developing countries. Given the interactive nature of the regressors in our approach, these results lend support to the literature that argues for simultaneous economic and political liberalization due to the possible positive effects and interaction between economic activities, institutions and openness.

Appendix

A. Gradient plot for each of the partial regression lines reported in Figure 1

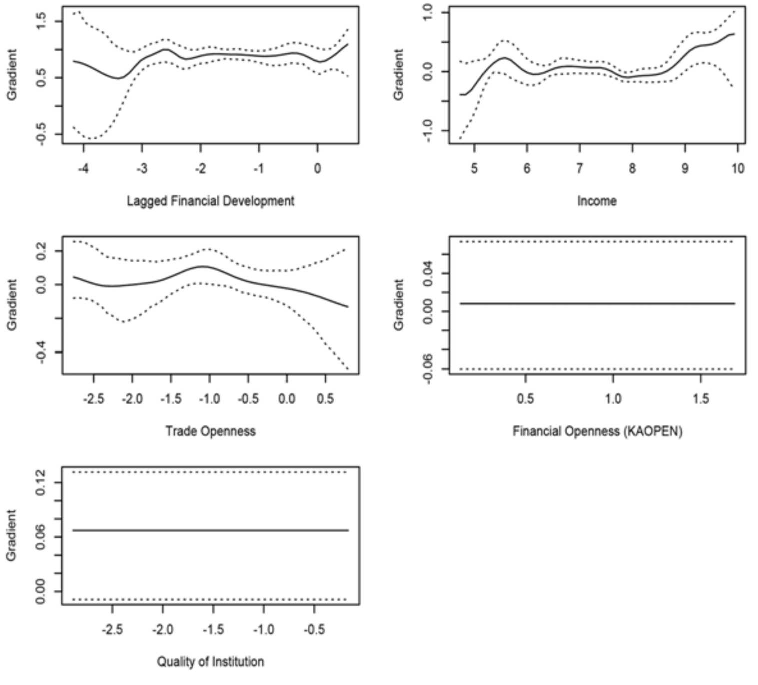
Figure A1. Gradient (elasticities) estimates from the nonparametric regression



Note: Income, trade openness, financial openness and institutions are lagged (second lag) to control for endogeneity.

B. Model based on KAOPEN as proxy for financial openness

Figure A2. Gradient plot for model based on KAOPEN as the proxy for financial openness



C. Descriptive statistics and correlation matrix

Table A1. Descriptive statistics and correlation matrix

Summary statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Private sector credit (% of GDP)	1542	32.023	26.838	1.542	167.536
Real GDP per capita (US$ 2005 prices)	1578	2,454.14	2706.962	113.008	2,0625.1
Trade openness (% of GDP)	1535	65.388	29.667	6.320	220.407
Financial openness (NFA % of GDP)	1583	-48.858	48.072	-406.555	95.967
Financial openness (KAOPEN)	1574	-0.374	1.294	-1.864	2.439
Institutional quality (0 – 1)	1584	0.455	0.142	0.056	0.850

Correlation matrix

	Private sector credit	Real GDP per capita	Trade openness	Financial openness (NFA)	Financial openness (KAOPEN)	Institutional quality
Private sector credit	1					
Real GDP per capita	0.3866	1				
Trade openness	0.3983	0.184	1			
Financial openness (NFA)	0.1108	0.248	-0.1624	1		
Financial openness (KAOPEN)	0.1706	0.2617	0.2199	0.0831	1	
Institutional quality	0.3096	0.2334	0.2024	0.0926	0.1313	1

D. Country list

Algeria, Bangladesh, Bolivia, Botswana, Cameroon, Chile, Costa Rica, Cote d'Ivoire, Equador, Egypt, El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Honduras, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Malawi, Malaysia, Mexico, Morocco, Nigeria, Niger, Pakistan, Paraguay, Philipinnes, Senegal, South Africa, Sri Lanka, Syria, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uruguay, Venezuela, Zambia, Zimbabwe.

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