

Thresholds in the Process of International Financial Integration:

Supplementary Material

The supplementary material below provides additional analysis of the related literature and further information and results on the semi-parametric approach used in the paper.

Literature Appendix:

- Tables 1-4 of the literature appendix provide reviews of previous empirical papers on the interaction effects of financial openness and growth in relation to four main categories of interaction variables – financial depth, institutions, income level and trade openness. Each of the tables contains details of the country and time coverage of the study, the econometric methodology, the dependent variable, the financial openness variable employed, the interaction or threshold variables and approaches used and the main findings on interaction effects.
- Table 5 provides more detailed information of the linear interaction effect estimates of a range of studies examining financial depth interaction variables, highlighting the variation in estimates of the range over which the overall financial openness coefficient is positive.

Semiparametric Appendix:

- The first section of the appendix provides background information on the differencing approach to partial linear models, drawing on Yatchew (1998, 2003) and Yatchew and No (2001).
- Analysis of the nonparametric relationship between financial openness and growth:
 - Figure 1 provides scatter plots of the relationship between unconditional growth and gross financial openness by sub-samples defined by quintiles of financial openness.
 - Figures 2 - 4 provide scatter plots, and estimated non-parametric plots, of the relationship between growth residuals from baseline parametric regressions against financial openness to GDP (measured as gross assets and liabilities, total external liabilities, FDI and portfolio equity external liabilities and debt external liabilities in Figures 2-4 respectively). Figure 2 uses a log scale for gross financial openness which helps illustrate the sample datapoints given the outliers in the data.
- Analysis of the nonparametric relationship between gross financial openness (external assets plus liabilities to GDP), financial depth and growth:
 - Figure 6 provides scatter plots of the relationship between unconditional growth and gross financial openness by sub-samples split by credit-to-GDP.
 - Figures 7 illustrates, using the double residual non-parametric, the estimated association of residual growth from the first-stage parametric regressions with the interaction effects of gross financial openness and credit-to-GDP.
- Analysis of the nonparametric relationship between alternative measures of gross financial openness, namely FDI and portfolio equity external liabilities to GDP and debt external liabilities to GDP, financial depth and growth:
 - Figures 8 and 9 replicate Figure 6 with the alternative financial openness measures.

- Figures 10 and 11 illustrate cross-sections of the estimated non-parametric association of residual growth, from the first-stage parametric regressions, with financial openness and credit-to-GDP for different levels of credit to GDP and financial openness.
- Figures 12 and 13 are 3D illustrations of the non-parametric estimated relationship between residual growth, from the first-stage parametric regressions, with financial openness and credit-to-GDP with the sample datapoints added to the plots.
- Analysis of the nonparametric relationship between gross financial openness (external assets plus liabilities to GDP), trade openness and growth:
 - Figure 14 provides scatter plots of the relationship between unconditional growth and gross financial openness by sub-samples split by trade openness-to-GDP.
 - Figure 15 is a 3D illustration of the estimated non-parametric association of residual growth, from the first-stage parametric regressions, with financial openness and trade openness-to-GDP.
- Analysis of the nonparametric relationship between gross financial openness (external assets plus liabilities to GDP), institutional quality and growth:
 - Figure 16 provides scatter plots of the relationship between unconditional growth and gross financial openness by sub-samples split by values of aggregate institutional quality index.
 - Figure 17 is a 3D illustration of the estimated non-parametric relationship between residual growth, from the first-stage parametric regressions, with financial openness and institutional quality with Figure 19 adding the sample datapoints to this plot.
 - Figure 18 illustrates cross-sections of the estimated non-parametric relationship between residual growth, from the first-stage parametric regressions, with financial openness and institutional quality at different values of institutional quality and financial openness.

LITERATURE APPENDIX

Literature Appendix Table 1: Interaction effects: Financial depth (FD)

Study	No. of econ. / period	Econometric methodology	Dependent variable	Financial openness variable	Interaction /threshold variables	Interaction/threshold approach	Main findings on interaction effect
1. FDI as financial openness (FO) measure							
Hermes and Lensink (2003)	67 developing (1970-1995)	Cross section OLS	Growth of real per capita GDP	Gross FDI inflows to GDP	Private bank credit to GDP	Linear	<i>Positive significant coefficient on interaction of FDI with FD variables.</i>
Alfaro et al (2004)	71 (1975-1995) for banking variables 50 (1980-1995) for stock market variables	Cross section OLS plus IV	Growth of real per capita GDP	Net FDI inflows to GDP	Banking: liquid liabilities to GDP; commercial bank assets to commercial bank plus central bank assets; private credit to GDP; private bank credit to GDP. Stock market: value traded to GDP; stock market capitalization to GDP.	Linear	<i>Positive significant coefficient on interaction of FDI with FD variables. Robust to additional controls and IV estimation.</i>
Durham (2004)	Up to 62 (1984-1998)	Cross section OLS	Growth of real per capita GDP	FDI flows from 1979-1983 (OECD and IFS measures) and net portfolio equity inflows from US from 1979-1983	Stock market capitalization to GDP	Linear	<i>Mixed results. Interaction coefficient positive significant for FDI using OECD data and with net portfolio equity inflows but insignificant with FDI using IFS data.</i>
Carkovic and Levine (2005)	Up to 68 (1960-1995)	Cross section OLS and 5-yearly panel dynamic system GMM	Growth of real per capita GDP	Gross FDI inflows to GDP	Private credit by financial intermediaries to GDP	Linear	<i>Mixed results. Interaction coefficient positive significant in cross-section but not significant in panel system estimation.</i>

Literature Appendix Table 1 (continued): Interaction effects: Financial development (FD)

Study	No. of econ./period	Econometric methodology	Dependent variable	Financial openness variable	Interaction /threshold variables	Interaction/threshold approach	Main findings on interaction effect
2. Other FO measures							
Kraay (1998)	n.a. ^a (1985-1997)	Cross-section OLS and IV. Event study	Growth of real per capita GDP	AREAER share; Quinn index; gross capital flows to GDP	M2 to GDP; domestic private credit to GDP; 1- average number of banking crises per year; freedom to undertake “non-traditional” banking activities	Linear (for regressions) Sample split (above/ below median) for event study	<i>Little evidence of interaction effects. Linear interaction coefficients either insignificant or mixed sign. Similar results with event studies.</i>
Arteta et al (2001)	Up to 62 (1973-1992)	Cross section and sub-period panel pooled OLS	Growth of real per capita GDP (PPP)	Initial value of Quinn capital account liberalization index	Initial liquid liabilities to GDP	Linear	<i>Coefficient on FD interaction term insignificant</i>
Bekaert et al (2005)	Up to 95 (1980-1997)	5-yearly panel (overlapping periods) GMM	5-year average growth rate of real per capita GDP	De jure international equity market liberalization	Private credit to GDP Stock market turnover	Sample split: Above/ below median	<i>Countries with higher FD have significantly higher growth gain post-liberalization</i>
Hammel (2006)	13 (1982–1995)	FE panel 3-year pre and post-liberalization	3-year growth in real sectoral value added	Bekaert et al de jure international equity market liberalization	Stock market capitalization to GDP	Sample split: various (base result for >10% GDP)	<i>Positive sig. coefficient on interaction of sectoral external finance dependence and liberalization for countries with stock cap. over 10% GDP (insig. if median split used)</i>
Prasad et al (2006)	83 (for aggregate analysis) (1980-1990)	Country and industry FE	Growth in real sectoral value added	Stock liabilities and gross and net flow liabilities to GDP: FDI; FDI and portfolio. De jure: Chinn-Ito; Edwards.	Private sector credit to GDP	Sample split: below median	<i>Generally negative significant coefficient on interaction of external finance dependence of industry and FO measure for countries with below median FD.</i>
Coricelli et al (2007)	31 European economies, 1996-2004	Annual panel dynamic GMM	Growth of real per capita GDP	Stock of external liabilities and assets plus liabilities to GDP: total, FDI; portfolio and other flows	Private sector credit to GDP and stock market capitalization plus private sector credit to GDP	Sample split: various (10% of GDP gradations) ^b	<i>Evidence supportive of non-linear interaction with coefficient on financial integration positive for financial development measures in the range 60-150% of GDP.</i>

Notes:^a Number of countries in interaction regressions not indicated in Kraay (1998). Financial openness measures are available for 117 countries for IMF AREAER share measure, 64 for Quinn liberalization measure and 94 for gross capital flows measure.

Samples and methodology: Details in table relate to sections of study when interaction effects are examined (and hence may differ from other parts of papers). Data for Hermes and Lensink (2003) from Tables 3 and 4, Alfaro et al from Tables 4, 6 and 7, Durham (2004) from Tables 1, 2 and 3, Carkovic and Levine (2005) from Table 8.4 and 8.6, Kraay (1998) from Tables 10-12, Arteta et al (2001) from Table 4, Bekaert et al (2005) from Table 8, Hammel (2006) from Table 7 and Prasad et al (2006) from Tables 7 and 8. Unless indicated country samples include industrial and developing economies. GDP noted as PPP where explicitly indicated in paper. Significant if at least 10% significance level.

Financial openness de jure measures: AREAER share: proportion of years in which countries had liberalized capital accounts based on the binary variable from AREAER; Quinn: de jure capital account liberalization measure based on Quinn (1997); Chinn-Ito: AREAER based measure of capital controls from Chinn and Ito (2006); Edwards index from Edwards (2005).

Literature Appendix Table 2: Interaction effects: Institutions

Study	No. of econ./ period	Econometric methodology	Dependent variable	Financial openness variable	Interaction /threshold variables	Interaction/threshold approach	Main findings on interaction effect
Kraay (1998)	n.a. ^a (1985-1997)	Cross-section OLS and IV. Event study	Growth of real per capita GDP	AREAER share; Quinn index; gross capital flows to GDP	Macro policy (weighted av. of gov. deficit and inflation); black market premium; ICRG corruption; ICRG bureaucracy quality ICRG law and order	Linear (for regressions) Sample split (above/ below median) for event study Linear	<i>Little evidence of interaction effects.</i> Linear interaction coefficients either insignificant or generally negative. Similarly no evidence from event studies.
Arteta et al (2001)	Up to 62 (1973-1992)	Cross section and sub-period panel pooled OLS	Growth of real per capita GDP (PPP)	Initial value of Quinn index		Linear	<i>Positive sig. interaction coefficient</i> in pooled sample (and for 1973-1981 and 1982-1987 but insig. for 1988-1992).
Durham (2004)	Up to 62 (1984-1998)	Cross section OLS	Growth of real per capita GDP	FDI flows (OECD and IFS) and net portfolio equity inflows from US from 1979-1983	Regulation; property rights; corruption	Linear	<i>Mixed results</i> with positive interaction effects not robustly significant across FO measures.
Bekaert et al (2005)	Up to 95 (1980-1997)	5-yearly panel (overlapping periods) GMM	5-year av. growth rate of real per capita GDP	De jure international equity market liberalization	Legal measures; institutional variables; investment condition variables ^b	Sample split: Above/ below median	<i>Mixed results.</i> Some measures associated with sig. higher growth gain post-liberalization, e.g. English legal origin, high investment profile, whilst others, e.g. creditor rights insignificant
Chanda (2005)	Up to 82 (1975-1995)	Cross section OLS	Growth of real per capita GDP	AREAER share; Freedom House measure	Ethno-linguistic homogeneity	Linear	<i>Interaction coefficient on capital controls and ethno-linguistic homogeneity is positive and sig..</i>
Klein (2005)	Up to 71 (1976-1995)	Cross-section OLS and IV, non-linear LS	Growth of real per capita GDP	AREAER share	Institutional quality (average of 5 ICRG measures) ^c	Cubic; quadratic spline, quintile dummies	<i>Intermediate levels of institutional quality associated with a positive relation between growth and capital account liberalization.</i>
Quinn and Toyoda (2006)	Up to 85 (1955-2004)	5-yearly panel FE and system GMM	Growth of real per capita GDP	Level of Quinn index	Ethnic fractionalization, black market premia, ICRG bureaucratic quality, ICRG corruption ^d	Linear	<i>Conclude that capital account liberalization effects generally direct over this period</i> with interaction effects generally insig. (or exhibiting contrary effects in different sub-periods).

Notes: ^a Number of countries in interaction regressions not indicated in Kraay (1998). Financial openness measures are available for 117 countries for IMF AREAER share measure, 64 for Quinn liberalization measure and 94 for gross capital flows measure. ^b Bekaert et al (2005) legal measures include legal origin, judicial efficiency, speed of process; institutions include ICRG summary index (sum of three International Country Risk Group (ICRG) indices on bureaucratic quality; corruption, and; law and order); investment conditions included ICRG economic risk index, ICRG investment profile index, anti-director rights, creditor rights and accounting standards. ^c Klein institutional quality measure is average of ICRG measures for 1984-1995 for bureaucratic quality, corruption, expropriation risk, risk of repudiation of government contracts and rule of law. ^d Quinn and Toyoda also examine the interaction of their capital account measure with banking crises and financial crises and find no significant interaction effects.

Samples and methodology: Details in table relate to sections of study when interaction effects are examined (and hence may differ from other parts of papers). Data for Kraay (1998) from Tables 10-12, Arteta et al (2001) from Table 4, Durham (2004) from Tables 1, 2 and 3, Bekaert et al (2005) from Table 8, Chanda (2005) from Tables 3 and 4, Klein (2005) from Table 3 and Quinn and Toyoda (2006) from Table 15. Financial openness de jure measures: See notes to Literature Appendix Table 1.

Literature Appendix Table 3: Interaction effects: Income level

Study	No. of econ./ period	Econometric methodology	Dependent variable	Financial openness variable	Interaction /threshold variables	Interaction/ threshold approach	Main findings on interaction effect
Arteta et al (2001)	Up to 62 (1973-1992)	Cross section and sub-period panel pooled OLS, weighted LS and IV 2SLS	Growth of real per capita GDP (international prices)	Level and change of Quinn index (plus AREAER share but not reported as insignificant)	Ln initial GDP per capita	Linear	<i>Interaction effects are very fragile and sensitive to sample and specification.</i>
Edwards (2001)	56 (1980-1989)	Cross section weighted 3SLS IV (weighting with GDP per capita in 1985)	Growth of real per capita GDP (international prices) and TFP	Level of Quinn index in 1987	Ln initial GDP per capita	Linear	<i>Direct effect of capital account liberalization negative with positive significant coefficient on interaction with level of initial income.</i>
Edison et al (2004)-	Up to 71 (1976-1995)	Cross section OLS	Growth of real per capita GDP	De jure share measures based on AREAER dummy and Bekaert et al (2005) liberalization dates; Quinn index	Ln initial GDP per capita	Quadratic	<i>Inverted U-shape relationship between coefficient on FO and level of development. Linear and quadratic interaction effects significant across FO measures.</i>
Carkovic and Levine (2005)	Up to 68 (1960-1995)	Cross section OLS and 5-yearly panel dynamic system GMM	Growth of real per capita GDP	Gross FDI inflows to GDP	Ln exports plus imports to GDP	Linear	<i>No evidence that growth impact of FDI depends on level of income.</i>
Quinn and Toyoda (2006)	Up to 85 (1955-2004) ^a	5-yearly panel FE and system GMM	Growth of real per capita GDP	Level of Quinn index	Ln per capita GDP	Linear, quadratic	No evidence from linear model of higher growth post-liberalization in richer countries. Quadratic model suggests that poorer and richer countries grew faster post-liberalization.

Notes: ^a Samples for relevant Tables in Quinn and Toyoda taken from corresponding baseline regressions detailed in Table 8. The authors also use smaller sample with data 1970-2004.

Samples and methodology: Details in table relate to sections of study when interaction effects are examined (and hence may differ from other parts of papers). Data for Arteta et al (2001) from Tables 1-3, Edwards (2001) from Table 10, Edison et al (2004) from Table 9, Carkovic and Levine (2005) from Table 8.4 and Quinn and Toyoda (2006) from Tables 14 and 15. Significant if at least 10% significance level.

Financial openness de jure measures: See notes to Table A.3.

Literature Appendix Table 4: Interaction effects: Trade openness measures

Study	No. of econ./period	Econometric methodology	Dependent variable	Financial openness variable	Interaction /threshold variables	Interaction/threshold approach	Main findings on interaction effect
Balasubramanyam et al (1996)	Up to 46 developing economies (1970-1985)	Cross section OLS and IV	Growth of real per capita GDP (PWT)	FDI to GDP	Imports to GDP (classify economy as import substituting IS or export promoting EP)	Regression estimated separately for the two sample splits	Significant difference across IS or EP samples. <i>Coefficient on FDI positive significant for EP countries but insignificant for IS.</i>
Arteta et al (2001)	Up to 60 (1973-1992)	Cross section and sub-period panel pooled OLS	Growth of real per capita PPP GDP	Initial value of Quinn index	Overall Sachs Warner (SW) openness indicator plus sub-components of tariff/non-tariff barriers and black market premium	Linear	Interaction with SW generally positive significant but insignificant if SW level added. Interaction with trade barriers measure insignificant. <i>Results supportive of positive relation between growth and capital account liberalization contingent on absence of large black market premium (interpreted as absence of macro imbalances).</i>
Carkovic and Levine (2005)	Up to 67 (1960-1995)	Cross section OLS and 5-yearly panel dynamic system GMM	Growth of real per capita GDP	Gross FDI inflows to GDP	Exports plus imports to GDP	Linear	<i>Interaction effect insignificant in OLS regressions. Positive significant results for panel not robust to inclusion of other controls.</i>
Gupta and Yuan (2006)	31 emerging economies (1981-1998)	Annual sector-level panel, country and year FE.	Growth of real sectoral value added	Liberalization of stock market to foreign investors.	“Trade competitiveness”, i.e. ratio of industry to total output of that industry across sample	Linear	Growth post-liberalization is significantly higher in industries which are more trade competitive.

Notes: Samples and methodology: Details in table relate to sections of study when interaction effects are examined (and hence may differ from other parts of papers). Data for Balasubramanyam et al (1996) from Table 1, for Arteta et al (2001) from Tables 5-7, for Carkovic and Levine (2005) from Table 8.6 and for Gupta and Yuan (2006) from Table 5. Significant if at least 10% significance level.

Literature Appendix Table 5: Financial depth (FD): Selected linear interaction effect estimates

$$y_i = \alpha + \beta_1 FO_i + \beta_2 FD_i + \beta_3 FO_i \times FD_i + \delta X_i + \varepsilon_i$$

$$\beta_{FO,i} \equiv \beta_1 + \beta_3 FD_i$$

I) Credit indicators

FD variable	Method	Direct FO β_1	Linear interaction coefficient β_3	Threshold for positive $\beta_{FO,i}$ (i.e. - β_1/β_3) ^a	Extra controls (see notes)	No. of obs.	Original source reference
1. Hermes and Lensink (2003)							
FO variable is gross FDI inflows to GDP. All developing 1970-1995							
Private bank credit to GDP	Cross	- *	+ ***	13%	A	67	Table 3
	section	- ***	+ *	39%	B	67	Table 3
	OLS	- ***	+ ***	15%	A'	67	Table 4
		- ***	+ ***	21%	B'	67	Table 4
2. Alfaro et al (2004)							
FO variable is log net FDI inflows to GDP. Mix of developing and industrial 1975-1995							
Bank credit to GDP ^b	Cross	+ **	+ ***	36%	C	71	Table 4, col 2
	section	+ ***	+ ***	37%	C'	71	Table 6, col 2
	OLS						
Private credit to GDP ^b	IV for FD	+	+ *	(44%)	C	71	Table 7, col 2
	Cross	+	+ ***	(47%)	C	71	Table 4, col 4
	section	+ **	+ ***	48%	C'	71	Table 6, col 4
	OLS						
	IV for FD	+ *	+ **	33%	C	71	Table 7, col 1
3. Carkovic and Levine (2005)							
FO variable is gross FDI inflows to GDP. Mix of developing and industrial 1960-1995							
Domestic credit to GDP ^c	Cross	+ ***	+ ***	29%	D	67	Table 8.5
	section	+ ***	+ ***	28%	E	269	Table 8.5
	OLS						
	Dynamic panel system	-	+ *	(1210%)	D	67	Table 8.5
		- **	+	(3390%)	E	269	Table 8.5

Notes: ^a Threshold for positive FO coefficient calculated on basis of coefficients reported in original studies (similarly for p-values if not reported in original studies). If both coefficients are insignificant then threshold reported in brackets.

^b Alfaro et al. use FD variables in logs. Thus threshold for positive overall FO coefficient may still be positive even if both direct and interaction coefficient are positive (since for $FD < 1$ $\ln FD$ is negative).

^c It is assumed Carkovic and Levine use domestic credit in logs as in previous regressions and correlations in their study.

Controls (excluding FO variable, FD variable and interaction effect):

A: Log initial GDP per capita, log initial secondary school enrolment. A': A plus domestic investment

B: A plus interaction of initial secondary school enrolment and FDI. B': B plus domestic investment

C: log initial GDP per capita, average years of secondary schooling, population growth, government consumption to GDP, institutional quality, sub-Saharan Africa dummy, black market premium, inflation, trade to GDP. C': C plus investment to GDP

D: log initial GDP per capita, average years schooling. Note direct impact of credit not included.

E: D plus average inflation, government consumption to GDP, trade to GDP, black market premium. Note direct impact of credit not included.

The symbols *, ** and *** indicate statistical significance at the 10 percent, 5 percent and 1 percent level.

Literature Appendix Table 5 continued

II) Stock market indicators

FD variable	Method	Direct FO β_1	Linear interaction coefficient β_3	Threshold for positive $\beta_{FO,I}$ (i.e. $-\beta_1/\beta_3$) ^a	Extra controls (see notes)	No. of obs.	Original source reference
1. Alfaro et al (2004)							
FO variable is log net FDI inflows to GDP. Mix of developing and industrial 1975-1995							
Stock market turnover ratio ^b	Cross	+ *	+ *	13%	C	53	Table 4, col 6
	section	+ **	+ *	11%	C'	53	Table 6, col 6
Stock market capitalization to GDP ^b	OLS						
	Cross	+	+ **	(70%)	C	49	Table 4, col 5
	section	+	+ *	(45%)	C'	49	Table 6, col 5
	OLS						
	Cross	+	+ **	(68%)	C'	50	Table 7, col 3
	section IV	+	+ **	(75%)	C'	50	Table 7, col 4
	for FD ^c	-	+ *	(150%)	C'	36	Table 7, col 5
	Cross	+	+	(70%)	C'	48	Table 7, col 6
	section IV	+ *	+ *	(29%)	C'	32	Table 7, col 7
	for FD and FO ^c						
2. Durham (2004)							
Mix of developing and industrial 1984-1998							
FO variable is FDI flows to GDP (OECD data)							
Stock market capitalization to GDP	Cross	-	+ *	(2%)	F	36	Table 1, col 5
	section						
Stock market capitalization to GDP	OLS						
	Cross	+ ***	-	n.a. (positive direct	F	49	Table 2, col 5
	section			effect)			
FO variable is net portfolio equity inflows from US to GDP							
Stock market capitalization to GDP	Cross	- **	+ **	41%	F	39	Table 3, col 5
	section						
	OLS						

Notes: ^a Threshold for positive FO coefficient calculated on basis of coefficients reported in original studies (similarly for p-values if not reported in original studies). If both coefficients are insignificant then threshold reported in brackets.

^b Alfaro et al use FD variables in logs. Thus threshold for positive overall FO coefficient may still be positive even if both direct and interaction coefficient are positive (since for $FD < 1$ $\ln FD$ is negative).

^c The different IV estimates reflect differing instrumentation used.

Controls (excluding FO variable, FD variable and interaction effect): For C and C' see notes to above table. F: initial GDP per capita, investment to GDP, population growth, education rate.

The symbols *, ** and *** indicate statistical significance at the 10 percent, 5 percent and 1 percent level.

Semi Parametric Appendix (SPA)

SPA: Differencing approach

For full details of this approach see Yatchew (1998, 2003) and Yatchew and No (2001) on which this appendix draws. The differencing approach first removes the non-parametric function in order to estimate the linear coefficients. In order to do so, the data are “ordered” by their values of the linear control variables. For example, in the case of multivariate x , given an initial observation the other observations are ranked by their Euclidean distance from this point. The ranked observations are then differenced relative to their nearest neighbour. For example, consider the simple cross-sectional case where there are N observations indexed by i with dependent variable Y modelled as a non-parametric function of a (set of) controls, X , and a linear combination of other controls, Z .

$$Y = Z\beta + s(X) + \varepsilon$$

with $Z = r(X) + u$ where $E(Z|X) = r(X)$; the functions $r(X)$ and $s(X)$ are smooth; and, conditional on x and z , the errors ε and u are mean zero with finite variance. If we difference the ordered observations we obtain,

$$\begin{aligned} Y_i - Y_{i-1} &= (Z_i - Z_{i-1})\beta + s(X_i) - s(X_{i-1}) + \varepsilon_i - \varepsilon_{i-1} \\ &= (r(X_i) - r(X_{i-1}) + u_i - u_{i-1})\beta + s(X_i) - s(X_{i-1}) + \varepsilon_i - \varepsilon_{i-1} \end{aligned}$$

If the observations are sufficiently close and the functions $g(x)$ and $f(x)$ are smooth with bounded derivatives then this approximates to:

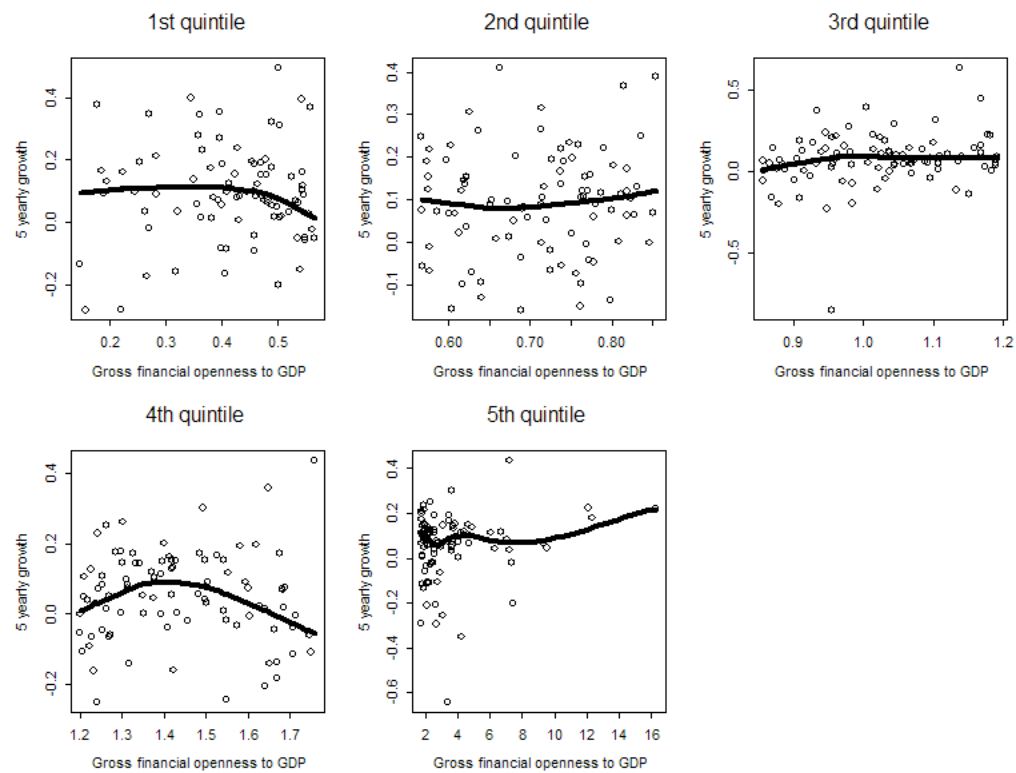
$$Y_i - Y_{i-1} \approx (u_i - u_{i-1})\beta + \varepsilon_i - \varepsilon_{i-1}$$

A consistent estimate for β can then be derived using OLS. This can then be plugged back into the original expression to obtain:

$$Y - Z\hat{\beta} \approx s(X) + \varepsilon$$

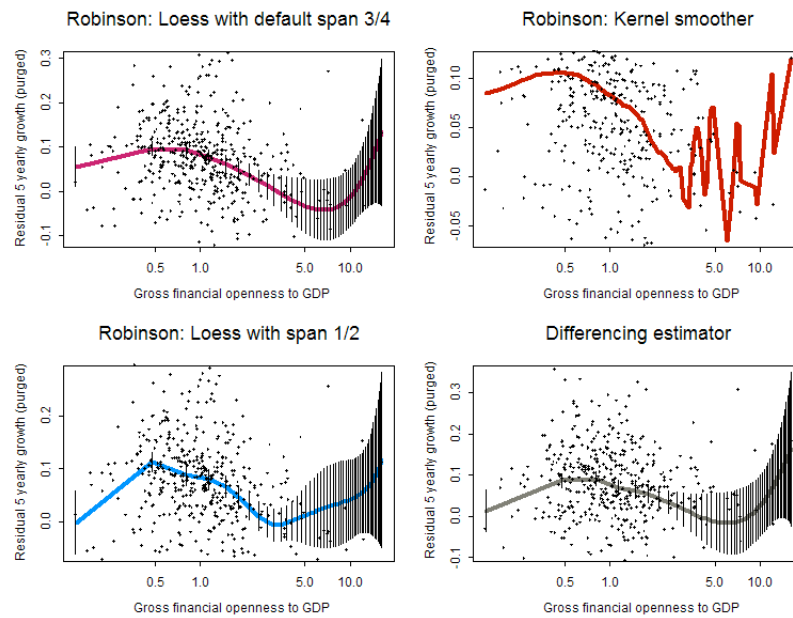
The non-parametric form of $s(X)$ can then be estimated using standard methods, eg locally weighted regression. As detailed in Yatchew (2003), the differencing method, whilst relatively simple, has certain disadvantages relative to other methods. For example, it can lead to a higher bias when the sample size is not large and, due to the increasing dispersion of the observations, cannot be used if x contains more than 3 variables.

SPA Figure 1: Unconditional relationship between five yearly growth and gross financial openness by quintile of gross financial openness

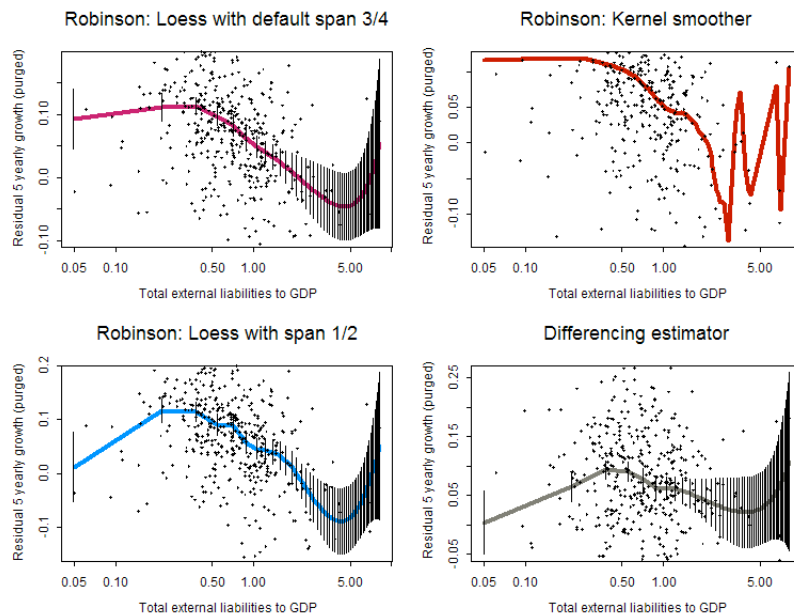


Note: Bold line indicates local regression smoother.

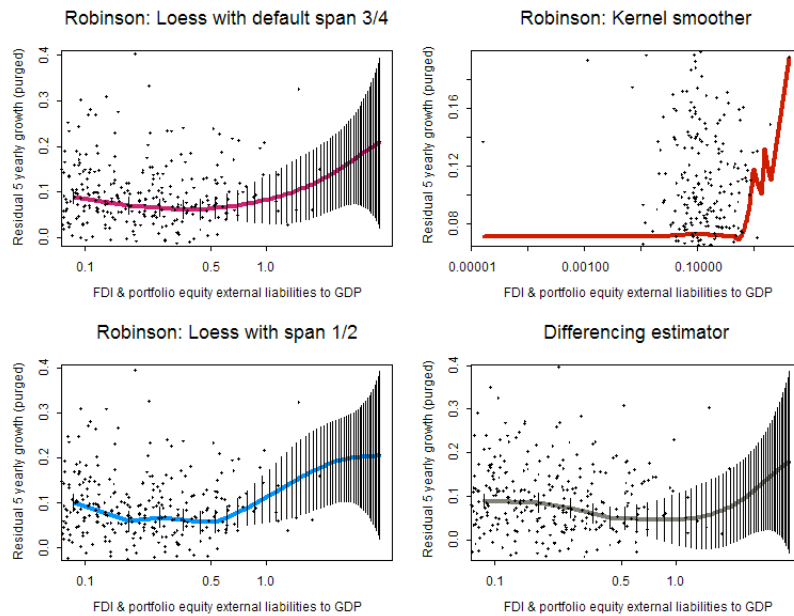
SPA Figure 2: Gross financial openness and residual five yearly growth “purged” with log scale for financial openness



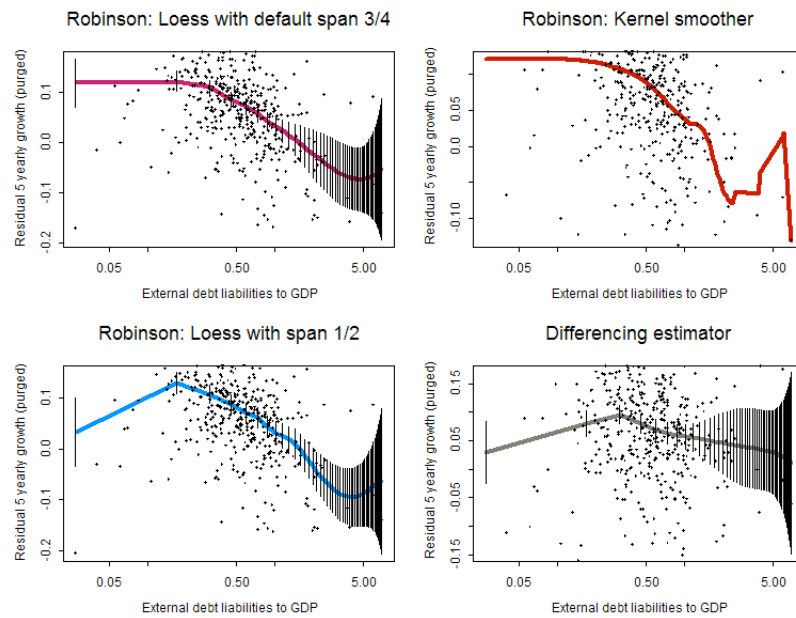
SPA Figure3: Total external liabilities to GDP and residual growth “purged” with log scale for financial openness



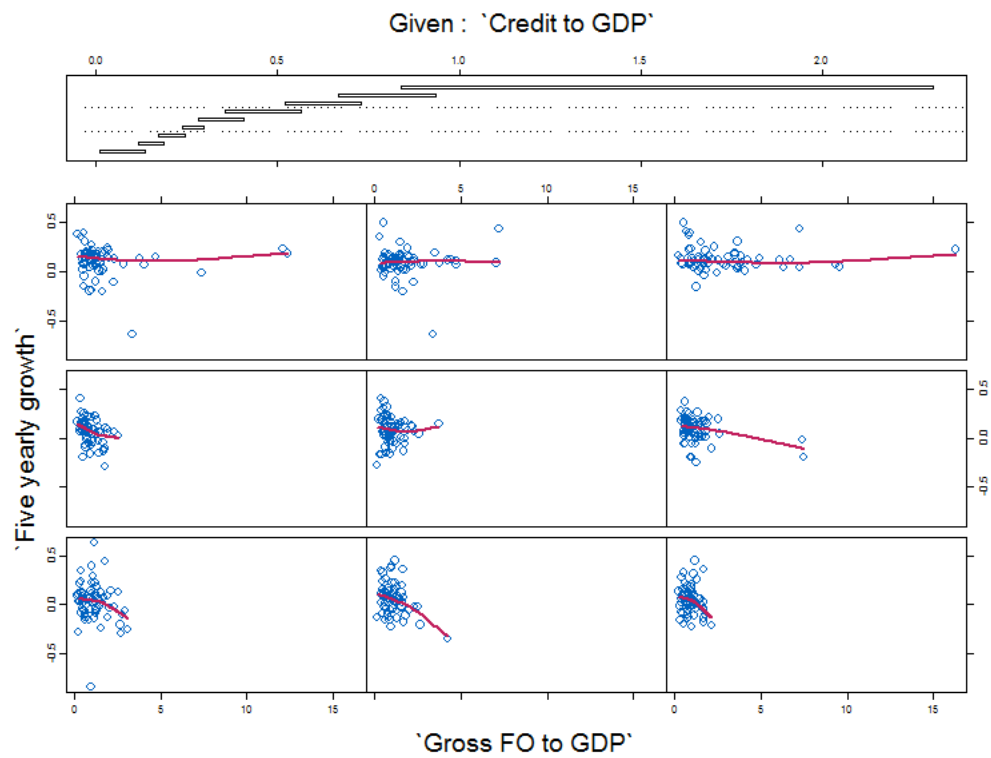
SPA Figure 4: Total FDI and portfolio equity external liabilities to GDP and residual growth “purged” with log scale for financial openness



SPA Figure 5: Total external debt liabilities to GDP and residual growth “purged” with log scale for financial openness

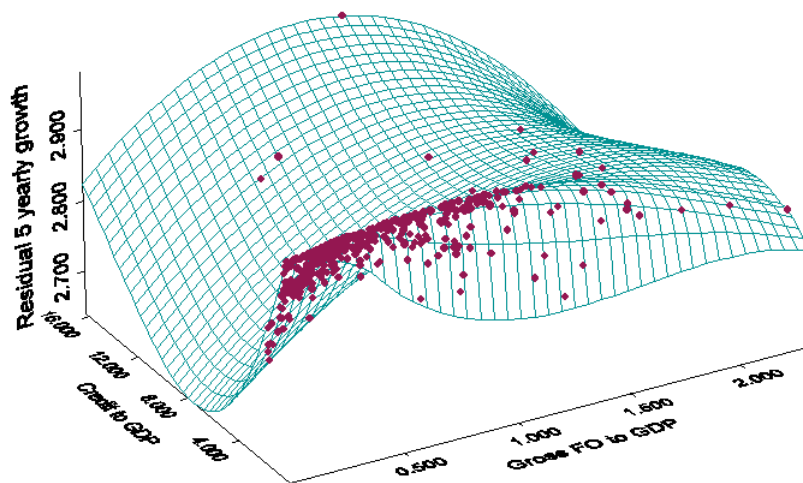


SPA Figure 6: Unconditional five yearly growth against gross financial openness to GDP (kopen) by sub-samples determined by credit to GDP (credpgdp)

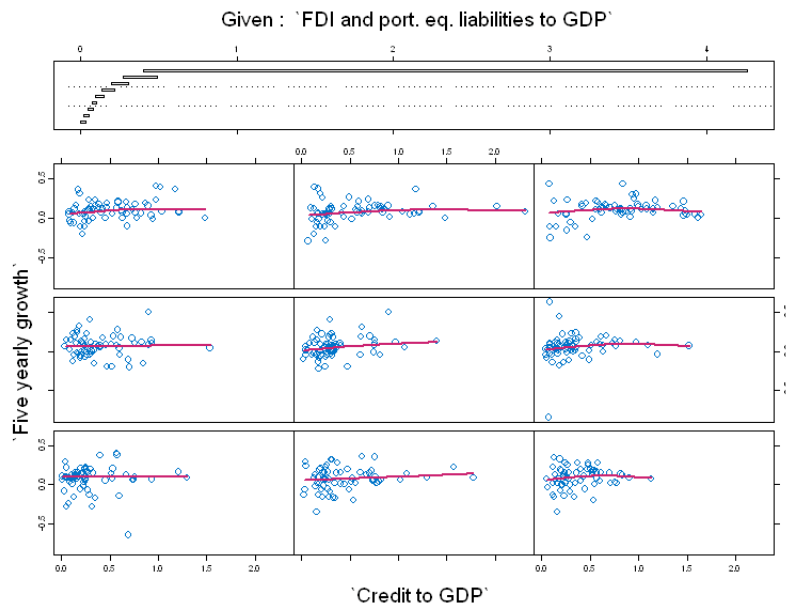


Note: Bold line indicates local regression smoother. The sub-sample with the lowest values of credit-to-GDP is represented in the bottom left-hand panel with the level rising in subsequent panels as one moves from left to right and then up and along the second and then the third panel. The top panel indicates the range of the different, non-overlapping sub-samples.

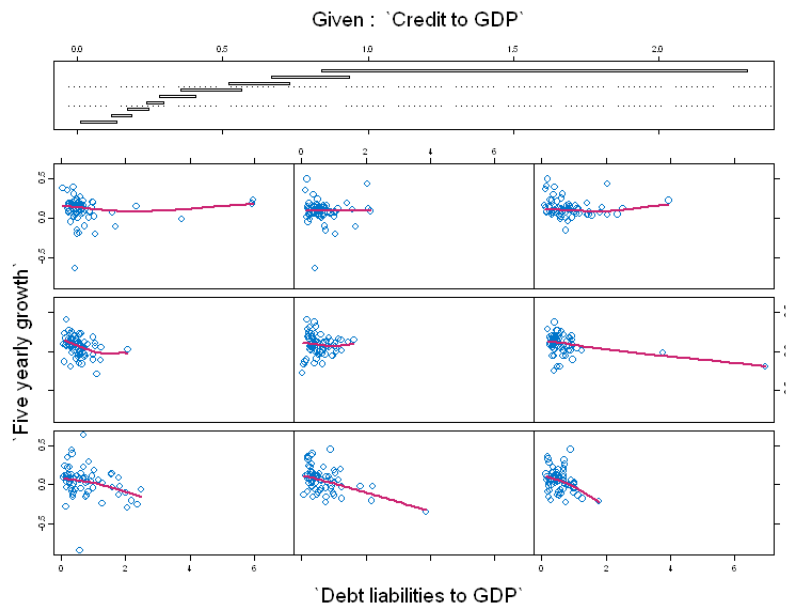
SPA Figure 7: Double residual non-parametric interaction effects with credit to GDP as threshold variable and gross financial openness to GDP as financial openness variable (interpolated estimation results with data points illustrated) using span of 0.75



SPA Figure 8: Unconditional five yearly growth against FDI and portfolio equity external liabilities to GDP (fdipelgdp) by sub-samples determined by credit to GDP (credpgdp)



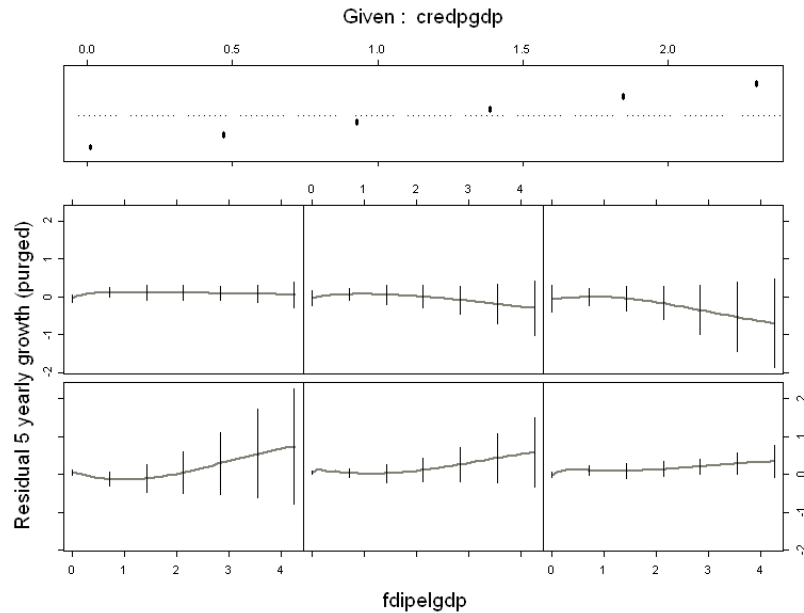
SPA Figure 9: Unconditional five yearly growth against debt external liabilities to GDP (dlgdp) by sub-samples determined by credit to GDP (credpgdp)



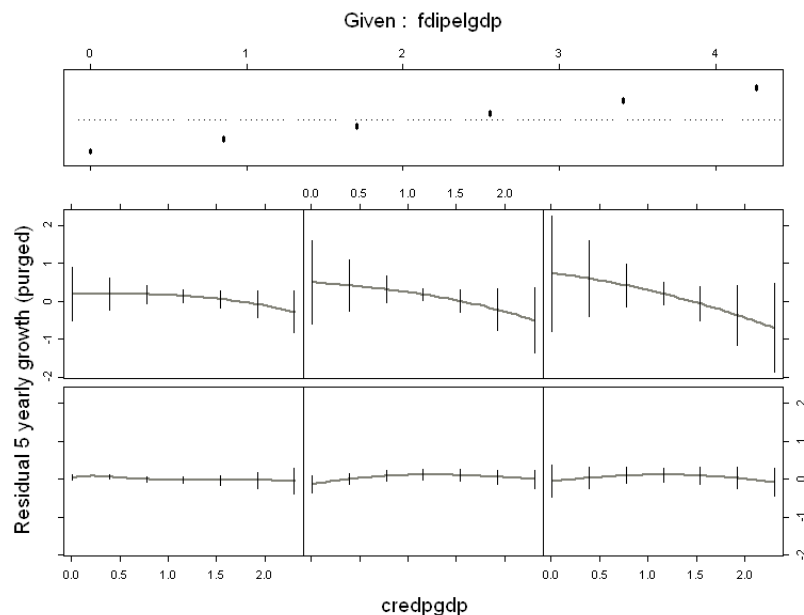
Notes for Figures 8 and 9: Bold line indicates local regression smoother. The sub-sample with the lowest values of credit-to-GDP is represented in the bottom left-hand panel with the level rising in subsequent panels as one moves from left to right and then up and long the second and then the third panel. The top panel indicates the range of the different, non-overlapping sub-samples.

SPA Figure 10: Cross-sections of double residual non-parametric interaction effects with credit to GDP (credpgdp) as the threshold variable and FDI and portfolio equity external liabilities to GDP as the financial openness variable (fdipelgdp)

a) Sliced at different values of credit to GDP



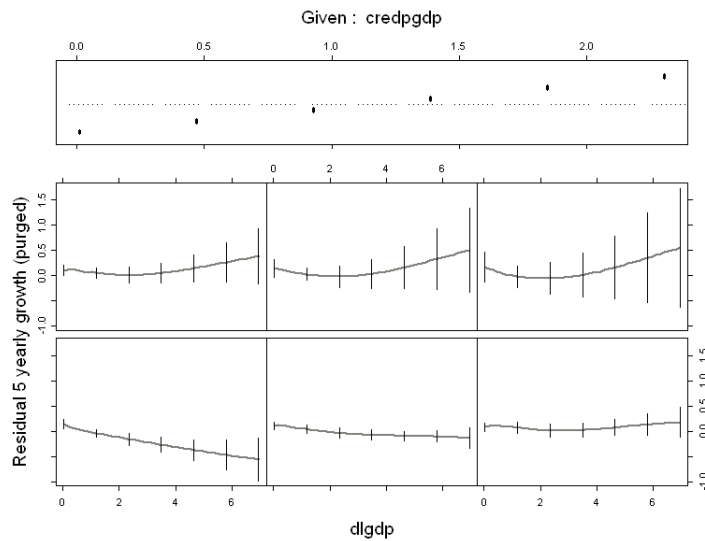
b) Sliced at different values of FDI and portfolio equity liabilities to GDP



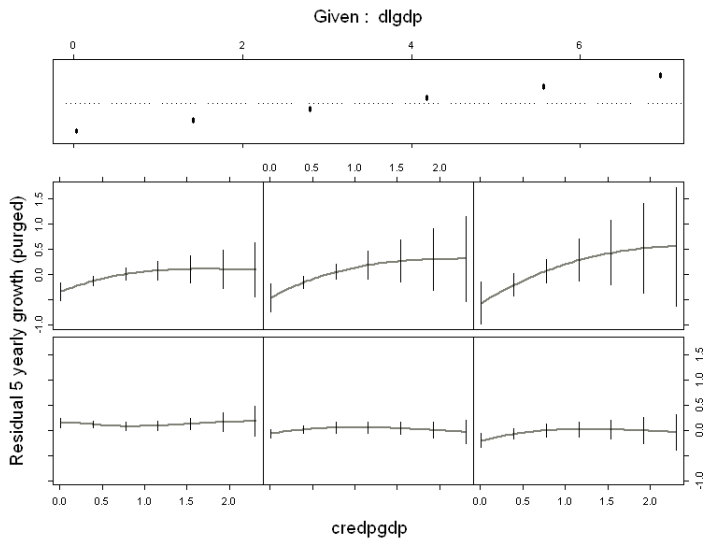
Note: The six lower panels show the relationship between residual growth and financial openness in part a and credit to GDP in part b with 95% confidence intervals indicated by the vertical lines. The six plots are taken at six equally space levels of credit-to-GDP and financial openness to GDP in parts a and b respectively. The lowest value of the given variable is represented in the bottom left-hand panel with the level rising in subsequent panels as one moves from left to right and then up and along the second panel. The corresponding values of the given variable at which the slice are made are indicated by the dots in the uppermost plot across the width of the figure.

SPA Figure 11: Cross-sections of double residual non-parametric interaction effects with credit to GDP (credpgdp) as the threshold variable and external debt liabilities to GDP as the financial openness variable (dlgdp)

a) Sliced at different values of credit to GDP

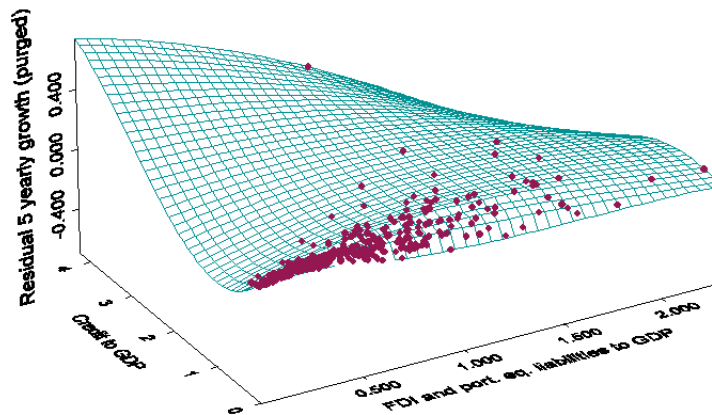


b) Sliced at different values of external debt liabilities to GDP

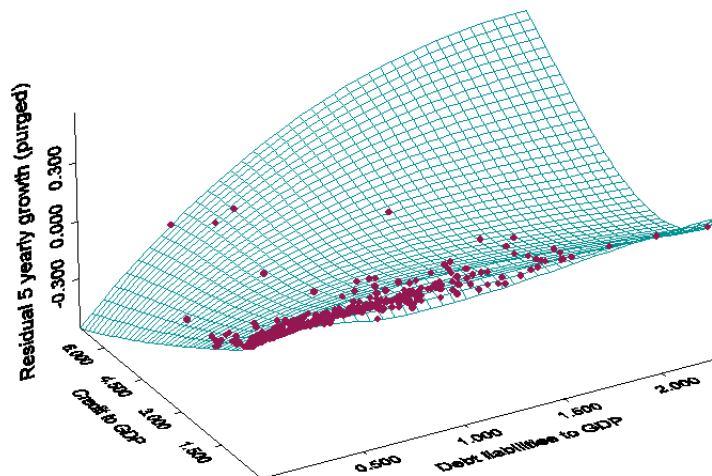


Note: The six lower panels show the relationship between residual growth and financial openness in part a and credit to GDP in part b with 95% confidence intervals indicated by the vertical lines. The six plots are taken at six equally space levels of credit-to-GDP and financial openness to GDP in parts a and b respectively. The lowest value of the given variable is represented in the bottom left-hand panel with the level rising in subsequent panels as one moves from left to right and then up and along the second panel. The corresponding values of the given variable at which the slice are made are indicated by the dots in the uppermost plot across the width of the figure.

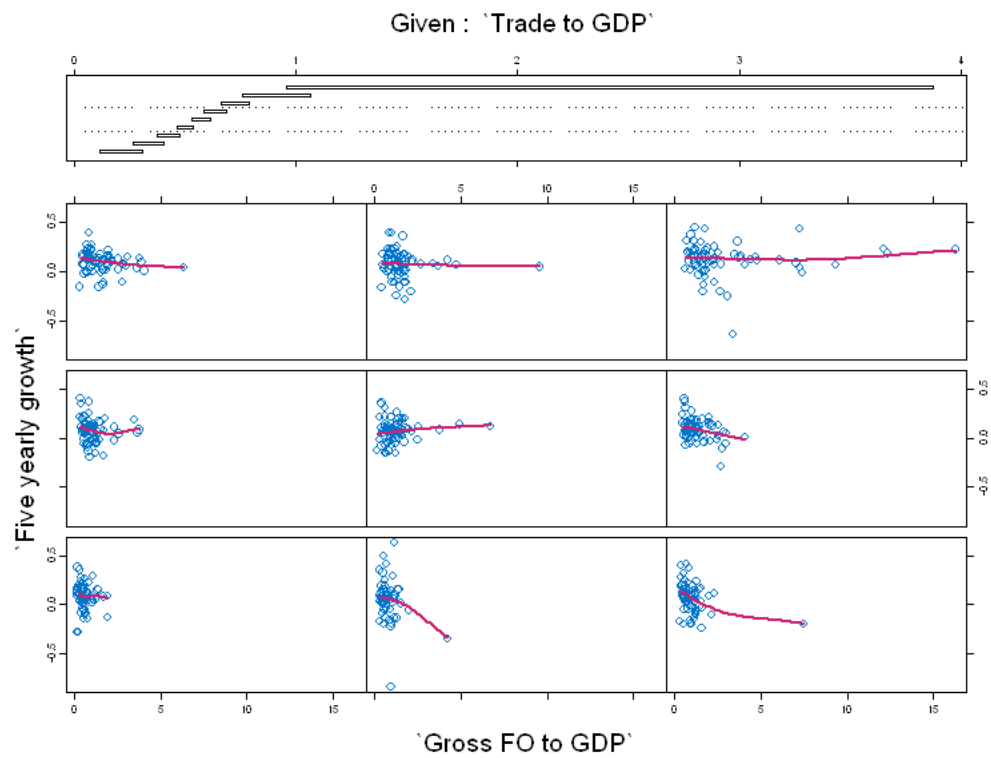
SPA Figure 12: Double residual non-parametric interaction effects with credit to GDP as the threshold variable and FDI and portfolio equity external liabilities to GDP as the financial openness variable (interpolated estimation results with data points illustrated)



SPA Figure 13: Double residual non-parametric interaction effects with credit to GDP as the threshold variable and external debt liabilities to GDP as the financial openness variable (interpolated estimation results with data points illustrated)

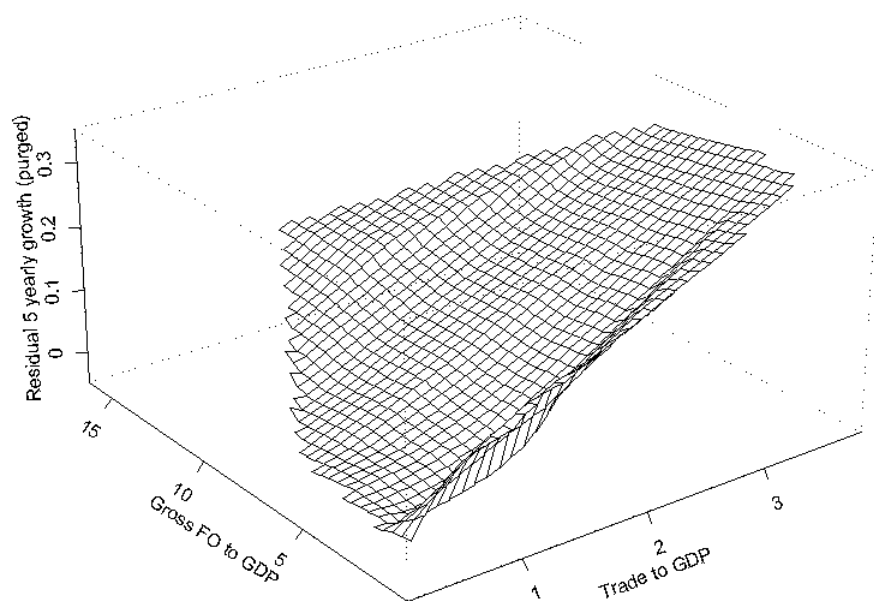


SPA Figure 14: Unconditional five yearly growth against gross financial openness to GDP (kopen) by sub-samples determined by trade to GDP (openc)

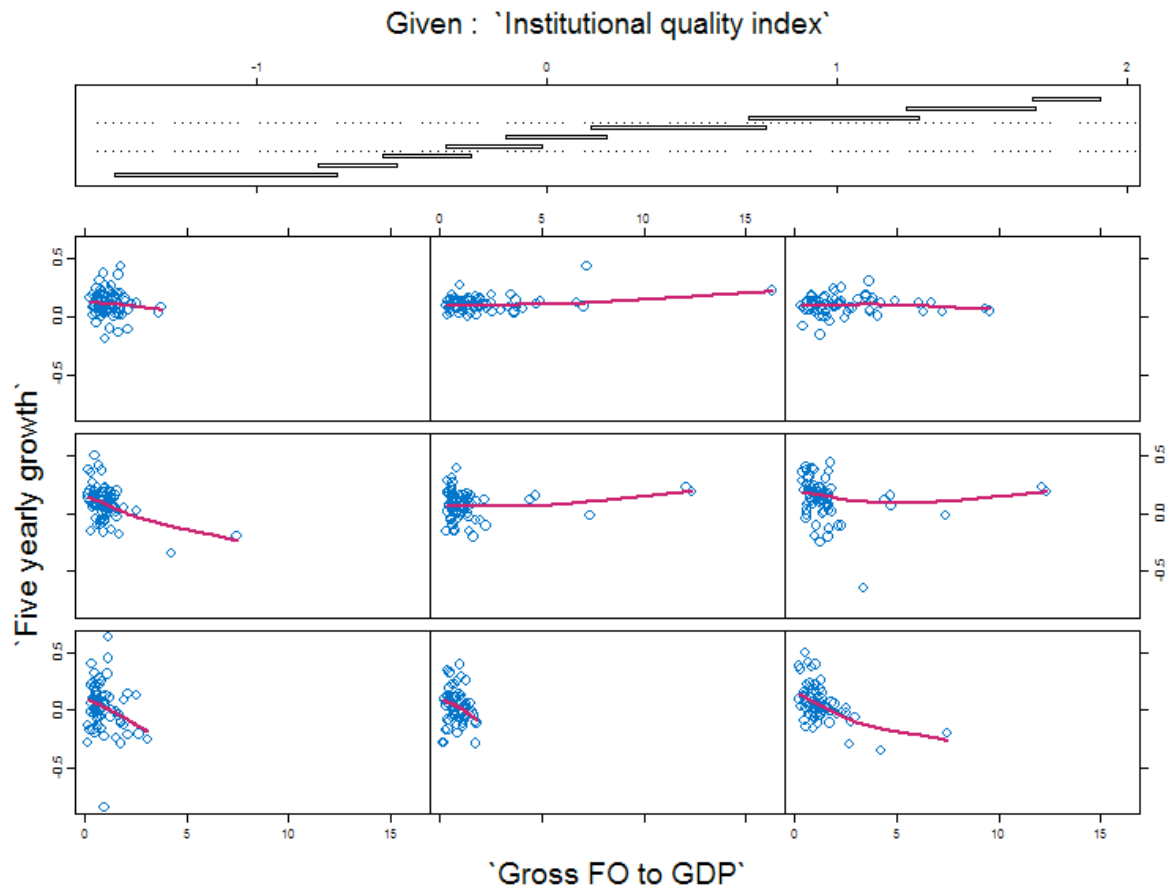


Note: Bold line indicates local regression smoother. The sub-sample with the lowest values of trade-to-GDP is represented in the bottom left-hand panel with the level rising in subsequent panels as one moves from left to right and then up and along the second and then the third panel. The top panel indicates the range of the different, non-overlapping sub-samples.

SPA Figure 15: Double residual non-parametric interaction effects with trade to GDP as the threshold variable and gross financial openness to GDP as the financial openness variable

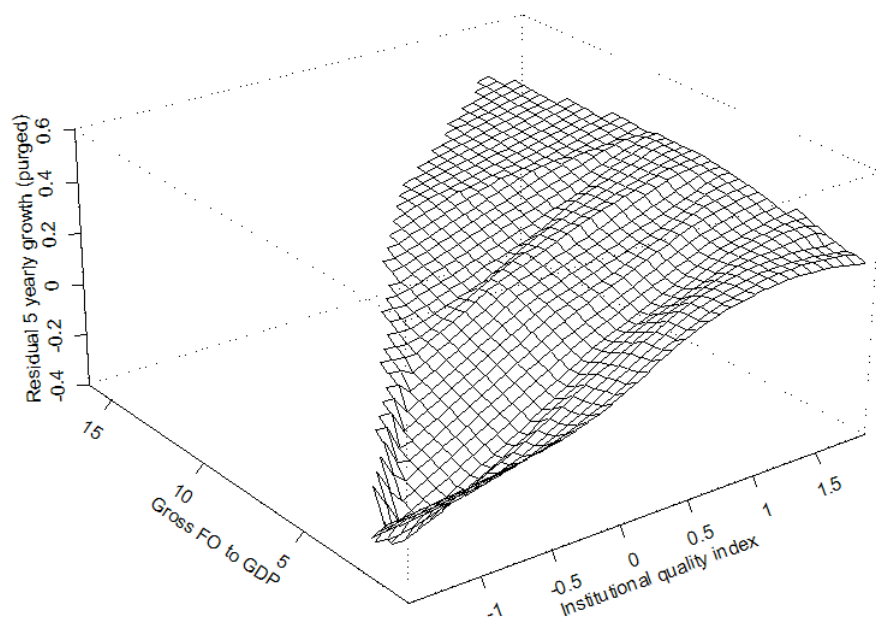


SPA Figure 16: Unconditional five yearly growth against gross financial openness to GDP (kopen)
by sub-samples determined by institutional quality index (iqindex)



Note: Bold line indicates local regression smoother. The sub-sample with the lowest values of trade-to-GDP is represented in the bottom left-hand panel with the level rising in subsequent panels as one moves from left to right and then up and along the second and then the third panel. The top panel indicates the range of the different, non-overlapping sub-samples.

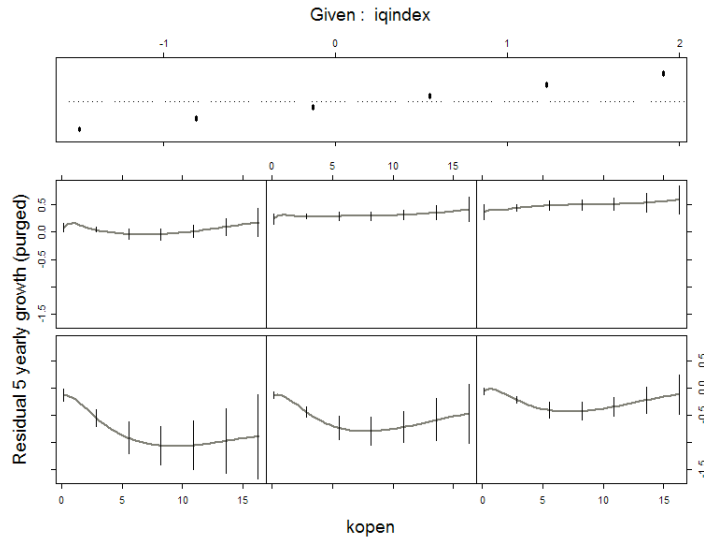
SPA Figure 17: Double residual non-parametric interaction effects with institutional quality index as the threshold variable and gross financial openness to GDP as the financial openness variable



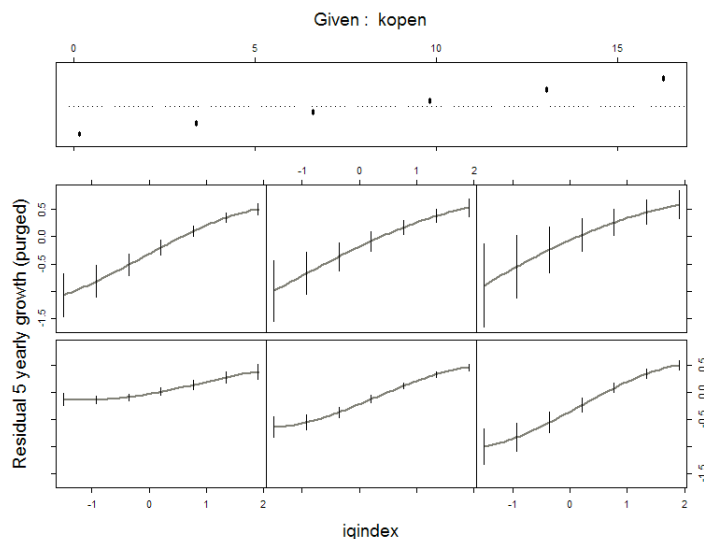
Note: Country dummy variables not included in this estimation.

SPA Figure 18: Cross-sections of double residual non-parametric interaction effects with institutional quality index (iqindex) as the threshold variable and gross financial openness to GDP as the financial openness variable (kopen)

a) Sliced at different values of institutional quality index

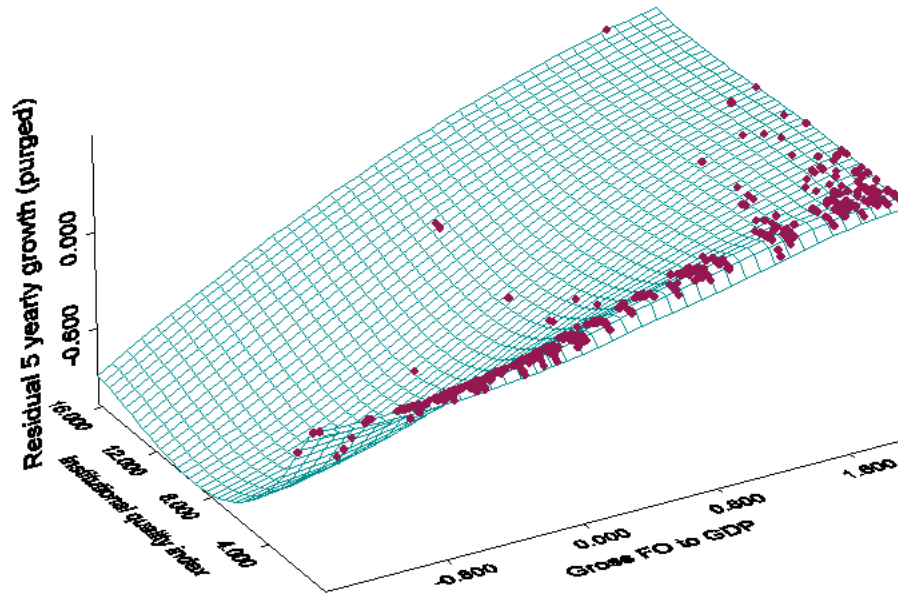


b) Sliced at different values of gross financial openness to GDP



Note: The six lower panels show the relationship between residual growth and financial openness in part a and credit to GDP in part b with 95% confidence intervals indicated by the vertical lines. The six plots are taken at six equally space levels of credit-to-GDP and financial openness to GDP in parts a and b respectively. The lowest value of the given variable is represented in the bottom left-hand panel with the level rising in subsequent panels as one moves from left to right and then up and along the second panel. The corresponding values of the given variable at which the slice are made are indicated by the dots in the uppermost plot across the width of the figure. Country dummy variables not included in this estimation.

SPA Figure 19: Double residual non-parametric interaction effects with institutional quality index as the threshold variable and gross financial openness to GDP as the financial openness variable (interpolated estimation results with data points illustrated)



Note: Country dummy variables not included in this estimation.