Foreign Direct Investment and Economic Growth: Evidence from Quantile Regression

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Abstract

In this paper we use country-level data to examine the role of absorptive capacity in contributing to the growth effects of FDI at different quantiles of the income distribution. We apply the instrumental variable quantile regression (IVQR) developed by Chernozhukov and Hansen (2008) to control for endogeneity of all the explanatory variables. Empirical analysis yields three main conclusions. First, the IVQR estimates suggest positive growth effects of FDI at higher quantiles of the distribution, while the estimates of FDI for QR are insignificant and small in magnitude across different quantiles. It implies that high-income countries with well-developed absorptive capacity seem to gain significantly more from FDI. Secondly, our IVQR analysis can provide the empirical evidence of convergence clubs (Quah, 1997). It means that high-income countries have the phenomenon of convergence, but low-income countries do not. Finally, in contrast with Hermes and Lensink (2003) and Alfaro et al. (2004), our empirical results show that the level of development of local financial markets is not crucial for the growth effects of FDI in lower quantiles.

Keywords: Absorptive capacity; Convergence clubs; Economic growth; Financial markets; Foreign direct investment; Instrumental variable; Quantile regression

JEL Classification: F21; F36; F43; O16

1 Introduction

Foreign direct investment (FDI) has increased dramatically since the 1980s. It is quite important to know whether FDI can accelerate economic growth in recipient countries. An influential economic rationale for offering incentives to attract FDI is based on the belief that FDI enhances host countries' economic growth through technology transfers and spillovers. However, the empirical literature provides debatable evidence concerning the growth effects of FDI. While microeconomic studies generally do not find positive spillovers of FDI (Aitken and Harrison, 1999; Djankov and Hoekman, 2000; Girma et al., 2001), numerous macroeconomic studies suggest a positive growth effect of FDI when the country has high absorptive capabilities (Balasubramanyam et al., 1996; Borensztein et al., 1998; Alfaro et al., 2004; Durham, 2004); see also de Mello (1997), Lim (2001), Grög and Greenaway (2004), and Crespo and Fontoura (2007) for recent surveys.

Absorptive capacity is the ability for the host country to absorb and internalize new technology from a foreign country. The degree of FDI spillovers is conditioned on the recipient's absorptive capacity, such as human capital, financial market development, trade openness and infrastructure provision. Blomström et al. (1994) find that FDI can promote economic growth if the host country is sufficiently wealthy. Balasubramanyam et al. (1996) and Borensztein et al. (1998) emphasize that trade openness and human capital development, respectively, are critical intervening or interactive variables with respect to FDI. Alfaro et al. (2004) and Durham (2004) attach importance to financial development as absorptive capacity that affects the degree of technology spillovers. Girma (2005) argues that the productivity benefit from FDI increases with technology gap until some threshold level beyond which it becomes less pronounced. Dimelis and Louri (2002) and Girma and Grög (2007) use the quantile regressions and firm-level data to investigate the role of the efficiency gap for spillovers from FDI.

In this paper, we use country-level data to examine the role of absorptive capacity in contributing to the growth effects of FDI. We investigate whether infrastructure provision and financial market development can capture the absorptive capacity of host countries to harness FDI toward economic growth. Our analysis adds to the existing literature in two ways. First, we allow for different growth effects of FDI at different quantiles of the income distribution by using the conditional quantile regression (QR). Compared with the firm-level study of Girma and Grög (2007), we use aggregate FDI flows for a broad cross section of countries to provide the macroeconomic study of FDI spillovers. Secondly, we apply, for the first time in this context, the instrumental variable quantile regression (IVQR) developed by Chernozhukov and Hansen (2006, 2008) and Chernozhukov et al. (2007) to control for endogeneity of all the explanatory variables. Moreover, the IVQR approach is asymptotically valid under weak identification.

Empirical analysis, using cross-country data between 1975 and 1995, yields three main conclusions. First, the IVQR estimates suggest positive growth effects of FDI at higher quantiles of the distribution, while the estimates of FDI for QR are insignificant and small in magnitude across different quantiles. It implies that high-income countries with well-developed absorptive capacity seem to gain significantly more from FDI; this is consistent with the results of Blomström et al. (1994) and Wang et al. (2004). Secondly, our IVQR analysis can provide the empirical evidence of convergence clubs (Quah, 1997). It means that high-income countries have the phenomenon of convergence, but low-income countries do not. Finally, in contrast with Hermes and Lensink (2003) and Alfaro et al. (2004), our empirical results show that the level of development of local financial markets is not crucial for the growth effects of FDI in lower quantiles. We also find that the black market premium distorts allocations of resource in lower quantiles. In conclusion, absorptive capacity is crucial in explaining the effect of FDI on economic growth.

The remainder of this paper is organized as follows. Section 2 describes the econometric methodology and its important properties. Section 3 discusses the data and empirical results. Section 4 provides a number of sensitivity analyses to assess the robustness of FDI growth effects. Section 5 gives some concluding remarks.

2 Econometric Framework

Empirical studies on assessing the growth effects of FDI commonly use the following econometric framework:

$$G_i = \alpha F_i + \beta' X_i + \varepsilon_i, \tag{1}$$

where G_i is the growth rate of real per capita GDP, F_i is the net FDI inflows as a share of GDP, X_i represents a set of conditioning variables, ε_i is the unobserved disturbance. One important concern in this estimation procedure is the possibility of endogeneity that could bias FDI's estimated coefficient and standard error. Thus, we need to construct instruments for FDI:

$$F_i = \gamma' Z_i + \delta' X_i + \zeta_i \tag{2}$$

where Z_i is a set of instrumental variables. After controlling for endogeneity, Carkovic and Levine (2005) find that, in contrast with past macroeconomic studies, FDI inflows do not exert a positive impact on growth. However, the spillover effect of FDI may vary across countries according to their absorptive capacity. The rationale is that countries with higher levels of absorptive capacity are able to obtain greater benefits from FDI. Unlike existing cross-country studies that use OLS or IV methods to investigate the "average" effects of FDI, it is more interesting to examine the spillover effects of FDI at different quantiles of the distribution of economic growth.

Quantile regression (QR) is a useful method for estimating the impact of regressors on the conditional distribution of the outcome; see Koenker and Bassett (1978), Buchinsky (1998), and Koenker (2005). The linear quantile regression can be written as:

$$G_i = \alpha(q) F_i + \beta(q)' X_i + \epsilon_i(q), \tag{3}$$

where $\alpha(q)$ and $\beta(q)$ present unknown parameters associated with the qth quantile, $q \in (0,1)$. Suppose that the conditional qth quantile of the error term is equal to zero, $Q_\epsilon(q|F,X) = 0$, but the distribution of $\epsilon_i(q)$ is unspecified. As q increases from 0 to 1, we can find out the influence of regressors on the entire conditional distribution of G_i.

Since solving (3) can be formulated as a linear programming problem, we can estimate the parameter vector efficiently with some form of the simplex algorithm.

In order to control for the potential endogeneity of FDI, we apply the instrumental variable quantile regression (IVQR) proposed by Chernozhukov and Hansen (2006, 2008) and Chernozhukov et al. (2007) to estimate the endogenous quantile effect. Define a structural quantile function as

$$S_G(q|F,X) = \alpha(q)F_i + \beta(q)'X_i, \tag{4}$$

and it follows that

$$\mathbb{P}\left(G_i \leq S_G(q|F,X)|Z,X\right) = q. \tag{5}$$

Equation (5) provides a moment condition that can be used to estimate the structural parameters α and β. In other words, the qth quantile of $G - S_G(q|F,X)$ conditional on Z and X solves the problem:

$$0 = \arg\min_{h\in\mathscr{F}} \mathbb{E}\,\rho_q[G - S_G(q|F,X) - h(Z,X)] \tag{6}$$

where $\mathscr{F}$ is the class of measurable functions of (Z,X), $\rho_q(u) = (q - I(u<0))u$ is the check function and $I(\cdot)$ is the indicator function.

Chernozhukov and Hansen (2008) propose a robust approach for estimating the structural quantile model through a series of ordinary QR steps. Consider the following objective function:

$$Q_n(q,\alpha,\beta,\gamma) = \frac{1}{n}\sum_{i=1}^{n}\rho_q(G_i - \alpha F_i - \beta' X_i - \gamma' Z_i), \tag{7}$$

where $\dim(\gamma) \geq \dim(\alpha)$. The IVQR estimator is computed as follows. For a suitable set of values $\{\alpha_j, j=1,\ldots,J\}$, we run the ordinary QR to obtain coefficients $(\widehat{\beta}(\alpha_j,q)$ and $\widehat{\gamma}(\alpha_j,q))$; i.e.,

$$\left(\widehat{\beta}(\alpha,q),\widehat{\gamma}(\alpha,q)\right) = \arg\min_{\beta,\gamma} Q_n(q,\alpha,\beta,\gamma). \tag{8}$$

Let $W_n(\alpha)$ be the Wald statistic for testing $\gamma(\alpha, q) = 0$. We then look for a value α that makes $\widehat{\gamma}(\alpha, q)$ as close to 0 as possible; i.e.,

$$\widehat{\alpha}(q) = \arg \inf_{\alpha \in \mathscr{A}} W_n(\alpha). \tag{9}$$

The estimate of $\beta(q)$ is given by $\widehat{\beta}(q) = \widehat{\beta}(\widehat{\alpha}(q), q)$. Under regularity conditions, Chernozhukov and Hansen (2008) show that $\widehat{\alpha}(q)$ and $\widehat{\beta}(q)$ are consistent and asymptotically normal. It is also noted that the IVQR estimators are fully robust to weak instruments.

3 Empirical Results

3.1 Data

We employ data on 72 countries to examine the various links between FDI and economic growth for the period 1975−1995.[1] The data set includes 20 OECD countries and 52 non-OECD countries. Countries in the sample are listed in Table 1, which are divided into sixteen groups according to the quartiles of FDI and growth rate, respectively. For each group, we compute the average per capita GDP growth rate shown in Figure 1.

Figure 1 presents a casual observation on the distribution of economic growth for sixteen groupings of countries ranked by foreign direct investment. q^G_{25} (q^F_{25}), q^G_{50} (q^F_{50}), and q^G_{75} (q^F_{75}) are the first, second, and third quartiles of growth rate (FDI), respectively. Each bar represents the average per capita GDP growth rate in each of the sixteen groups according to the quartiles of FDI and economic growth. Comparing with four segments divided by the quartiles of FDI, we observe that the positive effects of FDI on economic growth are not very clear. However, Figure 1 reveals the tendency that the higher is per capita GDP growth rate for well-developed countries (lying above the second quartile), the more FDI the countries receive.

[1] We are grateful to Sebnem Kalemli-Ozcan for providing the cross-country data used in Alfaro et al. (2004).

Table 1: Countries in the sample

	$G \leq q^G_{25}$	$q^G_{25} < G \leq q^G_{50}$	$q^G_{50} < G \leq q^G_{75}$	$q^G_{75} < G$
$F \leq q^F_{25}$	El Salvador (F) Iran (F) Malawi (E) Sierra Leone (E) South Africa (E) Zimbabwe (E)	Algeria (F) Congo (F) Sudan (E)	Finland (S) Germany (G) Syria (F)	Austria (G) India (E) Italy (F) Japan (G) Korea (G) Pakistan (E)
$q^F_{25} < F \leq q^F_{50}$	Cameroon (F) Ghana (E) Haiti (F) Nicaragua (F) Niger (F) Senegal (F) Venezuela (F)	Argentina (F) Brazil (F) Kenya (E) Sweden (S)	Denmark (S) Israel (E) France (F) United States (E) Uruguay (F)	Indonesia (F) Norway (S)
$q^F_{50} < F \leq q^F_{75}$	Bolivia(F) Gambia (E) Peru (F)	Ecuador (F) Honduras (F) Jamaica (E) Mexico (F) Philippines (F) Switzerland (G)	Canada (E) Dominican Republic (F) Greece (F) Panama (F) Paraguay (F)	Colombia (F) Sri Lanka (E) Thailand (E) Portugal (F)
$q^F_{75} < F$	Guyana (E) Togo (F)	Costa Rica (F) Guatemala (F) New Zealand (E) Papua New Guinea (E) Trinidad and Tobago(E)	Australia (E) Belgium (F) Netherlands (F) Spain (F) United Kingdom (E)	Chile (F) Cyprus (E) Egypt (F) Ireland (E) Malaysia (E) Malta (E)

Note: Legal origin is in parentheses. E: English common-law, F: French civil law, G: German civil law, S: Scandinavian civil law.

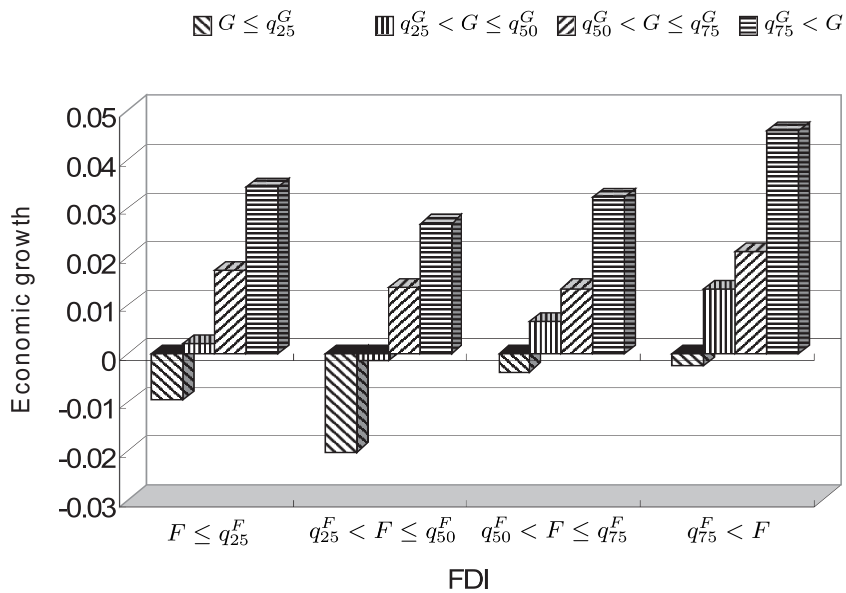

Figure 1: Average per capita GDP growth rates

3.2 Quantile Regression

To assess the relationship between FDI and economic growth, we consider a linear growth regression that includes a number of controls used in Alfaro et al. (2004) and Carkovic and Levine (2005). Initial income per capita equals the logarithm of real per capita GDP in 1975. The schooling variable measures human capital as the average years of secondary schooling in total population. Inflation equals the percentage changes in the GDP deflator. Government size equals total expenditure of the government as a share of GDP. Openness equals exports plus imports relative to GDP. Black market premium equals the black market premium in the foreign exchange market.

Table 2 presents the empirical results of the OLS and QR methods. For the QR model, we calculate the qth quantile (q = 5, 10, 25, 50, 75, 90, and 95) of the growth distribution and construct a 90% confidence interval around that value. As shown in Table 2, FDI does not exert a significantly positive impact on economic growth in the OLS regression. This result is consistent with that of Carkovic and Leiven (2005). For

Table 2: Economic growth and FDI: OLS and QR estimates

	OLS	QR						
		q_5	q_{10}	q_{25}	q_{50}	q_{75}	q_{90}	q_{95}
constant	0.063	-0.029	0.021	0.051	0.054	0.184*	0.183*	0.208*
	(0.028)	(0.036)	(0.039)	(0.033)	(0.041)	(0.060)	(0.075)	(0.069)
FDI	0.172	0.051	-0.083	-0.189	0.128	0.624	0.470	0.343
	(0.307)	(0.275)	(0.334)	(0.497)	(0.529)	(0.423)	(0.534)	(0.433)
Initial GDP	-0.009*	0.004	-0.003	-0.006	-0.006	-0.021*	-0.021*	-0.023*
	(0.003)	(0.005)	(0.005)	(0.004)	(0.005)	(0.006)	(0.007)	(0.007)
Schooling	0.017*	0.004	0.010	0.011*	0.009	0.022*	0.027*	0.030*
	(0.004)	(0.011)	(0.010)	(0.006)	(0.006)	(0.007)	(0.009)	(0.011)
Government size	-0.002	0.000	-0.001	0.004	-0.001	0.010	0.010	0.008
	(0.006)	(0.008)	(0.006)	(0.008)	(0.008)	(0.012)	(0.019)	(0.015)
Population	-0.559*	-0.428	-0.630	-0.706*	-0.575	-1.364*	-1.191*	-1.487*
	(0.289)	(0.462)	(0.504)	(0.398)	(0.379)	(0.593)	(0.524)	(0.466)
Inflation	-0.024*	0.014	-0.014	-0.024	-0.024	-0.014	-0.012	-0.012
	(0.012)	(0.018)	(0.022)	(0.015)	(0.017)	(0.021)	(0.024)	(0.032)
Black market premium	-0.009*	-0.010	-0.009	-0.009	-0.008	0.002	0.000	0.002
	(0.003)	(0.009)	(0.006)	(0.009)	(0.005)	(0.006)	(0.010)	(0.007)
Openness	-0.002	0.006	-0.005	-0.010	-0.004	-0.003	-0.004	-0.001
	(0.004)	(0.007)	(0.007)	(0.006)	(0.006)	(0.004)	(0.009)	(0.007)

1. Standard errors are in parentheses. $*$ indicates the estimate is significant at 10% level.

2. Initial GDP is the logarithm of initial per capita GDP. The schooling variable is the logarithm of (1+average year of secondary schooling) for the period of the regression. Population is the average growth rate for the period. Government size is log(average share of government spending/GDP) over the period. Inflation is log(1+ average inflation rate) for the period and the black market premium is the logarithm of (1+average black market premium). Openness is log(average of exports + imports as a share of GDP) for the period.

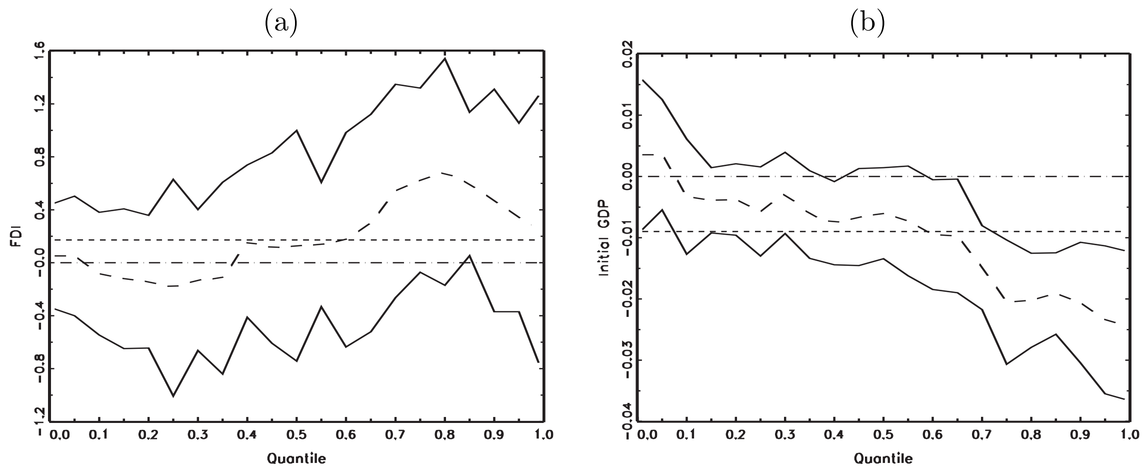

Figure 2: OLS and quantile estimates with 90% confidence interval

the QR model, FDI remains insignificantly linked with growth across different quantiles. The coefficients of FDI are even negative at the lower quantiles. Using the firm-level data and quantile regressions, Girma and Grög (2007) find that the presence of FDI matters for productivity growth. In this paper, we use aggregate FDI flows for a broad cross section of countries to provide the macroeconomic study of FDI spillovers. In contrast with Girma and Grög (2007), the QR results show that FDI does not exert an independent influence on different quantiles of the growth distribution.

The coefficient of initial GDP is significantly negative in the OLS regression. This result provides the evidence of conditional convergence; see Solow (1956).[2] The coefficient estimates of initial GDP in the QR are only significantly negative in upper quantiles of the growth distribution ($q > 60$). It follows that high-income countries have the phenomenon of convergence, but low-income countries do not. Because every country has different initial economic conditions, we can observe that countries do not converge to the same steady state level. This finding suggest a formation of convergence clubs; see Baumol (1986), Quah (1996, 1997), Barreto and Hughes (2004), and Aghion et al. (2005).

[2]The Solow model implies that the poorer countries should grow faster than the richer countries after controlling steady-state differences.

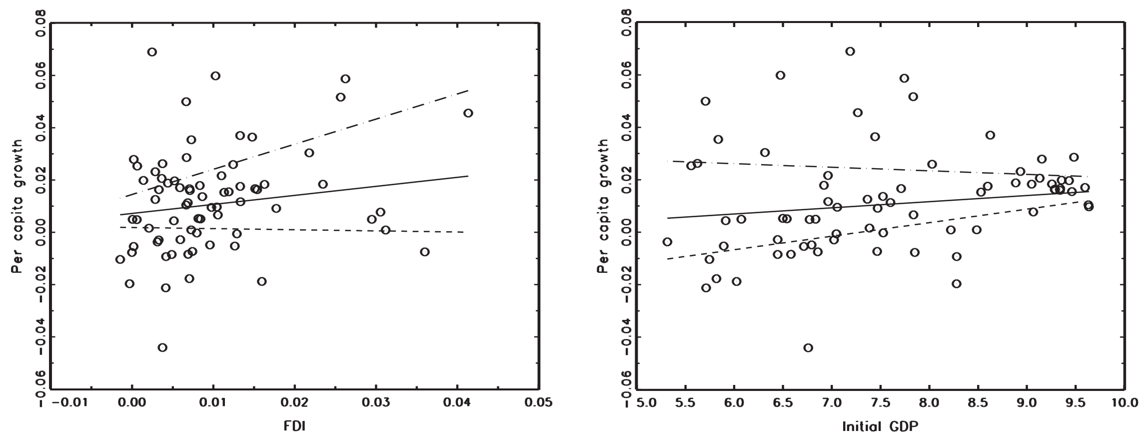

Figure 3: FDI, Initial GDP, and the GDP growth rate

Figure 2 (a) and (b) present the OLS and QR estimates of FDI and initial GDP at different quantiles. The short dashed line represents the OLS estimate and the long dashed line denotes the QR estimates. Besides, the two solid lines represent 90 percent confidence interval for the QR estimates. It is shown that FDI does not exhibit a positive impact on growth across quantiles. Figure 3 reveals the dispersion of growth as FDI increases. We superimpose three estimated quantile regression functions ($q = 25, 50, 75$) for these data.

The results on schooling indicate that at lower quantiles, increases in human capital have an insignificant positive effect on growth, but as we move across the quantiles the significance of schooling generally increases. It suggests that human capital is strongly correlated with economic growth in the upper tail of the growth distribution. Finally, population is negatively correlated growth, which indicates that the scale effect does not exist in the growth regressions; Barro and Sala-i-Martin (2003).

3.3 Instrumental Variable Quantile Regression

One important concern in investigating the effect of FDI on growth is the possibility of endogeneity. Sufficient provisions of infrastructure can help attract FDI by lowering the cost of foreign investment and raising the rate of return. Infrastructure can be measured by a number of variables, such as power generation capacity, telephone lines, the length of

Table 3: Absorptive capacity and Instrument variables

	Power	Telecommunications	Roads	FDI
Constant	9.315*	6.180*	11.277*	0.005*
	(0.259)	(0.084)	(0.922)	(0.001)
English	-1.776*	-1.725*	-0.116	0.011*
	(0.484)	(0.412)	(0.465)	(0.003)
French	-2.686*	-0.360*	-0.170	0.005*
	(0.331)	(0.132)	(0.296)	(0.001)
German	-0.889*	-2.326*	0.969*	-0.002
	(0.329)	(0.228)	(0.467)	(0.002)
Sub-Saharan Africa dummy	-1.779*	-2.822*	-1.237*	-0.009*
	(0.385)	(0.393)	(0.439)	(0.003)
F-statistic	11.701	19.698	2.269	5.455
p-value	0.000	0.000	0.072	0.001
Observations	66	72	66	72

1. Standard errors are in parentheses. $*$ indicates the estimates are significant at 10% level.

2. Power: electric power consumption; Telecommunications: main telephone lines per 1,000 workers. Roads: the length of roads; see Calderón and Servén (2004) and Kinoshita and Lu (2006).

roads, and so forth. However, infrastructure and growth are simultaneously determined and there may be omitted variable bias in the growth regression. Hence, we use the IV and IVQR methods to assess the robustness of the growth effects of FDI.

To confront the issue of endogeneity, we identify instrumental variables for absorptive capacity. There are many reasons for believing that legal origin is closely connected to absorptive capacity, such as institutional quality, financial intermediary development, and infrastructure provision. Therefore, this paper takes Sub-Saharan African dummy and four legal systems[3] as meaningful instrumental variables. Table 3 presents regressions of alternative infrastructure measures on the dummy variables for English, French, and German legal origin, relative to Scandinavian origin. As indicated by the p-values of the F statistic, the legal origin variables can explain the variation of infrastructure provision.

Table 4 provides the empirical results of the IV and IVQR estimations. The coefficient

[3] Table 1 lists the corresponding countries

Table 4: Economic growth and FDI: IV and IVQR estimates

	IV	IVQR						
		q_5	q_{10}	q_{25}	q_{50}	q_{75}	q_{90}	q_{95}
constant	0.055*	-0.004	-0.009	0.012	0.084	0.159*	0.210*	0.228*
	(0.032)	(0.033)	(0.041)	(0.047)	(0.056)	(0.062)	(0.053)	(0.057)
FDI	0.670	0.141	0.972	0.725	1.086	1.693*	1.480*	1.737*
	(0.510)	(0.319)	(0.724)	(0.542)	(0.792)	(0.905)	(0.893)	(0.938)
Initial GDP	-0.009*	0.001	-0.003	-0.003	-0.011*	-0.017*	-0.022*	-0.024*
	(0.003)	(0.004)	(0.005)	(0.006)	(0.005)	(0.007)	(0.006)	(0.007)
Schooling	0.016*	0.004	0.015*	0.008	0.012	0.016	0.024*	0.026*
	(0.005)	(0.004)	(0.007)	(0.006)	(0.009)	(0.011)	(0.010)	(0.012)
Government size	-0.002	0.011*	0.013	-0.002	0.003	0.017	0.026*	0.026*
	(0.007)	(0.006)	(0.014)	(0.010)	(0.016)	(0.014)	(0.009)	(0.009)
Population	-0.522*	0.598*	0.946	-0.435	-0.580	-0.911*	-0.968*	-0.959*
	(0.306)	(0.354)	(0.805)	(0.440)	(0.481)	(0.457)	(0.400)	(0.449)
Inflation	-0.025*	0.009	-0.016	-0.022	-0.019	-0.015	-0.019	-0.025
	(0.011)	(0.008)	(0.011)	(0.015)	(0.026)	(0.023)	(0.020)	(0.020)
Black market premium	-0.009*	-0.014*	-0.014*	-0.008*	-0.003	-0.002	-0.005	-0.007
	(0.004)	(0.003)	(0.004)	(0.004)	(0.011)	(0.010)	(0.009)	(0.010)
Openness	-0.007	-0.001	-0.014	-0.008	-0.007	-0.013*	-0.015	-0.017*
	(0.005)	(0.007)	(0.013)	(0.007)	(0.007)	(0.008)	(0.010)	(0.010)

1. Standard errors are in parentheses. $*$ indicates the estimate is significant at 10% level.

2. Initial GDP is the logarithm of initial per capita GDP. The schooling variable is the logarithm of (1+average year of secondary schooling) for the period of the regression. Population is the average growth rate for the period. Government size is log(average share of government spending/GDP) over the period. Inflation is log(1+ average inflation rate) for the period and the black market premium is the logarithm of (1+average black market premium). Openness is log(average of exports + imports as a share of GDP) for the period.

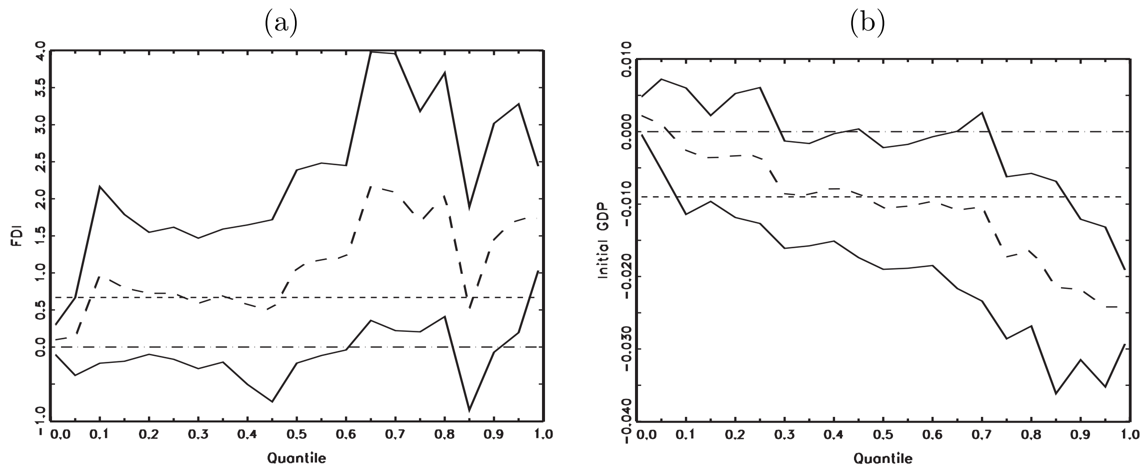

Figure 4: IV and IVQR estimates with 90% confidence interval

estimates of the IV regression is very similar to the OLS results. The impact of FDI on growth is still insignificant when controlling for the potential endogeneity of FDI. Our empirical result does not support the relationship between economic growth and FDI. The estimate of initial GDP is negative and significant. This finding suggests conditional convergence in the IV regression. We also find that the black market premium distorts allocations of resource.

In contrast with the QR results, the IVQR estimates of FDI are positive and significant at higher quantiles ($q > 50$) of the growth distribution. It implies that high-growth countries with well-developed absorptive capacity seem to gain significantly more from FDI. If the country has sufficient absorptive capacity, the country will benefit technology spillovers from FDI and attain the higher level of growth. These findings are consistent with the results of Blomström et al. (1994) and Wang et al. (2004). In our sample, the growth rates of 90% OECD countries are located beyond the median of the growth distribution as shown in Table 1. These high-income countries are the major FDI recipients[4] and are able to provide sufficient absorptive capacity. Firms in these countries are easily to take advantage of the new knowledge and reap such spillovers from FDI. Hence,

[4]See World Investment Report (UNCTAD, 2007).

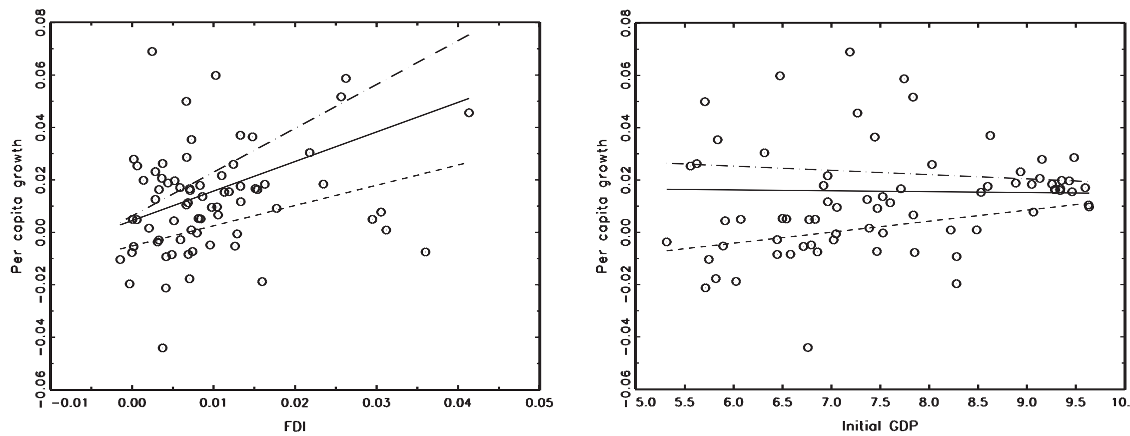

Figure 5: FDI, Initial GDP, and the GDP growth rate

the positive effects of FDI can be found only in the well-developed countries. Absorptive capacity plays an important role in explaining the effect of FDI on economic growth.

The parameter estimates of initial GDP are significantly negative in the upper tail of the growth distribution. It indicates that convergence for countries in the upper tail of the growth distribution is stronger than countries in the lower tail. This phenomenon is so-called convergence clubs. The schooling variable has positive impact on growth in upper quantiles of distribution. We also find that the black market premium distorts allocations of resource in lower quantiles. In addition, it should be noted that the IVQR results are robust to weak and partial identification and remain valid even in case where identification fails completely.

Figure 4 (a) and (b) present the IV and IVQR estimates of FDI and initial GDP at different quantiles. Compared with Figure 3, Figure 5 shows that the growth effect of FDI in the IVQR model is more steeper than the estimates of the QR model in higher quantiles. Thus, controlling for endogeneity is an important factor in estimating the effect of FDI on growth.

4 The Role of Local Financial Markets

In order to assess the robustness of the results, we examine the links among FDI, financial markets, and economic growth. Hermes and Lensink (2003) and Alfaro et al. (2004) emphasize that economics with well-developed financial markets can get more benefits from FDI to accelerate their economic growth. We use private credit to measure the financial intermediary development.[5] This indicator is used in many studies; see King and Levine (1993), Levine et al. (2000).

We include private credit, FDI $\times$ (private credit), and institutional quality in the growth regression. Table 5 presents the estimation results of the IV and IVQR models. The estimates of FDI and the interaction term are still insignificant and results are very similar to the IV results in Table 4. Compared with Alfaro et al. (2004), economies with better-developed financial markets do not necessarily benefit more from FDI to accelerate their economic growth. However, the coefficients of FDI and FDI $\times$ (private credit) are significantly positive at higher quantiles of the growth distribution. Figure 6 shows the IVQR estimates with 90% confidence interval across quantiles. Hence, our empirical results show that the level of development of local financial markets is not crucial for the growth effects of FDI in lower quantiles. This finding may be due to the distortion of resource allocation in less-developed countries. To summarize, FDI can boost economic growth when countries is sufficiently wealthy and with well-developed financial markets.

5 Conclusions

In this paper, we examine the role of absorptive capacity in contributing to the growth effects of FDI. Compared with the firm-level study of Girma and Grög (2007), we use cross-country data for the period 1975−1995 to provide the macroeconomic study of FDI spillovers. In order to control for endogeneity of all the explanatory variables, we apply the instrumental variable quantile regression developed by Chernozhukov and Hansen (2008) to yield more robust empirical results. We find that the IVQR estimates suggest positive

[5]Private credit equals the value of credit financial intermediaries to the private sector divided by GDP.

Table 5: FDI, financial development, and economic growth: IV and IVQR estimates

	IV	IVQR						
		q_5	q_{10}	q_{25}	q_{50}	q_{75}	q_{90}	q_{95}
FDI	1.106	0.696	1.967	0.213	-0.303	1.911*	0.371	0.885
	(0.776)	(1.588)	(1.392)	(2.110)	(1.445)	(0.954)	(0.877)	(0.817)
Private credit	0.002	-0.045*	-0.006	-0.008	-0.015	-0.017	-0.040*	-0.038*
	(0.010)	(0.027)	(0.015)	(0.016)	(0.015)	(0.017)	(0.016)	(0.016)
FDI × (Private credit)	0.813	1.413	2.025	0.425	0.522	1.792*	0.625	1.124*
	(0.581)	(1.434)	(1.691)	(1.743)	(1.207)	(0.825)	(0.977)	(0.570)
Initial GDP	-0.009*	-0.014*	-0.009	-0.005	-0.005	-0.010*	-0.015*	-0.015*
	(0.002)	(0.008)	(0.009)	(0.011)	(0.005)	(0.005)	(0.006)	(0.005)
Schooling	0.010*	0.024	0.010	0.006	0.005	0.009	0.026*	0.029*
	(0.004)	(0.018)	(0.030)	(0.016)	(0.010)	(0.010)	(0.014)	(0.012)
Investment	0.096*	0.185*	0.145	0.043	0.070	0.126*	0.233*	0.208*
	(0.037)	(0.094)	(0.227)	(0.104)	(0.063)	(0.074)	(0.091)	(0.056)
Government size	-0.011	0.006	-0.001	0.011	0.001	-0.007	0.010	0.004
	(0.008)	(0.018)	(0.062)	(0.030)	(0.014)	(0.017)	(0.015)	(0.011)
Population	-0.198	-1.071	-0.533	0.014	-0.263	-0.286	-0.900	-0.675
	(0.321)	(0.832)	(1.520)	(0.978)	(0.584)	(0.620)	(0.634)	(0.697)
Inflation	-0.005	-0.038	0.007	-0.018	-0.020	-0.020	-0.038	-0.039*
	(0.012)	(0.031)	(0.040)	(0.091)	(0.020)	(0.016)	(0.024)	(0.018)
Black market premium	-0.006	-0.007	-0.009	-0.011	-0.010*	-0.010*	-0.005	-0.007
	(0.004)	(0.008)	(0.023)	(0.023)	(0.005)	(0.005)	(0.007)	(0.005)
Openness	-0.003	-0.005	-0.012	-0.004	0.003	-0.003	-0.005	-0.004
	(0.005)	(0.009)	(0.015)	(0.018)	(0.008)	(0.010)	(0.008)	(0.006)
Institutional quality	0.004*	0.007	0.001	0.005	0.005	0.004	0.008	0.007*
	(0.001)	(0.006)	(0.004)	(0.006)	(0.005)	(0.003)	(0.005)	(0.004)

1. Standard errors are in parentheses. ∗ indicates the estimate is significant at 10% level.

2. Initial GDP is the logarithm of initial per capita GDP. The schooling variable is the logarithm of (1+average year of secondary schooling) for the period of the regression. Population is the average growth rate for the period. Investment is the average domestic investment ratio. Government size is log(average share of government spending/GDP) over the period. Inflation is log(1+average inflation rate) for the period and the black market premium is the logarithm of (1+average black market premium). Openness is log(average of exports+imports as a share of GDP) for the period. Institutional quality is measured by the average risk of expropriations.

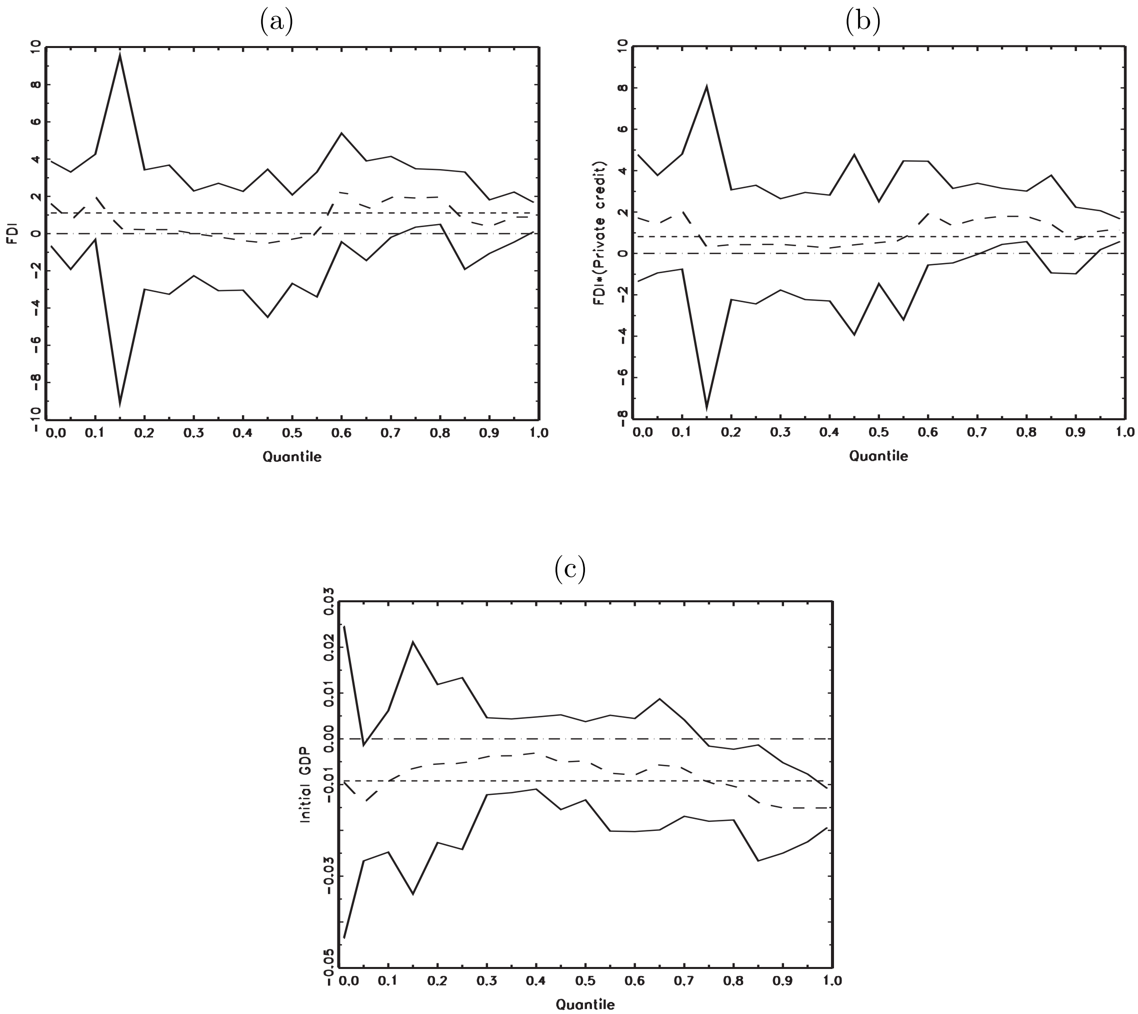

Figure 6: IV and IVQR estimates with the 90% confidence interval

growth effects of FDI at higher quantiles of the distribution, while the estimates of FDI for QR are insignificant and small in magnitude across different quantiles. It implies that high-income countries with well-developed absorptive capacity seem to gain significantly more from FDI. Our IVQR analysis also provides the empirical evidence of convergence clubs. It means that high-income countries have the phenomenon of convergence, but low-income countries do not. In contrast with Hermes and Lensink (2003) and Alfaro et al. (2004), our empirical results show that the level of development of local financial markets is not crucial for the growth effects of FDI in lower quantiles.

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