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The Impact of FDI on Economic Growth: An Empirical Evidence from IV Panel Quantile Regression*

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Abstract

FDI has increased substantially since the 1980s. Countries, especially under-developed countries, competes with each other to attract FDI by reducing tax and granting subsidies. We propose using instrumental variable quantile regression for panel data with fixed effects to analyze the impact of FDI on economic growth. Our empirical findings shows that FDI positively relates to economic growth in under-developed countries, and the contribution of FDI on growth is even greater than GDI.

KRF Classification : B030104
Keywords : Quantile Regression, Panel Data, Endogeneity, FDI

Ⅰ. Introduction

Intense debates on the impact of Foreign Direct Investment (FDI) on domestic economies, especially on the economies of developing host countries, have carried on for several decades and remained a hot topic till now. FDI is widely considered as a win-win co-

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operation between the investors and the local firms, since the investors can profit from holding share of the foreign firms and the local firms can also acquire positive productivity spillovers like capital, technologies, and knowledge and so on. FDI plays a vital role of transferring and disseminating international technologies. Therefore, many developing countries, who believe that FDI can positively impact on economic growth, compete with each other to attract FDI by making policies such as setting up special economic zones, reducing tax, and granting subsidies.

A lot of literature has emerged to discover the relationship between FDI and economic growth in host countries. Influential work by Levine and Renelt (1992) discovers a positive and robust correlation of share of investment with both growth rate and share of trade, through Leamer's extreme bounds analysis (EBA). Some cross-sectional and time-series analysis discovered that FDI would not positively or significantly influence host countries' economy, but under some special conditions, FDI would enhance the economic growth in host countries [see Blomström et al. (1992), Borensztein et al. (1998), Balasubramanyam et al. (1996, 1999), Olofsdotter (1998)]. Stocker (2000) finds no reliable significantly positive relationship or persistent Granger-causality between FDI and economic growth.

Compared to cross-sectional or time-series approaches, panel data analysis is generally considered more efficient, due to its flexibility in allowing for heterogeneity of different countries, which can help avoid 'omitted variable bias' induced by country-specific effects that can be correlated with the error term. For this reason, panel data analysis has been applied to investigate the relationship between FDI and economic growth [see, for example, Blonigen and Wang (2005), Carkovic and Levine (2005), Nair-Reichert and Weinhold (2001)]. Choe (2003) set up a panel dataset of 80 countries period from 1971-1995. By using panel VAR model, He finds that FDI

Granger-causes economic growth and vice versa, and the latter is more apparent investigated Granger-causality relation between economic growth and FDI and GDI. Carkovic and Levine (2005) construct a data set consisting of 72 countries and 7 five-year period from 1960 to 1990. Considering country-specific effects and possible endogeneity in the model, they used GMM (generalized method of moments) panel estimator to investigate the impact of FDI on economic growth, and they found that FDI inflows do not show any significantly positive impact on growth.

Since all of the different estimation methods mentioned above are based on LS-type regression, researchers are restricted to investigate the relationship between economic growth and FDI at the mean of the conditional distribution of the dependent variable; i.e, economic growth in our case. As an alternative approach of allowing for parameter heterogeneity, quantile regression proposed by Koenker and Bassett (1978) enables researchers to study the relationship between economic growth and FDI not only at the center but also at different parts of the entire conditional distribution. Moreover, quantile regression has additional advantages as follows. Firstly, the assumption of Gaussian error seems too strict and not common in empirical analysis, while quantile regression estimators can be more efficient when the error term is not normally distributed. Secondly, quantile regression will be more robust if outliers exist in the data. Stocker (2000) demonstrates how the presence of outliers can distort the relationship between economic growth and FDI; OLS regression using the full data set shows a significantly negative coefficient estimate of FDI whereas, after getting rid of 7 outliers from the regression, the effect of FDI turns to be insignificant. For these reasons, quantile regression has been already applied to the study of FDI. Dimelis and Louri (2002) use quantile regression to analyze the production efficiency of 4,056 firms in Greece in 1997 and find that

the entry of foreign affiliates can enhance the local labor productivity, but the impact is significant only at the median. Girma and Görg (2003) use a data set from 1980-1992 in UK to estimate the effect of various covariates on productivity at different quantiles. They find that productivity benefits from FDI spillovers while the efficient gap is reduced to some threshold level of the establishment in UK. However, panel quantile regression can still suffer from the problem of endogeneity; FDI can be endogenous in panel quantile regression. This particular problem remained unresolved until the work of Galvao (2011) who extends Chernozhukov and Hansen (2005, 2006) to develop the IV (instrumental variable) panel quantile regression method. In this paper, we use this novel technique to reinvestigate the impact of FDI on economic growth at various quantiles.

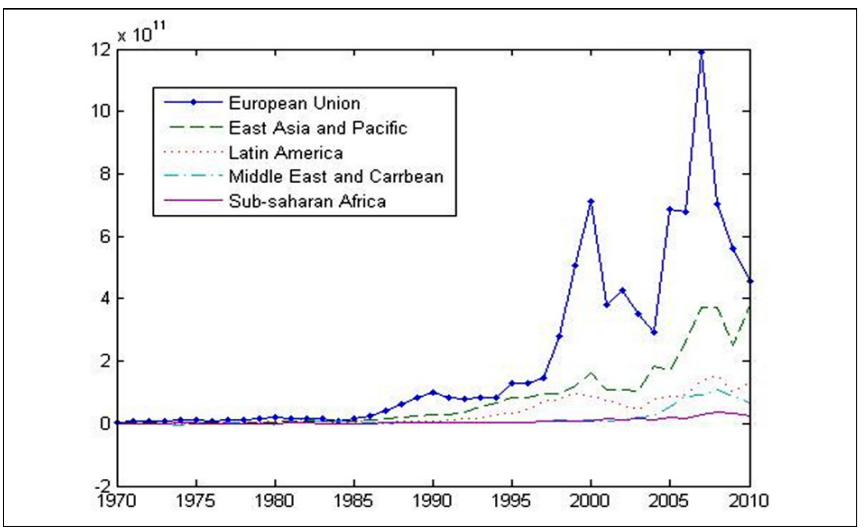
The rest of this paper is organized as follows. Section 2 discusses how FDI and economic growth have changed in different areas during the period of 1970-2010. Section 3 explains the IV panel quantile regression method added with two-way effects. The data description and regression results are provided in section 4. Section 5 concludes the paper.

Ⅱ. FDI and Economic Growth

In the last 40 years, FDI has increased dramatically, and peaked at 2.356 trillion US Dollar in 2007 on a global scale. We list some area-specific FDI inflow trends over the period of 1970-2010 in Figure 1. It is shown in Figure 1 that European Union enjoys the greatest amount of FDI among the areas under consideration. East Asia and Pacific area obtain the second largest amount whereas the Sub-Saharan Africa acquires the least amount among the five areas

and its FDI net inflows in 2007 is only about 8 percent of European Union or 20 percent of East Asia and Pacific area. There are two significant falls in Figure 1. The first one happened at the beginning of this century, which was largely caused by the significant drop in cross-border M&A among the industrial countries, coinciding with the correction in world equity markets (Patterson, et al., 2004). The other drop in 2008 was obviously caused by the subprime mortgage crisis.

【Figure 1】 FDI net inflows (BoP, current US$)

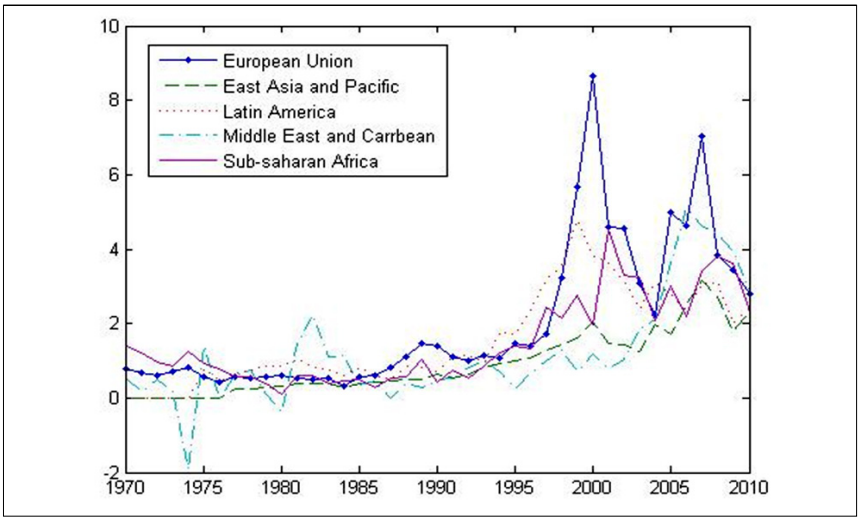


Note: FDI net inflows (BoP, current US$) from 1970 to 2010 in European Union, East Asia and Pacific, Latin America, Middle East and Carrbean, and Sub-Saharan Africa.
Data source: World bank (http://www.worldbank.org/)

Although low and middle income countries possess a small share of the total FDI, the impact of FDI on their economic growth should not be neglected. During last two decades, FDI to developing countries has risen prominently, and numerous papers have studied the impact of FDI on the growth rate of host developing countries. The strong positive effect of FDI on GDP growth in host developing countries has been repeated shown in the literature. As Stocker (2000)

describes, although developing countries have turned out to be less integrated with the world economy, the effect of FDI flows to poor countries are significant, regardless of their economic sizes. This observation can be supported by Figure 2, which displays the share of FDI net inflows in GDP. It is shown in Figure 2 that the share of FDI has fluctuated all the time and started an increasing trend from 1985. In 2007, the FDI net inflows in the Sub-Saharan Africa is about 30 billion US Dollars, while European Union enjoys nearly forty times of FDI net inflows. However, the share of FDI in GDP in the Sub-Saharan Africa is about 3.4%, which is only a little less than that of European Union. Although a low income area like the Sub-Saharan Africa obtains small FDI net inflows, the share of FDI in GDP even in such a case cannot be ignored.

【Figure 2】 FDI net inflows (% of GDP)



Note: FDI net inflows (% of GDP) from 1970 to 2010 in European Union, East Asia and Pacific, Latin America, Middle East and Carrbean, and Sub-Saharan Africa.
Data source: World bank (http://www.worldbank.org/)

Ⅲ. IV Quantile Regression Model for Panel Data with Fixed Effects

In this paper, a dynamic panel model is used to control for country-specific and time effects to avoid omitted variable bias. Carkovic and Levine (2005) have also considered time dummy in each period to control for time effects. We consider a panel-based model for FDI and economic growth as follows:

$$GY_{it} = \alpha Y_{i,t-1} + \beta FDI_{it} + X_{it}\gamma + \eta_i + \lambda_t + u_{it},$$
$$i = 1,2,\cdots;\ t = 1,2,\cdots,T \qquad (1)$$

where GY_{it} is the growth rate of GDP per capita in country i and year t, $Y_{i,t-1}$ is logarithm of GDP per capita in country i and year $t-1$, FDI_{it} is FDI net inflow (% of GDP), and X_{it} is a set of other independent variables that can influence economic growth such as government consumption, gross domestic investment, inflation, M2. The other two terms, η_i and λ_t, are country specific effects and year specific effects, respectively.

Since FDI might be influenced by growth rate simultaneously, FDI can be endogenous and needs to be taken into account when estimating the model in (1). The potential problem caused by the presence of endogeneity has been considered in the FDI literature when LS-type regression is employed for estimation; see Borensztein et al. (1998), Stocker (2000), Carkovic and Levine (2005). As for quantile regression, if an endogenous variable exists, Kim and Muller (2004) show that quantile regression is biased as well. However, there has been no method to deal with endogeneity in panel quantile regression until the work of Galvao (2011) who extends the work of Chernozhukov and Hansen (2005, 2006) to develop the IV panel quantile regression method. In this paper, we employ the IV panel

quantile regression method proposed by Galvao (2011). When employing the method, we use the lagged values of explanatory variables as instruments. To enhance the quality of such instrumental variables, we have chosen a sufficiently long length, i.e. 1st - 5th lagged values. The vector of all IVs is denoted as w_{it}. For a certain quantile θ, the parameters $\alpha_\theta, \Gamma_\theta, \eta_{i\theta}, \lambda_{t\theta}, \zeta_\theta$ are estimated by

$$\underset{\alpha_\theta, \Gamma_\theta, \eta_{i\theta}, \lambda_{t\theta}, \zeta_\theta}{\operatorname{argmin}} \sum_{i=1}^{N}\sum_{t=1}^{T} \rho_\theta(GY_{it} - \alpha_\theta T_{i,t-1} - \beta_\theta FDI_{it} - X_{it}^{'}\Gamma_\theta - \eta_{i\theta} - \lambda_{t\theta} - w_{it}^{'}\zeta_\theta)$$

where $\rho_\theta = u(\theta - I(u<0))$. Hence, the resulting estimators $\hat{\alpha}_\theta, \hat{\Gamma}_\theta, \hat{\eta}_{i\theta}, \hat{\lambda}_{t\theta}, \hat{\zeta}_\theta$ are functions of β_θ, which still needs to be estimated; thus they are denoted as $\hat{\alpha}_\theta(\beta_\theta), \hat{\Gamma}_\theta(\beta_\theta), \hat{\eta}_{i\theta}(\beta_\theta), \hat{\lambda}_{t\theta}(\beta_\theta), \hat{\zeta}_\theta(\beta_\theta)$. The true coefficient on w_{it} should be zero if w_{it} is a valid instrument because w_{it} must be independent of the error term u_{it} in (1). Hence, β_θ can be estimated by making $\hat{\zeta}_\theta(\beta_\theta)$ as close to zero as possible; i.e., by the following minimization

$$\widehat{\beta_\theta} = \min_{\beta_\theta} \| \hat{\zeta}_\theta(\beta_\theta) \|_A$$

where $\|x\|_A = \sqrt{x'Ax}$, and A is a positive definite matrix. Hence, the final IV panel quantile estimators are given by $\hat{\alpha}_\theta(\hat{\beta}_\theta), \hat{\Gamma}_\theta(\hat{\beta}_\theta), \hat{\eta}_{i\theta}(\hat{\beta}_\theta), \hat{\lambda}_{t\theta}(\hat{\beta}_\theta), \hat{\zeta}_\theta(\hat{\beta}_\theta)$. Readers are referred to Galvao (2011) for a more detailed discussion.

Ⅳ. Data and Empirical Results

The data set consists of 60 developed and developing countries, and the sample period is from 1992 to 2008. FDI net inflows (% of

GDP), gross domestic investment (% of GDP) denoted as GDI, GDP per capita (constant 2000 US$), general government final consumption expenditure (% of GDP) denoted as GCE, trade (% GDP) that equals to the sum of exports and imports of goods and services, and money and quasi money (M2)(% of GDP) are collected from World Development Indicators. Human capital is measured by average years of male secondary schooling, and these data are collected from Barro and Lee (2010). We use the initial value of every 5 years of male secondary schooling for the human capital stock.[1)]

The estimation results based on IV panel quantile regression are shown in Table 1, where the estimated coefficients at some pre-selected quantiles $(\theta = 0.1, 0.2, \cdots, 0.9)$ with standard error in parentheses are displayed.[2)3)] As shown in Table 1, FDI tends to have positive effects on economic growth at all quantiles, but the impacts are significant only at low quantiles between $\theta = 0.1$ and $\theta = 0.3$. The estimated coefficient for FDI starts at 0.2817 at the 10^{th} quantile and falls to 0.1686 at the 20^{th} quantile, and then rises to 0.2033 at 30^{th} quantile. At intermediate and high quantiles, i.e., $\theta = 0.4, 0.5, \cdots, 0.9,$ the positive impacts are not significant. It indicates that FDI can be a powerful engine of those economies located at the bottom of the conditional distribution of the growth rate variable. One possible interpretation is that FDI can be more effective, especially for countries which experience a period of low economic growth relative to other countries. Usually, very under-developed countries tend to suffer from low economic growth so that FDI can be helpful in such

1) Unit root test for panel data series shows that trade and M2 are I(1) process, so the stationary first differences of these two variables are used as explanatory variables in the regression.
2) Matlab code for IV panel quantile regression is based on the code provided by Prof. Christian Hansen's in his personal website: http://faculty.chicagobooth.edu/christian.hansen/research/.
3) The corresponding regression results without IV underestimate the impacts of FDI on growth, due to endogeneity. The details are available on request.

cases.

Table 1 also displays that GDI has a positive and significant impact on economic growth at all quantiles, and the degree of such impact rises while the considered quantile increases. However, at lower quantiles, FDI contributes more than GDI on growth. It can be seen from Table 1 that the income level in the last period negatively influences economic growth. Government expenditure shows negative impacts on growth, but the impacts are only significant in moderately slower and middle growth countries. The impacts of inflation, the change in Trade, and schooling are not significant. The increase of M2 has significantly negative effect on growth at all countries except very fast growth ones.

【Table 1】 IV Panel Quantile Regression Results

	FDI	Log GDP	GDI	GCE	Inflation	Schooling	ΔTrade	ΔM2
$\theta=0.1$	0.2817*	-13.6711***	0.1229*	-0.1716	0.0002	-0.3958	-0.0127	-0.0831*
	(0.1686)	(2.5945)	(0.0707)	(0.123)	(0.0023)	(1.482)	(0.0304)	(0.0459)
$\theta=0.2$	0.2033*	-9.1354***	0.1607***	-0.1256	0.0002	0.9399	-0.0129	-0.0985***
	(0.1156)	(1.7788)	(0.0484)	(0.0844)	(0.0016)	(1.0161)	(0.0208)	(0.0315)
$\theta=0.3$	0.1773*	-8.9983***	0.1691***	-0.0902	-0.0007	0.6668	-0.0073	-0.101***
	(0.1016)	(1.5638)	(0.0426)	(0.0742)	(0.0014)	(0.8933)	(0.0183)	(0.0277)
$\theta=0.4$	0.1531	-8.8081***	0.1541***	-0.1481**	0.0001	0.7315	-0.0004	-0.0635**
	(0.0976)	(1.5026)	(0.0409)	(0.0713)	(0.0013)	(0.8583)	(0.0176)	(0.0266)
$\theta=0.5$	0.1193	-7.0682***	0.1771***	-0.1511**	-0.0003	0.8059	0.0115	-0.0819***
	(0.0962)	(1.48)	(0.0403)	(0.0702)	(0.0013)	(0.8454)	(0.0173)	(0.0262)
$\theta=0.6$	0.0888	-6.8672***	0.1917***	-0.107	-0.0003	0.9247	0.0058	-0.0703***
	(0.097)	(1.493)	(0.0407)	(0.0708)	(0.0013)	(0.8528)	(0.0175)	(0.0264)
$\theta=0.7$	0.0942	-5.8446***	0.1861***	-0.1078	0.0007	0.7571	0.0032	-0.0466*
	(0.1022)	(1.5723)	(0.0428)	(0.0746)	(0.0014)	(0.8981)	(0.0184)	(0.0278)
$\theta=0.8$	0.0382	-6.6208***	0.1982***	-0.0799	0.0002	1.0744	0.007	-0.0381
	(0.1128)	(1.7368)	(0.0473)	(0.0824)	(0.0015)	(0.9921)	(0.0204)	(0.0307)
$\theta=0.9$	0.1417	-11.1332***	0.2099***	-0.1102	0.0002	1.4662	-0.0102	-0.0363
	(0.1571)	(2.4182)	(0.0659)	(0.1147)	(0.0021)	(1.3813)	(0.0283)	(0.0428)

Notes: (1) Standard errors are in parentheses.
(2) Constant estimates including the fixed effects terms are not shown.
(3) Significant coefficients are marked by ***(1%), **(5%), *(1%).

Ⅴ. Conclusion

Our analysis on FDI is based on the novel method called the IV panel quantile regression method, which can allow for heterogenous impact of FDI on growth at different quantiles, and it can control for endogeneity, country-specific and time-specific effects. Our investigation on 60 countries from the sample period of from 1992 to 2008 shows significant positive impacts of FDI on economic growth at low quantiles. It indicates that FDI can be a powerful engine of those economies located at the bottom of the conditional distribution of the growth rate variable. One possible interpretation is that FDI can be more effective, especially for countries which experience a period of low economic growth relative to other countries. Usually, very under-developed countries tend to suffer from low economic growth so that FDI can be helpful in such cases.

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Appendix: 60 Countries

Australia, Bahrain, Bangladesh, Bolivia, Botswana, Brazil, Canada, Chile, China, Congo, Rep., Costa Rica, Cote d'Ivoire, Cyprus, Denmark, Ecuador, Egypt, Arab Rep., El Salvador, Finland, Gabon, Ghana, Guatemala, Honduras, Iceland, India, Indonesia, Israel, Italy, Japan, Jordan, Kenya, Korea, Rep., Malaysia, Malta, Mexico, Morocco, New Zealand, Nicaragua, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Saudi Arabia, Senegal, Sierra Leone, Singapore, South Africa, Sri Lanka, Sudan, Sweden, Switzerland, Syrian Arab Republic, Thailand, Tunisia, Turkey, United Kingdom, United States, Uruguay, Venezuela, RB.

해외직접투자가 경제성장에 미치는 영향: IV 패널 분위수회귀분석에 기반한 실증분석

Lijuan Huo*

논문초록

20세기 90년대부터 해외직접투자는 신속히 증가하는 추세를 보였다. 세계 각국 특히 저개발국들은 관세 저하와 보조금 지불 등 방법으로 해외직접투자를 유치하기 위해 경쟁하고 있다. 본 논문에서는 기구변량 분위수회귀분석으로 패널 데이터의 고정효과를 분석함으로써 해외직접투자가 경제성장에 미치는 영향에 대해 고찰하였다. 실증분석 결과에 의하면 해외직접투자는 저개발국의 경제성장에 정의 영향을 미치며 그 영향은 GDI보다 더 크다.

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