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A Quantile Regression Analysis of International Financial Integration-Economic Growth Nexus

Mazlina Abdul Rahman, Saifuzzaman Ibrahim*, W.N.W Azman-Saini
Department of Economics
Faculty of Economics and Management
Universiti Putra Malaysia
E-mail: saifuzza74@yahoo.com ; saifuzzaman@upm.edu.my

ABSTRACT

This study aims to examine the relationship between international financial integration (IFI) and economic growth for countries with different level of economic development. Adopting the quantile regression technique on cross sectional data of 73 countries, the results show that IFI has a positive impact on economic growth. However, the impact does not exist in countries where the economic development are too low or in highly developed countries.

Keywords: international financial integration, economic growth, economic development, quantile analysis

INTRODUCTION

Factors driving economic growth have always been a center of interest among the economists since the era of Adam Smith where he viewed capital accumulation and labor productivity as a source of growth. Subsequently, technological advancement (Solow, 1956) and human capital (Romer, 1986; Lucas, 1988) are some other determinants of economic growth that has been proposed earlier. In this era of globalization, the importance of economic integration came to a light. IFI, a form of economic integration is believed to contribute to economic growth by eliminating frictions and barriers to exchange, and by allocating capital more efficiently (Baele et al., 2004).

In simple words, IFI is an integration of a country's domestic financial system with international financial markets and institutions. Cross-border capital flows, information sharing, direct funds borrowing and raising, direct investment in the international capital markets and quick adaption of fresh financial products in different countries are some types of IFI. The depth and breadth of IFI in the recent times are extraordinary to be compared with the early years of its implementation. According to Chen and Quang (2014), there was a rapid decline in capital controls of industrial countries in the 1980s and in developing countries since the early 1990s.

However, both theoretical and empirical studies could not achieve a consensus on reuniting the controversy over the interest of liberalizing capital flows. On one hand, the theory indicates that IFI can spur growth and facilitate risk sharing. On the other hand, the theory says that removing distorting effects of capital controls can actually magnify the negative effects of other pre-existing distortions, causing welfare loss. Empirical studies also unable to come up with robust evidence of a positive connection on IFI-growth nexus. Several empirical studies (Rodrik, 1998; Kraay, 1998) find no link between economic growth and IFI. Edison et al. (2002) report no strong effect of IFI on economic growth. In addition, some studies (Boyd and Smith, 1992; Bailliu, 2000; Gourinchas and Jeanne, 2013) even find negative impact of IFI on economic growth.

One of the reasons why the role of IFI in nurturing growth receive lots of criticism is that financial crisis was believed to be transmitted largely through financial channels and it appears to have powered the credit boom before the financial crisis. According to Berglof et al. (2010), this credit boom and the related stocks of private foreign debt are broadly believed to have caused the transition region quite vulnerable to the financial crisis, and are indeed strongly correlated with the decline of the output in the region during the crisis. In addition, Chen and Quang (2014) suggest that if there are outpourings in capital inflows, developing countries especially, can face perilous challenges such as strong currency appreciation, asset price bubbles or rapid credit growth that encourage fragilities in the financial sector. All these are somehow contradicts to the idea that IFI spurs growth.

Furthermore, some studies (Boyd and Smith, 1992; Arestis and Demetriades, 1997; Bhagwati, 1998; Stiglitz, 2000; Alfaro et al., 2004, 2008; Kamau, 2010; Samimi and Jenatabadi, 2014) highlighted that there are third factors such as economic developments that act as determinants of IFI's

impact on growth. Economic development here is the sustained and intensive actions in the generation of new ideas, knowledge transfer, infrastructure and institutional transformation which depends on functioning social and economic institutions and on cooperation between the public sector and private enterprise. According to Edison et al. (2002), some theories predict growth due to the increase of IFI, only in countries with sound institutions and good policies. Prasad, Rogoff, Wei and Kose (2003) have stated that the ability of a developing country to gain benefits from financial globalization can be significantly influenced by the quality of both its macroeconomic framework and its institutions.

In addition, Chang et al. (2009) found that the growth effects of openness may be significantly enhanced when there is a stronger investment in human capital, deeper financial markets, lower price inflation and more readily available public infrastructure. Also, Gu and Dong (2011) stressed that the hurtful and useful growth effect of financial globalization greatly hinge on the level of financial development of markets. Indeed, growth will be replaced by volatility if financial openness occurs without any improvement in financial system of countries. All these evidences suggest that a country needs to have a sufficient economic development in order to absorb the benefits of IFI.

In general, there is no clear picture on the relationship between IFI and economic growth as the findings are still mixed. Moreover, in methodological wise, importance are given more to the mean of the conditional growth distribution. This focus is not really driven by theoretical considerations but just that there is no guidance given by the neoclassical theory to the parts of the distribution of per capita growth rates where the effects of explanatory variables are likely to take place (Canarella and Pollard, 2004). Conditional mean is a vital location measure yet not sufficient enough to fully characterize the conditional distribution.

Thus, our study is intended to fill this gap by using quantile regression to examine whether the relationship between IFI and economic growth of available countries vary along quantiles of the conditional growth distribution. Quantile regression estimates the entire family of quantile functions, thus providing a wider view of the conditional distribution. There might be some possibilities in which, economic relationships that are significant at conditional mean, but insignificant over other segments of conditional distribution and vice-versa. To the best of our knowledge, none of the studies on the IFI-growth nexus has focused on this aspect. This study is believed to benefit the government and policymakers to make accurate decisions in the process of IFI under any circumstances.

METHODOLOGY AND DATA

The concept of quantile is explained by first considering a real valued random variable Y that is characterized by the following distribution function $F(y) = \Pr(Y \leq y)$ where the θ-quantile of Y is defined as $Q_Y(\theta) = \inf\{y: F(y) \geq \theta\}$. The quantile regression basically transforms a conditional distribution function $F_{Y|X}(y)$ in a conditional quantile function $Q_{Y|X}(\theta) = \inf\{y: F_{Y|X}(y) \geq \theta$ by dividing it into segments. With the use of previously defined quantiles, these segments describe the cumulative distribution of the conditional dependent variable Y given the various realizations of the explanatory variable X.

The quantile-regression model can be written in the simplest setting with only one exogenous regressor as:

$$Y_t = \eta_\theta X_t + \varepsilon_{\theta t} \quad (1)$$

To estimate η_θ, Koenker and Bassett (1978) solve the following optimization problem:

$$\min_{\eta\theta} \sum_t \rho_\theta (\varepsilon_{\theta t}) \varepsilon_{\theta t} \quad (2)$$

where

$$\rho_\theta(\varepsilon_{\theta t}) = \begin{cases} \theta \varepsilon_{\theta t} & \text{if } \varepsilon_{\theta t} \geq 0 \\ (\theta - 1)\varepsilon_{\theta t} & \text{if } \varepsilon_{\theta t} < 0 \end{cases} \quad (3)$$

is known as the check function. The solution provides an estimate of the parameter of interest, that is:

$$\hat{\eta}_\theta = \arg\min \sum_t \rho_\theta(\varepsilon_{\theta t}) \varepsilon_{\theta t} \quad (4)$$

and therefore allows to estimate the conditional quantile function of model (1), which is given by:

$$Q_\theta(Y_i|X_i) = \eta_\theta X_i \quad (5)$$

The quantile regression techniques was selected over other alternatives that followed mean-based estimation procedures because it provides a wider view of the conditional distribution as the entire family of quantile functions will be estimated. Besides that, quantile estimates are also more robust to the outliers in the response measurements and more efficient compared to a mean-based estimator in the presence of residual heteroskedasticity. It provides an interesting approach to the analysis of the parameter heterogeneity and to assess how policy variables have impact on countries according to their position along the conditional growth distribution (Mello and Perrelli, 2003).

With the purpose of obtaining a robust empirical evidence, this study combines the advantages of quantile-regression techniques with those of cross-sectional analysis. In detail, the distribution of the dependent variable is conditioned on a set of observable and all time-invariant characteristics of the countries in the sample. Thus, the following estimation model by Edison et al. (2002) is estimated:

$$GROWTH_i = \gamma_i + \eta_{1\theta} FI_{ji} + \eta_{2\theta} CONTROLSET_i + \varepsilon_{\theta i} \quad (6)$$

where $GROWTH_i$ is the latest real per capita GDP of country *i*, γ_i takes country-specific effects into account, FI_{ji} is a IFI indicator of type *j* measured in logarithms and $CONTROLSET_i$ is the conditioning set.

This study utilizes two sets of cross-sectional data for 73 countries. First set consists the data of capital flows (FOC) as an indicator of IFI while second set consists the data of capital inflows (IFOC). Controlled variables and countries used in both sets are the same. The sample period averaged from 1980 to 2013. All the data were obtained from IMF-IFS, World Development Indicator or UNCTAD except initial schooling from Barro and Lee (2013). Some of the variables were logged due to vast differences in the values.

To assess the relationship between IFI and economic growth, potential impact of other macroeconomic indicators is controlled. The selection of variables mostly follows Edison et al. (2002). Table 1 provides summary statistics and the full list of variables used in the empirical analysis. *Economic growth* in this study is latest real per capita GDP and this is the only proxy that differs from Edison et al. (2002). We choose this proxy based on the fact that when we say IFI has a positive impact on real per capita GDP, it will increase real per capita GDP. An increment in real per capita GDP is therefore, a growth.

RESULTS AND DISCUSSION

Table 1 also presents the correlation matrix of relevant variables. IFOC and FOC has a positive relationship with initial income and initial schooling. However, only FOC is significantly related to inflation with expected sign. In most of the previous studies, initial income is negatively correlated to growth which indicates economic convergence. But, this is not the similar case as we use different proxy for growth which is the latest real per capita GDP. Thus, the significant positive correlation between initial income and growth shown in Table 1 suggests that the level of future income is positively related with the initial income. Likewise, initial income has a positive correlation with initial schooling.

We present the estimation results using standard mean regression estimate, OLS regression in Table 2, which could be used as a benchmark against the quantile regression estimates to point out in which direction the parameter heterogeneity bias induced by OLS method works. First, we examined the effect of controlled variables on real per capita GDP without any IFI proxies. OLS estimated coefficients for the initial income and initial schooling show a robustly positive and significant impact on real per capita GDP. As mentioned earlier in the previous chapter, an increment in real per capita GDP indicates growth. The level of latest income is somehow depends on how high the initial real per capita GDP was. Even though a country has a low initial income, their real per capita GDP will still be higher for the latest year as income always increase but hardly decrease, following the notion of wage rigidity. However, if we are comparing it between countries and in term of absolute values, a country with higher initial income level tend to have higher latest real per capita GDP than the country with low initial income level.

Besides that, the significant and positive relationship between initial schooling and real per capita GDP suggest a positive relationship between educational attainment of the workforce and future economic growth. This is supported by a study of Glaeser and Saiz (2004) where they conclude that

education levels have a positive impact on future income and eventually growth at the country level. Inflation shows a robustly negative and significant impact on real per capita GDP. It is consistent with most of the previous studies (for instance Ayyoub et al., 2011; Kasidi and Mwakanemela, 2013). On the other hand, government balance estimated coefficients are not significant. It means that economic growth is not contributed by fiscal deficits significantly but mostly contributed by other factors. This is in line with Vuyyuri and Seshaiah (2004) and Thirunavukkarasu and Achchuthan (2013).

Controlling for the same benchmark regressors, we then examined the relationship between real per capita GDP and IFI where the results are also tabulated in Table 2. For the controlled variables, similar results were obtained. However, the results do not suggest a strong relationship between IFI and real per capita GDP. IFOC is not significantly associated to real per capita GDP while FOC is positively and significantly related to real per capita GDP. This is supported by Edison et al. (2002) based on its panel estimates that show only one IFI indicator is significantly associated with growth which is FOC.

Positive and significant estimated coefficient of FOC shows that an increase in FOC will increase GDP per capita, and eventually lead to a growth in economy. As discussed in the earlier chapters, IFI can help enhance growth through a number of direct and indirect channels such as risk sharing, technological spillover, etc. This positive and significant effect of IFI is backed by previous studies (for instance Obstfeld, 1994; Acemoglu and Zilibotti, 1997; Levine, 2001). On the other hand, insignificant estimated coefficient of IFOC shows that it doesn't contribute to real per capita GDP or economic growth. However, this does not really imply that IFI is unassociated with economic growth in whole.

IFOC might not clearly reflects IFI thus relatively not a good measure of IFI. According to Edison et al. (2002), it is important to measure both inflows and outflows in creating an IFI proxy. Vo and Daly (2007) also contended that de facto measures of international IFI which also known as volume based capital account openness measures should cover not only the ability of foreign investors investing domestically (inflow of capital) but also the ability of domestic investors in the host country to invest abroad (outflow of capital). Therefore, our analysis concentrates more on the results using FOC as we expect it to be a better measure of IFI than IFOC. The coefficient of determination R^2 in Table 2 shows that the model with or without IFI proxies, explains approximately 93 percent of cross-country variations in real per capita GDP.

Up to now, we have discussed about the effect of IFI on the mean of the conditional real per capita GDP distribution. However, in order to understand the relationship between IFI and economic growth in different level of economic development, we refer to quantile regression estimates. We use number of bootstrap replications at 100. This is a common number of bootstrap repetitions reported in the empirical literature (Andrews and Buchinsky, 2000). Quantile regression estimates in Table 3 and Table 4 show a heterogenous behavior of the coefficients for all the variables. We just focused on the effect of IFI on the quantiles of conditional growth distribution as this is what we wish to highlight in our paper.

Among the two measures of IFI considered in this study, the quantile estimates for IFOC are not significant across all estimated quantiles which is consistent with the OLS estimate that reports insignificant results as well, while FOC's coefficients are only significant in quantile between lower and upper tail of the conditional distribution. One of the primary points we want to make in this study is that the standard result of the literature that IFI influences mean of the conditional real per capita GDP distribution thereby economic growth distribution, can be motivated by something happening at specific quantiles of the distribution. In this case, we can say that the significant impact of FOC on the mean of the conditional real per capita GDP distribution reported by OLS regression can be driven by the tail between lower and upper tail of the conditional distribution. This is somehow evidence of quantile parameter heterogeneity.

Such behavior of FOC's coefficients can be interpreted as IFI will only increase real per capita GDP and boost economic growth when the gdp per capita is not too low and not too high. For that low income countries are usually least developed countries, they are not able to reap the benefits of IFI due to some constraints such as weak economic developments. For instance, unsound domestic institutions particularly those with weak property rights can lessen the profit opportunities of both domestic and foreign firms and eventually affect the patterns of international capital flows (Ju and Wei, 2010).

In contrast, countries with substantially high income level have well equipped and well developed institutions to facilitate IFI process yet not benefiting from it. In such scenario, IFI has neutral impacts because these particular countries might have other significant factors contributing to the economic growth such as research and development, information and communication technology (ICT) and technological efficiency. Growth trends of OECD countries over the past decade are likely to result from a mish mash of "traditional" factors which are frequently linked to the efficiency of labor

market mechanisms and the size of the ICT-producing industries together with the pace of adoption of this technology by other industries (OECD, 2003). Table 3 and Table 4 also reports the *pseudo* R^2, a quantile measure of goodness fit. The *pseudo* R^2 decreases from lower to higher quantiles, which point out that the model describes real per capita GDP for countries whose real per capita GDP are in the lower quantiles better than for countries whose real per capita GDP are in the higher quantiles.

There is a formal way to examine parameter heterogeneity by means of interquantile tests. We follow the standard practice in the literature such as in Andini and Andini (2014) and test the hypothesis that the coefficient at the 80^{th} quantile differs from the coefficient at the 20^{th} quantile. The results of the parameter heterogeneity tests based on bootstrap with 100 replications are shown in Table 5. Based on our main focus which are IFOC and FOC, the null hypothesis of homogeneity is not rejected in both cases where all the estimates of the coefficients for the two variables do not appear to be statistically different across quantiles. However, in both cases, the coefficient at the 80^{th} quantile is bigger in absolute value than the coefficient at the 20^{th} quantile.

CONCLUSION

Using quantile regression, we have found that among the two measures of IFI considered in this study, the quantile estimates for IFOC are not significant across all estimated quantiles while the quantile estimates for FOC are significant and positive between the lower and upper quantiles. Considering FOC as the main indicator of IFI in this study, we conclude that IFI has a positive impact on economic growth. However, the impact does not exist in countries where the economic development are too low or in highly developed countries.

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TABLE 1: Summary Statistics (73 countries, 1980-2013)

Variable	**gdp per capita**	**IFOC**	**FOC**	**initial**	**school**	**inf**	**gov**
Mean	8.998	1.977	1.730	8.414	1.778	2.319	16.058
Maximum	11.093	4.121	4.686	10.627	2.487	6.021	32.290
Minimum	6.012	1.250	-0.581	5.566	0.525	0.006	8.319
St. dev.	1.298	0.418	0.891	1.331	0.485	1.380	4.292
Correlations							
growth	1.000						
IFOC	0.405**	1.000					
FOC	0.674**	0.903**	1.000				
initial	0.956**	0.334**	0.612**	1.000			
school	0.781**	0.4475**	0.6330**	0.7519**	1.000		
inf	-0.383**	-0.082	-0.235*	-0.366**	-0.033	1.000	
gov	-0.306**	-0.165	-0.229	-0.259*	-0.314**	-0.172	1.000

Notes: *(**) indicates statistical significance at the 5(1) percent level. Growth = latest real per capita GDP in 2013; IFOC = FDI and portfolio inflows divided by GDP; FOC = FDI plus portfolio inflows and outflows divided by GDP; initial = initial real per capita GDP in 1980; school = average years of secondary schooling in the population over the age of 15 in 1980; inf = logarithmic difference of Consumer Price Index; gov = fiscal balance as a share of GDP.

TABLE 2: The Effect Of IFI On The Mean Of The Conditional Growth Distribution.

	FOC	**IFOC**	**Initial income**	**Initial schooling**	**Inflation**	**Government balance**	**R-sq.**
Benchmark	-	-	0.737** (0.000)	0.501** (0.002)	-0.105** (0.005)	-0.021 (0.051)	0.932
Set A	0.138* (0.048)	-	0.721** (0.000)	0.380* (0.033)	-0.091* (0.018)	-0.020 (0.054)	0.937
Set B	-	0.191 (0.124)	0.743** (0.000)	0.419* (0.020)	-0.099** (0.010)	-0.020 (0.051)	0.935

Note: *(**) indicates statistical significance at the 5(1) percent level. P-values in parenthesis are based on robust standard errors.

TABLE 3: Set A. The Effect Of FOC On The Shape Of The Conditional Growth Distribution.

	FOC	**Initial income**	**Initial schooling**	**Inflation**	**Government balance**	**Pseudo R-sq.**
Q10	0.020 (0.814)	0.843** (0.000)	0.537* (0.016)	-0.039 (0.565)	-0.028 (0.159)	0.790
Q20	0.045 (0.660)	0.829** (0.000)	0.403* (0.076)	-0.029 (0.639)	-0.024 (0.183)	0.785
Q30	0.174 (0.107)	0.792** (0.000)	0.287 (0.183)	-0.076 (0.171)	-0.012 (0.448)	0.781
Q40	0.194* (0.036)	0.773** (0.000)	0.315 (0.092)	-0.071 (0.137)	-0.011 (0.521)	0.783
Q50	0.180* (0.028)	0.781** (0.000)	0.153 (0.414)	-0.066 (0.158)	-0.007 (0.639)	0.785
Q60	0.146* (0.048)	0.738** (0.000)	0.187 (0.269)	-0.078* (0.022)	-0.006 (0.671)	0.789
Q70	0.160* (0.032)	0.676** (0.000)	0.282 (0.080)	-0.085** (0.004)	-0.004 (0.737)	0.793
Q80	0.126 (0.109)	0.688** (0.000)	0.309 (0.060)	-0.071* (0.027)	-0.005 (0.698)	0.778
Q90	0.173	0.732**	0.111	-0.048	0.000	0.714

	(0.171)	(0.000)	(0.686)	(0.369)	(0.991)

Note: *(**) indicates statistical significance at the 5(1) percent level. P-values in parenthesis are based on bootstrapped standard errors.

TABLE 4: Set B. The Effect Of IFOC On The Shape Of The Conditional Growth Distribution.

	IFOC	**Initial income**	**Initial schooling**	**Inflation**	**Government balance**	**Pseudo R-sq.**
Q10	0.038	0.846**	0.537*	-0.038	-0.028	0.789
	(0.823)	(0.000)	(0.011)	(0.589)	(0.227)	
Q20	0.051	0.817**	0.417*	-0.071	-0.026	0.784
	(0.794)	(0.000)	(0.019)	(0.327)	(0.169)	
Q30	0.033	0.805**	0.524*	-0.063	-0.014	0.776
	(0.878)	(0.000)	(0.010)	(0.294)	(0.414)	
Q40	0.301	0.848**	0.249	-0.056	-0.015	0.779
	(0.159)	(0.000)	(0.177)	(0.273)	(0.363)	
Q50	0.266	0.813**	0.195	-0.069	-0.010	0.778
	(0.165)	(0.000)	(0.299)	(0.147)	(0.526)	
Q60	0.207	0.749**	0.277	-0.099**	-0.010	0.781
	(0.259)	(0.000)	(0.177)	(0.018)	(0.504)	
Q70	0.182	0.683**	0.375	-0.092**	-0.004	0.783
	(0.277)	(0.000)	(0.091)	(0.031)	(0.782)	
Q80	0.183	0.704**	0.330	-0.077	-0.004	0.768
	(0.307)	(0.000)	(0.139)	(0.082)	(0.763)	
Q90	0.096	0.712**	0.225	-0.098	0.025	0.709
	(0.719)	(0.000)	(0.548)	(0.205)	(0.291)	

Note: *(**) indicates statistical significance at the 5(1) percent level. P-values in parenthesis are based on bootstrapped standard errors.

TABLE 5: Inter-quantile tests (Q80-Q20).
Set A. Flows of capital.

	FOC	**Initial income**	**Initial schooling**	**inflation**	**Government balance**
20^{th}-80^{th}	0.081	-0.142	-0.094	-0.042	0.018
	(0.559)	(0.205)	(0.740)	(0.519)	(0.447)

Set B. Inflows of capital.

	IFOC	**Initial income**	**Initial schooling**	**inflation**	**Government balance**
20^{th}-80^{th}	0.131	-0.114	-0.087	-0.006	0.022
	(0.587)	(0.293)	(0.770)	(0.934)	(0.369)

Notes: P-value in brackets are based on bootstrapped standard errors.