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In this paper, we analyze the effects of financial development and trade openness on income convergence via the application of pooled fractional probit model that developed by Papke and Wooldridge (2008). Our results confirm the hypothesis that trade openness accelerate the income convergence. Also we found financial development acts as a convergence factor only for financially middle advanced countries.

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In this paper, we analyze the effects of financial development and trade openness on income convergence via the application of pooled fractional probit model that developed by Papke and Wooldridge (2008). Our results confirm the hypothesis that trade openness accelerate the income convergence. Also we found financial development acts as a convergence factor only for financially middle advanced countries.

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1. Introduction

The neoclassical growth model under its standard assumptions including the substitution possibility and diminishing return to factors predicts that per capita income of every economy gravitates to a steady-state, so if the determinants of the steady state level are similar among a sample of countries, they will move toward a similar steady state per capita income in the long run. This prediction is known as the convergence hypothesis in the economic growth literature. According to the convergence hypothesis, poor countries can catch up with developed countries through implementation of policies that reinforce infrastructures and the determinants of the steady-state per capita income. Two main policies which are well-known in the literature that affect income convergence process include trade liberalization (or trade openness) and financial development. This paper seeks to find out whether two factors, trade openness (or trade liberalization) and financial development serve as determinants of per capita income convergence.

Previous studies have produced conflicting results on the effect of international trade[1]. Sachs and Warner (1995), Ben-David (1996), Ben-David and Loewy (1998), and Giles and Stroomer (2006) demonstrated that international trade through transferring technology, knowledge, and intermediate goods serves as a potent force for poor countries to catch up toward developed countries. In contrast Slaughter (2001) and Galor and Mountford (2006) challenged empirically the hypothesis that international trade contributes to income convergence and argued that international trade increased income gap between poor and rich countries. Galor and Mountford (2006) note: "The rapid expansion of international trade in the second phase of the industrial revolution... has been a prime cause of the "Great Divergence" in income per capita across countries in the last two centuries... International trade enhanced the specialization of industrial economies in the production of industrial, skilled intensive goods, and stimulated technological progress.... In nonindustrial economies, in contrast, international trade generated an incentive to specialize in the production of unskilled intensive, nonindustrial goods" (p.299).

Surveys of literature on the effect of financial development show that theoretical and empirical works on this subject is very scarce. Analyzing the effect of financial development on income convergence was started by Shu (1999) empirically and then extended by Aghion, et al. (2005) theoretically. Shu (1999) used intra-distribution dynamics approach to investigate whether financial development is a mechanism determining club formation. He found that countries in the high degree of financial intermediation group tend to converge to the top end of the income distribution while countries in low level of financial repression group converge to the lower end. Aghion, et al. (2005) introduced a multicountry Schumpeterian growth model with imperfect creditor protection. Their theoretical model predicts that the lower the current productivity of a firm, the more costly it is for that firm to catch up with the technological frontier, and therefore the lower the probability of technological catch up. Hence, in an economy with low financial development, firms that are initially closer to the technological frontier will tend to grow faster. They used cross-country regression with cross- sectional data for 71 countries over the period 1960-1995. Their empirical results suggest that financial development is a convergence factor and the lack of financial development accounts for the failure of some countries to converge to the growth rate of the global technological frontier.

Surveys of previous studies show that so far, in order to investigate the effect of trade openness and financial development on income convergence process, four methodologies namely,

[1] . Rassekh (2004) and Sakyia et. al (2015) surveys the literature on trade, growth, and convergence.

interaction terms in the cross-country regression (Aghion et al. 2005; Dowrick and Golley, 2004), difference-in-difference approach (Slaughter, 2001), dividing the full sample according to trade openness or financial development proxies and using distribution approach (Shu, 1999; Epestin et at. 2007), and calculation of half life of income gap and analyzing the effect of trade openness on half life (Giles and Stroomer, 2006) were applied. Conflicting results about the effect of trade openness and scarce empirical evidences about the effect of financial development on income convergence on the one hand and new data and advances in the econometrics of panel data on the other hand continue to motivate additional work on this debate. In this paper, we are going to use a new methodology. For this end, we specify an econometric model in which income gap is function of trade openness and financial development. Following to previous studies as such Giles and Stroomer (2006), we select the USA as benchmark or leading country and define the income gap as real per capita GDP of country i relative to real per capita GDP of USA. Since the real per capita GDP of USA is greater than real per capita GDP of other countries in our sample, the response variable in our model is bounded between zero and one. Hence, we apply the new approach of Papke and Wooldridge (2008) to model fractional responses with panel data.

The next section describes the data and variables. Section 3 explains the methodology. The results are reported in section 4 and the final section presents the conclusions of the paper.

2. Data and variables

We collected the dataset for 76 countries and all data are taken from the World Development Indicators (2015) available online. The panel of the countries includes almost all different income categories. The time period covers the years from 1970-2010 the longest time period for which variables are available for the maximum number of countries under investigation.

In order to analyze the impact of trade openness and financial development on income convergence, trade openness has been proxied by the ratio of exports plus imports to GDP[2]. Also, we use two proxies for financial development. The first one is the credit allocated to the private sector in the GDP (PRIV) and second is the credit by deposit money banks to the private sector divided by GDP (BANK).

3. Methodology

Since our response variable lies in the unit interval, we specify the following pooled fractional probit model:

$$E(RI_{it} \mid OP_{it}, FD_{it}, X) = \Lambda(\beta_{i1} + \beta_2 OP_{it} + \beta_3 FD_{it} + \gamma_1 \overline{OP}_i + \gamma_2 \overline{FD}_i + \alpha_1 Dum80 + \alpha_2 Dum90 + \alpha_3 Dum20) \quad (1)$$

Where RI is relative real per capita GDP (real per capita GDP of country i relative to real per capita GDP of USA). OP and FD are trade openness and financial development proxies respectively. $\overline{OP}_i$ and $\overline{FD}_i$ are the time average of OP and FD that enter in the Equation (1) to control for the correlation between β_{i1} and other explanatory variables[3]. X contains $\overline{OP}_i$,

[2]. Recently, Sakyia et. al (2015) used a new proxy for trade openness namely composite trade shares which was introduced by Squalli and Wilson (2011). It is define as: $[(X+M)_i/((1/N)(\Sigma_i^N{}_{=1}(X+M)_i)]*[(X+M)_i/GDP_i]$.

[3] . As noted by Mankiw et. al(1992), countries fixed effects in growth equation reflects not just technology but resource endowments, climate, institutions, and so on. Hence One of the main issues in the growth econometrics is correlation between countries effects and explanatory variables. We add the time averages of the explanatory variables in the quasi-MLE estimates, which are applied in this paper, to control for correlation between countries fixed effects and the explanatory variables.

$\overline{FD_i}$, $Dum80, Dum90, and Dum20$. $Dum80, Dum90, and Dum20$ are dummy variables for decades 1980_s, 1990_s, and 2000_s. $\Lambda(.)$ is the probit function and ensure that $E(RI_{it} \mid OP_{it}, FD_{it}, X)$ lies between zero and one. In order to estimate of Equation (1), we follow Papke and Wooldridge (2008) and use the pooled Bernoulli quasi-maximum likelihood estimator, which is obtained by maximising the pooled probit log-likelihood with robust estimation of variances to prevent misspecification, due to the fact that we are dealing with fractional data instead of Bernoulli. Additionally, it accommodates arbitrary heteroskedasticity and serial dependence across t[4].

4. Results

In order to analyze the impact of trade openness and financial development on income convergence process, we applied the pooled fractional model for estimating of Equation (1) and prepared the results in the Table (1). We estimate Equation (1) for the full sample and also in order to analyze the robustness of results and sample sensitivity checks, following to Shu(1999), we divided full sample to three groups namely financially less advanced, financially middle advanced, and financially advanced countries according to percentiles 0.25 and 0.75 of BANK variable in the year 1970 and estimate Equation (1) for all subsamples[5]. Also, we estimated Equation (1) for both proxies of financial development i.e. BANK and PRIV. The results for the full sample are reported in the second row of Table (1). When we use the BANK as a proxy for financial development, only average partial effect (APE) of trade openness is positive and statistically significant but financial development does not have a significant coefficient. In contrast, when we use the PRIV as proxy for financial development, both variables OP and FD have positive and statistically significant effects on convergence process.

The results for subsamples in the third, fourth and fifth rows show that there are considerable differences among financially based subsamples. The results for a financially advanced countries show that neither trade openness nor financial development has statistically significant effect on the income convergence process. The estimation results for financially middle advanced countries show that both trade openness and financial development have positive and statistically significant effects. The results for financially less developed countries show that financial development (especially in the bank sector) has a negative effect but trade openness has a positive effect on their catching up process. The results for this group show that the financial development in these countries especially in bank sector likely lacks an appropriate regulatory framework to affect on efficiency of investment and avoid costly banking crisis. Hence in these countries, financial development has negative effect on economic growth.

[4] . There is various estimator to estimate equation (1) such as fixed effect and or random effect. But, if we use these linear estimators to estimate an equation with bounded dependent variable between zero and one, it is possible that estimated dependent variable will be greater than one or less than zero in some points. But this nonlinear panel data model can recognize the bounded nature of the dependent variable.

[5] . Countries are prepared in appendix 1.

Table 1: Pooled fractional probit model results

Sample N = number of countries Obs= total observations	explanatory variable	Financial development proxy			
		BANK		PRIV	
		coefficient	APE	coefficient	APE
Full sample N=76 Obs=3116	OP	**0.0032 (0.000)**	**0.0007 (0.002)**	**0.003 (0.000)**	**0.0007 (0.002)**
	FD	0.0002 (0.617)	0.0001 (0.658)	**0.001 (0.031)**	**0.0003 (0.046)**
Financially less advanced N=19 Obs=779	OP	**0.005 (0.001)**	**0.0005 (0.067)**	**0.007 (0.021)**	**0.0007 (0.072)**
	FD	**-0.008 (0.001)**	**-0.0008 (0.049)**	-0.006 (0.445)	-0.0005 (0.525)
Financially middle advanced N=38 Obs=1558	OP	**0.003 (0.000)**	**0.0007 (0.000)**	**0.002 (0.005)**	**0.0005 (0.003)**
	FD	**0.001 (0.122)**	**0.0002 (0.075)**	**0.003 (0.001)**	**0.0007 (0.002)**
Financially advanced N=19 Obs=779	OP	0.0001 (0.882)	0.00005 (0.897)	0.0003 (0.784)	0.0001 (0.811)
	FD	0.0002 (0.599)	0.00006 (0.618)	0.0002 (0.524)	0.0001 (0.517)

Notes: (i) All models contain the time averages of the OP and FD variables and also dummy variables for decades 1980s, 1990s, and 2000s. For brevity, we report only the coefficients on financial development and trade openness. (ii) The number in the parenthesis is p-value. The standard error for the AEP is computed using 500 bootstrap replications.

5. Conclusion

In this paper, we analyzed the effect of financial development and trade openness on income convergence process using the pooled fractional probit model that developed by Papke and Wooldridge (2008). We found two important results. First, trade openness acts as an engine for low and middle income countries catching up. This result is complementary to those Sachs and Warner (1995), Ben-David (1996), Ben-David and Loewy (1998), and Giles and Stroomer (2006). Second, financial development acts as a convergence factor only for financially middle advanced countries and due to inadequate structure of financial sectors (especially bank sector) in financially low advanced countries, it acts as an obstacle for catching up by less developed countries.

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Appendix 1: Countries in any group

Financially middle advanced		**Financially advanced**	**Financially less advanced**
Algeria	Malaysia	Argentina	Bangladesh
Bolivia	Malta	Australia	Benin
Brazil	Mexico	Austria	Burundi
Chile	Morocco	Barbados	Cameroon
Colombia	Nicaragua	Belgium	Central African Republic
Congo, Rep.	Papua New Guinea	Canada	Congo, Dem. Rep.
Costa Rica	Paraguay	Finland	Gambia, The
Cote d'Ivoire	Peru	France	Ghana
Dominican Republic	Philippines	Germany	India
Ecuador	Portugal	Greece	Kenya
Egypt, Arab Rep.	Senegal	Ireland	Mali
El Salvador	South Africa	Israel	Nepal
Fiji	Swaziland	Italy	Niger
Gabon	Syrian Arab Republic	Netherlands	Pakistan
Guatemala	Trinidad and Tobago	Saudi Arabia	Sierra Leone
Guyana	Tunisia	Singapore	Sri Lanka
Honduras	Turkey	Spain	Sudan
Iran, Islamic Rep.	Uruguay	United Kingdom	Thailand
Korea, Rep.	Zambia	Venezuela, RB	Togo