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DOES BILATERAL TRADE LEAD TO INCOME CONVERGENCE? PANEL EVIDENCE

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Through panel-data regressions, we found that both per capita income *level* and *growth* turn out to converge when the trade intensity ratio increases between the countries. Geographical proximity and language similarities also turn out to be associated with convergence in both income level and growth.

Keywords: Trade, Convergence, Distance, Language
JEL classification: C23, F43, O40

1. MOTIVATION

Convergence on income level and growth among countries is a very old issue among common people as well as among economists. Furthermore, that topic has become more important than ever as globalization advances. This issue is generally more important in an open economy than in a closed economy. In this context whether trade leads to convergence or divergence in per capita income level and growth has been of a great concern.[1]

Based on endogenous growth model by Lucas (1988) and Romer (1990), Ben-David and Loewy (1998) explained that steady state growth rates depend on the rate of knowledge accumulation and trade flows between countries facilitate the diffusion of knowledge and spur the growth process. Therefore they argued that knowledge spillovers emanating from heightened trade lead to the same steady-state growth path and to similar per capita output in the long run.[2] Ben-David (1993, 1996, 2001) found that trade is related to income convergence by investigating data for a specific group of

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[1] Rassekh (1998) explained the convergence hypothesis and the role of globalization well.

[2] Refer to Grossman and Helpman (1991), Ben-David and Kimhi (2000).

countries. Using 1960-1985 data, Ben-David and Kimhi (2000) showed that an increase in trade flows led to an increase in the speed of income convergence by using 127 pairs of countries on the basis of export data and 134 pairs of countries on the basis of import data.

On the other hand, there are some researchers who doubt the effect of trade on income convergence. Slaughter (1997) argued that trade is not sufficient to produce income convergence and more research is needed to clarify the relationship. Analyzing data from after 1945, Slaughter (2001) found that trade liberalization caused income divergence, not convergence among liberalized countries. He performed his analysis by comparing the convergence pattern among the liberalizing countries before and after liberalization with the convergence pattern among control countries, chosen using a variety of methods, before and after liberalization. Hallet and Piscitelli (2002) employed a business-cycle model and found that large, stable economies with well-integrated economies are likely to diverge but smaller, more volatile or less well-integrated economies will converge.

So far, the empirical evidence of convergence is rather inconclusive and limited to a group of countries. Therefore in this paper, the hypothesis-that bilateral trade leads to both per capita income level and growth convergence between export and import countries-will be tested empirically by panel-data regressions with a much broader data set. This analysis will also help to determine whether recent globalization will converge incomes and growth rates among countries or not.

2. MODEL

There are several traditional ways to test convergence among countries.[3] The first is *σ-convergence*, which tests whether the cross-sectional income dispersion between periods becomes smaller or not as time goes by.[4] The second is *β-convergence*, which tests whether poor countries grow faster than rich countries.[5] Last, *stochastic convergence* tests whether the deviation in a country's income relative to per capita income in all the countries is a stationary stochastic process.[6] Compared with the traditional convergence tests, our test is rather direct.[7] We tested whether bilateral income level gaps or growth gaps decrease or increase when the trade intensity between two countries increases. To test whether the increase in bilateral trade leads to the convergence of per capita GNPs

[3] This issue is well summarized in Carlino and Mills (1996).

[4] See Barro and Sala-i-Martin (1991).

[5] See Baumol (1986) and Barro and Sala-i-Martin (1991).

[6] See Bernard (1991), Bernard and Durlauf (1995), and Carlino and Mills (1996).

[7] Similar way of testing income convergence is used in Choi (2004) which tested the relationship between bilateral FDI and income convergence.

and real per capita GNP growth rates respectively, we set up the following equations for estimation,

$$LOG(DPGNP_{ijt}) = \beta_0 + \beta_1 * LOG(RATIO_{ijt}) + \beta_2 * LOG(DISTANCE_{ij}) + \beta_3 * Language_{ij} + u_{ijt}, \quad (1)$$

$$LOG(DPGNPR_{ijt}) = \beta_0 + \beta_1 * LOG(RATIO_{ijt}) + \beta_2 * LOG(DISTANCE_{ij}) + \beta_3 * Language_{ij} + u_{ijt}, \quad (2)$$

where

$DPGNP_{ijt} = \left|PGNP_{it} - PGNP_{jt}\right| / (PGNP_{it} + PGNP_{jt})$, $DPGNPR_{ijt} = \left|PGNPR_{it} - PGNPR_{jt}\right|$, $RATIO_{ijt} = EXP_{ijt} / (GNP_{it} + GNP_{jt})$, and $t = 1970, 1980, 1990, 1992$.

Here subscript *i* represents an exporting country and subscript *j* represents an importing country. Therefore, EXP_{ijt} means an export volume from country *i* to *j* at the year *t*. The GNP_{kt}, $PGNP_{kt}$ and $PGNPR_{kt}$ stand for country *k*'s *GNP*, per capita *GNP* and real per capita *GNP* growth rates at year *t*, where $t = 1970, 1980, 1990, 1992$. $RATIO_{ijt}$ stands for the trade intensity ratio between exporting and importing countries and is defined as an export volume from country *i* to country *j* divided by the sum of these two countries' respective *GNP* at time *t*. $DPGNP_{ijt}$ stands for the per capita income gap: the ratio of the absolute difference in per capita *GNP* to the sum of country *i*'s and country *j*'s per capita *GNP* at time *t*. $DPGNPR_{ijt}$ is per capita real income growth gap defined as the absolute difference between real per capita *GNP* growth rates of exporting and importing countries at time *t*. If bilateral trade leads to convergence in income level and growth between exporting and importing countries, the coefficient β_1 is expected to be negative.

We used an absolute value of per capita *GNP* or growth difference. This is because technology spillovers can be possible even when goods are exported from a poor country to a rich country. Poor countries could enhance competitiveness of exports to compete with goods in rich countries and hence income gaps in absolute terms will also be narrowed. This argument applies equally to the case of real per capita *GNP* growth rates.

We also included additional explanatory variables such as distance between two countries and a common language dummy. We assume here that geographical proximity and common language also play a certain role in convergence as they can make the technology spillovers easier in addition to facilitating bilateral trade. The variable, $DISTANCE_{ij}$, stands for the distance between country *i* and country *j*. The dummy variable, $Language_{ij}$, is set equal to 1 when two countries use the same language, and 0 otherwise. When two countries are close and use the same language, the income gaps

and growth gaps will be narrowed. Therefore β_2 is expected to be positive and β_3 is expected to be negative.

3. EMPIRICAL RESULTS

All the data used in this analysis except real per capita *GNP* growth rates, are from Wei and Frankel (1995), Frankel, Stein, and Wei (1995), and Wei's homepage.[8] There are 63 countries included in the bilateral trade data and 62 partner countries for each exporting country.[9] Years included in the data are 1970, 1980, 1990, and 1992. Therefore, a total of 15,624 observations are used in the analysis ($63 \times 62 \times 4 = 15{,}624$). Real per capita *GNP* growth rates are from the World Development Indicators CD-ROM of the World Bank (2001). There are pairs of observations (for country *ij*, and *ji*) with the same left-hand variable, and except for export level, the same right-hand variables: distance, common language and absolute income gaps. This can induce correlations in the error terms across observations, with the implications for the reported standard errors.[10] Therefore, we classified all the data into two groups depending on whether the per capita *GNP* gap or real per capita *GNP* growth gap is positive or negative.

Table 1. Summary Statistics

Variable	Obs.	Mean	Std. Dev	Min.	Max.
$EXPORT_{i,j,t}$	12062	667.83	3429.97	0.001	110971.13
Per Capita $GNP_{i,t}$	12062	7165.79	8667.65	60.00	37499.31
Per Capita $GNP_{j,t}$	12062	7260.95	8688.65	60.00	37499.31
$DISTANCE_{i,j}$	12062	7580.80	4781.43	173.56	19946.66
Per Capita GNP Growth $Rate_{i,t}$	9645	2.58	7.55	-24.3	104.0
Per Capita GNP Growth $Rate_{j,t}$	9645	2.62	7.63	-24.3	104.0

Table 1 and Table 2 list the regression results for equations (1) and (2), respectively. In both Table 1 and Table 2, pooled ordinary least squares (OLS) regression is used in columns (a) and (b) and a random effects model is used in columns (c) and (d). We classified the whole data into two subgroups; positive gaps (columns (a) and (c)) and negative gaps (columns (b) and (d)). Dependent variables, however, are denoted in

[8] http://www.nber.org/~wei/

[9] Refer to the Appendix for the list of countries included in the analysis.

[10] This issue is addressed on page 13 in Ben-David and Kimhi (2000).

absolute numbers for easy comparison across estimations. All the regressions include year dummies.

In Table 2, the per capita income gap ratio (*DPGNP*) is regressed on trade intensity (*RATIO*), distance (*Distance*), and the common language dummy (*Language*). Coefficients of *RATIO* are negative and significant at 5% across all the regressions. This means that when the trade intensity ratio increases by 1%, per capita *GNP* gap ratio turns out to decrease by 0.034% to 0.057%. Coefficients of *Distance* are positive and significant at 5%. The more distantly located two countries are, the bigger the income gap becomes. The coefficient of *Language* is negative and significant at 5% in columns (a) and (b), at 15% in column (c), and at 10% in column (d). This implies that when two countries use the same language, the income gap between two countries becomes small.

Table 2. Trade and Per Capita Income Convergence[a,b]

	(*a*)[c]	(*b*)[c]	(*c*)	(*d*)
Dependent Variable	Income gap ratio: LOG (*DPGNP*)			
Estimation Method	Pooled OLS	Pooled OLS	Individual Random Effects	Individual Random Effects
Subsample	$PGNP_i > PGNP_j$	$PGNP_i < PGNP_j$	$PGNP_i > PGNP_j$	$PGNP_i < PGNP_j$
Constant	-2.666**	-2.719**	-2.646**	-2.771**
	(0.174)	(0.170)	(0.203)	(0.193)
LOG (*RATIO*)	-0.038**	-0.057**	-0.034**	-0.039**
	(0.007)	(0.007)	(0.008)	(0.006)
LOG (*DISTANCE*)	0.176**	0.162**	0.166**	0.172**
	(0.020)	(0.020)	(0.024)	(0.023)
LANGUAGE	-0.062**	-0.082**	-0.085[#]	-0.101*
	(0.042)	(0.042)	(0.055)	(0.053)
Period *dummies*[d]	Yes	Yes	Yes	Yes
Adjusted R^2	0.04	0.06	0.68	0.80
No. of obs	5,957	6,105	5,957	6,105

Source: author's calculation.

Notes: a. **, *, and [#] indicate significance at the 5%, 10%, and 15% levels, respectively.

b. $LOG(DPGNP_{ijt}) = \beta_0 + \beta_1 * LOG(RATIO_{ijt}) + \beta_2 * LOG(Distance_{ij}) + \beta_3 * Language_{ij} + u_{ijt}$.

c. Newey and West's (1987) heteroscedasticity- and autocorrelation-consistent covariance matrix assuming a lag length of one is used for standard errors.

d. Coefficients of year dummies are not reported.

In Table 3, real per capita *GNP* growth gap ratio (*DPGNPR*) instead of per capita *GNP* gap is used as the dependent variable. Coefficients of *RATIO* are negative and significant at 5% across all the regressions. When the trade intensity ratio increases by 1%, the real per capita *GNP* growth gap turns out to decrease by 0.027 to 0.028%. Coefficients of *Distance* are positive and significant at 5%. The more distantly located two countries are, the bigger the income growth gap becomes. Coefficients of *Language* are negative and significant at 10% in column (a), significant at 5% in column (c), and insignificant in columns (b) and (d). This means that when two countries use the same language, the income growth gap between two countries tends to become small in columns (a) and (c).

Table 3. Trade and Real Per Capita Income Growth Convergence[a,b]

	$(a)^c$	$(b)^c$	(c)	(d)
Dependent Variable	Growth gap: LOG (*DPGNP*)			
Estimation Method	Pooled OLS	Pooled OLS	Individual Random Effects	Individual Random Effects
Subsample	$PGNPR_i>PGNPR_j$	$PGNPR_i<PGNPR_j$	$PGNPR_i>PGNPR_j$	$PGNPR_i<PGNPR_j$
Constant	-0.031	-0.038	-0.029	-0.035
	(0.183)	(0.184)	(0.203)	(0.202)
LOG (*RATIO*)	-0.028**	-0.028**	-0.027**	-0.028**
	(0.009)	(0.008)	(0.009)	(0.009)
LOG (*DISTANCE*)	0.096**	0.095**	0.097**	0.095**
	(0.023)	(0.023)	(0.025)	(0.025)
LANGUAGE	-0.087**	-0.048	-0.108**	-0.067
	(0.047)	(0.047)	(0.053)	(0.052)
Period *dummies*[d]	Yes	Yes	Yes	Yes
Adjusted R^2	0.01	0.01	0.28	0.27
No. of obs	4,840	4,805	4,840	4,805

Source: author's calculation.

Notes: a. **, *, and # indicate significance at the 5%, 10%, and 15% levels, respectively.

b. $LOG(DPGNPR_{ijt}) = \beta_0 + \beta_1 * LOG(RATIO_{ijt}) + \beta_2 * LOG(Distance_{ij}) + \beta_3 * Language_{ij} + u_{ijt}$.

c. Newey and West's (1987) heteroscedasticity- and autocorrelation-consistent covariance matrix assuming a lag length of one is used for standard errors.

d. Coefficients of year dummies are not reported.

To summarize, we found that the more two countries trade, the smaller the per capita income gap and real per capita income growth gap become. This result applies whether

gaps are positive or negative.[11] This implies that a relatively poor and slow-growing exporting country can catch up with the rich and fast growing country by increasing its exports. A rich and fast-growing exporting country can also stimulate the importing country's economy by increasing its export.

4. CONCLUSION

Our empirical results support the hypothesis that both income level and growth tend to converge when bilateral trade increases between two countries. When two countries are located closely and share the same language, the effect is even greater. We conjecture that bilateral trade, geographical proximity, and common language are related to the transfer of knowledge between two countries. Therefore, we can safely conclude that recent globalization contributes to narrowing income and growth gaps rather than widening them between advanced countries and underdeveloped countries.

Appendix: List of Countries[a]

	OECD Member Countries		Non-OECD Member Economies
1	Australia	24	Algeria
2	Austria	25	Argentina
3	Belgium	26	Bolivia
4	Canada	27	Brazil
5	Denmark	28	Chile
6	Finland	29	China
7	France	30	Colombia
8	West Germany	31	Ecuador
9	Greece	32	Egypt
10	Iceland	33	Ethiopia
11	Ireland	34	Ghana
12	Italy	35	Hong Kong
13	Japan	36	Hungary
14	Netherlands	37	India
15	New Zealand	38	Indonesia
16	Norway	39	Iran
17	Portugal	40	Israel

[11] Our result is partly consistent with page 16 of Ben-David and Kimhi (2000).

18	Spain	41	Kenya
19	Sweden	42	Korea
20	Switzerland	43	Kuwait
21	Turkey	44	Libya
22	UK	45	Malaysia
23	US	46	Mexico
		47	Morocco
		48	Nigeria
		49	Pakistan
		50	Paraguay
		51	Peru
		52	Philippines
		53	Poland
		54	Saudi
		55	Singapore
		56	South Africa
		57	Sudan
		58	Taiwan
		59	Thailand
		60	Tunisia
		61	Uruguay
		62	Venezuela
		63	Yugoslavia

Note: a. OECD membership is based on the year 1992.

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