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The impact of international trade and domestic savings on convergence in China

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ABSTRACT

This paper tests the liberalization of trade and the role of domestic savings in the process of per-capita income growth in the Chinese economy. This issue has become important to China since the introduction of its economic reforms in 1978 and its emergence as a major international trade partner in the world economy. The important question addressed here is whether economic reform has had a strong impact on reducing the difference of per-capita income between China and its partners. The analysis of the relationship between economic reform (liberalization of trade) and income convergence indicates that there was significant convergence in all of the trade groups, geographic groups, and the random group in the period after the Chinese economic reform, and that higher domestic savings can accelerate the convergence rate in most of these cases. However, we did not find significant results for all of these groups before the Chinese economic reform. These tests have shown that international trade led to higher economic growth and helped reduce the gap in per-capita incomes within the country groups considered in the period after the Chinese economic reform. Generally, higher domestic savings also raised the rate of Chinese economic growth.

Key word: income convergence, income divergence, domestic savings, unit root, liberalization of trade, and international trade

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I. Introduction

In recent studies of economic growth, income divergence, or more exactly, income non-convergence, appears to characterize the behavior of most cross-country income differentials. In a closed-economic growth model, domestic savings is the main factor, which can cause convergence although we ignore the impact of international trade.[1] Under the phenomenon of world economic integration, the movement towards free trade may actually have just the opposite effect, leading to a reduction in income disparity among countries even if they do not have specific international trade agreements between themselves in an open-economy growth model.

International free trade, i.e. trade liberalization, and commerce clubs are playing important roles in the process of convergence. Many papers show that both factors mentioned above have significant effects on the convergence for developed countries (**Ben-David**, (1996); **Slaughter** (1998) etc.**)**, but we have ambiguous results for developing countries. Domestic savings is a traditional element in processes on convergence not only in closed-economy but also in opened economy with trade liberalization. Higher domestic savings can accumulate productivity and make poor countries tend to grow faster than rich ones.

In the present research, we explore data on personal income in the Chinese economy and its partners since 1960, as well as data on Chinese domestic savings since 1978. China's economic reform and its opening to the outside world have resulted in the phenomenal growth of its output and international trade. After its economic reform, the Chinese economy provided weekly evidence of convergence in the sense that its economic growth is faster than its high-income partners.

In this paper, we will apply Ben-David's model (Ben-David, 1996) and use time-series information to verify whether or not there is convergence of the Chinese economy with

[1] Robert J. Barro and xaviers Sala-I-Martin (1992)

its trade partners. We will use the method of empirical test to analyze per-capita income convergence in trade groups, geographic groups, and a random group. Finally, we are able to show that international trade (i.e. trade liberalization) is playing an important role in the growth process of the Chinese economy since its economic reform, and that higher domestic savings can significantly raise the rate of growth.

The rest of the paper is organized as follows: the next section provides some background and pertinent information on the Chinese economy and its trade development. Section three reviews related literatures. Section four presents the details of theories and relationship between international trade and the role of domestic savings on convergence. Section five focuses on the empirical results and tests on the convergence in the Chinese economy. Section six presents the conclusions of this research.

II. Pertinent information

Since the initiation of economic reforms in 1978, China has been opening its domestic markets to the outside world, and China has become one of the world's fastest growing economies. Beginning in 1979, China launched several economic reforms, which included a lot of new measures such as creating special economic zones, opening up coastal port cities, and establishing open coastal economic areas. All of these measures result in China's emerging as a major trading nation in the world trading system.

1) Special economic zones

A special economic zone is the forward position of opening-up and a special channel for China to absorb foreign capital and advanced technologies from international sources and markets.

In 1988, Shenzhen, Zhuhai, Shantou, Xiamen and Hainan became comprehensive special economic zones.

2) Open coastal cities

Since 1984, there have been 14 open coastal cities in China. Because of their convenient transportation and large outward harbors, these cities are usually important trade ports in Chinese economy.

3) Export processing zones

In export processing zones, strict measures are adopted to control the sale of processing trade products in domestic markets to protect related domestic industrials.

4) Bonded area

The function of bonded area is to develop export trade and export processing service to promote the development of the export-oriented economy.

Since the introduction of economic reforms, China's economy has grown substantially faster than during the pre-reform period (5.22% average annual rate between 1960 - 1978). According to World Bank, from 1979 to 2000, Chinese real GDP grew by 9.7% annually, making China the world's fastest growing economy. [2]

[2] World Bank indicators 2003

According to World Bank Indicators, China's per capita GDP was only 824$US in 2000. This data means that personal income and living standards in China are lower than those in developed countries, and even than those in a lot of other developing countries. However, many economists consider that if we use PPP measurements, China's per capita GDP was supposed to increase to 4228$US due to the fact that price in China for many goods and services are much lower than those in developed countries. Table 1 shows this change.

Table1. Comparisons of U.S., Japanese, German, and Chinese GDP and Per Capita GDP In Nominal U.S. Dollars and PPP: 1999

Country	Nominal GDP ($Billions)	GDP in PPP ($Billions)	Nominal Per Capita GDP	Per Capita GDP in PPP
U.S.	9,234	9,234	33,835	33,835
Japan	4,370	2,935	34,519	23,465
Germany	2,111	1,748	25,694	21,841
China	997	5,201	790	4,228

Source: DRI/McGraw Hill. *World Economic Outlook*, Volume I 1st Quarter, 2000, p.A-27.

China's export success is part of its general economic achievement and can be explained by the rapid pace of its domestic structural change. It may continue to outpace world trade growth over long term. By establishing special economic zones and by using other measures for the purpose of attracting foreign investment, boosting exports, and importing high technology products into China, China's international trade grew faster even than its GDP growth rate and it has become one of the most important partners in the world economic system. In 1970, China's total international trade was only 3.7% of its GDP. However, this number increased to 13.4% in 1979. Because of the persistent increase of international trade, in 2000 China's total international trade (exports plus imports) is about 50% of its GDP. [3] In 1978, China accounted for only 0.75% of total world exports, but in 1995 it accounted for 3.0%. [4]

[3] World Bank indicators 2003
[4] International Monetary Fund, Direction of Trade Statistics Quarterly 1996.

Figure 1. Ratios of China Trade to GDP

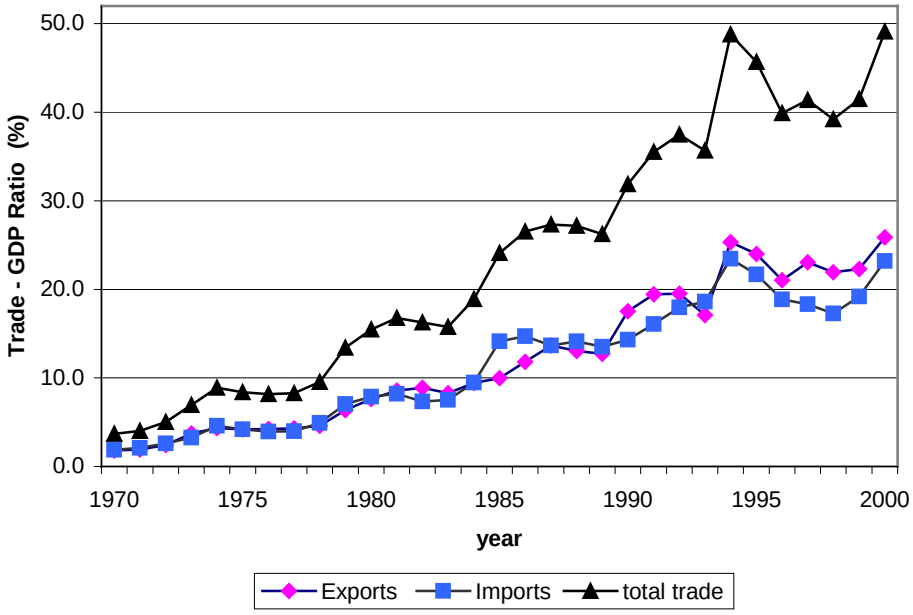
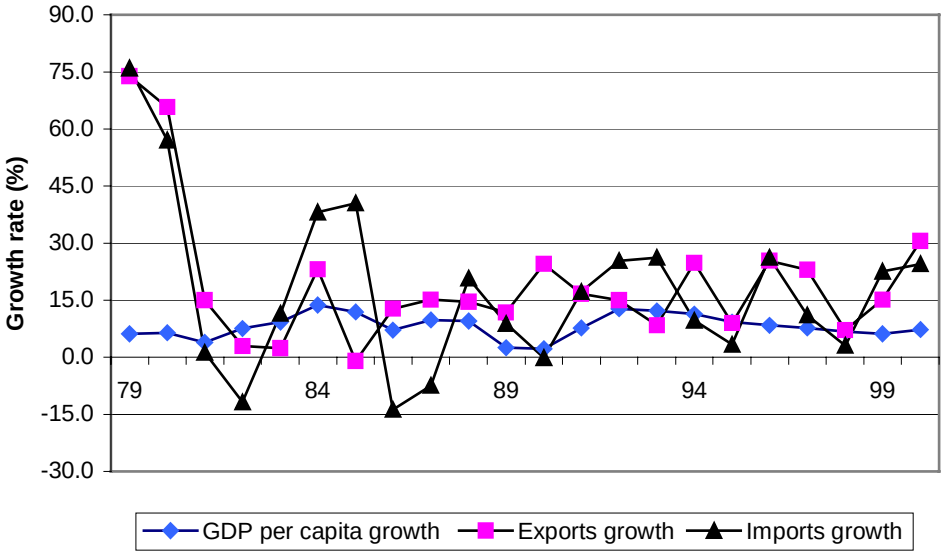


Figure 2. China's per capita GDP and trade growth (annual %)



Source: World Bank indicators 2003

With GDP growth accelerated, China's manufactured export has grown by 22% per year between 1984 and 1995.[5] We may conclude logically that China is becoming a trading nation.
With figure 2, the international trade growth (exports growth and imports growth) is more volatile than GDP per-capita income growth, GDP per-capita income growth is relatively constant in recent years.

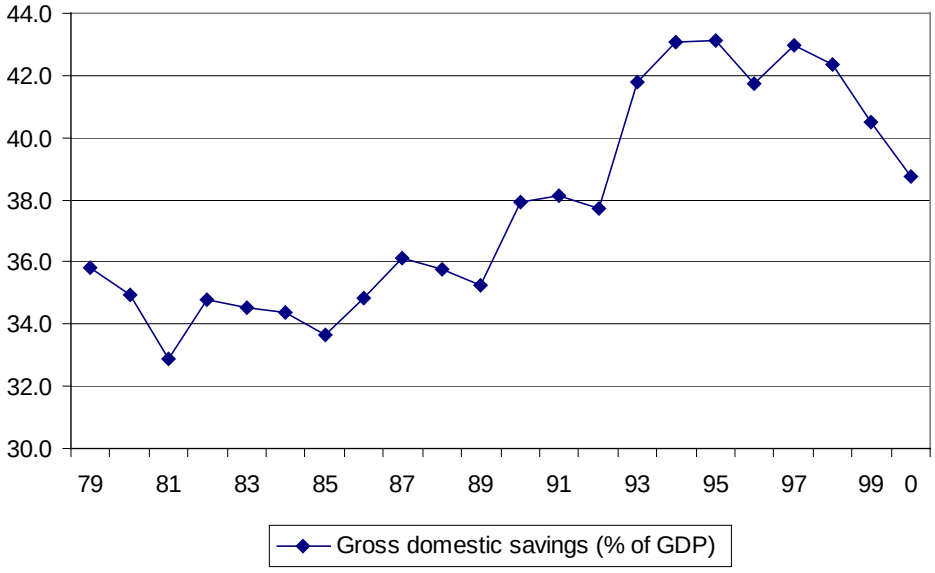
China's rapid economic growth is generally caused by two main factors: large-scale capital investment (financed by large domestic savings and foreign investment) and high productivity. Chinese economic reform led to high efficiency in its economy.

China has historically maintained a high rate of domestic savings. In 1979, we found out that the ratio of gross domestic savings to GDP was 36%. As a result of its economic reforms and the decentralization of economic production, the structure of domestic savings has changed, which causes the substantial growth in Chinese household savings, but domestic savings as a percentage of GDP has steadily risen. It was 42.7% in 1998, among the highest saving rates in the world.

After almost 15 years of negotiations with the other 142 Member Nations of the World Trade Organization (WTO), in 2000, China officially became a member of the WTO. As a result of the negotiations, China has agreed to undertake a series of important commitments to open and liberalize its regime in order to integrate more easily into the world economy and offer a more predictable environment for trade and foreign investment in accordance with WTO rules. Among some of the commitments undertaken by China, all foreign enterprises will have the right to import and export all their goods and to trade them throughout customs territory with limited exceptions within three years.

[5] Barry Naughton (1996)

Figure 3. China's gross domestic savings (% of GDP)



Source: World Bank indicators 2003

In 2000, China was the 7th leading exporter and the 8th largest importer of merchandisable trade in the world trade. Pertaining to commercial services, China was the 12th leading exporter and the 10th largest importer.

For historical reasons, Hong Kong is treated as a separate entity by many countries (like China, the United States, etc). This is why China's trade data often differs from those of its major trading partners. China treats a large share of its exports through Hong Kong as Chinese exports to Hong Kong for statistical purposes, while many countries that import Chinese products through Hong Kong generally attribute their origin to China for statistical purposes. In this research, we also consider that Hong Kong is a separate entity from China as World Bank did in their data.

III. Reviews of related studies

1. Economic growth and savings:

As many literatures presented, saving rates and growth rates are positively correlated across countries. Using standard growth models, **Solow** (1957) argued that high savings result in temporarily high growth, on the other hand, **Rebelo** (1991) confirmed high savings can result in permanently high growth with an endogenous growth model.

1). **Rober M. Solow (1957)**

"A contribution to the theory of economic growth"

By using the usual short-run classical analysis, in 1957 Solow presented his growth model, which is known as Solow's growth Model.

With simplifying assumptions that there is only one good in the closed economy, this good is produced, consumed and saved, and saving is assumed to be equal to investment in this closed economy.

The production function and per capita capital growth rate are defined as:

$$y = f(k) \qquad \text{and} \qquad \dot{k} = sf(k) - nk$$

The *s* is saving rate, *n* is growth rate of the population $\dot{L}/L$, *k* is per capita capital K/L.

One of the simplifying assumptions is the constant saving rate in this model. For each level of saving rates, we may have different levels of *k*, so we can say that k is a function of *s*.

High saving results in temporarily high growth of output. If per capita capital is less than k^* (the steady state level), then capital and output will increase temporarily until the steady state.

2). **Sergio T. Rebelo (1991)**

"Long run policy analysis and long run growth"

Being different from Solow's exogenous model, Rebelo(1991) presented an endogenous growth model, by using two types of factors of productions: reproducible (e.g., physical and human capital) and non-reproducible (e.g., land).

In this endogenous model, the steady-state growth is defined as:

$$g_y = \alpha \frac{(A - \delta_z)s}{\alpha + (1-\alpha)s}$$

A and δ are technology and capital depreciation respectively.

With this equation, high saving rates cause high growth rates.

According to Solow's model, saving rate (s) is an exogenous variable, it can only cause short-run growth. However, in an endogenous model, saving rate (s) as an endogenous variable causes a permanent growth.

Causation running between growth and savings is not clear. **Sebastian Edwards (1995)** concludes that the rate of output growth has a significant and positive effect on savings. On the other hand, with their studies for World Band, **Ross E. Levine and David Renelt (1992)** have shown that savings can also cause growth.

3). **Sebastian Edwards (1995)**

"Why are saving rates so different across countries? An international comparative analysis"

In this paper, the author mentioned that traditional analyses on savings and growth have general trait on two important aspects: (a) the effect of high savings on economic growth; and (b) the impact of an increase in domestic savings on investment.

In an open economy, high domestic savings does not mean high domestic investment. However, if the degree of international capital flow is limited, it can cause high domestic investment and growth.

Using instrumental variables estimation method, the author found out that per capital growth is one important factor of domestic savings (both private and public savings). Growth affects savings. Savings will tend to impact growth through their effect on capital accumulation. The estimation suggests that there is a positive relation between growth and domestic savings.

With equation :

$$s_{tk} = a_0 L_{tk} + a_1 G_{tk} + a_3 F_{tk} + a_4 M_{tk} + a_5 D_{tk} + a_6 E_{tk} + a_7 P_{tk} + a_8 S_{tk} + u_{tk}$$

The author also confirmed that growth on savings has an important positive influence in East Asia developing countries. According to the World Bank (1993b), for example, in

these countries there has been a "virtuous circle" going from high growth to high savings, and even higher growth.

4). **Ross E. Levine, David Renelt (1992)**

"A Sensitivity Analysis of cross-country Growth Regressions."

With simple estimation of per capita GDP growth or the share of investment in GDP,

$$Y = \beta_i I + \beta_m M + \beta_z Z + \mu$$

by using 119 countries' data, which cover the period 1960-1989, the author found out that countries that grew faster than average over the period 1960-1989 tended to have a high share of investment in GDP. Investment share is significantly correlated with average real per capital growth rate.

2. Convergence:

For modern growth theory and the phenomenon of convergence, a basic point is whether poor countries or regions tend to grow faster than rich ones. Economists also want to find out which element leads an economy to convergence over time. There are different methods that can be used to measure convergence. The first method is *cross sectional convergence test,* which is introduced by Willam J. Baumol(1986) and Barro and Sala-i-Martin(1992).

1). **Willam J. Baumol(1986)**

"Productivity growth, convergence, and welfare: what the long-run data show"

By using Maddison's data from 1870 to 1979, Baumol (1986) showed that convergence existed among industrialized nations (with 3.1% average annual growth rate in per capita GDP). This phenomenon also appeared both in *intermediate*[6] and centrally planned countries (3.6% for centrally planned economies, 3.0% for middle-income market economies). Only low-income countries did not show this trend. So the author confirmed that there exists more than one convergence clubs.

[6] Intermediate country: which is middle-income market country

In his paper, Baumol showed that there is a strong negative relation between growth rate and GDP per work hour. Based on annual gross domestic production data from 1870 to 1973 for seven industrialized countries, there is a tendency that these countries' productivity approached each other. Therefore, if the level of GDP per work hour is high in 1870, the growth rate will be lower in the following century. Innovation and investment are two main factors for supporting productivity growth in industrialized countries. High investment rate generally raises productivity and living standards.

2). **Barro, Robert, and Xavier Sala-i-Martin (1991)**

"Economic Growth"

Using neoclassical growth models, long run personal income data and gross state product data since 1963 in USA, Barro and Sala-i-Martin(1991) presented that U.S. economy provide clear evidence of convergence that poor states tend to grow faster than rich ones.

By using these two measures of real personal income or gross state product through the U.S, and by applying the following equation:

$$\frac{1}{T}\log\left(\frac{y_{i,t_0+T}}{y_{i,t_0}}\right) = B - \left(\frac{1-e^{-\beta T}}{T}\right)\log\left(y_{i,t_0}\right) + \mu_{i,t_0,t_0+T}$$

The author found out that by including changes in agricultural shares, the convergence rate is about 2% for the U.S. economy by using both two measures. Compared with the 20 original countries of the OECD, the coefficient of convergence β is only 1%, and for other 98 countries, this coefficient is about 0.3%. This means for the world economy there is no convergence at all.

Measuring by per capita product, if we excluded the manufacturing sector, β is less than 2% per year. However, for manufacturing the coefficient is over 4% per year. So, for U.S. economy the poorer states grow faster not only in terms of overall GSP per person, but also in terms of labor productivity within various sectors of production.

Barro and Sala-i-Martin argued that there is a positive relation between per-capita income and net immigration over time, but this relation slightly affected the convergence's

coefficient β. This can explain why in closed economy models, these two measures are different but their results are very close to each other.

Standard neoclassical growth model considers that preferences and technology are exogenous, and if we assume that the technologies are the same, then by using U.S. data we found that the speed of the convergence for output is faster than that for income.

3. Convergence and international trade

Ben David (1993, 1996, etc.) used other methods to analyze the relationship between the timing of trade reform and the reduction in income disparity.

1). **Ben David (1993)**

(Equalizing exchange: trade liberalization and income convergence)

For analyzing the relationship between the timing of free trade and income differences within the six original countries of the European Economic Community (EEC)[7], the author used log per capita annual incomes, and found out that there is a negative relationship between a country's initial level of per capita product and its per capita growth rates. Within these major trading partners, convergence appeared with the timing of trade reform, and with different periods of liberalization, it would be related to different periods of convergence.

In his paper, the author argued that trade liberalization has an impact on incomes in the absences of free trade; convergence can not be found out by analyzing the whole world economy.

2). **Ben David (1996)**

(Trade and convergence among countries)

Different from other's methods of using the trade's relationship in the convergence process, in his paper the author used reduction in income differential to analyze convergence within specific groups of countries over time.

[7] France, West Germany, Belgium, the Netherlands, Luxembourg and Italy

Creating trade groups according to their trade indicators (import, export or total trade[8]) and comparing with random groups, the author found that convergence would appear within the major partners. Including any special country, the convergence would not change. However, if excluding a trade partner who is a major player in most of the groups, the results tend to be relatively robust.

3). **Matthew J. Slaughter (1998)**

(International trade and per-capita income convergence: A difference-in-difference analysis)

To test the effect of international trade on per-capita income convergence across countries, the author used another method to analyze the effect of liberalization on the process of the convergence. Such method is named as "Difference-in-Difference". The following is the estimation in this method :

$$\sigma(y)_{jrt} = a_1 + a_2(d_r) + a_3(d_j) + a_4(d_{jr}) + b_1(t) + b_2(t)(d_r) + b_3(t)(d_j) + b_4(t)(d_{jr}) + e_{jrt}$$

$\sigma(y)_{jrt}$ is the income dispersion for country group *j* in time t for regime r. a_i (i=1,2,3,4) are intercepts, b_i (i=1,2,3,4) are convergence rates in difference cases. With this equation, we can calculate convergence rate before or after the liberalization in different regimes. The trade-policy change, which means trade liberalization, is presented by b_4. If there exists convergence, b_4 will be negative; otherwise, it will be positive.

According to trade theory, trade can either converge or diverge incomes. By using the "Difference-in-Difference" method, the author concluded that there is no proof that trade can help to cause the convergence before and after liberalization, and there is no case that the convergence rate accelerates after the liberalization. More particularly, the author indicated that the liberalization results in divergence in each of these four cases (pre and post liberalization for liberalizing groups, pre and post liberalization for control groups).

[8] In this paper, we use the union of import and export trades as total trade.

4. Important weaknesses:

These related studies usually ignore some important variables not only in closed economy model (Solow's model) but also in open economy model.(Ben David's model). The analysis of standard neoclassical model of cross-country convergence of per-capita incomes excluded the element of international trade. In this model, convergence is supported by accumulation of capital, and is financed only by domestic savings.

However, as Slaughter (1996) presented, there are at least three ways which international trade can influence the factor price equalization (FPE). There exist also many other factors such as domestic savings, investment, and demographic changes across countries, immigration flows, and international transfer payments, which can also influence the convergence between free trade and per-capita income. Therefore trade between countries is not sufficient proof that trade helps to cause per-capita income convergence.

On the other hand, these papers usually analyzed per-capita income convergence among developed countries. There are few papers on studies from developing countries. We can conclude that there is no convergence in the whole world economy, but we do not have clear results for developing countries under all conditions.

IV. Theoretical analysis

1. Approach of savings and growth models:

A lot of recent studies on economic growth with neo-classical are based on Solow's model. This model concluded that if each country or economy is independent of one another, *convergence arises from cross-country differences in rates of capital accumulation financed entirely by domestic savings. International linkages do not contribute to the process.*[9]

According to Romer (1996), the neo-classical production function is defined by three properties:

1) For all Y=F (K, L), K>0 and L>0, the marginal products should be positive and diminishing with respect to each input.
2) Y=F (K, L) exhibits constant returns to scale.
3) The marginal product of capital (or labor) approaches to infinity as capital (labor) goes to zero and approaches to zero as capital (or labor) goes to infinity.

Solow's growth model applied a neo-classical production model, and is simplified by only one good (Yt) in a closed economy. The personal income is equal to the total production. It is also equal to consummation (Ct) and savings (St). In this closed economy, savings are also equal to investments.

The capital growth can be defined as follows:

$$\frac{dk}{dt} = \dot{k} = sY$$

Solow's model also assumed that the growth rate of population is n. In this closed economy, every individual is a member of the labor force, this equation can be rewritten as:

$$\dot{k} = sf(k) - nk$$

[9] Slaughter (1997)

In the stead state, $\dot{k}$ is equal to zero, and the per capita saving sf (k) is equal to nk. Therefore in the stead state, the growth rate of per capita capital and per-capita income are both zero.

In Solow's model, in the stead state, the output growth rate is stable, and is equal to the population growth n. If per capita capital is less (more) than k^*[10], capital will increase (decrease) until the stead state point.

Solow's model is a basic growth model. In this model there are many assumptions and simplifications such as one sector of production. Also many other variables (like saving rates) are exogenous. Saving rates are constant in Solow's model, k^* is different for each saving rates level. Therefore saving rates temporarily affect growth rate. However, according to Robele(1991), if we use endogenous model, saving rates can cause a permanent high growth .

The starting point of endogenous model is that there are two types of production factors in this economy: reproducible factors and non-reproducible factors. Robele (1991) argued that in the context of neoclassical growth model, with the assumption of not using non-reproducible factors in the production of core capital goods, growth rate is possibly perpetual. In Solow's neo-classical model, technology is the only factor that determines growth rate. However, in Robele's model, growth rate is defined by both technology and preferences. In his model government actions can influence long run outcomes.

2. Approach of convergence and trade models:

As we mentioned earlier, in Solow's model, trade does not contribute to the process of convergence. On the other hand, according to the factor-prices-equalization (FPE) theorem, trade can influence convergence in two ways[11]:

1) International flows of factors can lead to convergence of endowments and factor prices;
2) International flows of technology can cause convergence of factor prices

[10] k^* is stead state level of per capita capital
[11] Slaughter (1997)

Like Samuelson (1948) and Hanson, Slaughter (1999) showed that factor price equalization is an effect observed in models of international trade, and that the prices of inputs to production in different countries like wages are driven towards equality in the absence of barriers to trade.

In a simplified economy just with only one good and two factors of productions, the equation accounting for per-capita income (PCGDP) is defined by:

$$PEGDP = \frac{Nationalincome}{L} = \frac{wL + rK}{L} = w + r\left(\frac{K}{L}\right)$$

The *w* and *r* are national factor prices for labor and capital; L and K are endowments of labor and capital respectively.

In standard neoclassical model[12], production technology and time preference are identical across countries. This implies that all countries develop toward the same K/L and thus the same *w* and *r*. In standard neoclassical model, international trade plays no role in the process of convergence.

According to the factor-prices-equalization, we may ask how international trade can help cause per-capita income convergence. Slaughter (1997) suggested that there are three possibilities that international trade can influence the convergence:

1) First, according to FPE, a country with free trade has factor prices equal to factor prices in the rest of the world under certain circumstances.
2) Second, by improving and using high technologies, international trade can affect per-capita incomes. A high technology, which means high marginal productivities K/L, also implies high per-capita incomes according to equation of PEGDP.
3) Third, international trade can affect per-capita income through trade in capital goods.

In contrast, since FPE is used with strict assumptions that it only predicts the stead state equilibrium and zero trade barriers etc, Leamer (1995) presented that "*it challenges us to find combinations of assumptions regarding factor-supply differences, technological*

[12] Standard neoclassical model: which is Solow's model

differences, and numbers of factors and goods for which economic integration reduces international factor-price differences."

A number of authors have pointed out that trade liberalization can also cause the opposite effects, which means that it can cause divergence of the per-capita income. By influencing factor prices, factor quantities, and production technology, trade liberalization has an ambiguous net effect on cross-country per-capita income. Trade can either converge or diverge the per-capita income.

Using the approach named as difference-in-difference, Slaughter (1998) presented other method to analyze the relationship between international trade and per income convergence across countries. The key issue of this approach is to test the effect of trade on convergence. The author suggests that if trade causes convergence (divergence), then an exogenous movement to free trade should accelerate this convergence (divergence), relative to the case if liberalization doesn't occur.

The estimation of this method is defined as follows:

$$\sigma(y)_{jrt} = a_1 + a_2(d_r) + a_3(d_j) + a_4(d_{jr}) + b_1(t) + b_2(t)(d_r) + b_3(t)(d_j) + b_4(t)(d_{jr}) + \varepsilon_{jrt}$$

Where: $\sigma(y)_{jrt}$ is income dispersion for country group *j* during time t with regime *r*, j=0 for liberalization group and j=1 for control group. r=0 for pre-liberalization regime and r=1 for post-liberalization regime. *d* is a set of dummy variables; ε_{jrt} is error term.

a_i (i= 1, 2, 3, 4) are intercepts. By calculating $b_1, b + b_2, b_1 + b_3, b_1 + b_2 + b_3 + b_4$, we can have different convergence rates. With this equation, if international trade causes convergence, meaning that $\sigma(y)$ diminishes over time. In his paper, the author confirmed that convergence accelerates after each trade agreement starts.

Convergence club is the club of economies linked together by international trade (Sachs and Warner, 1995). Ben-David (1993, 1996) argued that factor price equalization theorem provides a framework for relating trade's impact on income convergence.

The basic convergence model defined by Ben-David (1993, 1996) is:

$$(y_{i,t} - \bar{y}_t) = \phi(y_{i,t-1} - \bar{y}_{t-1}) + \varepsilon_{i,t}$$

$y_{i,t}$ is natural log of country *i*'s real per-capita income at time t, and $\bar{y}_t$ is un-weighted average of natural log per-capita incomes for the group in year t, ϕ is coefficient of convergence, $\varepsilon_{i,t}$ is term error .

In this regression, convergence is indicated by a diminution of the per-capita income between country *i* and the group countries considered.

If:

ϕ <1 indicates the existence of income convergence within the group;

ϕ >1 indicates the existence of income divergence within the group.

We can also calculate convergence rate within the given groups. Equation above can be rewritten as:

$$(y_{i,t} - \bar{y}_t) - (y_{i,t-1} - \bar{y}_{t-1}) = \delta(y_{i,t-1} - \bar{y}_{t-1}) + \varepsilon_{i,t}$$

If $\delta < 0$ there is convergence

$\delta > 0$ there is divergence

The larger (in absolute) δ is , the faster the convergence (divergence) is.

The half-life of convergence (divergence), the number of years that it takes for the income gap to be cut in half (or double) is defined as: HL=$\frac{\ln(0.5)}{\ln(\phi)}$

V. Empirical analysis

There are two main concepts of convergence in the studies of economic growth and convergence. One of the main concepts is β-convergence. According to Sala-i-Martin (1996), "*there is β-convergence …if we find a negative relationship between the growth rate of income per capita and the level of initial level of income"*. Another main concept is σ convergence, which means that the dispersion of per-capita income between countries and regions falls over time. A number of authors such as Ben-David (1993, 1996) and Slaughter (1997, 1998) used σ to test the relationship between international trade and convergence. In this paper, we will use Ben-David's model to test the effect of trade liberalization and domestic savings in convergence in China. In this section, first we introduce data and creation of groups, then we present the convergence's model, finally we analyze the results in different groups.

1. Data:

In this paper, each country's real per-capita income (1960-2000) and Chinese domestic savings (1978-2000) are from " World Bank Indicators 2003". Chinese exports of goods and services, Chinese gross capital formation are also from "World Bank Indicators 2003". The reason of such data selection is that China's economic reform began between the end of 1978 and the beginning of 1979. For trade groups, data of trade relationship are according to " Direction of trade statistic", March 2002, IMF.

2. Creation of groups:

We have three type groups (trade groups, geographic groups and a random group) in this paper. Trade groups are created as exports-based group, imports-based group, and total trade based group[13]. Each group is chosen according to their trade relationship with China in 2000. All of these groups are presented in Table 2.

As Ben-David (1996) indicated, each trade group was formed according to their trade values. Since trade patterns are not the same according to imports and exports, it is interesting to create each group respectively. For each trade group of China, major export

[13] The total trade group is defined as the union of exports-based and imports-based group

trade partners are selected from the countries to which China exported more than 1.5% of Chinese total exports. This rule also applies to imports-based group and total trade group.

Table 2. Direction of trade (Export, Import, Total trade)

(Mn US dollars; calendar year 2000)

Export-based group: total exports 52161.7 US dollars

Country	Exports	Exports/total exports (%)
1. United States	52161.7	21%
2. Hong Kong, China	44519.8	18%
3. Japan	41654.0	17%
4. Korea, Rep. of	11292.5	5%
5. Germany	9278.1	4%
6. Netherlands	6687.2	3%
7. United Kingdom	6310.2	3%
8. Singapore	5761.3	2%
9. Italy	3802.3	1.5%
10. France	3714.6	1.5%

Import-based group: total imports 225096 US dollars

Country	Imports	Imports/total imports
1. Japan	41511.8	18%
2. Korea, Rep. of	23207.3	10%
3. United States	22374.6	10%
4. Germany	10408.8	5%
5. Hong Kong, China	9429.2	4%
6. Russia	5769.9	3%
7. Malaysia	5480.0	2.4%
8. Singapore	5059.7	2.2%
9. Australia	5024.1	2.2%
10. Indonesia	4402.0	2.0%
11. Thailand	4381.0	1.9%
12. France	3951.5	1.8%
13. United Kingdom	3592.0	1.6%

Total trade based group: total trade 474291.5 US dollars

Country	Trade	Trade/total trade
1. Japan	83165.8	18%
2. United States	74536.3	16%
3. Hong Kong, China	53949	11%
4. Korea, Rep. of	34499.8	7%
5. Germany	19686.9	4%
6. Singapore	10821	2.3%
7. United Kingdom	9902.2	2.1%
8. Australia	8453.1	1.8%
9. Malaysia	8045	1.7%
10. Russia	8002.9	1.7%
11. Netherlands	7923.2	1.7%
12. France	7666	1.6%
13. Indonesia	7464	1.6%
14. Italy	6880.3	1.5%

Source: Direction of Trade statistics (March 2002) IMF.

Using 1.5% as the criteria, there are ten trade partners in the exports-based group. There are 13 and 14 members in the imports-based group and the total trade group, respectively. In these cases, if we set the criterion level higher than 1.5%, the size of trade group would be too small. It is an interesting discovery that most of the trade partners are developed industrialized countries in exports-based group. In contrast, in the imports-based group, one-third of the members are developing countries.

On the other hand, country groups are also created according to their geographic location. We create trade patterns for China as North American countries group, European countries group, and Asian countries group. The North American trade group includes Canada, American, and Mexico. The European countries trade group includes 15 countries of European Economy Community. Countries and regions in the Asian countries trade group are Bangladesh, Hong Kong (China), Macao (China), India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, and Thailand.

As we mentioned earlier, we also consider that Hong Kong (China) and Macao (China) are two special trade destinations for China, which means that we count the trade between China-Hong Kong (China) and China-Macao (China) as international trade. All of these geographic groups are presented in Table 3.

Table 3. List of countries in geographic groups

North American countries group:

Source country	Countries group		
China	Canada	Mexico	United States

European countries group:

Source country	Countries group			
China	Austria	Belgium	Denmark	Germany
	Greece	Finland	France	Ireland
	Italy	Luxembourg	Portugal	Spain
	Sweden	United Kingdom	Netherlands	

Asian countries group:

Source country	Countries group			
China	Bangladesh	Hong Kong, China	Macao, China	India
	Indonesia	Korea, Rep.	Malaysia	Pakistan
	Philippines	Singapore	Sri Lanka	Thailand
	Japan			

To compare results in different groups, we create a random group by using the maximum number of members (15 countries) in our analysis. This group is presented in Table 4.

Table 4 List of counties in random group

Source country	Countries group			
China	Australia	Bangladesh	Chile	Denmark
	Egypt	France	Greece	Ireland
	Jamaica	Korea Rep.	Luxembourg	Malaysia
	Norway	Philippines	Singapore	

3. The convergence model:

As we mentioned earlier, in this paper we will use σ convergence test to analyze the processes of convergence. The basic model is Ben-David's convergence model:

$$(y_{i,t} - \bar{y}_t) = \phi(y_{i,t-1} - \bar{y}_{t-1}) + \varepsilon_{i,t} \qquad (1)$$

Where: $y_{i,t}$ is natural log of country i's real per-capita income at time t, and $\bar{y}_t$ is un-weighted average of natural log per-capita incomes for the group in year t, ϕ is coefficient of convergence, $\varepsilon_{i,t}$ is term error.

For this estimation,

ϕ=1, which means that there is neither convergence nor divergence

ϕ>1 there is divergence, which means that the gap of per-capita income within the group increases over time.

ϕ< 1 there is convergence, which means that the gap of per-capita income within the group decreases over time.

ϕ is also an indication of the rate of convergence within the given group. The number of the years that it takes for the income gap to be cut into half is named as half-life and defined by HL=$\frac{\ln(0.5)}{\ln(\phi)}$. With this indicator, we can calculate the rate of convergence on the convergence process.

In equation (1), it is necessary to test the unit root null. Ben-David (1996) presented the augmented Dickey-Fuller equation as:

$$z_{i,t} = \phi z_{i.t-1} + \sum_{j=1}^{k} c_j \Delta z_{i,t-j} + \varepsilon_{i,t} \quad (2)$$

Where: $z_{i,t} = y_{i,t} - \bar{y}_t$ and $\Delta z_{i,t} = z_{i,t} - z_{i,t-1}$

With no intercept and trend, as Quah (1994), Levin and Lin (1992) argued, the critical values are nearly identical to the standard t-values. It is possible to use the standard t-statistic for testing the unit root null.

In this equation:

If $\phi = 1$ there is unit root

$\phi \neq 1$ there is no unit root

If there is unit root, we need to use the method of the augmented Dickey-Fuller to test equation (2) and add $\Delta z_{i,t-j}$ for modification.

To determine the number of lags k, we choose the maximum of the *k* in this equation first, and then we test the last lag. If it is not significant at 10% level, then we use k-1 and repeat the test. This test will continue until the last lag is significant at 10% level. Then we can determine that the max of the number is k-1.

To test the role of domestic savings in the process of convergence, a set of explanatory variables are added in equation (1), the modified equation is:

$$(y_{i,t} - \bar{y}_t) = \phi(y_{i,t-1} - \bar{y}_{t-1}) + z_{i,t} + \varepsilon_{i,t} \quad (3)$$

$z_{i,t}$ is country i's domestic saving at time t (% of GDP).

In order to obtain consistent estimators and avoid the simultaneity problem in equation (3), we choose $x_{i,t}$ and $I_{i,t}$ as two instrumental variables for $z_{i,t}$, where $x_{i,t}$ is country i's exports of goods and services at time t (% of GDP), $I_{i,t}$ is country i's gross capital formation at time t (% of GDP). We use two stages least squares (2SLS) method instead of OLS estimation in this equation.

4. Estimation and results:

In this section, we analyze the effect of trade liberalization in the process of convergence in different type groups, and we also test the impact of high domestic savings in these processes.

4.1). Trade groups:

4.1.1) Estimation for trade groups before Chinese economic reform:

In this section, the convergence is estimated by using the OLS of equation (1).

$$(y_{i,t} - \bar{y}_t) = \phi(y_{i,t-1} - \bar{y}_{t-1}) + \varepsilon_{i,t}$$

For each of these trade groups, we use the following equation to test the unit root.

$$z_{i,t} = \phi z_{i.t-1} + \sum_{j=1}^{k} c_j \Delta z_{i,t-j} + \varepsilon_{i,t}$$

Where: $z_{i,t} = y_{i,t} - \bar{y}_t$ and $\Delta z_{i,t} = z_{i,t} - z_{i,t-1}$

In this equation:

If $\phi = 1$ there is unit root

$\phi \neq 1$ there is no unit root

$\phi > 1$ there is divergence

$\phi < 1$ there is convergence

Table 5 shows the results for the period from 1960 to 1977. Since this period is before the Chinese economic reform, China was in a closed economy and there was nearly no trade liberalization. When we use the data from this period, we found out that in each of China's trade group, there are not significant results in per-capita income convergence. After testing the unit root, we found out that the coefficient of convergence $\hat{\phi}$ is 0.9995996 for the imports-based group; it is 1.000269 for the exports-based group, and 0.9984745 for the total trade group. All of these coefficients are not statistically significant.

Figure 4. Per-capita income in China and its trade groups:

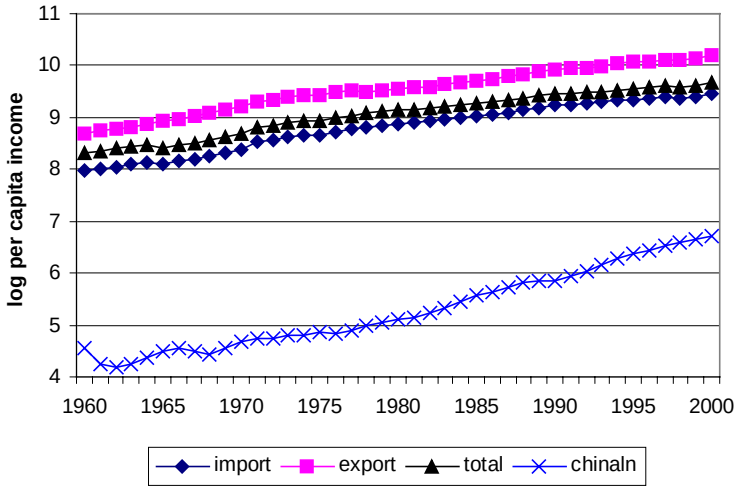
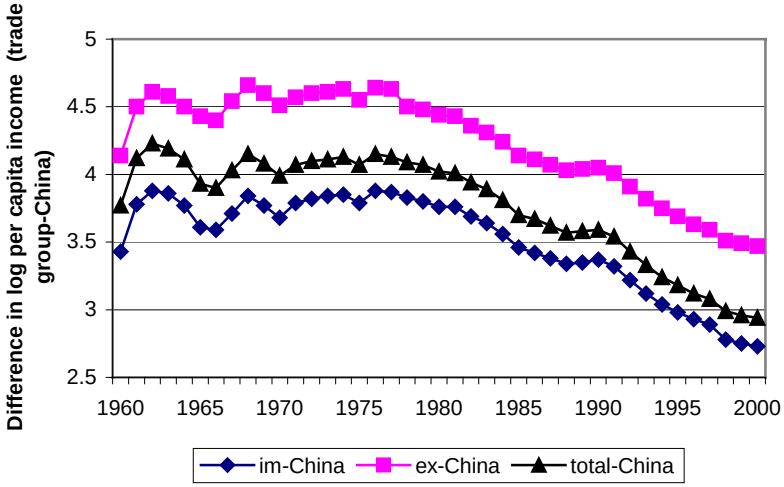


Figure 5. The gap in per-capita income between China and trade groups: (From 1960 to 2000)



Source: World Bank Indicator (2003)

From figure 4 and figure 5, it is very clear that the difference in log per-capita income between China and its trade groups was not stable between 1960 and 1977. When we used the Ben-David's (1996) model, we cannot confirm that there existed convergence or divergence before Chinese economic reform since all of these results are not statistically significant.

4.1.2). Estimation for trade groups after Chinese economic reform:

With the same regression model and trade partners, the effect of trade liberalization in the process of convergence is also tested. Data after Chinese economic reform (from1978 to 2000) are used and compared with the results before Chinese economic reform from 1960 to 1977.

With the results in Table 5, we found out that the results in these three groups are similar to one another, and convergence exists in each of these groups. The coefficient is 0.985241for import-based group, 0.9884698 for export-based group, and 0.9855307 for total trade group. All of these coefficients are significant even at 1% level. As Ben-David (1996) argued, in each of these regressions there is neither constant nor trend, so we can use the standard t-value to test the level of significance. We also discovered that, in each regression, there is no unit root. As a result, k is equal to zero in each of these three groups. The half-life is 46.6, 59.7, and 47.6 for the import-based group, the export-based group, and the total trade group respectively. As presented in figure 4, the export-based group has the highest average natural log per-capita incomes for the group in time t. Therefore, it needs more time to reduce the lag of per-capita incomes between China and export-based group.

From 1978, China began its economic reform and has become a major trade member in the world trade. With the change of its trade liberalization, we found out that the gap in per-capita income between China and each of its trade groups decreased over time, and the trend of these diminutions are nearly parallel in each of its trade groups. It can be confirmed from these results that convergence exists between China and each of its trade group over time, although the convergence rate is different between each other.

4.1.3) Estimation for trade groups with domestic savings:

(Since there is not enough domestic savings data before Chinese economic reform, we only analyze the effect of domestic savings in the process of convergence after Chinese economic reform in this section.)

To test the effect of domestic savings in the process of convergence, the basic model of Ben-David (1996) is also used. But we added a set of explanatory variables this time, which means that we added a set of domestic savings as variables z_{it} in equation (1).

$$(y_{i,t} - \bar{y}_t) = \phi(y_{i,t-1} - \bar{y}_{t-1}) + z_{i,t} + \varepsilon_{i,t} \quad (3)$$

In order to obtain consistent estimators and avoid the simultaneity problem in equation (3), we estimate this equation by choosing $x_{i,t}$ and $I_{i,t}$ as two instrumental variables for $z_{i,t}$, where $x_{i,t}$ is country i's exports of goods and services at time t (% of GDP), $I_{i,t}$ is country i's gross capital formation at time t (% of GDP). We also use two stages least squares (2SLS) method instead of OLS estimation.

The results of this regression are presented in Table 5. From these results we found out that if we added explanatory variable of domestic savings in the regression, all of the coefficients $\hat{\phi}$ are less than one, with 2 of the 3 results significant at the 10% level. For the imports-based group the coefficient is ($\hat{\phi}$=0.9213087, Std=0.0663488), for the exports-based group ($\hat{\phi}$=0.9159151, Std=0.0630577), for the total trade group ($\hat{\phi}$=0.9053051, Std=0.0066134). All of these coefficients of convergence are less than one, 2 of these results were significant at the 10% level, which means that domestic savings plays a significant role on the process of per-capita income convergence. If we added domestic savings in the regressions, the convergence rates would be accelerated according to these results.

In figure 4, the gap of per-capita income between China and the three trade groups decreased over time (from 1978 to 2000). But the diminution is different from one another, which means that the convergence rates are different in these three groups.
Since equation (1) can be rewritten as:

$$(y_{i,t} - \bar{y}_t) - (y_{i,t-1} - \bar{y}_{t-1}) = \delta(y_{i,t-1} - \bar{y}_{t-1}) + \varepsilon_{i,t} \quad (4)$$

In this equation δ is the rate of convergence of y_{it} to $\bar{y}_t$. If δ<0 there is convergence. In contrast, if δ>0 there is divergence. The larger (in absolute) δ is, the faster the convergence is. Table 5 presents the results of convergence rate in trade groups.

These results show that the exports-based group has the highest average per-capita income, then the total trade group, and the last the imports-based group, which has the lowest average per-capita income and the highest convergence rate. The total trade group has the second highest convergence rate; and the exports-based group has the slowest convergence rate. But if we added domestic savings in the regressions, we cannot have the same conclusion.

Table 5 The results of trade groups

	Before Chinese economic reform (from 1960 to 1977)			After Chinese economic reform (from 1978 to 2000)					
				Without domestic savings			With domestic savings		
Variable	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
$y_{it} - \bar{y}_{t-1}$	0.9996 (-0.07)	1.0003 (0.06)	0.9985 (-0.26)	0.9852* (-6.38)	0.9885* (-6.82)	0.9855* (-6.81)	0.921 (-1.19)	0.916*** (-1.33)	0.905*** (-1.43)
z							0.921*** (1.60)	0.975*** (1.66)	1.228** (1.78)
δ	-0.0004	0.0003	-0.0015	-0.0148*	-0.0115*	-0.0145*	-0.0787	-0.0841***	-0.0947***
n	13	10	14	13	10	14	13	10	14
N	16	16	16	22	22	22	21	21	21
Half-life				46.62*	59.8*	47.6*	8.45	7.89***	6.97***

(1) :Import-based group (2) :Export-based group (3) :Total trade group

* The results are significant at 1% for H_0: ϕ=1

** The results are significant at 5% for H_0: ϕ=1

*** The results are significant at 10% for H_0: ϕ=1

n: number of partners

N: Number of observations

t-statistics in parentheses

4.2) Geographic groups:

4.2.1). Estimation for geographic groups before Chinese economic reform*:*

In geographic groups, Ben-David's model is also used to test the processes of convergence. By using the OLS of equation (1), the regressions of convergence are as follows:

$$(y_{i,t} - \bar{y}_t) = \phi(y_{i,t-1} - \bar{y}_{t-1}) + \varepsilon_{i,t}$$

For each of these geographic groups, we use the following equation to test the unit root.

$$z_{i,t} = \phi z_{i.t-1} + \sum_{j=1}^{k} c_j \Delta z_{i,t-j} + \varepsilon_{i,t}$$

where: $z_{i,t} = y_{i,t} - \bar{y}_t$ and $\Delta z_{i,t} = z_{i,t} - z_{i,t-1}$

In this equation:

If $\phi = 1$ there is unit root

$\phi \neq 1$ there is no unit root

$\phi > 1$ there is divergence

$\phi < 1$ there is convergence

Similar to the trade groups, the effect of trade liberalization in the process of convergence in geographic groups is also tested. We use the Ben-David's model and the geographic groups; however, we choose the data in the period before Chinese economic reform (from 1960 to 1977). The results are presented in Table 6 after testing the unit root.

It is shown from the results that when we use the data before Chinese economic reform, all of the convergence's coefficients are not statistically significant. Therefore, we cannot reach a clear conclusion in the process of convergence. It can only be confirmed that we didn't find significant divergence before Chinese economic reform.

4.2.2). Estimation for geographic groups after Chinese economic reform:

With these results in Table 6, we found out that convergence exists in each of these geographic groups. The coefficient of convergence is 0.9824084 for North American countries group. It is 0.9874065 for European countries group and 0.9808477 for Asian countries group. All of these coefficients are statistically significantly less than one, so we can confirm that there is convergence in each of these geographic groups. As we mentioned earlier, there is neither constant nor trend in these regression. After testing the unit root in each of these regressions, k is equal to zero in each of these geographic groups.

From figure 6 and figure 7, we clearly know that the European countries group has the highest average log per-capita income among all the geographic groups. When we use the data after Chinese economic reform (from 1978 to 2000), there is convergence in each of these groups. As we calculated, the half-life for these groups is 39.05, 54.69, and 35.84 respectively. European countries group has the highest average per-capita income among all three groups.

Comparing China's per-capita income and the gap of per-capita income between trade groups and geographic groups, we found out that the gaps of per-capita income have reduced in both groups after Chinese economic reform. However, in geographic groups, this gap was nearly a constant from 1970 to 1980, which means that the trade groups are more sensitive than geographic groups due to the policy change.

According to figure 7, the gap of per-capita income between China and the three other geographic groups has decreased over time since 1978. But the decrease is different from one another, which means that the convergence rates are different in these three groups. We can also use equation (4) to calculate the convergence rates in the case of the geographic groups. Results are shown in table 6. Since δ are all negative in period from 1978 to 2000, there exist convergences in all three geographic groups. Among these groups, European countries group has the highest average per-capita income and the slowest convergence rate. In contrast, Asian countries group has the lowest average per-capita income and the fastest convergence rate. This is the same conclusion as the trade

groups. The lowest average per-capita income group has the highest convergence rate without the explanatory variable of domestic savings.

Figure 6. The per-capita income in geographic groups (From 1960 to 2000)

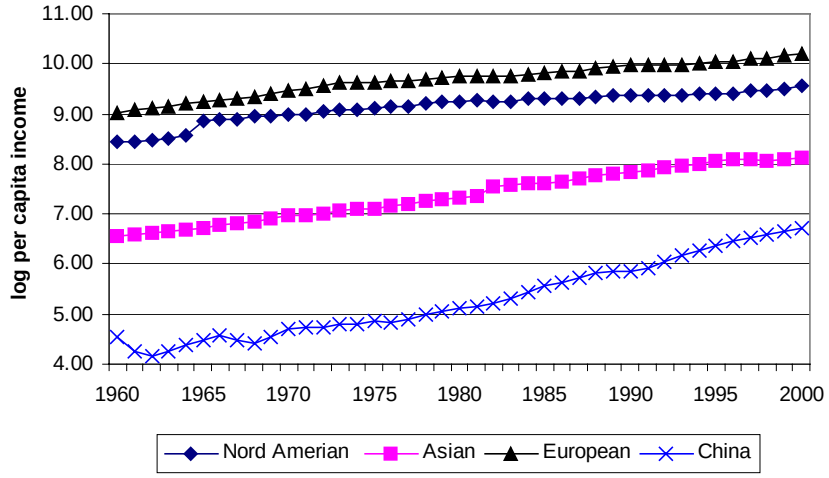
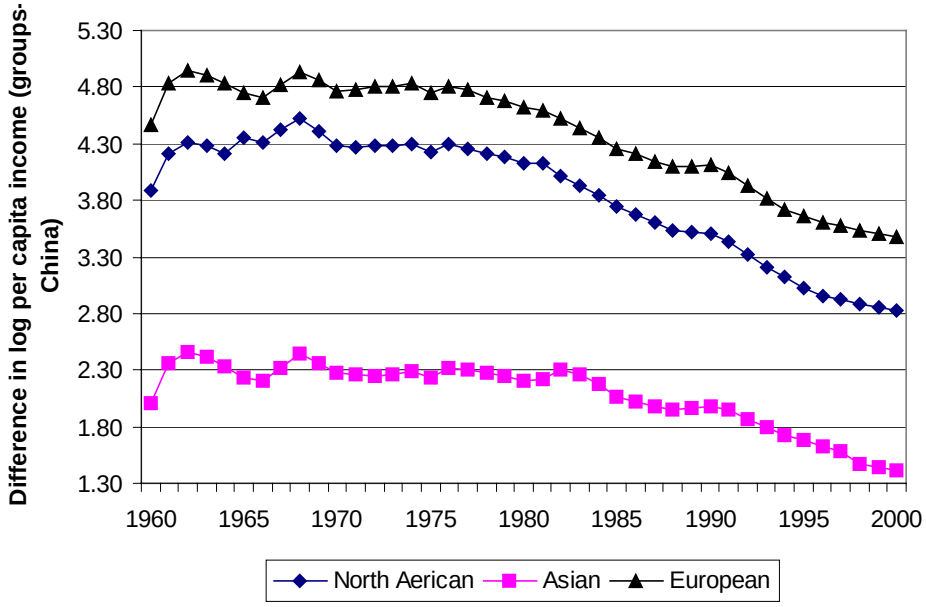


Figure 7. The gap in per-capita income between China and geographic groups (From 1960 to 2000)



Source: World Bank Indicators (2003)

4.2.3). Estimation for geographic groups with domestic savings:

(**As we mentioned earlier, we only test the effect of domestic savings in the process of convergence after the Chinese economic reform)**

To test the effect of domestic savings in the regression of geographic groups and the process of convergence, we also use the equation (3)

$$(y_{i,t} - \bar{y}_t) = \phi(y_{i,t-1} - \bar{y}_{t-1}) + z_{i,t} + \varepsilon_{i,t}$$

In order to obtain consistent estimators and avoid the simultaneity problem in equation (3), we estimate this equation by choosing $x_{i,t}$ and $I_{i,t}$ as two instrumental variables for $z_{i,t}$, where $x_{i,t}$ is country i's exports of goods and services at time t (% of GDP), $I_{i,t}$ is country i's gross capital formation at time t (% of GDP). We use two stages least squares (2SLS) method instead of OLS estimation.

It is shown from these results that there is convergence in each of these geographic groups; 2 of the 3 coefficients of convergence are statistically significant at 10% level. By testing the statistic-t with domestic savings, we found out that domestic savings is statistically significant at least 10% level in each of the geographic group. The coefficient of domestic savings is 1.472784 for the European countries group, and 0.8849655, 0.8692766 for the North American countries group and the Asian countries group respectively. All of these results are statistically significant, which means that domestic savings plays a significant role in the process of per-capita income convergence. This can be explained by the fact that, in a relatively open economy like Chinese economy, higher domestic savings usually means higher investments and higher growth rates.

Without the effect of domestic savings in the regression, the lowest average per-capita income group has the highest convergence rate. However, if we add domestic savings as an explanatory variable in the regression, we could not have the same conclusion. It can be only confirmed that, by including domestic savings as an explanatory variable, higher domestic savings can significantly raise the convergence rates in 2 of these 3 geographic groups.

Table 6 The results for geographic groups

	Before Chinese economic reform (from 1960 to 1977)			After Chinese economic reform (from 1978 to 2000)					
				Without domestic savings			With domestic savings		
Variable	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
$y_{it} - \bar{y}_{t-1}$	0.9997 (-0.06)	0.9959 (-0.54)	0.9981 (-0.51)	0.982* (-8.12)	0.987* (-7.75)	0.981* (-3.79)	0.885** (-1.86)	0.873* (-7.75)	0.869 (-1.14)
z							1.586** (1.93)	1.473** (2.03)	1.439*** (1.66)
δ				-0.0176*	-0.0136*	-0.0192*	-0.1150**	-0.1274*	-0.1307
n	3	15	13	3	15	13	3	15	13
N	16	16	16	22	22	22	21	21	21
Half-life				39.05*	54.69*	35.84*	5.67**	5.09**	4.95**

(1): North American countries group (2) : European countries group (3) : Asian countries group
* The results are significant at 1% for H_0: ϕ=1
** The results are significant at 5% for H_0: ϕ=1
*** The results are significant at 10% for H_0: ϕ=1
n: number of partners
N: Number of observations:
t-statistics in parentheses

4.3) Comparison with different groups:

We can create a random group by using the maximum number of members (15 countries) in our analysis. As we did in the trade groups and the geographic groups, we also test the per-capita income convergence before and after the Chinese economic reform, the results among difference groups were then compared. The results are presented in Table 7.

In this table, we used the total trade group as the trade group; it has 14 partners in this regression. European countries group is chosen as the geographic group, it has 15 partners. The random group also has 15 partners.

It is clearly shown from table 7 that before the Chinese economic reform, convergence is not significant in each of these groups. However, after the Chinese economic reform and without domestic savings, income convergence appears in all of these groups. Furthermore, if we add domestic savings as an explanatory variable in the regression by using instrumental variables estimation method, we found that all of these groups show significant results. It is reported from the results that in a country that has a big international trade, domestic savings is also a significant factor for the process of convergence. Therefore, we can conclude that economic reform (trade liberalization) can help to cause income convergence in different types of groups. Moreover, higher domestic savings can significantly influence the process of convergence in post-liberalization period in China.

Table 7 The results with different groups

	Before Chinese economic reform (from 1960 to 1977)			After Chinese economic reform (from 1978 to 2000)					
				Without domestic savings			With domestic savings		
Variable	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
$y_{it} - \bar{y}_{t-1}$	0.9985 (-0.285)	0.9981 (-0.510)	0.960 (-1.150)	0.9855* (-6.807)	0.9874* (-7.751)	0.9826* (-8.00)	0.905*** (-1.432)	0.873** (-2.03)	0.915** (-1.55)
z							1.228** (1.78)	1.473** (2.03)	0.880*** (1.54)
δ				-0.0145*	-0.0136*	-0.0174*	-0.0947***	-0.1274**	-0.0823***
n	14	15	15	14	15	15	14	15	15
N	16	16	16	22	22	22	21	21	21
Half-life				47.6*	54.69*	39.53*	6.97***	5.09**	7.78***

(1): Total trade group (2): European countries group (3): Random group

* The results are significant at 1% for H_0: ϕ=1

** The results are significant at 5% for H_0: ϕ=1

*** The results are significant at 10% for H_0: ϕ=1

n: number of partners

N: Number of observations

t-statistics in parentheses

VI. Conclusion

Since its economic reform, China has become a more and more import international trade partner in the world economic system. Its international trade has been increasing rapidly in several decades. At the same time China is a country with high economic growth and higher domestic savings, therefore it is interesting to test whether trade liberalization and international trade can cause per-capita income convergence. It is also intriguing to test what the net effect of domestic savings is in the process of convergence.

With Solow's model, in a closed economy, economic growth is financed only by investment, or more precisely, by domestic savings. Therefore, higher domestic savings can cause high economic growth. However, trade theory gives an ambiguous answer in economic growth, which can cause either income convergence or income divergence. In this research, by using the Ben-David's model, we tested the possibility of convergence before and after Chinese economic reform. In all types of the groups (trade groups, geographic groups, and random group), there are no statistically significant results before Chinese economic reform. However, there are income convergences after Chinese economic reform. With all the results, we can conclude that international trade and trade liberalization can cause income convergence in different kinds of the groups. Due to the limitation of the data availability, we only test the effect of domestic savings in post-liberalization period, and we argued that higher domestic savings can significantly raise the rate of economic growth after Chinese economic reform.

As we know, the basic point of Ben-David's model is the factor-price-equalization theorem, but this theorem has some limitations on analysis of the relationship between international trade and per-capita income convergence. We are suggesting that further studies on this subject may also include other factors such as demographic changes across countries, immigration flows, foreign investments, and international transfer payments, all of which can influence economic growth and income convergence.

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