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Jenni Pääkkönen

Are there industrial and agricultural convergence clubs in China?

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Tiivistelmä

Tässä tutkimuksessa arvioidaan Kiinan maaseudun ja teollistuneiden alueiden välisiä talouskasvueroja viimeisen kolmen, talouden uudistusten sävyttämän vuosikymmenen ajalta. Kansainvälisen kaupan ja endogeenisen kasvun teorioiden pohjalta näyttäisi siltä, että alueiden väliset erot johtuvat niiden välisistä resurssieroista reformin alkuvaiheessa. Alueet, joilla oli reformin alkuvaiheessa suhteellisen paljon pääomaa, erikoistuivat teollisuuteen. Vastaavasti alueet, joilla oli suhteessa enemmän työvoimaa, erikoistuivat työvoimavaltaiseen tuotantoon, lähinnä maatalouteen. Tässä työssä osoitetaan, että teollistuneiden alueiden ryhmän BKT:n tasot lähestyvät toisiaan ja vastaavasti alkujaan maatalousvaltaiset alueet erkanevat toisistaan. Erityisesti ne alueet, jotka ovat reformin jälkeen modernisoineet tuotantorakennettaan ja kehittyneet maatalousvaltaisista teollistuneiksi, ovat BKT:llä mitattuna alkaneet saavuttaa jo aiemmin teollistuneiden alueiden ryhmää. Vastaavasti edelleen voimakkaasti maatalouteen panostavat alueet näyttävät jäävän jälkeen talouden kehityksessä.

Asiasanat: talouskasvu, maanviljely ja tuloerot

Are There Industrial and Agricultural Convergence Clubs in China?*

Jenni Pääkkönen†

August 6, 2009

Abstract

This paper discusses growth differentials of Chinese provinces geared to agricultural activities and those focusing on industrial production over three decades of economic reform. Following trade theory and endogenous growth theory, we suggest that the fundamental differences between regions arise from their resource allocations at the start of reforms. Thus, capital-abundant regions have tended to specialize in industrial production, while the labor-abundant regions have concentrated on labor-intensive production (agriculture). Many of China's agricultural provinces suffer from oversupplies of labor, which has led large numbers of people to migrate within the country to work in non-farming sectors of economy. We show that provinces with high shares of industrial production (the industrial club) have converged, and that agricultural provinces shifting to industrial production have been catching up to initially industrialized provinces. Provinces that have stayed with an agricultural strategy (the agricultural club) show no evidence of convergence and appear to have been left behind in terms of economic development.

JEL Classification: O17, O40, O57.

Key Words: Growth, Agriculture, Convergence.

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1 Introduction

In 2008, China celebrated its 30-year anniversary of its reform and opening-up policy. During these three decades, the Chinese economy grew about 8% a year on average, lifting some 400 million Chinese from poverty according to World Bank estimates (dollar-per-day definition). The political challenge for China's leaders has been dealing with the fact that the income gains have not been shared evenly. Indeed, while reforms were initially implemented to help raise living standards in the countryside, the outcome has hardly met this ideal. Disposable income per capita in 1978 was 2.6 times higher for the urban population than rural residents. By 2008, the ratio of urban to rural income was 3.3.[1] We ask, therefore, what accounts for the emergence of provincial income disparities during this critical reform period?

One suggestion is that the rural-urban divide has led to provincial divergence (Zou et al. 2008).[2] Under this view, sequential reforms proceeded at different paces in rural and urban areas. Early reforms were geared to helping rural areas, but this touched off dissatisfaction in the cities. The government responded in 1984 with a switch to more visible reforms oriented to improving the lot of urban dwellers. As the pendulum swung back in favor of the city, the catch-up in income differences halted and the wealth disparity gap between the countryside and cities again began to widen. For the period overall, reforms and China's opening-up policy have largely benefitted the non-farming sectors of the economy.

Trade theories can also explain the uneven development of China's regions. Krugman (1981, 1991) proposes a two-region model in which an initial discrepancy in capital-labor ratios between the regions accumulates over time, leading to the division of world into a capital-rich industrial region (core) and capital-poor, agricultural region (periphery). Here,

[1] The income comparison is somewhat difficult, since no data for disposable income exists for rural areas. The numbers reported are calculated using disposable income for urban and net income for rural residents as in Lu and Song (2006). Using cash income for rural residents (which more closely correspinds to disposable income in urban circumstances), we get an urban-to-rural income ratio of 2.1 in 1985 and 2.4 in 2006, i.e. a less profound income disparity than Lu and Song suggest.

[2] China's economic regions, for historical reasons, were never divided solely into provinces. To this day, five large autonomous administrative regions remain, as well as the three huge municipalities of Chongqing, Beijing, and Tianjin. For purposes of discussion here, however, we treat autonomous regions, super-municipalities and provinces as regions. We exclude the special administrative regions of Hong Kong and Macao.

it is assumed manufacturing will concentrate in the region that gets a head start, and indeed, the evidence for reform impacts, opening-up, and preferential policies suggests this is actually happened in China. Roughly, the initial gains of agriculture were swiftly surpassed by the advance of the non-farming economy due to the marketization of enterprises and an explosion in foreign trade. While migration of labor likely promoted the agglomeration of industry, it appears that the benefits to industry from economies of scale generally outweighed the temptation of firms to migrate to regions abundant with labor, resources, and land. Under this view, we can further assume that between the two extremes of fully industrialized and non-industrialized regions, China had regions potentially poised to join either the agricultural or industrial "club." Thus, regions initially labelled agricultural may eventually embrace industry and vice versa. Considering the rapid industrialization of China, the scenario that initially agricultural regions industrialize appears to have played out far more often than instances of regional de-industrialization.

This paper considers the agricultural-industrial divide in explaining for growth rate differences among Chinese regions since the reform and opening-up policy was launched in 1978. Chinese agriculture is at the low end of the productivity spectrum, so we assume that areas dominated by agriculture tend to grow more slowly than areas devoted to industrial production. We take the initial share of the value of output in agriculture to that of industry as an indicator of industrialization, and using this indicator, we can delineate an agricultural-industrial divide that roughly resembles the east-west geographic divide of China's regions.

To estimate the convergence among regions, we apply panel unit root tests. Respecting Pesaran's (2007a) critique that first-generation panel unit root tests do not account for the cross-section dependency, we use a modified IPS test (Im et al. 2003) to account for single-factor cross-section dependencies (i.e. second-generation tests). Our first- and second-generation panel unit root tests reveal the evolution of differences in output and economic growth across regions. Convergence of incomes apparently occurs among China's industrialized regions, but not among predominantly agricultural regions. We find no evidence of income convergence between industrialized and agricultural regions.

Somewhat counter-intuitively, we find that agricultural regions on average grew slightly faster than regions initially classed as industrialized. To evaluate this, we examine those agricultural regions that experienced the steepest declines in the share of agriculture and

find that these regions on average grew faster than those that lagged in industrialization. In other words, regions that later took the industrial path appear to catch-up with their initially industrialized counterparts, which, for historical reasons, enjoyed a head-start before grand reform. The difference in the growth rates between newly industrialized regions and agricultural laggards seems tiny, just one percentage point per annum. Yet across thirty years, it has created a huge wedge between the average incomes of these regions.

Our findings are in line with empirical growth studies that find convergence within industrialized countries in OECD (e.g. Li and Papell, 1999;Strazicich et al., 2004). With regard to divergence in agriculture, Chen et al. (2008) report similar findings for China, while Zou and Shou (2007) report convergence within and between the developed and developing clubs. Our results support the technological catch-up hypothesis as industrialized regions exhibit convergence. On the other hand, our results also affirm the markedly sceptical findings of Lehmijoki and Pääkkönen (2009), who find insufficient demographic transition may cause poor countries to be been left. Paralleling these findings, our results suggest that regions left behind in industrialization may require special government policies to catch-up with industrialized regions. Appropriate policy here should be geared to promoting industrialization and providing incentives that raise agricultural productivity and promote industrialization of developmental stragglers.

The outline of the paper is as follows. Section 2 describes briefly the reforms in China and the evidence for provincial convergence in China. Section 3 presents the empirical results of this paper, while Section 4 discusses the findings.

2 Background

2.1 Evidence of economic growth and convergence in China

There is a vast literature on the growth in China, with the sources of the cross-provincial variations of economic growth receiving particular scrutiny. Li et al. (1998) estimate the Solow-Swan growth model for 29 Chinese regions between 1978 and 1995. They note lower population growth, greater openness to foreign countries, and increased investment in physical and human capital all contribute to growth. Moreover, they see a tendency for regional economies to converge. Evaluating a shorter time span, Chen and Feng (2000)

find that degree of privatization, access to higher education, and international trade lead to higher growth, while high rates of fertility and inflation, as well as the presence of state-owned enterprises, reduce growth rates among regions. They also find support for the convergence among Chinese regions. Kuo and Yang (2008) identify evidence for that knowledge capital, as well as international and regional technology spillovers and the ability of a region to absorb human capital have had a positive impact on Chinese regional economic growth.

Zou et al. (2008) apply a counterfactual econometric analysis to 28 Chinese regions during 1981-2004 to measure the effect of various factors contributing to economic growth. They find that factors such as infrastructure, human capital, and urbanization contribute significantly to provincial economic growth – and to provincial divergence, in particular. Using the same set of data, Zou and Zhou (2007) sort Chinese regions into developed or developing clubs according to each region's initial technology level. They find evidence of both convergence at the national level and growth convergence within clubs, with a higher rate of convergence within the developed club. Here, the impact of infrastructure on growth is somewhat paradoxical; it positively correlates with growth convergence at the national level and within the developed club, but correlates negatively with growth convergence in the developing club.

Maasoumi and Wang (2008) evaluate the properties (moments) of distributions of growth rates across regions. Implementing a cluster analysis for 28 regions that uses both pre- and post-reform data, they reject the hypothesis of nationwide convergence. Instead, they find evidence for small convergence clubs for both periods and suggest that convergence clubs cannot be characterized by such simple features as region or the extent of policy preference.

There is also some evidence for the cross-section dependency in terms of provincial spill-over effects in sectoral value-added. Xu (2002) decomposes provincial real value-added growth by sector into common national effects, industry-specific effects, and region-specific effects. The data shows that region-specific factors account for only a third of the variance of real output growth over the short run. China's coastal areas seem to follow the business cycle most closely, while the central region tends to follow the national growth cycle, due in part to spillover effects from the neighboring coastal region. Some other regions manifest countercyclical patterns. Their findings are confirmed by Brun et al. (2002).

2.2 Key reforms since 1978

2.2.1 Agriculture

Land, labor, capital (human and mechanical), and institutions are key factors in production. Ownership of land is a central issue in development. Not only is the land supply finite, but disputes over ownership of land can provoke revolutionary movements and major social upheavals. Galor et al. (2008) propose a model in which a high concentration of land ownership adversely affects the emergence of human-capital-promoting institutions (e.g. public schooling). Briefly, they argue that, due to the low degree of complementarity of land and education, landowners see fewer benefits from education reforms than the owners of capital. Thus, a land reform that sufficiently reduces the concentration of land ownership in the economy may expedite implementation of solid education policies and promote industrialization.

Ongoing rural reforms have vastly impacted Chinese agriculture. Households gained the right to use and occupy land, even as ownership remained with local collectives.[3] China's initial land allocations to families were based on household size or household labor supply, and contracts typically ran for 15 years. In 1993, land occupiers won the right to a further 30-year extension upon expiration of their original contract. Today, land use rights can be transferred under a will.

Since land itself cannot be owned by households, however, it cannot be used as loan collateral. This inability to use land as collateral makes it hard for the land occupier to borrow money to invest in the land. Thus, rural institutional arrangements act as a barrier to investment in agriculture and keep productivity at sub-optimal levels.[4] Brandt et al. (2002), in reviewing the extensive research on agriculture in China, identify several explanations for the slowing of productivity growth in the agricultural sectors. First, tenure insecurity discourages investment in agriculture. Second, institutional deficiencies of credit markets, the lack of land registration system, and an incomplete legal system limit any possibility of successful privatization. Third, the possibility to reallocate or rent out the land was rarely used during 1983-1996. When reallocation finally was applied, affected

[3] For details, see Han (2009) or Brandt et al. (2002)

[4] Ho and Spoor (2006) debate the institutional arrangements related to land markets in transition economies. They conclude that private land ownership is not essential for the effective functioning of the rural economy or for a land market.

households were rarely compensated for investments they had made before the state taking.

Ho and Lin (2003) note that the pervasive illegal use of land in rural areas creates extensive opportunities for corruption and that elucidation of land use rights is meaningless without proper enforcement. Guo (2001) cites evidence on land expropriation, whereby local leaders and the government appropriate land to establish village administration offices or private businesses. Such takings typically occurred without consultation with the affected villagers and without adequate compensation. Brandt et al. (2002) also point to evidence of unwillingness on the part of village leaders and local cadres to reallocate land among farmers.

2.2.2 Industry

Firm ownership represents a major reform for China's non-farming economy. Prior to 1978, private business was subject to strict regulation and most of the economy was state-run. Shulian (2000) examines four stages of reform in regulation of ownership. In 1978, individual ownership was acknowledged and granted lawful status. The period 1984-1987 saw the emergence of a private economy with companies hiring and government toleration of a widening variety of ownership structures. Between 1988 and 1997, the emphasis went to recognizing the right of private companies to compete with other economic sectors and China's opening to the global economy and foreign funding of Chinese enterprises. Property rights of state enterprises were transferred to local governments, giving local governments the right to retain earnings and an incentive to maximize the value of enterprises (Li 1997). The transfer of ownership broke the monopoly of state-owned enterprises (SOEs) by creating hundreds of firms under the control of local administrators. Gradual liberalization of market entry forced producers to become ever more competitive.

A second major reform was introduction of dual-track price system. Under this system, enterprises had to deliver a quota of products to be sold at an officially set price in exchange for access to inputs. Production in excess of the quota could be sold at prices determined by market forces. This system created an incentive to produce at levels above the quota. It also reduced political opposition to reforms, while causing new agency problems, incentives for transfer pricing, and new opportunities for official corruption.

The progress of reforms is clear from in enterprise statistics. Based on observations from 1978 to 1999 (the latest available), the number of non-state-owned enterprises in-

creased from 265,000 to 787,000. The share of gross output of non-state-owned enterprises increased from 22% in 1978 to 72% in 2006. While the earlier figures do not clearly document foreign-funded enterprises, their share from the total gross industrial output value in 2006 constituted 21% of the total. Li (1997) presents evidence that over 87% of total-factor productivity (TFP) growth in SOEs during 1980-1989 can be attributed to greater incentives, intensified product market competition, and improved factor allocation.

Reform of enterprises remains incomplete to this day thanks to some persisting stumbling blocks. Aram and Xiaoli (1991) point out that conflicting government objectives left enterprises confused over their roles. Aram and Xiaoli (1991) and Qian (1996) find that SOEs continue to face high agency and political costs. Wen (2004) presents stylized facts of Chinese enterprises that show a declining share of SOEs in industrial output and that domestic private enterprises are small compared to foreign-owned and collective-owned enterprises. Two highly critical observations emerge: many industries still suffer from excess capacity and many SOEs continue to post losses.

Scissors (2009) argues that China has little to show for its most recent decade of reform. His basic thesis that reform in China has come to a standstill (or even reversed) is bolstered by substantial evidence. First, price liberalization has been partly undone. The State Council now sets prices for all key services and for many products; exchange rate policy remains under the tight control of the People's Bank of China; and the state completely controls grain distribution, food prices, and the energy sector. Second, the trend to privatization has been replaced with re-nationalization or forms of state ownership masquerading as private business. Total state ownership is often diluted by the division of ownership into shares that are primarily held by the state. By Scissors' estimate, three-quarters of companies listed as domestic on Chinese stock exchanges are, in fact, state-owned. All core industries, including those with obvious strategic importance (e.g. power generation, telecommunications, construction, and finance) are de facto state-controlled. Third, he finds indications that recent reform legislation such as labor law and anti-monopoly law are being applied in ways that limit the activities of foreign firms.[5]

The World Bank Group's *Doing Business 2009* report ranked China 88 out of 181

[5] The Freedom House assigned China a status of 'Not Free' in its year 2009 survey. According to their report, the China is still among the world's most repressive regimes in terms of political freedoms and human rights.

countries. China received particularly poor marks in the categories of "Starting a Business" (151) and "Dealing With Construction Permits" (176). Registering a firm was found to take 40 days on average, while obtaining a construction permit took almost a year. The comparable OECD averages are 13 days and 162 days, respectively.

2.3 The opening-up policy and reforms affecting both the agricultural and industrial sectors

A generally acknowledged driver of Chinese growth today is the free flow of rural labor force between urban and rural areas. Indeed, as the labor force has shifted out of low-productivity agriculture to more productive industries, China has seen an overall increase in productivity.[6] Population statistics put the number of rural laborers at about 310 million in 1978 and just above 500 million in 2007. Thus, despite as shift of some 200 million of rural workers to non-farming industries, the oversupply of rural labor today is still on the order of 100 million (Han, 2009).

The policy of gradual opening to the world mainly took place between the early 1980s and China's 2001 WTO membership. During this period, the competitive emphasis shifted to trading firms and state monopolies were dismantled. The government abolished most quotas and import licenses, and reduced tariffs. Initially, preference was given to foreign-owned companies to spur investment in China. The opening-up policy largely succeeded; openness has grown from 18% in 1978 to 56% in 2003.[7] World Bank statistics, in turn, show that the volume of exports rose 30-fold from 1978 to 2006, while net FDI flows soared from $386 million in 1982 to $60 billion in 2006. Despite opening up, however, China's government continues to use policy tools such as tariffs to guide foreign trade flows.

Since reforms in agriculture and industry took place in stages with different timing of reforms, one would expect the agricultural and industrial sectors to follow different growth paths. Démurger et al. (2002) provide an extensive survey on geography, preferential economic policy, and regional development in China. The sequential economic reforms inaugurated in 1978 mainly benefitted the agricultural sector. In 1984, however, the state

[6] Migration mitigates the problem of differentiated development in two ways. First, the migrant workforce flows to regions and industries with higher productivity. Second, worker remittances sent home augment (at least, unofficially) to rural incomes.

[7] For details, see Penn World Tables 6.2.

began to relax restrictions on export activities, FDI, and private enterprises. The latter reforms mostly benefitted the coastal regions, which enjoyed better connections to overseas markets and greater degrees of industrialization. By the mid-1980s, non-coastal agricultural regions found themselves lagging further behind the more industrialized Manchurian regions and the coastal agricultural regions. Démurger et al. (2002) explain that China's interior regions, in addition to their geographic disadvantages, suffered from an overabundance of agricultural labor, stringent regulations on FDI and international trade, and a lack of access to capital.

To evaluate the relative growth prospects of the agricultural sector and the industrial sector, Cai et al. (2002) examine the impact of labor market distortions on regional disparity and economic growth in 29 Chinese regions during the first 20 years of reform. They compare labor productivity in agriculture and industry to demonstrate that labor market distortions hamper regional growth. In addition, there is conditional growth convergence within China. Evaluating regions during 1990-2003, Chen et al. (2008) find that technical progress has been largely responsible for productivity growth in agriculture and that provincial disparities in productivity growth have worsened over time.

3 The agriculture-industry divide and convergence

3.1 Evidence of conditional convergence

We draw our annual data on Chinese provincial incomes from the All China Data Center. Our data on real GDP per capita cover 22 provinces, five autonomous regions, and four municipalities (for purposes of discussion, we refer to all as provinces). Chongqing and Tibet are excluded from our data due to lack of observations. The data cover all years from 1978 to 2007.

We consider the share of agricultural output relative to industrial output as an indicator of the degree of industrialization of a region. Using a simple clustering technique, we partition our data into two clubs. We minimize the distance of each observation of a club from the club average, i.e. the sum of squared residuals is minimized using the regression tree analysis proposed by Durlauf and Johnson (1995).[8] While this divide is admittedly

[8] While some authors apply more complex techniques to uncover the number and size of clubs, the simplest version of the technique is adequate here.

simple, it seems to capture the essential differences among regions (see Appendix A). The first club largely contains the agricultural regions (N=14) in western and central China, while the second club mainly includes the coastal and central regions where production is dominated by industrial production (N=15). The unweighted average real growth per capita is 7% for the industrial club and 7.7% for the agricultural club. The differences in the average growth rates between the clubs are remarkably small.

To discern the cross-section dependency in the data, we perform two tests. Using the CD-test proposed by Pesaran (2007a), we obtain

$$CD = \sqrt{\frac{2T}{N\left(N-1\right)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\gamma}_{ij}\right), \tag{1}$$

where T and N are the number of observations in time and cross-sections, and $\hat{\gamma}_{ij}$ is the residual correlation between countries i and j, these residuals being obtained from individual ADF(p) regression. The test statistic is normally distributed with $N\left(0,1\right)$. The drawback here is that it lacks power when the population average pair-wise correlation tends to zero. Our second test, proposed by Breusch and Pagan (1980),

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\gamma}_{ij}^{2} \tag{2}$$

is based on $\chi^2_{N(N-1)/2}$ distribution. While this test is not adversely affected by the zero averages, it is likely to exhibit substantial size distortions when N is large and T is small.

Table 2 presents the test results for Club 1 (agricultural), Club 2 (industrial) and the complete dataset. These CD-tests for clubs find no evidence of cross-section dependency (nothing statistically significant at 5% level of significance), but suggests that cross-section dependency is present for the data as a whole. Since the test is biased when the average cross-section residual correlation tends to zero (apparently the case here), it is likely unreliable. The LM-test, however, is significant for all three datasets, indicating that cross-section dependency is present in our data. As we cannot clearly rule out the possibility of cross-section dependency, we estimate the second-generation unit root test and first-generation unit root tests known to be robust in the presence of a moderate cross-section dependency.[9]

To test for convergence, we estimate the following model:

[9] For details, see Pesaran (2007) and Lehmijoki and Pääkkönen (2009).

	Club 1	Club 2	Full Sample
$\hat{\gamma}$	-0.01	-0.03	0.02
N	14	15	29
$CD-test$	-0.61	-1.70	1.91
$LM-test$	567.1	593.0	2485.5
$d.f.$	91	105	406

Table 1: Descriptive statistics from Clubs 1–2.

$$\Delta\left(y_{i,t}-\bar{y}_t\right)=\alpha_i+\rho_i\left(y_{i,t-1}-\bar{y}_{t-1}\right)+\left(u_{i,t}-\bar{u}_t\right), \tag{3}$$

where $\bar{y}=\frac{1}{N}\sum_{i=1}^{N}y_{i,t}$ and $u_{i,t}$ is iid. We test the conditional convergence, whereby the unit root test includes a region-specific constant α_i allowing some heterogeneity in the growth model.[10]

Figure 1 in Appendix A presents the evolution of the average log output of Club 1, Club 2 and the Full Sample from 1978 to 2007. While it appears that all these three series are relatively smooth, there could be a break in the data in early 1990s, which may cause the unit root tests not to reject the false hypothesis of a unit root when the break is not accounted for. Unfortunately, this is not possible in panels, but we note that since the tests are applied for the de-meaned data, as suggested by equation (3), de-meaning should mitigate the problem if most of the series within a club exhibit same pattern and experience similar breaks. Using the Quandt-Andrews breakpoint test (Andrews, 1993) for individual series and then regressing the de-meaned output to its first lag, constant, and trend, we find that in four cases of 14 there seems a break present in Club 1. For Club 2, we find an apparent break in five of 15 regions (see Appendix B). We conclude that for most of the series de-meaning mitigates the problem of structural breaks.

Table 2 presents the results from the unit root tests. The results for Club 1 are worth noting as none of the unit root tests reject the null of non-stationarity (i.e. no support for the convergence hypothesis). The results for the Club 2 are different, since all the tests support the rejection of non-stationarity. We find evidence for the conditional convergence

[10] Pesaran's second-generation unit root test is based on IPS-test (CIPS, hereafter), whereby the unconditional convergence cannot be tested with it.

within industrialized regions. For the Full Sample, only Choi's inverse normal test suggests that non-stationarity should be rejected. The other two tests fail to reject the null.[11]

	Club 1		Club 2		Full Sample	
	test	p-value	test	p-value	test	p-value
IPS	0.76	0.79	-1.92	0.03	-1.08	0.14
Choi	31.77	0.28	44.24	0.05	86.58	0.01
CIPS	-1.44	0.89	-2.21	0.04	-1.61	0.78

Table 2: Unit root tests Clubs 1–2 and whole data.

Considering the rate of convergence, estimating equation (3) as a pooled fixed-effects model gives the average rate of convergence within Club 2. While this evidence is merely suggestive, we find that $\bar{\rho}$ equals -0.032, which is significant at the conventional 5% level of significance. At this rate, income differences will be halved from the original in 22 years, which is somewhat quicker than typically estimated $\bar{\rho}$ = -0.02, in the cross-section of countries. This fast phase, however, makes sense as there are no barriers to spill-overs in place within China as we observe in a cross-section of countries.

To summarize, we find strong evidence for conditional convergence among industrial regions, but no support for convergence among agricultural regions or the economy as a whole.

3.2 Decline in the value of agricultural output

While the gross value of output increased in both sectors from 1978 to 2007, the increase in the value of industrial output was approximately three times that of agriculture. Table 3 shows that the share of the agriculture to industry has decreased in all of the regions in China, with an average reduction of 55.3%. The decline has been more pronounced for the agricultural club (58.4%), since those regions that were already industrialized in 1978 have not been able to downsize the share of the agriculture as much as those less industrialized.

[11] We also tested for the presence of a breakpoint under the Zivot-Andrews unit root test (Zivot and Andrews, 1992). In the agricultural club, most individual series are stationary (the exceptions are Fujian, Jianxi, Hubei, Hunan, and Yunnan). In the industrial club, non-stationarity is even rarer (only Hebei, Heilongjiang, and Shandong). Most of these provinces do not experience the break, so the test lacks power. Of those data of Yunnan, Hebei and Heilongjian are stationary when a regular ADF-test is used.

Dividing the agricultural club to two according to the size of the decline in the share of agriculture, allows us to study whether the different trends in outputs have been caused by different phases and paces in industrialization. We split Club 1 to those that have downsized the share of agriculture more than the club average (Inner Mongolia, Zhejiang, Anhui, Fujian, Jiangxi, Henan, and Hainan) and to those that have downsized the share of agriculture less than the club average (Hubei, Hunan, Guangxi, Sichuan, Yunnan, and Xinjiang). The average growth rate is 8.1% in the first group and 7.1% in the second group. The club average is 7.7%.[12] While this difference seems small, a one percentage point difference over thirty years creates a wedge in the incomes as the regions that have grown faster are now on average 10.3 times richer than in 1978, while those that have grown slower are now only 7.8 times richer than in 1978. We take this as an indication that industrialization promotes catch-up.

4 Conclusions

The 1978 economic reforms have boosted the prosperity of hundreds of millions of Chinese. Even so, and despite phenomenal economic growth, income disparity increased for most of the past three decades.

Our examination found that initially industrialized regions experienced income convergence with regions that later took the industrial path, but no evidence for convergence within agricultural regions or at the national level. Some agricultural regions, however, made large income gains as their shares of agricultural production decreased and they became more industrialized. As has been well documented, excess labor in rural areas migrated to cities and the industrial sector, and thereby increased total provincial productivity. Moreover, several newly industrialized regions have grown faster than initially industrialized regions as the initially industrialized appear to have exhausted most of the benefits of their head start before the grand reform. This finding strengthens the argument that such provincial catch-up is due to a deliberate choice of the industrial path.

Agricultural regions that have experienced the lowest growth may be amenable to several

[12] To put it the other way around, if we concentrate on those agricultural regions that have experienced higher-than-average growth, we find that they have downsized the agriculture more than others in their club.

remedies. Above all, the government needs to deal with institutional shortcomings, as institutions help to promote the productivity by increasing the possibilities and incentives to invest in land and education. Considering China's current policy mix, we can say the government is on the right track in promoting the shift away from agriculture to more productive sectors and regions.

A Clubs

Table 3 describes that data for 29 economic regions, municipalities, and provinces in the sample. Club 1 is the agricultural club. Club 2 is the industrial club. As industrial production increases, its importance in China's production structure rises. All provices become more industrialized through higher industrial value-added. Growth rates are real growth per capita averages from 1978 to 2007.

Club 1				Club 2			
	Ratio of agriculture (%)		Growth		Ratio of agriculture (%)		Growth
Region	1978	2007	78-07	Region	1978	2007	78-07
I. Mongolia	53.5	22.0	10.1	Beijing	12.9	2.8	7.8
Zhejiang	49.7	4.4	8.7	Tianjin	4.3	2.4	6.0
Anhui	66.4	26.1	6.4	Hebei	34.6	18.0	9.0
Fujian	57.5	13.5	10.5	Shanxi	14.5	6.4	8.4
Jiangxi	67.0	23.0	8.2	Liaoning	13.3	11.7	5.5
Henan	55.8	19.0	10.1	Jilin	33.5	21.0	6.2
Hubei	50.5	23.9	8.3	Heilongjiang	28.7	27.7	6.8
Hunan	57.0	31.3	7.9	Shanghai	3.6	1.1	4.1
Guangxi	66.0	44.2	6.3	Jiangsu	31.3	5.7	10.0
Hainan	133.3	54.7	5.3	Shandong	34.4	9.6	8.6
Sichuan	60.7	30.6	5.8	Guangdong	41.6	5.1	7.7
Guizhou	66.6	27.7	5.5	Shaanxi	37.6	17.6	8.2
Yunnan	72.2	31.0	5.9	Gansu	29.0	21.2	4.6
Xinjiang	56.4	32.3	8.4	Ningxia	34.7	14.8	5.5
				Qinghai	44.1	17.1	6.6
Average growth			7.7%	Average growth			7.0%

Table 3: Clubs, their shares of the value of agricultural output to that of industrial 1978 and 2007, and economic growth

Figure 1 illustrates the average log output performance in both clubs and the full sample. All averages appear to move in tandem, whereby the income differences between the clubs has not decreased. Also, the regions seem to share a common break(s) in early 1990s.

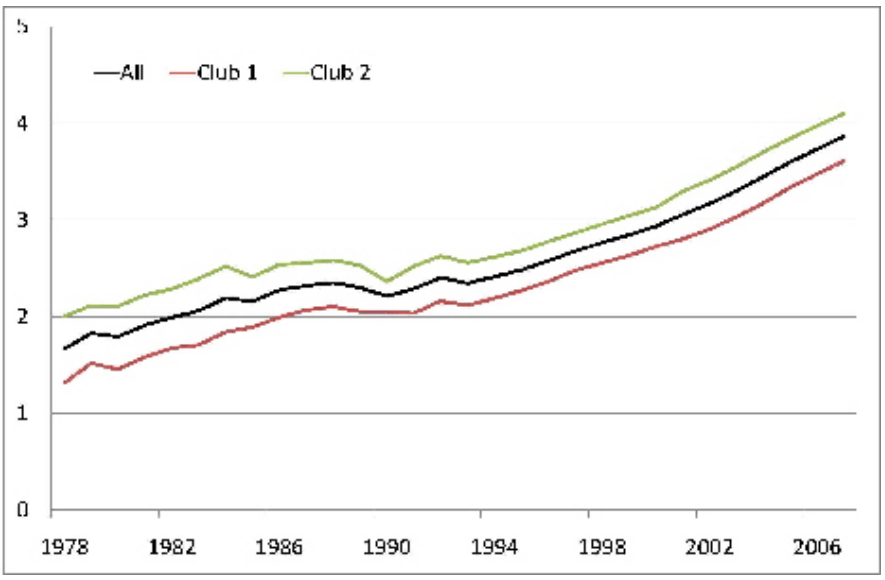

Figure 1: Average evolution of outputs in Club 1, Club 2 and Whole data.

B Break points, unit roots, and rate of convergence

Table 4 presents the results of a Quandt-Andrews breakpoint test in the presence and absence of trends, as well as the Zivot-Andrews unit root test for individual series. For the sake of simplicity, the breakpoint tests we report here only consider whether the test statistic is statistically significant or not, i.e. whether the null of no trend can be rejected in the favor of a break in the series. For the unit root tests, we only report if we can reject the null of the unit root.

Club 1				Club 2			
	breakpoint test		individual		breakpoint test		individual
Region	no trend	trend	unit root	Region	no trend	trend	unit root
I. Mongolia	5%	n.s.	reject	Beijing	n.s.	5%	reject
Zhejiang	n.s.	n.s.	reject	Tianjin	n.s.	1%	reject
Anhui	n.s.	1%	reject	Hebei	n.s.	n.s.	not reject
Fujian	5%	n.s.	not reject	Shanxi	n.s.	n.s.	reject
Jiangxi	n.s.	n.s.	not reject	Liaoning	1%	n.s.	reject
Henan	n.s.	n.s.	reject	Jilin	1%	1%	reject
Hubei	n.s.	n.s.	not reject	Heilongjiang	n.s.	n.s.	not reject
Hunan	5%	n.s.	reject	Shanghai	1%	5%	reject
Guangxi	1%	n.s.	reject	Jiangsu	n.s.	n.s.	reject
Hainan	1%	1%	reject	Shandong	n.s.	n.s.	not reject
Sichuan	1%	1%	reject	Guangdong	5%	n.s.	reject
Guizhou	1%	1%	reject	Shaanxi	n.s.	n.s.	reject
Yunnan	n.s.	n.s.	not reject	Gansu	5%	1%	reject
Xinjiang	n.s.	n.s.	reject	Ningxia	1%	n.s.	reject
				Qinghai	n.s.	n.s.	reject

Table 4: Results from the break point tests and individual unit root tests when break points are allowed

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