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ESSAYS ON REGIONAL DEVELOPMENT AND INTERNATIONALISATION

Presentata da:

Barbara Barone

Coordinatore Dottorato

Roberto Fanfani

Relatore

Roberto Fanfani

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ABSTRACT

This collection of essays examines various aspects of regional development and the issues of internationalization.
The first essay investigates the implications of the impressive growth of China from a rural-urban perspective and addresses the topic of convergence in China by employing a non-parametrical approach to study the distribution dynamics of per capita income at province, rural and urban levels. To better understand the degree of inequality characterizing China and the long-term predictions of convergence or divergence of its different territorial aggregations, the second essay formulates a composite indicator of Regional Development (RDI) to benchmark development at province and sub-province level. The RDI goes beyond the uni-dimensional concept of development, generally proxied by the GDP per capita, and gives attention to the rural-urban dimension. The third essay "Internationalization and Trade Specialization in Italy. The role of China in the international intra-firm trade of the Italian regions" - deals with another aspect of regional economic development: the progressive de-industrialisation and de-localization of the local production. This essay looks at the trade specialization of selected Italian regions (those regions specialized in manufacturing) and the fragmentation of the local production on a global scale. China represents in this context an important stakeholder and the paper documents the importance of this country in the regional intra-firm trade.

ESSAY I
CONVERGENCE IN CHINA

Rural-Urban and Spatial Dynamics

"China is now suffering from poverty, not from unequal distribution of wealth".
Sun Yat-sen - Capital and the State (1924)

Abstract

There is one China we all know that has grown exponentially since the adoption of the market reforms in 1978, maintaining in the last years an average annual growth rate of about 9%. This success was sustained by specific policies aiming at creating a two-speed system favoring the coastal and urban areas, thus to attract foreign investments and boost industrialization and trade. This paper investigates the implications of this enormous growth from a rural-urban perspective and addresses the topic of convergence in China by employing a non-parametrical approach to study the distribution dynamics of per capita income at province, rural and urban levels.

Introduction

China has experience impressive growth rates since the adoption of the market reforms in 1978. In the first section I will present the nature of the Chinese development, accounting for spatial differences and policy changes across time. In the second section I will define the theoretical framework and the methods to perform this analysis of convergence. The third section will discuss some stylized facts on regional inequality and convergence in China and then look at the distribution dynamics of per capita income at province, rural and urban level. This analysis will infer on the presence of a nation-wide process of convergence or alternatively the presence of clubs of convergence. A narrative approach will be also employed to discuss changes occurred in spatial distribution of per capita income the in aftermaths of the China's WTO accession. Section IV concludes.

1. China's reform-driven development

The People's Republic of China was an equal society at birth, which turned highly unequal at mature age. At the time of Mao's central planning rural areas played a determinant role for the stability and the self-sufficiency of the whole country. In later times, when the Chinese government abandoned the full-central planning and opened-up the economy to the rest of the world, the gains did not reach all part of the country equally and growing inequalities appeared between rural and urban areas as well as across provinces. This intended or unintended effect of the impressive economic performance of China reveals one face of the "problematic development" of this country, which is worth investigating (Pei, 2006; Bernstein, 2007;Lee and Selden, 2007).

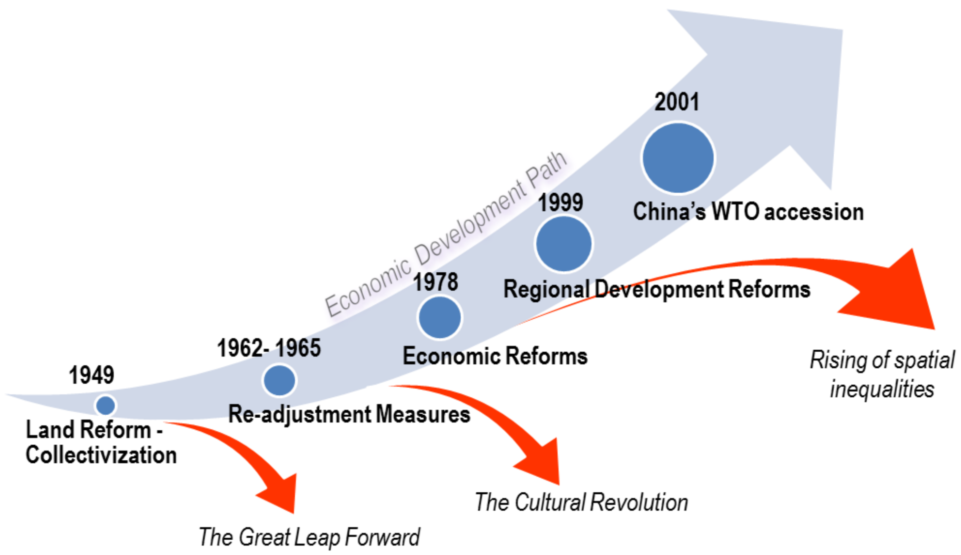
In this section I present the nature of the Chinese development, accounting for spatial differences and policy changes across time. I will describe the major economic events and reforms, characterizing the modern economic history of China and affecting its development. This brief historical review offers useful information for the understanding of the results obtained in the remainder of the paper.

1. The modern economic history and reforms of China

Far more than in any other economy, China's economic development has been "reform-driven", being shaped by the policy making of the last sixty years. With the establishment of the People's Republic of China in 1949, the government took over the private sector and ruled out the market mechanism, taking full control on prices, wages, production, land and natural resources. It is only with the economic reforms of 1978 that the State started to step back, gradually shifting the country from a planned economic structure to a market-based socialist economy. Over this whole period, the role of the authorities has been determinant; on one hand they had to manage the supply and demand coming from an increasingly larger population, meeting the objectives of food security and self-sufficiency; on the other hand, they put forward policies and reforms supporting an unprecedented economic growth.

The development path followed by China so far has been exponential; nevertheless, on several occasions, the economy failed to respond to the challenging objectives imposed by the government and deviated from the steady growth path on which it was set. In Fig.1 it is represented a stylized picture of the economic development path followed by China. In this representation, some "milestone reforms" were recognized to enable and foster the development of the Chinese economy, while, along the way, some "deviating factors" undermined and challenged this economic growth.

Figure 1 -China's Development Path: the "milestone reforms" for growth and the "deviating factors"



Source: Author's elaboration

The ***"milestone reforms"*** have been those policy interventions fostering economic growth. They represent real milestones in the process of economic development of China, given the "multiplier effect" they had on the whole economy. The ***"deviating factors"*** are those major events disrupting the socio-economic stability of the country with drawbacks on all sectors of the economy.

The first important "milestone reform" was the ***Land Reform*** (1949). The process of collectivization of the land in the countryside and the taking over of the private enterprises coupled with massive investments (Lei, Yao 2009) engendered a rapid economic growth in the country. The "semi-feudal" agriculture was turned into a "soviet-style collective agriculture", where farmers were organized in People's Communes obeying to the production decision established by the central government in the production plan. This shift increased both agricultural output and the living standards of the rural residents (Lei, Yao 2009).

Despite the initial success of the newly established system, the central planning soon revealed its limitations and failures. In 1958 the government launched a high-speed growth programme -*The Great Leap Forward* – aspiring at increasing the pace of growth and the process of catching up of China with the Western economies. This package of interventions imposed to the communes a higher economic performance and targets to be met, setting up for instance unreasonable output quotas to be produced. In this context, the limited presence of free markets in rural areas was soon ended and farmers lost their pale right to retain output for their personal use. On the side of the industrial development, during this period a strong emphasis was put on the heavy industry and in the rural areas the communes were required to set up furnaces for the production of iron. The Great Leap Forward acted as a deviating factor for the Chinese development, dragging down the economy into a deep recession. A huge famine broke out across the nation and over 25 million people died (Lei, Yao 2009).

The ***Re-adjustment Measures*** taken during the 1962-1965 period revitalized the economy. They consisted in an increase of autonomy and a set of incentives to boost the production in both urban and rural areas. The over demanding production targets were abolished, while managers gained some minor discretion on the production process. In the countryside the retained production from farmers was restored and it is argued by Lei and Yao (2009) that even some form of contract farming system was set up in some regions as part of the production incentives (Lei, YAO 2009:17).

In 1966 the impulse coming from these reforms was stopped by the breaking out of ***The Cultural Revolution***. Mao Zedong, the leader of the Communist Party decided to shape the society on the ideals of socialism which had to be spread everywhere around the country. This movement had its hardest impact on education. People dropped out of school in order to dedicate themselves to manual work and farming. Despite the increasing input into the farming sector, the output production steadily decreased pushing up prices for cotton, rice and other products. Also transportation was affected since trains and trucks were confiscated by the authorities and employed for carrying the young Red Guards around the country to spread the ideology mainly through violence and control the nation (Worden, Matles Savada, Dolan 1987). The political instability disrupted directly and indirectly the economic life of the country and the recovery could initiate only after Mao's death in 1976.

1978 is a real turning point in the economic history of China. The set of ***Economic Reforms*** (see Annex I) introduced from this moment onwards led to impressive changes in the Chinese economic structure as well as in its growth. In the pursuit of an industrial development strategy (Lin, Cai, Li 1996), the country's leader Deng Xiaoping put forward a series of interventions aiming at re-thinking China's development path and catching up the industrial gap with the most developed countries with which China had reestablished commercial and international relations – the most important, Japan and the US. The economic reforms put forward a gradual transition of the Chinese economy from the central-planning to the market-base socialism. Under this new regime, economic growth boomed at unprecedented rates - over 9% per year in the past three decades (Lei and Yao 2009) - and living standards soared. In order to smooth the transition and to enable the population and the whole system to accept changes, interventions were phased out. The most radical measures included the dismantling of the people's communes, the setting up of a land-lease system, some measures at support of foreign trade and Foreign Direct Investment and the bourgeoning of the non-state sector and of the "Township and village enterprises" (TVEs) in the rural areas.

Since the 1980s, development in China has gone through a ***Rising of Spatial Inequalities*** between rural and urban areas as well as across provinces (Fan and Sun 2008; Xu and Zou 2000; Maasoumi and Le Wang 2006). Urban income for instance was estimated to be roughly three times larger than the rural equivalent in 1995 (USDA 2009). This phenomenon has engendered massive migration to the coastal provinces and urban areas and threatened the social and political instability of the country (Fan and Sun 2008). In explaining the widening gap between rural and urban areas and across provinces, traces of inequalities are to be recognized in the earlier setting of the People's Republic of China. The *Hukou* - Household Registration System- in place since 1958 set up a differentiated regime for rural and urban residents, making compulsory the registration of households to either the rural or the urban account and restricting the mobility to the urban areas. This system was set up to fulfill the objective of securing enough agriculture production in rural areas as well as limiting congestion in the cities. According to the Hukou, rural residents were required to meet harsh entry conditions in order to be able to migrate to the urban areas. In addition, in the urban areas a rationing system was in place and food, housing, schooling, healthcare and job provisions were bounded to the registration to an urban account; for these reasons illegal migration was nearly inexistent. With the setting up of the market-based economy, it then became possible to find a job outside SOEs and to purchase food and services at market price; it is in this changed context, that migration from rural to urban areas occurred, causing inequality to rise also within the urban areas.

The steep rise of spatial inequality has a strong connection with the implementation of the economic reforms (Heshmati 2004; Kanbur and Zhang 2003). The Chinese government itself recognized its own responsibility in the unequal development of the country asserting that:

"(…)since the adoption of reforms and open door policies, we have encouraged some regions to develop faster and get richer, advocated that the richer should act as a model for and help the poor. Each region has had immense economic development and the people's standard of living has had great improvement. But for some reasons, regional economic inequalities have

widened somewhat"[1] (People's Daily Overseas Edition, Oct. 5, 1995, p4 in Pedroni and Yao 2002). Indeed, the economic reforms implemented an "urban-biased" development strategy. This favored the industrial development in urban areas and in targeted coastal and development areas, thus generating a divide along the costal-interior axis. Furthermore, policy interventions on price guaranteed a higher income and profits to urban residents. Explicit and implicit fees and taxes were imposed to the farmers until the late 1990s, which on one side were justified by the necessity to fund the basic services in the countryside, on the other hand aimed at guaranteeing low prices for the supply of food (i.e. the price paid per grain quota delivered to the marketing State bureaus was lower than the market price -USDA 2009) and labor to the urban economy.

Aware of the importance of narrowing the rural-urban wealth gap in order to foster the economic development and secure the stability of the whole country, the government has approved since 1995 a series of ***Regional Development Reforms***. These measures aimed at improving life conditions in the countryside both in economic and social terms. Premier Zhu Rongji stated in 2000 that: *every possible means should be adopted to increase the income of farmers because this concerns both the development of agriculture and rural areas and the development of the economy as a whole*[2]. Together with income, the rural development programs targeted the improvement of the rural infrastructure - funding projects for the construction of rural roads, irrigation facilities and schools – and the rural welfare assistance – launching a new rural cooperative health care system, some worker training programs, a plan of support for elderly and low-income households, etc.

The speed of the rural reforms gained momentum in 2003 when the new government declared its goal was the foundation of a "new socialist countryside". Each year since then, China's State Council initiated a wide array of programs and plans to improve incomes and living standards in the

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[1] excerpt of the document "Proposals by the Central Committee of the Chinese Communist Party on the 'Ninth Five Year' Plan of National Economic and Social Development and Foreward Target for Year 2010" passed on September 28, 1995

[2] Premier Zhu Rongji's Explanation of 10th Five-Year Plan Drafting - "Look into the next five years " October 9 - 11/ 2000, Beijing. http://www.china.org.cn/e-15/15-3-g/15-3-g-1.htm (9/01/2012)

countryside (USDA 2009; Gale, Lohmar, and Tuan, 2005). In addition, the government adopted a tailored approach to some critical areas. In 1999 it launched the Western strategy at support for the poorer provinces of the western region (Maasoumi and Le Wang 2006). In 2004 it promoted economic growth in the Pearl River Delta region and the integration of wealthy and less developed provinces of the southern and southwestern China (Yeung, 2005; Fan and Sun 2008).

Despite the efforts of the government to narrow the urban-rural income gap, some argue that these policies have fallen short (USDA 2009; Keliang Prosterman 2007). Indeed, the urban-development bias still exists today (Fang, Zhang and Fan 2002) and life in the rural and urban areas differs for a number of factors:

1) *Mobility*. The *Hukou* is still in place in China and visible and invisible restrictions hamper the free movement of labor from rural to urban areas (Fan, Fang, Zhang (2002)). Now it has become possible for migrants to obtain food and lodging on a market basis in urban areas, however unregistered migrants (including illegal and temporary migrants) lack access to schooling for children, state-run healthcare and other urban services (Jian, Sachs, Warner 1996); these have to be considered informal limitations to perfect mobility of labor across the country.
2) *Employment*. Land is the most important asset of the rural economy. In China it is collectively owned and farmers are allocated land-use rights from the village according to the size of their household. Land rights are temporary, but the duration of the lease has increased over time. Since 1993 it has been set at 30 years. Long-term investments, agricultural productivity and therefore the achievement of higher farmers' income depend on the farmers' security of their own land rights, which is still a critical issue.
3) *Schooling. G*overnment spends more in urban than rural education (Fan, Fang, Zhang (2002)). University admission scores are higher for rural students (Fan, Fang, Zhang (2002)). As consequence urban households have a much higher average education level and higher returns on education (OECD 2010c).

4) *Healthcare and welfare assistance.* According to Sicular et al. (2007) the estimates for pension and social assistance in rural and urban areas are much different. Rural residents have for instance a working life some nine years longer than urban residents (OECD 2010c:146). So far, attempts to build successful rural pension schemes have failed to achieve the expected results (OECD 2010c).

China's WTO accession in 2001 strongly contributed to the steady economic growth of the country, as stated in the concluding remarks of the WTO Trade Policy Review Body's meeting in 2008[3]. Nevertheless, the further integration of China into the Global Economy hasn't been able to compensate the unequal regional development and the gap between rural and urban areas; perhaps, it has made it worse. There is a heated debate in the literature on the effects of globalization on inequality, with a strand supporting the view that trade increases differentials in returns to education and skills and the marginalization of disadvantaged groups and regions (Stiglitz 1998; Hurrell and Woods 2000); while other authors stress the power of liberalization in increasing productivity and specialization thus reducing income gaps among countries (Srinivasan and Bhagwati 1999; Ben-David 1993). A blurred picture comes also from the studies on the effects of FDI on the domestic economy. Some studies suggested that FDI boost growth; this, being the case for China, where foreign firms have been found to contribute for more than 40% of China's economic growth between 2003 and 2004 (Whalley and Xin 2006). On the other side, findings support the view that FDI might increase wage differentials between foreign and domestic firms as well as have a detrimental effect on the skill composition of the enterprises; foreign enterprises in China have been found to be more skill-intensive than the private and the collectively-owned enterprises (Chen, Ge, Lai 2011). In preparation to the WTO accession China issued new laws and regulations concerning service trade, legal services, telecommunications, financial institutions, insurance, audio and video products, and tourism, etc. Laws regarding entry of foreign sales companies and joint ventures of stock exchange have been withdrawn. Also, measures have been taken to ensure

[3] http://www.wto.org/english/tratop_e/tpr_e/tp330_e.htm

compliance with rules of the WTO on intellectual property, foreign investment, and information transmission (Wan, Lu, Chen 2007).

2. Theoretical Framework for the Analysis of Regional Convergence

The blurred picture coming from the analysis of the reforms implemented by the Chinese government raises a number of questions regarding the nature and the evolution of the spatial disparities in China. A first question to be investigated is whether regional inequalities in income per capita have been growing over time, or alternatively a closing gap of inequalities is revealing a process of convergence within the country.

A second research question deals instead with the progressive opening up of the Chinese economy and whether this influenced the regional development and convergence. Let's discuss our two investigation hypothesis separately.

2.1. On the existence of a *convergence* process within China. Are regional inequalities growing over time, or are the poorer provinces catching up with the richer ones?

The term *convergence* encompasses a number of concepts which must be spell out. Looking at convergence across different countries or regions implies the interest in comparing a situation at an initial time *t* and the one at time *t+s*.

One of the crucial debates in the growth literature has been whether or not countries with lower initial per capita level exhibit higher growth rates than the richer counterpart. The process of catching-up of the poorer economies with the richer ones goes under the name of *β-convergence*.

The origin of this concept traces back to the neo-classical Solow-Swan model (Solow 1956; Swan 1956).According to it, the functioning of an economy is described by a standard production function (3) with decreasing returns to capital and constant returns to scale.

$$Y = \mathrm{K}_t^{\alpha}\mathrm{A}_t\mathrm{L}_t^{1-\alpha} \qquad (1)$$

where Y is the real output, K is the stock of physical capital, L is labor and A is the level of technology.

L and A are exogenous and supposed to grow respectively at rates *n* and *g*. The net increment of K results instead from the difference between the fraction of output invested *s* and the rate of depreciation of the capital *δK*.

$$\frac{\mathrm{dK_t}}{\mathrm{d_t}} = \mathrm{sY_t} \text{-} \ \delta\mathrm{K_t} \qquad (2)$$

Defining k = K/AL (unit of capital-per effective unit of labor) and y = Y/AL the level of output per effective unit of labor, we can derive

$$\frac{dk_{\mathrm{t}}}{d_t} = sy_{\mathrm{t}} \text{-} \ (n+g+\delta)k_{\mathrm{t}} \qquad (3)$$

Since the production function in the intensive form is

$$y_t = k_t^{\alpha} \qquad (4)$$

we obtain

$$\frac{dk_t}{d_t} = sk_t^{\alpha} - (n+g+\delta)k_t \tag{5}$$

To find the steady-state level of the capital per effective labor, k^*, we set eq.(5) equal to zero and solving for k we get

$$sk_t^{\alpha} = (n+g+\delta)k_t \tag{6}$$

Dividing both members for k we find that

$$k^* = [s/(n+g+\delta)]^{\frac{1}{1-\alpha}} \tag{7}$$

We then find the steady-state output per capita Y* by substituting eq.(7) to the production function and taking the log

$$ln\left[\frac{Y_t}{L_t}\right]^* = lnA_0 + gt + \frac{\alpha}{1-\alpha}ln(s) +$$

$$-\frac{\alpha}{1-\alpha}ln(n+g+\delta) \tag{8}$$

In the long run the model predicts that all economies will reach a steady state where the *growth rate* will be constant and determined by the rate of technological progress (g), which is set exogenous in the model. The *level* of steady state per capita output instead is determined by the saving rate (s) and population growth rate (n); both s and g are exogenous and influence in opposite way the long run level of per capita income. In the case of s, the higher is the rate of saving the higher will be the level of per capita income in the long run. Oppositely, the higher is the population growth rate n the lower will be the steady-state per capita income. The long run economic equilibrium of a country – the steady state- is therefore determined by the population growth rate, the savings rate and the technological progress. When a country is below the steady-state level – thus having a lower stock of capital per labor - will enjoy higher marginal returns to capital and grow faster than richer countries. This process makes that all countries in the long run will then converge to the same level and rate of growth of the per capita income.

This hypothesis, known as absolute convergence, has been criticized especially by the endogenous growth theorists (Romer 1989), who stressed the empirical evidence of the persistence of the differences in income levels and growth rates across countries. In particular, the endogenous growth models departed from the main neoclassical paradigm of decreasing marginal returns to capital and tried to explain the differences in the long-run growth rates and the determinants of the technological progress. One strand of endogenous models stressed the role played by human capital and innovation in explaining technological progress and persistent growth paths.

In response to the critics moved to the concept of absolute convergence, Barro (1989) and Barro and Sala-i-Martin (1992) reinterpreted the Solow paradigm by relaxing the hypothesis of the existence of a unique steady-state towards which all economies are moving. Empirical evidence of convergence was then found among countries that shared the same fundamentals (preferences, technology, institutions, economic structure etc.), giving birth to the concept of conditional convergence. In this updated view, the process of convergence in income growth rate is temporarily dependent on the initial level of the income per capita and on the presence of some “conditioning” factors that determine the long-run steady state such as for instance the saving rate, population growth, human capital and a bunch of several other variables that have been found significant by the vast empirical literature on growth. Mankiw, Romer, Weil (1992) tested the Solow model on a larger set of countries and came to the conclusions that while the predictions of the Solow growth model regarding the directions of the impact of saving and population growth rates on income were right, the predicted magnitudes were not (Mankiw, Romer, Weil 1992: 408). Their conclusion was that an important variable had been omitted by the model: the human capital. For this reason they specified the Augmented-Solow model by including human capital as a form of capital inside the neoclassical production function.

According to the conditional convergence hypothesis similar economies move towards the same steady state, therefore to find evidence of convergence, there are two solutions: 1) to restrict the analysis to similar group of countries; 2) to identify those structural differences which determine the presence of multiple steady states in a cross-section of countries and control for that. Indeed, in the empirical literature evidence of absolute convergence has been found when the analysis targeted a homogeneous group of countries such as the US states or the European regions (Barro and Sala-i-Martin (1991), the Japanese prefectures (Sala-i-Martin 1996); the Australian states and New Zealand (Cashin 1995).

A third type of convergence identified by the literature is the *club-convergence*, according to which countries with similar initial conditions tend to cluster and have a similar long-run behaviors. It would seem from this definition that there is an overlapping of concepts between the *conditional* and the *club-convergence*, which indeed sometimes have caused a certain degree of confusion. To clarify this point is important to draw the main distinction between the two. Conditional convergence assumes that it is possible to find a convergence process across countries with different structural parameters, once the effect of those differences has been neutralized. The hypothesis of club convergence instead highlights the presence of multiple steady states, towards which countries belonging to the same "club" will converge. In this case, the presence of convergence means that countries characterized by similar initial conditions in the long-run converge to each other; simply put, rich countries will converge within their group as well as poor countries will do in their group, giving way to a phenomenon of polarization.

The possibility of the co-existence of multiple steady states, and therefore of parallel growth paths within a group of countries or regions taken for analysis, raises some methodological concerns. Indeed, it signals the necessity to depart from parametrical methods that synthetize in one parameter all the dynamics affecting the evolution of the income per capita distribution in a time-interval. Indeed, looking at the distribution dynamics would allow to inferring on the mobility, polarization and stratification of the distribution.

As pointed out by Quah (1993) the *β-convergence* does not allow one to infer on whether cross-country income differences at two points in time have decreased. On the contrary, *β-convergence* only represents an average behavior within the cross-section of countries, where the poorer ones grow at an average growth rate higher than the richer ones. Moreover the *β* parameter estimated in a number of studies that assessed very different cross-section of countries showed a tendency to assume a value around the 2%[4]. The presence of *β-convergence* does not guarantee that the gap between the rich and the poor has reduced over time. If our interest is to reveal whether or not this phenomenon has occurred, the focus of our analysis should rather be the distribution of the per capita income and at the decline of the variance σ^2 over time.

Since it has been proved that *β-convergence* alone does not imply *σ-convergence,* while the contrary is true we will start our analysis of convergence by looking at the *σ-convergence.*

The static analysis of the variance, it is however not much revealing of the substantial intra-distribution dynamics, characterized by crisscrossing and leap-frogging phenomena (Quah 1996). Although σ-convergence offers valuable insights on the convergence in distribution of the variable of interest, this type of analysis only takes into consideration the variance at two points fixed in time. It does not provide information on the dynamic ruling the evolution of the variance neither gives an idea of the heterogeneous behavior of the observations within the distribution. In a case of perfect reversion of the rich with the poor countries between time t and time $t+s$, σ^2 stays the same. This extreme and unrealistic example highlights the importance to understand the intra-distribution dynamics in order to infer on the convergence across different units.

In paragraph 2.3.2 I will present the theory of Quah and explain his approach to the distribution dynamics that relies on the use of the *Stochastic Kernel Operator*. This estimator allows to modeling the evolution of the income per capita as a one-stage Markov process, thus describing the law of movement for the entire distribution during the period under analysis. This method is then applied insect. III for testing the distribution dynamics of the per capita income of the Chinese provinces.

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[4]The starting point of the Quah's discussion is then if one should believe in this uniform 2% convergence-rate estimated within different environments or instead one should question the validity of the estimator and look for more "mechanical" econometric-based explanations of this regularity. For a complete discussion on this pointrefer to Quah (1995).

2.2. How the opening up of the China to the international economy has affected its internal dynamics of convergence?

Since 1978 China has undergone a series of gradual market reforms which have been implemented at different speed by the different provinces. It is difficult to draw some conclusions specifically related to the impact of the opening up of China on the internal dynamics of convergence and regional inequalities without taking a pre-reform – post-reform approach. However, the literature has widely documented this shift and a study on this topic would provide no further contribution. My choice instead is to infer on the most recent developments of China and the impact of the further opening-up embraced through the accession to the WTO. Indeed This event has speed up the implementation of some reforms (namely those related to the price controls) and boosted both trade and FDI flows. The impact on the spatial convergence-divergence dynamics of China might have been twofold. On one side the WTO accession might have further exacerbated the disparities between rural and urban areas, since the latter are those benefiting the most from a further shift towards perfect market competition, enhancing the efficiency of the private industrial sector. On the other side, spill-over and export-dragging effects could have boosted both rural and urban living conditions.

For this analysis I opted for a narrative approach and forcefully split the data sample into two sub-periods, considering as thresholdthe year of 2001 –the year of China's accession to the WTO. The hypothesis to be tested is that *2001* has been a structural break in the economic history of the Chinese provinces, with pervasive effects both on the regional growth and on the convergence process. To test this hypothesis I first carried out a convergence analysis for the 1996-2009 period and then for the two sub-periods 1996-2001 and 2001-2009. For the analysis I used the non-parametrical approach as it is the most suitable to identify changes occurred within the distribution. Given the degree of discretionality in splitting the sample at 2001, future research could further investigate the year of the structural break, letting the data determine endogenously this point. The pre-accession years as well the immediate post-accession have the potential to be appropriate structural break points.

2.3 Methodology

There is a range of methods to test the hypothesis of convergence within a group of countries. The choice of the appropriate one strictly depends on the interest of the investigation. The objective of this paper is to look at the distribution of the wealth across the Chinese provinces and whether the spatial inequalities have reduced over time. For this reason, this analysis will target the convergence on distribution and the distribution dynamics, testing for the presence of sigma-convergence (par. 2.3.1) and the shape of the spatial distribution of the per capita income in China (par. 2.3.2).

2.3.1 Sigma-convergence

The central hypothesis of the *σ-convergence* is that

$$\sigma^2_{\log y,t} - \sigma^2_{\log y,t+s} > 0 \quad (9)$$

As pointed out by different authors (Barro, Sala-i-Martin 1995; Lichtenberg 1994, Quah 1995; Bernard and Durlauf,1996; Young et al. 2004) while the presence of *σ-convergence* implies a process of mean-reversion (*β-convergence*), the contrary it is not true. To see why, let's follow the Lichtenberg's demonstration and take a general convergence regression equation

$$y_1 - y_0 = \beta y_0 + u \quad (10)$$

and let's rewrite this equation as

$$y_1 = (1+\beta)y_0 + u = \pi y_0 + u \quad (11)$$

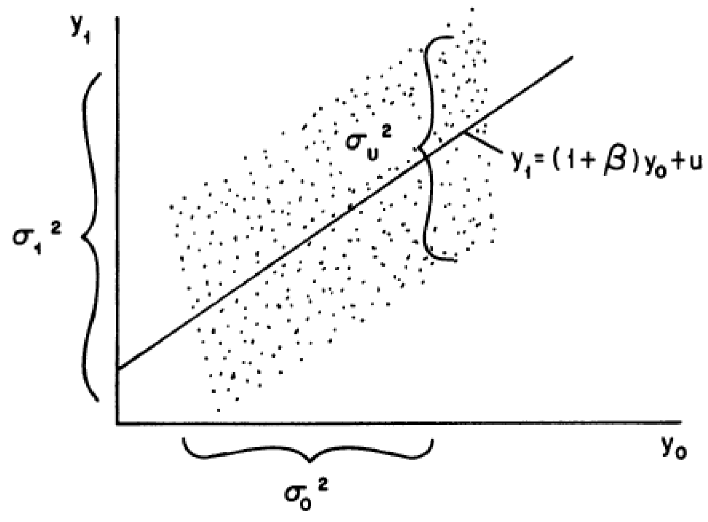
where the variance of y_1 , σ_1^2 is

$$\sigma_1^2 = (1+\beta)^2\sigma_0^2 + \sigma_u^2 \quad (12)$$

and σ_0^2 represents the variance of y_0. Then the degree of convergence in distribution is shown in (13) and in Fig. to depend on both π -the slope of the regression (11) - and on the variance of the disturbance relatively to that of y_0.

$$\frac{\sigma_1^2}{\sigma_0^2} = (1+\beta)^2 + \frac{\sigma_u^2}{\sigma_0^2} \qquad (13)$$

Figure 1 - Lichtenberg(1994) p. 577



If the u is large thenσ_1^2/σ_0^2 will be larger than 1 even in the case of *β-convergence*, where π takes a value less than one.

Given the above reasoning, the *σ-convergence* would seem to be a preferable approach to the understating of how regional inequalities in China are evolving. To test for the presence of *σ-convergence* three tests have been proposed.

The first test proposed is the *Lichtenberg's Test* (1994)which takes the form (13)[5] and follows from the arguments exposed above regarding the relation of *β-convergence* and *σ-convergence* (see eq.11 and 12).

$$\mathrm{T}_1 = \hat{\sigma}_1^2/\hat{\sigma}_0^2 \qquad (14)$$

where $\hat{\sigma}_1^2$ is the variance of the per capita income at time 1 and $\hat{\sigma}_0^2$ at time 0.

Other two tests have been later proposed by Caree and Klomp (1997) as the T_1 had been proved to be subject to "Type II error" thus failing to reject the false null hypothesis of *no-convergence*. The two tests are described by (15)[6] and (16)[7].

$$\mathrm{T}_2 = (\mathrm{N} - 2{,}5)ln\left[1 + \frac{1}{4}\frac{\hat{\sigma}_0^2\hat{\sigma}_1^2}{\hat{\sigma}_0^2\hat{\sigma}_1^2 - \hat{\sigma}_{0,1}^2}\right] \qquad (15)$$

$$\mathrm{T}_3 = \left[\frac{\sqrt{N}(\hat{\sigma}_0^2/\hat{\sigma}_1^2 - 1)}{2\sqrt{1-\hat{\pi}^2}}\right] \qquad (16)$$

where$\hat{\sigma}_1^2$ and $\hat{\sigma}_0^2$ have been already defined and$\hat{\sigma}_{0,1}^2$ is the covariance of the variable between time 0 and time 1; $\hat{\pi}^2$ is the estimated parameter from eq.(10). As explained before and derived from eq. (10), $\hat{\pi}^2 < 1$ is a necessary condition for convergence. Then if T_1 T_2 and T_3 have a value over that one corresponding to the threshold of significance, then one can reject the null hypothesis of *no-convergence*. If instead $\hat{\pi}^2 > 1$, the T_3 cannot be computed and the validity of T_2 concludes for the hypothesis of *divergence*.

Although *σ-convergence* offers valuable insights on the convergence in distribution of the variable of interest, it is important to clarify that this type of analysis only takes into consideration the variance at two points fixed in time. It does not provide information of the dynamic ruling the evolution of the variance neither gives an idea of the heterogeneous behavior of the observations within the distribution over time.

---

[5] $T_1$is distributed as F with (n-1;n-1) degrees of freedom
[6] T_2 is distributed as a $\chi^2(1)$
[7][7] T_3 is distributed as a N~(0,1)

2.3.2 Distribution Dynamics

As discussed above, the literature on growth took different directions depending on the evidence that cross-country convergence is more a theoretical construct than an empirical finding. The endogenous growth theorists stressed the point that not necessarily the production function is constraint to constant returns to scale and decreasing marginal returns.

An interpretation of the uneven convergence has been proposed by Danny Quah, who contrasted the neoclassical assumption that countries follow constant growths paths. He found unrealistic the idea of this homogeneity both in the economic behavior of countries over time and within country over space. Indeed similar initial and final conditions measured on a cross-section of countries at two points in time hide the whole evolution of the income distribution in that time-interval. As he highlighted, countries might be affected by different shocks, react differently and speed-up and slow-down accordingly. We will present the methodology proposed by Quah in the next paragraph. First let's introduce the idea behind the study of the income distribution and how this then develops into the Quah's formulation.

A useful approach to investigate the changes in the distribution of a variable over time is to look at the marginal density function. From the analysis of the marginal distribution of a variable in one time period it is in fact possible to identify the shape of the distribution and understand around which values the observations concentrate. Taking a second time period to observe the marginal distribution of a variable allows one to describe the changes occurred and the shift to the new shape. This type of analysis will show where there are peaks in the distribution and how they evolve in time. For instance observations could cluster around one value or on the opposite, being concentrated on two extreme positions in the distribution and so on.

The analysis of the marginal distribution has however the shortcoming of not revealing who is moving within the distribution. It is a static approach that simply provides a snapshot of the distribution at one point in time. Therefore there are no insights on the dynamics within the distribution. Here it comes the major contribution of Danny Quah to the study of the distribution dynamics (Quah 1993,1995,1996,1997).

What Quah presented is a new approach to the analysis of convergence based on the observation of the evolution of the distribution over time, without assuming a pre-determined theoretical model of how the distribution should evolve. His approach relies on the use of the stochastic Kernel to estimate the probability of transition of countries from one class to another of the income distribution.

The stochastic kernel operator (M) analyses the stochastic process determining the evolution of the per capita income distribution (F) over time. M maps the current distribution (at time *t*) into a future distribution (at time *t+1*). The function describing this process is

$$F_{t+1} = M \cdot F_t \quad (1)$$

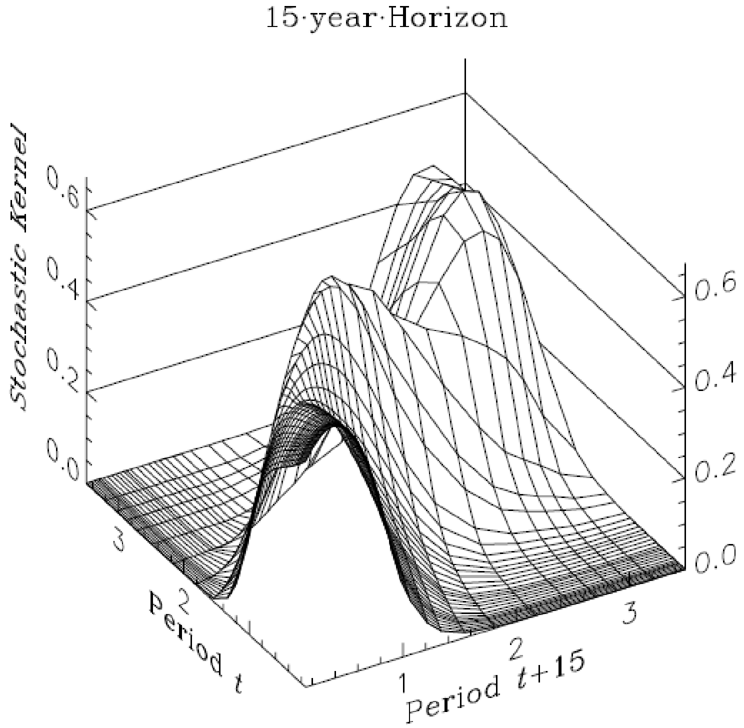
By iterating this operation in subsequent periods it is possible to obtain an estimator of the future distributions F_{t+s} defined as

$$F_{t+s} = (M \cdot M \cdot \ldots \cdot M) \cdot F_t = M^s \cdot F_t \quad (2)$$

For s→∞ we obtain the long-term distribution of the per capita income and explore the probability of convergence in distribution. The usefulness of this analysis is that it reveals if the distribution is affected by "*persistence*" – where there are no expected changes in the relative positions of countries within the cross-country income distribution; by "*convergence*" - where all observations cluster around the same values; by *"polarization"*- where poor countries and rich countries widen their gap in terms of income.

These dynamics can be read through the three-dimensional representation of the Stochastic kernel function (Fig.3). The figure shows the probability density describing the transition over 15 years (t+15) from the income value in period t. On the third axis are reported the estimates of the kernel function.

Figure 2 – Stochastic Kernel



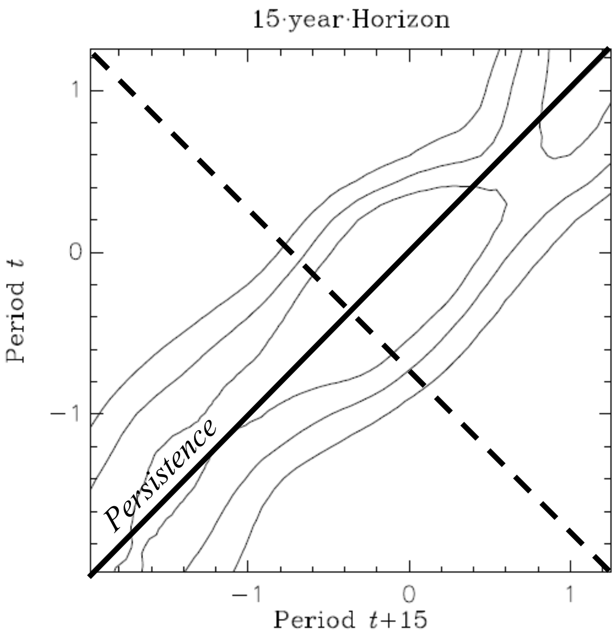
Source: Quah 1997

When the surface of the kernel has a distribution along the main diagonal of the graph (the "persistence diagonal" see fig. 3), the distribution shows no internal mobility; all countries maintain their relative position in the distribution. If instead the surface aligns along the opposite diagonal, a "reversal" trend can be identified, where the countries initially belonging to the lowest class of the distribution managed to reach the upper class of the distribution at the end of the transition period.

A tendency to converge can be identified when the surface of the Kernel is rotated counterclockwise from the diagonal of persistence. There is a perfect convergence if the kernel surface is parallel to the t axis and observations cluster around a unique mode (represented by a peak in the Kernel distribution). More than one peak indicates a pluri-modal distribution where observations tend to converge to different values. In the empirical studies of Quah, he found evidence of a tendency of the income distribution at t+s to be bimodal or twin-peaked, meaning that rich converge to rich, while poor cluster with poor and the middle-income class is vanishing[8].

To better read this dynamics another tool is at disposal: the dimensional contour plot, which is a two-dimensional graphic representation of the Kernel. The contour plot is to be read as a map of the evolution of the distribution from time *t* to *t+s*(t +15 in the case of fig. 4).The interpretation is the same as the one of the Kernel. On the t axis is reported the value of the per capita income at the beginning of the time-period considered, while on the t+s axis are instead represented the long-term values of the variable of interest. The lines on the surface plot the kernel surface. In case of persistence the lines dispose along the main diagonal.

Figure 3 – Contour Plot



Source: Quah 1997

In this paper I first studied the marginal distributions of the per capita income and then I applied the stochastic kernel operator (par.3.2.).

[8]Quah 1996

3. Stylized Facts on Regional Inequality and Convergence

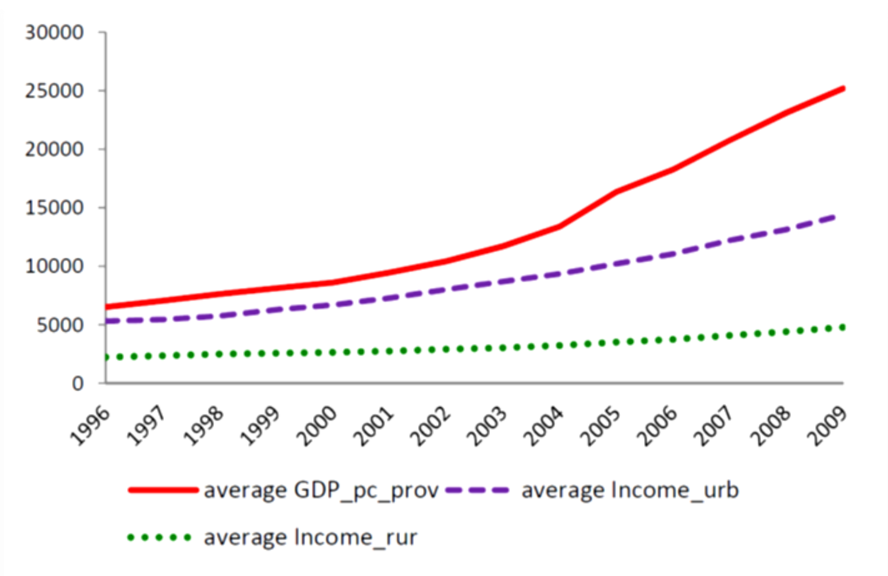
The question we aim to answer with this analysis refers to the existence of a process of convergence within China or whether the impressive growth rate of this country has just benefitted a few, thus increasing the spatial inequalities. We address the macroeconomic face of the inequality by looking at the differences across the Chinese provinces and within them along the rural-urban disparity line. In the first paragraph we will present some descriptive facts regarding the economic performance of the rural and urban areas and the spatial inequality. In the second paragraph we will discuss the results from the analysis of the distribution dynamics of the per capita income.

3.1. Main trends on Regional Inequalities and Convergence in China

There is one China we all know that is growing exponentially since the adoption of the market reforms in 1978, maintaining in the last years an average annual growth rate of around 9% (CIA 2011). This success was sustained by specific policies aiming at creating a two-speed system, where coastal and urban areas could obtain special benefits, thus to attract foreign investments and embrace the industrialization faster. Certainly this spatial bias was meant to have spill-over effects and drag the rest of the country out of the agricultural stagnation and poverty. Indeed, the effective "great leap forward" experienced by China in the last two decades boosted the average income per capita of all provinces, while a widening gap has divided the rural and urban average per capita incomes (fig.4). According to many economists regional inequalities have in fact grown since the late 1990s as a consequence of the reforms implemented by the central government.

Several studies documented the nation-wide process of divergence taking place since then (Weeks and Yao, 2003; Pedroni and Yao, 2006; Hu and Wang, 1996). A milder vision was provided by other authors which emphasized the presence of convergence within groups of similar provinces: convergence within coastal areas as well as within internal ones (Jian 1997); convergence conditional to similar structural parameters such as physical investment share, employment growth, and coastal location (Chen and Fleisher,1996; Li, Liu Rebelo, 1998).

Figure 4 –Trends of the average Income/GDP per capita at province, rural and urban level (1996-2009)



Source: our processing on Statistical Yearbook Data (various eds.)

It is true that inequality reduction and growth don't usually go hand in hand and as documented in the economic literature, the relation between the two may be approximated by a Kuznets' reverse U-shape function Kuznets (1955), with increasing inequality in the take-off phase of development and redistributive gains in the long run, such that convergence is expected to occur. And while the spill-over effects could take longer, the mobility of factors and congestion problems are sometimes interfering with the convergence process. In the case of China, the government had restricted in the pre-reform period the internal mobility of the labor force through explicit and implicit forms of control. The population registered in the countryside –via the Hukou system - was not freely allowed to move within the country. With the progressing of the reforms some of the stringent Hukou measures have been relaxed, while the development of the market economy has enabled the illegal migration. It has been estimated that over 250million migrants have moved from the countryside to the urban areas (CIA 2011), creating tensions in terms of distribution of resources, job market competition and unequal opportunity between the migrants and the permanent urban residents. Also it is not trivial the discussion on the impact of migration on the rural areas. Has it boosted the productivity and fuelled the development with the remittances or on the contrary, the problem of remoteness of the rural areas has worsened and these areas have been trapped in a loop of underdevelopment?

At first sight the situation within the rural areas seems to be more heterogeneous than within the urban ones. In Table 1 the values of the coefficient of variation (CV)[9] of both rural and urban areas are displayed at three points in time. The CV is a representation of the standard deviation as percentage of the sample mean and allows one to infer on the inequality characterizing distributions with a different mean. In the case of rural and urban areas the CV shows that differences across rural areas are stronger than in the urban ones. While in rural areas the dispersion of the per capita income has been in the range of 42% -46% of the sample mean during the 1996-2009 period, in urban areas the CV has never reached the 30%. In the 1996- 2001 sub-period, the CV of rural areas has decreased, revealing a light tendency to converge; however from 2001 onwards it has increased at a double speed. Across urban areas, the trend of the CV has been mainly stable (Fig.5). At province level instead the magnitude of the CV is very high: over 60% of the sample mean along the whole 1996-2009 period. It seems however that the degree of spatial disparity has reduced over time. In 2009 its value was 4.2% less than in 1996.

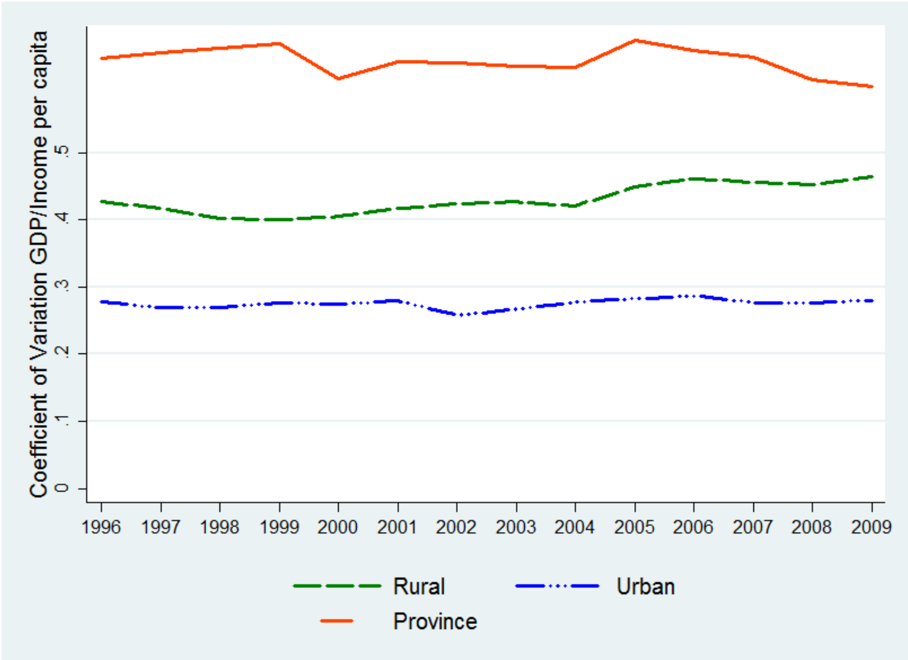
Table 1 – Coefficient of Variation

	1996	2001	2009
C.V. Rural Income	42.7%	41.7%	46.4%
C.V. Urban Income	27.7%	27.9%	28.0%
C.V. GDP per capita by province	64.0%	63.4%	59.8%

Source: our processing on Statistical Yearbook data (various eds.)

[9] The coefficient of variation has been calculated as the ratio of the standard deviation of the income per capita and the average for rural and urban areas. At province level we have used the GDP per capita.

Figure 5 – Trends of the Coefficient of Variation for the Chinese provinces and within rural and urban areas

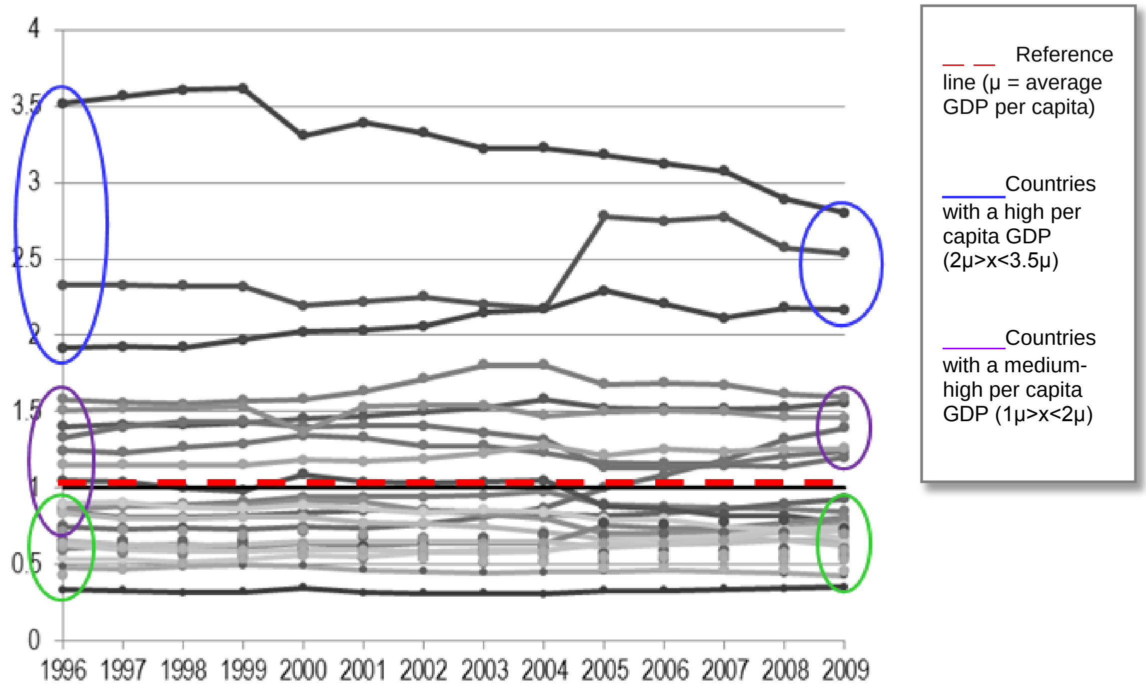


Source: our processing on Statistical Yearbook data (various eds.)

An inspection of the behavior of the single province with respect to the national average is then needed to understand this counterintuitive trend of the inequality across provinces. Looking at fig.6 we notice indeed that the distance of the provincial per capita income level to the national average was larger in 1996 than in 2009. As we see in Fig.6 one province (Shanghai) had in 1996 a GDP per capita which was 3.5 times higher than the Chinese average. Over time this gap has somehow reduced.This reduction has not been a downward process as the picture seems to suggest, but rather a permanent increase of the national average, combined with a transfer of population from poorer to richer provinces[10]. The general tendency of the provinces in terms of their GDP per capita relatively to the average is persistence; this is evident in fig.6. Three main groups of provinces can be identified according to growth paths they follow and the three different non-converging long-term equilibria towards which they seem directed.

[10]Part of the reduction of the GDP per capita of rich provinces relatively to the average can be explained by the fact that those provinces have attracted more and more people. As a consequence, taking the ratio of GDP over population indicates a decrease of the values in the rich provinces and an relative increase in those areas of outward migration.

Figure 6 – Provincial GDP per capita over the national average



Source: our processing on Statistical Yearbook data (various eds.)

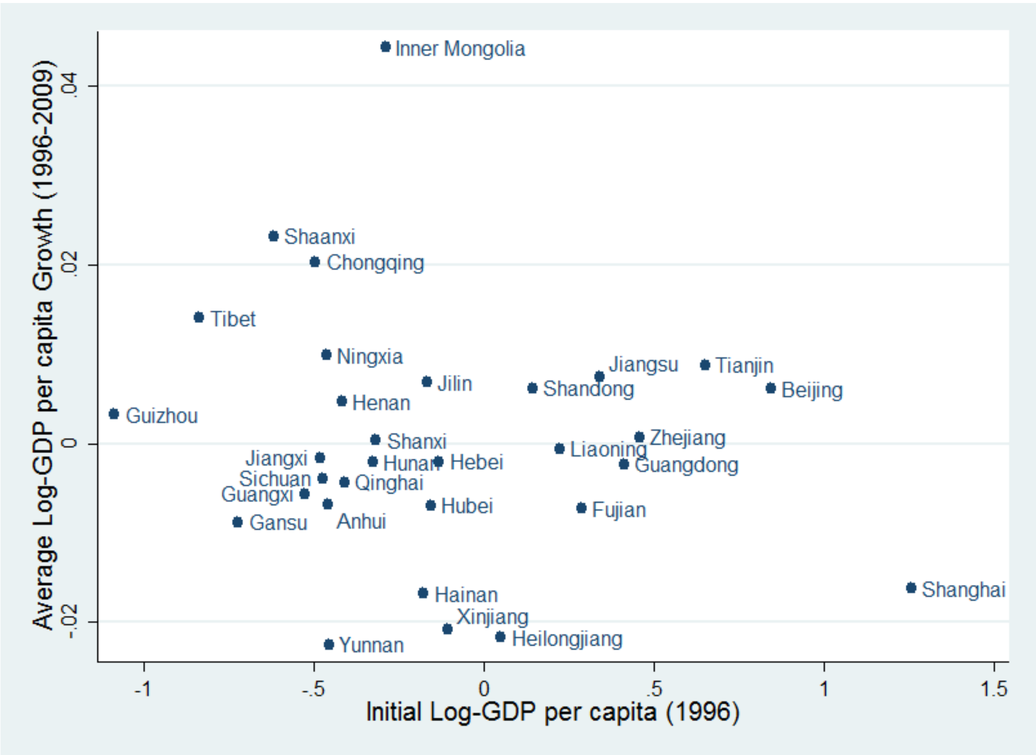
Two considerations are possible here. One is that there are three different steady states determined by the province's fundamentals and controlling for that would imply to reveal a potential convergence process in the long run. The initial income per capita level conditions are different between the three groups but clearly similar within the groups.

The second consideration follows from that. Are we instead in presence of three different clubs of convergence, where the initial conditions permanently determine the long-term outcomes as a sort of "standing on shoulders" effect?

In this preliminary analysis of the stylized facts characterizing the evolution of income inequalities across province and sub-province areas, it is useful to plot the average growth rate experienced by the provinces between 1996 and 2009 against the level of income at the initial time (1996). In presence of absolute convergence we would expect a linear downward slope in Fig.7. As we see, this is not the case. In Fig.7 the growth rate represented on the y axis has been normalized with the average value of all observations; therefore it has to be interpreted as value with respect to the average. This method allows us to identify those provinces having a growth rate higher than the average (set at zero).

Looking at the relation between the average annual growth rate of the GDP per capita and the initial level of it,is the basic cross-sectional approach to convergence. This method of inference is however affected by problems related to the number of observations and the high probability of omitting important time-invariant and country- specific effects.

Figure 7 – The relation between the average annual GDP per capita growth rate (1996-2009) and the initial level of GDP per capita (1996)



Source: our processing on Statistical Yearbook data (various eds.)

When a conditional convergence is tested via cross-section inference, the problem of the distortion of the estimates given the potential endogenity of regressors is even higher. Despite the issues of the cross-sectional approach, several studies on convergence within China adopted this method (Li,Liu, Rebelo 1998; Cheng, Fleisher 1996). As exploratory exercise we align to those studies and run a cross-section growth regression of the type

$$\Delta y_{it_0,t} = \beta \, ln(y_{it_0}) + \varepsilon_i \qquad (3)$$

where the dependent variable Δy is the average annual growth rate calculated as$\Delta y_{it_0,t} = 1/t(lny_{it} - lny_{it_0})$. With this specification we found no convergence, meaning that the level of heterogeneity of the Chinese cross-section is sufficiently higher and provinces are not moving to the same steady state, neither are characterised by the same structural paramenters.

We tried another specification, by including different dummies proxing the geographic location of the provinces. Either controlling for the coast-non-coast location or for the nature "prevalently rural", "prevalently urban", "intermediate of the province"[11], we found the presence of convergence. Results are reported in table 2. The convergence parameter is negative and significative. The dummy variable indicate the difference value of the intercept for the observations included in the regressions with respect to those excluded.

Table 2 - Cross-section β-Convergence including a coastal dummy

				N. obs = 31 F(2,28) = 5.83 Prob>F = 0.0076 R-squared = 0.3934
Δy (1996-2009)	β	st.err	t	p-value
y1996	-0.03315	0.010077	-3.29	0.003
d_coast	0.014946	0.005016	2.98	0.006
c	-0.00684	0.002802	-2.44	0.021

(i) *Δy* is the average annual growth rate of the province experience during the time period 1996-2009
(ii) *y1996* is the GDP per capita at time t_0
(iii) *d_coast* is a dummy variable assuming value 1 when the province is located on the coast, value 0 when is an internal province
(iv) *c* is the constant

Source: our processing on Statistical Yearbook data (various eds.)

[11] we use the OECD classification of the Chinese provinces into three groups (OECD 2009b).

Table 3 - Cross-section β-Convergence including dummies for the "rural" and "prevalently rural" nature of the province				
				N.obs = 31 F(3,27) = 3.11 Prob > F = 0.0428 R-squared = 0.1822
Δy (1996-2009)	β	st.err	t	p-value
y1996	-0.01361	0.004657	-2.92	0.007
d_PR	-0.01973	0.007423	-2.66	0.013
d_INT	-0.00937	0.004758	-1.97	0.059
c	0.012061	0.004404	2.74	0.011

(v) *Δy* is the average annual growth rate of the province experience during the time period 1996-2009

(vi) *y1996* is the GDP per capita at time t_0

(vii) *d_PR* is a dummy variable assuming value 1 when the province is "prevalently rural", and 0 when the province is either "intermediate" or "prevalently urban"

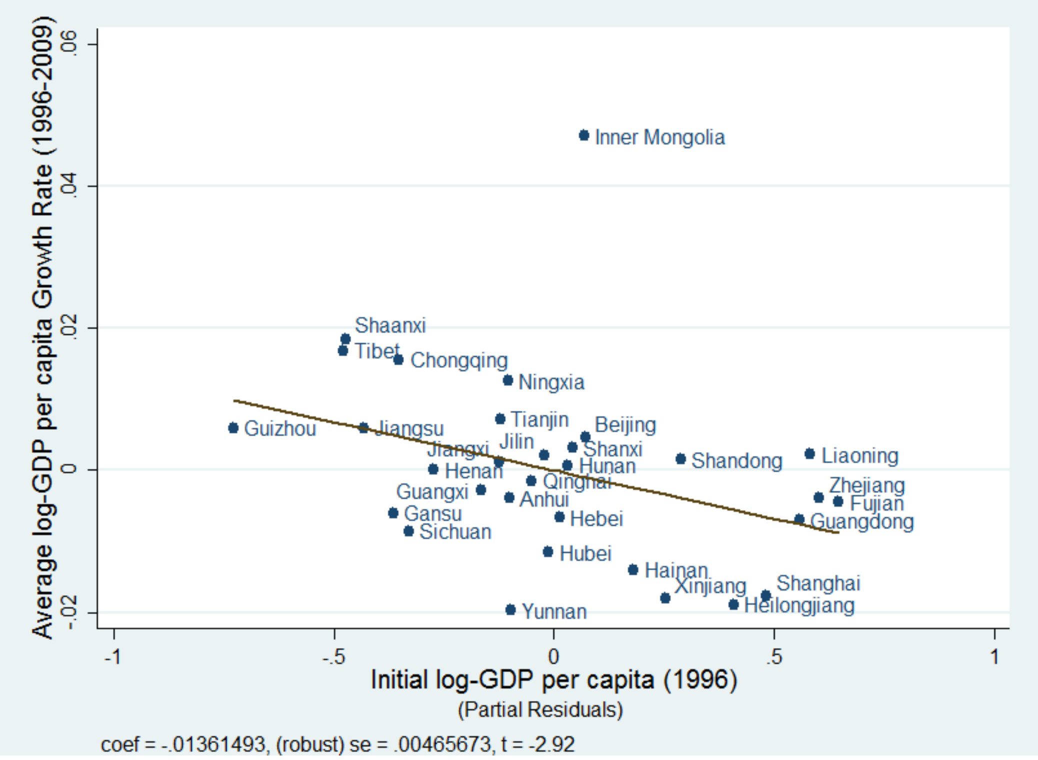
(viii) *d_INT* is a dummy variable assuming value 1 when the province is "intermediate", and 0 when the province is either "prevalently rural" or "prevalently urban"

(ix) *c* is the constant

Source: our processing on Statistical Yearbook data (various eds.)

Therefore the average intercept of the provinces prevalently rural is -0.01973 with respect to the prevalently urban (whose value is the one calculated by the constant term). the geographical location dummies included in the regressions are: the nature "prevalently rural" and "rural" of the provinces (Table 3). and the coastal dummy (Table 2). The estimated speed of convergence after controlling for the geographical characteristics is calculated from the formula λ=(1-$e^{-\beta t}$) and is equal to approximately 1.5% in the rural/urban specification and 4.4% in the coast-internal model. Fig.8 shows the partial residual plot of the model including the rural-urban dummies.

Figure 8 - Partial residual plot



Source: our processing on Statistical Yearbook data (various eds.)

From this first tentative inference of the nature of regional disparities in China and their evolution over time we conclude that we are dealing with a highly heterogeneous country and a process of convergence which implies the presence of multiple steady states, which could be determined either by the different structural parameters of the provinces (conditional convergence) or by the self-perpetuating differences in the initial income level conditions (in the case of club-convergence).

To better understand the evolution of the per capita income distribution I decided to adopt a distributional approach and look at the long run distribution dynamics.

3.2. Empirical analysis and results

As explained in section II with the use of a distributional approach it is possible to describe the evolution of the income per capita distribution at province and sub-province level in the long run. In par 3.2.1 I present the results from the test on sigma-convergence. In the following paragraph I deal with the marginal distributions of the per capita income of the Chinese provinces, the rural areas, the urban areas and the combined distribution of rural and urban per capita incomes. In the last paragraph I will report the findings of the application of the Stochastic Kernel Operator to map the evolution of the per capita income distribution in the long run. The analysis was done for the three levels of investigation of this research (province, rural areas, urban areas) plus the combined distribution of rural and urban areas. In fact I decided to pool the rural and urban observations into the same dataset in order to investigate whether in the long run there is the tendency of the two groups to converge to similar levels. A last note on this part of the analysis is that I split the time interval into two, taking 2001 as time threshold. Results are presented for both the two sub-periods (1996-2001;2001-2009) and the whole time interval (1996-2009).

3.2.1. The Sigma-Convergence

In this paragraph we report the results of the sigma-convergence test (Table 4). We found evidence of nation-wide divergence of the per capita income and per capita GDP. This result is in line with the general findings of the growth literature on China.

Moreover, the hypothesis that the 1996-2001 period could present different trends with respect to the 2001-2009 period is rejected. Both across provinces as well as across rural and urban areas in both periods

Table 4 - Test for σ-convergence

ACROSS URBAN AREAS							
	π	T_1	T_2	T_3	N		
1996-2009	1.12	1.04	37.40	-	31	π>1 T2>3.84	***σ-divergence***
1996-2001	1.04	1.05	59.37	-	31	π>1 T2>3.84	*σ-divergence*
2001-2009	1.08	0.99	50.37	-	31	π>1 T2>3.84	*σ-divergence*
ACROSS RURAL AREAS							
	π	T_1	T_2	T_3	N		
1996-2009	**1.03**	**0.86**	**78.38**	**-**	**31**	**π>1 T2>3.84**	***σ-divergence***
1996-2001	1.07	0.98	88.60	-	31	π>1 T2>3.84	*σ-divergence*
2001-2009	1.10	0.88	86.02	-	31	π>1 T2>3.84	*σ-divergence*
ACROSS PROVINCES							
	π	T_1	T_2	T_3	N		
1996-2009	**1.16**	**0.98**	**60.38**	**-**	**31**	**π>1 T2>3.84**	***σ-divergence***
1996-2001	1.04	0.96	105.29	-	31	π>1 T2>3.84	*σ-divergence*
2001-2009	1.11	1.03	63.82	-	31	π>1 T2>3.84	*σ-divergence*

Source: our processing on Statistical Yearbook data (various eds.)

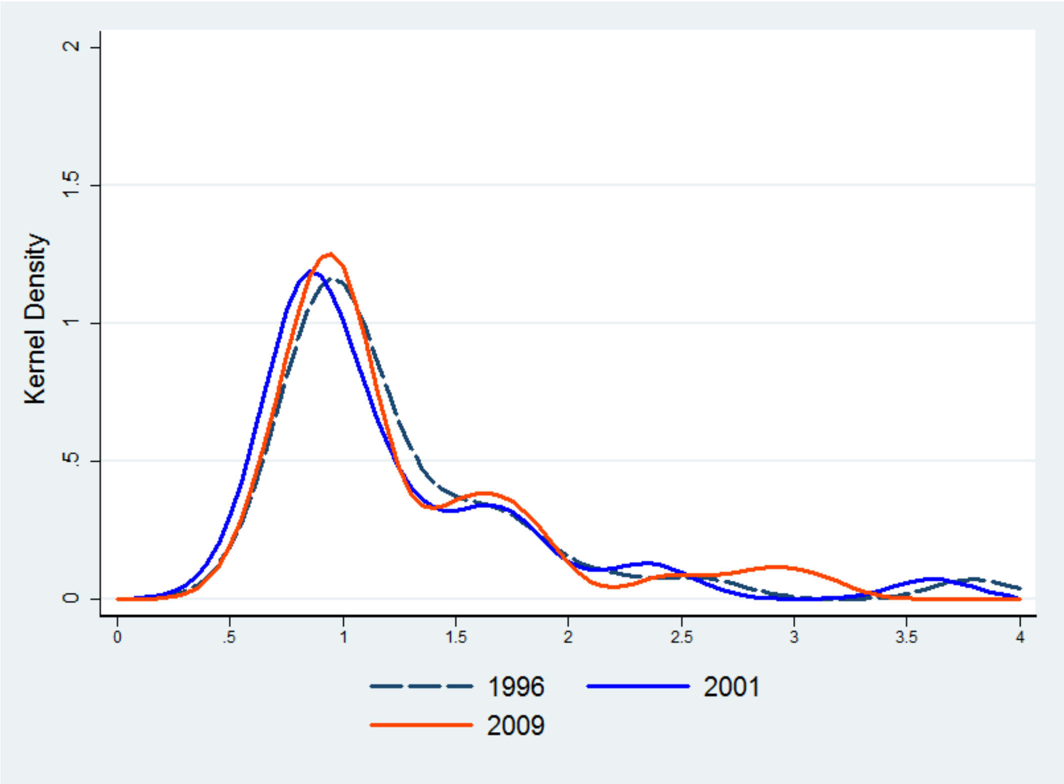
3.2.2. A study of the marginal distributions of per capita income in China

In this paragraph I present the marginal density functions of the per capita income taking as reference various disaggregation levels of the Chinese territory: the Chinese provinces, the sub-provincial level (both urban and rural); the joint distribution of the per capita income at both rural and urban level. The variable taken for analysis is the GDP per capita at province level and the per capita income at both rural and urban level. Note that before the estimation of the marginal density function. the value of each observation has first been divided by the mean of all the observations in the same year, thus to have a unitary value representing the mean.

i. *Changes in the marginal distribution of the per capita GDP of the Chinese provinces*

Figure 9 – Marginal Distribution of the GDP per capita

Province level



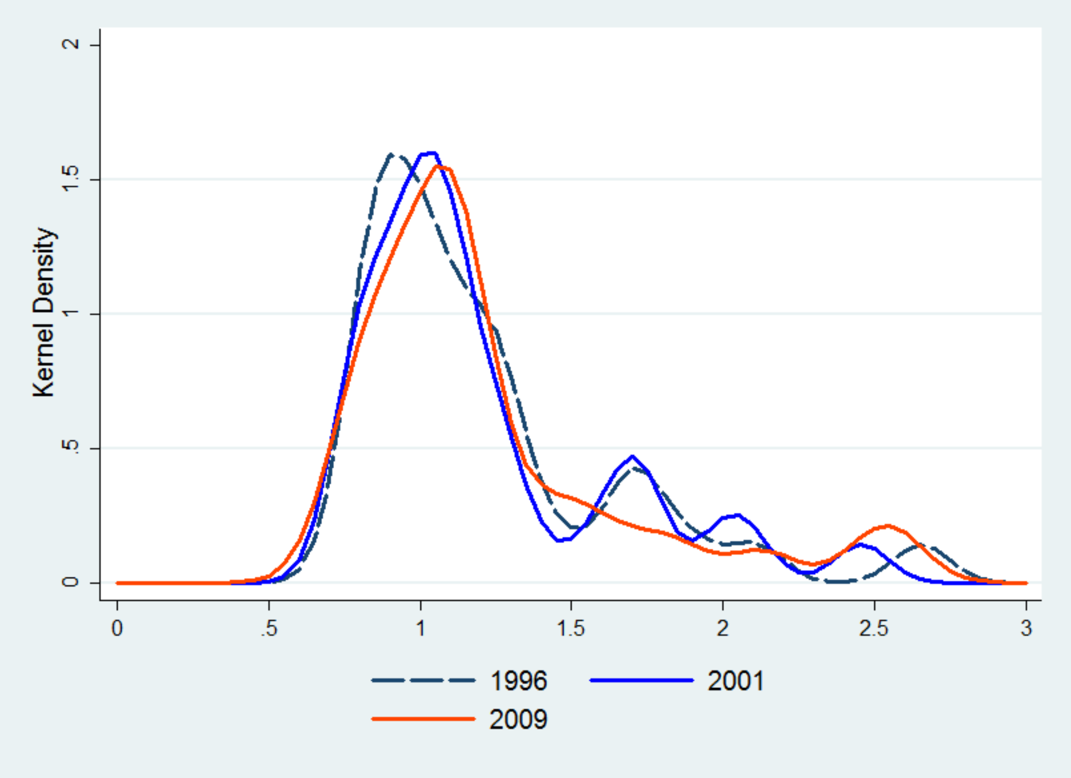
Source: our processing on Statistical Yearbook data (various eds.)

As we see in Fig.9 the situation at province level is quite stable, meaning that the distribution of the GDP per capita is not affected by major changes. The provinces maintain their relative position with respect to the mean. There is only some movement in the upper part of the distribution, showing a progressive reduction of the standard deviation taking place between 2001 and 2009. As we see in Fig.9 the distribution of the GDP per capita is characterised by the presence of three bumps: one around the unit (representing the mean); a smaller one in correspondence to the range 1.5-2; a third one representing the richest provinces which have a GDP per capita around 3 - 3.5 times the average. In 2009 the upper bump is closer to the average than it was in 2001 and 1996, but we will need to investigate this dynamic further in order to understand better the evolution of the distribution in the long run.

ii. Changes in the marginal distribution of per capita income in rural areas

Figure 10 - Marginal Distribution of the Income per capita

Rural areas



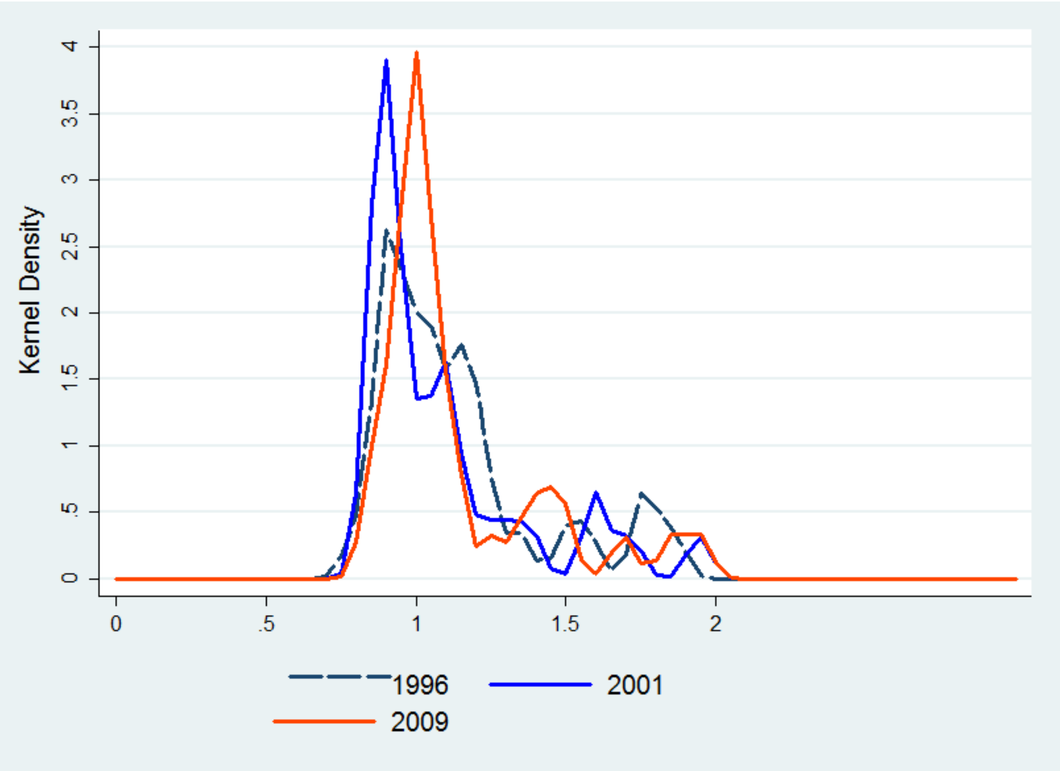
Source: our processing on Statistical Yearbook data (various eds.)

In rural areas the marginal distribution shows that over time the number of converging group has decreased. While in 1996 there were four bumps in the marginal distribution, this number has gone to two by 2009, showing a progressive polarization within the distribution and a vanishing of the middle-income class. This phenomenon is shown to have occurred in the second time-period considered – that is between 2001 and 2009. Another characteristics is that the mode around the unitary mean has slightly shifted rightwards, meaning that in 2009 the rural areas clustered around an average value slightly higher than in 1996. It seems however that it is between 1996 and 2001 that this shift has occurred.

iii. Changes in the marginal distribution of the per capita income in urban areas

Figure 11 - Marginal Distribution of the Income per capita

Urban areas

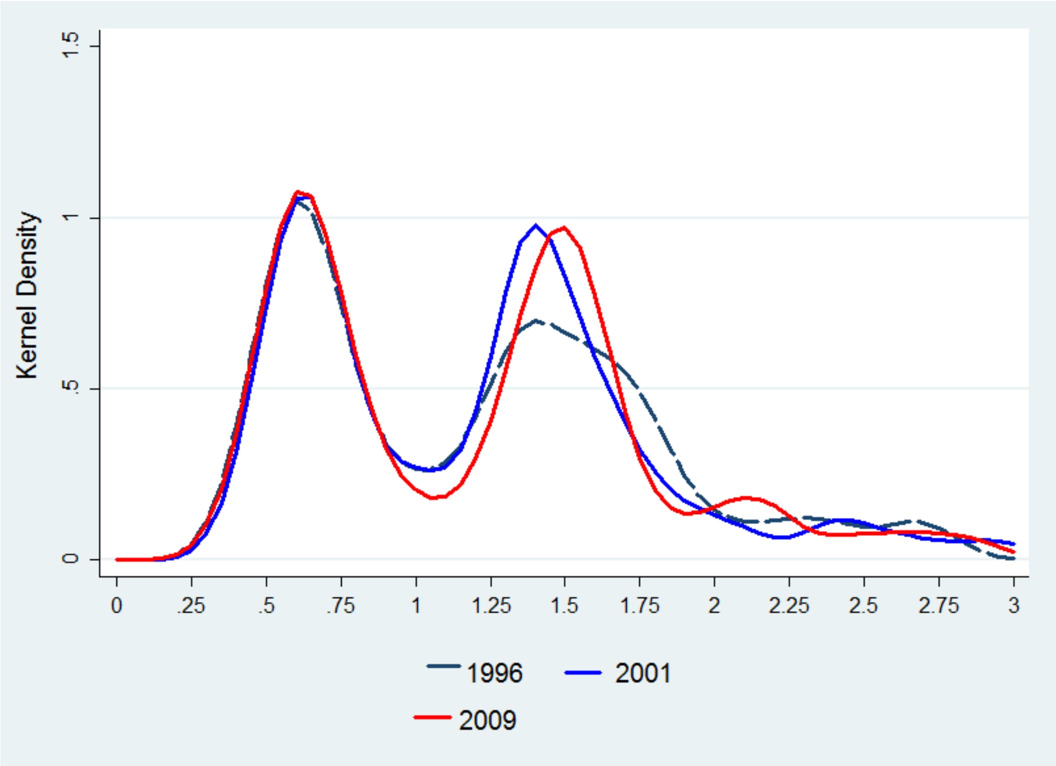


Source: our processing on Statistical Yearbook data (various eds.)

The marginal distribution of the urban income per capita between 1996 and 2009 (Fig. 11) shows a sharper concentration of the observations around the mean value in the years 2001 and 2009 with respect to 1996. Also in urban areas the mode around the mean value has shifted rightwards; in this case the shift occurred in the second sub-interval (2001-2009).

iv. Changes in the marginal distribution of the per capita income of rural and urban areas

Figure 12 - Marginal Joint Distribution of the Income per capita Rural and Urban areas



Source: our processing on Statistical Yearbook data (various eds.)

Pooling together the rural and urban observations we obtained the distribution in Fig. 12. The distribution shows that the observations cluster around two values in 1996 and 2001: one within the range of 0.5 -0.75 - representing a level of income per capita that is about 50% to 75% of the nation-wide rural-urban average; the other between 1.25 and 1.75 – which is a value of income per capita about 25% to 75% higher than the average. We notice that between 1996 and 2001 the second mode has concentrated approximately around a value that is 30% higher than the average, thus reducing the dispersion around the second mode. Between 2001 and 2009 the second mode has slightly shifted rightwards and another prominence has appeared in correspondence to a value of income comprised between 2 - 2.25 times the average.

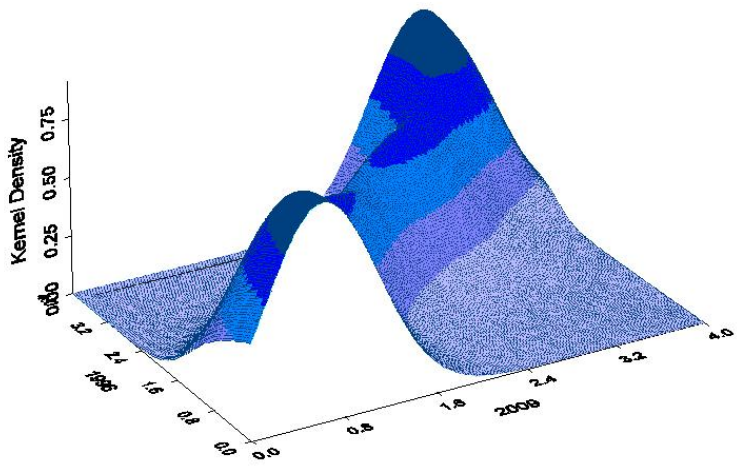
3.2.3. Distribution Dynamics

This paragraph will look at the distribution dynamics of the per capita income at province, rural and urban level and illustrate the changes occurred in the distribution after the China's accession to the WTO. With these objectives we performed different analysis for the 1996-2001 and 2001-2009 period as well as for the whole interval. Let's discuss the results for each geographic aggregation level

i. Evolution of the distribution per capita GDP of the Chinese provinces

In figure 13 it is displayed the graphic representation of the Stochastic Kernel of the regional GDP per capita (see sect II for the definition and computational details) for the time interval 1996-2009.

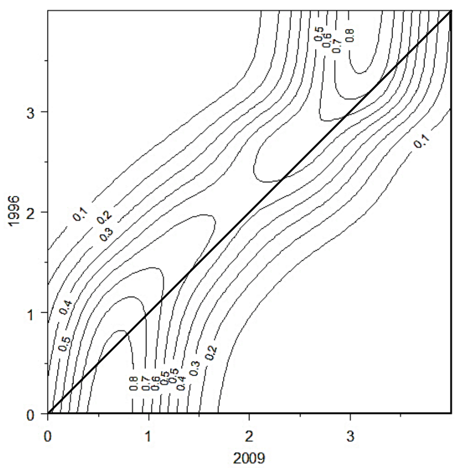
Figure 13 – Stochastic Kernel of the regional GDP per capita (1996-2009)



Source: our processing on Statistical Yearbook data (various eds.)

The kernel surface is disposed along the diagonal of persistence and is characterised by te presence of two converging groups at the extreme of the distribution. By looking at the contour plot for a cleerer picture of the dynamics (Fig. 14), we can see that the first converging group is located around a value which is about 90% of the national average. While the other converging group is at an income level about three times larger than the national average. The shape of this distribution highlights the presence of highly heterogeneous country, where provinces are polarized into two groups far from each other.

Figure 14 - Contour Plot of the province-level GDP per capita (1996-2009)



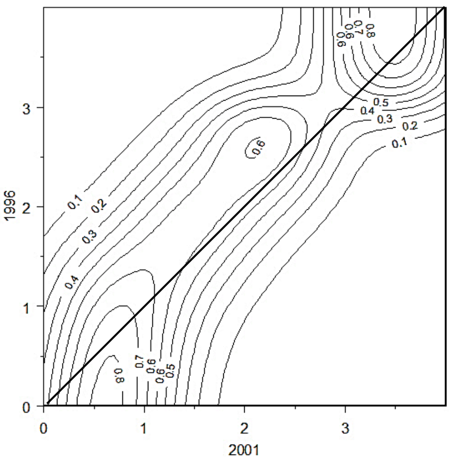
Source: our processing on Statistical Yearbook data (various eds.)

There is a high degree of persistence in the distribution. A part from the extreme poor provinces and the extreme rich ones, which both tend to cluster on the opposite sides of the distribution, there is not much intra-distribution movement in the 1996-2009 period. Nevertheless, we notice that the standard deviation has reduced. This result is coherent to the general tendency of decreasing inequality highlighted by the reduction of the Coefficient of Variation of the regional GDP per capita (Table 1).

Regarding the implication of the China's accession to the WTO, in Fig.15 and Fig. 16 we can compare the situation in the pre-accession and post accession periods respectively. We see that the first plot (Fig.15) has some small differences with respect to the contour plot for the whole period. In fig. 15 we can see that the distance between the three groups was larger and there was a smaller group in the middle of the distribution where probably two or three provinces showed the tendency to converge to each other.

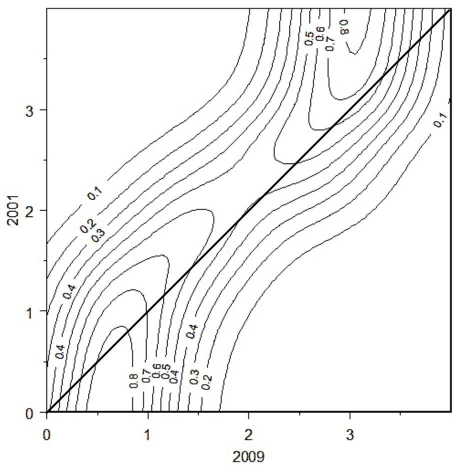
The second sub-period contour plot (Fig.16) is identical to the one representing the whole period. From this analysis we can infer that the changes occurred in the second half of the period taken under consideration, mainly affected the upper part of the distribution that reduced over time the "distance" to the national average.

Figure 15 -- Contour Plot of the province-level GDP per capita (1996-2001)



Source: our processing on Statistical Yearbook data (various eds.)

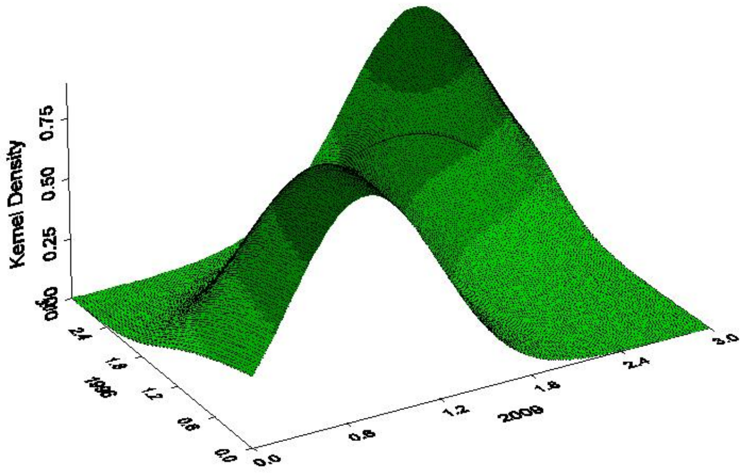
Figure 16 - Contour Plot of the province-level GDP per capita (2001- 2009)



Source: our processing on Statistical Yearbook data (various eds.)

ii. *Evolution of the distribution ofper capita income of the rural areas*

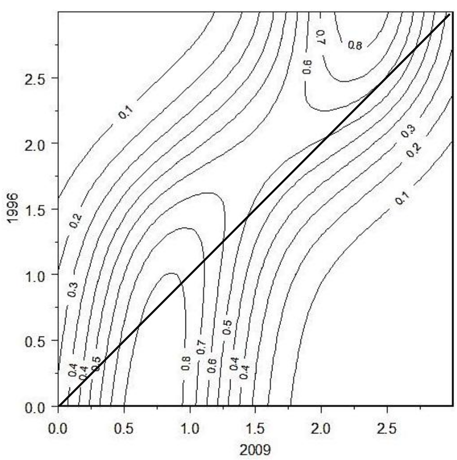
Figure 17 - Stochastic Kernel of the Rural Income per capita (1996-2009)



Source: our processing on Statistical Yearbook data (various eds.)

The stochastic kernel in Fig. 17 represents the kernel distribution of the per capita income in rural areas for the 1996-2009 period. As we can see in both Fig. 17 and Fig.18 the kernel surface is concentrated along the main diagonal, indicating "persistence" in the distribution and two clubs of convergence can be identified at the extreme of the distribution. Poorer provinces tend to converge to a value of 0.75 of the average, while the richer to a level which is twice the average.

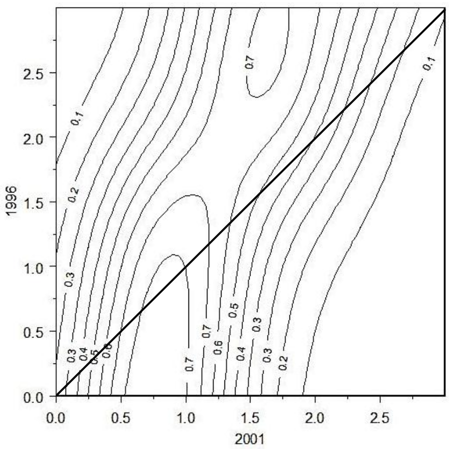
Figure 18 - Contour Plot of the Rural Income per capita (1996-2009)



Source: our processing on Statistical Yearbook data (various eds.)

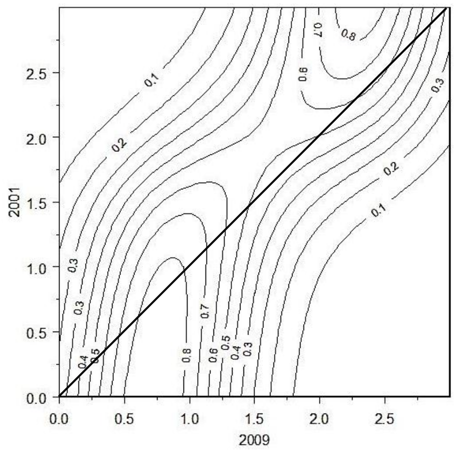
Splitting the time-period in two, we notice that the situation was much different in the first sub-period (Fig.19). Indeed in the time interval 1996-2001 the kernel surface was align almost parallel to the 1996 axis, indicating a tendency of the rural areas to converge to similar income per capita levels. The “distance between the riches and the poorest provinces was smaller than in the second time period (Fig.20). In fig.20 we see that the distribution shifted to a situation of polarization and persistence in the intra-distribution positions of the provinces.

Figure 19 - Contour Plot of the Rural per capita Income (1996-2001)



Source: our processing on Statistical Yearbook data (various eds.)

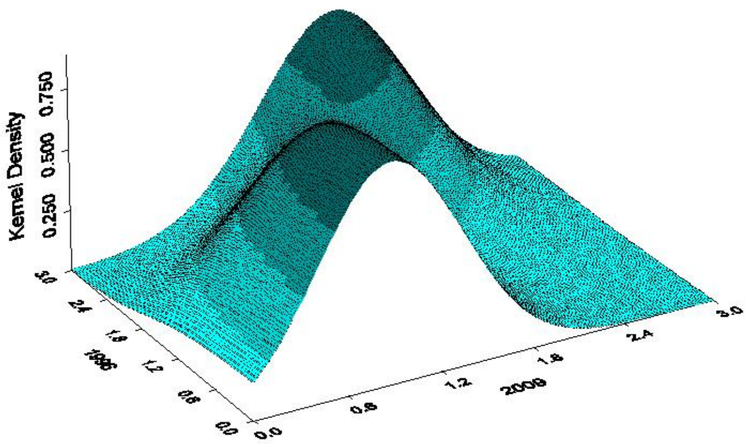
Figure 20 - Contour Plot of the Rural per capita Income (2001-2009)



Source: our processing on Statistical Yearbook data (various eds.)

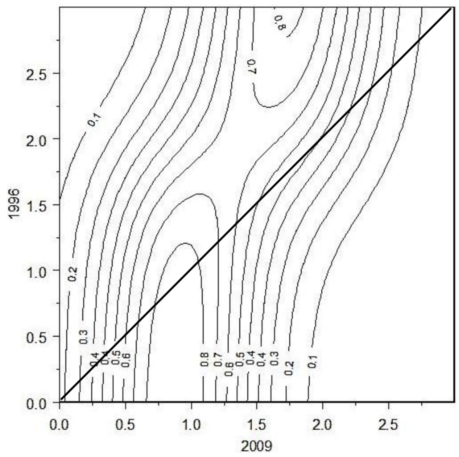
iii. *Evolution of the distribution of per capita* ***income of theurban areas***

Figure 21 – Stochastic Kernel of the Urban Income per capita (1996-2009)



Source: our processing on Statistical Yearbook data (various eds.)

Figure 22 – Contour Plot of the Urban per capita Income (1996-2009)

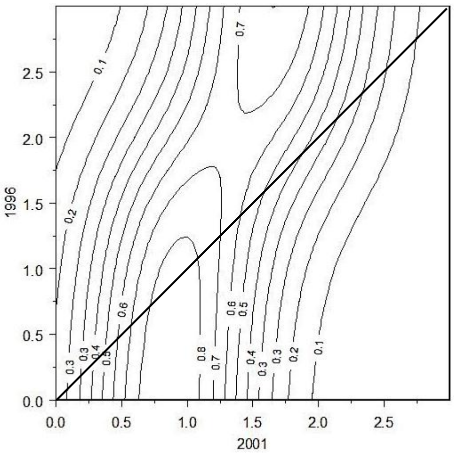


Source: our processing on Statistical Yearbook data (various eds.)

The stochastic kernel in Fig. 21 represents the kernel distribution of the per capita income in urban areas for the 1996-2009 period. As we can see in both Fig. 21 and Fig.22 the kernel surface is turned towards the main diagonal, indicating "persistence" in the distribution, although there is the low-income level group of provinces which shows a stronger tendency to converge. Indeed the kernel surface at lower level of the distribution is parallel to the 1996 axis. The distribution is concentrated around two clubs of convergence, one that clusters around a value of 0.9 with respect to the mean and the other around a per capita income level which is about 50% higher than average.

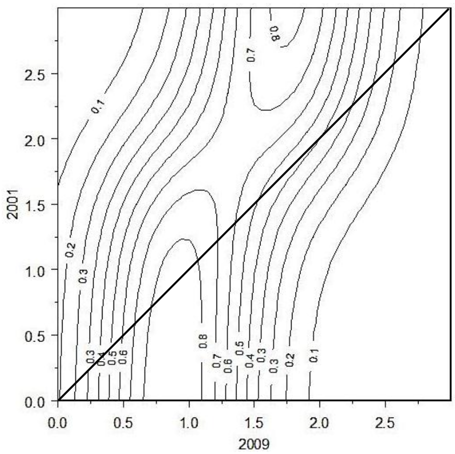
In the case of urban areas no major changes can be accounted for the entry of China in the WTO (Fig.23 and 24), since the distribution shows pretty identical results in the pre-and post-WTO accession periods.

Figure 23 - Contour Plot of the Urban per capita Income (1996-2001)



Source: our processing on Statistical Yearbook data (various eds.)

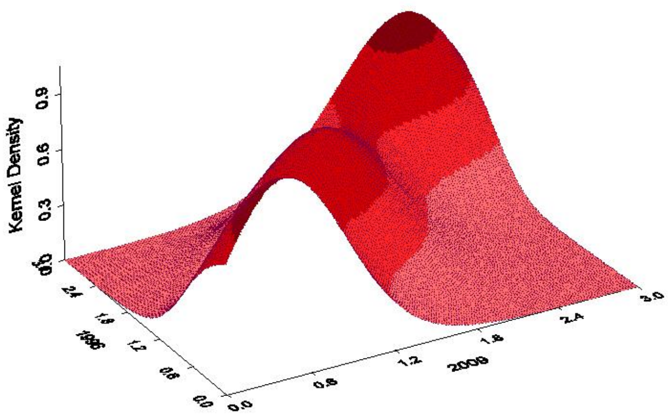
Figure 24 - Contour Plot of the Urban per capita Income (2001-2009)



Source: our processing on Statistical Yearbook data (various eds.)

iv. *Evolution of joint distribution of the per capita income of rural and urban areas*

Figure 25 - Stochastic Kernel of the Rural and Urban per capita Incomes (1996-2009)

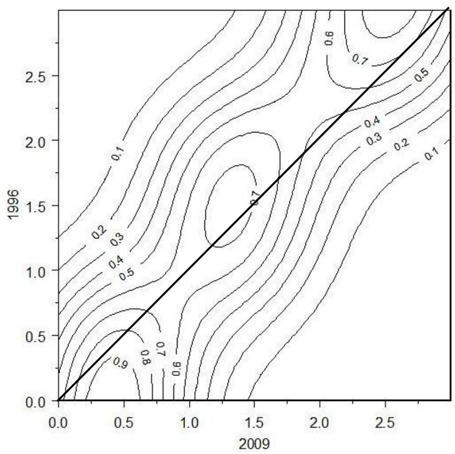


Source: our processing on Statistical Yearbook data (various eds.)

Looking at the "pooled" per capita income distribution of the rural and urban areas (Fig.25 and 26), there is evidence of a substantial immobility of the distribution and the presence of three clusters. The lower income per capita group is composed by the rural areas, the one in the middle of the distribution brings together the lower income urban areas and the richer rural areas (Shanghai, Beijing) and finally the richest agglomeration, which includes the richest and most industrialized urban areas (Beijng, Shanghai). Non univocal growth paths characterize the urban areas however, since some of the richest provinces further improved their situation relatively to the rest (for instance Zhejiang and Tianjin), while others have experienced a downward trend (Guangdong). Also in the case of the pooled distribution the rate of clustering and polarization of the provinces has shown to increase in the second sub-period (2001-2009).

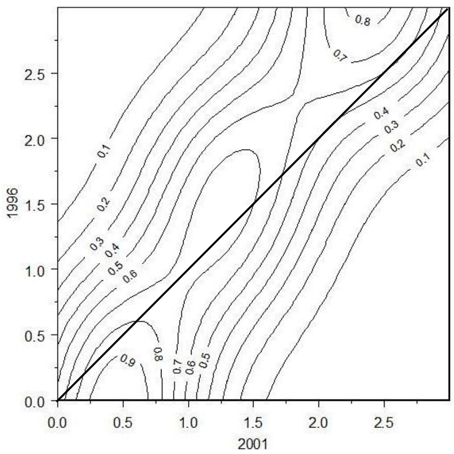
In this joint rural-urban distribution the accession to the WTO shows no effect (Fig. 27 and 28).

Figure 26 - Contour Plot of the Rural and Urban per capita Incomes (1996-2009)



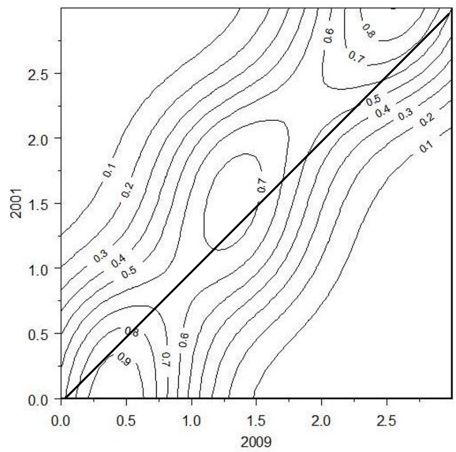
Source: our processing on Statistical Yearbook data (various eds.)

Figure 27 - Contour Plot of the Rural and Urban per capita Incomes (1996-2001)



Source: our processing on Statistical Yearbook data (various eds.)

Figure 28 - Contour Plot of the Rural and Urban per capita Incomes (2001-2009)



Source: our processing on Statistical Yearbook data (various eds.)

4. Conclusions

The analysis of convergence through non-parametrical methods has revealed the presence of club convergence in China. These clubs are mainly evident at province level. Provinces with initial similar conditions tend to converge to each other and stay distinct from the other groups. There is therefore no nation-wide convergence in progress in China. If we restrict the field of analysis to the rural and urban contexts, this picture changes slightly. Rural areas are currently polarized into two groups at the extreme levels of the per capita income distribution, while the poorest and middle-income part of the urban areas shows a tendency to converge. The richest urban areas stay instead separated by the rest of the provinces. The polarization process in the rural income distribution has mainly occurred in the aftermaths of the China's WTO accession. For the whole period considered the rural and urban incomes don't show any tendency to converge to similar levels, with the exception of the richest rural areas of Shanghai and Beijing which show the tendency to catch up with the levels of their respective urban areas.

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ANNEX I

Economic Reforms since 1978

Trade and Marketing Reforms

Before the reform, international trade was under the plan of the central government that sought to maintain self-sufficiency in agriculture, particularly for strategic products. With the aim of making China more integrated in the global economy, the 1979 trade reform promoted a progressive liberalization, although *tariff* and *non-tariff barriers* remained in place for long.

The categorization of goods was one of the main *non-tariff* devices for trade control by the State. More than 90 percent of trade corresponding to over 3000 kinds of commodities (Wan, Lu, Cheng 2007), was in fact under the plan- regime. These products were classified into *plan-commanded goods* and *plan-guided goods*; the former being strictly controlled by the authorities both in the value and in volume of trade, the latter being controlled only in their value of trade. Between 1985 and 1994 this regime was reformed and the number of these goods progressively reduced. By 1991 only a minor quota of exports – about 15 percent – was placed under the control of trading companies appointed by the State and 18.5 percent of imports were still under the plan-commanded regime (Wan, Lu, Cheng 2007). Also the licensed trading and quotas introduced in the early 1980s for imports narrowed down since 1992, reaching the 5 percent in 1997 (Yin, 1998, p. 129). *Tariff barriers* instead, remained in place for longer. Tariffs on imports still averaged at 44.05 percent in 1992 and fell to 17.1 percent in 1998 (Yin, 1998, p.126). Further tariff reductions followed the WTO accession in 2001.

Reforms occurred also in the marketing activities. Throughout the reform period interregional markets developed and private trading networks arose with an increased freedom for private trades, benefiting of the dual-track price system set up in 1981 that allowed the development of a free market system alongside with the existing planned economy. Despite the liberalization, the price paid for the agricultural quotas delivered to the State marketing bureaus was much lower than the market price; this inevitably favoring the development of the urban industrial sector over the rural. However, productivity and efficiency grew also in the rural areas, thanks to the re-establishment of the rural markets and the possibility of selling products at market price.

Thanks to the progressive liberalization, China became an export-led economy. It climbed up the ranking of world's larger traders, going from the 32nd position in 1978 to the 6th in 2001 with a trade-GDP ratio equal to 42.78 percent in 2002 (Wan, Lu, Cheng 2007). In 2010 China was 2nd for exports and 3rd for imports in the CIA ranking of the world largest exporters and importers[12].

Special Economic Zones (SEZs)

The gradual Opening Of The Chinese Economy pass through the establishment of five Special Economic Zones (SEZs) in three provinces, Guangdong, Fujian, and Hainan in 1980. In the SEZs, exporting firms were granted special privileges such as the right to import their intermediate inputs without duty. Here also Foreign Direct Investments were encouraged, although they started to pour in only after 1984. The success of these pilot SEZs led in 1984-1985 to the granting of a similar regime to 14 coastal cities

[12] https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html

of further 8 provinces (Jian, Sachs, Warner 1996). In 1992 China experienced a second wave of FDI inflow and became in 2002 the number one in the world for amount of FDI received - US$52.743 billion (Wan,Lu, Chen 2007). FDIs brought capital and technology for economic growth and on the same time boosted the development of non-state enterprises. In 1992, the industrial output value of the non-state sectors reached 51.9 percent of the total industrial output (Wan,Lu, Chen 2007).

Rural reforms

The two main determinants of the rural economic growth in the first phase of the economic reforms have been the increased agriculture productivity and the expansion of the non-agricultural sector - both consequences of the rural reform.

Starting in 1979 till 1985, a new policy - *The Household Responsibility System (HRS)* – disposed the dismantling of the people's communes and the allocation of land rights to farm households. Each household typically received by the village 4-6 separate small plots of the collective owned land (USDA 2009) for a period of 15 years and had to compile to the obligation of delivering a fixed quota of "strategic crops" to the State marketing bureaus at a predetermined price. In this new system, farmers gained the freedom of producing more than the established quota and to use the surplus for self-consumption or for selling it at market prices on rural markets. Further, farmers could produce cash crops and livestock products aside the required production of strategic products (i.e. grain). Both grain and cash crop outputs boomed during this period thanks to the gains in efficiency from the dismissal of the collective working mode and the price-premium of selling surpluses on the market.

Equally important, the rural reform encouraged the non-agricultural activities, giving birth to small-scale industrial, construction, and commercial enterprises – *the Township and Village Enterprises (TVEs*). TVEs absorbed the excess of labor resulting from the closure of the people's communes and the huge rise in the agricultural labor productivity. By 1992, TVEs were responsible for32.2 percent of the total output value and more than 24.2 percent of the rural labor force (Gang 1994).

Industrial reforms

In 1978, 78% of total industrial output produced and 60% of the non-farm workforce employed came from the State Owned enterprises (SOEs); the rest was provided by collective-owned enterprises (OECD 2010c). The SOEs had to compile to a mandatory production plan; prices were set by the pricing authorities and wages and salaries followed a national scale, independently from the productivity (Lei, Yao 2009). With the industrial reform, the setting up of private firms was authorized and although the SOEs continued to expand, their share of total employment and output declined in favour of the growing private sector. Within the SOEs, manages obtained more autonomy in the decision making process and enterprises were allowed to retain profits under a set of conditions imposed by the Ministry of Finance and the local finance bureaus(Lei, Yao 2009). These measures aimed at increasing the efficiency of the industrial sector, under the threat that inefficient units and companies would shut down or be merged. The reformed SOEs were also allowed to hire personnel without following the state appointments and to dismiss the redundant labor. Gains in efficiency boosted both the private industrial sector and the SOEs. The higher profits were supported also by the relaxation of the internal migration policy, allowing labor mobility from the rural to urban areas thus creating the condition of labor abundance in urban areas and the driving down of the market salaries.

In the 1990s following the SOEs reform, the government introduced a side-measure- a programme called Minimum Living Allowance (MLA) to absorb the shock of the increasing redundant labor dismissed by the SOEs. With this programme, local authorities provided assistance to people recognized to be under a certain threshold corresponding to the Minimum Cost of Living (MCL); those people could receive by the State a top-up income corresponding to the difference between the MLA and the MCL and other supplementary health and education benefits. This system was first applied to the urban areas and much later extended to the rural areas; here progress were slow and by 1999 only 11 provinces had fully implemented this system. Only in 2007 90% of the rural counties were covered by the MLA (OECD 2010c).

Fiscal Reforms

With the economic reforms, China underwent a program of fiscal reforms with the intent of spreading investment across the country. First, the fiscal reform promoted allocative efficiency, through the decentralization of the fiscal system that gradually gave back the fiscal power to the provinces. This provision caused however a slow-down of the rural economy provided that intergovernmental transfers disappeared and many rural governments were left with a thin tax base; heavier fees and taxes were thus imposed on farmers to fund local services (USDA 2009). Second, marginal corporate income tax rates were applied to foster the development of TVEs in the interior as well as in the coastal areas. Prior to the 1994 tax reform in fact the marginal corporate tax rates ranged from 10% to 55 and the effective average tax rate for TVEs resulted much lower than the one of SOEs; it was estimated that in 1992 the average tax rate for TVEs was only 21% compared to 29% for SOEs (Jian 1997).

The 1994 tax reform shifted the economy to a flat tax rate putting forward the idea of a uniform tax rate system with no differentiation among private, collective or state-owned enterprises that would enhance competition in the industrial sector. 33% corporate tax rate was then applied to all kinds of firms (Jian 1997). The switch to flat corporate tax rates had substantial drawbacks on the equal development of the country. First, the costs for TVEs increased both in absolute terms as well as relatively to larger firms. Second, the economic development of the interior was penalized by the more favorable tax rates of the SEZs (about 15%) and the so-called "Development zones" (24%), having the effect of directing the industrial investments more towards the urban and coastal areas (Jiin 1997).

ESSAY II
BENCHMARKING DEVELOPMENT WITHIN CHINA

An Indicator of Local and Regional Development

Abstract

China is a highly heterogeneous country, characterized by enormous spatial disparities between provinces and within provinces. The heritage of the "urban-biased growth strategy" undertaken by the central government has been a sharp increase of spatial disparities, of which the rural-urban dichotomy represents a large share. To better understand the degree of inequality characterizing China and the long-term projection of convergence or divergence of its different territorial units, we decided to benchmark the degree of development within the country. The outcome of this research has been a composite indicator of regional development (RDI) that goes beyond the uni-dimensional concept of development, generally proxied by the GDP per capita and gives attention to the rural-urban dimension of development. The RDI is composed of five dimensions: Macroeconomic Climate, Research and Innovation, Human Capital, Infrastructure and Economic Efficiency; the last three dimensions have been computed at rural and urban level and then aggregated as a weighted average into a province level value.

Introduction

China is a highly heterogeneous country, characterized by enormous spatial disparities between provinces and within provinces. In the previous paper, "Convergence in China" we described some of the main features of the unequal development path followed by China since the adoption of the market reforms in 1978. The most striking element is perhaps the explicit "urban-biased growth strategy" undertaken by the central government, with the objective of speeding up economic growth and catch up with the international economic standards. The heritage of this set of policy measures has been a sharp increase of spatial disparities, of which the rural-urban dichotomy represents a large share.

To better understand the degree of inequality characterizing China and the long-term projection of convergence or divergence of its different territorial units, we decided to benchmark the degree of development within the country. In this exercise we decided to go beyond the uni-dimensional concept of development, generally proxied by the GDP per capita; also we explored further the level of development within the Chinese provinces, giving attention to the rural-urban dimension. The outcome of this research has been a composite indicator of regional development (RDI) for the Chinese provinces[13]. This indicator is computed as the average of five dimensions considered important drivers for the economic development of the province: Macroeconomic climate, Research and Innovation, Human Capital, Infrasturcture and Economic Efficiency. The last three dimensions have been computed at rural and urban level and then aggregated as a weighted average into a province level value[14]. The availability of data for these three dimensions has allowed us to work on a further disaggregation level, thus improving our understanding on the rural and urban contexts. The choice of the time period of this analysis has been restricted by the data availability and we could compute the RDI only for two years, 1996 and 2006 (see Annex 1 for more details). In the remainder of the paper we will present the definition of the Regional Development Indicator, the step-by-step procedure for the computation of this indicator and finally the results of multidimensional approach to convergence via the use of the RDI as measure to test convergence in China.

[13]In this paper we will use indistinctively the term "region" or "province"; both terms refer to the highest-level administrative division of the People's Republic of China (PRC) with the exclusion of the 2 special administrative regions (Hong Kong and Macau). The list considered in this paper encompass the 22 provinces (Anhui, Fujian, Gansu, Guangdong, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Yunnan, Zhejiang), the 4 municipalities (Beijing , Chongqing, Shanghai, Tianjin) and the 5 autonomous regions (Guangxi, Inner Mongolia, Ningxia,Xinjiang, Tibet)

[14] The share of population in the two areas has been the weight use in the aggregation procedure.

1. The Step-by-Step Methodology: from Theory to Practice

The concept of development has for long been associated to that of economic growth. In this perspective the variable used for comparative analysis has been the GDP per capita. One of the crucial debates in the economic growth literature has been whether or not countries with lower initial per capita level exhibit higher growth rates than the richer counterpart. The process of catching-up of the poorer economies with the richer ones goes under the name of β-convergence . The origin of this concept traces back to the neo-classical Solow-Swan model (Solow 1956; Swan 1956). According to it, economies are described by a classical production function where the output is determined by the combination of two factors (capital and labor) with decreasing marginal returns and constant returns to scale. The long run economic equilibrium of a country – the steady state- is determined by the population growth rate, the savings rate and the technological progress. When a country is below the steady-state level – thus having a lower stock of capital per labor - will enjoy higher marginal returns to capital and grow faster than richer countries. This process makes that all countries in the long run will converge to the same level and rate of growth of the per capita income. This hypothesis, known as *absolute convergence*, has been criticized to be more a theoretical construct than a reality (Quah 1993). Some empirical studies[15] have contributed and supported the Solow model as the authors found trace of convergence among countries sharing the similar fundamentals. This gave birth to the concept of *conditional convergence*, which predicts that countries move towards their own steady states determined by the structural characteristics of their economy; similar countries converge to the same steady state. Another strand of the literature, the endogenous growth, highlighted instead the importance of innovation and human capital as determinant of growth (Romer 1989). In this case, the functioning of the economy is not bound to the assumption of decreasing marginal returns to capital; on the contrary, investment in human capital, innovation and knowledge are significant contributors to economic growth

[15] Barro and Sala-i-Martin (1991); (Sala-i-Martin 1996); (Cashin 1995)

and explain persistent growth paths. According to this theory economic development occurs as a consequence of the positive externalities and spillover effects of a knowledge-based economy.

Drawing from the mainstream literature on growth, we identified five dimensions, being potential good benchmarks for the degree of development within China: *Macro-Economic Climate*, *R&D and Innovation*, *Human Capital*, *Infrastructures* and *Economic Efficiency*.

Accounting for those dimensions partly overcomes the myopia of looking at development only in economic terms. The RDI is a multi-dimensional indicator of development that goes beyond the analysis of a single economic variable (such as the GDP). It is indeed to be seen as a "middle-way" from the solely economical perspectives on development (e.g. studies taking into consideration only GDP per capita) to the opposite strand of the literature, which privileges the focus on the living conditions and well-being of the population (e.g. the Human Development Indicator -HDI). The RDI provides some insights on the variable that mostly influence the economic growth of a region, but on the same time leaves room for socio-economic considerations related to the education of the population, water accessibility, distribution of hospitals and doctors and other socio-economic variables.

With respect to the HDI, the RDI could be seen as a more appropriate measure of development for the regional level. Indeed, the HDI is an index generate for international comparison purposes. Going for breadth in international comparisons has however the deficit of sacrificing some depth, mainly related to the specificity of each different context under analysis. When applied to the regional level it can be argued that the HDI does not synthetize the bulk of internal disparities affecting the development of one country's regions. The HDI is composed by a simple average of three indicators (Life Expectancy; GDP in PPP; Education) that might level out much of the internal differences in crucial dimensions for development. The RDI instead processes a higher number of variables, thus aiming at returning a more reliable image of the reality under consideration.

1.1. Definition of the Dimensions

The dimensions of the RDI are: Macro-Economic Climate, R&D and Innovation, Human Capital, Infrastructures and Economic Efficiency[16]. The first two are measured at province level, while the other three are composite measures, combining the rural and urban components. The province-level dimensions match with the need to provide some "context-variables" in order to measure the general functioning of the regional economy. Treating the R&D as a provincial dimension rather than as a local one (either rural, urban or both) has the benefit of overcoming the problem of data availability[17]. Besides that, it is perhaps more reasonable to treat technology and knowledge at province level, given their ability to rapidly expand and generate spill-over effects and positive correlations across space.

The three dimensions measured locally - namely infrastructures, human capital and economic efficiency - belong to the category of those universally-agreed parameters[18]which foster the economic growth of a country.

The choice of third dimension - *Human Capital* - has a longstanding support in the literature of growth (especially by the endogenous growth theory). The importance of human capital as dimension to be considered when assessing rural and urban disparities finds is supported also by the empirical literature on China. Indeed, rural and urban areas have been found to differ greatly in terms of schooling. Illiteracy rate, for instance was equal to 2.5% in urban areas in 2003, while this figure reached the 8.7% in rural areas (HDR 2005).

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[16]Details on the single variables included in each dimensions can be found in Annex II
[17]Data on R&D investments are not available at local level. Other variables could have been used as proxy for R&D and Innovation, such as the mechanization of agriculture (for rural areas) or the level of investments in R&D by foreign firms (for urban areas), however this would have raised concerns on the comparability and validity of the variables chosen. Indeed, other than R&D expenditure, patent applications and high-tech education, there seems not to be not much consensus in the literature on the variable used to proxy innovation and technological progress.
[18] Over time, the evolution of the growth literature has pointed out numerous drivers of growth, reaching impressive numbers (see Durlauf, Johnson and Temple (2004) on this point, p.74). There isn't a general agreement on the majority of the regressors included in the growth equations and most of those have not proved to be "robust" across different model specifications. Taking a conservative approach to the identification of the growth dynamics, we have therefore opted for the definition of a few uncontested measures influencing growth.

Infrastructure, instead proxies the level of capital accumulation and investments. Indeed, it is common practice to proxy the level of investments (thefore the capital accumulation) with the fixed assets as percentage of the GDP (Bassanini et al. 2005; Li, Liu, Rebelo 1998). In the specific case of China, this dimension has to be considered one of the main drivers of development for at least two reasons. First, this variable determines the location decision of firms, thus attracting more foreign investors as well as private entrepreneurs. Second, infrastructures play an enormous role in the interdependency of regional economies and their efficiency. An example made by Demuger (2000) regards the distances in China and the fact that the main industrial basis are located on the east coast, while natural resources are on the western part of China (i.e. coal, gas). Also, Jimenez (1995) stressed the importance of infrastructure as facilitator of market transactions and technology and knowledge transfers. The infrastructure network enters therefore the inter-provincial economic activities as a key element that facilitates the transmission and transfer of both tangible and intangible assets across different localities.

Economic efficiency is a representation of the parameter "A" of the neoclassical production function, which enhances the productivity of both inputs (labor and capital). Economic efficiency encompasses two main concepts: the technical and the allocate efficiency (Farrell 1957). The first reflect the capacity to obtain maximal output given a set of inputs; the second deals with the optimal use of inputs given their prices.

1.2. Data check and validation

For each dimension a number of candidate variable have been chosen according to the literature and the positive correlation with the average growth rate of the respective geographic area under analysis. In a second phase the candidate simple indicators have been screened by a set of univariate and multivariate statistical analysis, aiming at checking the consistency of the relation between them and the theoretical foundation of the dimension they belong toas well as the internal consistency of the dimension itself. A set of transformation of the original data have been undertaken where the value of the skewness fell beyond the range defined by two times its standard error. For those variables we applied the Box-Cox transformations[19].

Regarding missing the missing data we adopted two strategies. The first is that of imputation of the data where only one observation of the same variable was missing and the imputation was realistic; an example for this is the case of Chongqing[20]. Another strategy – that of deleting the observations- has been adopted in presence of more missing data, which would have required an imputation exercise with a high probability of failure. This procedure has been adopted for Tibet in the case of the economic efficiency dimension[21].

1.3. Background of the Research

The use of the PCA in the derivation of the components to be aggregated in composite indicators has several examples in the literature (HDR 1993; Tatlidil 1992; Desai 1993; Annoni, Kozovska 2010). Although the most common implementation of the PCA is that of selecting a number of variables and including them all in the same elaboration, we decided to apply a slight modification of this procedure, which has also valuable examples in the literature (Annoni, Kozovska 2010). In particular, instead of running a PCA on the whole dataset we decided to predetermine the set of "development dimensions" and choose a number of representative variables to be included in the PCA performed on each dimension. We run one PCA for each of the two province-level dimensions (Macro-economic climate; R&D and Innovation) and for the rest of the dimensions we performed a PCA on both rural and urban variables keeping them separated for a total of six PCAs. In each analysis we included both 1996 data and 2006 data. This procedure ensured

[19]taking the log for the variables characterized by positive asymmetry and applying the formula $(x^{\lambda} - 1)/\lambda$(Zani, Cerioli 2007)

[20] This method was applied to Chongqing since data are not available for 1996. This municipality was created in 1997 form a secession of the Sichuan province. 1996 data on Sichuan are proportionally equivalent to the sum of 1997 Sichuan and 1997 Chongqing. Therefore we used the assumption that the 1997 share of Chongqing of the sum of the two areas (Sichuan and Chongqing) has been constant between the two years.

[21]Data for the urban dimension of economic efficiency mostly come from the City Yearbook. Data for Tibet were missing for almost all the variables present in this yearbook. We decided therefore to compute this dimension only on 30 provinces.

the inter-temporal comparability of the PCA scores for each province, since the coefficients of the PCA have been kept constant for both years.

1.4. Principal Component Analysis (PCA)

The Principal Component Analysis (PCA) is a data reduction method, which helps to summarize and order the information in a large data set, and hence to avoid double counting. Hotelling (1993) introduced the most famous formulation of PCA, while the methodology itself comes from Pearson (1901). Since the objective of PCA is to maximize the variability explained by the components, the total variability of the p extracted components equals the total variability of the p original variables. It permits easier selection of a sub-set of components (Mazzocchi, 2008). The equation of PCA can be expressed as follows:

$$C = XA' = \begin{cases} c_1 = a_{11}x_1 + a_{12}x_2 + \ldots + a_{1p}x_p \\ c_2 = a_{21}x_1 + a_{22}x_2 + \ldots + a_{2p}x_p \\ \ldots\ldots \\ c_p = a_{p1}x_1 + a_{p2}x_2 + \ldots + a_{pp}x_p \end{cases} \tag{1}$$

where C is the $n \times p$ matrix of principle component scores, X is the data matrix, and A is the $p \times p$ matrix of component loadings. Once the matrix A has been computed, the component scores can be calculated as follows:

$$\hat{a}_{ij} = \frac{a_{ij}}{\sqrt{\lambda_j}} \tag{2}$$

where λ_j is eigenvalues.

We run separated PCA for each dimension. Macro-economic Climate and R&D and Innovation components sere computed on province-level data, while the rest of the dimensions used sub-province level data (rural and urban). From each PCA we retained the scores of the first component as indicator of that dimension, provided that the value of the variance explained was over 55% and that the value of the other components never exceeded the 20%. In the phase of the multivariate analysis we rejected the variables having a negative correlation with the rest of the simple indicators included in the dimension.

The scores of the first component have been saved and transformed into values ranging from 0 to 100 by using the min-max transformation[22].

1.5. Aggregation Method

One of the major issues in the development of a composite indicator is the aggregation method employed to combine the single simple indicators of which it is composed. In this paper we decided to present the RDI obtained as the sum of the single five sub-dimensions.This equal weighting procedure is a common practice in the literature (some examples are The UK competitiveness Index (Huggings and Izushi 2008); the Finnish case (Huovari et al. 2001); the HDI (HDR various editions). Another method is that of weighting the components according to the importance of those, depending on the different stages of development reached by the country/region. This method was applied to the European Regional Competitiveness Index (Annoni, Kozovska 2010) as well as to the World Global Competitiveness Index produced at country level by the World economic Forum. In these cases the stage of development of each country is determined by two criteria (the level of GDP per capita and the share of exports of primary goods on the total exports of goods and services). For the three groups of countries identified the components of the index are given different weights (see Annoni, Kozovska 2010 for further details). This system is conceptually very appealing; nevertheless the different weights given at each dimension is arbitrarily decided by the researcher. For this reason, we retain that the value added of this procedure with respect to the equal weighting is little. We prefer to further explore other methods to give appropriate weights to the RDI subcomponents and we are currently working on a method that stands on the estimation of a model of conditional convergence and the decomposition of the logarithmic variance of the dependent variable into the single contributions of the conditioning variables included into the equation (see Annex IV for further details).

In the case of the three dimensions – Human Capital, Economic

[22]We reported the distribution of the component score within a range defined by the minimum and the maximum of the distribution, according to the formula ((x-min)/(max-min))*100

Efficiency and Infrastructure- instead, we used a weighting procedure based on the share of the population living into the two areas. We first calculated the rural and urban subcomponents of each dimension and then we aggregated the two parts into a provincial value. We also combined the three sub-components into a single indicator for each of the two areas, thus obtaining a Local Development Indicator for the rural and the urban China. In this computation we also employed the equal weighting method.

2. The RDI and the other measures of development

2.1. RDI vs. GDP

Our RDI is highly correlated to the GDP per capita (see Fig.1) demonstrating the validity of this indicator as proxy for the economic development of the Chinese provinces.

Despite that, the two indicators show different outcomes when testing the process of convergence. While the hypothesis of convergence tested on the GDP per capita does not holdFig.2), the opposite happens when taking the RDI as reference Fig.3).

Figure 1 – Correlation between the GDP per capita and the RDI

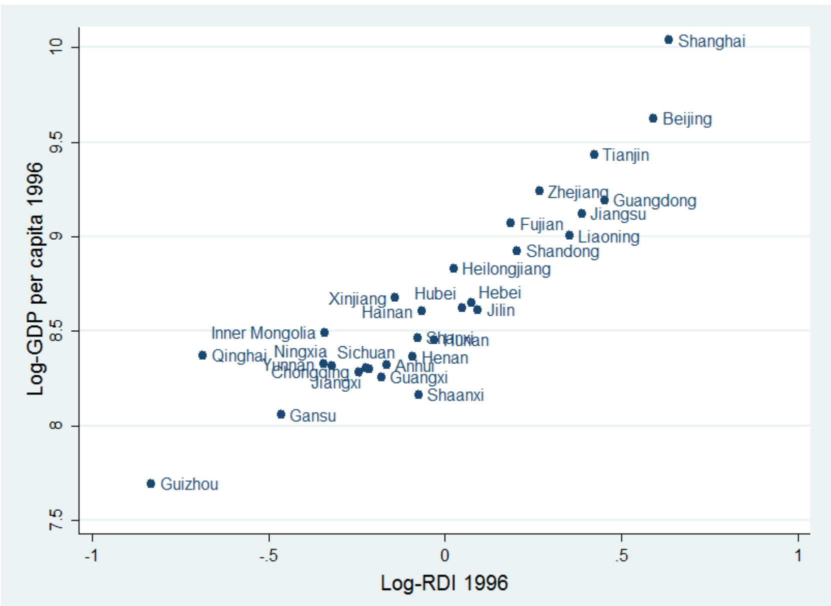


Figure 2 – Absolute Convergence of per capita GDP in China

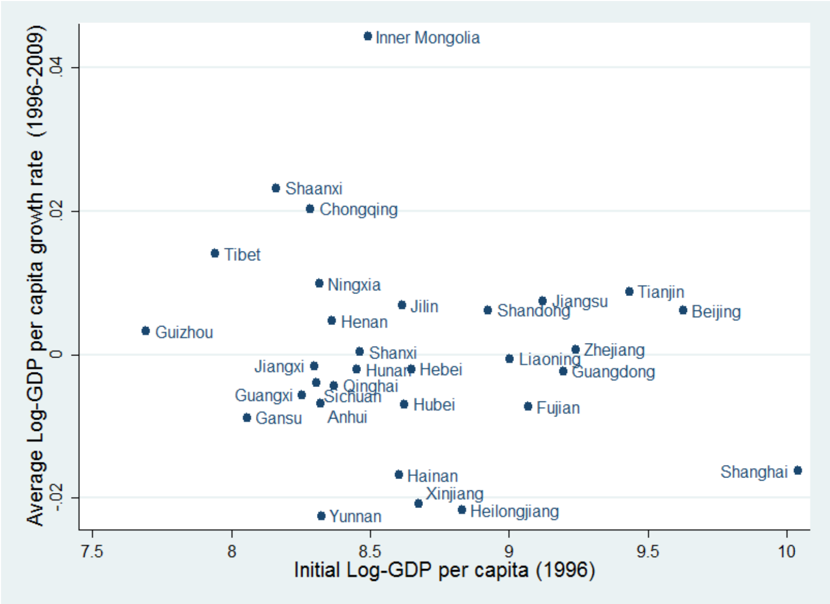
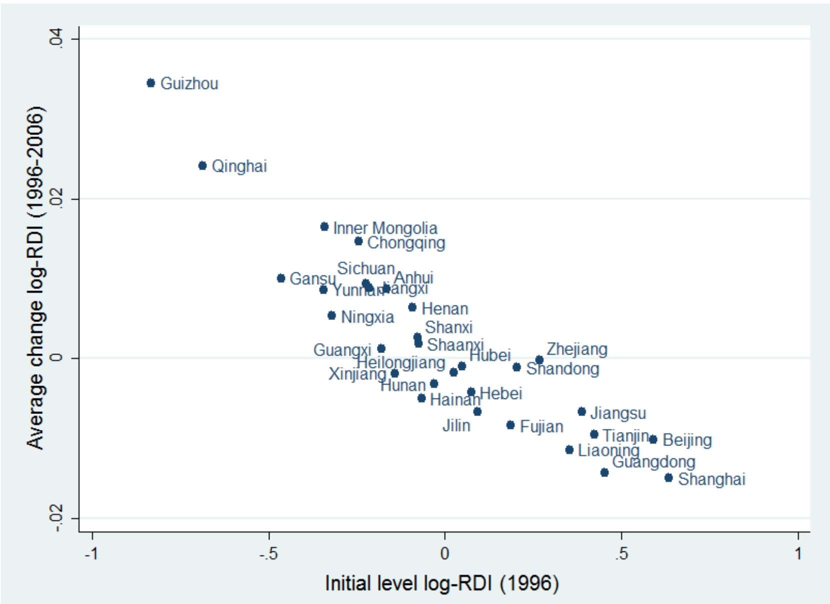


Figure 3 - Absolute Convergence of RDI in China



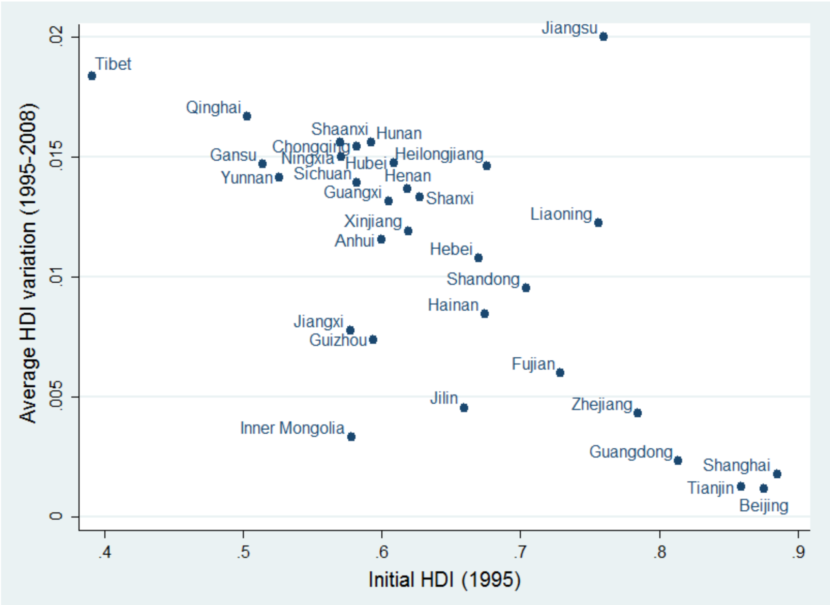
2.2. RDI vs. HDI

We cannot compare the HDI and the RDI for the same years so we won't be able to show the correlation of the two measures[23]. We can compare however the behavior of these two indicators in the context of convergence. As

[23]The HDI for the Chinese provinces has not been produced either for year 1996 or 2006, which are the only to available year of our indicator.

we see in Fig.4 the HDI shows similar results to the RDI. Indeed these indicators reveal a process of convergence among the Chinese provinces.

Figure 4 – Absolute Convergence of the HDI in China



Source: our processing on UNDP data (UNDP, China Human Development Reports various years)

When taking into account composite measures of development there is strong evidence that the provinces with a lower value of the indicator tend to catch up with the most developed ones. This result however is not confirmed by the performance of the GDP per capita and the test for convergence using this variable.

The contradictory behavior of the GDP per capita and the RDI has similar examples in the literature related to the relation between the HDI and the GDP (Gidwitz, Heger, Pineda, Rodriguez 2010).It seems indeed that the HDI tend to show a convergence process even where the GDP does not. Two considerations follow from this evidence. First the HDI and RDI are measures bounded above by 1[24] and one could argue that progress near this bound is limited. This hypothesis has however found not true in the case of

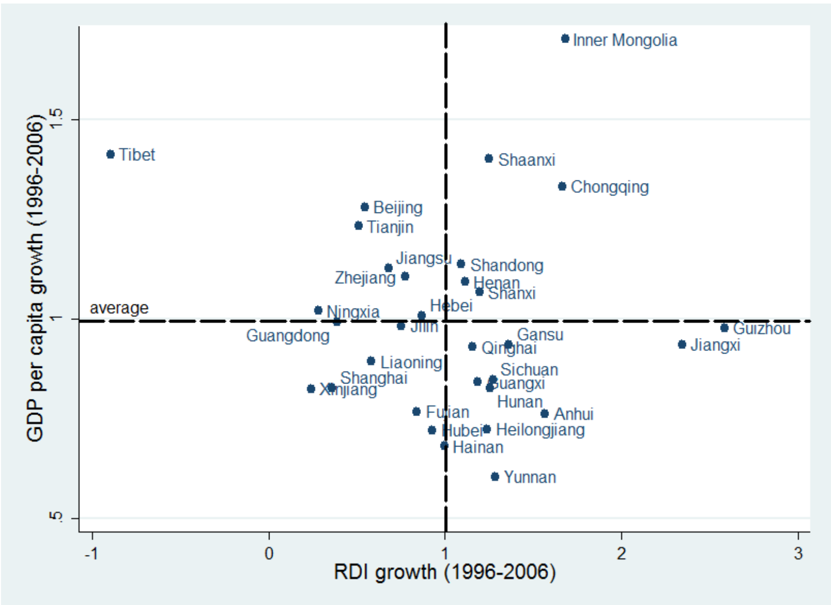
[24]The RDI is bounded to 100 simply because we expressed the value as percentage for improving the readability of the results.

the HDI (Gidwitz, Heger, Pineda, Rodriguez 2010) and the authors argued that the upper bound is simply the effect of the normalization process and has no effects on the rate of change of the indicator. This explanation can apply also to our RDI.

A second consideration deals instead with the process of convergence. Why is that visible via RDI and not via GDP per capita? Moreover why changes in the GDP per capita do not automatically translate into change of the RDI of vice-versa?

Fig.6 identifies the provinces which grew faster during the period 1996-2006 and the relation of those and the RDI. As we see in the upper right quadrant Inner Mongolia, Shaanxi, Chongqing, Shandong, Henan and Shanxi are the provinces for which there is a positive correspondence between GDP per capita growth and RDI improvements.

Figure 5 – Correlation between the GDP per capita growth rate and the RDI rate of change



Source: our processing on Statistical Yearbook data (various eds.)

It seems therefore that poorer provinces which are also those ones characterized by a lower value of the RDI tend to grow faster, showing a perfect correspondence between RDI and the GDP per capita and a negative relation between the initial conditions and the speed of growth. At higher levels of both RDI and GDP per capita this correspondence does not occur. In particular it seems that improvements in the RDI (and RDI dimensions) does not translate into a correspondent increases of the GDP per capita, meaning that growth in the GDP per capita is not explained by the growth in the RDI dimensions. This result would suggest a different impact of the variables included in the RDI to the growth of the GDP per capita, leaving unexplained the growth behavior for those provinces with a higher-level of the initial GDP per capita.

3. Convergence: a Multi-Dimensional Approach

In the literature there are just few example of the analysis of convergence that takes as measure of development something closer to people's living standards (2008, Konya & Guisan; Asongou 2012).

In this paragraph dedicated to the multi-dimensional approach to convergence I will employ the Regional Development Indicator and the rural and urban Local Development Indicators[25] to study the tendency of the Chinese provinces to converge or diverge to the mean of the distribution.

These three indicators have been produced for 1996 and 2006 and this allows us to infer on changes occurred within this interval. Given the fact that we have only two years of data, we won't be able to look at the dynamics ruling the evolution of the distribution; thus our approach will be static. For this analysis we will look at the kernel density distribution.

3.1. Analysis of the Kernel Density of the RDI

To proceed to the estimation of the Kernel density function we transform our RDI data in order to take into account the changes in the mean values of the distribution at time 1996 and at time 2006. We therefore normalized the values of each observation with the correspondent average value for that year. The outcome has been a distribution centered on a unitary mean value. In the next pages we will present the results of the inter-temporal comparison of each dimension for both rural, urban and the aggregate province level.

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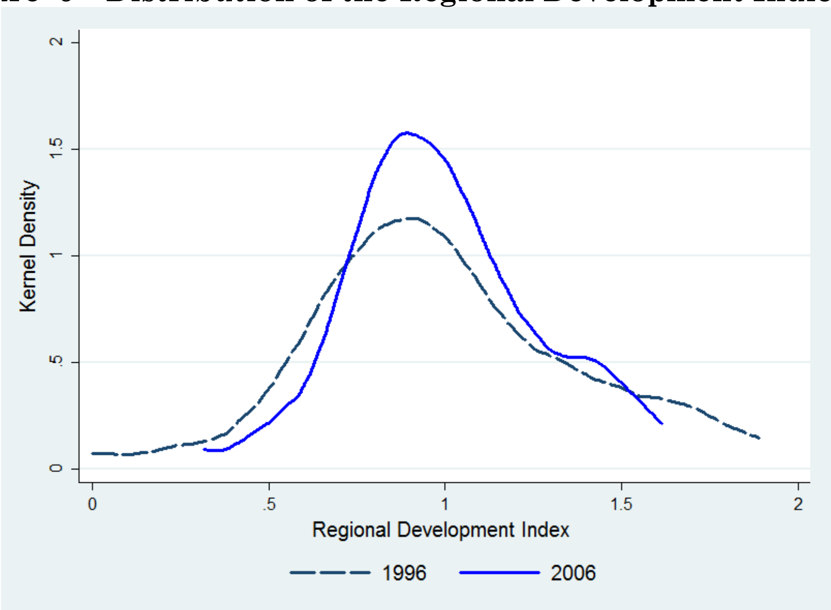
[25] While the RDI (calculated at province level) includes the R&D and Innovation and the Macro-economic Climate, the LDI (Local Development Indicator) is calculated for the rural and urban areas separately and is composed of only three dimensions (those for which rural and urban data were available).

In Fig. 6 it is represented the kernel distribution of the RDI in 1996 and 2006. In this time-interval the distribution has become more concentrated around the mean value, indicating that the distance across the Chinese provinces in terms of development has reduced over time. In 2006 it is also possible to identify a prominence around a value of the RDI which is 40% higher than the sample mean that represents a minor group of more developed regions clustering around this value of the indicator.

Figure 6 – Distribution of the Regional Development Indicator



a) h[26]= 0.1492 for the 1996 distribution
b) h= 0.1207 for the 2006 distribution
Source: Author's calculation

At rural level (Fig. 7) the distribution has followed a similar evolution. The level of the RDI was more dispersed in 1996 than in 2006. In this second year the distribution is more concentrated around the sample mean. The persistence of the lower tail still indicates the presence of some extreme values, that is some provinces with a much lower degree of development[27].

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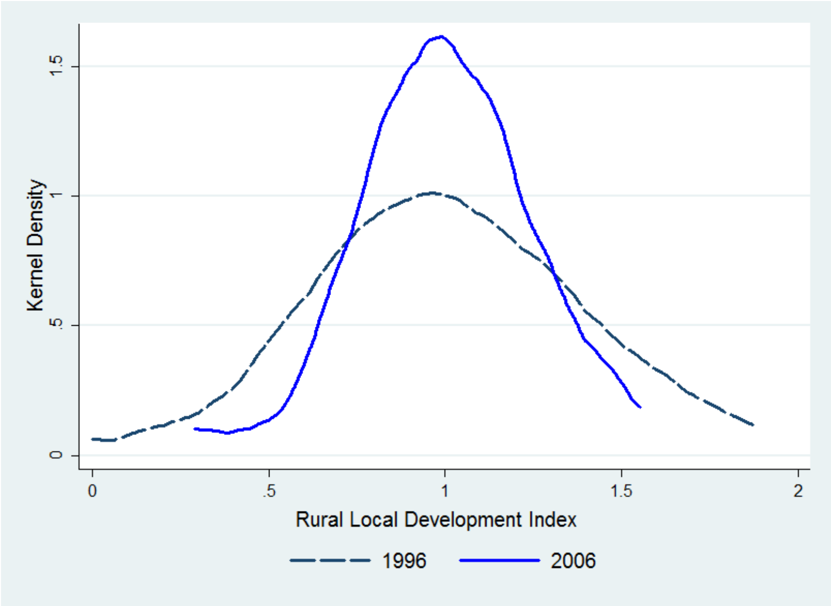
[26]The formula used to calculate the optimal bandwidth h is the one proposed by Silverman: $h = \frac{0.9m}{n^{1/5}}$, where $m = min\left(\sqrt{Var(X)}, \frac{\text{IQR(X)}}{1.349}\right)$, n is the number of observations, Var(X) is the variance and IQR(X) is the first quartile of the distribution (Silverman 1992).

[27] In Annex III are reported the rankings of the RDI and all the sub-dimensions for further details.

Figure 7 - Distribution of the Rural Local Development Indicator



a) h= 0.1756 for the 1996 distribution
b) h= 0.1066 for the 2006 distribution
Source: Author's calculation

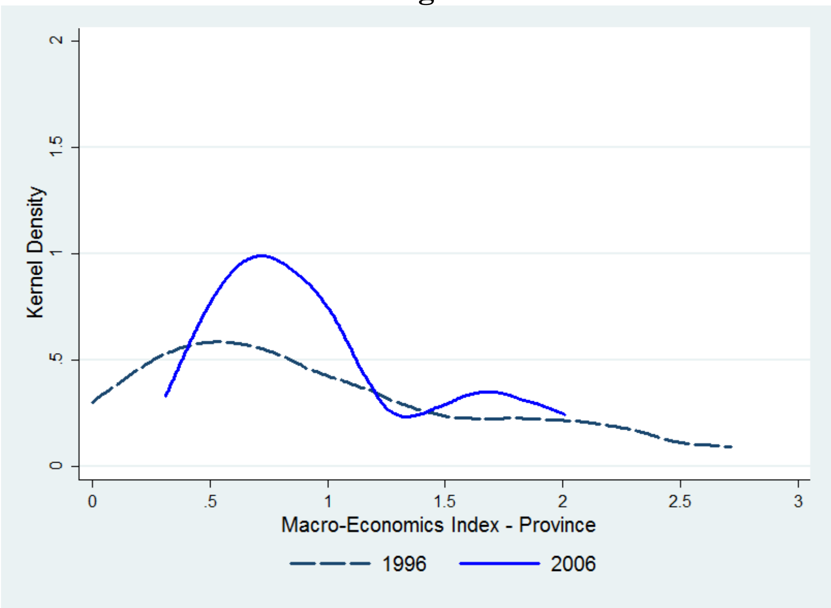
In urban areas (Fig.8) we see that there has been an overall tendency of the provinces to come closer to the average value. Nevertheless the distribution of the indicator has been inverted, meaning that in 1996 the distribution was characterized by a longer tail above the value of the sample mean (1), while in 2006 it is the contrary. This change in the shape of the distribution indicates that the urban areas with a lower value of the LDI have not improved with respect to the average. Improvement in terms of this indicator have therefore been experienced by the provinces falling in the middle of the distribution rather than on the extremes.

Figure 8 - Distribution of the Urban Local Development Indicator

a) h= 0.1911 for the 1996 distribution
b) h= 0.0819 for the 2006 distribution

Let's now turn to each of the dimensions included in the RDI. The indicator of Macro-Economic Climate has turned into a bimodal distribution during the 1996- 2006 period. We see in fact that the majority of the provinces have a score which is below the average (around 70% the average), while there is a group of provinces (larger than in 1996) now reaching a score value 80% higher than the average. The indicator of Macro-economic climate embodies the general economic context of the province, defined by the degree of openness , the consumption , the activity rate of the population and the GDP per capita. In terms of these variables we can see that the regional disparities have grown in China, moving towards a more polarized distribution.

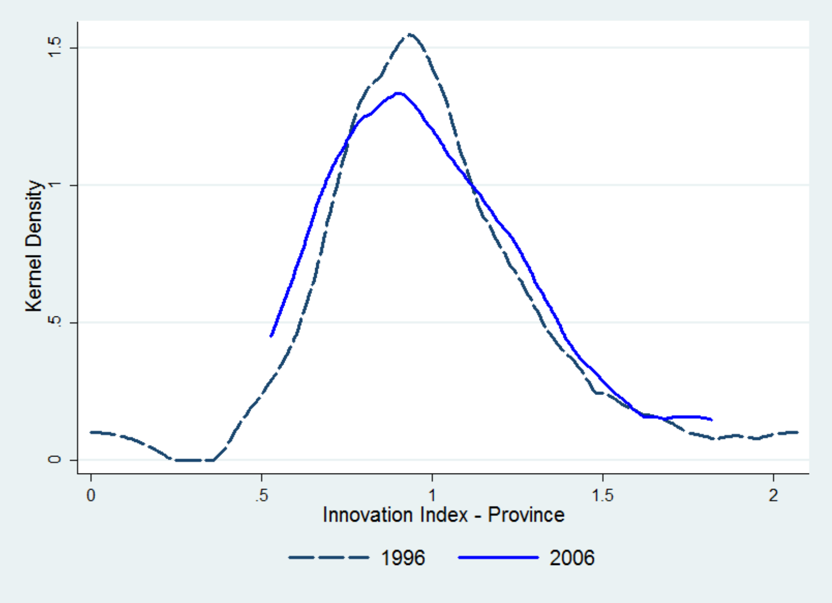
Figure 9 - Distribution of the Regional Macro-Economic Climate



a) h= 0.3436 for the 1996 distribution
b) h= 0.2171 for the 2006 distribution
Source: Author's calculation

In terms of innovation the distribution was symmetric in 1996. In 2006 instead the density is higher around values below the average, while is more dispersed for the positive values of the indicator. This means that there is more concentration around values below the average, while provinces scoring higher than the average do not show the tendency to reach similar values.

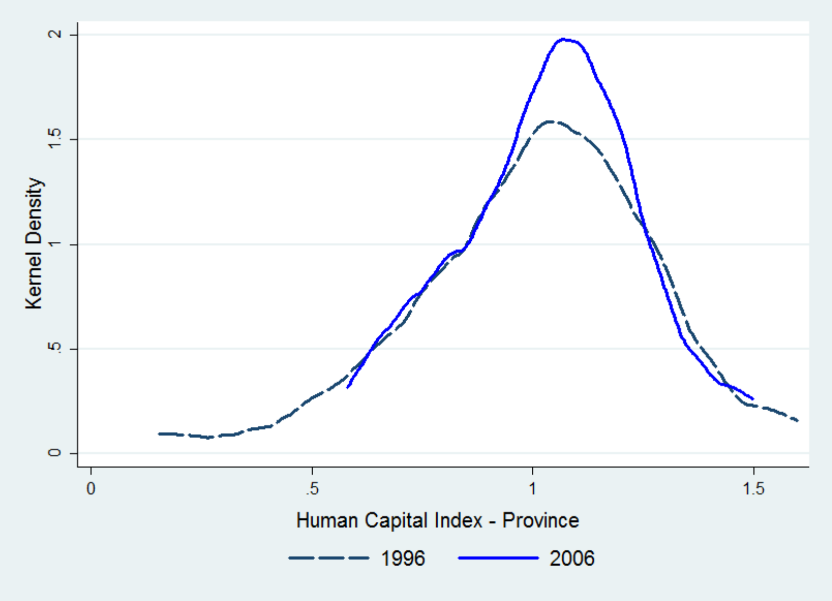
Figure 10 - Distribution of the Regional R&D and Innovation



a) h= 0.1067 for the 1996 distribution
b) h= 0.1271 for the 2006 distribution
Source: Author's calculation

In the dimension Human Capital, there has been almost no change in the distribution. For those provinces having a value of the index higher than the average the situation is similar; in the lower end of the distribution instead, the situation is more heterogeneous, despite the overall improvement of the Human Capital indicator.

Figure 11 - Distribution of the Regional Human Capital

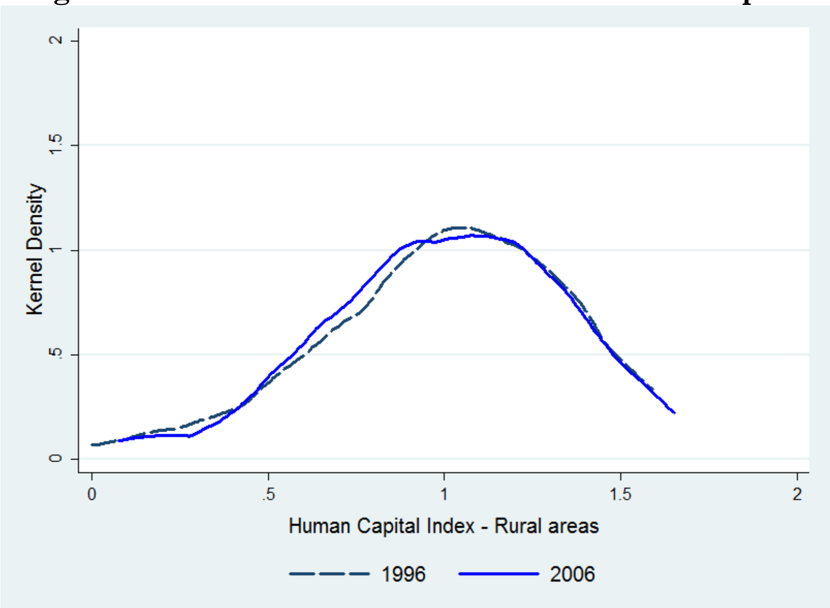


a) h= 0.1160 for the 1996 distribution

b) h= 0.0891 for the 2006 distribution
Source: Author's calculation

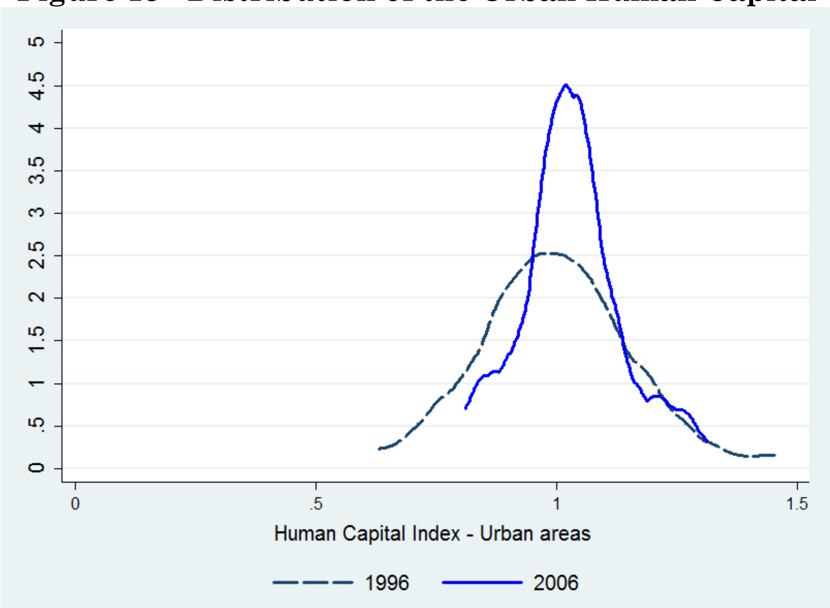
At sub-province level the situation is diverse. The rural areas are characterized by a more dispersed distribution, with higher heterogeneity among those provinces with lower scores (Fig. 12). Between 1996 and 2006 there has been no change in the distribution. Urban areas instead are characterized by higher level of the indicator and display a strong tendency of the situation to equalize across the areas. The density around the mean is indeed much higher (Fig.13).

Figure 12 - Distribution of the Rural Human Capital



a) h= 0.1529 for the 1996 distribution
b) h= 0.1547 for the 2006 distribution
Source: Author's calculation

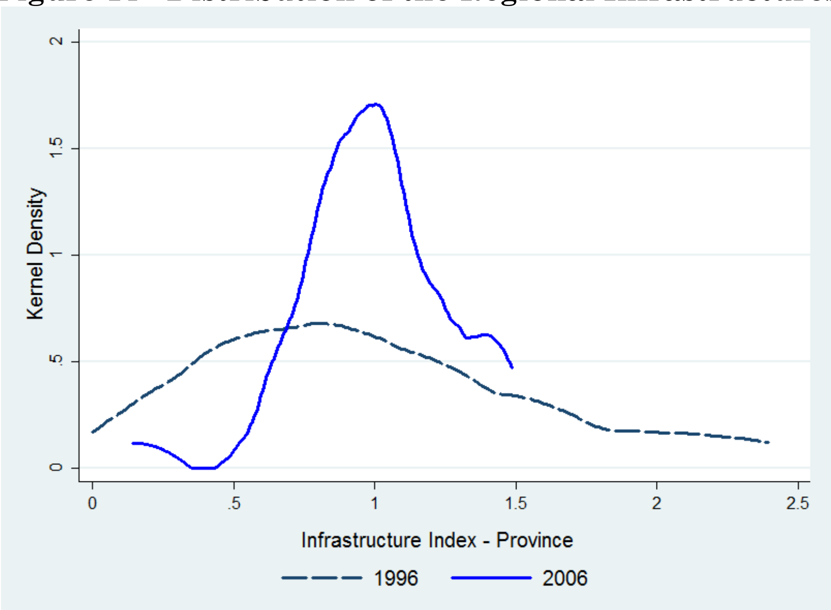
Figure 13 - Distribution of the Urban Human Capital



a) h= 0.0688 for the 1996 distribution
b) h= 0.0344 for the 2006 distribution
Source: Author's calculation

The degree of development of the infrastructure has become more homogeneous over time (Fig.14). In 1996 this dimension was characterized by a higher heterogeneity, with the majority of the provinces concentrated on values below the average and a few provinces with a much higher value of this indicator. In 2006 instead, the distribution is concentrated around the average with the exception of some extreme values in the left tail of the distribution and a second mode around 1.4.

Figure 14 - Distribution of the Regional Infrastructures

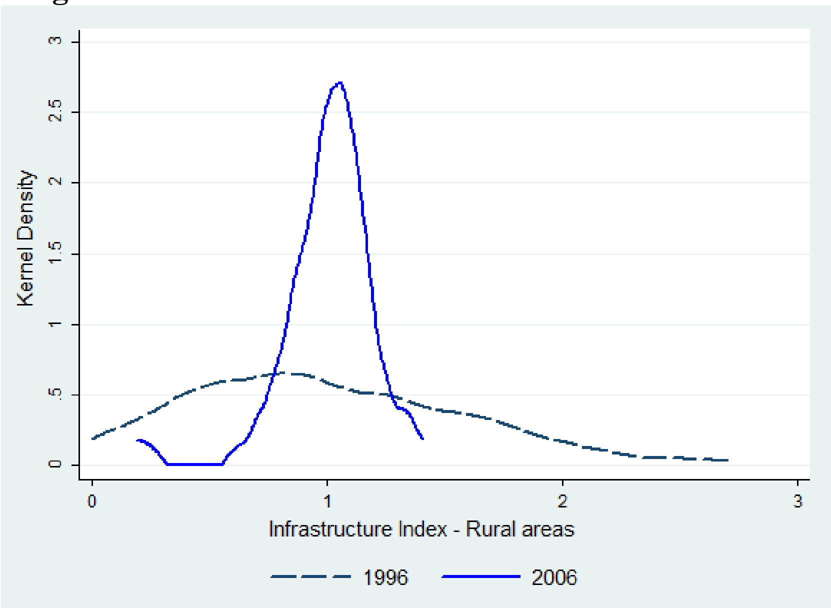


a) h= 0.2522 for the 1996 distribution
b) h= 0.0919 for the 2006 distribution
Source: Author's calculation

The analysis at sub-province level reveals that the shift towards a more concentrated distribution must be seen as the result of what happened in rural areas. Indeed, as we can see from Fig.15 rural areas have all improved their scores and converged towards similar higher value of this indicator.

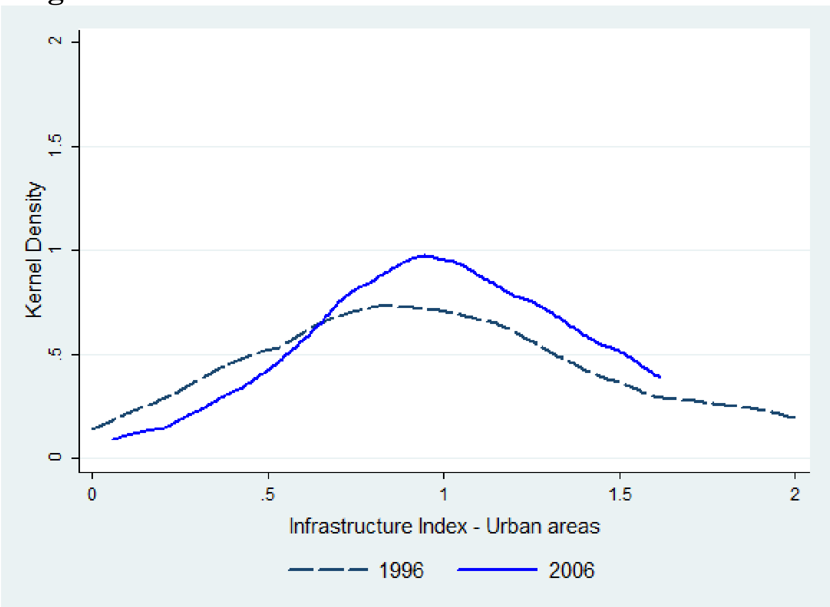
At urban level the situation stays instead more heterogeneous. Despite the overall improvement of the indicator for all the areas, the "distances" between them have been maintained.

Figure 15 - Distribution of the Rural Infrastructures



a) h= 0.2719 for the 1996 distribution
b) h= 0.0604 for the 2006 distribution
Source: Author's calculation

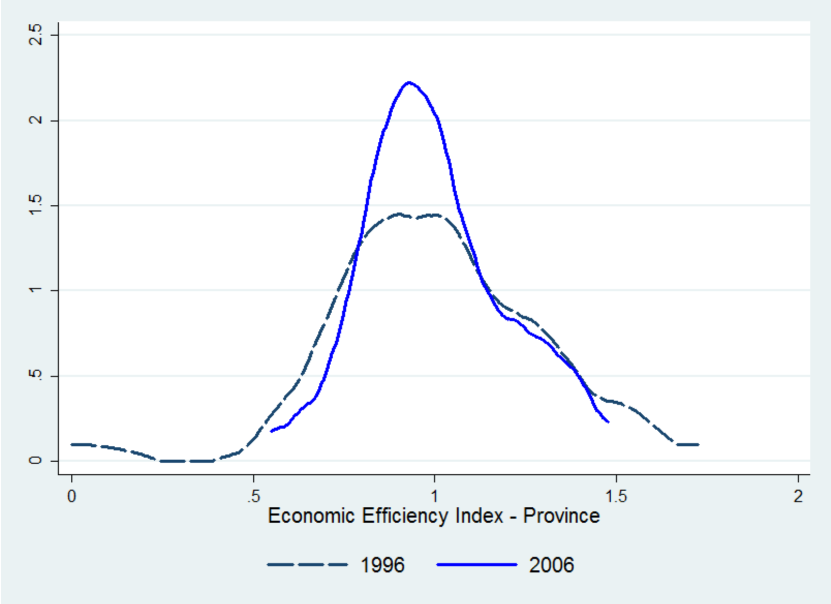
Figure 16 - Distribution of the Urban Infrastructures



a) h= 0.2376 for the 1996 distribution
b) h= 0.1759 for the 2006 distribution
Source: Author's calculation

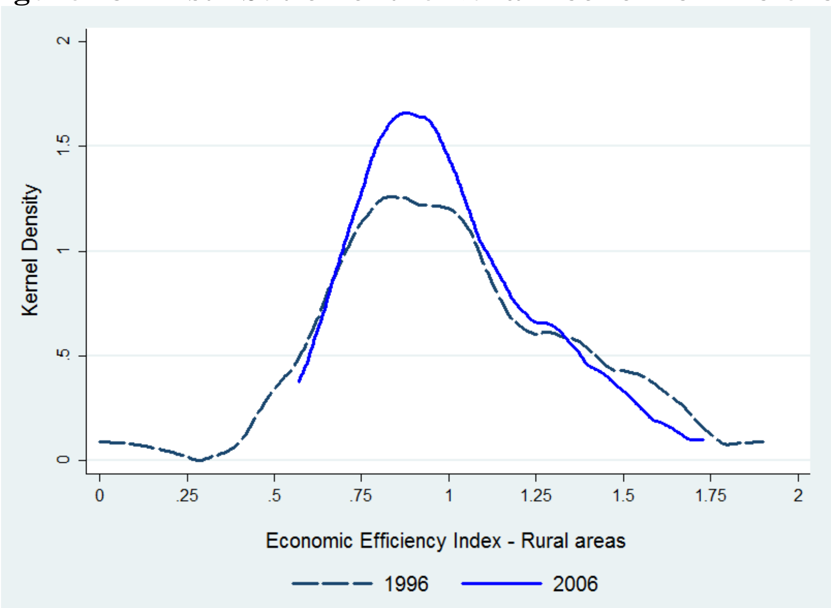
The last dimension taken into consideration is the Economic Efficiency. Between 1996 and 2006 the provinces with a lower level of this indicator have been able to catch up with the average. As we see in Fig.17 the left tail of the distribution has disappeared, instead the density around the unitary mean has increased. To this improvement contribute equally the rural and the urban areas. In Fig.18 it represented the distribution of the Economic Efficiency indicator in rural areas and it is clear that the lower end of the distribution has shifted to a value closer to the average. The longer right-hand side tail reveals instead a wider range of performance among the provinces in the higher part of the ranking (Annex III). In urban areas (Fig. 19) the distribution of the indicator was highly dispersed in 1996 (some provinces reached values 4 times higher than the average). In 2006 instead the whole situation improved and the distribution collapsed to a much smaller range of values going from half of the sample mean to 1.5 times the sample mean.

Figure 17 - Distribution of the Regional Economic Efficiency



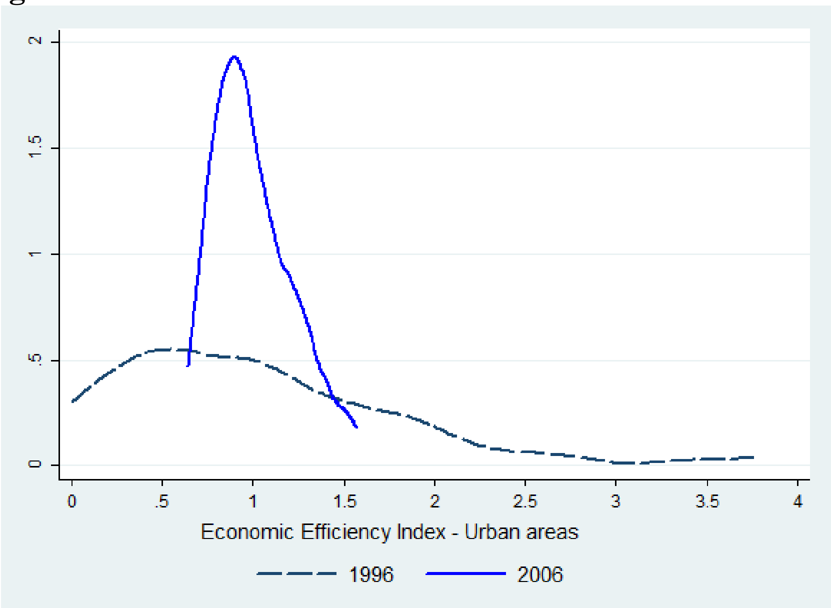
a) h= 0.1099 for the 1996 distribution
b) h= 0.0872 for the 2006 distribution
Source: Author's calculation

Figure 18 - Distribution of the Rural Economic Efficiency



a) h= 0.1242 for the 1996 distribution
b) h= 0.1108 for the 2006 distribution
Source: Author's calculation

Figure 19 - Distribution of the Urban Economic Efficiency



a) h= 0.3301 for the 1996 distribution
b) h= 0.0983 for the 2006 distribution
Source: Author's calculation

4. Conclusions

This paper addressed one of the major issues of the regional development in China: the rural-urban disparities. The current understanding of the nature of these disparities in scares and with this research we aimed at producing a useful instrument for future analysis. The RDI that we propose here process a large number of information relatively to the degree of development in rural and urban areas and reduces all this information into a few indicators. Thanks to the RDI is possible to benchmark the progress of the provinces in terms of development both a province and sub-province level. Not only it gives information on the main determinants of growth, but also provides an overview of the trends characterizing changes in the long run. The RDI proposed in this paper is not the definitive version, as we reckon that much more work is necessary to refine this measure. The paragraph on convergence does not address the convergence in the classical sense of the term. It has rather to be seen as an exercise of comparison of the situation in rural and urban areas at two points in time in order to understand whether provinces have become closer in terms of development and its determinants. Despite the Chinese provinces do not show any tendency to converge in terms of GDP per capita, this paper reveals that the situation has become more homogeneous in terms of development. The performance of rural and urban areas however greatly differ in some development dimensions considered here. In rural areas for instance, the value of the human capital indicator take a larger range of values than in urban areas. This highlights a higher heterogeneity of the rural areas in this dimension which is considered one of the main growth determinants. On the contrary the level of infrastructures has become quite higher in rural areas since 1996, while almost no change occurred in urban areas. Economic efficiency improved both at urban and rural level. Indeed the shift to a market economy has released some redundant labor and shifted it to more productive sectors than agriculture. The overall level of the regional development indicator as well as its rural and urban component has improved over time for all provinces. The rankings reported in the Annex III document the general improvement of the indicator over time and on the same time give an idea of the movement within the distribution.

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ANNEX I

Brief note on the data

Data have been collected from various official sources. Rural data are taken from the two National Agricultural Censuses of China (1996 and 2006), the Rural Statistical Yearbook (1997;1998; 2007;2008 eds.) and the Statistical Yearbook (1997 ;1998; 2007;2008 eds.).

Urban data have been taken from the City statistical Yearbook (1997;1998; 2007;2008 eds.), the Statistical Yearbook (1997 ;1998; 2007;2008 eds.) and the Population and Employment statistical Yearbook (1997 ;1998; 2007;2008 eds.).

Province level data were collected from the Statistical Yearbook (1997 ;1998; 2007;2008 eds.).

Data on the urban population have been estimated as difference from the data published in the two agricultural censuses and the Statistical Yearbook.

Monetary variables included in this paper have been deflated by using the price indexes collected at province, rural and urban level from various annual editions of the Statistical Yearbook. Since the price indexes published in the Statistical Yearbook show the annual percentage change, we collected the Price Indexes for the whole 1996 and 2006 period and deflated the year 2006 data taking 1996 as basis.

In this paper we presented the results of the calculation of the RDI for just two years. However, as our intention is to produce an annual indicator we collected data regarding the whole 1996-2009 period from the above mentioned sources.

ANNEX II

Technical note on the construction of the Local and Regional Development Indicator

LIST OF VARIABLES

Regional Macro-Economic Climate

FDI / GDP

Trade/ GDP

Export / GDP

Employment / Population

Consumption/ population

GDP/ population

Regional Innovation

Employment in R&D Sector

Funding collection in R&D sector

No. Patent Application received/ 10000 people

No. Patent Granted/ 10000 people

Expenditure in R&D/ GDP

Rural Human Capital

% of Towns with middle schools

% of Towns with vocational and technical schools

% of villages with kindergartens

% of illiterate and semi-illiterate employment

% of employment with middle school education

% of employment with high school education

Urban Human Capital

illiteracy rate

Female illiteracy rate

Enrollment in higher education

Female enrollment in higher education

No. higher education institutions/ 10000 inhabitants

Enrollment in high school

Female Enrollment in high school

Rural Infrastructures

% of Villages with access to the highways

% of Villages with telephone network

% of Villages with TV signal

% of Villages with access to tap water

% of Villages with bus station within 5 km

No. of Hospital beds/10000 people

% of Villages with hospital

% of Villages with doctors

Urban Infrastructures

No. of Transport vehicles/ 10000 people

No.passengers/10000 people

No.taxies/ 10000 people

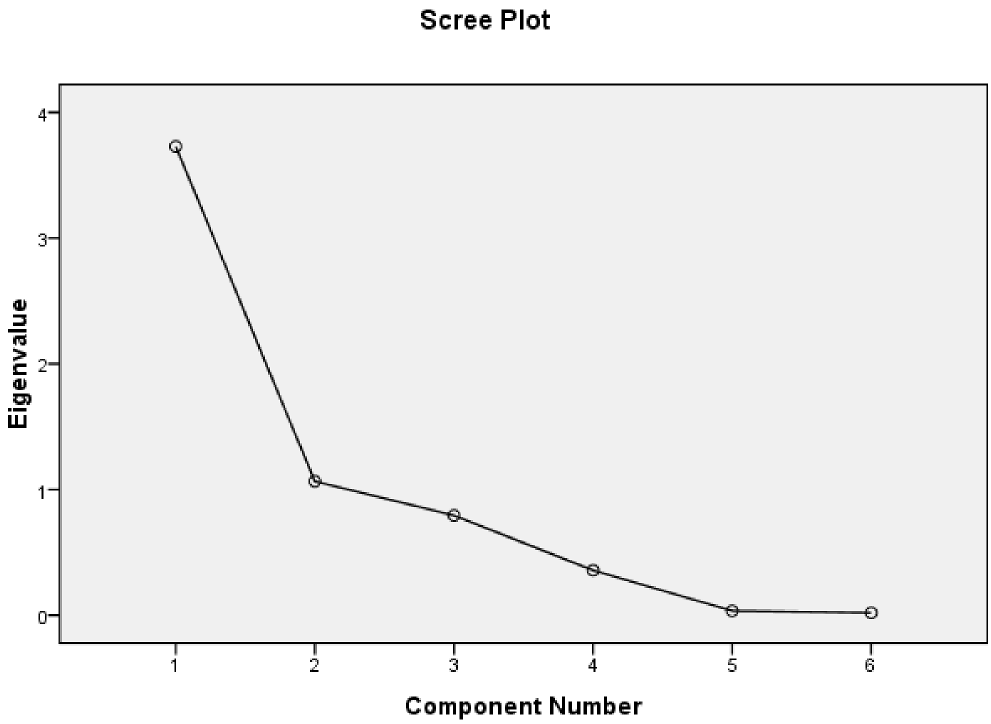
% of population with water access

% of population with gas access

No. of Hospital beds/10000 people

Rural Economic Efficiency	**Urban Economic Efficiency**
Financial Revenues /10000 inhabitants	Labor productivity
Investments in Fixed Assets /10000 inhabitants	Investment in Fixed assets / 10000 inhabitants
Private Employment/Tot Employment	Consumer Goods Retail Sales/ 10000 inhabitants
Land productivity	Urban average earnings
Productivity of the animal husbandry sector	Private Employment/Tot Employment
% of Towns with special markets	Unemployment rate
Non-agricultural Employment/Tot Employment	Industry pre-tax value added/ 10000 employees
	Foreign capital Utilization / 10000 employees

Macro economic climate



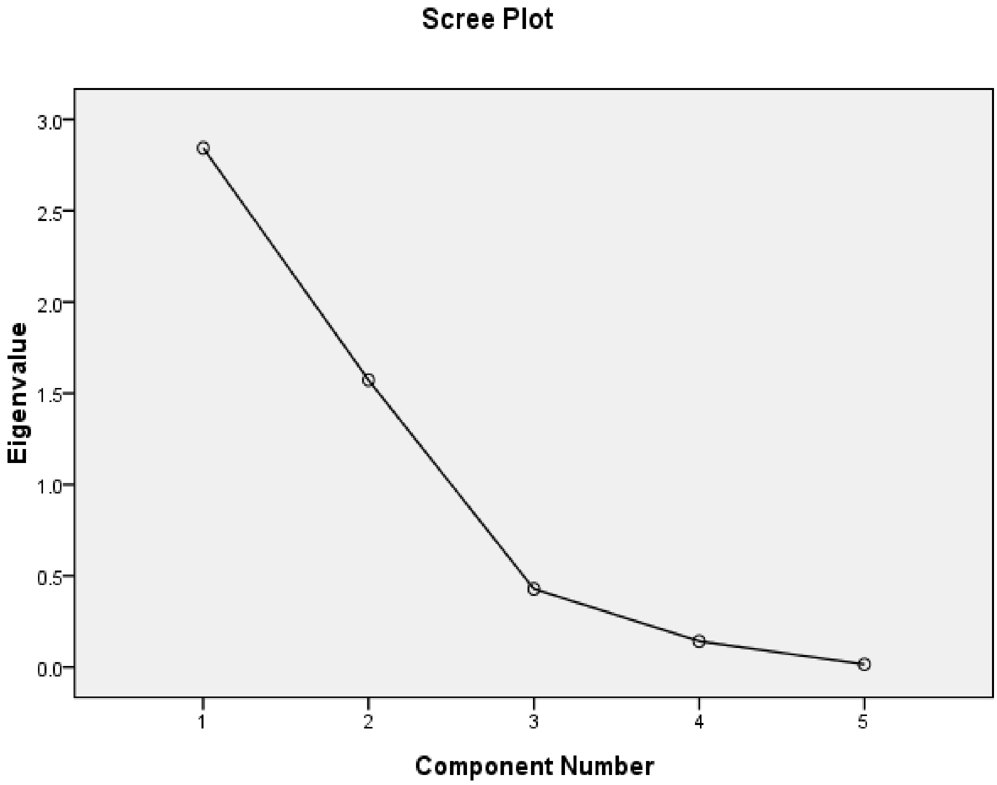
Total Variance Explained

Component	Initial Eigenvalues Total	% of Variance	Cumulative %	Extraction Sums of Squared Loadings Total	% of Variance	Cumulative %
1	3,729	62,153	62,153	3,729	62,153	62,153
2	1,066	17,761	79,914	1,066	17,761	79,914
3	,794	13,230	93,143			
4	,357	5,954	99,097			
5	,035	,580	99,677			
6	,019	,323	100,000			

Component Matrix[a]

	Component 1	2
FDI_ratio	,682	-,390
TRADE_ratio	,921	-,275
EXP_ratio	,905	-,259
Activity_rate	,299	,765
consumpt_pc	,855	,336
GDP_pc	,881	,270

Innovation



Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,844	56,870	56,870	2,844	56,870	56,870
2	1,572	31,448	88,318	1,572	31,448	88,318
3	,428	8,559	96,878			
4	,142	2,831	99,709			
5	,015	,291	100,000			

Component Matrix[a]

	Component	
	1	2
R_D_employment	,697	,565
R_D_funding_collection	,851	,098
Patent_application_received_pc	,801	-,577
Patent_granted_pc	,795	-,587
R_D_exp_GDP_ratio	,599	,752

Rural Human capital

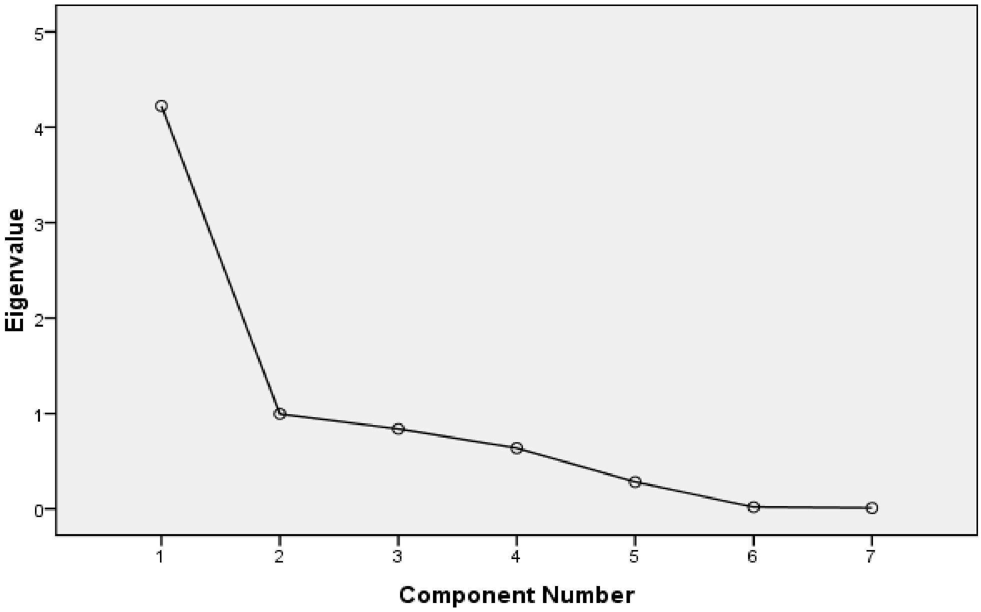
Total Variance Explained

Component	Initial Eigenvalues Total	% of Variance	Cumulative %	Extraction Sums of Squared Loadings Total	% of Variance	Cumulative %
1	3,234	53,906	53,906	3,234	53,906	53,906
2	1,028	17,140	71,045	1,028	17,140	71,045
3	,690	11,496	82,541			
4	,594	9,897	92,438			
5	,297	4,953	97,391			
6	,157	2,609	100,000			

Component Matrix[a]

	Component 1	2
Town_coverage_middle_schools	,675	,356
Town_coverage_vocational_tech_schools	,552	,695
Village_coverage_Kindergartens	,692	,215
illiterate_semi_illiterate_empl_REV	,761	-,519
middle_edu_empl	,919	-,210
high_school_edu_empl	,755	-,245

Urban Human capital



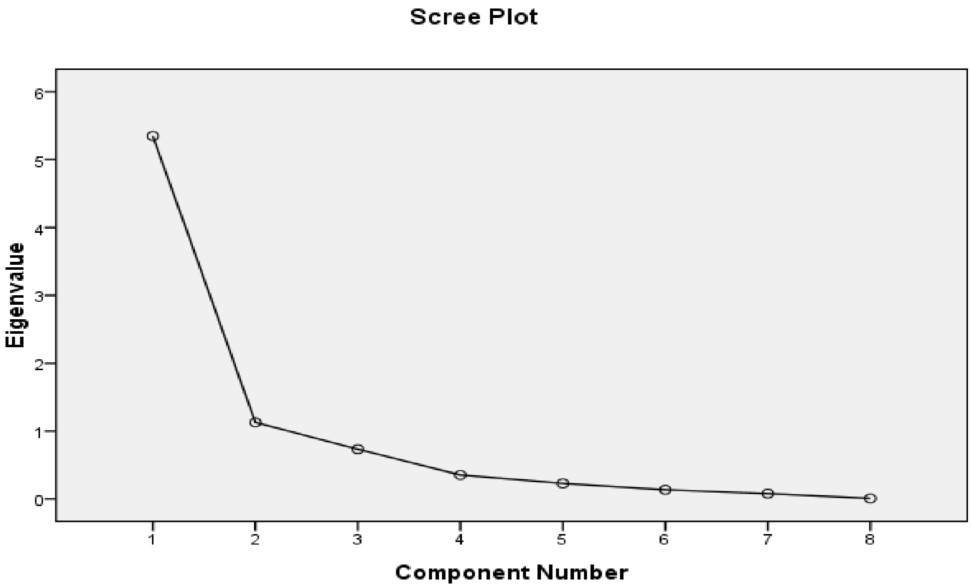
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,2229345	60,3276357	60,3276357	4,2229345	60,3276357	60,3276357
2	0,9951159	14,2159414	74,5435771			
3	0,83749317	11,9641882	86,5077653			
4	0,63574569	9,08208135	95,5898467			
5	0,28173521	4,02478875	99,6146354			
6	0,01773084	0,25329777	99,8679332			
7	0,00924468	0,13206682	100			

Component Matrix[a]

	Component
	1
literacy_rate	0,855145
female_literacy_rate	0,88386098
higher_edu_enroll_ratio	0,8197106
female_higher_edu_enroll_ratio	0,80768196
higher_edu_inst	0,58867689
high_school_enroll_ratio	0,74452706
female_high_school_enroll_ratio	0,69664528

Rural infrastructures



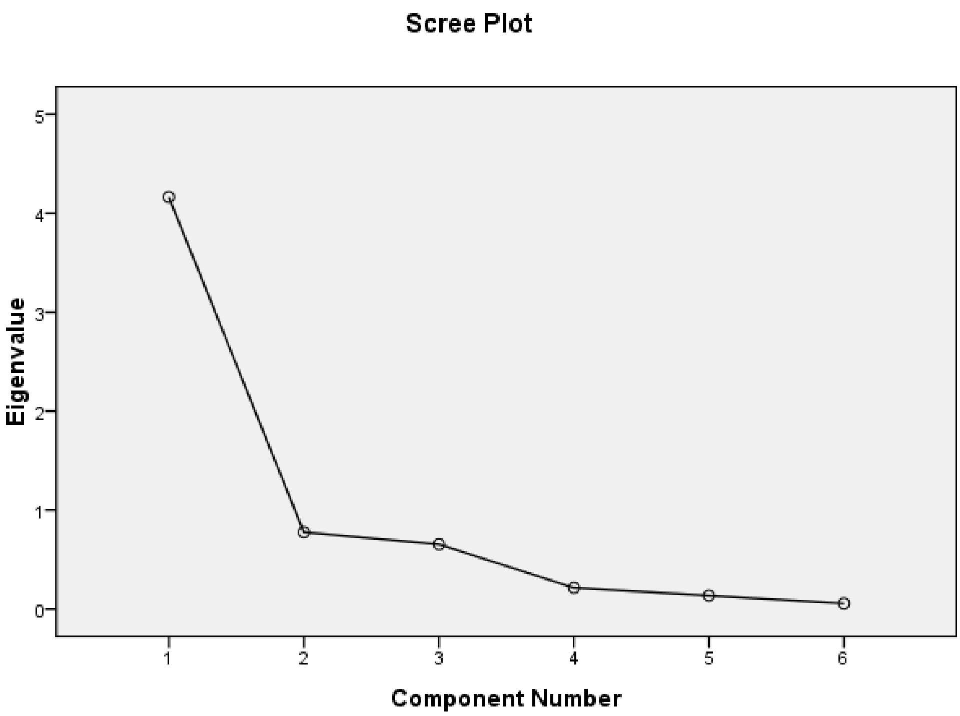
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,348	66,850	66,850	5,348	66,850	66,850
2	1,127	14,093	80,943	1,127	14,093	80,943
3	,732	9,147	90,090			
4	,351	4,390	94,481			
5	,227	2,839	97,319			
6	,133	1,666	98,985			
7	,076	,954	99,939			
8	,005	,061	100,000			

Component Matrix[a]

	Component	
	1	2
Village_coverage_highways	,759	,417
Village_coverage_tel_network	,942	,002
Village_coverage_tv_signal	,694	,526
Village_coverage_water_access	,580	,502
Village_coverage_bus_st_5km	,954	-,117
hosp_beds_10000p	,801	-,104
village_hosp_coverage	,868	-,450
village_doct_coverage	,872	-,445

Urban infrastructures



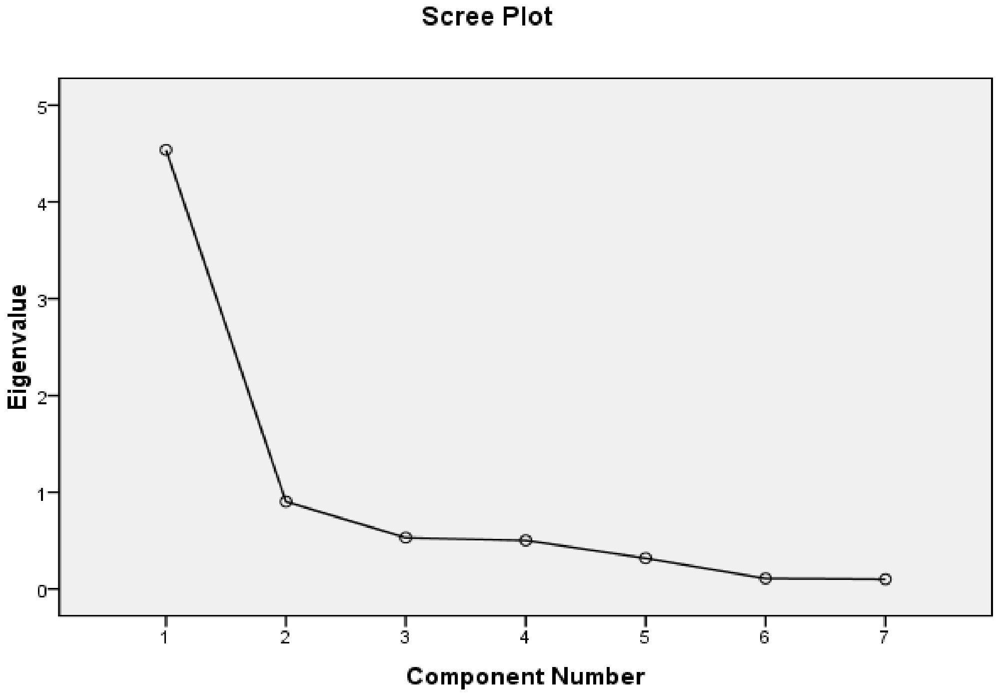
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,164	69,398	69,398	4,164	69,398	69,398
2	,776	12,927	82,324			
3	,654	10,900	93,225			
4	,214	3,573	96,798			
5	,136	2,261	99,058			
6	,057	,942	100,000			

Component Matrix[a]

	Component
	1
trasp_veh	,949
passengers	,950
taxies_pc	,903
water_access	,890
gas_access	,656
beds_hosp	,569

Rural economic efficiency



Total Variance Explained

Component	Initial Eigenvalues Total	Initial Eigenvalues % of Variance	Initial Eigenvalues Cumulative %	Extraction Sums of Squared Loadings Total	Extraction Sums of Squared Loadings % of Variance	Extraction Sums of Squared Loadings Cumulative %
1	4,538	64,823	64,823	4,538	64,823	64,823
2	,903	12,899	77,722			
3	,530	7,571	85,294			
4	,502	7,172	92,466			
5	,318	4,538	97,004			
6	,109	1,555	98,559			
7	,101	1,441	100,000			

Component Matrix[a]

	Component 1
revenue_pc	,816
fix_assets_pc	,950
empl_priv_rur	,902
land_productivity	,784
animal_husb_output_per_empl	,624
town_coverage_special_markets	,748
non_agri_empl	,769

Urban economic efficiency

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,707	71,341	71,341	5,707	71,341	71,341
2	1,166	14,573	85,913	1,166	14,573	85,913
3	,385	4,808	90,721			
4	,331	4,132	94,854			
5	,173	2,168	97,021			
6	,127	1,591	98,612			
7	,071	,886	99,498			
8	,040	,502	100,000			

Component Matrix[a]

	Component	
	1	2
Labor prod	,951	-,188
inv fix asset pc	,913	-,040
consumer goods retail sales pc	,817	,483
urb inhab salary pc	,936	,041
share priv empl_prov	,929	-,238
unempl rate	,727	-,533
ind tax value added empl	,843	-,037
foreign_capital_utilization_empl	,567	,743

ANNEX III

RDI Rankings

Regional Development Indicator (RDI)				
1996			2006	
Shanghai	74		Beijing	100
Beijing	71		Shanghai	99
Guangdong	61		Tianjin	85
Tianjin	60		Jiangsu	85
Jiangsu	58		Guangdong	83
Liaoning	56		Zhejiang	81
Zhejiang	51		Liaoning	78
Shandong	48		Shandong	75
Fujian	47		Fujian	68
Jilin	43		Hubei	64
Hebei	42		Hebei	64
Hubei	41		Jilin	63
Heilongjiang	40		Heilongjiang	62
Hunan	38		Henan	61
Hainan	37		Shanxi	59
Shaanxi	36		Shaanxi	59
Shanxi	36		Hunan	58
Henan	36		Anhui	58
Xinjiang	34		Chongqing	57
Anhui	33		Jiangxi	55
Guangxi	33		Sichuan	55
Jiangxi	32		Hainan	55
Sichuan	31		InnerMongolia	53
Chongqing	31		Xinjiang	53
Ningxia	28		Guangxi	52
InnerMongolia	28		Yunnan	48
Yunnan	28		Ningxia	48
Gansu	25		Gansu	43
Qinghai	20		Qinghai	41
Guizhou	17		Guizhou	39
Tibet	0		Tibet	20

Rural Local Development Indicator (LDI)			
1996		2006	
Shanghai	67	Beijing	94
Beijing	61	Shanghai	84
Jiangsu	48	Jiangsu	74
Tianjin	41	Tianjin	70
Guangdong	28	Guangdong	54
Liaoning	55	Liaoning	78
Zhejiang	46	Shandong	66
Shandong	41	Zhejiang	63
Fujian	77	Hebei	100
Hebei	63	Fujian	85
Hubei	53	Henan	74
Jilin	41	Shanxi	64
Henan	49	Jilin	72
Heilongjiang	37	Hainan	65
Shanxi	53	Jiangxi	75
Anhui	44	Anhui	71
Hunan	46	Hunan	62
Hainan	41	Heilongjiang	63
Jiangxi	57	Hubei	83
Xinjiang	33	Guangxi	61
Sichuan	39	Shaanxi	65
Guangxi	31	Chongqing	56
Shaanxi	34	Ningxia	50
Chongqing	19	InnerMongolia	44
InnerMongolia	27	Yunnan	52
Ningxia	0	Xinjiang	19
Yunnan	33	Sichuan	58
Gansu	24	Gansu	48
Guizhou	19	Guizhou	40
Qinghai	28	Qinghai	56
Tibet	34	Tibet	51

Urban Local Development Indicator (LDI)			
1996		2006	
Shanghai	66	Beijing	100
Beijing	62	Shanghai	92
Xinjiang	59	Jiangsu	84
Guangdong	51	Heilongjiang	82
Liaoning	50	Liaoning	82
Jiangsu	48	Shandong	77
Tianjin	46	Zhejiang	76
Zhejiang	41	Xinjiang	74
Jilin	38	Hunan	74
Hubei	36	Guangdong	73
Hebei	35	Hubei	72
Shandong	35	Tianjin	72
Heilongjiang	34	Shanxi	71
Henan	31	Henan	70
Hunan	31	Jilin	69
Shanxi	30	Hebei	69
Fujian	30	Jiangxi	66
Guangxi	27	Anhui	65
Shaanxi	26	InnerMongolia	65
Hainan	25	Shaanxi	62
Sichuan	25	Guangxi	62
Anhui	24	Sichuan	60
InnerMongolia	23	Chongqing	59
Ningxia	22	Fujian	58
Qinghai	22	Hainan	53
Yunnan	21	Yunnan	52
Chongqing	21	Qinghai	51
Jiangxi	18	Guizhou	49
Gansu	18	Gansu	45
Guizhou	13	Ningxia	29
Tibet	4	Tibet	0

Regional Human Capital			
1996		2006	
Beijing	80	Beijing	100
Jiangsu	72	Shanghai	92
Shanghai	68	Tianjin	90
Tianjin	62	Shanxi	82
Henan	61	Jiangsu	81
Shanxi	61	Liaoning	80
Liaoning	60	Henan	77
Jilin	60	Guangdong	77
Shandong	59	Jilin	76
Hebei	56	Shandong	76
Hunan	56	Zhejiang	75
Guangdong	56	Hebei	75
Fujian	55	Heilongjiang	72
Zhejiang	55	Hunan	71
Heilongjiang	55	Guangxi	71
Hubei	53	Hubei	70
Anhui	49	Jiangxi	70
Guangxi	49	Fujian	69
Hainan	49	Hainan	69
Jiangxi	49	Shaanxi	64
Shaanxi	48	InnerMongolia	63
Xinjiang	46	Anhui	63
InnerMongolia	44	Chongqing	59
Sichuan	42	Xinjiang	59
Ningxia	42	Ningxia	54
Chongqing	40	Sichuan	52
Gansu	36	Yunnan	51
Yunnan	33	Guizhou	47
Qinghai	29	Gansu	46
Guizhou	26	Qinghai	39
Tibet	8	Tibet	0

Regional Innovation			
1996		2006	
Beijing	90	Beijing	100
Shanghai	75	Shanghai	92
Tianjin	66	Tianjin	77
Liaoning	60	Zhejiang	73
Guangdong	58	Jiangsu	73
Jiangsu	54	Guangdong	72
Shaanxi	54	Liaoning	67
Zhejiang	50	Shaanxi	64
Jilin	49	Sichuan	63
Heilongjiang	48	Shandong	62
Shandong	47	Hubei	61
Hubei	46	Jilin	58
Hunan	43	Heilongjiang	56
Sichuan	43	Fujian	56
Fujian	42	Chongqing	54
Hebei	41	Henan	51
Henan	40	Hunan	50
Shanxi	40	Hebei	50
Xinjiang	39	Xinjiang	48
Gansu	39	Shanxi	48
Chongqing	38	Anhui	46
Yunnan	37	Yunnan	45
InnerMongolia	37	Gansu	44
Ningxia	36	InnerMongolia	43
Guangxi	35	Jiangxi	42
Jiangxi	34	Hainan	39
Anhui	32	Guangxi	39
Hainan	28	Guizhou	38
Qinghai	27	Ningxia	37
Guizhou	26	Tibet	30
Tibet	0	Qinghai	29

Regional Macro-economic Climate				
1996			2006	
Shanghai	75		Shanghai	100
Guangdong	75		Beijing	95
Tianjin	63		Guangdong	91
Fujian	56		Tianjin	90
Beijing	49		Jiangsu	86
Zhejiang	48		Zhejiang	85
Jiangsu	47		Fujian	73
Hainan	47		Shandong	68
Liaoning	46		Liaoning	66
Shandong	39		Hainan	50
Guangxi	26		Heilongjiang	46
Hebei	25		Hubei	44
Jilin	24		Hebei	42
Heilongjiang	21		Anhui	41
Hunan	21		Chongqing	40
Shaanxi	21		Qinghai	39
Chongqing	19		Xinjiang	39
Hubei	18		Hunan	38
Jiangxi	17		Jiangxi	38
Ningxia	17		Jilin	38
Shanxi	15		Ningxia	36
Yunnan	15		InnerMongolia	36
Xinjiang	14		Sichuan	34
Anhui	14		Shaanxi	33
InnerMongolia	10		Guangxi	33
Tibet	10		Shanxi	32
Qinghai	9		Henan	32
Sichuan	7		Yunnan	31
Henan	4		Tibet	29
Gansu	4		Gansu	21
Guizhou	0		Guizhou	15

Rural Infrastructure				Urban Infrastructure			
1996		2006		1996		2006	
Shanghai	74	Shanghai	100	Beijing	75	Beijing	100
Beijing	56	Jiangsu	91	Liaoning	74	Shandong	98
Jiangsu	48	Beijing	89	Guangdong	73	Shanghai	97
Guangdong	47	Liaoning	83	Shanghai	73	Liaoning	97
Liaoning	45	Tianjin	82	Shandong	57	Jiangsu	94
Tianjin	45	Shandong	81	Jiangsu	55	Guangdong	92
Jilin	40	Hebei	79	Hubei	55	Hubei	79
Shandong	37	Jilin	78	Zhejiang	48	Zhejiang	77
Hebei	36	Guangdong	78	Tianjin	46	Hebei	77
Fujian	35	Henan	77	Henan	43	Heilongjiang	74
Heilongjiang	34	Fujian	76	Hebei	41	Henan	72
Zhejiang	34	Heilongjiang	76	Heilongjiang	40	Sichuan	66
Hubei	29	Anhui	76	Jilin	40	Jilin	65
Anhui	25	Zhejiang	75	Sichuan	40	Anhui	65
Shanxi	24	Chongqing	74	Xinjiang	39	Hunan	63
Yunnan	24	Ningxia	74	Hunan	39	Tianjin	62
Henan	23	Yunnan	73	Anhui	35	Fujian	60
Hunan	22	Jiangxi	72	Shanxi	32	Xinjiang	59
Xinjiang	22	Hubei	71	Fujian	30	Shaanxi	57
Jiangxi	21	Hunan	69	Chongqing	29	Chongqing	56
Hainan	20	Shanxi	68	Guangxi	29	Shanxi	54
Sichuan	16	Hainan	67	Yunnan	27	Guangxi	50
InnerMongolia	15	Guangxi	66	Shaanxi	26	Jiangxi	50
Ningxia	15	Shaanxi	65	Jiangxi	21	Yunnan	44
Chongqing	14	InnerMongolia	64	Guizhou	20	InnerMongolia	43
Shaanxi	13	Sichuan	62	InnerMongolia	20	Guizhou	38
Gansu	12	Gansu	61	Gansu	18	Qinghai	37
Qinghai	11	Xinjiang	58	Hainan	13	Gansu	37
Guangxi	11	Guizhou	56	Qinghai	13	Hainan	25
Guizhou	1	Qinghai	48	Ningxia	8	Ningxia	25
Tibet	0	Tibet	13	Tibet	0	Tibet	3

Regional Infrastructure				
1996			2006	
Shanghai	73		Beijing	100
Beijing	71		Shanghai	99
Liaoning	61		Jiangsu	93
Guangdong	59		Liaoning	92
Jiangsu	50		Shandong	90
Tianjin	45		Guangdong	87
Shandong	43		Hebei	78
Jilin	39		Zhejiang	76
Zhejiang	39		Henan	75
Hubei	38		Heilongjiang	75
Hebei	37		Hubei	75
Heilongjiang	36		Anhui	71
Fujian	33		Jilin	71
Xinjiang	27		Fujian	68
Anhui	27		Tianjin	67
Henan	27		Hunan	66
Shanxi	26		Chongqing	65
Hunan	26		Yunnan	64
Yunnan	24		Sichuan	63
Sichuan	21		Jiangxi	63
Jiangxi	20		Shanxi	62
Chongqing	18		Shaanxi	61
Hainan	17		Guangxi	60
Shaanxi	16		Xinjiang	58
InnerMongolia	16		InnerMongolia	53
Guangxi	15		Gansu	53
Gansu	13		Ningxia	51
Ningxia	12		Guizhou	50
Qinghai	11		Hainan	46
Guizhou	5		Qinghai	43
Tibet	0		Tibet	10

Rural Economic Efficiency				Urban Economic Efficiency			
1996		2006		1996		2006	
Shanghai	77	Shanghai	100	Shanghai	59	Shanghai	100
Beijing	61	Beijing	84	Guangdong	37	Tianjin	89
Zhejiang	61	Zhejiang	83	Tianjin	35	Beijing	88
Tianjin	60	Tianjin	77	Zhejiang	26	Guangdong	80
Jiangsu	59	Jiangsu	77	Jiangsu	26	Liaoning	78
Guangdong	58	Guangdong	74	Beijing	24	Jiangsu	78
Hebei	49	Shandong	67	Fujian	24	Zhejiang	74
Liaoning	48	Hebei	66	Liaoning	23	InnerMongolia	74
Fujian	48	Fujian	66	Hainan	21	Shandong	72
Shandong	47	Liaoning	63	Xinjiang	21	Jilin	69
Hubei	46	Anhui	58	Shandong	19	Chongqing	66
Anhui	42	Hainan	58	Ningxia	16	Hubei	64
Hainan	42	Shanxi	57	Hubei	15	Xinjiang	64
Jilin	40	Henan	57	Heilongjiang	13	Hainan	61
Henan	39	Jiangxi	55	Hebei	12	Fujian	60
Hunan	37	Hubei	54	Hunan	11	Shaanxi	59
Sichuan	37	Hunan	54	Sichuan	10	Heilongjiang	58
Xinjiang	37	Jilin	52	Guangxi	10	Anhui	58
Jiangxi	36	Shaanxi	51	Yunnan	10	Guangxi	56
Shanxi	35	Ningxia	51	Jilin	9	Qinghai	56
Guangxi	35	Guangxi	49	Gansu	9	Shanxi	55
Chongqing	34	Sichuan	49	Chongqing	8	Gansu	54
Shaanxi	33	Chongqing	48	Henan	8	Hebei	54
Heilongjiang	33	InnerMongolia	47	Shaanxi	7	Ningxia	53
Ningxia	29	Qinghai	46	Anhui	5	Yunnan	52
InnerMongolia	28	Xinjiang	45	InnerMongolia	5	Hunan	52
Yunnan	27	Heilongjiang	43	Jiangxi	2	Sichuan	51
Guizhou	27	Gansu	42	Shanxi	1	Henan	50
Gansu	26	Yunnan	42	Qinghai	1	Jiangxi	49
Qinghai	23	Guizhou	39	Guizhou	0	Guizhou	41
Tibet	0	Tibet	33	Tibet	-	Tibet	-

Regional Economic Efficiency			
1996		2006	
Shanghai	73	Shanghai	100
Jiangsu	60	Beijing	90
Guangdong	60	Tianjin	90
Zhejiang	60	Zhejiang	86
Tianjin	57	Jiangsu	85
Fujian	51	Guangdong	84
Beijing	50	Liaoning	78
Shandong	50	Shandong	77
Hebei	49	Fujian	72
Liaoning	49	Hebei	71
Hubei	47	Hainan	68
Hainan	46	Jilin	68
Anhui	44	Anhui	67
Henan	42	Hubei	67
Xinjiang	42	InnerMongolia	66
Hunan	41	Shanxi	66
Jilin	40	Henan	64
Sichuan	40	Chongqing	64
Guangxi	38	Shaanxi	63
Jiangxi	38	Jiangxi	63
Heilongjiang	37	Hunan	62
Chongqing	37	Ningxia	61
Shaanxi	36	Heilongjiang	60
Shanxi	36	Guangxi	60
Ningxia	34	Xinjiang	59
InnerMongolia	32	Qinghai	58
Yunnan	31	Sichuan	58
Gansu	30	Gansu	54
Guizhou	30	Yunnan	53
Qinghai	27	Guizhou	47
Tibet	0	Tibet	37

ANNEX IV

Exploratory phase of a different aggregation method

The RDI has been obtained by combining the five dimensions into a single indicator, giving an equal weight to each of them. It is important to question whether this aggregation procedure is the most appropriate and experiment further methods.

There is some working progress in this direction. We address this question by specifying a model of conditional convergence and then to apply the Shorrocks' method of Inequality decomposition by factors to the log-variance of the dependent variable of our model. In fact, according to Cowell (2009) the logarithmic variance can be considered a measure of inequality. By applying the Shorrock's decomposition to it, it is possible to estimate the contribution to inequality of each variables included in the conditional convergence regression.

On the model of β-Convergence from cross-section to panel data

Testing for the presence of absolute or conditional regional convergence within China has a high potential for understanding the nature of cross-province inequalities in a long-term perspective. First of all the test for absolute convergence will work as an "acid test" in the sense that it will show the intrinsic heterogeneity of the country; indeed, one would expect absolute convergence not to occur if the structural parameters influencing regional growth in the long run are not the same. Second, if instead the negative relationship between initial per capita incomes and their growth rates holds when controlling for the cross-province structural characteristics, evidence will concludes for the presence of conditional convergence and this result will open up the possibility to explore further the regional growth determinants.

The earliest studies on convergence used the cross section approach to test the relation between the levels of income and the average growth rates experienced by a set of countries during a certain period. In a cross-section framework the canonical regression takes the form

$$\gamma_{it_0,t} = \beta \, ln(y_{it_0}) + \omega X_i + \pi Z_i + \varepsilon_i \qquad (3)$$

where γ_i[28] is the average growth rate of a country/region i in the time-interval $t_0 - t$ and X_i is the set of steady state determinants specified in the Solow model[29]. The empirical literature has been further augmented this equation so that to include other variables Z_i, recognized to capture the cross-country heterogeneity and have an influence on the long run per capita income level and growth rate. The parameter β represents the speed of convergence and gives an indication of the number of years necessary to a poor economy to close half of the gap with the rich ones. Indeed from $e^{-\beta^* T}$ in eq. 1, it is possible to derive the following formulas

$$e^{-\beta^* T} = 1/2$$

$$T = ln(2)/\beta$$

$$T = 0.69/\beta \qquad (4)$$

As pointed out by some authors (Islam 1995; Hoeffler 2002), cross country regressions might be seriously biased. First of all, these models might suffer from endogeneity of the regressors included as control variables. For instance, the cross-section approach of Mankiw, Romer and Weil (1992) to the Augmented Solow model assumed that the saving and population growth rates (respectively s and n) were exogenous and uncorrelated with the error term ε. Only under this assumption - Islam (1995) noted - that the OLS could be applied; on the contrary, allowing for the correlation of s and n and some unobserved country-specific effects would have raised issues of endogeneity of the regressors and made the case for the use of IV estimator. Also cross-

[28]generated as $\gamma_{it_0,t} = \frac{1}{T}\left[log(y_{it}) - log(y_{it_0})\right]$ where T is the number of years in the time-interval $t_0 - t$

[29]which included the $log(n+g+\delta)$, that is the population growth rate, the technological progress and the rate of depreciation of capital, $log(sk)$, the investment in capital and $log(sh)$, the level of investment in human capital (for the Augmented Solow model)

section growth regressions are likely to encounter OLS omitted variables bias as fixed unobserved effects and cross-country heterogeneity are not taken into account; differences in initial levels of technology have for example being omitted by the cross-section approach and left as unobserved country specific effects included in ε. A second problem derives from the structure of the cross-section analysis. In this setting, the observations are averaged over a time period, meaning that not all the available information will be used (Hoeffler 2002). Taking the within country variation over time will improve the estimates as it overcomes the bias induced by the omission of time-invariant and country- specific effects.

In the particular case of China, controlling for omitted variables and endogeneity is determinant for understanding the different economic performance at province and sub-province levels. As a matter of fact, despite the shift from central planning to market economy, there are still in China a number of channels through which the government interferes in the free functioning of economy and generates distortions hampering the internal convergence process. One example is the restriction on labor and capital mobility. Another source of heterogeneity is the gradual and experimental approach to reforms by the local authorities (Dayal-Gulati, Husain 2000; Bell, Khor, Kochhar 1993). The decentralization of the authority from the central government to the local entities - which occurred after 1978 – generated a heterogeneous approach to the market reforms. The enhanced responsibility of local governments to introduce reform measures on an experimental basis might explain some of the cross-province differences in the attractiveness of the local territory to foreign investments. The propensity of localities towards the shift to a market economy is however difficult to proxy and therefore has to be considered as an unobservable province-specific factor with a substantial influence on the province economic efficiency.

A common solution to address the unobserved heterogeneity and endogeneity of the regressors is to use a panel data approach. Indeed the use of a panel approach allows for increasing the number of observations and controlling for the endogeneity of the regressors and omitted variables by using the appropriate estimators. In the case of China, controlling for the omitted variables especially related to the different provincial policy framework is determinant to identify the different steady states and growth paths in order to uncover the convergence dynamics taking place within this country.

For these reasons we will opt for a dynamic panel data approach. Our Augmented-Solow Model reflects the considerations made by Mankiw, Romer, Weil (1992) on including human capital in the production function, which becomes

$$Y = K_t^{\alpha} H_t^{\eta} A_t L_t^{1-\alpha-\eta} \quad (5)$$

where Y, K, L as defined above are respectively real output, capital and labor. The human capital included in the function is H. Following Li, Liu, Rebelo (1998), in our specification the labor augmenting parameter A absorbs both the level of technological progress as well as the general efficiency of the regional economy. We keep the assumption of decreasing marginal returns to each input factor and constant returns to scale.

The growth behaviors of L and A are described by

$$L_t = L_0 e^{nt} \quad (6)$$

$$A_t = A_0 e^{gt} Z^{\theta} \quad (7)$$

where L is assumed to grow at rate n, as in the original specification. The growth rate of A depends instead on g, the exogenous rate of technological progress, and Z, which represents the set of those variables influencing the efficiency of the regional economy, with θ being the elasticity of A with respect to Z.

As done above, let's express Y, K and H in terms of effective unit of Labor[30] denoted by the lower-case letters y, k, h. The evolutions of k and h are then

$$\frac{dk_t}{d_t} = s_k y_t - (n+g+\delta)k_t \quad (8)$$

$$\frac{dh_t}{d_t} = s_h y_t - (n+g+\delta)h_t \quad (9)$$

[30] y=Y/AL; k=K/AL; h=H/AL

$s_k y_t$ is the fraction of income invested in capital and $s_h y_t$ is the fraction of income invested in human capital. At the steady state the level of physical capital k*, the level of human capital h* and the level of income per capita Y/L* are defined by

$$k^* = \left[s_k^{1-\eta} s_h^{\eta} / (n+g+\delta)\right]^{\frac{1}{1-\alpha-\eta}} \quad (10)$$

$$h^* = \left[s_k^{\alpha} s_h^{1-\alpha} / (n+g+\delta)\right]^{\frac{1}{1-\alpha-\eta}} \quad (11)$$

$$ln\left[\frac{Y_t}{L_t}\right]^* = lnA_0 + gt + +\theta ln(Z) - \frac{\alpha+\eta}{1-\alpha-\eta} ln(n+g+\delta) +$$

$$\frac{\alpha}{1-\alpha-\eta} ln(s_k) + \frac{\eta}{1-\alpha-\eta} ln(s_h) \quad (18)$$

The log-linear approximation of the behavior of an economy in the neighborhood of its steady state can be defined as

$$\frac{dln(y_t)}{d_t} = \beta(ln(y_t^*) - ln(y_t) \quad (19)$$

$$ln(y_t) = (1 - e^{-\beta T})\, ln(y^*) + -e^{-\beta T} ln(y_0) \quad (20)$$

wherey^* is the steady-state per capita income and β is the speed of convergence which equals $(n+g+\delta)(1\text{-}\alpha\text{-}\ \eta)$. Substituting eq. 20 into eq. 18, we obtain that the growth rate of per capita income is

$$ln\left[\frac{Y_t}{L_t}\right] - ln\left[\frac{Y_0}{L_0}\right] = -(1-e^{-\beta T}) ln\left(\frac{Y_0}{L_0}\right) - (1-e^{-\beta T})\left[\frac{\alpha+\eta}{1-\alpha-\eta} ln(n+g+\delta)\right]$$

$$+(1-e^{-\beta T}) lnA_0 + gt + (1-e^{-\beta T})\, ln\left[\frac{\alpha}{1-\alpha-\eta} ln(s_k)\right]$$

$$+(1-e^{-\beta T}) ln\left[\frac{\eta}{1-\alpha-\eta} ln(s_h)\right] 1 - e^{-\beta T})\, \theta ln(Z) \quad (21)$$

In this augmented version of the Solow model, the growth of income per capita is determined by the proportion of output invested in human capital and physical capital, the population growth, the initial level of the per capita income and a number of variables included in the vector Z, which are supposed to influence the overall efficiency of the economy and the technological progress. While the population growth and the initial level of y are negatively correlated with growth of income between $t_0 - t$, the parameters α, η are instead positive according to the neo-classical predictions. Therefore the higher is the rate of investment in human capital and physical capital, the faster an economy will grow. Similarly, θ highlights the positive influence of Z on the per capita income growth. Taking the example of Li.Liu.Rebelo (1998) one possible variables to be included in Z is the degree of openness of an economy, proxied by the proportion of FDI over the regional GDP. In this case a positive θ reflects the positive spill-over effect of FDI to the efficiency and technological progress of the province. In the empirical literature the Solow model has been further augmented to take into consideration the variables which are hypothesized to have an effect of the long term per capita income. In the case of China, Chen, Fleisher (1996) augmented the Solow model by including human capital, foreign direct investment and a coastal dummy for testing the neoclassical hypothesis of convergence across provinces for the time period 1978-1993. Their work was then extended by Li, Liu, Rebelo (1998), who reaffirmed the importance of a human capital and FDI augmented specification of the Solow model for the analysis of the Chinese context. The fact of including FDI in the model for China reflects the intention of the authors to take into consideration the variables which have mostly influenced the heterogeneous provincial growth performance in the aftermath of the market reforms. In our specification of the augmented Solow model, the vector Z will include a proxy of the degree of "openness" of the province, the level of infrastructures and a proxy for innovation.

We would like to test the hypothesis of conditional convergence within the rural and urban areas by using different estimators, namely the Within-Groups (WG), the Difference-GMM (DIFF-GMM) and the System-GMM (SYS-GMM).

The panel analog of the growth regression (3) is the following expression

$$lny_{i,t} = \lambda \, lny_{i,t-1} + \omega X_i + \pi Z_i + \alpha_i + \mu_i + \varepsilon_i \qquad (22)$$

where λ=(1+ β) and α_i is the country-specific effect and μ_i is the time-specific effect. It has to be noted that the coefficient of the lag income per capita has not to be interpreted as β , the speed of convergence but as 1+ β in this form. In this AR(1) model as shown, the OLS estimates will be biased and inconsistent since the lag dependent variable is positively correlated with the time-invariant country-specific effects α_i, which are not accounted for in the pooled model. One way to address this issue it to use the Whitin-Group estimator, that eliminates the time-invariant individual characteristics and for each entity estimates a different intercept and then the conditional impact of the other variables over time on the individual outcomes. While controlling for the time-invariant form of cross-country heterogeneity, the WT does not use the information contained in the between-country variation, failing to measure the impact of the time-invariant differences (such as geographic location and characteristics). Another shortcoming of the WT is that in short panels it has been proved to produce estimates of λ severely biased downwards, given the arising correlation of the error and the lagged dependent variable (Nickell 1981).

Another possible way to eliminate the fixed effects is to difference the model. This transformation however generates a correlation between the differenced lagged dependent variable and the error term and it would require an instrumental variable procedure to address the problem of endogeneity of the regressors (Durlauf, Johnson, Temple 2004). The work of Caselli, Esquivel and Lefort (1996) introduced the use of the Generalised Method of Moments (GMM) to the dynamic panel data growth modeling. To solve the problem of endogeneity, they proposed the use of the Arellano-Bond (1991) estimator, which relies on the use of lagged levels of the dependent variable as instrument for the model in first differences.

Following Bond, Hoeffler and Temple (2002) we can identify our dynamic panel data as an AR (1) model with unobserved individual specific effects η_i

$$y_{it} = \alpha y_{i,t-1} + \eta_i + v_i \qquad |\alpha| < 1 \qquad (23)$$

for i=1,..N, t=2,..T, $\eta_i + v_i = u_i$, $E[\eta_i] = 0, E[v_i] = 0, E[\eta_i v_i] = 0$

Errors are assumed to be independent across countries and serially uncorrelated

$E[v_{it}v_{is}] = 0$ for$i$=1,..N and $s \neq t$. While the initial conditions are predetermined so that to satisfy $E[y_{i1}v_{it}] = 0$ for t≥ 2.

Therefore, to find valid instruments for the first-difference equation Arellano, Bond (1991) propose to use the values of y_{it} lagged two periods of more since

$$E\left[y_{i,t-s}\Delta v_{it}\right] = 0 \qquad \text{for } t = 3,\ldots \text{T and } s \geq 2 \qquad (24)$$

Indeed assuming that $y_{i,t-1}$ is predetermined with respect to Δv_{it} , means that values of y_{it} lagged two periods or more are correlated with $y_{i,t-1}$ but not with Δv_{it}.

In the more general case of a dynamic panel growth equation as (24), the X_{it} set of regressors might also contain valid instruments for the differenced equations, provided that X_{it} is strictly exogenous $E[x_{it}v_{is}] = 0$ for all ts. In this case all past, current and future values of the strictly exogenous X_{it} might be used as instruments. Nevertheless, as pointed out by Hoeffler (2002) especially in empirical growth model it is difficult to make this assumption of exogeneity of the regressors. They provide a highly explicative example of variables that need to be treated as endogenous and what this implies in terms of instruments choice. They present the case of investment, which can hardly be treated as strictly exogenous. Making the assumption that current shocks to GDP are uncorrelated with the current level of investment - but allowing for past shock to have a feedback effect on current investment- implies that predetermined values of this variable lagged one period of more are valid instruments in the first-difference growth equation. If instead investments have to be treated as endogenous, meaning that a correlation exists with both current and past shocks to GDP, then the values of investment lagged to periods or more are to be used as valid instruments.

To detect the validity of the instruments, Bond, Hoeffler and Temple (2002) suggest to compare the DIFF-GMM estimates with those coming from the use of the OLS and WG estimators. Since the OLS level estimates will be biased upwards and the WG seriously biased downwards, the DIFF-GMM estimates should fall in-between these upper and lower bounds. If this is not the case and the GMM estimates are close to the WG parameter estimates, this has to be interpreted as a signal that the instruments employed are weak.

Although the Difference-GMM (DIFF-GMM) estimator is one of the most popular and relevant method to address the problem of endogeneity, some authors identified some shortcomings in it (Bond, Hoeffler and Temple 2002; Blundell and Bond 1998).

For example the lagged value of the income per capita when the series is highly persistent was demonstrated by Blundell and Bond(1998) to be a weak instrument for the transformed dependent variable. Using the GMM-SYS estimator allows one to overcome this problem. Blundell and Bond proposed to estimate a system of equations: the first in differences and the second in levels. What they do is to use the variables in differences as instruments for the equation in levels. So the approach of Blundell and Bond seems to be a reverse of that of Arellano-Bond. Arellano-Bond estimator use as instruments for the "transformed" equation the levels of the variable included as regressors, while Blundell-Bond propose to difference the instruments and use them for the equation in levels. The underlying assumption is that a valid instrument has to be uncorrelated with the unobserved fixed effects. As stressed by Rodman(2006;2008) it is more likely that past changes of closed-to-random-walk variables convey more information on current levels than past levels of current changes, provided that errors are not serially correlated. Depending on whether variables are strictly predetermined or endogenous, different instruments in differences are valid. In the case of predetermined variables (where the variable is not correlated with current shocks but possibly correlated to the past) the transformation in differences of the current variable ($\Delta w_{i,t} = w_{i,t} - w_{i,(t-1)}$)is a valid instrument for the eq. in levels. If the variable is instead endogenous (therefore correlated to both past and current shocks) the available instruments are the lagged differences of that variable ($\Delta w_{i,(t-1)} = w_{i,(t-1)} - w_{i,(t-2)}$).

The GMM-SYS considers a further assumption

$$E[\eta_{i1}\Delta y_{i2}] = 0 \qquad \text{for } i\text{=1..N} \qquad (25)$$

which implies that the series has to be stationary in order to be able to use the first differenced variables as instruments for the equation in levels.

On the Shorrock's Decomposition by Factors

The decomposition of inequality measures by factors was formulated by Shorrock (1982). We found an interesting application on China made by Zhang, Zhang (2010); the authors estimated a standard production function using the Chinese province level data and used the logarithmic variance of the output per capita as measure of inequality. Following their exposition, the formula that describes the relation between the logarithmic variance and the factors included in the regression is derived by

$$y = cov(y, \beta_2 k_2) + cov(y, \beta_3 k_3) + \sigma_0^2 + \sigma_u^2 \qquad (26)$$

$$\sigma^2 = cov(y, \beta_2 k_2) + cov(y, \beta_3 k_3) + \sigma_0^2 + \sigma_u^2 \qquad (27)$$

The hypothesis is to find unbiased estimates of the growth determinants in case a process of conditional convergence could be modeled and then to apply the Shorrocks' decomposition method to quantify the percentage of the variance explained by each factor. These percentages could then be applied to the Regional Development Indicator and the rural and urban Local Development Indicators as alternative to the simple average components aggregation method.

Some preliminary findings

For the moment we tested the stationary of the series of income per capita for rural and urban areas and of the GDP per capita at province level. Both the GDP per capita and the rural per capita income are non-stationary. In the case of the rural series we found a significative presence of cross-sectional dependence by applying the Pesaran's test (Pesaran, 2007). In the case of urban areas the unitroot tests[31] rejected instead the hypothesis of non-stationarity for all the panels; while the Hadri Lagrange multiplier stationarity test (Hadri 2000) rejected the hypothesis of stationarity for all panels. Further work will address the consideration on whether this is an appropriate model to be applied to these non-stationary series with cross-sectional dependence or other models addressing both the spatial dependency and the non-stationarity are more appropriate.

[31] The Levin–Lin–Chu (2002), Harris–Tzavalis (1999), Breitung (2000; Breitung and Das 2005), Im–Pesaran–Shin (2003), and Fisher-type (Choi 2001) tests

Essay III
Internationalisation and Trade Specialization in Italy

The role of China in the international intra-firm trade of the Italian regions[32]

Abstract

This paper analyses the structure of comparative advantages of the Italian manufacturing regions and the changes occurred since 2000. To describe the trade specialisation, we will calculate an index of relative comparative advantages for the manufacturing sectors of the main manufacturing Italian regions using the formula elaborated by Lafay (1992). Our analysis will also target the nature of the regional trade specialisation, by looking at the technological content of the sectors of specialisation. Finally, we will discuss the contribution of the intra-firm trade to the stability of the regional economies and their structure of comparative advantages. We will focus on the role of China in the regional intra-firm trade.

Introduzione

Nell'era della globalizzazione diviene sempre più cruciale misurare e monitorare il volume degli scambi commerciali. L'individuazione dei "vantaggi comparati" aiuta a spiegare la capacità di un paese di produrre un certo bene "meglio" degli altri grazie alla diversa dotazione di fattori produttivi, all'esistenza di economie di scala, o ancora, di agglomerazione. Le misure utilizzate per rappresentare la struttura dei vantaggi comparati sono gli indici di Balassa (1965), che sintetizzano la rilevanza delle esportazioni settoriali di una determinata area geografica rispetto ad un'area più grande. Una letteratura più recente (Iapadre 2001; Boffa, Bolatto, Zanetti 2009) ha però evidenziato come le esportazioni non siano più una rappresentazione

[32] This paper was realized under the supervision of Prof. Brasili and published in Rapporto ICE 2011. English version of this paper will be provided upon request

esaustiva dei vantaggi comparati delle realtà produttive operanti nell'odierno contesto economico internazionale.

Con la frammentazione della produzione su scala globale si è aperta una vasta gamma di scelte operative che vedono l'interazione di contesti produttivi localizzati in territori più o meno lontani, collegati da reti invisibili. Alla luce di questi mutamenti come si può dunque rappresentare la struttura dei vantaggi comparati di un territorio?

Sono state proposte svariate analisi sul legame tra i flussi di commercio di beni intermedi e la produzione "globale" (Feenstra 1998; Yeats 1998; Arndt, Kierzkowski 2001). Più nello specifico Lafay (1992) ha proposto una misura della specializzazione e dei vantaggi comparati ricorrendo all'analisi di entrambi i flussi dell'interscambio commerciale, ovvero quelli "in uscita" e "in entrata" in una determinata realtà produttiva, per cogliere il fenomeno del transito di input produttivi intermedi. L'indicatore di Lafay utilizza pertanto il saldo commerciale per determinare la struttura di quelli che vengono chiamati "vantaggi comparati rivelati" di un'economia. Questo indicatore - come vedremo in dettaglio nel paragrafo 1 - permette di ricostruire la struttura di specializzazione, confrontando il contributo relativo che ogni comparto apporta al saldo commerciale[33].

Ci proponiamo di analizzare la struttura della specializzazione regionale relativamente all'industria manifatturiera per regioni italiane: Piemonte, Lombardia, Veneto, Emilia-Romagna e Marche. Nelle regioni individuate l'industria manifatturiera è il primo settore di specializzazione[34] e di valutare come questa struttura si sia evoluta nel tempo. E' infatti interessante studiare i mutamenti avvenuti, ricorrendo all'utilizzo degli indici di Lafay cumulati calcolati per l'intervallo temporale 2000-2010. Gli indici di Lafay cumulati si ottengono sommando i valori dell'indice per settore, seguendo un ordine dettato dal crescente contenuto tecnologico delle produzioni, in modo

[33] I settori merceologici a cui fanno riferimento i grafici sono riportati in Annex 1.
[34] Regioss (2010), La specializzazione produttiva delle regioni, l'effetto della crisi: una "rottura"?, rapporto presentato nel corso della II edizione del workshop Unicredit-Regioss "Le regioni italiane:ciclo economico e dati strutturali. La specializzazione produttiva, il territorio e l'uscita dalla crisi", Bologna, 13 aprile 2010.

da visualizzare il legame tra la struttura di specializzazione, i mutamenti intervenuti nel tempo e l'intensità tecnologica[35] dei settori.

Per completare l'analisi della struttura competitiva regionale si è inoltre ritenuto opportuno approfondire l'analisi delle importazioni dai paesi emergenti dirette verso le realtà distrettuali. Nel paragrafo 2 si trova quindi un focus sulla filiera Tessile-Abbigliamento che comprende un'analisi a livello provinciale degli scambi commerciali. In questo caso la provincia viene utilizzata come "proxy" per le aree distrettuali per esaminare il ruolo giocato dalle importazioni da paesi emergenti e a "basso costo", verso cui sono spesso state dirette forme di esternalizzazione della produzione. Costruiremo a tal fine un "Indicatore di controllo delle importazioni" (Trenti, Foresti 2006) per provincia, calcolato sulle importazioni provenienti da Cina e dai paesi dell'Est Europa. I dati provinciali verranno poi aggregati per regione così da ottenere un indicatore sintetico del "controllo delle importazioni" delle realtà distrettuali e non, che operano sul territorio regionale.

1. La struttura dei vantaggi comparati delle regioni italiane manifatturiere e la sua evoluzione dal 2000 ad oggi

Le cinque regioni prese in esame, ovvero Piemonte, Lombardia, Veneto, Emilia-Romagna e Marche, hanno una struttura commerciale abbastanza eterogenea. Per valutare la struttura di specializzazione regionale si è scelto di utilizzare il saldo commerciale normalizzato, applicando la formula di LAFAY (1992)[36] e ottenere cosi' un indicatore del contributo che ogni comparto dell'industria manifatturiera da' alla bilancia commerciale regionale. Questo indice, che varia tra -1 e 1, se positivo indica specializzazione; se negativo de-specializzazione.

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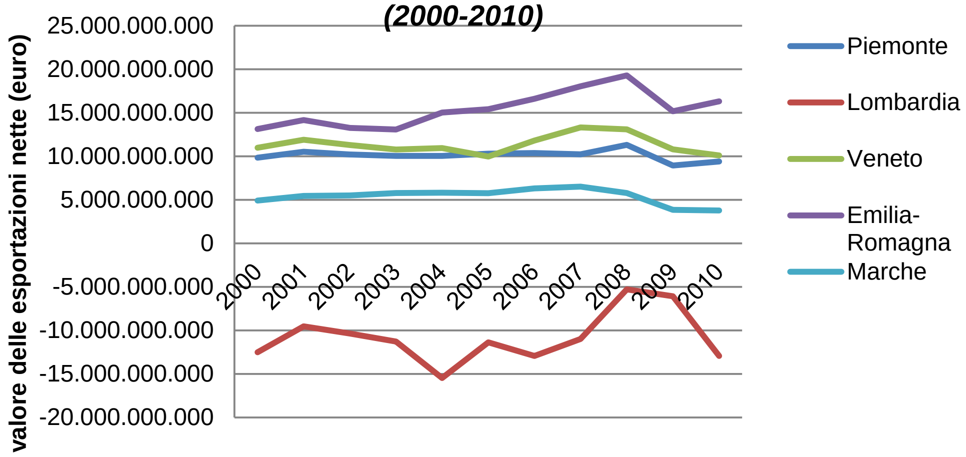
[35] L'ordinamento dei settori per crescente intensita' tecnologica e' stato ricostruito sulla base della classificazione dei settori contenuta in Boffa, F., Bolatto, S., Zanetti, G., (2009), calcolata come rapporto tra spesa in R&D a livello settoriale e il valore aggiunto del settore derivati dall' OECD Technology and Industry Scoreboard 2007. Per la classificazione utilizzata si veda Annex 2.

[36] L'indice di Lafay (1992) si calcola facendo la differenza tra il saldo normalizzato di un settore industriale e il saldo normalizzato dell'insieme dei comparti industriali, moltiplicati per il peso dei flussi del settore industriale in esam sul totale dei flussi commerciali dell'industria

$$IS_i = \left[\frac{x_j^i - m_j^i}{x_j^i + m_j^i} - \frac{\sum_j x_j^i - \sum_j m_j^i}{\sum_j x_j^i + \sum_j m_j^i}\right] \times \left[\frac{x_j^i + m_j^i}{\sum_j x_j^i + \sum_j m_j^i}\right] \times 100$$

Il saldo commerciale dell'industria manifatturiera (Grafico 1.1.) è estremamente negativo per la Lombardia (intorno ai -10 milioni di euro), basso per le Marche (intorno ai 5 milioni di euro), simile per Veneto e Piemonte (ca. +10 milioni di euro) e mediamente superiore ai 15 milioni di euro per l'Emilia Romagna. Con la crisi si è verificato un crollo sui livelli del saldo per tutte le regioni.

Garfico 1.1 - Il saldo commerciale regionale delle regioni manifatturiere
(2000-2010)



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

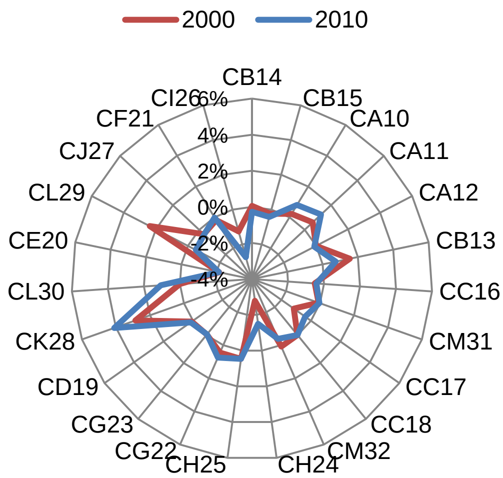
Partendo da questo scenario quali sono i settori del manifatturiero che contribuiscono positivamente al saldo commerciale? Ed in particolare è possibile evidenziare elementi comuni e dinamiche trasversali alle singole realtà regionali che hanno percorso la storia della specializzazione del settore manifatturiero italiano?

Il Piemonte

La struttura di specializzazione dell'industria manifatturiera del Piemonte risulta concentrata prevalentemente intorno ai settori: "Macchinari e Apparecchiature meccaniche n.c.a." (CK28), "Bevande" (CA11) e "Prodotti alimentari" (CA10) (Grafico 1.2). In particolare, la specializzazione è alta per i comparti “Parti ed accessori per autoveicoli e loro motori” (CL293), “Macchine di impiego generale” (CK281), “Altre macchine per impieghi speciali” (CK289), “Bevande” (CA 110), “Altri prodotti alimentari” (CA108)(Grafico 1.3)

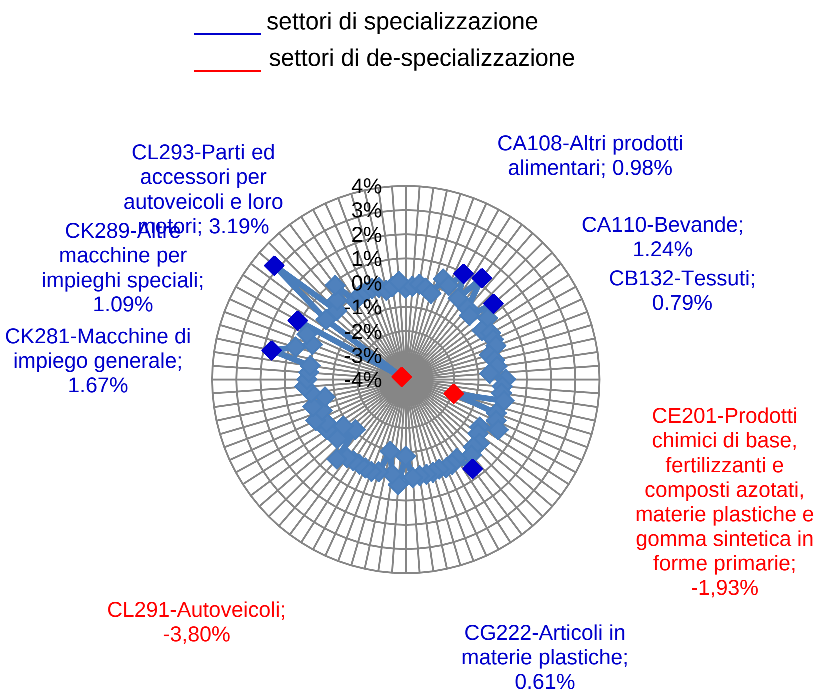
Nel corso del tempo, come si vede nel Grafico 1.2, vi è stata la progressiva erosione del vantaggio comparato relativo al settore “Autoveicoli, rimorchi e semirimorchi” (CL29) e una crescente frammentazione su scala globale del processo produttivo di importanti case produttrici, che hanno incrementato le importazioni di alcuni segmenti produttivi (vedi “CL29 - Autoveicoli”), specializzandosi in altri. Allo stesso tempo le interdipendenze settoriali hanno fatto sì che la specializzazione aumentasse in altri comparti dell’industria meccanica, portando così ad un miglioramento del “vantaggio comparato rivelato” del settore “CK28”.

Grafico 1.2 - La struttura di specializzazione del Piemonte nel 2000 e nel 2010



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Grafico 1.3 - Struttura di specializzazione della regione Piemonte (2010)



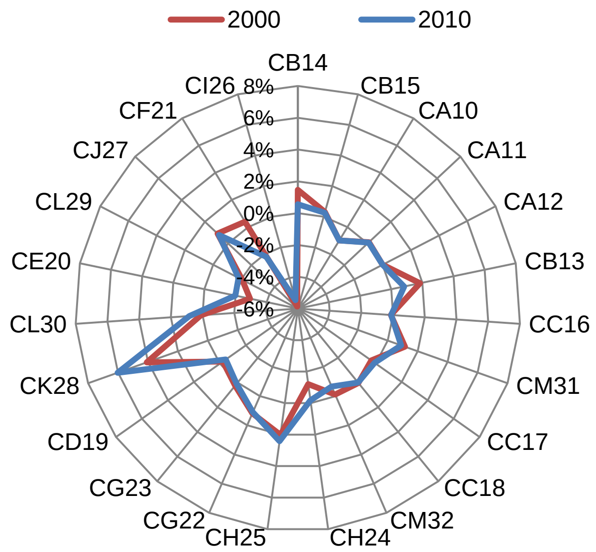
Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

La Lombardia

Anche la specializzazione dell'industria lombarda è incentrata sul settore meccanico, "Macchinari e Apparecchiature meccaniche n.c.a." (CK28), seguito da "Prodotti in metallo, esclusi macchinari e attrezzature" (CH25) (Grafico 1.4). Il commercio di questa regione ha più punte di diamante, circa una decina di settori appartenenti alla filiera Meccanico e Metalli, e quattro settori di fortissima de-specializzazione, appartenenti all'industria chimico-farmaceutica e informatica (Grafico 1.5).

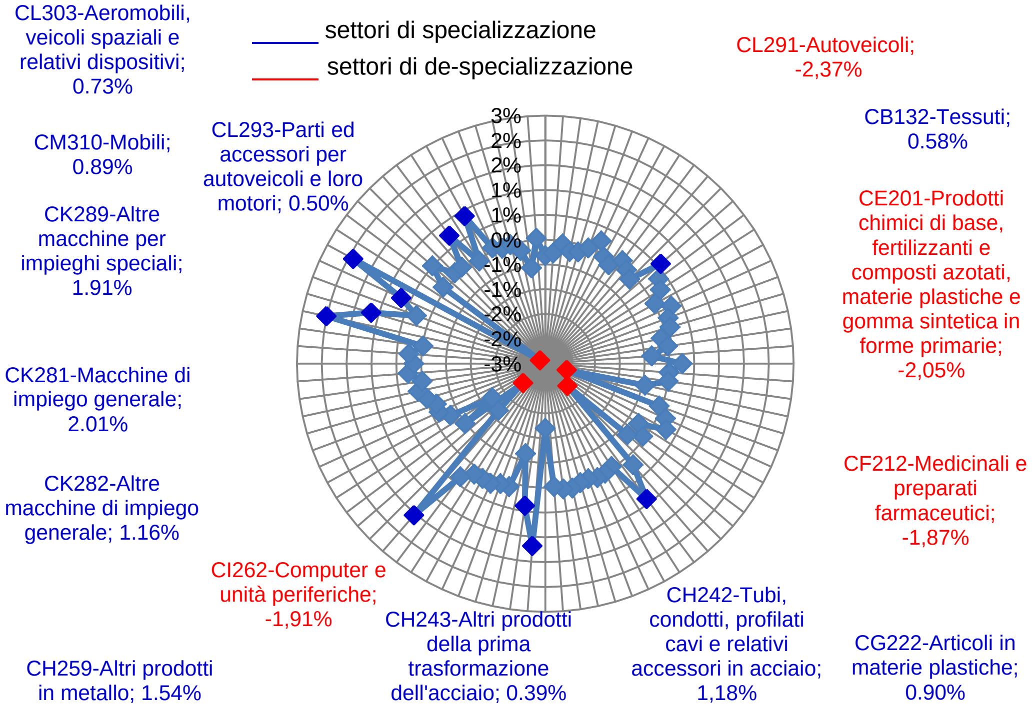
Dal 2000 ad oggi non è avvenuta una rilevante ristrutturazione della specializzazione regionale. Alcuni settori hanno diminuito il loro contributo relativo al saldo commerciale dell'industria manifatturiera, come ad esempio i prodotti tessili, altri come il settore dei macchinari hanno visto leggermente in aumento la propria importanza relativamente agli altri settori del manifatturiero.

Grafico 1.4 - La struttura di specializzazione della Lombardia nel 2000 e nel 2010



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Grafico 1.5 - Struttura di specializzazione della regione Lombardia (2010)

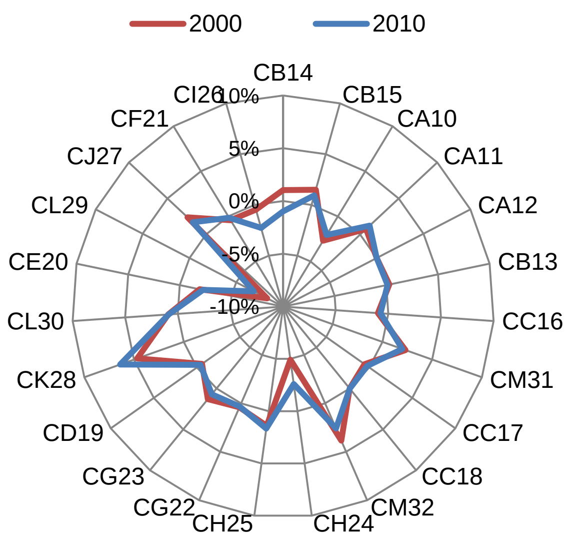


Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Il Veneto

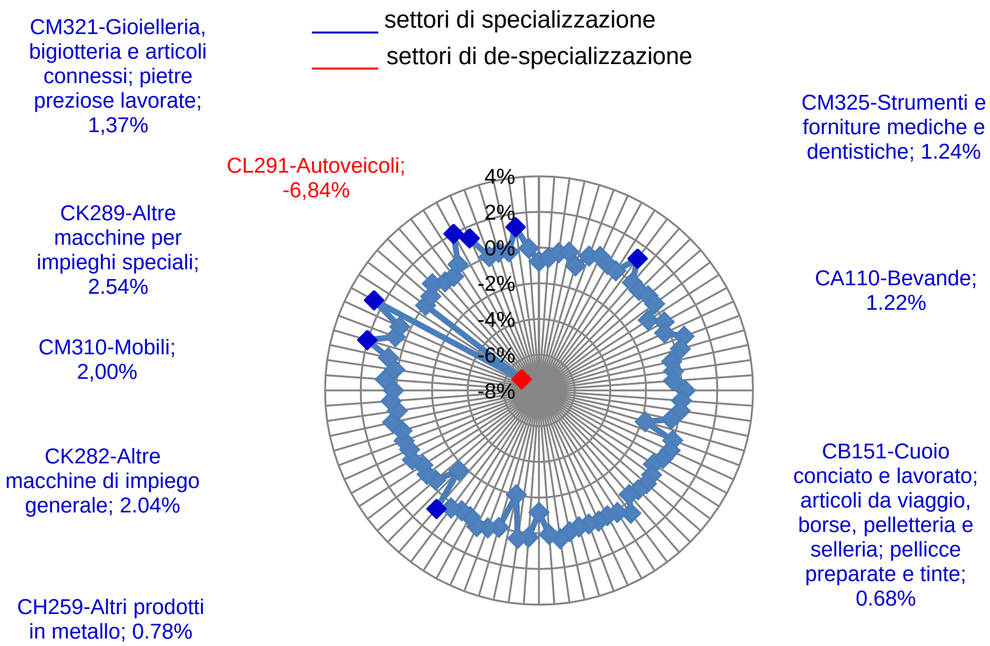
L'industria manifatturiera veneta si caratterizza per un'elevata specializzazione nei comparti del settore dei macchinari, delle altre industrie manifatturiere (tra cui mobili e gioielleria e pietre preziose), bevande e apparecchiature e elettrodomestici (Grafico 1.6). Vi è invece una forte despecializzazione nel settore della metallurgia e degli autoveicoli (Grafico 1.7). Tra il 2000 e il 2010 si nota l'aumento del peso dei macchinari sulla bilancia commerciale, mentre si è ridotto il valore dell'indicatore per quanto riguarda il comparto "CM32", che comprende le famose produzioni regionali di mobili e di gioielleria e pietre preziose lavorate.

Grafico 1.6 - Lastruttura di specializzazione del Veneto nel 2000 e nel 2010



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Grafico 1.7 - Struttura di specializzazione della regione Veneto (2010)



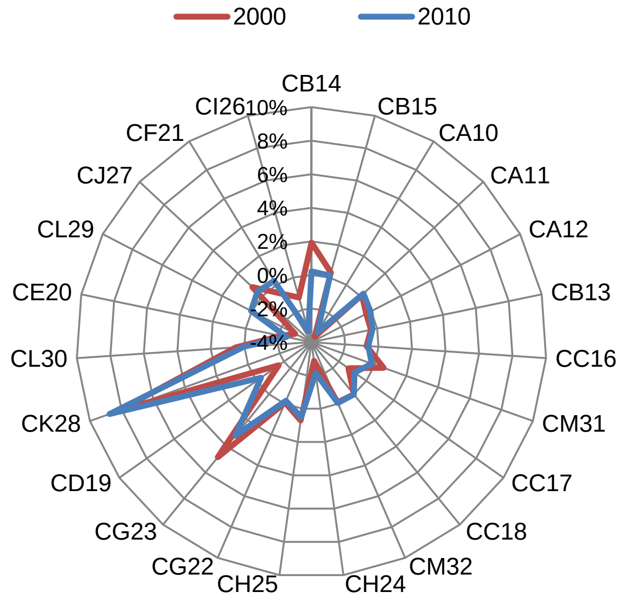
Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

L'Emilia-Romagna

La specializzazione di questa regione è molto polarizzata sul settore meccanico, con una forte despecializzazione nella maggioranza dei settori del manifatturiero (Grafico 1.8). Fanno eccezione il settore "Altri prodotti della lavorazione di minerali non metalliferi" (CG23) (Grafico 1.9), trainato dalle ceramiche di Sassuolo. Tra i comparti a più elevata de-specializzazione ci sono quelli appartenenti all'industria agroalimentare, una delle attività produttive a più alto valore aggiunto dell'economia romagnola.

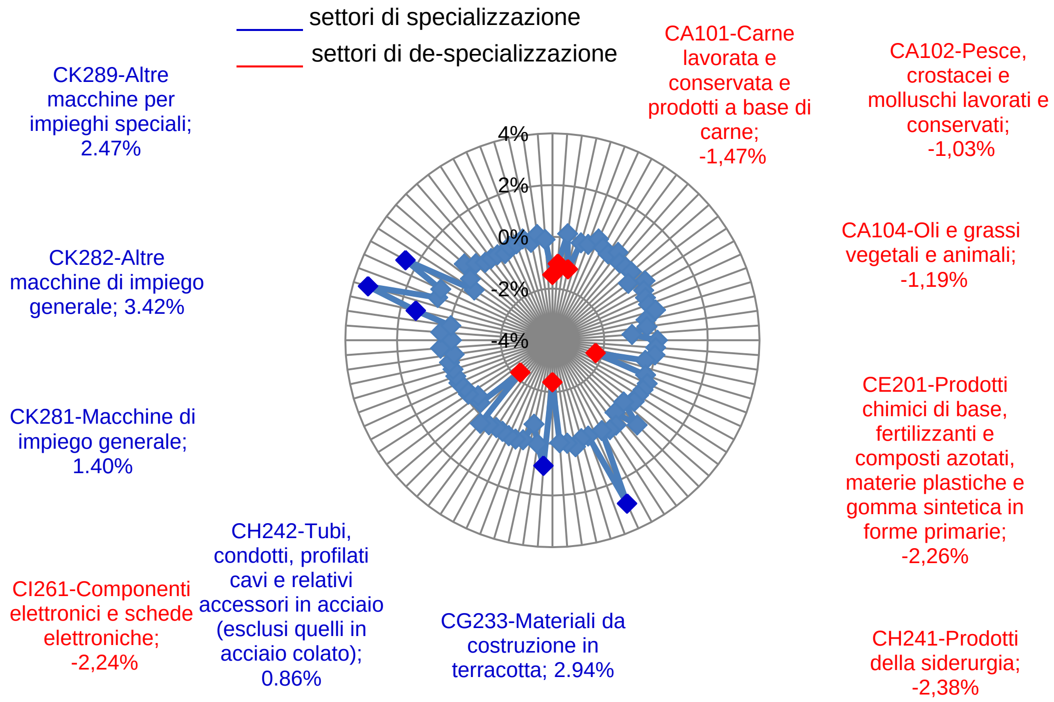
Guardando ai mutamenti intervenuti negli ultimi dieci anni si nota come il settore "Macchinari e Apparecchiature meccaniche n.c.a." (CK28) sia l'unico ad aver mantenuto immutata la sua posizione relativa. Una forte variazione negativa si nota invece nel settore "Articoli di abbigliamento (anche in pelle e in pelliccia) " (CB14) e "Mobili" (CM31), nei quali l'Emilia-Romagna vantava un discreto vantaggio comparato nell'anno 2000 (Grafico 1.8).

Grafico 1.8 - La struttura di specializzazione dell'Emilia-Romagna nel 2000 e nel 2010



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Grafico 1.9 - Struttura di specializzazione della regione Emilia-Romagna (2010)



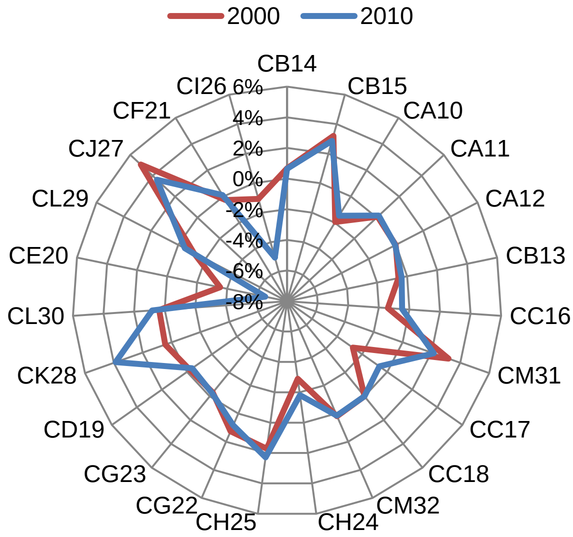
Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Le Marche

La struttura di specializzazione dell'industria manifatturiera delle Marche e' concentrata su cinque settori chiave: "Apparecchiature elettriche e apparecchiature per uso domestico non elettriche" (CJ27); "Articoli in pelle (escluso abbigliamento) e simili"; "CM31-Mobili"(CB15) ; "Prodotti in metallo, esclusi macchinari e attrezzature" (CH25) ;" Macchinari e apparecchiature nca" (CK28) (Grafico 1.10).

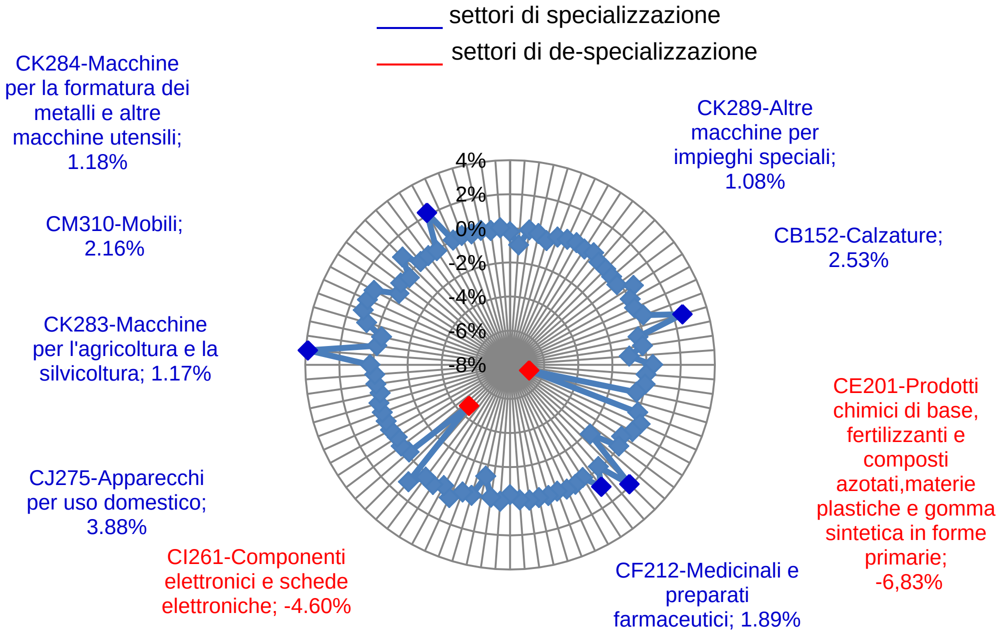
Nel tempo la specializzazione del settore "CB15" che comprende il rilevante comparto calzaturiero non ha subito variazioni di specializzazione, nonostante la marcata competizione estera soprattutto su segmenti produttivi a basso costo. Un settore che ha perso e' invece quello degli elettrodomestici, mentre anche in questa regione,si e' verificato un aumento della specializzazione nel settore delle macchine di uso generale.

Grafico 1.10 - La struttura di specializzazione delle Marche nel 2000 e 2010



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Grafico 1.11 - Struttura di specializzazione della regione Marche (2010)



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Il contenuto tecnologico della specializzazione regionale

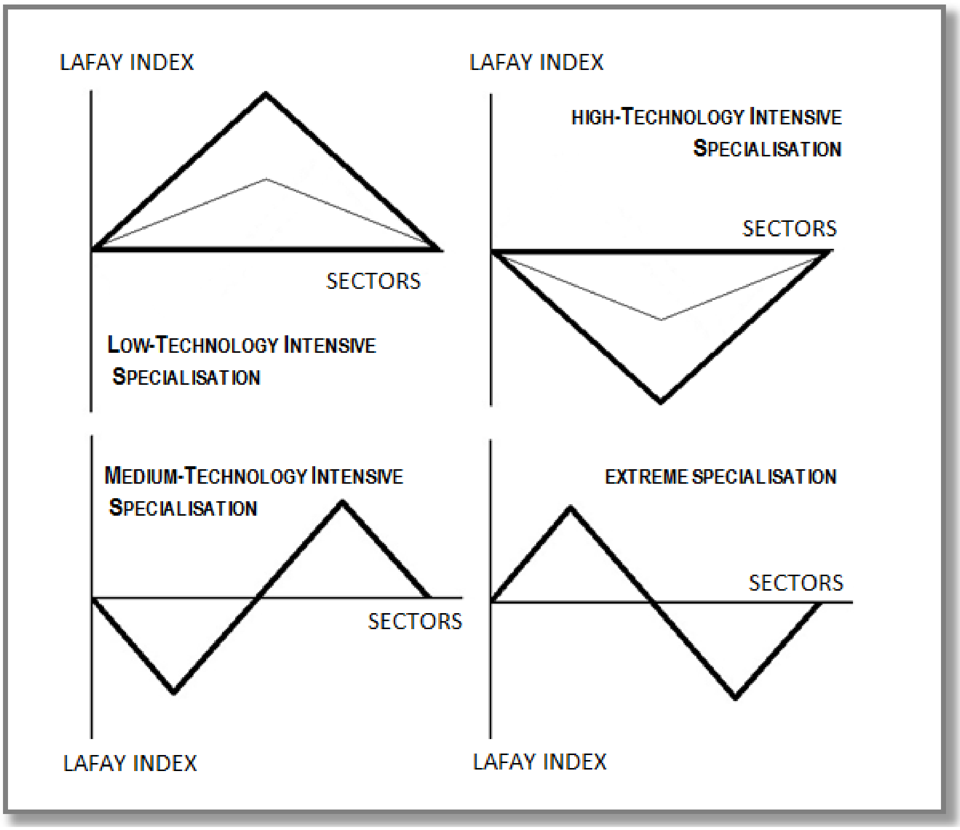
Per approfondire la fotografia della specializzazione regionale negli anni 2000 e 2010, ci si è proposti di valutare ulteriormente i cambiamenti intervenuti in questo intervallo e di metterli in relazione al contenuto tecnologico dei vari settori. Abbiamo proceduto ordinando i vari comparti dell'industria manifatturiera in base alla crescente "intensità tecnologica", misurata come spesa in ricerca e sviluppo in percentuale al valore aggiunto. Si è poi proceduto all'aggregazione degli indici di specializzazione Lafay seguendo questo ordinamento di settori. La rappresentazione della distribuzione di questo indice di Lafay Cumulato[37] su un grafico cartesiano con l'ordinamento settoriale sull'asse delle ascisse e il valore dell'indice sull'asse delle ordinate permette di visualizzare contributo positivo o negativo che ogni settore

[37] Indice di Lafay cumulato (si veda nota 5 per la costruzione dell'Indice di Lafay singolo (1992)

$$IS^c{}_j = \sum_{k=1}^{j} \left[\frac{x_k^i - m_k^i}{x_k^i + m_k^i} - \frac{\sum_j x_k^i - \sum_j m_k^i}{\sum_j x_k^i + \sum_j m_k^i} \right] \times \left[\frac{x_k^i + m_k^i}{\sum_j x_k^i + \sum_j m_k^i} \right] \times 100$$

apporta all'indice cumulato, considerando anche il suo contenuto tecnologico. Le possibili distribuzioni (Figura1) permetteranno quindi di interpretare il modello di specializzazione, che risulterà alternativamente incentrato su settori a bassa tecnologia, ad medio-alta tecnologia o modelli misti.

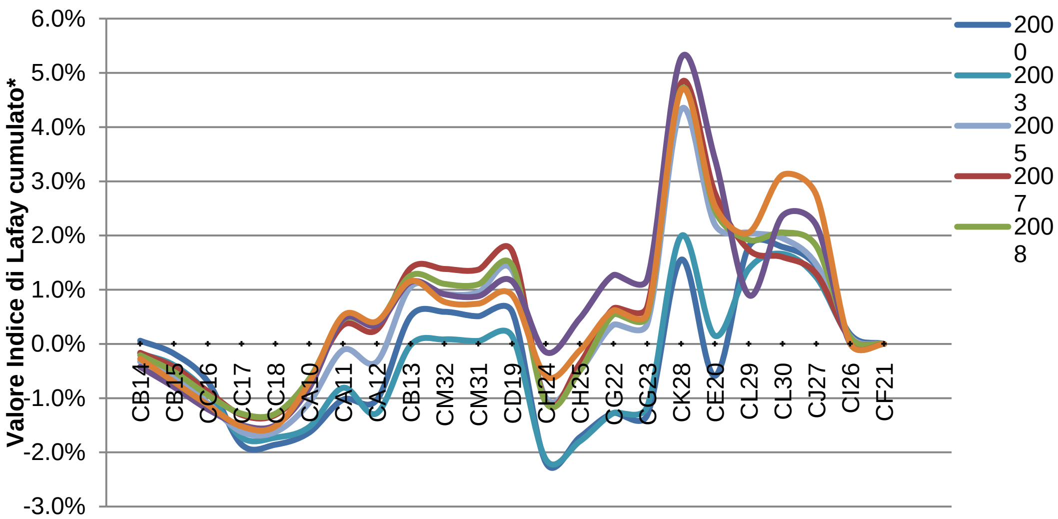
Figura 3.1 - Le quattro possibili realizzazioni dell'indice cumulato di Lafay con ordinamento dei settori per crescente intensità tecnologica



Fonte: nostre elaborazioni

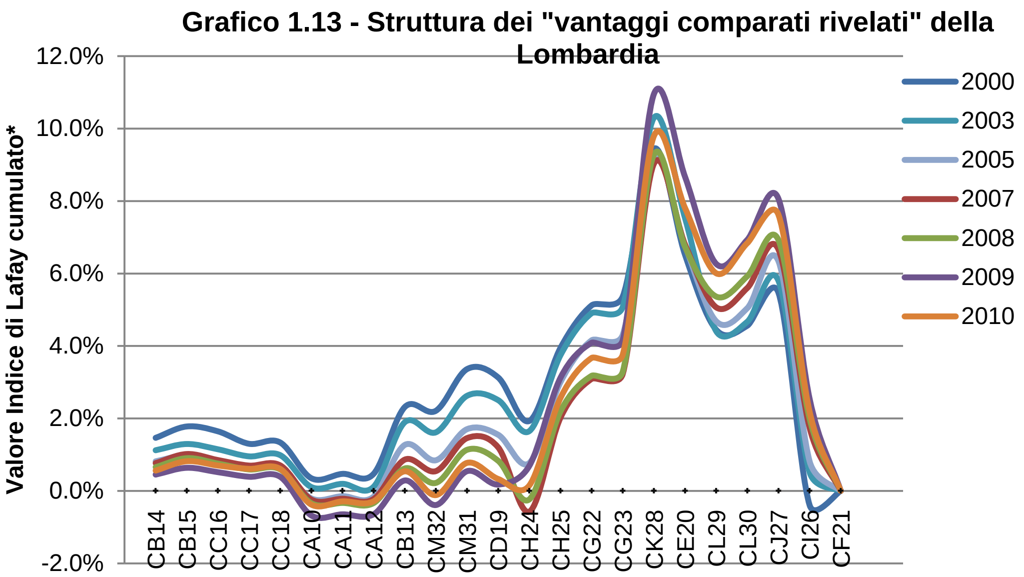
Il Piemonte è passato da un modello di specializzazione a medio-alta tecnologia nel 2000 ad uno caratterizzato da un'accresciuta importanza di settori a basso contenuto tecnologico, in particolare si annovera il settore delle bevande e quello tessile (Grafico 1.12). Precedentemente il saldo commerciale era positivamente sostenuto dalle produzioni del settore degli autoveicoli, che ha progressivamente perso il suo vantaggio comparato.

Grafico 1.12 - Struttura dei "vantaggi comparati rivelati" del Piemonte



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

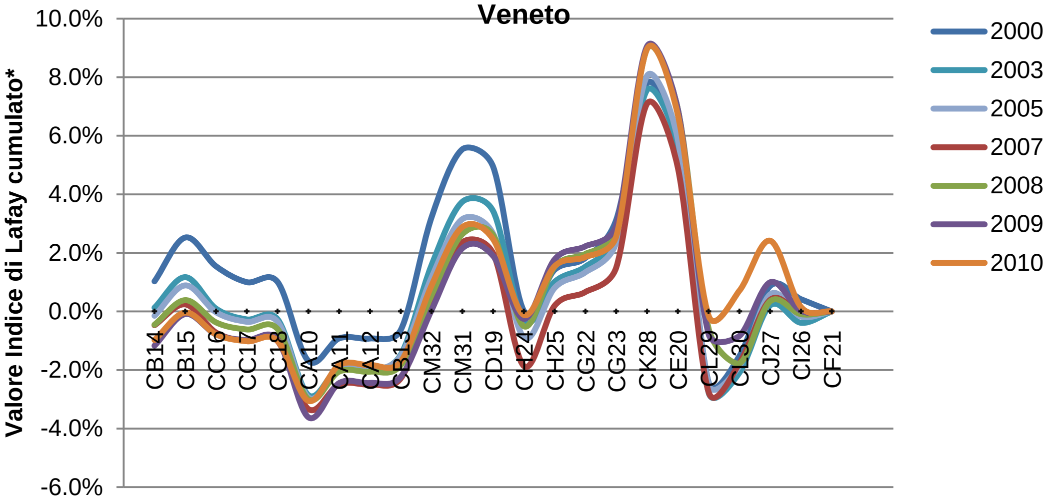
La Lombardia ha mantenuto nel tempo la struttura del suo modello di specializzazione centrata sui settori a medio-alta tecnologia (Grafico 1.13). Si nota la progressiva erosione del vantaggio comparato relativo ai settori a più basso contenuto tecnologico (come quelli del Tessile-Abbigliamento). Si mantiene invariato invece il contributo positivo dell’industria meccanica, anche durante gli anni della crisi.



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

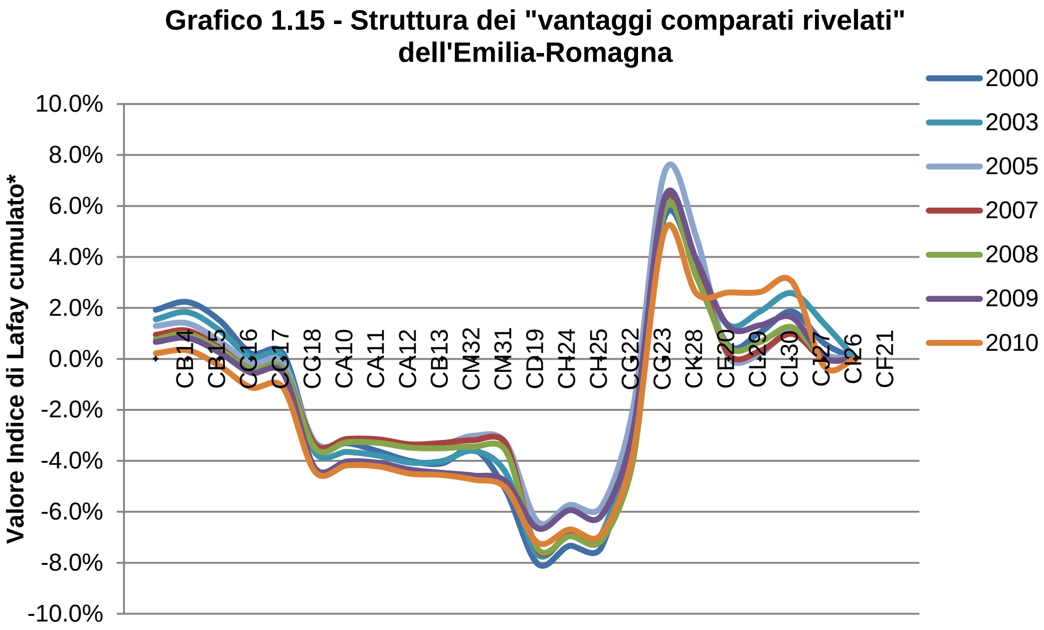
Il modello di specializzazione veneto, in linea con quanto accaduto in Lombardia, dal 2000 ad oggi vede ridursi il peso relativo dei comparti del tessile-abbigliamento e del settore della metallurgia. Mostra anche qui una buona tenuta il settore meccanico, che forse proprio grazie alla sua distribuzione su tutto il territorio regionale e alla sua forte interdipendenza con i processi di delocalizzazione delle produzioni più tradizionali ha beneficiato in questi ultimi anni di una fase di forte espansione. al contrario del Piemonte il modello di specializzazione veneto sta passando da un modello di specializzazione prevalentemente "a basso contenuto tecnologico" ad uno "a medio-alta tecnologia".

Grafico 1.14 - Struttura dei "vantaggi comparati rivelati" del Veneto



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

L'Emilia-Romagna ha un modello di specializzazione a medio-alta tecnologia, caratterizzato da una forte despecializzazione in tutti i comparti a "basso" contenuto tecnologico così come in quelli a contenuto "alto" (Grafico 1.15). Il modello è rimasto stabile negli anni pre-crisi ed è stato capace di resistere alle sfide della competizione internazionale. La stabilità di questo modello non trova paragoni con le altre regioni manifatturiere. Tuttavia gli anni della crisi hanno scosso questa stabilità, non tanto sul fronte del singolo settore dei macchinari, quanto più che altro sulle produzioni più tradizionali che utilizzano fasi della filera meccanica.

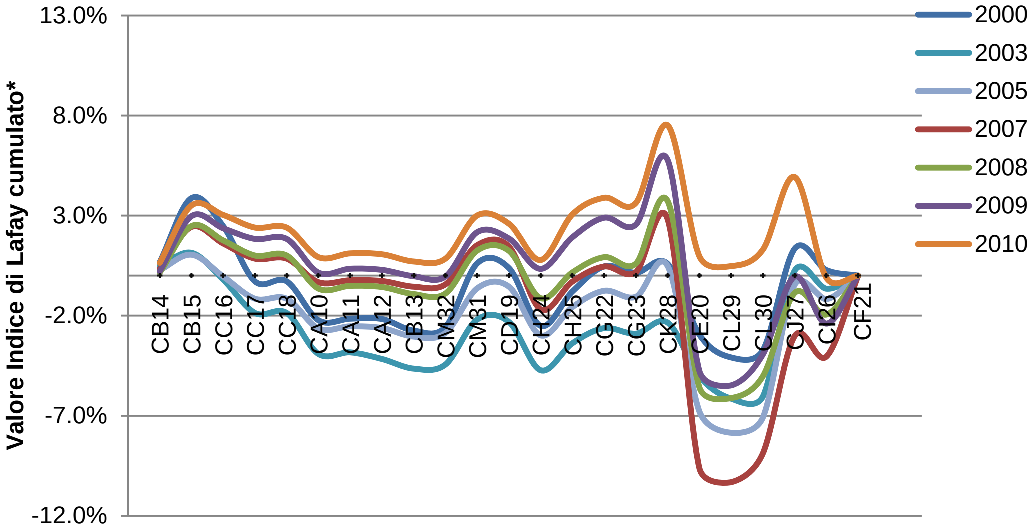


Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Il modello di specializzazione delle Marche ha subito notevoli cambiamenti negli ultimi dieci anni, passando da una certa specializzazione in produzioni a piu' elevato contenuto tecnologico (elettrodomestici) ad una a piu' basso contenuto tecnologico (calzature) (Grafico 1.16). In realta' pero', questi mutamenti non sembrano seguire una logica di "contenuto" tecnologico" delle produzioni; piuttosto sembrano legate agli andamenti delle produzioni tipiche della regione tra cui "beni per la casa", che ha progressivamente perso quote di mercato internazionale.

A differenza dei grafici precedenti si nota infatti che la distribuzione dell'indice cumulato e' in questo caso fortemente dipendente da tendenze contrastanti nelle cinque produzioni tipiche regionali.

Grafico 1.16 - Struttura dei "vantaggi comparati rivelati" delle Marche



Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

2. L'internazionalizzazione delle realtà distrettuali: il caso della filiera Tessile-Abbigliamento

Il primo paragrafo ha evidenziato come in generale le regioni manifatturiere abbiano mantenuto i loro vantaggi comparati legati a settori a medio-alta tecnologia come quello dei macchinari e che addirittura nel tempo, la specializzazione verso questo settore sia aumentata.

L'erosione dei vantaggi comparati è avvenuta invece per le produzioni a basso contenuto tecnologico, come ad esempio quelle appartenenti alla filiera Tessile-Abbigliamento. Calcolando "l'indicatore sintetico di controllo delle importazioni" [38] per le cinque regioni relativamente ai comparti della filiera

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[38] Una prima componente di questo indicatore misura il rapporto fra peso di una provincia sulle i mportazioni da uno o più paesi emergenti rapportato al peso della provincia sulle importazioni complessive italiane (proxy della rilevanza dei consumi in una data provincia). Questo rapporto se superiore all'unità sta ad indicare la propensione di una provincia ad importare beni in misura superiore ai propri bisogni (Foresti, Trenti 2006:109). L'indicatore assume valori compresi tra zero e infinito, indicando con la concentrazione delle importazioni in province non appartenenti alla filiera Tessile-Abbigliamento.
Per costruire tale indicatore su scala regionale si è proceduto come sopra all'aggregazione degli indici di propensione all'importazione di tutte le province appartenenti alla medesima regione.

$$I_i = \frac{\sum_{p=1}^{P}\left(\frac{\frac{M^{emerg}_{ip}}{M^{emerg}_{i}}}{\frac{M_p}{M}}\right)\times\left(\frac{X_{ip}}{X_i}\right)}{\sum_{p=1}^{P}\left(\frac{X_{ip}}{X_i}\right)}$$

Tessile-Abbigliamento abbiamo voluto studiare il legame esistente tra le importazioni da paesi emergenti e la capacità delle realtà distrettuali di esportare e mantenere i propri vantaggi comparati. Più è elevato il valore dell'indicatore più è alta la concentrazione delle importazioni verso le province distrettuali della filiera, lasciando così presupporre l'esistenza di forme di internazionalizzazione produttiva.

Gli indicatori sintetici regionali con riferimento alle importazioni dalla Cina (tabella 1) evidenziano per il Piemonte l'indicatore valori molto più elevati negli ultimi quattro anni, a conferma che il recente aumento del vantaggio comparato della regione nel settore tessile è supportata da uno stabile ricorso a forniture di input intermedi e prodotti semi-finiti dalla Cina.

Per tutte le regioni il valore dell'indicatore aumenta notevolmente a partire dal 2005, mentre nel 2010 si nota un calo probabilmente dovuto alla "rottura" dei legami produttivi, se non la fine della produzione stessa, causata dalla crisi dell'economia reale iniziata alla fine del 2007.

In Tabella 2, riportiamo l'analogo indicatore regionale calcolato sulle importazioni provenienti dai paesi dell'Est Europa. Anche in questo caso l'indicatore ha valori molto alti relativamente ai comparti della filiera Tessile-Abbigliamento in cui la regione è specializzata. Tali valori dell'indicatore risultano più elevati di quelli dell'indicatore di controllo delle importazioni dalla Cina.

Riguardo alle differenze interregionali, il Piemonte e la Lombardia risultano importare relativamente di più i prodotti del comparto "Prodotti Tessili" (CB 13), mentre Veneto e Emilia-Romagna presentano valori più alti dell'indicatore delle importazioni per gli "Articoli di abbigliamento" (CB14). Le Marche invece concentrano le proprie importazioni nel settore "Articoli in pelle" (CB15) con valori estremamente più elevati per le importazioni dai paesi dell'Est Europa rispetto alla Cina.

Tabella 1 - Indicatore di controllo delle importazioni dalla Cina *Comparti della filiera Tessile-Abbigliamento*											
INDICATORE SINTETICO - PIEMONTE											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	3,37	2,97	2,42	2,23	2,61	4,15	5,86	9,08	12,12	12,79	14,32
CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)	1,59	1,31	1,41	1,47	1,65	2,51	1,93	2,30	2,26	2,00	2,15
CB15-Articoli in pelle (escluso abbigliamento) e simili	0,17	0,15	0,27	0,19	0,17	0,17	0,12	0,15	0,18	0,22	0,30
INDICATORE SINTETICO - LOMBARDIA											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	8,54	8,39	7,26	5,82	5,82	6,74	7,90	10,09	13,10	10,63	9,89
CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)	4,86	3,98	3,49	4,44	5,88	8,52	9,12	15,09	11,76	9,56	10,40
CB15-Articoli in pelle (escluso abbigliamento) e simili	0,48	0,42	0,36	0,36	0,42	0,48	0,56	0,89	1,51	1,76	1,78
INDICATORE SINTETICO - VENETO											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	0,46	0,51	0,47	0,49	0,49	0,58	0,94	0,98	1,10	1,14	0,99
CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)	8,34	7,39	6,04	7,29	8,60	14,81	15,75	28,96	26,60	18,48	18,75
CB15-Articoli in pelle (escluso abbigliamento) e simili	3,83	2,85	2,71	3,10	4,14	6,64	7,10	11,27	15,18	16,27	13,21
INDICATORE SINTETICO - EMILIA-ROMAGNA											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	0,06	0,06	0,05	0,07	0,09	0,12	0,12	0,21	0,22	0,25	0,22
CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)	4,93	4,24	3,72	4,36	6,04	9,04	14,16	24,84	23,77	23,73	29,38
CB15-Articoli in pelle (escluso abbigliamento) e simili	0,37	0,29	0,35	0,31	0,48	0,57	0,71	1,02	1,46	1,41	1,70
INDICATORE SINTETICO - MARCHE											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	0,00	0,00	0,01	0,01	0,02	0,03	0,04	0,08	0,12	0,10	0,11
CB14-Articoli di abbigliamento (anche in pelle e in	1,11	0,65	0,85	1,19	1,45	1,63	1,73	2,37	1,52	1,38	1,55

Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

Tabella 2 - Indicatore di controllo delle importazioni dai paesi dell'Est Europa* *Comparti della filiera Tessile-Abbigliamento*											
INDICATORE SINTETICO - PIEMONTE											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	5,05	7,54	10,08	11,69	16,15	22,61	23,25	30,98	41,79	42,80	43,01
CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)	1,05	0,80	0,95	1,07	1,27	1,59	1,39	2,25	1,67	1,63	0,78
CB15-Articoli in pelle (escluso abbigliamento) e simili	0,10	0,08	0,06	0,07	0,07	0,10	0,09	0,21	0,40	0,73	0,48
INDICATORE SINTETICO - LOMBARDIA											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	3,20	2,85	3,16	2,94	3,04	3,83	4,69	5,73	6,72	6,03	5,40
CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)	6,28	5,69	5,27	6,21	7,42	11,03	11,12	18,10	13,77	12,12	14,13
CB15-Articoli in pelle (escluso abbigliamento) e simili	0,18	0,17	0,18	0,19	0,18	0,23	0,18	0,33	0,47	0,73	0,77
INDICATORE SINTETICO - VENETO											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	1,29	1,70	1,73	1,82	2,62	2,88	2,95	4,30	5,71	5,31	4,30
CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)	25,65	21,89	18,91	21,88	27,68	38,86	37,07	60,77	48,50	29,53	26,87
CB15-Articoli in pelle (escluso abbigliamento) e simili	8,92	6,99	7,29	7,92	10,11	11,61	13,48	20,55	29,77	31,60	25,47
INDICATORE SINTETICO - EMILIA-ROMAGNA											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	0,03	0,03	0,04	0,04	0,03	0,03	0,03	0,06	0,07	0,15	0,20
CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)	10,82	7,42	6,71	7,09	8,61	17,30	21,06	39,43	34,64	34,10	37,69
CB15-Articoli in pelle (escluso abbigliamento) e simili	0,23	0,18	0,17	0,16	0,27	0,28	0,33	0,76	0,74	0,76	0,65
INDICATORE SINTETICO - MARCHE											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CB13-Prodotti tessili	0,01	0,01	0,01	0,00	0,01	0,01	0,01	0,01	0,02	0,01	0,01
CB14-Articoli di abbigliamento (anche in pelle e in	1,70	2,07	2,46	2,60	3,88	5,40	5,90	5,78	4,17	3,31	4,39

Fonte: nostre elaborazioni su dati ISTAT (database Coeweb)

3. Conclusioni

L'analisi fin qui effettuata ha evidenziato alcuni elementi comuni che hanno caratterizzato l'evoluzione della struttura di specializzazione regionale dell'industria manifatturiera.

Un primo elemento è l'aumento dell'importanza relativa del settore delle macchine d'impiego generale, che è avvenuto a una maggiore o minore intensità in tutte e cinque le regioni analizzate.

Un secondo elemento riguarda la concentrazione della specializzazione. L'industria manifatturiera regionale è molto concentrata attorno a poche produzioni che trainano il saldo commerciale. Fanno eccezione le Marche, al cui saldo commerciale contribuiscono per lo più equamente i comparti appartenenti a cinque settori merceologici distinti. Con il passare del tempo poi, quest'ultima caratteristica della specializzazione commerciale manifatturiera sembra essersi accentuata, quasi a conferma della necessità dell'industria manifatturiera italiana di concentrare le proprie risorse e la propria specializzazione in poche produzioni per poter competere sui mercati internazionali e a difendere le proprie quote di mercato.

La direzione in cui nel primo decennio del nuovo millennio si sposta invece la specializzazione produttiva delle regioni manifatturiere italiane (con riferimento al contenuto tecnologico) non è univoca.

Il Piemonte riduce la propria specializzazione in alcuni fasi produttive relative ai settori a più alto contenuto tecnologico, ricorrendo a forme più intensive di esternalizzazione della produzione su scala internazionale. Al contempo aumenta la specializzazione in altre fasi della filiera meccanica.

La Lombardia e il Veneto, con un modello di specializzazione molto simile riducono progressivamente la specializzazione in settori a bassa-tecnologia, come quello tessile, concentrando le proprie risorse locali in settori a media-alta tecnologia. Sono noti infatti fenomeni di interdipendenza settoriale che hanno portato allo sviluppo a livello locale del settore dei macchinari tessili, a scopo di esportazione verso i paesi di delocalizzazione delle fasi produttive della filiera Tessile-Abbigliamento.

L’Emilia-Romagna si distingue invece per un modello di specializzazione molto stabile ed incentrato da tempo sul settore a “medio” contenuto tecnologico, con una forte dipendenza dall’estero per i settori a “basso” e ad “alto” contenuto tecnologico. Questo modello ha mostrato una forte instabilità rispetto agli shock di breve periodo legati ai consumi, contemporaneamente ad una forte capacità di ripresa. Le Marche mantengono vantaggi comparati molto forti anche su produzioni a basso contenuto tecnologico, come le calzature, grazie anche a un’organizzazione su scala internazionale del processo produttivo che ha saputo mantenere un equilibrio tra produzione a basso costo e qualità.

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Annex I

Lista Settori dell'industria manifatturiera – Codice ATECO

CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)
CB15-Articoli in pelle (escluso abbigliamento) e simili
CC16-Legno e prodotti in legno e sughero (esclusi i mobili); articoli in paglia e materiali da intreccio
CC17-Carta e prodotti di carta
CC18-Prodotti della stampa e della riproduzione di supporti registrati
CA10-Prodotti alimentari
CA11-Bevande
CA12-Tabacco
CB13-Prodotti tessili
CM32-Prodotti delle altre industrie manifatturiere
CM31-Mobili
CD19-Coke e prodotti derivanti dalla raffinazione del petrolio
CH24-Prodotti della metallurgia
CH25-Prodotti in metallo, esclusi macchinari e attrezzature
CG22-Articoli in gomma e materie plastiche
CG23-Altri prodotti della lavorazione di minerali non metalliferi
CK28-Macchinari e apparecchiature nca
CE20-Prodotti chimici
CL29-Autoveicoli, rimorchi e semirimorchi
CL30-Altri mezzi di trasporto
CJ27-Apparecchiature elettriche e apparecchiature per uso domestico non elettriche
CI26-Computer e prodotti di elettronica e ottica; apparecchi elettromedicali, apparecchi di misurazione e orologi
CF21-Prodotti farmaceutici di base e preparati farmaceutici

Fonte: Codice ATECO 2008

Annex II

Ordinamento Settori in base al Contenuto Tecnologico		
N°	Contenuto Tecnologico	Settore
1	LT	CB14-Articoli di abbigliamento (anche in pelle e in pelliccia)
2	LT	CB15-Articoli in pelle (escluso abbigliamento) e simili
3	LT	CC16-Legno e prodotti in legno e sughero (esclusi i mobili); articoli in paglia e materiali da intreccio
4	LT	CC17-Carta e prodotti di carta
5	LT	CC18-Prodotti della stampa e della riproduzione di supporti registrati
6	LT	CA10-Prodotti alimentari
7	LT	CA11-Bevande
8	LT	CA12-Tabacco
9	LT	CB13-Prodotti tessili
10	LT	CM32-Prodotti delle altre industrie manifatturiere
11	LT	CM31-Mobili
12	MLT	CD19-Coke e prodotti derivanti dalla raffinazione del petrolio
13	MLT	CH24-Prodotti della metallurgia
14	MLT	CH25-Prodotti in metallo, esclusi macchinari e attrezzature
15	MLT	CG22-Articoli in gomma e materie plastiche
16	MLT	CG23-Altri prodotti della lavorazione di minerali non metalliferi
17	MHT	CK28-Macchinari e apparecchiature nca
18	MHT	CE20-Prodotti chimici
19	MHT	CL29-Autoveicoli, rimorchi e semirimorchi
20	MHT	CL30-Altri mezzi di trasporto
21	MHT	CJ27-Apparecchiature elettriche e apparecchiature per uso domestico non elettriche
22	HT	CI26-Computer e prodotti di elettronica e ottica; apparecchi elettromedicali, apparecchi di misurazione e orologi
23	HT	CF21-Prodotti farmaceutici di base e preparati farmaceutici

Fonte: nostro adattamento della classificazione elaborata in Boffa, F., Bolatto, S., Zanetti, G., (2009)