UNIVERSITY OF TRENTO - Italy

UNIVERSITÀ DEGLI STUDI FIRENZE

Doctoral School of Social Sciences

Doctoral programme in Development Economics and Local Systems

Curriculum in Development Economics/Local Systems

Multidimensional Development and Inequality in China

The effects of the reforms after Deng Xiaoping

A dissertation submitted in partial fulfillment of the requirements for the Doctoral degree (Ph.D.) in Development Economics and Local Systems

Luca Bortolotti

2017/2018

Supervisor Prof. Mario Biggeri (University of Florence)

Co-supervisor Prof. Giovanni Andrea Cornia (University of Florence)

Doctoral Committee

Prof. Christine Oughton (Soas University of London)

Prof. Noemi Pace (University Ca' Foscari Venice)

Prof. Martina Menon (University of Verona)

Acknowledgments

I am deeply grateful to my supervisor, Professor Mario Biggeri and to Professor Giovanni Andrea Cornia, who supervised the first chapter of this thesis; their precious suggestions and assistance were fundamental to realize my thesis.

I also want to thank professor Li Shi and all the other scholars from the Chinese Institute or Income Distribution, who welcomed me in the Beijing Normal University and supported the realization of this work.

Professors and colleagues from the University of Florence also provided a precious contribution.

Finally, I want to thank Professor Carlo Federico Perali and Professor Pasquale De Muro for their interesting and constructive revisions. The remaining errors and inaccuracies are mine.

Contents

Introduction

The aim of this thesis is to investigate the development of China since the Nineties from a multidimensional perspective, considering also those aspects of wellbeing that the Chinese development strategy often sacrificed for the sake of GDP growth. This thesis provides an original contribution in the literature about Chinese economic and human development. Methodologies traditionally adopted to investigate the expansion and the distribution of income, are here applied to other interest variables (as education and nutrition) or to more comprehensive multidimensional indexes. The same construction of such indexes, according to methodologies recently introduced in the literature about composite measures of well-being, has an intrinsic value for the analysis of Chinese development. Moreover, we emphasize how the (multidimensional) benefits triggered by the reformers were distributed across the population. A particularly sensitive topic is indeed the development of the poor provinces in inner China and of vulnerable social groups, including women and rural dwellers, who were the "losers" of the reform process.

The economic development of China represents one of the greatest events in the recent economic history. The launching of market reforms in 1978 by Deng Xiaoping is generally considered as the starting point of this process. These reforms triggered an impressive expansion of income (according to official data, between 1978 and 2016 the yearly average growth of GDP has been 9.6%), and supported other major outcomes, as poverty reduction, urbanization, modernization and structural transformation. Economic success transformed China from a low-income agricultural country into 'the world's factory'. No country – not even the USA during its Golden Age of 1870-1914 – recorded such a rapid and profound economic transformation and decline of poverty.

These achievements had an international echo, and Chinese development is a core topic in several research areas. In international trade and international relations, China has (re)gained a central role. Moreover, the goals in the agenda of the international community (e.g. Millennium and Sustainable Development Goals, Paris Agreement) are largely dependent on the performances recorded in China. Finally, in terms of policy-making, Chinese reformers showed the capacity of leading an (unexpectedly) effective guidance, without resorting to the approaches promoted by the Western international organizations, attracting therefore the attention of policy-makers from other developing countries.

The next subsection resumes the main steps of the Chinese reforms since their introduction in 1978, emphasizing the policies implemented after Deng Xiaoping travel in South China, their effect on multidimensional wellbeing and the following attempts to correct the unbalances in China's development

strategy. After this general introduction, we present the structure of the thesis, composed by three chapters, devoted respectively to: the distribution of income, education and nutrition; the measuring of multidimensional deprivation; the balancing of development in different spheres of wellbeing at provincial level.

Chinese Development

Chinese reforms are characterized by a gradual and pragmatic approach since the implementation of the first liberalization measure, the "Household Responsibility System," in 1979. This approach has resulted in a variety of policies and outcomes across provinces and years, despite the rhetoric discourse of Chinese leadership is prone to emphasize the continuity of economic and politic measures. In the first stage of reforms, not observed in this thesis, the "Household Responsibility System" in the agricultural system involved mainly the rural areas, allowing the farmers to retain part of their profits. After 1984, the focus of reforms shifted toward urban areas, implying more pervasive price liberalizations. During the Eighties the political orientation of reforms was still unclear, resulting in contrasting instances and priorities, and in growing conflicts. In 1989, the protests of Tiananmen were followed by a harsh repression, which lead to the partial isolation of China and the slowdown of the reforms in the following years.

Deng Xiaoping, the architect of the reforms, emerged victorious from the Tiananmen events and chose to relaunch the reforms through a travel in southern China (1992) that reinforced his leadership and provided a new guideline for the following policy measures. On that occasion, he pronounced the famous sentence "To get rich is glorious" (致富光荣), that paved the way for the future liberalization and growth of the private-owned sector. In 1992, these considerations drove the 14th National Congress of the Chinese Communist Party (CCP), triggering the modernization and opening-up of China. The following years were characterized by strong economic outcomes but also by the widening of inequalities and the weakening of the role of the state in providing social security.

At the end of the Nineties, the Chinese leadership started to change the attitude toward public intervention for equity reasons, actively adopting policies to fight poverty and provincial inequality, respectively through the subsidies related to the "Dibao" (低保) program and through the "Go-West Strategy" (西部大开发). In the new millennium, the leaderships of Hu Jintao (2002-2012) and Xi Jinping (currently in charge) considered a broader conception of Chinese development, reviving the concept of "moderately prosperous society" (小康社会), in which the economic prosperity is a precondition of wellbeing, but not the ultimate end. In this perspective, it is important to mention the support of Hu Jintao for a "harmonious society" (和谐社会) and Xi's objective of eradicating poverty by 2020. Another major project of Deng, the "New Silk Road" (新丝绸

之路), is also likely to promote the diffusion of development across the most remote Chinese provinces (and in other countries).

In this thesis, we analyze the development of China in the aftermath of Deng's travel in south China. Along with the evolution of Chinese reforms just mentioned, Chinese development was characterized by major events in the international economic history: the Asian crisis (1998-2002), the admittance of China in the WTO (2001) and the financial crisis (2007-2008).

The Chinese development strategy, on one hand, resulted in an impressive GDP growth and modernization of the country. On the other hand, it also caused major shortcomings for the wellbeing of people, in terms of inequality, pollution, pressure on urban resources, social security and provision of welfare. These shortcomings were initially overshadowed by the monetary achievements, both in terms of political support and economic investigation. However, these topics are now inescapable issues if China wants to maintain the promise of a "moderately prosperous society", ensuring the support toward institutions that will be no longer able to guarantee the growth rates previously achieved (the forthcoming "New Normal" period, 新常态).

More details about Chinese reforms and their effects in the fields of inequality, deprivations and unbalances are provided in the following chapters, which analyze these topics separately.

Structure of the Thesis and Theoretical Framework

This thesis comprises three chapters, respectively titled "The Distribution of Income, Education and Nutrition in China", "Introducing a New Method to Analyze Chinese Multidimensional Deprivation" and "The Development Patterns of Chinese Provinces". The thesis sheds light on the development of China from a multidimensional standpoint adopting thus a perspective often overshadowed by traditional analysis about the emergence of China. Indeed, all the chapters critically investigate the impact and inclusiveness of Chinese reforms in the last decades. Each chapter addresses these issues from a different angle, with different tools (associated to different streams of economic literature) and can be read independently from the others.

The first chapter investigates the trend and distribution of income, education and nutrition of Chinese individuals between 1989 and 2011. These three issues were selected for their important role in the literature about Human Development and were analyzed separately (dashboard approach) through analogue techniques, to preserve the possibility to compare the results of analyses from different dimensions. The inequality in the three variables is measured (and decomposed) with the Gini index, and is associated to the policies of the government. Moreover, the first chapter investigates how each type of inequality is related to the inequality of opportunities faced by Chinese people, and how the different types of discrimination evolved over time.

The second chapter deals with the measurement of multidimensional deprivations in China between 1989 and 2011. Two alternative methodologies, the Multidimensional Poverty Index (MPI) and the Multidimensional Synthesis Indicator (MSI), are adopted and compared, highlighting the strengths and weaknesses of both indexes. In this chapter, we also propose a new approach to include income in the computation of multidimensional wellbeing, based on the MSI aggregation technique. The inequality amongst different groups of Chinese people is analyzed within this framework.

The third chapter measures the multidimensional development of Chinese provinces with composite indexes that include up to ten dimensions of wellbeing. The chapter considers the development trajectory of all the 31 provinces of China between 1993 and 2016. We investigate the effects of "harmonious society" policies in terms of synergic development (i.e. a strategy where there are not trade-offs between different macroeconomic targets) and in terms of convergence amongst provinces.

Despite each chapter has an independent structure, the three parts are connected by a common theme: multidimensional and inclusive development in China. The multidimensional perspective is adopted to provide an informative analysis about the sustainable human development of Chinese population. Indeed, the terrific GDP growth achieved through Deng Xiaoping's reforms is not considered here as an end, but rather as a mean to enhance individual wellbeing. Such wellbeing is investigate considering a multidimensional set of indicators, because we assumed that no single variable, considered alone, could catch its complexity. The theoretical background of this thesis intercepts the literature about the Sustainable Human Development and the Capability Approach, combining their elements with the paradigms of the Harmonious Society that has been development within China in the last decades.

The treatment of this argument, multidimensional and inclusive development in China, crosses all the chapters and evolves in the thesis. The first chapter analyzes three dimensions of wellbeing separately; the second chapter investigates the possibility to aggregate different dimensions in a single index maintaining an accurate description of wellbeing and deprivation. Finally, in the third chapter, various multidimensional indexes are computed at the macro level and compared with each other.

Therefore, the three chapters are different in how the "multidimensionality" is framed: the first chapter adopts a "dashboard approach", which maintains the analysis of different spheres of well-being separated, observing how the features of inequality change according to the phenomenon analyzed. The second and the third chapter, on the contrary, enter in the field of "composite indexes", exploiting the novelties of the MSI methodologies to address some issues typical of this literature. Indeed, the second chapter introduces a variation to the MSI technique to provide an original theoretical and empirical conceptualization of the role of income in multidimensional measures, while the third chapter focuses on the differences between monetary and non-monetary indexes of development.

The analysis of the three chapters is founded therefore on various quantitative methodologies. Consistently with the purpose of measuring composite indexes of wellbeing, the MSI technique has been widely adopted (and eventually adjusted), while other indexes, as the MPI, are also described and applied. These multidimensional indexes are adopted in order to describe the trend of well-being across years, provinces and socio-economic groups. Among the other methodologies adopted, the first chapter contains a regression-based decomposition of inequality, while the third chapter makes use of random effect regressions as well as β- and σ-convergence methods.

The data underlying the economic analysis also change in the chapters, according to the different analyses. The first two chapters are based on the China Health and Nutrition Survey (CHNS), which collects micro-level data between 1989 and 2011; the third chapter adopts instead official macroeconomic data at provincial level from the Chinese National Bureau of Statistics (NBS), covering the years between 1993 and 2016. Therefore, the thesis progressively shifts its focus from a micro-level perspective in separate dimensions, to the computation of indexes of wellbeing deprivation, to macro-level measures of multidimensional achievements.

The underlying data, from the CHNS and NBS, are used to compare scores across time, space and social groups, while comparisons with other countries are not in the purpose of this analysis. Indeed, the peculiar nature of Chinese reforms does not support the external validity (i.e. for different countries) of the conclusions of the thesis. Note that the choice of limiting the analysis within Chinese borders allows getting around the issue of reliability of Chinese official data (NBS). However, the scarcity of information about political freedom and human rights has limited the set of indicators adopted to measure multidimensional wellbeing.

Chapter I

The Distribution of Income, Education and Nutrition in China

Trends and Causes in Chinese Wellbeing Inequality, 1989-2011

Abstract

The purpose of this chapter is to document and analyze the trend in the inequality of various dimensions of wellbeing in China. The market reforms introduced since 1978 produced massively different effects on the income of people belonging to different social strata, creating "winners" and "losers". Among the latter, the largest groups were the internal migrants, inhabitants of western provinces and people with low level of education. Another critical point of the reforms was the difficulty in translating income achievements in improvements in other spheres of wellbeing. Most of the existing literature considers these issues separately. This chapter measures the inequality changes in three spheres of wellbeing: income, education and nutrition (three aspects which recall the Human Development Index pillars, because of the close relation between nutrition and health).

Our analysis aims at identifying which policies were successful (or harmful) in the fight against inequality, a step that is necessary for the central government target of building a "Xiaokang" or "harmonious" society. We also highlight which factors determined the changes in inequality of opportunity (measured at the individual level). Through a regression-based Gini decomposition, we observe how much factors as sex; ethnicity; household location etc. contributed to increase (or decrease) inequality in each of these three dimensions of wellbeing over time.

Keywords: Multidimensional Inequality; Income Inequality; Health; Education; China

JEL classification: O15; I14; I31

1. Introduction and Motivations

The market reforms launched almost forty years ago had impressive effects in terms of GDP growth as well as in the fight against poverty and illiteracy[1]. However, a comprehensive evaluation of the impact of the reforms points to several problems. Two main shortcomings of the Chinese reforms concern the divergence between economic and social outcomes (health, education, environment, working conditions etc.) and the distribution of the achievements amongst the population, particularly concerning the rural/urban gap and the inner/coastal gap. The literature suggests that the positive results and the drawbacks were simultaneously generated by an institutional framework that privileged an investment- and export-led growth at the expenses of domestic consumption, public spending, innovation and environmental protection (Biggeri, 2007; Woo, Garnaut and Song, 2013; Lo, 2018).

Concerning the discrepancy between economic and social outcomes, the literature has focused, for instance, on the poor improvements in health conditions, as measured by trends in life expectancy at birth (Aiguo, 2006; Cornia, Rosignoli, and Tiberti, 2009). Other areas of wellbeing that have generated growing concern are pollution, environmental protection and education (Shue and Wong, 2007; Woo et al., 2013).

The second problem of the Chinese development model involves not the *level* of the achievements realized but their *distribution* among the population. The first stage of reforms (1979-1984) targeted rural development and succeeded in keeping inequality stable at a low level. However, since 1984, the richer strata of the Chinese society captured much of the gains triggered by the industrial reforms (Sicular, 2013). Likewise, the Eastern region has been the main engine of Chinese development, while the rest of the country grew much more slowly.

All in all, the progress recorded in China since 1978 has been more pronounced in the fields of growth, structural transformation, average household incomes, and poverty reduction. Progress in the fields of healthcare and education was much less marked, particularly between 1984 -the end of rural reforms- and the turn of the century.

To provide a comprehensive assessment of the recent changes in different dimensions of wellbeing in China, this chapter investigates the progress realized between 1989 and 2011 in nine Chinese provinces covered by the Chinese Health and Nutrition Survey (CHNS).

[1] Chinese achievements were fundamental in achieving the Millennium Development Goals. Progress in the fight against illiteracy and the promotion of primary education were strong in the new millennium (China UNDP, 2007). Another evidence of the reform success is the adoption (in the 13th Five-Years Plan, 2016-2020) of poverty eradicating by 2020 as an official target. The overall Chinese development is even more impressive if compared with the results achieved in other transition economies, as the countries of the former Soviet Union (Cornia, 1994; Stiglitz, 1999). This led China to (re)gain a preeminent political and economic role in the global economy (Nolan, 2005 and Arrighi, 2007).

Labar (2011) provides a first attempt to study inequality in multiple dimensions in China using this dataset. This chapter, aside from changing slightly the sample and the dimensions, updates Labar's work to include the achievements recorded in the years of the harmonious society (2006-11) and the turning point in income inequality trend (2008). Moreover, our analysis extends the purposes of Labar's investigation, shedding lights also on the sources of such inequalities at the national and provincial level, focusing on inequality of opportunities and political interventions.

The next section presents the background of the analysis, describing the three variables of interest: income, years of education and Body Mass Index. These three variables recall the pillars of the Human Development Index (Living Standard, Education and Health), given the strong association between health and nutrition (this relation is examined in detail in Annex 2). In the economic literature, these variables were already adopted by Labar and Bresson (2011) as the core indicators that identify multidimensional poverty in China. We describe the average achievements in these fields, to look then at how disadvantaged groups were included or bypassed by the economic and social progress. Section 3 describes the CHNS dataset (a panel survey that randomly selected households from nine provinces over the period 1989-2011).

Sections 4 to 7 are devoted to our research questions. Section 4 describes the achievements in income, education and nutrition, considered as a proxy of health, to track their trend since 1989; such achievements are studied in the whole sample as well as in specific subgroups (adopting a *between-group* inequality standpoint). Section 5 describes the aggregate and provincial trends in Gini coefficients for each dimension (*within-group* inequality). Section 6 studies the allocation and the incidence of overall and specific subsidies. Section 7 investigates through a regression-based decomposition which were the main determinants of inequality in each dimension over time (and therefore how strong was inequality of opportunities). Section 8 provides the conclusions, and is followed by two annexes, devoted respectively to the construction of our variables and to the relation between nutrition and health.

2. Changes in Income, Health and Education Inequality in the Reform Period

2.1 Changes in Income Distribution

Chinese income inequality broadly stagnated between 1978 and 1984, but rose rapidly between 1984 and 2008, to decrease slightly thereafter (Li, 2015)[2]. Despite this recent decrease, nowadays the Chinese Gini index of income inequality remains close to 0.45 (according to official estimates). This level is very high, especially for a country historically accustomed to lower inequality as most of the planned economies.

[2] Note that the reduction in China inequality is strongly related to the decrease in the rural-urban gap, while severe problems remains in the within-urban inequality of income and wealth (Li et al. 2013; Li, 2015; Sato et al., 2017).

The introduction of market principles (particularly in the growing new private sector) was expected to generate an increase in wage and income inequality and a rise in the capital share. However, the recorded increases outpaced most of the predictions about the post-reform inequality.

The Chinese growth strategy implied a rapid increase in public and private investments and exports rather than in private and public consumption (Lo, 2018). In addition, until recently, an almost infinitely elastic labor supply at a constant wage rate (due to the large labor reserve in low productivity agriculture) resulted in an increase capital remuneration at the detriment of wages. Many scholars, including Piketty (2013), see the growth of the capital share as a fundamental cause of inequality growth in OECD countries. Molero-Simarro (2017) tested empirically the effect of this phenomenon on the Chinese functional and personal distribution of income. He found that workers' wages grew less than their productivity, enhancing the growth of the capital share. In turn, this favored the top-incomes capital owners, also leading to a widening rural-urban gap, and an increasing income inequality.

An ILO report (2015) stresses the relevance of labor market liberalizations in shaping inequality in emerging and developing countries. This phenomenon has been particularly relevant in China, where important labor market reforms started in the Eighties and accelerated after Deng's South China Tour (1992). The effect of State-Owned Enterprises' (SOEs) reforms in terms of wage inequality are investigated by Xia et al. (2014): these measures lead not only to the shrinking of state employment but also to a growing wage gap *within* the SOEs, because of wages liberalization and higher skill-premia.

Chinese welfare services are linked to the employment in the formal sector. Therefore, dismantling the commune system and downsizing the SOEs involved not just the firing of workers, but also worsening their access to social security (Ringen and Ngok, 2017). The end of the "iron rice bowl" principle and the liberalization of domestic markets and foreign trade had different effects for different social groups. Therefore, we draw attention to the divergence of incomes across Chinese provinces and between specific groups (men and women, skilled and unskilled workers, etc.). Along with rural people, the domestic migrants, or *nongmingong* (农民工), were a particularly disadvantaged group. These people were allowed to urbanize and were employed in the industry sector (consistently with the Lewis Model) but suffered a major legal discrimination in the access to public services. This phenomenon is due to the *hukou* (户口), a system of internal passports that despite its recent relaxations, still discriminates Chinese citizens based on their birthplace (Biggeri and Hirsch, 2008; Goodburn, 2014). The literature about Chinese inequality also considers individual characteristics as gender, ethnicity, and membership in the CCP (Li, Sato, and Sicular, 2013; Huang, 2015).

Between-province inequality also grew during the first stages of reforms (Goodman and Segal, 2002). In 1988 the central government allowed provinces to keep a larger share of the revenues they collected. Under this decentralized tax system, the divide between advanced and backward provinces widened. The advantage of

coastal provinces was twofold. On one hand, their strategic geographic position resulted in lower transport costs: the closeness to Taiwan (Fujian), Hong Kong (Guangdong) and other rich areas encouraged international trade and foreign investments. On the other hand, the central government seized the opportunity to open in these areas – and only there, at least initially – Special Economic Zones (SEZs), supported by fiscal advantages that channeled foreign capitals and domestic labor in the East. The structure of the incentives faced by local officials and the inequitable distribution of their budgets exacerbated provincial inequality (Shue and Wong, 2007).

The 'Tax Sharing System' reform (1994) was the first attempt to re-centralize revenues control. However, also this system ultimately favored richer provinces, allowing them to still retain a larger share of revenues, with expenditure obligations unchanged (Shue and Wong, 2007). It also paved the way for the accumulation of provincial debt. As a result, in the Nineties, the divide between coast and inner China involved not only the GDP per capita but also the provision of public services. Because of scarce fiscal resources, local governments often introduced user fees for compulsory and non-compulsory education as well as for healthcare services.

The central government's awareness of rising inter-provincial inequality resulted in the "Go West" strategy, launched in 1999. In the new millennium, other policies contributed to revive the "Xiaokang" (小康社会) idea, i.e. a "moderately prosperous" society, tackling inequality and improving wellbeing beyond the monetary aspect. The "Hu-Wen" decade (2003-2013) focused on the construction of a "harmonious society", bringing inequality among the main concerns of the CCP agenda. This choice contributed to alleviate the inequality issue (Li et al. 2013). The 2020 goal of eradicating poverty and the diversification of commercial roads through the "One Belt-One Road" initiative are other strategies currently going in the same direction.

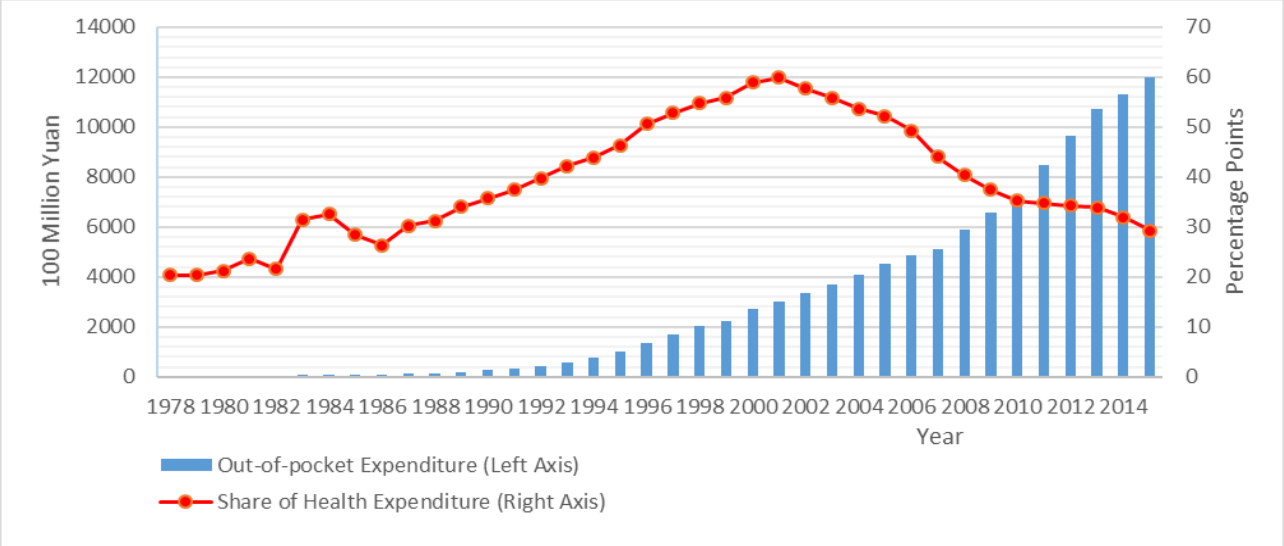
2.2. Changes in Health and Nutrition Distribution

Chinese economic reforms and rapid GDP growth did not translate immediately in better health conditions. On the contrary, the decline of the share of health expenditure in total government's spending and the decentralization and commercialization of health system led to a rapid growth of the private health expenditure (Figure 2.1).

Before reforms, despite the low income per capita, China had a simple but efficient healthcare system, characterized – in principle - by the universal coverage of the population. This situation reversed since the Eighties, as highlighted among other things by the scarce Life Expectancy at Birth (LEB) improvements and the diffusion of infectious diseases. Therefore, the GDP per capita does not appear to be a good predictor of health status.

Cornia, Rosignoli, and Tiberti (2009) studied the LEB in China and other regions of the world between 1980 and 2000. According to their estimates, in these 20 years the Chinese LEB could have increased much more (3.6 years) if the country had maintained the policies adopted before 1980. Indeed, despite the rapid increase in average households' incomes triggered a positive effect on health, serious drawbacks[3] characterized this period and contributed to the slowdown in LEB improvements.

Figure 2.1: Private health expenditure in China, absolute (left scale) and relative (right scale), 1978-2015



Source: 2016 China Statistical Yearbook, author's elaboration.

Aiguo (2006) studied LEB's lower-than-expected improvements and the reappearance of infectious diseases over the period 1978-2002. Aiguo sustains that the main causes of such negative outcomes were the privatization and marketization of healthcare services and the abandonment of the "prevention first" strategy. Central government's disengagement also caused a differentiation of the services between rich and poor provinces. As a result, by 2000, China fell to the 188th place in the WHO ranking in terms of "fairness of financial distribution" in the health system (World Health Organization, 2000).

The neglect of collective provision of health characterized the first decade of reforms, but new policies emerged in the late Nineties and, especially, in the new millennium. In 1998, the central government launched a mandatory insurance program linked to employment, the Urban Employee Basic Medical Insurance[4]. Further reforms were implemented to include rural and unemployed people (the Urban Resident Basic Medical Insurance in 2007 and the New Cooperative Medical Scheme for rural areas in 2003). The effectiveness of these insurances is disputed[5].

[3] Including, among others, rising income volatility and inequality, psychosocial stress, women's unequal access to education, and declining access to healthcare services

[4] This reform merged the previous insurance programs into a single broad system. However, at the same time, the costs faced by patients increased (Huang and Gan 2017).

[5] Yang and Wu (2014, p.187) find that the New Cooperative Medical Scheme had little effects in reducing payments but "*may also have contributed to an observed increase in total per episode outpatient costs billed to the insured patients*".

Several indexes can be adopted to investigate health conditions, including LEB and the number of hospital beds per capita. The CHNS database, designed to study health issues, allows considering several variables. According to our estimates, the Body Mass Index (hereafter BMI) is strongly correlated with every specification of health status, and hence adopted as one of the three outcome variables adopted in this chapter. The choice of BMI as a proxy of health is discussed more in-depth in Annex 2.

BMI is a nutritional index strictly related to individual health status. It is a continuous variable that can differentiate the individual's condition better than dummy variables, such as access to specific health services. BMI, as other variables, does not capture all the aspects of health conditions, nor it can be representative of all health-related problems, which crucially depend also on the history, habits and surrounding environment of the individual. However, it correlates closely with health status (Annex 2).

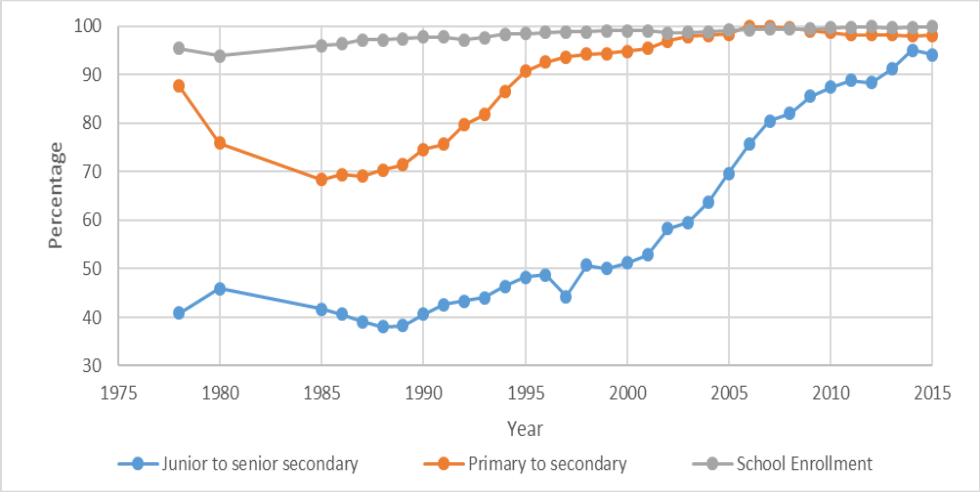
Several works have pointed out the relevance of the nutritional aspects in Chinese wellbeing, emphasizing the emergence of the overweight and obesity issues (He et al., 2015; He et al., 2017). Other scholars have investigated the relation between economic development and body mass (Cao et al., 2014; Clément, 2017).

Apart from its intrinsic importance, BMI has an (inverted-U) association with health risks. According to the WHO, to maximize health status, the BMI level should range between 18.5 and 25 points. In the literature, 22.5 points generally emerges as the level below which health problems occurs in people aged 20 or more (Berrington de Gonzalez et al., 2010; Chen et al., 2012). In a specular way, a growing number of studies focus on an upper threshold for the growing obesity issue in China (He et al., 2015).

2.3 Changes in Education Distribution

China achieved important results in the field of education, both before and after 1978. The economic expansion required skilled workers, so the government targeted universal primary enrolment and expanded the compulsory education up to nine years (in 1986, with the Compulsory Education Law). Official data shows, however, a stagnation or worsening in school enrollment and progression to secondary schools between 1978 and the Nineties (Figure 2.2). Moreover, not everybody benefitted equally of the expansion in years of education, due to the marketization of the education system and growing income gap among Chinese provinces (Shue and Wong, 2007; Li et al., 2015).

Figure 2.2: Enrolment Ratio in Primary School and Promotion Rate to higher levels, 1978-2015, China



Source: 1999 and 2016 China Statistical Yearbook (respectively items 20-17 and 21-23)

Knight et al. (2013) studied the inequality in the access to education in Chinese recent history. The huge increase in average schooling since the Sixties has been mostly due to improvements in higher education in urban areas[6]. The bias against education in backward provinces and rural areas worsened after 1978, during Deng's reforming era. Recent analyses confirm the unbalances in education system and the advantages of citizens with urban *hukou*, either in terms of access to colleges and elite colleges (Li et al., 2015) and in terms of years of education (Golley and Kong, 2017).

In the new millennium, new policies strengthened rural education. According to Chyi and Zhou (2014), the introduction of a maximum level to tuition fees in rural areas (2005) and new types of subsidy targeted at poor and rural students (2006) both had positive effects on enrollment. With these measures, the central government tried also to set in motion a redistribution from richer to poorer (rural) areas.

Another phenomenon that influences the distribution of educational achievements is migration. The educational achievements of backward provinces have worsened with the growing opportunities for domestic 'informal' migration (De Brauw and Giles, 2017).

3. Dataset

To document empirically the evolution of average levels of income/c, education, and nutrition – as well as their distribution - and to evaluate their determinants, it is necessary to rely on individual data concerning these three dimensions of wellbeing. The CHNS database is a well-suited survey that provides such information. Several papers adopt this dataset to investigate various topics in different fields, including income inequality, health and nutrition (Pei and Rodriguez, 2006; He et al., 2015).

[6] The "Cultural Revolution" (1966-1969) was an exception, again characterized by tragic economic and social effects.

The CHNS data are a panel survey provided by the Carolina Population Center (North Carolina) and the National Institute for Nutrition and Health (Chinese Center for Disease Control and Prevention). The sample is randomly selected to include about 4,400 households spread over nine provinces (plus three direct-controlled municipalities) and nine years; the first survey round was carried out in 1989, the last in 2011[7]. In 2011 data from Beijing, Shanghai and Chongqing municipalities were added, allowing a comparison between direct-controlled municipalities and provinces. Several important events in the history of Chinese Reforms characterize this time span[8], impacting on the mean and distribution of our interest variables.

Among the surveyed provinces, three are coastal and six belong to the inner area (two in the West and four in the Center region). Following the classification and literature about the Western Development Program (Tsui, 2007), Guangxi is considered as one of the western provinces (the poorest area of China), along with Guizhou. Henan, Hubei and Hunan are central provinces traditionally devoted to agriculture; with reforms, they experienced a strong emigration toward the fast-growing provinces; recently they recorded a rapid rate of growth and urbanization, causing an increase in inequality and rural/urban gap (Li and Wei, 2014). Heilongjiang (central region) and Liaoning (East), are two northern provinces sharing a similar history; their crucial position in the pre-reform era apparently lost importance with the opening-up; still today the legacies of Maoism and planned economy are stronger here than in most of the other provinces. Jiangsu and Shandong (East) are two coastal provinces moving toward the Guangdong development model, despite they are far from the strategic borders of Hong Kong and Taiwan. The direct-controlled municipalities (observed in 2011) are Beijing, Shanghai and Chongqing. Beijing and Shanghai are, respectively, the administrative and the financial capital of China; these two cities renewed their role in the reform period to maintain their traditional importance. Between 2007 and 2012, Chongqing implemented a controversial set of neo-Maoist policies, the "Chongqing Model" (Zhao, 2012).

CHNS questionnaires include several topics, and average data vary in space and time, allowing to observe the heterogeneous paths undertaken by Chinese provinces and the different reactions to central policies (trade liberalization, tax reforms, internal migration, etc.).

[7] The project is still ongoing, and a tenth wave was recently released with data about 2015. The time series of Jiangsu, Shandong, Guangxi, Guizhou, Henan, Hubei and Hunan are complete. Heilongjiang only entered in the program in 1997 (appearing in six rounds until 2011); Liaoning is missing in the fourth round (1997). Data about the three municipalities are available only in the last round (2011).

[8] As mentioned in the introduction, in the 1978-1989 decade, there was a struggle for the control of the reforms between different groups, which culminated in the 1989 events. In 1992, during the 'Southern Tour', Deng relaunched his reforming strategy. Other major events in the recent Chinese economic history are: the attempts to re-centralize public finances and kick-start economic growth in the West (1994 and 1999); the policy measures introduced to tackle the Asian crisis (1998-2002); the admission to the WTO (2001); the launch of the 'harmonious society' strategy (11th five-year plan, 2006); the outbreak of the international financial crisis (2007-2008).

This chapter adopts individual-level data; the pooled sample, restricted to individuals aged 20 or more[9], consists of 117744 observations. The individual level disaggregation (as opposed to other units of observation, as households or provinces) allows pointing out, beside provincial residence, other individual characteristics that can trigger inequality. Among these, particularly interesting are those out of agent's control, the 'circumstances' that give rise to inequality of opportunities (Roemer, 1993; Roemer and Trannoy, 2015).

The outcome variables are the equivalent income, years of education and Body Mass Index of individuals. The characteristics adopted to control whether there is horizontal inequality/inequality of opportunities are: province; gender; age; rural/urban; ethnicity; relatives' party membership. Annex 1 describes how these variables are built. Other characteristics that could influence inequality, but which does not lead to inequality of opportunities (i.e. measures of "effort")[10] are instead not analyzed in this chapter.

4. Income, Education and Nutrition achievements

This section is meant to answer questions such as: What are the national and provincial trends in the three wellbeing dimensions? How did the national and local policies influence these trends? Are inequalities rising or falling, vertical or horizontal? How did inequalities evolve over time?

The trends of the average equivalent income, years of education, and BMI are compared, focusing then on the differences across regions. We also discuss the changes in the shares of deprived[11] population.

A comparison of average outcomes in different "groups" offers a snapshot of horizontal inequality, whose significance is tested through a t-test[12]. The accumulation of human capital largely concerns inequality of

[9] Note that the standard way to calculate undernutrition and obesity for children (below 20 years old) bases on percentiles rather than on absolute values, making more complex a comparison of undernutrition (obesity) over time.

[10] According to Roemer and Trannoy (2015) "Effort comprises those choices that are thought to be the person's responsibility, and hence they are consequences of his choices – but not all such consequences, since effort may itself be influenced by one's circumstances." Effort is therefore a tricky variable to be measured, the same amount of years of education (which is treated in this chapter as an end rather than as a mean) hinders individual efforts as well as the family background, outside agent's control (Bourguignon, Ferreira and Menéndez, 2007; Roemer and Trannoy, 2015). This chapter adopts therefore the decision of treating effort as unobserved, consistently with Roemer (1993) and Brunori, Ferreira and Peragine (2013). This technique has the drawback of calculating only a rough, upper bound of inequality of effort, because of the possible existence of unobserved circumstances. Other studies attempted to construct proper measures of efforts through different techniques (see the literature review by Ramos and Van de Gaer, 2016). Relatively to the CHNS data, some variables could be used as proxies of individual's effort (e.g. time use, preferences for intellectual activities, nutrition and health habits, etc.), but they refer to different spheres of well-being. Indeed, income, education and health outcomes are conditioned by very different types of efforts: this chapter wants to compare these dimensions, and therefore an in-depth analysis of the effort determinants in each of these fields is left as possible focus of further investigations.

[11] The identification of income, education and health poverty lines is described in Annex 1.

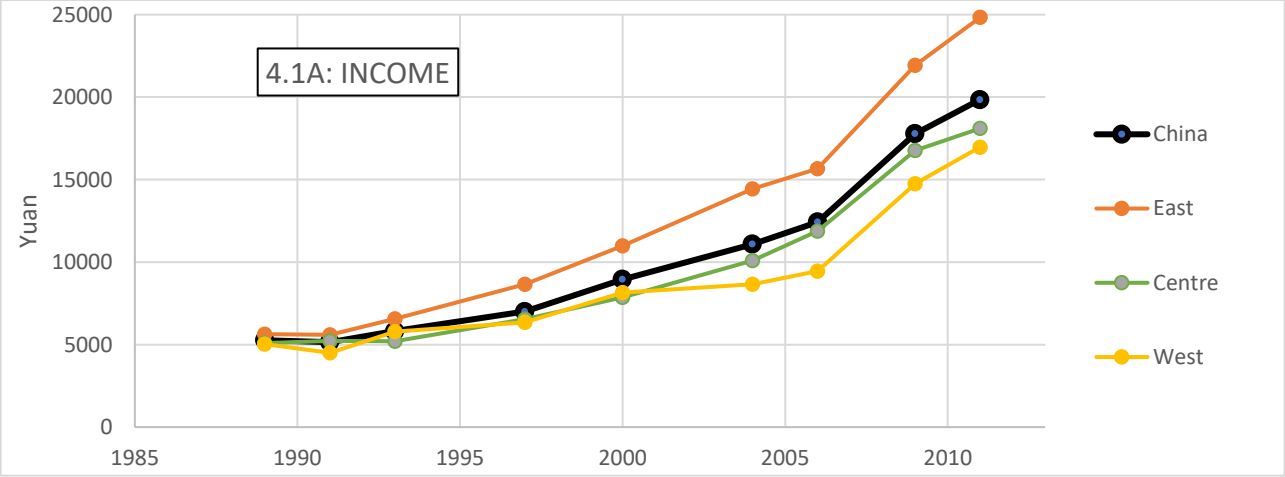
[12] The two-sample t-tests measure the significance of the difference in average outcomes among two groups, defined by different individual characteristics.

efforts as opposed to inequality of opportunities (Roemer and Trannoy, 2015)[13]. However, how much this capital can trigger economic rewards is a matter of labor market equilibria, beyond the control of individuals' actions. Therefore, we study the evolution of the skill premium (i.e. the average wage of skilled with respect to non-skilled individuals) in the framework of inequality of opportunities.

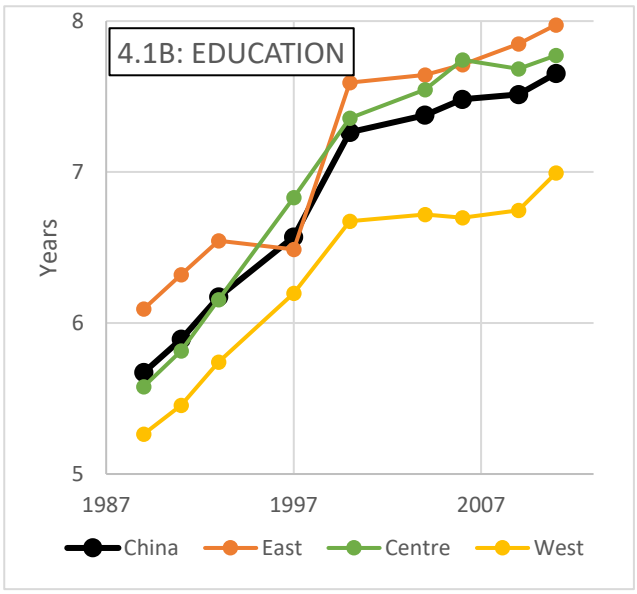
In the literature about provincial income growth in China, the years 1994, 2001 and 2008 emerge as particularly relevant for the Chinese development. In 1994 the Chinese government implemented the Tax Sharing System, a first attempt to re-centralize fiscal policies. In 2001 China joined the WTO, an event with heterogeneous impacts on different provinces, resulting for example in growing inequality between coastal and inner provinces (Han, Liu and Zhang, 2012). In 2008 China was affected by the international financial crisis, reacting with a vigorous stimulus package in 2009.

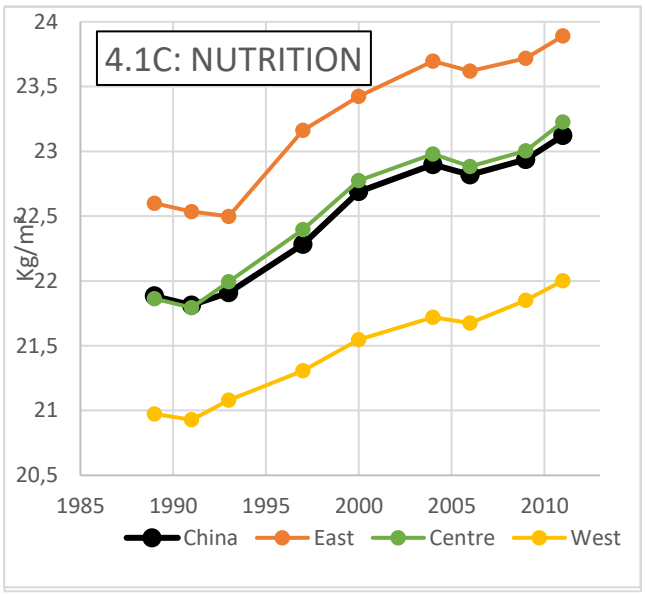
The empirical evidence shows that growth has not been uniform across China. The coastal region (and especially Beijing and Shanghai) is economically more advanced, while Center and West China do not seem able to close the gap (in absolute terms, differences are increasing) (Figure 4.1A). A similar trend emerges also with respect to BMI (Figure 4.1C).

Figure 4.1: Achievements in average Income (4.1A), Education (4.1B), and Nutrition (4.1C)



[13] This issue is usually tackled considering as circumstance the parents' level of education (Roemer and Trannoy, 2015).





Source: Author's calculation based on CHNS, 1991-2011 - Excluding Beijing, Shanghai and Chongqing data

Educational differences across regions are less evident (4.1B). Indeed, the years of study largely vary *within* the coastal area. Liaoning, Shanghai and Beijing combined economic growth with a strong growth of human capital[14], while in Jiangsu and Shandong, despite a remarkable GDP growth, the education improvements were below the national average. This trajectory seems to follow the "Guangdong Model" (Lo, 2003) adopted by the south-east, a development strategy based on the export of cheap products, that are labor-intensive and do not require sophisticated skills.

Years of education, on aggregate, grew less since 2000. This is partly a physiological result: when the achievement of primary schooling completion becomes widespread, further expansions of schooling are more difficult. However, a comparison between municipalities and other provinces shows that still nowadays there is much room for schooling improvements if backward provinces catch-up with the best performing ones.

The Western area remains backward, particularly in terms of nutrition achievements. In terms of income and education, Guizhou results the weakest province in most of the years, while Chongqing municipality stands for the lowest average level of education, despite its considerable average income.

Apart from cross-provincial differences, the data tell a success story: every year – with few exceptions, as the regression occurred after 1989 interruption of reforms - performances improved in all dimensions in all provinces.

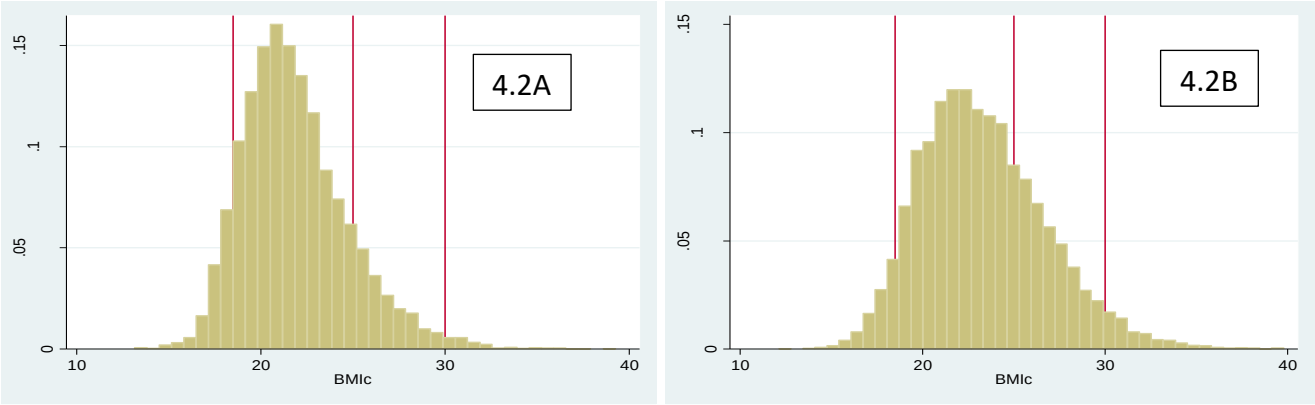
As for nutrition, on one hand, average BMI growth can alleviate the undernutrition problem. At the same time, beyond a certain threshold, it suggests the emergence of an "overweight issue". Many provinces in the

[14] In 1997 Liaoning was excluded from the sample and education in the East markedly dropped below the average.

West, are getting closer, on average (!), to the threshold between normal-weight and overweight, 25 kg m^{-2} -a value that He and others (2015) consider overestimated for the Chinese population[15].

Moreover, the distribution of the BMI seems now 'flatter' than before (Figure 4.2): the average BMI increase did not eradicate the undernourishment issues, while the severity of over-nourishment and obesity increased.

Figure 4.2: BMI distribution in 1989 (4.2A) and in 2011 (4.2B)



Source: Author's calculation based on CHNS, 1989 and 2011

Along with the reduction in the undernutrition issue, the population without a secondary degree too (in 2011, including direct-controlled municipalities more than 60% of the sample had at least a secondary degree). In the income domain, the share of absolute poverty reduced, while relative poverty slightly increased. The reduction in unskilled and absolute poor population has been weaker in west China.

To observe horizontal inequality, we divided the sample into 'groups' using the following criteria: gender, Chinese Communist Party (CCP) membership, ethnicity and geography. As expected, female, people without party membership, ethnic minorities and people living in inner provinces all reports significantly lower economic, educational and nutritional achievements. The only exception is women's income, non-significantly different from men's income. However, income is obtained from a household-level variable and we expect a (non-testable) male-skewed intra-household income distribution too. Therefore, women's income discrimination is likely to be underestimated[16]. Interestingly, women used to have a significant advantage in terms of BMI, that constantly reduce during the 1989-2011 period, and is now reversed. Changes in preferences could play a role in this phenomenon, as well as a better capacity of the women to control their nutrition (avoiding undernutrition in years of food scarcity and overnutrition in years of food abundance). The recorded party membership reduced between 1991 and 1997, but their privileges remained

[15] They estimate a cutoff lower than 23 kg m^{-2}; the China Obesity Task Force fixed instead the overweight threshold at 24 kg m^{-2}. According to our estimate (Annex 2), the turning point for health concern is close to the overweight cutoff.
[16] To further investigate this issue, we adopted other procedures, as: restricting the sample to include "females-only" and "males-only" households; considering individual wages rather than overall income. Both these methodologies suggest a gender-gap higher than our lower-bound.

sharp. Rural and inner inhabitants are disadvantaged in all the three dimensions. Table 4.1 indicates the performances of the groups with respect to the total average over time.

Table 4.1: Income, Education and Nutrition Achievements in Different Groups, 1989-2011

	Female			Party			Ethnic Minority			Inner China			Rural China		
	Inc.	Edu.	Heal.	Inc.	Edu.	Heal.	Inc.	Edu.	Heal.	Inc.	Edu.	Heal.	Inc.	Edu.	Heal.
1989	99.7	83.2	100.8	139.2	164.3	106.0	85.3	93.7	97.7	96.2	96.0	98.2	84.2	91.1	99.3
1991	99.8	82.9	100.7	135.8	174.0	106.3	87.0	94.0	98.0	95.5	96.1	98.2	86.1	92.3	99.3
1993	99.6	82.9	100.6	137.4	178.8	106.1	86.6	94.7	97.9	93.7	96.9	98.6	84.4	92.8	99.3
1997	99.8	85.0	100.5	135.2	172.6	107.0	84.4	88.7	97.0	92.5	100.4	98.7	89.8	92.9	99.0
2000	99.5	87.2	100.4	Not Available			83.1	92.2	97.4	89.1	97.9	98.4	86.6	93.2	99.3
2004	99.5	87.2	100.3	N.A.			81.7	93.0	97.4	86.2	98.3	98.4	82.0	92.7	99.2
2006	98.4	87.5	100.0	N.A.			80.4	90.6	97.5	88.3	98.5	98.3	85.4	91.9	99.4
2009	99.1	88.5	99.9	N.A.			83.6	91.5	97.8	89.9	97.8	98.4	89.1	91.9	99.5
2011	98.8	91.2	99.7	N.A.			84.8	88.3	96.9	83.9	90.5	97.9	86.0	87.5	99.2

Source: Author's calculation based on CHNS. All the data refers the yearly national average (in the whole sample) made equal to 100.

Skilled and unskilled people have different income. Skilled wages were initially lower[17], but increased much faster over time than unskilled wages. The catch-up occurred at the end of the Nineties (before in east China), and in 2011 the skilled workers earned about 60% more than their unskilled counterparts.

The skill-premium peaked around 2006[18] and is stronger in the direct-controlled municipalities. In provinces with more skilled labor force (e.g. Liaoning, Shandong, Hunan, and Guangxi) the skill premium almost disappeared in 2011. The skill premium is higher amongst urban residents[19], it also used to be very high amongst *nongmingong*, but among this group the skill premium increased less than the average, consistently with the scarce incentives of domestic migrant to invest in education (De Brauw and Giles, 2017).

5 Changes in the distribution of Income, Education and Nutrition

This section is meant to answer questions such as: How did inequality change across years and provinces? Do these results depend on the economic policies implemented? And to endogenous local conditions?

Several indexes measure inequality; the Gini coefficient is the most widespread, then useful to make comparisons with other studies (Li, Sato, Sicular, 2013; Xia et al., 2014; Molero-Simarro, 2017; Sicular et al.,

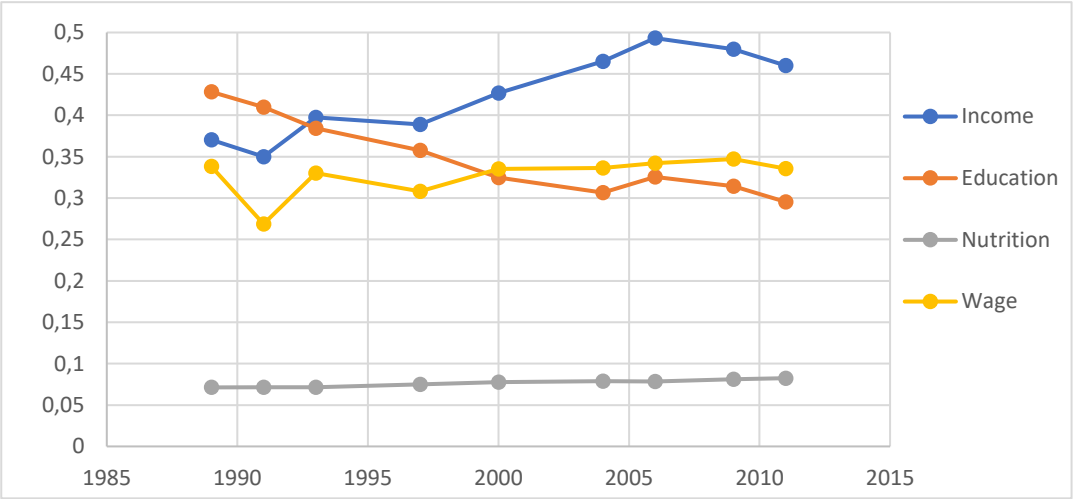
[17] Despite a lower income, until 1993 unskilled individuals had higher wages. This unexpected finding can be explained by their higher average age (i.e. working experience).
[18] 69% higher than unskilled workers. This ratio increased again in 2011 because of the inclusion of municipalities. Wage premium is now rapidly increasing in the West and decreasing in the other regions.
[19] This can also reflect a higher quality of education, consistently with anecdotical evidence.

2017). We compute the Gini index of inequality in each year and dimension, at the national and provincial level, and observe its correlation with provincial performances and characteristics (as SOEs and corruption).

Education, Income, and BMI have different distributions and variances: this prevents us from comparing the absolute values of their Gini indexes of inequality. We can instead analyze the differences between their trends over time and across provinces.

Figure 5.1 describes the trend of the Gini coefficient relatively to Income, Education, Nutrition and Wage. Figure 5.2 includes more in detail the inequality in the three dimensions computed at provincial level.

Figure 5.1 Different types of inequality (Gini Index)

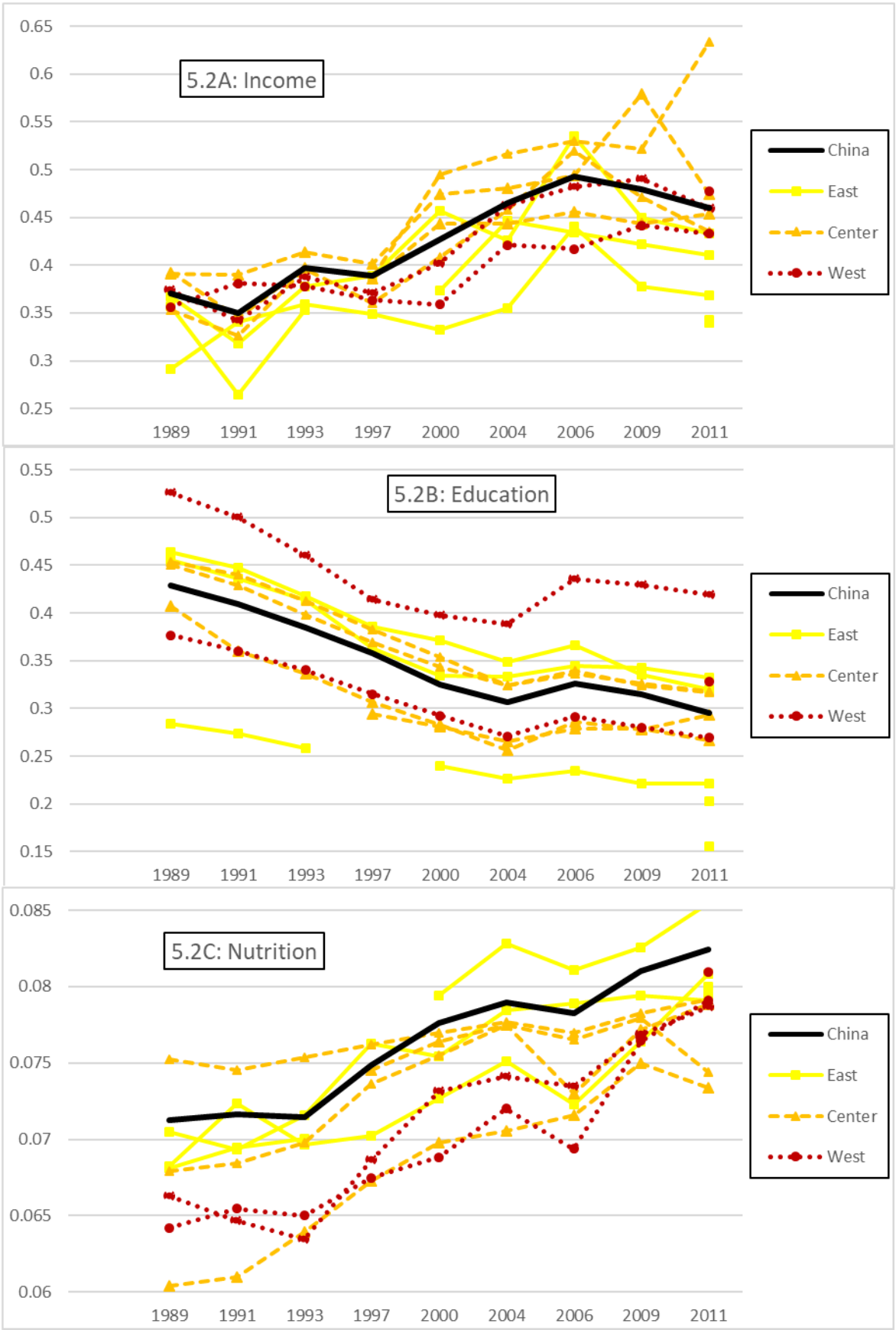


Source: Author's calculations based on CHNS, 1989-2011

The trend of income and education inequality diverged: income inequality rapidly grew until a peak between 2006 and 2009 (close to 50 Gini points), and then it slightly decreased. This trend is consistent with the literature about income inequality in China (Li, Sato, Sicular, 2013; Xia et al., 2014; Sicular et al., 2017)[20].

[20] Note that our results are based on a different sample, which includes only a group of provinces and individuals who are at least 20 years old. Finally, we calculated the *equivalent* income, rather than the simple *average* income (i.e. we weight the income per capita according to the number and age of family members). As a robustness check, we calculated the Gini coefficient of per capita income finding similar results: the Gini peaks between 2006 and 2009, and then slightly decrease. The Gini index of per capita income is slightly bigger than the Gini index of equal income (0.504 as opposed to 0.488, in 2011).

Figure 5.2 Provincial inequality in 3 Regions, Income (A), Education (B), Nutrition (C)



Source: Author's calculations based on CHNS, 1989-2011

Education inequality, on the other hand, fell until 2006, then it stabilized (the pace of the increase in average education stabilized in the new millennium too). A strengthening in education efforts seems therefore necessary to sustain its expansion. On the other hand, BMI inequality is the only type of inequality that keep growing until (at least) 2011. The trends of wage and income inequality are similar; however, income inequality grew more than wage inequality, causing a divergence in these trends. This suggests that other components of income[21] play an increasing regressively role. The recent literature about Chinese income inequality supports this finding (Piketty et al., 2017).

Inequality in education decrease almost every year in every province (Figure 5.2B). Liaoning, Beijing and Shanghai are the provinces with the lowest education inequality, while Shandong, Jiangsu (in the East) and Chongqing municipality are among the most unequal provinces. Indeed, provinces with the highest average education are also those with lower inequality (a result consistent with the Kuznets Curve). Inequality in education (differently from income and nutrition) is not triggered by within-province inequality: large differences exist between people from the same province. Indeed, the age cohort (that is not province-specific) is highly correlated with education achievements (a point further developed in Section 7).

The inequality of the BMI index increased remarkably in every province, including those in the West, characterized by lower BMI. Liaoning and Chongqing are the provinces with the highest BMI inequality.

The lowest income inequality is recorded in eastern provinces (Beijing, Shanghai[22] and Liaoning provinces are particularly egalitarian in this dimension). Central provinces are the most unequal, with a Gini index above the national level. This result can have several plausible explanations, involving institutions, factors endowments and industrial structure.

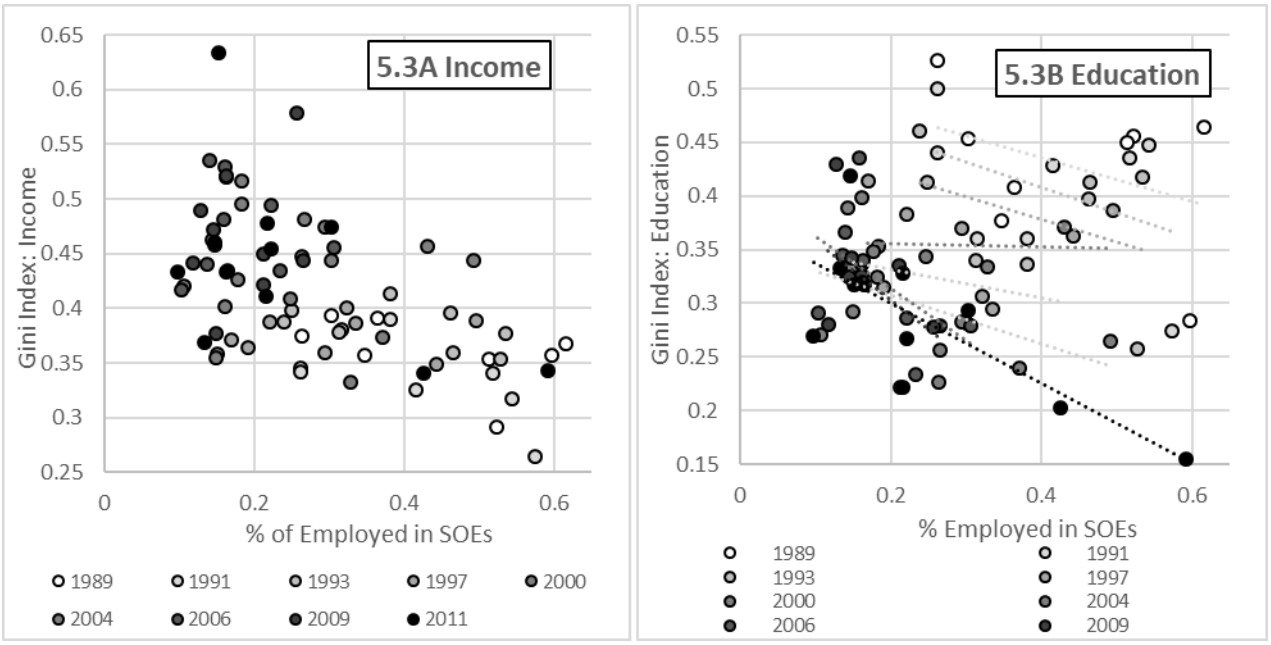
1. About institutional differences, in the East the (stronger[23]) civil society could be able to oblige the local officials (who have richer resources) to redistribute more than in inner China.
   Li (2016) proposed a measurement of corruption based on three types of variables (perception-based measures; demand-side measures[24]; supply-side measures[25]). In 2011 (the year in which more provinces were comparable), the perception-based corruption appears positively correlated with all provincial inequality in all the three dimensions of wellbeing. Adopting other measures of corruption[26], the correlation is less straightforward. The intrinsic difficulty of collecting panel data

[21] The income per capita is a variable based on the Total Gross Household Income which, by construction, includes income from: business; farming; fishing; gardening; livestock; wages; retirement; subsidies; other sources.
[22] Note that those provinces, as already written, have a much lower share of rural inhabitants. This fact that can reduce the estimated income inequality.
[23] E.g. According to the data of the China Labour Bulletin, workers from coastal provinces have organized more (and more numerous) strikes.
[24] The registered cases of corruption, corruption of high-ranked officials, convictions and the amount of funds recovered
[25] The firms' expenditures in travel, entertainment and conferences
[26] We adopted a simple average of the normalized values of the various components of supply-side corruption as measured by Li (2016) and we operated an analogue treatment for the demand-side components.

concerning corruption (Li, 2016), allows carrying out only a preliminary analysis, that has to be verified with ad hoc investigations.

2. Central provinces (and especially Henan, suffering the highest within-province inequality), highly depend on natural resources, a sector traditionally linked with higher inequality (Cornia and Scognamillo, 2016).
3. The level of reforms implementation varies greatly across provinces, because of Government's pragmatic attitude toward and its trial-and-error process. This difference can be measured by the presence of SOEs[27] (Biggeri, 2003). Figure 5.3A shows the correlation between employment in SOEs and income inequality. The correlation with other types of inequality is less straightforward[28].

Figure 5.3: Relation between SOEs' employment and income (A) and education (B) inequality



Source: Author's calculations based on CHNS, 1989-2011

6 Subsidy allocation and incidence, and their effect on Inequality

This section is meant to answer the following question: Were the welfare subsidies (in-kind and cash) allocated progressively, so as to reduce income inequality?

[27] Note that SOEs constitute both an effect and a cause of opposition against to market reforms.

[28] The correlation between education inequality and employment in SOEs (5.3B), is always negative, masked by the simultaneous reduction of both the variables over years (longitudinal). Health inequality results non significantly correlated with employment in SOEs.

To check the progressivity of public transfers, we distinguished the beneficiaries of welfare subsidies[29] by province and by income decile. A strongly progressive subsidy allocation would imply higher benefits for the most disadvantaged groups/areas, both in absolute *and* relative (household income from subsidies over total income) terms. However, the literature about Chinese policies suggests that the fiscal policies implemented in the Eighties and in the first Nineties went in the opposite direction (Shue and Wong, 2007).

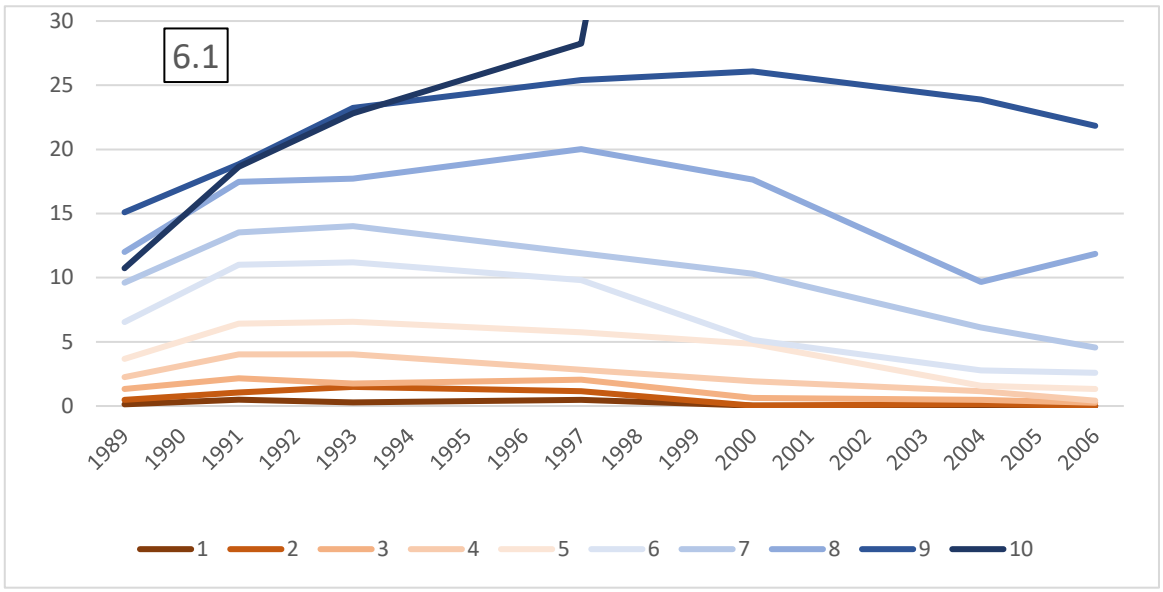
Along with this traditional concept of progressivity in subsidy allocation, we adopt a 'broader' interpretation of progressivity. Dealing with a multidimensional framework of welfare intervention, this 'broader' progressivity prescribes not only that more income should be redistributed to poorer people, but entails also more food for the less nourished and more education incentives for the less educated. Note that the traditional and the 'broader' interpretations of progressivity can also intersect[30].

The individual subsidies, recorded only between 1989 and 2006, shows an inverted-U trend. This pattern is common to all regions of China. Eastern residents received higher average subsidies, with a less pronounced inverted-U shape, in which turning point came earlier. Regional differences in absolute individual subsidies are a first warning about the scarce progressivity of Chinese public spending.

Between 1989 and 2006, rural people always received fewer subsidies than western people: subsidies in urban areas were from three to five times higher than in rural areas. A decile differentiation confirms that rich individuals received, on average, higher support (Figure 6.1).

Figure 6.1: Monthly Individual Subsidies grouped by Decile

[29] The CHNS record two types of subsidies: 'Individual subsidies' and 'overall household subsidies'.
Individual subsidies were initially divided in different categories. Between 1989 and 1997, the categories investigated included, among the others, 'Meat/grocery subsidy' and 'Book and newspaper subsidy'. We considered these categories as 'food subsidies' and 'culture subsidies'. Between 2000 and 2006 questionnaires asked the 'average monthly subsidy last year', i.e. the sum of the different types of subsidy (no longer recorded separately). Since 2009 individual subsidies are no longer collected, but grouped in the question about wage + subsidies received last month.
Household subsidies are divided between childcare subsidies and energy provision subsidies. Household subsidies are collected in an analogue way in the whole time span.
[30] As an example, we study the relation between income subsidies and educational attainment.



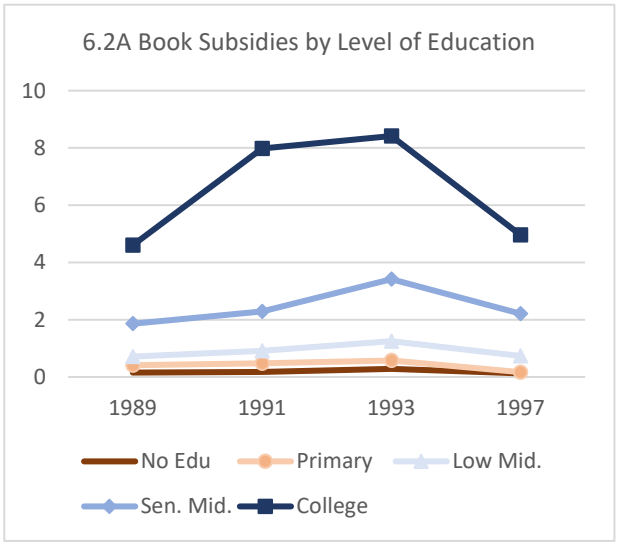
Source: Author's elaboration based on CHNS, 1989-2006. The curve of the 10th decile in 2000-2006 are outside the graph, more than the doubling the level of subsidies recorded amongst the 9th decile.

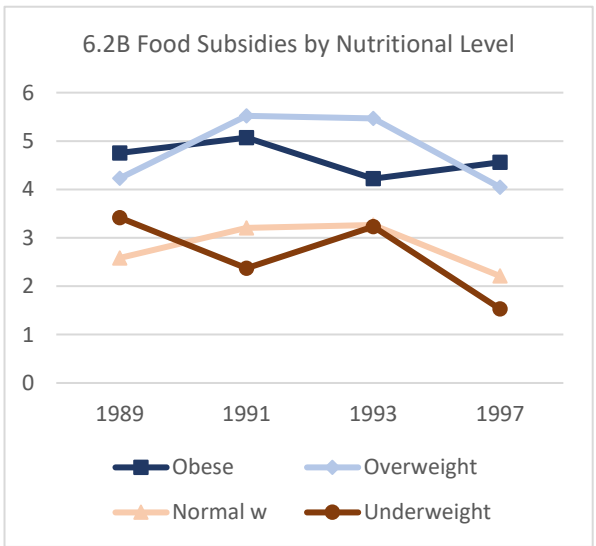
The ninth and tenth deciles received the higher shares, particularly when nominal subsidies peaked (2000-2006). In the Nineties, after Deng's Southern Tour, subsidies of different deciles converged toward the bottom, while a Chinese middle class independent from government assistance emerged.

Focusing on *household* subsidies, (a category providing comparable results in the whole period, differently from individual subsidies), we find a similar trend in the period 1989-2006, followed by an uptick in 2011.

Shifting our interest from monetary to non-monetary targets, the allocation of subsidies remains unfair. Book subsidies mainly targeted relatively high-educated people (Figure 6.2A), while food subsidies were channeled to overweight and obese people (6.2B).

Figure 6.2: Specific Subsidies by achievements in Education (A) and Nutrition (B)

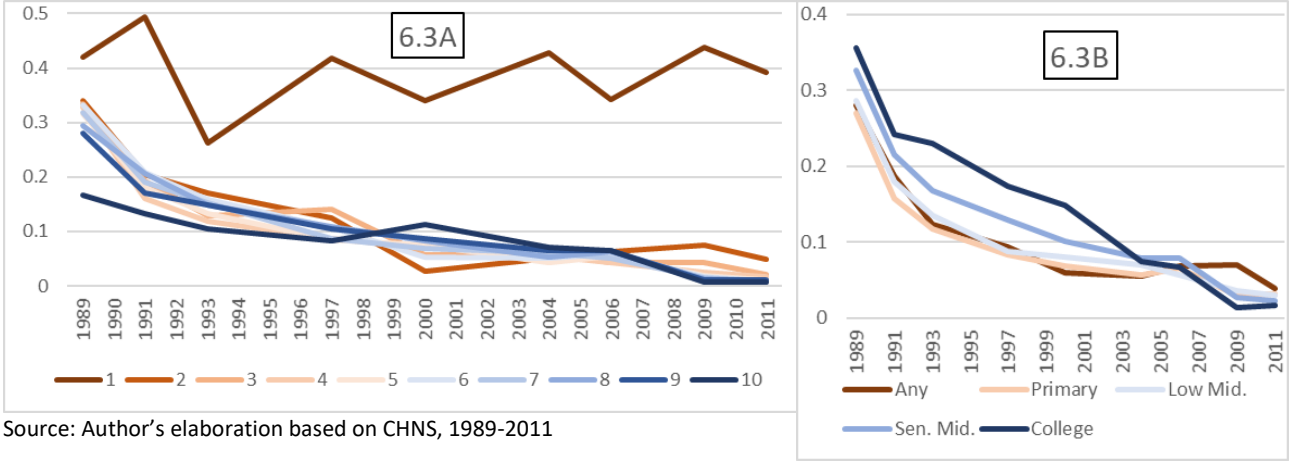




Source: Author's elaboration based on CHNS, 1989-1997

Relatively richer households received larger amounts of subsidies in absolute terms; however, the subsidy allocation is technically not regressive. Indeed, in relative terms, the income of poorer deciles relied more on subsidies. Figure 6.3A describes the relative share of subsidies in household gross income. The distribution of relative subsidies is slightly progressive. This implies that linear cuts in subsidies affect more harshly the poor. East, center and west residents received similar shares of subsidies, while more educated people received higher subsidies, in absolute and relative terms (Figure 6.3B).

Figure 6.3: Relative Subsidies by Income Decile (A) and by Educational Attainment (B)



Source: Author's elaboration based on CHNS, 1989-2011

7. Determinants of inequality in the three Dimensions

This section is meant to answer the following question: Which are the determinants of changes over time in income, education and nutrition inequality?

To see which variables are at the base of the three types of inequality, we adopt a regression-based decomposition of inequality. We follow Morduch and Sicular (2002) methodology, in turn based on the Shorrocks (1982) decomposition. To strengthen the focus on inequality of opportunities, we included in the regression only the "circumstances". Under the assumption that such circumstances are completely beyond individual control[31], our procedure computes how much of the total Gini is related to the observed circumstances. A summary of the decomposition strategy follows.

Let Y_{wi} be the outcome variable registered in the dimension of wellbeing w (i.e. income, education or nutrition) for the individual i. These outcomes are explained with the vector K_i, which includes all the covariates k faced by i, corresponding to his circumstances. The fact that individuals face different

[31] Note that this assumption implies also the absence of reverse causality, hence limiting the scope of possible endogeneity problems. Assuming that circumstances are beyond individual control, the income, education and BMI levels recorded will not affect them (the presence of other omitted variables would not affect them too).

circumstances is a source of inequality of opportunities. To add a provincial fixed effect, we include in the regression the dummies p_i (a dummy for each province, equal to 1 when *i* lives in the province). p_i is another source of inequality of opportunities. The efforts done by *i* are not explicitly included in the regressions: their effect is captured by the residual ϵ_{wi} to the extent they are independent from the circumstances.

$$Y_{wi} = \alpha_w + \beta_w K_i + \gamma_w p_i + \epsilon_{wi} \quad (1)$$

To deal with the time effect, we adopt two strategies, finding similar results. The first is considering time as one of the individual characteristics. This corresponds to assume that the time effect is additive, linear and independent from the effects of other circumstances. Alternatively, relaxing such assumptions, we can estimate different coefficients for each year. We will proceed considering time as one of the individual characteristics; the alternative strategy is used as a robustness check.

The vectors of coefficients β_w and γ_w contain respectively the coefficients of each circumstance and the coefficients of each province. Their estimates, $\widehat{\beta_w}$ and $\widehat{\gamma_w}$, allow to calculate the estimated contribution of circumstances ($\widehat{Y_{wi}^k}$) and the estimated contribution of province of origin ($\widehat{Y_{wi}^p}$) in the determination of the outcome Y_{wi} of each individual, as shown by equation (2) and (3).

$$\widehat{Y_{wit}^k} = \widehat{\beta_w} K_{it} \quad (2)$$

$$\widehat{Y_{wit}^p} = \widehat{\gamma_w} p_{it} \quad (3)$$

The computation of the Gini index of inequality is applied in each year to all the outcomes Y_{wpit} to obtain a measure of inequality through equation (4). The same computation method is also applied to the estimated contributions triggered by each circumstance separately through equation (5).

$$G_{wt}(Y_{wit}) = \frac{2}{{n_{wt}}^2 \mu_{wt}} \sum_{i=1}^{n} \left(i_{wt} - \frac{n_{wt}+1}{2} \right) Y_{wit} \quad (4)$$

$$\widehat{G_{wi}^k}(\widehat{Y_{wit}^k}) = \frac{2}{{n_{wt}}^2 \mu_{wt}} \sum_{i=1}^{n} \left(i_{wt} - \frac{n_{wt}+1}{2} \right) \widehat{Y_{wit}^k} \quad (5)$$

Where Y_{wit} and $\widehat{Y_{wit}^k}$ are defined as above (and are specific to the year t); n_{wt} and μ_{wt} are the simple average and the numerosity of the sample; i_{wt} is the position of individual i in the ordered ranking of n_{wt} according to their Y_{wit}.

The ratio between the Gini relative to the circumstance *k* (5) and the Gini calculated among the actual outcomes (4) defines how much of the total yearly inequality is explained by that specific factor. This allows to investigate how much each circumstance 'matters' in explaining every type of inequality and what has been its contribution over the years. Analogously to the computation of the role of each circumstance k, we can compute the effect of the provincial effects $\widehat{Y_{wi}^p}$.

The dependent variables are the equivalent income, the years of education and the BMI. The independent variables are all the observed "circumstances" that contribute to explain these achievements:

- The first circumstance (variable "Time") explains the improvements in wellbeing simply through the development that occurs with the passing of the time;
- The second circumstance ("Fem") is a dummy that measures the gender discrimination;
- The third and fourth circumstances ("Rur_d" and "Urb_i") measure respectively the discrimination of rural dwellers and how much urbanized is the place of residence, according to the index proposed by Jones-Smith and Popkin (2010);
- The fifth circumstance ("Minority") measures the ethnic discrimination;
- The sixth circumstance ("CCP") measures the advantage of having relatives affiliated to the Communist Party (the choice of considering relatives' rather than individual's affiliation was adopted to cope with the nature of the "circumstances" versus the individual efforts);
- The last circumstance is the interaction of gender and rural/urban dummies, measuring the additional disadvantages of women living in the countryside.

Tables 7.1 reports the coefficients of these circumstances estimated through a regression with fixed provincial effects (fixed effects are omitted for space concerns).

Table 7.1: Factors that influence Income, Education and Nutrition

	Income		Education		Health	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Time	564.9***	6.8	0.078***	0.002	0.028***	0.002
Fem	-477.3***	155.7	-1.631***	0.036	-0.058*	0.034
Age	-29.7***	2.7	-0.142***	0.001	0.014***	0.001
Rur_d	-2737.5***	145.7	-0.219***	0.035	-0.137***	0.032
Urb_i	109.0***	2.9	0.073***	0.001	0.021***	0.001
Minority	-623.2***	143.2	0.048	0.035	-0.083	0.032
CCP	2572.3***	174.1	1.521***	0.042	0.150***	0.038
Rur_d x Fem	269.0	187.5	-0.379***	0.045	0.214***	0.041
Number of obs	114489		92170		101922	
F(19,114469)	1288.68		4149.82		632	
Prob > F	0		0		0	
R-squared	0.1762		0.4611		0.1054	
Adj R-squared	0.1761		0.461		0.1053	
Root MSE	14678		3.2201		3.0924	

Source: Author's estimation using CHNS, 1989-2011. The constant term and the provincial fixed effects are omitted. *, **, *** refer respectively to 10%, 5% and 1% significance levels.

The estimated coefficients are usually significant at 1% level, and the signs of their effect are generally consistent with our expectations[32].

By adopting these estimated coefficients, we calculated the contribution to inequality of each factor in each year in each dimension according to equation (5). Table 7.2 shows how much the three types of inequality are related to each circumstance and their trend over time.

Table 7.2: Inequalities and their Contributions by Circumstances

		Gini	Contribution %					
			gender	province	age	rural	ethnicity	party
Equivalent Income	1989	**37.79**	-0.66	7.54	0.20	34.36	0.70	5.05
	1991	**35.71**	-0.64	8.83	0.42	36.84	0.58	3.77
	1993	**40.45**	-0.48	7.31	0.47	26.53	0.31	2.34
	1997	**39.51**	-0.27	6.69	0.78	17.94	0.36	2.11
	2000	**43.57**	-0.20	5.87	0.36	13.94	0.24	1.60
	2004	**47.70**	-0.17	5.92	0.02	12.16	0.21	1.23
	2006	**50.73**	-0.12	3.41	-0.01	9.22	0.12	0.98
	2009	**49.43**	-0.08	2.89	-0.04	5.07	0.08	0.58
	2011	**47.23**	-0.08	5.79	-0.05	6.12	0.07	0.23
Years of Education	1989	**43.35**	5.13	2.21	26.25	7.69	-0.01	1.51
	1991	**41.55**	5.39	2.15	26.96	8.21	-0.01	1.30
	1993	**38.98**	5.73	2.07	26.42	8.79	-0.01	1.15
	1997	**36.31**	5.42	1.01	26.44	10.50	-0.02	1.80
	2000	**33.11**	4.93	2.00	24.98	10.50	-0.02	1.34
	2004	**31.27**	5.56	2.13	23.61	12.78	-0.02	1.45
	2006	**33.18**	4.91	2.07	22.19	12.59	-0.02	1.19
	2009	**31.98**	4.84	1.93	23.27	12.11	-0.02	0.63
	2011	**30.01**	4.08	6.20	22.37	15.07	-0.02	0.19
BMI	1989	**7.27**	-0.01	7.97	0.41	1.60	0.07	0.15
	1991	**7.30**	-0.04	7.78	0.35	1.78	0.06	0.09
	1993	**7.27**	-0.06	6.82	0.32	1.59	0.07	0.11
	1997	**7.63**	-0.11	6.85	0.36	2.19	0.08	0.12
	2000	**7.91**	-0.07	6.68	0.45	1.70	0.07	0.05
	2004	**8.09**	-0.07	6.17	0.53	1.73	0.07	0.07
	2006	**7.99**	-0.08	6.56	0.69	1.41	0.07	0.05
	2009	**8.24**	-0.07	6.04	0.72	1.17	0.06	0.02
	2011	**8.39**	-0.12	5.26	0.64	1.52	0.07	-0.01

Source: Author's estimation using CHNS, 1989-2011.

[32] Note that males, urban residents (according to both specifications) and party members have significantly higher scores in the three dimensions surveilled. Moreover, older people are poorer and less educated, ethnic minorities are poorer and women suffer a major discrimination in rural areas in terms of education. The year control show that, ceteris paribus, the income, education and body mass improved over time.

Dealing with income, $G_{wt}(Y_{wit})$ increased, despite the rural/urban discrimination (the main source of inequality of opportunity) reduced over time. Provincial differences are another major source of inequality of opportunities.

As for education, the main sources of inequality are: age, sex and urbanicity. The regressive effect of the first two factors declined over time, contributing to the decrease in overall inequality. The rural/urban gap still affects education with a strong and growing role.

Dealing with BMI, a big part of the variation in our sample is unexplained. The (decreasing) effect of provincial differences is the main observed engine of inequality of opportunities. Other characteristics, not measurable in this framework, may play an important role: awareness about a correct nutrition; availability of healthy food; genetic characteristic (all these factors are arguably related to inequality of opportunity, that is "unobserved circumstances"). Further qualitative analysis is encouraged to analyze in depth this issue through a study specifically focused on the nutrition dimension[33]. Indeed, as the literature points out (Cao et al., 2014; Clément, 2017), the same nature of nutritional problems in China is evolving, implying a shifting in in the population at risk and in the policies to be prioritized.

The approach adopted until now, by construction, catches the effect of the passing of the time (apart from individuals' ageing) in the 'year' variable. This variable has a null contribution to inequality in every year because the Gini measures are calculated on a yearly base (inter-temporal inequality is not discussed).

However, the passing of the time could also affect Y_{wit} and its distribution in indirect ways, modifying the effects of other control variables[34]. As a robustness check, by running separate regressions every year (for every w), we allow the coefficients of our controls to change over time. With the estimated coefficients of each year, we apply the same methodology as before (equation 5) to obtain a new estimate of the sources of inequalities. Most of these results[35] resemble the outcomes of Table 7.2 in trends and magnitudes, with the only exception of 2011 (when the estimates are sensitive to the choice about whether to include or not Shanghai, Beijing and Chongqing). Note that this procedure does not affect the overall inequality $G_{wt}(Y_{wit})$, which does not depend on how we estimate the contribution of each factor. The passing of the time is no longer caught by a variable, and its coefficient goes rather in the estimated intercept. This method allows a lower risk of biases at the cost of higher variance (each regression is based on a lower number of observations), in a typical econometric dilemma.

This chapter has analyzed the three dimensions of wellbeing separately. The building of a synthetic measure of wellbeing and its application is discussed in detail in the next chapters. Relatively to the investigation of

[33] The comparison amongst dimensions, which is the aim of this chapter, provides insights only on the aspects that are shared between income, education and nutrition (see footnote 10).
[34] E.g. A variable as ethnic minority could be more harmful in the past with respect to nowadays.
[35] Not reported for space constraints. The data and the graphics are available upon request to the author.

income, education and nutrition inequality, we calculate an index based on the simple average among these dimensions[36]. We arbitrarily assign them an equal weight, rejecting factor analysis, which appeared quite blind[37]. By applying the decomposition procedure described in equation (5), two main causes of inequality in overall wellbeing emerges: age differences (with a reducing role over years) and rural/urban gap[38]. This result depends on our specification of wellbeing, and further research is needed to identify more accurately an index of wellbeing.

8. Conclusions

Chinese reforms brought tremendous changes in the average level of wellbeing. Along with changes in average levels, the distributions changed as well. This chapter provides an overview of the trends of three fundamental dimensions: income, education and nutrition (also related to the HDI pillars).

Since the end of the Nineties, China is struggling to "rebalance" its economic and social development. However, still today, Chinese provinces have different levels (and distributions) of wellbeing. Moreover, "the patterns" of inequality vary in the different dimensions of wellbeing. Therefore, discourses about income and wellbeing inequality do not overlap, calling for specific analyses about the dimensions considered.

Income growth represents more than anything else the success of reforms. Income distribution follows a well-documented steep rise until the 2008 peak (almost 50 Gini points according to our estimates). Despite the improvements in schooling, the nature of the reforms encouraged a growing "inequality of efforts", resulting in an increase of total inequality. On the other hand, the Go-West strategy (1999), the "harmonious society" target (2005) and the partial liberalization of domestic migration (2006) partially corrected the imbalances in opportunities (in turn caused by urban and coastal biased policies by Deng). The coexistence of high inequality, decreasing inequality of opportunities and rising average income constitutes a challenging situation, resembling the equity-efficiency trade-off. Income inequality is higher in those provinces where the market reforms were stronger. Policy interventions targeted at reducing inequality of efforts should give priority to the low-skilled labor force, quite excluded from the benefits of reforms. On the other hand, such interventions could imply sacrifices in terms of efficiency.

The rapid expansion of secondary education brought a reduction in the inequality of education itself. The inequality of opportunities, strongly related with intergenerational differences, is reducing too. However, the

[36] Analogously to the HDI procedure, we calculated the difference between each component of wellbeing and the minimum of value recorded and then divided by the difference between minimum and maximum recorded. We then take the average of standardized nutrition, income and education.
[37] Through principal component analysis, the first component explains a proportion lower than 50% of variance.
[38] Not reported for space constraints. The data and the graphics are available upon request to the author.

commitment in tackling education inequality should not be relaxed. The reduction of the rural/urban gap seems an unescapable strategy to promote further education improvements and inequality reduction.

As for health, government efforts focused on ex-post strategies, including more (and better distributed) medical insurances. However, the distribution of the BMI indicates a coexistence of undernutrition and obesity issues, that should be tackled with ad hoc policies.

Interventions to alleviate inequality in China should therefore consider the multidimensional nature of wellbeing, suggesting the adoption of an integrated approach as the most efficient strategy.

References

Aiguo, L. (2006). Transition, inequality, stress and health status in China. *project 'Heath amnd Social Upheavals' sponsored by the John D and Catherine T MacArthur Foundation, Institute of World Economics and Politics, Chinese Academy of Social Sciences, Beijing*.

Arrighi, G. (2007). *Adam Smith in Beijing: Lineages of the twenty-first century*. Verso books.

Berrington de Gonzalez, A., Hartge, P., Cerhan, J. R., Flint, A. J., Hannan, L., MacInnis, R. J., ... & Beeson, W. L. (2010). Body-mass index and mortality among 1.46 million white adults. *New England Journal of Medicine*, *363*(23), 2211-2219.

Biggeri, M. (2003). Key factors of recent Chinese provincial economic growth. *Journal of Chinese Economic and Business Studies*, *1*(2), 159-183.

Biggeri, M. (2007). China in Perspective: From Economic 'Miracle'to Human Development. *Globalization and Development: A Handbook of New Perspectives, Oxford University Press, New Delhi*.

Biggeri, M., & Hirsch, G. (2008). L'altra Cina. *Studi e Note di Economia*, *13*(2), 265-298.

Bourguignon, F., Ferreira, F. H., & Menéndez, M. (2007). Inequality of opportunity in Brazil. *Review of income and Wealth*, *53*(4), 585-618.

Brunori, P., Ferreira, F. H. G., & Peragine, V. (2013). Inequality of opportunity, income inequality and economic mobility: Some international comparisons, IZA Discussion Papers, No. 7155, Institute for the Study of Labor (IZA), Bonn

Burchi, F., & De Muro, P. (2016). From food availability to nutritional capabilities: Advancing food security analysis. *Food Policy*, *60*, 10-19.

Cao, H., Hansstein, F. V., Liu, F., & District, B. (2014). Dynamic Links between Socioeconomic Status and Obesity in China.

Chen, Z., Yang, G., Offer, A., Zhou, M., Smith, M., Peto, R., ... & Whitlock, G. (2012). Body mass index and mortality in China: a 15-year prospective study of 220 000 men. *International journal of epidemiology*, *41*(2), 472-481.

China, UNDP. (2007). Access for all: Basic public services for 1.3 billion people. *Beijing: Human Development Report China*, *8*, 2008.

Chyi, H., & Zhou, B. (2014). The effects of tuition reforms on school enrollment in rural China. *Economics of Education Review*, *38*, 104-123.

Clément, M. (2017). The income-body-size gradient among Chinese urban adults: A semiparametric analysis. *China Economic Review*, *44*, 253-270.

Cornia, G. A. (1994). Income distribution, poverty and welfare in transitional economies: A comparison between Eastern Europe and China. *Journal of International Development*, *6*(5), 569-607.

Cornia, G. A., Rosignoli, S., & Tiberti, L. (2009). Did globalisation affect health status? A simulation exercise. *Journal of International Development: The Journal of the Development Studies Association*, *21*(8), 1083-1101.

Cornia, G. A., & Scognamillo, A. (2016). Clusters of Least Developed Countries, their evolution between 1993 and 2013, and policies to expand their productive capacity. *CDP background paper*, (33).

De Brauw, A., & Giles, J. (2017). Migrant opportunity and the educational attainment of youth in rural China. *Journal of Human Resources*, *52*(1), 272-311.

Golley, J., & Kong, S. T. (2016). Inequality of opportunity in China's educational outcomes. *China Economic Review*.

Goodburn, C. (2014). The end of the hukou system? Not yet. *University of Nottingham China Policy Institute Policy Papers*, *2*.

Goodman, D. S., & Segal, G. (2002). *China deconstructs: Politics, trade and regionalism*. Routledge.

Han, J., Liu, R., & Zhang, J. (2012). Globalization and wage inequality: Evidence from urban China. *Journal of international Economics*, *87*(2), 288-297.

He, W., Li, Q., Yang, M., Jiao, J., Ma, X., Zhou, Y., ... & Zhu, S. (2015). Lower BMI cutoffs to define overweight and obesity in China. *Obesity*, *23*(3), 684-691.

He, Y., Pan, A., Wang, Y., Yang, Y., Xu, J., Zhang, Y., ... & Yan, D. (2017). Prevalence of overweight and obesity in 15.8 million men aged 15–49 years in rural China from 2010 to 2014. *Scientific reports*, *7*(1), 5012.

Huang, F., & Gan, L. (2017). The impacts of China's urban employee basic medical insurance on healthcare expenditures and health outcomes. *Health economics*, *26*(2), 149-163.

Huang, X. (2015). Four worlds of welfare: Understanding subnational variation in Chinese social health insurance. *The China Quarterly*, *222*, 449-474.

ILO. (2015). *Global wage report 2014/15: Wages and income inequality*. International Labour Office.

Jones-Smith, J. C., & Popkin, B. M. (2010). Understanding community context and adult health changes in China: development of an urbanicity scale. *Social science & medicine*, *71*(8), 1436-1446.

Knight, I., Sicular, T., & Yue, X. (2013). Educational inequality in China. *Rising inequality in China: Challenges to a harmonious society*, *142*.

Labar, K. (2011). Multidimensional Inequalities In China.

Labar, K., & Bresson, F. (2011). A multidimensional analysis of poverty in China from 1991 to 2006. *China Economic Review*, *22*(4), 646-668.

Li, S., Sato, H., & Sicular, T. (Eds.). (2013). *Rising inequality in China: Challenges to a harmonious society*. Cambridge University Press.

Li, Y., & Wei, Y. D. (2014). Multidimensional Inequalities in Health Care Distribution in Provincial China: A Case Study of H enan P rovince. *Tijdschrift voor economische en sociale geografie*, *105*(1), 91-106.

Li, S. (2015) *The latest changes in income inequality in China*. UNU-WIDER 30th Anniversary Conference http://www1.wider.unu.edu/30thanniversary/sites/default/files/IGA/Shi.pdf

Li, H., Loyalka, P., Rozelle, S., Wu, B., & Xie, J. (2015). Unequal access to college in China: How far have poor, rural students been left behind?. *The China Quarterly*, *221*, 185-207.

Li, X. (2016). Measuring Local Corruption in China: a Cautionary Tale. *Journal of Chinese Political Science*, *21*(1), 21-38.

Liu, J., & Li, S. (2011). *Changes in consumption inequality in China* (No. 2011-11). CIBC Working Paper.

Lo, D. (2003). Assessing the Role of Foreign Direct Investment in China's Economic Development: Insights from Sectoral-regional Analyses. Economic Research Journal, 9(004).

Lo, D. (2018). Consideration on China's New Normal Economic Growth. *Journal of China and International Relations*, *6*(1), 73-94.

Molero-Simarro, R. (2017). Inequality in China revisited. The effect of functional distribution of income on urban top incomes, the urban-rural gap and the Gini index, 1978–2015. *China Economic Review*, *42*, 101-117.

Morduch, J., & Sicular, T. (2002). Rethinking inequality decomposition, with evidence from rural China. *The Economic Journal*, *112*(476), 93-106.

Nolan, P. (2004). China at the Crossroads.

Pei, X., & Rodriguez, E. (2006). Provincial income inequality and self-reported health status in China during 1991–7. *Journal of Epidemiology & Community Health*, *60*(12), 1065-1069.

Piketty, T. (2013). *Le capital au XXIe siècle*. Le Seuil.

Piketty, T., Yang, L., & Zucman, G. (2017). *Capital accumulation, private property and rising inequality in China, 1978-2015* (No. w23368). National Bureau of Economic Research.

Roemer, J. E. (1993). A pragmatic theory of responsibility for the egalitarian planner. *Philosophy & Public Affairs*, 146-166.

Roemer, J. E., & Trannoy, A. (2015). Equality of opportunity. In *Handbook of income distribution* (Vol. 2, pp. 217-300). Elsevier.

Ringen, S., & Ngok, K. (2017). What kind of welfare state is emerging in China?. In *Towards Universal Health Care in Emerging Economies* (pp. 213-237). Palgrave Macmillan, London.

Shi, L. (1993). Health care in China: a rural-urban comparison after the socioeconomic reforms. *Bulletin of the World Health Organization*, *71*(6), 723.

Shorrocks, A. F. (1982). Inequality decomposition by factor components. *Econometrica: Journal of the Econometric Society*, 193-211.

Shue, V., & Wong, C. (Eds.). (2007). *Paying for progress in China: Public finance, human welfare and changing patterns of inequality*. Routledge.

Sicular, T. (2013). The challenge of high inequality in China. *Inequality in focus*, *2*(2), 1-5.

Sicular, T., Li, S., Yue, X., & Sato, H. (2017). Changing Trends in China's Inequality: Key Issues and Main Findings.

Stiglitz, J. (1999). Whither Reform? Ten Years of the Transition. Keynote Address at the World Bank Annual Conference on Development Economics, Washington, DC, April 28-30. *New Republic*.

Tsui, K. Y. (2007). Forces shaping China's interprovincial inequality. *Review of Income and Wealth*, *53*(1), 60-92.

Woo, W. T., Garnaut, R., & Song, L. (2013). *China's New Place in a World in Crisis: Economic, Geopolitical and Environmental Dimensions* (p. 461). ANU Press.

World Health Organization. (2000). *The world health report 2000: health systems: improving performance*. World Health Organization.

Wyatt, S. B., Winters, K. P., & Dubbert, P. M. (2006). Overweight and obesity: prevalence, consequences, and causes of a growing public health problem. *The American journal of the medical sciences*, *331*(4), 166-174.

Xia, Q., Song, L., Li, S., & Appleton, S. (2014). The effect of the state sector on wage inequality in urban China: 1988–2007. *Journal of Chinese Economic and Business Studies*, *12*(1), 29-45.

Yang, W., & Wu, X. (2014). Paying for outpatient care in rural China: cost escalation under China's New Co-operative Medical Scheme. *Health Policy and Planning*, *30*(2), 187-196.

Zhao, Y. (2012). The struggle for socialism in China: The Bo Xilai saga and beyond. *Monthly Review*, *64*(5), 1.

Annex 1: Data construction

Table A1: Summary Statistics

	Variable	Variable Name	Unit	N	Mean	SD	Item (CHNS folder)
Outcomes	Equiv. Income	eincome	Equiv. ¥	116370	11695	16168	Own calculation
	Years of Educ.	education	Years	93778	6.98	4.38	Own calculation
	Body Mass Index	BMIc	BMI Pts	103634	22.60	3.27	Own calculation
Circumstnces	Survey Round	Wave	Years	117744	2001.59	7.56	wave (all files)
	Gender	Female	Dummy	117744	0.52	0.50	gender (master ID)
	Age	Age	Years	117665	44	16	age (surveys)
	Rural/Urban	Rural	Dummy	117744	0.69	0.46	T2 (all files)
	Eth. Minority (C)	minority3	%	115993	0.14	0.35	Own calculation
	Party Family	Hhparty	Dummy	117744	0.07	0.26	Own calculation
	Urbaniz. Index	Index	%	117626	58	20	Own calculation
	Rural & Female	Rufem	Dummy	117744	0.36	0.48	Own calculation
	Beijing	province1	Dummy	117744	0.01	0.10	T1 (all files)
	Jiangsu	province2	Dummy	117744	0.11	0.31	T1 (all files)
	Liaoning	province3	Dummy	117744	0.09	0.28	T1 (all files)
	Shandong	province4	Dummy	117744	0.10	0.31	T1 (all files)
	Shanghai	province5	Dummy	117744	0.01	0.10	T1 (all files)
	Heilongjiang	province6	Dummy	117744	0.06	0.24	T1 (all files)
	Henan	province7	Dummy	117744	0.12	0.32	T1 (all files)
	Hubei	province8	Dummy	117744	0.11	0.32	T1 (all files)
	Hunan	province9	Dummy	117744	0.11	0.32	T1 (all files)
	Chongqing	province10	Dummy	117744	0.01	0.10	T1 (all files)
	Guangxi	province11	Dummy	117744	0.13	0.34	T1 (all files)
	Guizhou	province12	Dummy	117744	0.13	0.34	T1 (all files)
Other Achievements	Absolute Poverty	poorI	Dummy	116370	0.30	0.46	Own calculation
	Unskilled People	poorE	Dummy	93778	0.52	0.50	Own calculation
	Underweight	poorH	Dummy	103634	0.05	0.22	Own calculation
	Relatively Poor	groupI	Dummy	116370	0.29	0.45	Own calculation
	Educ. Category	groupE	Category	91721			Own calculation
	Weight Category	groupH	Category	103634			Own calculation
Other Variables	Wage	Wage	¥/Month	31868	998	1669	Own calculation
	Medical Insurance	m1	Dummy	81709	0.48	0.50	M1 (insurance)
	Coastal Province	Coast	Dummy	117744	0.32	0.47	T1 (all files)
	Employed in SOE	Soe	Dummy	65448	0.30	0.46	Own calculation
	Reported Ethnicity	minority	Dummy	8497	0.11	0.31	A19(individual roster)
	Party Memb.	Party	Dummy	40278	0.05	0.22	A14(individual roster)
	Resid. Category	Hukou	Category	117744			Own calculation
	Individual Subs.	Sustot	¥/Month	117744	7.39	76	Own calculation
	Realtive Subsidies	Subinc	%	34974	0.13	0.17	Own calculation

Equivalent income is calculated based on the household level data (household income file, item hhinc_cpi)[39]. We assume a perfectly equal distribution of income among adult household members (therefore we are likely to underestimate the gender gap, as discussed above). We apply the OECD equivalence scales, consistently with Liu and Li (2011).

Years of Educ. corresponds to the item A11 (individual education file). In case of missing values, we include the information from the item A12 (same file), corresponding to the highest level of education attained. If the variable is still missing but the individual provides education information in previous and future years, we apply a linear interpolation to replace the missing value.

Body Mass Index is based on the ratio between weight (physical examination, item weight) and squared height (physical examination, item height). We calculate the median height and weight values (excluding the extremes values), to obtain a "median BMI". This value replaces the observed BMI in case the distance between the two is too high. This procedure is adopted to identify and correct the cases of misreporting.

Party Family is a dummy based on 'Party Memb.'. We assign value 1 to all individuals who have in their family someone(s) else recorded as party official(s) (in any wave) and value 0 to all the others.

Urbanization index corresponds to the urbanicity scale proposed by Jones-Smith and Popkin (2010). It measures at the county level the extent of urbanization based on twelve components, mainly related to the available infrastructures. Urbanicity scale and rural/urban dummy are correlated but not perfectly overlapping: we use both variables to have a more detailed picture.

Eth. Minority (C), is based on the dummy 'minority', which includes several missing values in the recent rounds. These values are replaced by the respondent's average answers in different years. If the variable was never declared, we adopt the average answer of other household components. If any household member in any round has answered to the question about ethnic minority, we assume he belongs to the Han majority.

Rural & Female is an interaction between 'Gender' and 'Rural/Urban'.

Absolute Poverty and Relative Poverty. Consistently with Chinese statistics, absolute poverty is calculated with different standards in urban and rural areas. We refer respectively to the urban provincial dibao threshold (城市低保标准)[40] and to the government's 2010 new poverty line[41]. Relative poverty is based on the OECD procedure (people with equivalent income lower than 60% of the median are poor).

[39] The total household income, net of the total expenditure (so it can also assume a negative sign), is inflated to 2001.
[40] The dibao (低保) is calculated for urban areas at provincial level to identify a subsistence level. This level is updated quarterly. We adopt the provincial average of the four 2011 values as threshold (correcting the threshold for inflation).
[41] In 2011 the 2010 poverty line was fixed at 2300 yuan per capita (irrespectively of any equivalence scale). Our estimate of poverty applies the 2010 threshold backward (we adjust the values according to inflation and reject the poverty lines adopted previously, on the basis of less ambitious targets). Indeed, the moving target adopted by the government is useful for policy making but does not allow comparisons over time.

Unskilled People and Educ. Category; individuals who did not reach the secondary degree (nine years of education, i.e. the compulsory education level since 1986) are considered unskilled. A categorical variable distinguishes 5 levels of education: any; primary; junior secondary; senior secondary; college or higher.

Underweight and Weight Categories. Undernutrition threshold, consistently with the standard World Health Organization measure (higher thresholds were suggested by the literature) is fixed at 18.5 BMI points. Other categories highlighted are overweight (≥25) and obesity (≥30).

Wage is calculated as the summation of monthly pension, salary and bonus received last year or month (individual earnings file, respectively items B2D, C8, I19).

Employed in SOE is a dummy variable based on the occupation unity of the primary occupation (individual jobs file, item b6). Government and State services/institutes are also included in SOEs (dummy= 1).

Residence is based on 'Rural/Urban' dummy, but the urban group (are the people living in an urban area) is further divided into two categories: the urban residents and the *nongmingong.* The latter individuals reported having a rural *hukou* (Individual Roster Data, item A8B1).

Individual Subs. are based on the total average subsidies received last month (Individual Subsidy Income, item i14a). We also computed the summation of individual subsidies received in specific fields and months (Individual Subsidy Income, items i9/i14). In case the item i14a is missing or lower than the summation of all specific monthly subsidies, we replace the i14a item with the summation.

Relative subsidies are calculated as the share of total household income from subsidies (household income file, item hhsub) over the total gross household income (household income file, item hhincgross).

The percentage of male remains stable at around 50% of the sample (slightly less, consistently with the lower life expectancy of men). The percentages of ethnic minorities and rural/urban population is stable too. Surprisingly the share of migrants does not increase over time and, at the opposite, decreases slightly[42]. In 1989 the percentage of local officials was much higher than in the following years, even if the questionnaires did not change in the meanwhile. The percentages of inhabitants in the three regions seems stable, apart from 1997, when Liaoning was excluded from the sample (an exclusion affecting the regional trend of education).

[42] This does not mean necessarily that the effective number of migrants decreased: more migrants could have obtained the urban hukou or moved increasingly toward other rural destinations. Moreover, the number of respondents to a sensitive question as the number of missing observations about hukou is not constant and could affect this trend.

Annex 2: Notes on Health and Nutrition

This section briefly describes our attempts to individuate a continuous individual variable suitable as a proxy for health. As we show thereafter, nutrition results a variable strongly related with health (through an-inverted-U function), despite the two dimensions relates to different phenomena and many other variables can influence health without affecting nutrition (or vice versa). An exhaustive theoretical analysis about the relation between nutrition and health is not in the aims of this appendix[43], that only means to describe empirically the correlation between these dimensions in the CHNS sample.

The computation of a synthetic measure of health status suitable with an inequality investigation is not easy. The CHNS database contains much information about individual health conditions. However, the high frequency of missing observations and the need of a non-categorical variable for an inequality investigation make less trivial the choice of an appropriate index.

We selected several possible specifications of health status, analyzing their trend over time. Through OLS and probit regressions, we investigate their relations with socioeconomic characteristics. A robust non-linear correlation appears between BMI and every specification of health status (Table A1).

The six specifications of health status are:

- Hstat1, a categorical variable about self-reported health. It responds to the question: "Right now, how would you describe your health compared to that of other people of your age?" (Individual Medical Insurance File, item M1A). This variable runs from 1 ("Excellent") to 4 ("Poor"). This variable is only collected in three rounds, between 1991 and 1997.

- Hstat2 is a dummy where 1 correspond to answers "yes" to the question "Have you been sick or injured within the last four weeks? Have you suffered from a chronic or acute disease?" (Individual Health Care File, item M23). This variable is available for all rounds but 1989.

- Hstat3 is a categorical variable about the number of days of inability caused by illnesses. It reports the answer to the question "How many days were [you] unable to carry out normal activities due to this illness?" (Individual Health Care File, item m26a).

- Hstat4 estimates the expected number of days of inability to work combining information from Hstat2, Hstat3 and Hstat6[44] to reduce the number of missing values.

[43] More information about this topic, in developed and developing countries, can be found in Wyatt et al., 2006; Chen et al., (2012); Burchi and De Muro (2016).

[44] The number of days considers whether the respondent has suffered a number of specific diseases (Individual Health Care File, items m24b_1 / m24b_20). Hstat4 has value 0 if the respondent never declared any illness and was able to carry out normal activities (and he answered to at least one of these questions). We apply to those who suffered an

- Hstat5 is a discrete variable dealing with the number of days of hospitalization. It reports the answer to the question “For how many days [you] were hospitalized or have been hospitalized?” (Individual Health Care File, item m29). The number of respondents to this question is much lower than the other collected variables.

- Hstat6 is a categorical variable about the self-reported severity of the illness, runs from 1 (“not severe”) to 3 (“quite severe”). It reports the answers to the question “How severe was the illness or injury” (Individual Health Care File, item m25).

We discarded self-reported health condition variables (Hstat1 and Hstat6) for three reasons. Firstly, an inequality measure cannot rely on categorical variables. Secondly, too many observations are missing, sensitively reducing the time span. Thirdly, the self-reporting has not a scientific foundation.

The dummy for having been sick (Hstat2) is also unsuitable. Indeed, between two individuals cannot exist any degree of similarity/difference in health status, apart from being exactly the same (two zeroes or two ones) or being completely different (a one and a zero). No middle way is allowed. This makes possible only measuring differences on average between two communities, not between two individuals.

Days of inability to carry on normal activities and days of hospitalization (Hstat3, Hstat4 and Hstat5) are attractive variables because they are continuous. However, we face again many missing variables. Moreover, the choice about how to select the sample (e.g. accounting for people who declare not to have suffered sickness/injury or limiting the sample to the respondents) do change the characteristics of this variable. This is because the variable being sick or not behaves differently from the severity of the sickness itself. For example, females, urban people and party members seem more prone to declare having suffered an illness. On the other hand, males, rural people, and non-party members lost more days because of illness. Similarly, the number of people who declare having suffered an illness increased over time between 1989 and 2011, but the number of days lost on average decreased. Apart from these differences, some regularities in the behaviors of health status emerge independently from the specification adopted.

Even if any of these six variables is suited to measure health inequality, all of them catch important aspects of health. Table A2 shows which factors are econometrically related to health conditions (Table A2).

illness without indicating the days of inability the average days indicated by individuals suffering the same illness with the same severity. In case more illnesses are recorded, we applied the number of days related to the most severe one.

Table A2 Effects of the main controls on health status (measured in 6 specifications)

	OLS Hstat1		probit Hstat2		OLS Hstat3		OLS Hstat4		OLS Hstat5		OLS Hstat6	
	β	p-val	β	p-val	β	p-val	β	p-val	B	p-val	β	p-val
Insurance	0.025	0.04	0.260	0.00	-0.025	0.90	0.088	0.00	1.523	0.08	0.029	0.06
Income	-7.40E-06	0.00	-3.27E-06	0.00	-2.44E-05	0.00	-4.86E-06	0.00	-2.48E-05	0.36	-1.21E-06	0.01
BMI	-0.147	0.00	-0.282	0.00	-0.575	0.00	-0.295	0.00	-0.325	0.72	-0.043	0.01
BMI squared	0.003	0.00	0.006	0.00	0.011	0.01	0.006	0.00	0.006	0.74	0.001	0.01
Years of Education	-0.007	0.00	-0.005	0.17	-0.050	0.03	-0.007	0.04	0.001	0.99	-0.008	0.00
Wave	-0.004	0.05	0.018	0.00	-0.137	0.00	0.004	0.05	-0.137	0.03	-0.004	0.00
Female	0.054	0.00	0.208	0.00	-0.654	0.00	0.006	0.81	-1.059	0.14	-0.052	0.00
Coast	-0.147	0.00	-0.066	0.02	0.524	0.00	0.032	0.22	-0.566	0.45	0.027	0.08
Age	0.012	0.00	0.035	0.00	0.055	0.00	0.024	0.00	0.055	0.06	0.004	0.00
Rural	-0.072	0.00	-0.310	0.00	0.435	0.02	-0.111	0.00	-1.602	0.04	-0.033	0.04
Minority	-0.057	0.00	-0.212	0.00	0.401	0.11	-0.031	0.36	0.128	0.90	0.039	0.07
Party	-0.063	0.01	0.134	0.05	-0.208	0.65	0.003	0.97	-0.651	0.70	-0.027	0.49
Health Infrastruct.	-0.003	0.29	-0.025	0.00	-0.032	0.40	-0.017	0.00	0.218	0.20	-0.005	0.11
Health Subsidies	-0.001	0.38	-0.006	0.26	-0.008	0.82	-0.002	0.60	-0.103	0.42	-0.001	0.82
_cons	10.963	0.00	-36.514	0.00	282.250	0.00	-5.066	0.23	286.462	0.02	9.581	0.00
BMI Turning point:	26.39		24.50		26.49		24.98		26.04		25.30	

Source: author's calculation based on CHNS data. Note that all the specifications of health status grow with the deterioration of health status: positive coefficients indicate therefore a negative effect on health conditions.

The BMI is linked with the health status through an inverted-U relation. A turning point TP[45], determines at which level of BMI further increases in body mass become harmful. This result, consistent with the literature, holds irrespectively to the specification of health adopted. This fact encouraged us to use BMI not only as a measure of nutrition (which is intrinsically relevant for well-being), but also as a determinant of health[46].

In every specification, the estimated BMI turning point falls within our sample and is close to 25 points (the threshold between normal- and over-weight). Moreover, a t-test[47] shows that belonging to the underweight or obese categories (rather than normal weight) worsen the health status. Underweight people are significantly (5% level) worse off in all specifications but Hstat5. Obese people are significantly (5% level) worse off in all specifications but Hstat3, Hstat5 (non-significant) and Hstat6 (10% level).

The negative coefficients of education and income (i.e. positive effect on health) are expected for two reasons. Firstly, a frail health undermines the productivity and consequently the wage and the learning capacity. Secondly, a rich and educated individual can be more likely to adopt a healthy lifestyle. The ageing effect is harmful for health conditions, as expected.

[45] Turning points are calculated with the equation $\widehat{TP} = -\frac{\hat{\beta}_{BMI}}{2 \times \hat{\beta}_{BMI^2}}$. This equation applies both on OLS and logit estimated coefficients, as long as the turning point falls within the sample.

[46] Note that the inverted-U relation strengthens the relevance of nutrition inequality in multidimensional well-being, because both the tails of the BMI distribution are harmful for health concerns.

[47] The two-sample t-test measures the significance of the differences in average health status (according to every specification) between two groups. We firstly compare normal weight and underweight groups. Then we repeat the procedure with normal weight and obesity. Overweight people, an intermediate category, is never considered.

Contrary to our expectations and previous researches (Shi, 1993; Li and Wei, 2014), rural residence affects positively health status (not in Hstat3 specification). A possible explanation is that urban people have higher expectations, resulting in higher concerns and denounces about health diseases even if they are indeed healthier than rural people. We reject the hypothesis that rural people are effectively healthier thanks to an analysis of the mortality in our sample[48].

The endowment of health infrastructures, calculated at the county level, is significantly and positively related with health status, except for the "days of hospitalization" specification[49].

Another phenomenon strongly correlated with health is the ownership of a health insurance. Meng and others (2015) reviewed the literature about causality in the health insurance/health status relation in China. They concluded that the "*existing evidence suggests that social health insurance schemes can improve the health of some population subgroups*" (Meng et al., 2015, p. 1486). The diffusion of health insurances is therefore an encouraging signal.

To investigate who benefitted the most from health insurance, we run a logistic regression with the probability of being covered by health insurance as dependent variable[50]. As expected, the people less covered by insurances usually belong to the more vulnerable social groups (poor, unskilled, women, rural people, inner residents, migrants, ethnic minorities, non-affiliated to the CCP). The passing of the time significantly and positively affects the likelihood of being insured. Indeed, in the last twenty years, China obtained important achievements in terms of diffusion of medical insurances.

The larger availability of medical insurances favored the access to health and reduced inequality. Indeed, the gap in insurance coverage between "privileged" and "non-privileged" groups reduced. The spreading of health insurances among "non-privileged groups" triggered a more equitable distribution of insurances.

[48] During the period covered by the survey, 1929 death occurred. This datum refers to the *death* occurrences, and not by other causes of attrition. We excluded two cases, in which the year of birth is not available. Dividing our sample between rural and urban people, it emerges that the higher percentage of deaths occurred in the rural subsample and that these deaths occurred on average at a significantly lower age (64.2 years compared to 66.7 years in the urban subsample). This data is consistent (but lower) with the difference in LEB recorded by Shi (1993). We further investigate the coastal gap in mortality by dividing the sample into "coastal" and "inner" subsamples. In the coast the deaths are (in percentage) ewer and involve (on average) significantly older individuals (about two years later in the coast).

[49] The availability of hospitals can push ill people to resort more easily to medical assistance at their same health condition. In this perspective, Hstat5 is not necessarily a negative measure of health status.

[50] Not reported for space constraints. The data and the graphics are available upon request to the author.

Chapter II

Introducing a New Method to Analyze Chinese Multidimensional Deprivation

An Application of MPI and MSI to China, 1989-2011

Abstract

The purpose of this chapter is to measure the Chinese poverty reduction in the multidimensional space. The reduction of monetary poverty in China has been an impressive outcome of the reforms, and the fight against poverty remains a target priority, at the core of 13th Five-Years Plan.

The international community, through the Sustainable Development Goals (SDGs), is also promoting the eradication of poverty, which is described not only as a matter of money shortage. Indeed, achieving a multidimensional development is crucial in China, where the pace of economic expansion recorded in the last decades will be no longer feasible.

These conditions solicit a long-run investigation of multidimensional deprivations in China. In doing this, we adopted both the Multidimensional Poverty Index (MPI) proposed by Alkire and Foster (2011) and the Multidimensional Synthesis Indicator (MSI) by Mauro, Biggeri and Maggino (2018). The MSI aggregates several dimensions of wellbeing (in our case Education, Health, Nutrition, Housing, Sanitation, Work, Leisure), satisfying the proprieties of strict monotonicity, continuity, and heterogeneity penalization.

MPI and MSI are calculated with the China Household and Nutrition Survey data, including about 4,400 households spread over nine provinces and nine years, between 1989 and 2011.

The two approaches document the evolution of multidimensional deprivations over time and across provinces. We also investigate the wellbeing of different socio-economic groups, as well as which dimensions are to prioritize in the different contexts.

Keywords: China; Multidimensional Poverty; Gender Bias; Poverty Measurement.

JEL classification: I32 O1 O18 R11

1. Introduction

Poverty alleviation has been one of the most impressive outcomes of the reform programs China started in 1978. In that year, by launching the reform programs, China undertook a path of rapid income growth and poverty alleviation (see, among the others, Ravallion and Chen 2007; Montalvo and Ravallion, 2010; China and UN, 2013). This chapter explores the development and poverty-reduction outcomes from a multidimensional perspective.

Chinese contribution in the fight against monetary poverty is a worldwide phenomenon, fundamental in the campaigns for the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs)[51]. According to the MDGs report (China and U.N., 2013), between 1970 and 2000, the rural Chinese population without food and clothing decreased from 250 million (30.7% of the total rural population) to 32 million (3.5%). The drop of income poverty is equally impressive: according to the World Bank data[52], the proportion of poor people decreased from 66.6% in 1990 to 7.9% in 2011. The commitment of Chinese government in poverty alleviation is also a domestic issue. Important policies started before the formulation of the MDGs in 2000 and involved monetary subsidies (the most important policy in this perspective was the launching of the 低保 "DiBao" subsidies in the 1990s) as well as medical insurances schemes and education subsidies[53].

Despite the impressive steps achieved, the fight against monetary poverty in China remains a priority target, now related to the SDGs (United Nations, 2015). Recently, the commitment in poverty alleviation resulted in the government's decision to pursue the target of poverty eradication, announced in the 13th Five-Years Plan (2016-2020). The achievement of this goal was thus anticipated of ten years with respect to the international SDGs agenda.

Along with income, inequality increased too, and the achievements in other dimensions of wellbeing did not keep pace with monetary growth. Especially between 1984 and the end of the Nineties, the reforms were biased toward urban and coastal areas, while market forces prevailed over the central government capacity of reallocating resources and promoting social security. Chinese development and poverty alleviation were therefore complex phenomena, especially if we separate monetary poverty (considered as only the reference point by policy-makers and scholars in the earliest phases of the reform) from multidimensional poverty.

[51] The first SDG is to "end poverty in all its forms everywhere".

[52] By adopting the standard poverty headcount ratio at $1.90 a day (2011 PPP).

[53] Gustaffson and Quheng (2011) describe critically the history, the impact and the targeting of the DiBao program. Dealing with insurances schemes, we recall the introduction of the Urban Employee Basic Medical Insurance (UEBMI) in 1998 and the implementation of similar programs for urban (URBMI, in 2007) and rural residents (NCMS, in 2003). For a critical analysis of the evolution of the Chinese healthcare system from the Maoist period to the recent trends, see Aiguo (2006) and Meng et al. (2015). Dealing with education reforms, see Chyi and Zhou (2014).

A comprehensive fight against poverty cannot involve uniquely the monetary aspect. Allowing people to satisfy their basic needs in terms of health, education, social security etc. is widely recognized as an essential aspect of poverty mitigation strategy[54]. Enhancing such capabilities is valuable for breaking the "poverty traps" (instrumental value) and for their intrinsic value (Sen, 1999).

Moreover, conceiving development as a multidimensional target, is particularly important in nowadays China. The Hu Jintao presidency, which took office in 2003 with Wen Jiabao as Prime Minister, promoted the rhetoric about a "harmonious society" (和谐社会 "héxié shèhuì"). This narrative substituted the emphasis about sustained monetary growth, typical of the first decades of reforms. In a context where the previous fast-growth condition is no longer viable (the "New Normal"), the need to promote balanced and inclusive development has been frankly admitted by Hu Jintao's successor, president Xi Jinping.

This chapter aims to analyze Chinese multidimensional deprivation with two different methods based on micro-level data (Chinese Health and Nutrition Survey - CHNS). The first method is the Multidimensional Poverty Index (MPI) developed by Alkire and Foster (2011), an index widely used in the literature[55]. The second method is the Multidimensional Synthesis Indicator (MSI) developed by Mauro, Biggeri and Maggino (2018)[56], and here applied for the first time to microdata and specifically re-arranged to this purpose. These indexes are compared with information about geographical belonging and socio-economic status to describe how different groups were included (or not) in the poverty-reduction process.

The chapter contributes to the literature about multidimensional wellbeing and poverty in China from a threefold perspective.

Firstly, with respect to the Chinese context, previous studies only adopted the MPI or similar methodologies, and usually refer to shorter time spans. This is the first time the traditional MPI methodology is applied to China in the interval 1989-2011. The merits and limitations of the measuring of Chinese multidimensional development through the MPI are then critically discussed and compared with different methodologies.

[54] Among the several possible definitions of poverty, we stick to the SDGs, where the "end poverty in all its forms everywhere" is the first goal. The Social Policy and Development Division of the United Nations writes: "*Poverty entails more than the lack of income and productive resources to ensure sustainable livelihoods. Its manifestations include hunger and malnutrition, limited access to education and other basic services, social discrimination and exclusion as well as the lack of participation in decision-making. Various social groups bear disproportionate burden of poverty.*" (https://www.un.org/development/desa/dspd/poverty-social-policy-and-development-division.html).

[55] World Bank's Policy Research Notes welcome the introduction of MPI in the attempt to achieve a "world free of poverty" (Cruz et al., 2015). The Oxford Poverty and Human Development Initiative also adopts this index. Dealing with the Chinese case, we recall the MPI-based analysis of poverty by Alkire and Shen (2015). Note that in this chapter the acronym "MPI" exclusively refers to the Multidimensional Poverty Index; it should be not confused with the Mazziotta-Pareto Index (Mazziotta and Pareto, 2016), whose scope is also related to multidimensional aggregation; the latter index is not discussed here for space concerns.

[56] See also Biggeri and Mauro (2018, forthcoming)

Secondly, this chapter applies for the first time the MSI technique to micro-data. This implies on one hand that the individual multidimensional wellbeing is measured with a methodology that guarantees continuity and heterogeneity penalization, differently from previous investigations. Moreover, this index is particularly suitable for China. Indeed, a multidimensional measurement of wellbeing that stresses not only the traditional deprivation cutoffs, is consistent with the "moderately prosperous society" target. Until today the MSI has been applied only to macro-data, as in the cross-country level comparison studied by Biggeri and Mauro (2018) to improve the HDI of UNDP. Its properties, however, are suitable also to evaluate the wellbeing at the individual level. In the Chinese context, as well as in other emerging and backward countries, the opportunity to measure individual wellbeing is particularly interesting. Indeed, it allows comparing the scores of different subsamples of the population, grouped by gender, ethnicity, etc. The difference with the MPI (based at the household level), makes the comparison between the two indicators interesting also from a methodological perspective, that goes beyond the Chinese case.

Finally, we present some novelty in the variables and parameters included in the MSI methodology, creating the Income-adjusted Multidimensional Synthesis Indicator (IMSI), that departs from the traditional MSI under theoretical and empirical perspectives. The MSI is a flexible tool so that its technique can apply to any dimension we want to consider. We combined an original set of dimensions consistent with the aspects of wellbeing relevant in China with the prescriptions of other multidimensional indexes and the Capability Approach. Among the dimensions considered by our index, we assigned an original role to income. In the literature about capabilities, income is a controversial indicator of wellbeing[57], excluded by some indexes (e.g. the Alkire and Foster's MPI) and included by others (e.g. the HDI). In the IMSI, as discussed later, income is not one of the dimensions included but it is however included because of its instrumental role (Sen, 1999). It measures how much a household is wealthy, and thus able to compensate the deprivation in a dimension with the abundance of wellbeing in a different one. A detailed description of the dimensions and the formulas adopted to calculate the (I)MSI is reported in the methodological section. The remaining of the chapter is divided as follows.

The next section briefly reviews some of the most recent investigations about multidimensional wellbeing in China. In the third section, we present the China Health and Nutrition (hereafter CHNS) dataset and the MPI and the MSI methodologies to aggregate multidimensional information of poverty and wellbeing. Each index is described in detail in two specific subsections. The MPI subsection resumes the variables selected for the MPI and the aggregation technique, along with the merits and shortcomings associated to the 'double cutoff' strategy, necessary to calculate the MPI. The MSI methodological subsection presents the traditional MSI

[57] Amartya Sen revived the (Aristotelic) idea that economist should consider income as a mean, rather than as an end. In the book "*Development as Freedom*" (1999, p.14), he writes: "*An adequate conception of development must go much beyond the accumulation of wealth and the growth of gross national product and other income-related variables*." In practice, how to go "*beyond*" income preserving its role as a mean, is still an open question.

and our version, the IMSI. This subsection also describes our original contribution to the literature about multidimensional wellbeing, because we slightly modified the index introduces by Mauro, Biggeri and Maggino (2018), introducing the instrumental role of income in the synthesis formula.

The fourth section describes the results of the analyses related to the MPI and the MSI in two subsections, one for each index, to compare then the different versions of the indexes adopted. The results are decomposed according to geographical and socio-economic characteristics to provide a better picture of winners and losers of the reforms. In the case of MPI, the whole 1989-2011 period is considered, while the analysis of MSI is limited to 2011.

Conclusions and policy implications follow.

2. Multidimensional Poverty Indexes in China

The reduction of monetary poverty in China is a well-documented phenomenon[58]. Recently, consistently with the increasing sophistication of Chinese government goals, many scholars diverted their attention from monetary to multidimensional achievements. In this section, we present a brief literature review of the most significant empirical analyses of Chinese multidimensional poverty. Table 1 summarizes this review.

Labar and Bresson (2011) adopt the multidimensional stochastic dominance criterion to see whether multidimensional poverty reduced significantly between 1991 and 2006. Based on the CHNS, the poverty reduction in health, education and income, are considered both individually (unidimensional case) or jointly (multidimensional). In the multidimensional case, the reduction of poverty was significant between 1991 and 2004, and non-significant thereafter. Unidimensional trends, on the contrary, have different shapes.

Yu (2013) applies the Alkire-Foster (A-F) methodology to the CHNS database between 2000 and 2009. The dimensions considered are: income; education; health (proxied by the Body Mass Index); social security (medical insurance) and living standard (in turn based on four different indexes). Multidimensional poverty reduced in this time span, especially because of the drop of deprivation in income and social security (which used to be the more widespread deprivation). On the contrary, the relative contribution of education increased over time; this fact exacerbates the multidimensional poverty in rural areas, abandoned by more educated individuals. The rural/urban and the inner/coastal divides are indeed relevant issues also in terms of multidimensional poverty.

[58] Monetary poverty is not the main topic of this analysis, we therefore report here only a short number of fundamental references, including: the official statistics provided by the already mentioned MDGs report (China and UN, 2013); the critical analysis of causes and limits of poverty reduction by Ravallion and Chen (2007) and by Montalvo and Ravallion (2010), which gave emphasis to issues as inequality, rural/urban and regional divides, sectorial differences.

Nicholas et al. (2013) apply to the Chinese context (2000-2011) a combination of the A-F MPI with a time-dependent measure of poverty. Including both dimensional and durational convexity, their index summarizes information about longitudinal deprivations in a single value. The dataset (from the CHNS) includes individual-level and household-level indicators, both numerical and categorical. With this poverty measure, it is possible to rank the intertemporal, multidimensional wellbeing in the nine provinces surveyed and across social groups. Female and rural people appear more disadvantaged. It is also possible to see which deprivations are more likely to come jointly (as lack of proper fuel and illnesses). By incorporating the dynamic aspect, however, this index is unable to measure the trend of poverty over time (on the contrary, poverty-reduction and poverty-increase trends are considered in the same way).

Alkire and Shen (2015) apply the MPI method (adopting nine out of the original ten indicators) to the China Family Panel Studies (CFPS) database. Their study indicates a low and decreasing level of multidimensional poverty between 2010 and 2014. The household residence (rural/urban and western/central/eastern) and some characteristics of the household head (gender, education, marital status, ethnic group etc.) were used to explain the MPI. As expected, rural people and citizens of western provinces suffer a higher poverty rate. The same is not true for women-lead households. Further information about the results by Alkire and Shen (2015) are available in subsection 4.1, where these results are compared with our investigation about multidimensional poverty.

Qi and Wu (2015) adopt the MPI method. Their observations include children (aged 0-18) and a group of indicators relative to 7 dimensions (Nutrition, Water, Sanitation facilities, Shelter, Education, Health, Information) between 1989 and 2009. Poverty reduced in every province and for each dimension over time. Poverty reduction was stronger in rural areas and in provinces with middle economic growth rates. It was also stronger in the period 1993-1997, reducing thereafter.

Wang and Wang (2016) apply the MPI methodology to Hechi (a city in Guangxi comprising 11 counties which is part of the 14 contiguous destitute areas) with data from the poor households' census (2013). The MPI is calculated over 4 dimensions (Housing, Health, Education, Living conditions), 10 indicators and various alternative poverty thresholds. The indicators with the highest contribution to poverty are: 'dangerous housing', 'poor health' and 'adults' illiteracy'. The 11 counties are grouped according to various possible classifications. By applying the Theil-T index to the MPI, the inequality in poverty achievements is decomposed in its inter-classification and intra-classification components: with intra-group inequalities resulting stronger. Finally, the rocky desertification degree and the topographic fragmentation degree are both positively correlated with multidimensional poverty.

Feng et al. (2016) use the Gray Correlation Method to analyze multidimensional poverty in poverty-stricken areas of China. Their measure of poverty considers twenty macro-level indicators, grouped in five dimensions equally weighted (Economic Development, Living Standard, Social Development Ability, Poverty Situation,

Protection of Resources and Environment). By evaluating the 2014 level and the 2010-2014 growth in multidimensional poverty, the authors distinguish three geographical groups. The first group (Desertification Area of Yunnan, Guangxi and Guizhou) exhibits favorable outcomes both in current development and in growth. The second group (Quinba, Wuling and Dabie Mountain Areas) has low and slightly decreasing poverty. The last group (Tibet, South Xinjiang and Daxing'anling Mountain Areas) has high and slightly decreasing multidimensional poverty.

Yang and Mukhopadhaya (2017) apply the MPI methodology to the 2010 CFPS data, considering 5 dimensions (analogue to Yu, 2013), 13 indicators, and different possible poverty thresholds. Results are decomposed to distinguish the outcomes of different provinces and rural/urban areas, while the contribution of the different dimensions and indicators is observed separately. Their analysis points out that multidimensional poverty is more widespread than income poverty, especially because of deprivation in social security. Central and Western provinces (and especially Guizhou and Sichuan) are poorer than the coastal ones.

Beside the peculiarities of each study described above, all these investigations owe much to the discussion about multidimensional poverty started by Bourguignon and Chakravarty (2003). Based on this work, several indexes were proposed to synthetize a matrix with information from different dimensions of wellbeing from different individuals into a single value, representing the level of multidimensional poverty in the society. Among these indexes, we recall the measurement of social exclusion by Chakravarty and D'Ambrosio (2006),[59] the Multidimensional Poverty Index by Alkire and Foster (2011), the Better Life Index by the OECD (Boarini and d'Ercole, 2013), the non-compensatory index by Mazziotta and Pareto (2016), the synthesis of indicators proposed by Mauro, Biggeri and Maggino (2018).[60]

This chapter is rooted in this stream of literature, applying different multidimensional indexes to the Chinese context. Indeed, the methodologies underlying the MPI and the MSI, described in the next section, are suitable to deduce information about multidimensional deprivation in China, which we will expose and compare in the fourth section.

Table 1: Recent Studies about Multidimensional Poverty in China

Authors (Year)	Dimensions Included	Dataset Source	Methodology	Findings

[59] The measurement of social exclusion considers whether each individual is excluded (1) or not (0) from a series of functionings, summing this information in a single value.

[60] For a more exhaustive critical analysis about the existent multidimensional indexes of development, see Ravallion (2010).

Nicholas, Ray, Sinha (2017)	Toilet; Fuel; Electricity; Drink Water; Vehicle; Radio/TV; BMI; Illness; Blood Pressure; Education	CHNS 2000-2011	Dynamic multidimensional poverty: "Dimensional" and "Durational" convexity penalize individuals with several deprivations across time and dimensions.	Rural residents, female and inhabitants of Guizhou and Henan provinces are particularly disadvantaged groups. High blood pressure, lack of education and lack of drinking water are the most severe issues.
Yang Mukhopadhaya (2017)	Income; Living standard; Education; Health; Social security	CFPS 2010	MPI	Rural areas and inner provinces are poorer. Monetary poverty is lower than multidimensional poverty. Social security is the main cause of poverty.
Wang Wang (2016)	Housing; Health; Education; Living conditions	2013 census Hechi city	MPI (considering several possible poverty cutoffs); Theil-T coefficient; GIS	Unsafe housing, family health and adults' illiteracy are the main determinants. Poverty is related to rocky desertification. The inequality in poverty is mainly caused by intra-classification components.
Feng, Chu, Chen (2016)	Economic; Living Standard; Social Development; Poverty; Resources and Environment	CPAD 2012-2014	Gray correlation method to compare multidimensional current developemtn and growth in 14 contiguous poor areas	Multidimensional poverty reduction is heterogeneous in different poor areas. There is "a big gap in the current poverty reduction ability between areas"
Alkire, Shen (2015)	Education; Health; Living Standard	CFPS 2010-2014	MPI	Rural areas and inner provinces are poorer. Economic growth does not perfectly predict multidimensional poverty. Nutrition, schooling, fuel, drinking water are the main causes of poverty.
Qi; Wu (2015)	Nutrition; Water; Sanitation; Shelter; Education; Health; Information	CHNS 1989-2009 child only	MPI based on variables and thresholds chosen by authors and checked in comparison with income	Children poverty reduced in every dimension and every year. The most critical dimension is 'Sanitation facilities'; the biggest poverty reduction occurred in 1993-97.
Yu (2013)	Income; Living standard; Education; Health; Social security	CHNS 2000-2009	MPI methodology, with parameters adapted to the 5 dimensions included.	Multidimensional poverty alleviation, but income poverty fell faster than other types of poverty. Wide disparities across provinces and rural/urban gap.
Labar, Bresson (2011)	Income per capita; years of education: BMI	CHNS 1991-2006	Stochastic dominance criterion to evaluate the poverty reduction in the multidimensional domain (intersection)	Reduction of multidimensional poverty more sensitive in the initial period and for urban dwellers. Inequality issue can weaken the poverty reduction.

Source: Author's elaboration

3. Data and Methodologies

The dataset selected for our purpose is the Chinese Health and Nutrition Survey (CHNS) [61], already adopted in the first chapter of this thesis. Several investigations about Chinese economic conditions adopt this dataset, including various studies about multidimensional poverty (among the others, Labar and Bresson, 2011; Yu, 2013; Qi and Wu, 2015; Nicholas et al., 2017). Indeed, CHNS is appreciated for the variety of information available and its time span, lasting more than twenty years.

The survey includes all the information about the ten variables[62] necessary to build the MPI in nine years between 1989 and 2011, with the only exception of flooring (one of the six indexes in the "Living Standard" dimension), only collected in the first seven CHNS rounds (1989-2006).

Our version of MSI is based on a set of eight indicators (see the subsection 3.2), which we selected among the variables collected by CHNS in the 2011 round based on the multidimensional wellbeing literature. Five of these variables are collected at the individual level, 3 at the household level. In addition to these indicators, we consider the household total income inflated to 2011. In selecting the sample to compute the MSI, we run in a trade-off between the number of years considered and the wideness of dimensions potentially included. Indeed, the questionnaire adopted in 2011 is more detailed than the previous ones; extending the analysis to the whole period would have implied a significant loss of information about the data necessary to build our eight indicators.

In the literature, several indexes are suggested to measure multidimensional poverty and wellbeing. We adopt the MPI to have a picture of the evolution of the multidimensional poverty over a long time-span (1989-2011), while the MSI was chosen to have a more punctual representation of the wellbeing of adult individuals in 2011. The MPI is a well-established methodology, and its underlying indicators are available for the whole 1989-2011 period, allowing a comparison between years and with other researches based on the same method. The MSI is a more recent tool, its flexibility allows including several variables in the computation. Due to changes in the questionnaires, we decided to apply the MSI technique only to adult

[61] The CHNS is a nine-rounds panel survey conducted by the by the Carolina Population Center (University of North Carolina at Chapel Hill) and the National Institute for Nutrition and Health. The first round of the survey was collected in 1989, while the last available data refer to 2011 (the other rounds of the survey are: 1991, 1993, 1997, 2000, 2004, 2006 and 2009). The sample was randomly selected in a limited group of Chinese provinces, spread over the three macro-regions of China (East, Centre and West). In 1989 the survey included 8 provinces, an amount gradually enlarged up to 12 provinces in 2011. The original 8 provinces are: Guangxi and Guizhou (West), Henan, Hubei, Hunan (Centre), Liaoning, Shandong, Jiangsu (East). Beside these, Heilongjiang was added in 1997 and Beijing, Shanghai and Chongqing in 2011. Liaoning provinces was not surveyed in 1997, but it was again included since 2000 (the following wave).

[62] These are: Years of Schooling; School Attendance; Child Mortality; Nutrition; Electricity; Sanitation; Water; Flooring; Cooking Fuel; Assets. More information in subsection 3.1.

individuals who answered the 2011 question (13041 individuals), selecting an original set of individual-level indicators from eight different domains of wellbeing, which makes impossible a comparison across years or with different studies, but allows entering in the details of individual wellbeing in several different dimensions. For the sake of completeness, we decided to compare these indexes. In this way, we want to see whether they are overlapping or not, and in case what can trigger the differences.

The next subsections go into the details of these two indexes, pointing out their preconditions, their adaptation to the CHNS dataset and the differences in their interpretation. Moreover, we discuss the theoretical assumption underlying the formulation of the IMSI.

3.1 Multidimensional Poverty Index

In their analysis of multidimensional poverty, Alkire and Foster (2011) propose a new FGT class of indexes to measure multidimensional poverty. The two most famous indexes of this class are H and M_0. H is a headcount ratio: the percentage of individuals that we consider multidimensionally poor (analogously to the unidimensional Poverty Headcount Ratio). M_0 (sometimes referred to as Global MPI or simply as MPI), gives a measure of *how much* poverty exists (similarly to the poverty gap in the unidimensional poverty analysis). The Oxford Poverty & Human Development Initiative (hereafter OPHI) adopted these two indexes as main tools to measure and compare multidimensional poverty around the world.

The MPI operates through a 'dual cutoff' counting approach, similar to the measurement of social exclusion by Chakravarty and D'Ambrosio (2006). Given a matrix $N \times D$, where i are the surveyed individuals ($i = 1 \dots N$) and d are the aspects of wellbeing considered, indicators or dimensions ($d = 1 \dots D$), two cutoffs determine which individuals i are multidimensionally poor. These cutoffs are the *deprivation cutoff* and the *poverty cutoff*. The individuation of poor individuals through the 'dual cutoff' immediately allows calculating the multidimensional poverty headcount ratio H; it is also at the basis of the technique to calculate M_0.

The deprivation cutoff z_d is specific for each dimension. It tells whether the score of individual ***i*** in dimension ***d*** is good enough not to be considered deprived. The vector z_d is used as a reference target to replace the matrix $M_{N\times D}$ with the matrix $M'_{N\times D}$ through a formula that relates to each element m_{id} of the matrix, an element m'_{id}, which is alternatively 0 (no deprivation) if the element is sufficiently high, or 1 (deprivation) if the element is too low. The parameters z_d, that determine the specific cutoff for each dimension, can be applied also to ordinal data (where low values correspond to poor achievements). Mathematically:

$$m'_{id} = \begin{cases} 0 \; if m_{id} < z_d \\ 1 \; if m_{id} \geq z_d \end{cases}$$

The poverty cutoff k $(0 < k \leq 1)$ indicates the "minimum deprivation count" (Alkire and Foster, 2011, p.483) an individual should suffer in order to say he is multidimensionally poor. This count is calculated at the

individual level and corresponds to a weighted average of the deprivations m'_i. The weights w_d $\left(\sum_{d=1}^{D} w_d = 1\right)$ are assigned to each dimension/indicator according to its importance. The deprivation count c_i is obtained with the following formula:

$$c_i = \sum_{d=1}^{D} w_d m'_{id}$$

An individual i is multidimensionally poor if $c_i \geq k$. In this way, we obtain a column vector that tells whether every individual is poor or non-poor. Each element of the vector summarizes the performances in every dimension m'_{id} alternatively in 0 (the individual is not deprived in enough dimensions to be considered multidimensionally poor) or 1 (the individual is multidimensionally poor because he is deprived in more than k dimensions). In the MPI, the second cutoff is generally $k = 1/3$.[63]

The poverty headcount ratio H is the percentage of individuals with $c_i \geq k$ over the total number of individuals N. H describes *how many* individuals are poor but is blind with respect to *how much* poor they are. The MPI, M_0, considers both this information summing up the c_i for all and only the individuals with $c_i \geq k$; this summation is divided by N to get a value $0 \leq M_0 \leq 1$.

Along with M_0 and H, another interesting variable is the "average deprivation count" of the poor, A. A indicates how many (weighted) deprivations poor people suffer on average. Note that mathematically $H \times A = M_0$, therefore A measures the part of M_0 not explained by H.

The MPI technique is intuitive and immediate in its representation of poverty, because each person univocally results either completely poor or non-poor. However, each of the two cutoffs implies a loss of information.

The first cutoff groups together all the poor (not poor) household who are (are not) poor in each dimension, irrespectively of *how much* below (above) the poverty threshold they are in that dimension. The indifference toward achievements "above" the threshold can be justified or even advocated[64] from a Rawlsian perspective. However, individuals who get closer (farther) to the deprivation cutoff can increase (decrease) the risks of future poverty, but this risk is not accounted in the MPI methodology. Binary outcomes -deprived or not- are more justified and less disputable when the observed phenomena are not measured by a cardinal variable (e.g. not having access to …; having experienced …; give a bad evaluation to … etc.). Note that the OPHI measurement of MPI only adopts non-cardinal indicators.

[63] The adoption of the ⅓ poverty cutoff allows to reject both the *intersection* and the *union* approaches (Alkire and Foster, 2011) in favor of an intermediate criterion to individuate who is poor. The intersection approach considers an individual as multidimensional poverty "only if the person is deprived in all dimensions" (Ibid, p.478). At the opposite, in the union approach multidimensional poor individuals are all persons who suffer any type of deprivation, without further discussion about how many dimensions are deprived.

[64] Bourguignon and Chakravarty (2003) define the Strong Focus property (SF) that requires the poverty index to be independent from variations in non-poor attributes.

Relatively to the Chinese target of a "moderate prosperous society" (小康社会 "xiǎokāngshèhuì"), the increase in wellbeing also beyond the deprivation cutoffs should not be neglected. Moreover, considering equal all the deprivations, irrespectively of their severity, can be even more disputable. Note that this generalization occurs both in H and in M_0, because in both cases deprivations, if any, are considered with the value $m'_{id} = 1$ and weighted according to w_{id}.

The second cutoff groups together as multidimensionally poor (not poor) all the individuals with a score above (below) the 1/3 threshold, irrespectively of how much higher (lower) than the threshold is the number of deprivations. Having a deprivation count slightly higher or extremely higher than 1/3 will not impact on H, but only on M_0. Moreover, the summation at the basis of M_0 does not give priority to the poorest among the poor[65]. Finally, individuals without "enough" documented deprivation(s) are considered in the same way of people without deprivations as far as their deprivation count is $c_i < 1/3$, so the harmful effects of these deprivations are totally neglected both in H and in M_0. With reference to China's "moderate prosperous society" target, the presence of a limited number of deprivations ($c_i < 1/3$) does not seem an issue to be overlooked. This is particularly true in backward contexts, where household have difficulties in overcoming these deprivations because of poorer social security schemes (Shue and Wong, 2007).

Another limitation of the OPHI MPI, common to many other multidimensional indexes, lies in its underlying indicators: all the 10 indicators included are collected at the household level, not individually. In this way, it is difficult to catch the within-household unequal wellbeing (e.g. differences between male and females). Note that this limitation, which is common to other indexes, is caused by the OPHI specification of indicators included, and it is not intrinsically connected to the MPI methodology. Theoretically, the MPI procedure can apply also to individual-level indicators, or to a mix of individual- and household-level indicators[66]. However, in our opinion, the fact that the MPI (in the version promoted by the OPHI) only includes household-level data is not a coincidence: the selection of household level indicators seems coherent with the methodology adopted. Indeed, the application of the MPI requires a straight division between deprived and non-deprived dimensions; this forces the scholars to clear away the "mild" individual wellbeing shortages, considering only

[65] As an example, consider an improvement in the deprivation count c_i in an individual whose c_i was exactly $1/3$ and in an already extremely poor individual, with $c_i = 2/3$. This improvement has the same effect to both individuals in terms of H and M_0, despite in the second case the worsening affects a poorer household. This issue is addressed by the measurement of inequality in deprivation scores (Seth and Alkire, 2014) and by the adjusted FGT class of multidimensional poverty measures (Alkire and Foster, 2011).

[66] With reference to China, see Yu (2013); Qi and Wu (2015); Yang and Mukhopadhaya (2017); Nicholas et al. (2017). A more general literature about gender gap measures adopting the Alkire-Foster dual cutoff is based on the Women's Empowerment in Agriculture Index-WEAI (Alkire et al., 2013). Despite the widespread adoption in the field of gender economics, by specifically focusing on this issue (and by selecting *ad hoc* variables, informative about male's and female's bargaining power in the rural contexts but excluding variables about multidimensional deprivation that are not agriculture- or gender-specific), loses the general purpose of the MPI.

the extreme conditions. Such conditions, as the death of a child or his school dropout, indicates shortcomings involving the whole family.

In our analysis, we adopt the standard MPI formulation, leaving the investigation of individual-level indicators to the MSI calculation. This formulation includes ten indicators from three dimensions of well-being (Health, Education and Living Standards): Years of Schooling; Child School Attendance; Child Mortality; Nutrition Electricity; Improved Sanitation; Improved Drinking Water; Flooring; Cooking Fuel; Assets ownership. The poverty cutoff is $k = {}^{1}/_{3}$; the deprivation cutoffs and the weights are indicator-specific (more information in Table 2). The deprivation cutoffs were adapted to the Chinese context and, when necessary, the specifications were slightly changed to guarantee the consistency with the CHNS information. The biggest deviation is in the Flooring indicator, available only for 7 (out of 9) waves: we replaced this indicator with an indicator about "near house excreta removing" in 2009 and in 2011. Its deprivation cutoff considers deprived households with "some excreta" or "much excreta" around the dwelling place. We pick this indicator for its theoretical and empirical proximity to the "Flooring" variable[67]. Note that the difficulty in obtaining floor information is common to Alkire and Shen (2015), that excluded *tout-court* this indicator (obtaining an MPI based only on 9 indicators).

Dealing with the missing values, we exclude the missing observations in the computation of H and M_0, basing the minimum deprivation count only on the available indicators. In these cases, we adopt new w_d preserving the principles that the three dimensions (education, health and living standard) are equally weighted, and available indicators referring to the same dimension are equally weighted.

Table 2: Dimensions, Indicators, Weights and Deprivation Cutoffs in the MPI

[67] The deprivations in flooring and in excreta removing are positively correlated, and their combination shows a decreasing trend, consistently with other indicators. The table below shows the percentage of deprivation in Flooring (1989-2006) and Excreta Removing (2009-2011) indicators over the years. By adopting the excreta removing criterion, deprivation in 2006 would have resulted in 0.108% rather than 0.127%.

1989	1991	1993	1997	2000	2004	2006	2009	2011
0.293	0.272	0.131	0.130	0.102	0.130	0.127	0.098	0.069

Dimension	Indicator	Weight	Deprived if (standard MPI)	Deprived if (our calculation)
Education	Years of Schooling	1/6	No household member aged 10 years or older has completed five years of schooling	No household member aged 10 years or older has completed five years of schooling
	Child School Attendance	1/6	Any school-aged child is not attending school up to the age at which he/she would complete class 8.	Any child *between 7 and 15 years old* is not attending school.
Health	Child Mortality	1/6	Any child has died in the family in the five-year period preceding the survey.	Any child has died in the family *in any previous year*.
	Nutrition	1/6	Any adult under 70 years of age or any child for whom there is nutritional information is undernourished in terms of weight for age.	Any adult *(i.e. 18 years old or more)* or any child is undernourished *according to the WHO definition*.
Living Standard	Electricity	1 / 18	The household has no electricity.	The household *does not normally use electric-type lightning*.
	Improved Sanitation	1 / 18	The household's sanitation facility is not improved (according to MDG guidelines) or it is improved but shared with other households.	The household's sanitation facility is *a cement/earth openpit or the household has no bathroom at all*.
	Improved Drinkin Water	1 / 18	The household does not have access to improved drinking water (according to MDG guidelines) or safe drinking water is at least a 30-minute walk from home, roundtrip.	The householddoes not have access to drinking water from in-house or in-yard tap water, nor from in-yard dwell.
	Flooring	1 / 18	The household has a dirt, sand, dung, or 'other' (unspecified) type of floor.	The household has a *earth (or other material not-in the list)* type of floor *(1989/2006); near the house there is some or much excreta (2009-2011)*.
	Cooking Fuel	1 / 18	The household cooks with dung, wood, or charcoal.	The household cooks with *sticks, straw*, wood, or charcoal.
	Assets Ownership	1 / 18	The household does not own more than one of these assets: radio, TV, telephone, bicycle, motorbike, or refrigerator, and does not own a car or truck	The household does not own more than one of these assets: *cellphone*, TV, telephone, bicycle, motorbike, or refrigerator, and does not own a car or truck

Source: Standard MPI is based on Alkire and Robles (2017). Our calculation is an original contribution, that slightly modifies the MPI to make it consistent with the CHNS.

3.2 Multidimensional Synthesis Indicator

Mauro, Biggeri and Maggino (2018) introduced the MSI to better aggregate data from different dimensions, abandoning the hypothesis of perfect substitutability in the wellbeing from different domains. This index satisfies the proprieties of strict monotonicity, continuity and heterogeneity penalization (Mauro et al., 2018). The malleability of the MSI methodology allows adopting and adapt this index to the Chinese context. Differently from the MPI, the MSI conceives wellbeing as a continuous variable rather than a dummy variable. Indeed, Chinese progress is measured beyond the mere satisfaction of basic needs. As we argued above, this feature seems more consistent with the targets of the Chinese government. For all these reasons, to analyze more deeply the individual multidimensional wellbeing in China, we prefer to accompany the MPI with the "Multidimensional Synthesis Indicator" (MSI).

Methodologically, the shift from an index based on dummy variables to an index based on continuous variables implies new challenges. The issues to be addressed are:

- the harmonization of the indicators included. Different variables have different distributions, and we need a specification that allows the aggregation of values relative to different dimensions. Note that the first cutoff in the A-F MPI carried out this task;
- a function that aggregates the harmonized indicators into a single value. Note that the second cutoff in the A-F MPI carried out this task. The aggregation can occur through summation (as for H and M_0), simple mean, geometric mean etc., depending on the belief about complementarity/substitutability among different deprivations.

The United Nations Development Programme faced a similar problem in formulating the Human Development Index (HDI), which is based on three continuous indicators. Dealing with the harmonization, they adopted a standardization based on maximum and minimum values. Dealing with the aggregation of different dimensions, they firstly opted for the arithmetic mean, recently replaced by the geometric mean (Klugman et al. 2011). This change was introduced to penalize heterogeneity among multidimensional outcomes[68]. However, the geometric mean conduces to some well-known problems of calculations and interpretability (Klugman et al. 2011, p.24). Indeed, the HDI suffers the risk of collapsing toward zero if a single dimension is zero. Note that this risk increases with the number of dimensions included. Finally, both the MPI and the HDI, in their standard specification, are based on household or community level indicators, which makes it difficult the analysis of inequality within the household/community.

The MSI criterion to aggregate the different dimension of wellbeing responds to the following formula:

$$I_i = 1 - \left[\frac{1}{k}\sum_{j=1}^{k}\left(1 - x_{ij}\right)^{g_i}\right]^{\frac{1}{g_i}}$$

Where I_i is the Synthesis Indicator of individual *i*'s scores; x_{ij} is the standardized score of *i* in dimension *j*; *k* is the total number of dimensions *j* considered; g_i determines the way of aggregating the *j*-dimensions. The function $g_i = g(x_i)$ must assume only positive values: $g_i > 0 \; \forall \; i$. By restricting the range of g_i in the interval $0 < g_i \leq 1$, we enforce heterogeneity penalization (values $g_i > 1$ would instead "reward" heterogeneity).

Indeed, g_i is crucial in computing the MSI, because it indicates how we aggregate the indicators x_{ij}. In case g_i is a constant, the same aggregation criterion decided *a priori*[69] applies to every individual. A special case is $g_i = 1 \; \forall i$, corresponding to the arithmetic mean. If g_i is a constant lower than 1, the aggregation criterion,

[68] If two samples A and B have the same average, but the A has a lower variance, the arithmetic mean is the same, while the geometric mean of A is higher. B suffers a 'heterogeneity penalization', which is crucial in the analysis of multidimensional wellbeing. Indeed, if we subtract a certain amount of wellbeing from a non-deprived dimension and add the "same amount" to a deprived dimension, we can assume that the overall wellbeing increase (i.e. the marginal improvements in a single dimension of wellbeing have a decreasing contribution on overall wellbeing).

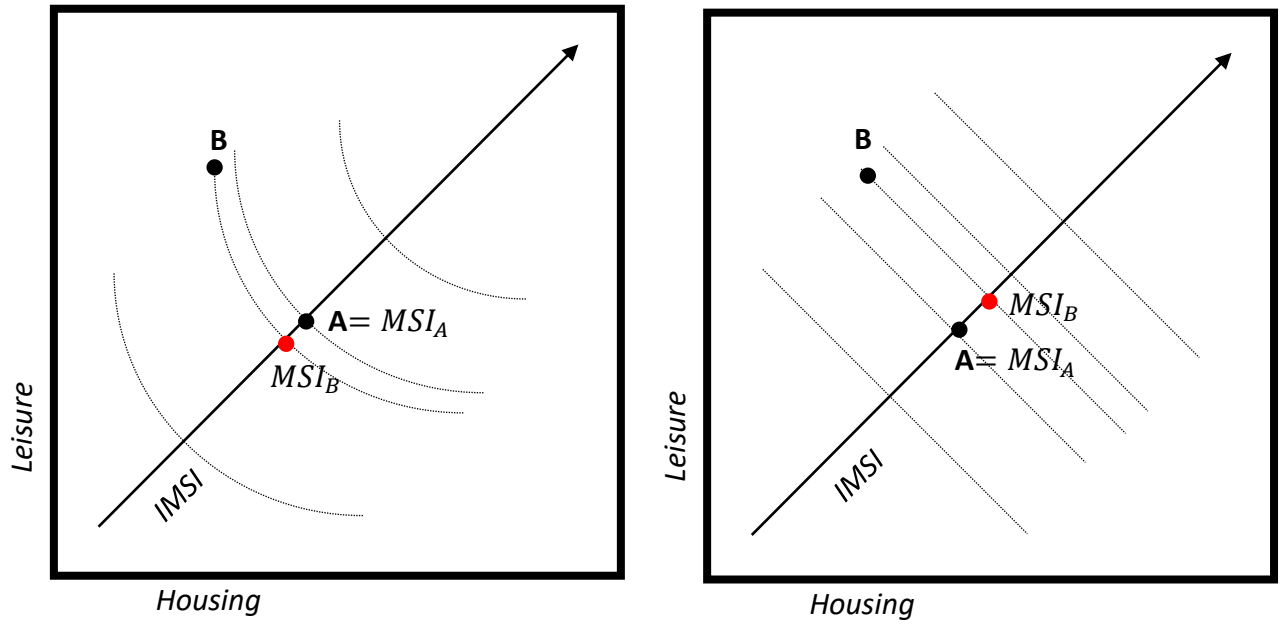
[69] Anand and Sen (1997, p.16) refer to this issue as the ''inescapable arbitrariness in the choice of α''. Note that also the Mazziotta and Pareto (2016) indexes, introduced to tackle the imperfect substitutability issue, does not addressed this arbitrariness.

equal for each individual, penalizes heterogeneity: the lower g_i, the higher the penalization. Mauro et al. (2018) suggests heterogeneity penalization should vary from individual to individual, according to their wellbeing: amongst (on average) poorer individuals, whose coping strategies are more limited, heterogeneity should be penalized more (indeed, wellbeing in scarce dimensions hardly compensates wellbeing in abundant dimensions). Therefore, in the traditional MSI methodology, the function g(x) is calculated as the inverse of the simple mean amongst all dimensions, that is $g_i = \left(\sum_{j=1}^{k} x_{ij}/k\right)^{-1}$.

This chapter enriches the literature about MSI suggesting an alternative method to determine g_i that considers income with an instrumental role in the measuring of wellbeing. Consistently with the idea of income as a mean rather than as an end (Sen, 1999), income is excluded from the dimensions of wellbeing *j*, but it is at the basis of the parameter g_i. We named this procedure Income-adjusted Multidimensional Synthesis Indicator (IMSI), differentiating it from the traditional Mean-adjusted MSI (hereafter MMSI). The indexes $MMSI_i$ and $IMSI_i$ are used to explore the wellbeing across provinces and socio-economic groups.

The theoretical foundation of the IMSI is the assumption that income-poor individuals are less able to substitute deprivation in a dimension with abundance in another. On the contrary, the scarce achievement of income-rich individuals in a dimension can be triggered by their preference structure and not by a real deprivation. Rather than being an immediate source of wellbeing, in this framework income is a proxy of the capacity to freely arbitrage between different domains of wellbeing, "emancipating" from an exogenous allocation of wellbeing. Figure 1 provides an example of IMSI based on two dimensions, H (Housing) and L (Leisure). The endowments of H and L corresponding to point A and point B, are evaluated differently according to the individual being rich (left panel) or poor (right panel).

Figure 1: MSI of income poor (left) and income rich (right) individuals



Source: Author's elaboration. Note that with homogeneous endowments (point A, i.e. H = L), the IMSI is defined irrespectively of income: IMSI=H=L. In this case income do not affect wellbeing (a person with perfect satisfaction in every dimension has full wellbeing independently from her income and vice versa). If instead one dimension is more expanded than the other (point B), the poor individual (left panel) has a lower IMSI. Indeed, his IMSI considers the fact that poverty reduces his capacity of arbitraging between dimensions through monetary exchanges, so each deprivation has a stronger negative effect.

These considerations led us to base the parameter g_i over the variable y_i, where y_i is the natural logarithm of the income per capita. The parameter g_i must be higher than zero, differently from y_i[70]; therefore, we set a lower bound, under which heterogeneity penalization stops decreasing. The threshold adopted corresponds to half of the poverty line[71]. Everybody below this level is equally (un)able to operate arbitrage among multiple dimensions.

Any measurement of multidimensional wellbeing highly depends on which dimensions, indicators and aggregation methodology the researcher chooses to apply. To reduce as much as possible the arbitrariness in these choices, we considered the dimensions included previous literature, with particular reference to the OPHI BMI, the HDI and the Capability Approach (Sen, 1999; Clark, 2003; Alkire, 2007; Biggeri and Mehrotra, 2011; Nussbaum, 2011). Moreover, the literature about the pillars of the "Harmonious Society" and the main sources of concern for its development strategy (Pun et al., 2012; Alkire and Shen, 2015; Qi and Wu, 2015; Yang and Mukhopadhaya; 2017) were also considered in the selection of these dimensions (and the undelaying indicators) to under.

This process resulted in the inclusion of 8 dimensions: Education, Health, Nutrition, Housing, Sanitation, Assets, Work, Leisure. Note that this sample include the pillars of the MPI and HDI indexes: ***Education***, Living Conditions, Health (Living Condition is in turn divided into three dimensions: ***Housing***, ***Sanitation***, and ***Assets***, while ***Nutrition*** and ***Health*** are measured separately). This sample is also consistent with the new "three big mountains" (三座大山) that hampers the well-being of nowadays China: Housing, Education and Health. Two other *dimensions,* ***Work*** *and* ***Leisure****,* were added to account the quality of life and interpersonal relations of Chinese individuals. These aspects, crucial in the Capability Approach and in the Harmonious Society discourse, have been often overlooked in the studies on multidimensional poverty, but resulted an importantin hampering the satisfaction of Chinese individuals (Clark and Senik, 2014).

We maintain the methodological assumption that no dimension included is a-priori more (or less) important than the others. All the variables range between 0 and 1 (respectively, the worst condition of wellbeing and the level at which a wellbeing dimension is considered fully satisfied). Annex 2 provides the details about how we build these eight variables. To avoid missing variables, we excluded from the sample of adult

[70] The CHNS computes income per capita starting from the summation of several sources of income (business; farming; fishing; gardening; livestock; wages; retirement; subsidies; other) minus the expenditures. Therefore, income per capita can be also lower than zero (45 out of 13041 observations). Further details in the CHNS website: http://www.cpc.unc.edu/projects/china/data/datasets/Household%20Income%20Variable%20Construction.pdf

[71] We exclude the observation where 3/5 or more of the questionnaires are left blank. More information in Annex 2.

individuals those who provided "too less" information[72] adopting then some imputation through the Multiple Imputation by Chained Equations (MICE) among the remaining 13041 individuals to have a complete matrix of information. Annex 1 describes the selection of the population sample and the imputation procedure. Table 3 shows the achievements in the eight dimensions included in the MSI.

Table 3: Achievements in eight dimensions of wellbeing in China, 2011

Dimension	Obs.	Mean	Std. Dev.	Min	Max
Education	13041	0.46	0.24	0	1
Health	13041	0.85	0.25	0	1
Nutrition	13041	0.79	0.16	0	1
Housing	13041	0.38	0.22	0.04	1
Sanitation	13041	0.83	0.22	0.11	1
Assets	13041	0.54	0.16	0	1
Work	13041	0.71	0.35	0	1
Leisure	13041	0.74	0.15	0	1

Source: Author's elaboration based on CHNS, 2011

4. Results

The following subsections analyze separately the results obtained from the analysis of MPI and MSI indexes. Finally, this section compares the two indexes.

4.1 MPI

By applying the MPI methodology described above to the CHNS data, we calculate M_0, H and A between 1989 and 2011. Table 4 summarizes the average MPI scores in each year.

The trends of H and M_0 indicate a rapid decrease in poverty. According to both the indexes, poverty in 2011 is only around 15% of the 1989 level. The trend of the two variables is similar (H lies above by construction), and highlights that poverty reduction occurred every year, with the significant exception of 1991 and a small uptick in 2009 H. The 1991 peak emphasizes the harmful consequences of the 1989 Tiananmen events, which were followed by isolation and freezing of the reforms. Income per capita shows a minimum in 1991 too.

The intensity of deprivations A (the deprivation score among poor individuals), ranges around the value 0.40 in most of the years. This value is greater or equal to 0.33 by construction[73]. The trend of A is stable and the

[72] More information in the Annex 1.

[73] Any individual with lower deprivation score (i.e. $c_i < k$) is automatically excluded from the sample of poor individuals.

drop of M_0 is mostly triggered only by a reduction of H: poverty reduced because the number of poor reduced while dealing with the condition of poor people, this has not improved much. A slight improvement in their condition emerges only in the last two waves (A below 0.39). If confirmed, this trend implies that poverty reduction is affecting most deprived individuals too, not by immediately pushing them out of poverty, but improving however their conditions.

Table 4: MPI in China, 1989-2011

	M_0	H	A
1989	0.070	0.174	0.401
1991	0.073	0.186	0.394
1993	0.054	0.132	0.408
1997	0.042	0.105	0.401
2000	0.028	0.070	0.403
2004	0.016	0.040	0.396
2006	0.015	0.039	0.401
2009	0.015	0.040	0.373
2011	0.010	0.026	0.383

Source: Author's elaboration based on CHNS, 1989-2011. The indexes are calculated on the overall sample. Note that, as recalled in the above section, some provinces were added over the years. E.g. Shanghai, Beijing and Chongqing are included only in 2011[74].

A "raw headcount ratio" tells how many people suffer a deprivation in each of the 10 indicators included in any time. All the deprivations became less widespread over time, but the starting levels, the arriving levels, and the rates of reduction vary widely. This variety stresses the importance of adopting a multidimensional perspective, since no indicator alone can resume the complexity of the Chinese development. In 1989 the most severe indicators were 'Improved Sanitation' (62% deprivations) and 'Asset Ownership' (49%). In 2011, 'Improved Sanitation' remains the most widespread deprivation (32%), followed by two other deprivations that decreased below the average: 'Nutrition' (20%) and 'Cooking Fuel' (14%).

The MPI can be compared with Alkire and Shen investigation (2015) based on the CFPS survey, covering three waves in the 2010-2014 interval. Beyond the dataset, they also changed slightly the methodology[75]. Our results show a lower level of M_0 and H: in the 2009-2011 period, with a poverty headcount ratio below 4%. This ratio ranges between 5% and 8% in 2010-2012 CFSP. Consistently with the lower level of poverty recorded in our analysis, the speed of poverty reduction reduces.

[74] These provinces have lower-than-average multidimensional poverty; therefore, 2011 scores are upward biased. By removing these three provinces, M_0, H and A are respectively 0.012, 0.031 and 0.384. Other changes in the sample are the exclusion of Liaoning in 1997 and Heilongjiang in 1989, 1991 and 1993. These provinces are slightly less poor than the average in terms of M_0. The overall trend of poverty is however robust to the exclusion of these five provinces.

[75] CFPS includes 25 provinces and is nationally representative. Moreover, Alkire and Shen (2015) deviates from the standard MPI technique by excluding the 'flooring' indicator from the Living Standard dimension.

Important geographical divides appear between areas with more multidimensional poverty and less deprived areas. Table 5 summarizes the average results in rural and urban areas, and in the three macro-regions of China (East, Center and West). We also point out the performance of Shandong and Guizhou provinces, showing respectively particularly low and particularly high levels of poverty. The last column shows the overall trend of M_0 and can be used as reference point.

Table 5: M_0 in different parts of China, 1989-2011

	Urban Area	Rural Area	Region			Shandong Province	Guizhou Province	Total
			East	Center	West			
1989	0.033	0.086	0.028	0.076	0.109	0.023	0.141	0.070
1991	0.033	0.090	0.033	0.082	0.106	0.028	0.119	0.073
1993	0.026	0.065	0.031	0.061	0.070	0.024	0.077	0.054
1997	0.015	0.054	0.023	0.041	0.059	0.020	0.084	0.042
2000	0.014	0.034	0.013	0.032	0.041	0.011	0.057	0.028
2004	0.007	0.020	0.009	0.014	0.027	0.007	0.039	0.016
2006	0.005	0.020	0.008	0.014	0.026	0.006	0.040	0.015
2009	0.008	0.017	0.006	0.011	0.029	0.004	0.043	0.015
2011	0.003	0.013	0.003	0.007	0.021	0.002	0.040	0.010

Source: Author's elaboration based on CHNS, 1989-2011.

Poverty reduction occurred in both rural and urban areas. Rural areas have always been more disadvantaged, and the gap has not closed yet. The differences between rural and urban areas were wide in the Nineties (a period of strong poverty reduction), but also in the new millennium. Since 2004 urban areas register an M_0 below 0.01, which makes it difficult further poverty reduction[76]; nevertheless, in the same period, rural poverty reduction seems to have stabilized too. Moreover, rural areas record a higher intensity of multidimensional poverty A in all the observed periods. Indeed, rural areas suffer a double disadvantage: poverty is more widespread and, when it hits, its intensity is stronger. A persistent rural/urban gap in terms of H and A (and consequently in M_0 too) is also found by Alkire and Shen (2015).

East, Central and West China have different economic structures, the former being the most advanced area, and the latter the weakest one (similar results in CFPS data). This gap was already evident in 1989 and persisted over the decades. Poverty reduction in Central China has been stronger than in the West, especially in the new millennium, suggesting a divergence of the two zones.

As expected, the provinces with the lowest M_0 overlap to the provinces with the higher per capita income and vice versa. An exception in this negative correlation is Henan, in the central region. Henan records a low level and growth rate of income per capita, but also a good performance in terms of multidimensional

[76] An exception is the 2011 wave, which saw richer areas as Beijing and Shanghai entering in the sample, causing a drop in the poverty indices

poverty and (especially) poverty reduction. This case recalls that the study of multidimensional poverty requires proper indicators and cannot be inferred simply on the basis of income.

Gender differences are more difficult to be measured in the MPI framework: its indicators are measured at household level, making intra-household gender differences unobservable. In our sample (as in Alkirie and Shen, 2015) male and female samples do not differ significantly in terms of multidimensional poverty[77]. Despite on average poverty rate is lower among women, the difference is not significant at 5%, neither with respect to M_0, nor to H, neither in the first nor in the last wave of the survey. To overcome this issue, Alkirie and Shen (2015) analyze separately households with male and female head, but they find again non-statistically significant results. In our sample, women-led households have had significantly lower poverty rate between 1989 and 1997; on the other hand, men-led households have significantly lower poverty in 2011. The difference is not statistically significant in the intermediate years. The 1989-1997 differences do not necessarily deny the discrimination of women, because of endogeneity problems. Richer and more educated families, as well as households where the husband migrated, could be more likely to have a female household head. Omitted variables (as the size, the type of job and the age structure of the household) can contribute to explain the different performances too.

Ethnicity and party affiliation are two other characteristics that influence multidimensional poverty in China. CHNS collected such sensible information only in some waves: the affiliation to Chinese Communist Party is available only in the first five waves, between 1989 and 2000. The information about belonging or not to the Han ethnic group (the majority, who is likely to be less discriminated) contains many missing values. We build a household-level variable about having at least one non-Han member exploiting the time invariance of this characteristic: every household in which at least one member ever declared belonging to an ethnic group, is considered entirely and for the whole period as ethnic minority, the remaining households are considered as Han majority. This simplification is clearly inaccurate and only allows to draw rough results. A more complete analysis would require an ad hoc investigation.

However, the performances of all these groups, party members and non, ethnic minorities and non, are in line with our expectations. Party members are much less affected by multidimensional poverty in all the available years. They were particularly able to avoid the deleterious consequences of the 1989 events. It is important to underline that the direction of causality in the party affiliation is not explored, and this trend can have different explanations. Ethnic minority families, on the other hand, are more affected by

[77] To measure empirically the gender differences tackled in this paragraph, as well as in the cases of ethnic and other dichotomies analyzed subsequently, we refer to a two-sample t-test with equal variances. The results of the tests are not reported in detail for space constraints. The null hypothesis of this test is that the mean of the two sample is the same, versus the two-tail alternative hypothesis (the mean is different). The null hypothesis is accepted when the t-value is higher than the critical value at 0.05 significance level (i.e. the p-value is lower than 0.05).

multidimensional poverty. Since 1991, poverty reduction occurred both in Han and minority families, but a clear convergence trend has not appeared yet.

Table 6 summarizes the average level of M_0 according to the social characteristics described above. Note that families in which nobody ever declares its ethnicity were excluded by the relative columns; the same applies for individuals who did not answer to the question about party membership (not recorded from 2004 onwards). The last column shows the overall trend of M_0 and can be used as reference point.

Table 6: M_0 in different social groups, China, 1989-2011

	Gender		Household Head		Ethnic Group		Official Cadre		Total
	Male	Female	Male	Female	Han	Minority	Yes	No	
1989	0.070	0.070	0.074	0.046	0.062	0.113	0.017	0.027	0.070
1991	0.074	0.073	0.078	0.046	0.068	0.104	0.015	0.072	0.073
1993	0.055	0.053	0.057	0.036	0.050	0.078	0.015	0.053	0.054
1997	0.043	0.041	0.045	0.029	0.036	0.085	0.004	0.044	0.042
2000	0.028	0.028	0.029	0.026	0.025	0.046	0.003	0.029	0.028
2004	0.015	0.016	0.016	0.015	0.014	0.028	*Not Available*		0.016
2006	0.014	0.016	0.015	0.016	0.012	0.033	*N.A.*		0.015
2009	0.014	0.015	0.015	0.014	0.013	0.029	*N.A.*		0.015
2011	0.010	0.010	0.009	0.012	0.008	0.025	*N.A.*		0.010

Source: Author's elaboration based on CHNS, 1989-2011.

4.2 MSI

The MSI index is based on the performance in eight dimensions of wellbeing (see the Annex 2 for a detailed description). Before analyzing the wellbeing with the MSI index, we check the average scores in the eight indicators separately and their correlation between each other.

Table 7 shows the average achievement in the eight dimensions for the whole sample of adult individuals (as already done in Table 3) and in 5 specific subgroups: Female, Rural, Coastal, Young (age ≤ 30), Old (age ≥ 60). Note that three of these subgroups (Female, Young, Old) can hardly be analyzed in the OPHI MPI framework, based on household-level data.

Table 7: Eight dimensions of wellbeing, average achievements, China, 2011

Dimension	Whole Sample	Female	Rural	East	Age 30-	Age 60+
Education	0.616	0.563	0.547	0.685	0.832	0.425
Health	0.832	0.856	0.850	0.802	0.947	0.716
Nutrition	0.794	0.790	0.794	0.787	0.769	0.785

Housing	0.573	0.572	0.606	0.539	0.528	0.608
Sanitation	0.832	0.833	0.756	0.881	0.853	0.818
Assets	0.694	0.690	0.684	0.750	0.757	0.621
Work	0.711	0.653	0.719	0.765	0.728	0.557
Leisure	0.739	0.734	0.739	0.734	0.792	0.708
Mean	0.724	0.711	0.712	0.743	0.776	0.655

Source: Author's elaboration based on CHNS, 2011.

The "horizontal" comparisons, among values in the same line, tell whether there are differences in the specific achievement between different samples; the "vertical" comparisons, among values in the same column, is less informative, because the data refer to different dimensions calculated with different methodologies. Note that all indicators run from 0 (the worst level of wellbeing) to 1 (the best level of wellbeing). The bottom line of Table 7 points out the simple average. This value corresponds to an elementary version of the MSI, where the function $g(\cdot)$ assumes constantly the value 1.

These results are generally consistent with our expectations.

Women have lower average achievements; strong gaps appear in the fields of Education and Work. On the other hand, women record higher scores in the Health dimension. Housing, Sanitation and Assets, by construction, are measured at the household level, and therefore presents small gender differences.

Dealing with the rural-urban gap, rural people are generally worse off. Interestingly, they have a lower level of education but higher employment opportunities; they have larger houses (in terms of room per capita), which are less equipped of sanitation facilities; they have a lower amount of assets but report better health conditions. Dealing with the last issue, it is worth to note that the foundation of the Health indicator are self-reported information and other information related to medical diagnosis. Therefore, the lack of medical infrastructures and a (related) scarce awareness of health conditions, can lead to overestimate the value of health[78].

In the eastern region (coast), the richest part of China, houses are smaller but better endowed. These provinces record higher assets and employment, but worse health conditions (the explanation of this bad result can be symmetrical to the good health performance recorded in rural areas described above).

Younger individuals (between 18 and 30 years old) have higher scores in health, education, and in all the dimensions of wellbeing, with the notable exception of housing. Symmetrically, older people (above 60 years

[78] Consider the case of highly aware/sensitive individual, who considers more seriously the same symptoms of an illness with respect to a less concerned individual. Ceteris paribus, the former is likely to self-report more severe diseases, to devote more days to recover from an illness and to provide more complete information about his (permanent) disease history. To an extreme, communities where hospitals are scarcely accessible and the public awareness about health security is lacking, will have fewer diagnosis of chronic diseases. While the individuals of these communities will be less concerned (then happier), the risk for their health will be higher. Therefore, our measure of health is more suitable to catch the subjective aspect of the health dimension, which only partially overlaps to the objective aspect (and is partially even negatively related, as just shown). More information available in Chapter I of the thesis (Annex).

old) are worse off in all the dimensions but housing. The peculiarity of the Housing dimension can be explained by two non-excluding factors: consumption behaviors and household size, as well as by the increasing difficulty for young Chinese people to find a spacious house (Wei and Zhang, 2011)[79].

Table 8 shows the correlation between the eight dimensions of the MSI.

Table 8: Correlation Matrix of Eight dimensions of wellbeing, China, 2011

Correlation Matrix	Education	Health	Nutrition	Housing	Sanitation	Assets	Work	Leisure
Education	1							
Health	0.112***	1						
Nutrition	0.038***	0.075***	1					
Housing	-0.126***	-0.041***	0.005	1				
Sanitation	0.345***	-0.065***	0.001	-0.061***	1			
Assets	0.330***	0.045***	0.005	-0.045***	0.230***	1		
Work	0.263***	0.119***	0.057***	-0.010***	-0.010	0.187***	1	
Leisure	0.142***	0.084***	0.027***	-0.013	0.054***	0.086***	0.050***	1

Source: Author's elaboration based on CHNS, 2011. Significance levels 0.01, 0.05 and 0.10 are indicated respectively by ***, **, *.

We consider highly correlated variables those with a correlation coefficient above 0.2 (or, in case of negative correlation, below -0.2). The highly correlated dimensions are: Education and Sanitation; Education and Assets; Education and Work; Sanitation and Assets. All these correlations are positive and suggest that the more educated individuals are usually better endowed in terms of sanitation facilities and assets; they are more able to avoid unemployment too. Other remarkable correlations are between Leisure and Education; Work and Health; Work and Assets; Health and Education; Housing and Education. The last correlation is negative, meaning that more educated people live on average in worse houses (in terms of rooms per capita and house ownership); this result is likely driven by age differences[80]. Note also that Work and Leisure are

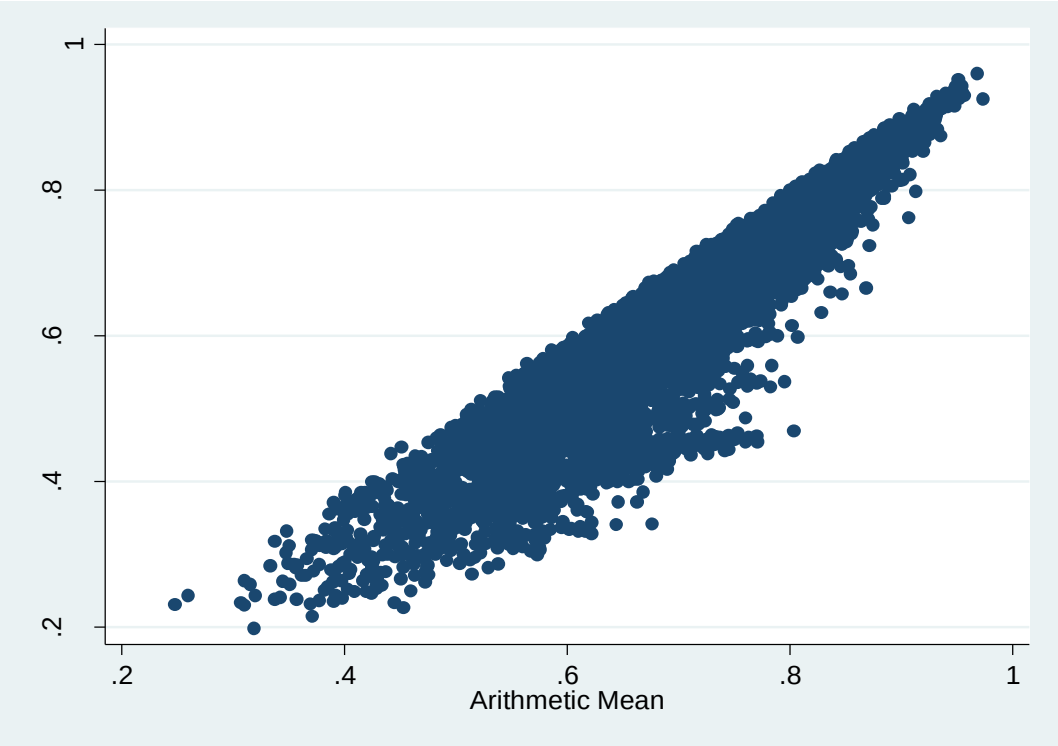
[79] Housing is an issue of growing concern, especially for young people living in big cities (consistently with the trend of Housing in Rural, East and Young subsample of our estimations). Further analysis at provincial level (not reported here for space concern) indicates that coveted municipalities as Beijing and Shanghai have the lowest Housing scores (on the other hand they also record the highest scores in terms of sanitation facilities and assets). Indeed, housing, education and healthcare are called in China the new "three big mountains" (三座大山), representing a renewal of China's biggest concern in present era (the original mountains in Maoist China were imperialism, feudalism and bureaucrat-capitalism).
[80] As mentioned above, older people have lower Education scores, but higher Housing scores.

positively correlated, signaling that employment does not necessarily imply a trade-off with the time devoted to leisure. The relation between Sanitation and Assets is negative and weak. Theoretically two contrasting effects could cause this relation: on one hand, are two normal goods, and the expenditure on both of them increase with income. On the other hand, richer areas endowed with better sanitation facilities, have higher floor prices, making it more difficult to own large apartments; therefore, there is a trade-off between the availability of sanitation and the availability of (cheap) housing[81].

The MMSI and the IMSI are based over these eight dimensions of wellbeing. The MMSI is on average lower than the IMSI: in the whole sample, the average MMSI is 0.684, while the average IMSI is 0.659. This difference comes from the fact that the parameter g_i calculated on the basis of the income is on average higher than the average of the 8 indicators.

The difference between the two indicators is not only in their average level. By incorporating income (with an instrumental role) in its computation, the IMSI differs from the MMSI, especially in the case of poorer individuals, where the sensibility to unequal performance among the indicators is higher. Figure 2 shows that, the dispersion of the IMSI values reduces with the average level of wellbeing. The IMSI methodology also led to a higher variance in the outcomes with respect to the MMSI[82].

Figure 2: IMSI and Arithmetic Mean, 8 dimensions of wellbeing, China, 2011



Source: Author's elaboration based on CHNS, 2011.

[81] More details about the housing issue are provided in the footnote 79.
[82] The standard deviation of MMSI and IMSI are respectively: 0.124, 0.129.

The arithmetic and the geometric mean are two alternative techniques that synthetize multiple indicators in a single index (all these indexes are based on the same indicators, and their only difference relies in the aggregation technique). The former, which can be considered as a special case of MSI, provides always the higher average outcomes, because it does not contain any heterogeneity penalization. It is also associated to lower variance and standard deviation.

Table 9 and Table 10 show the average MMSI, IMSI, Arithmetic and Geometric mean applied to the eight dimensions of wellbeing considered. Table 9 focuses on geographic subgroups: rural and urban inhabitants, households from the Eastern, Central and Western region, households from Beijing[83] and from Guizhou[84]. Table 10 focuses on individual characteristics, like gender, age, being the household head.

Table 9: Multidimensional Wellbeing in China, geographic subgroups, 2011

	Urban Area	Rural Area	Region			Beijing Province	Guizhou Province	Total
			East	Center	West			
IMSI	0.68	0.64	0.69	0.64	0.63	0.73	0.62	0.66
MMSI	0.70	0.67	0.71	0.67	0.66	0.75	0.65	0.68
A. Mean	0.74	0.71	0.74	0.72	0.70	0.78	0.69	0.72
G. Mean	0.63	0.57	0.65	0.56	0.54	0.72	0.49	0.59

Source: Author's elaboration based on CHNS, 2011.

The rural-urban gap appears in term of multidimensional wellbeing, triggered by the differences in Education and Sanitation (see Table 7). Irrespectively from the aggregation technique, the difference between the two areas is statistically significant[85]. The Western region records lower levels of multidimensional wellbeing, particularly in Chongqing and in Guizhou. The East records higher levels of multidimensional wellbeing, particularly in Beijing and in Shanghai. The advantages of urban communities are similar to those of Eastern provinces; living in the West entails a disadvantage even larger than rural and Central locations.

Table 10: Multidimensional Wellbeing in China, individual characteristics, 2011

[83] Irrespectively from which synthesis methodology we decide to apply, Beijing is the province with the highest level of multidimensional wellbeing.

[84] Guizhou is the province with the lowest level of multidimensional wellbeing according to arithmetic mean and MMSI. According to the IMSI Henan has the lowest level of wellbeing, while according to the Geometric mean the lowest level is in Chongqing. These three provinces are those with lower multidimensional wellbeing irrespectively of the synthesis methodology adopted, but their ranking changes in the different specifications. We recall that Guizhou is also the province with the highest level of multidimensional poverty as calculated with the MPI.

[85] T-tests show the difference is significant at 1% level (in favor of urban areas) in all the four cases. The test is not reported here for space concerns.

	Gender		Age		Non-head	Head	Total
	Male	Female	30-	60+			
MMSI	0.68	0.64	0.71	0.58	0.66	0.66	0.66
IMSI	0.70	0.67	0.75	0.60	0.69	0.68	0.68
A. Mean	0.74	0.71	0.78	0.65	0.73	0.72	0.72
G. Mean	0.64	0.55	0.70	0.43	0.59	0.59	0.59

Source: Author's elaboration based on CHNS, 2011.

A gender gap exists and is significant according to all the four indexes. The magnitude of this gap is comparable with the rural-urban gap, despite the geographical issue is more studied in Chinese literature. Among the drivers of this gap, we recall the higher educational level of men and their higher employment rates (as described in Table 7). Dealing with age, younger cohorts report higher level of multidimensional wellbeing. Value judgement on this advantage, triggered by better health and education, are not straightforward. On one hand, the age differences determine inequalities within Chinese society; on the other hand, they are the symptoms of Chinese multidimensional development. Household heads, who are more likely to be men, older and to live in smaller households, have a slightly lower multidimensional wellbeing index.

4.3 MPI and MSI in China: A comparison of their results

Chinese development in the multidimensional space can be described both by MPI and MSI. In turn, these two indexes comprise different computation methodologies and variants. The MPI is more widely adopted, also because of its easy interpretability and an empirical foundation based on indicators (relatively) easy to find. In our case, for example, (almost) all the information necessary to calculate the MPI were available since 1989, documenting its evolution up to 2011.

On the other hand, the MSI can broaden the aspects of wellbeing included, also considering individual characteristics, and aggregate these indicators. In our case, the identification of relevant and measurable aspects of wellbeing has entailed difficulties, which resulted in the possibility to compute properly the MSI only in the year 2011.

On the practical level, adding the MSI to the analysis is noteworthy wherever this index catches aspects of wellbeing that are relevant for the individuals but are overlooked in the MPI. Moreover, also in case the dimensions included in our MSI are noteworthy, the MSI aggregation technique, which is more complex and less straightforward than traditional methods (as arithmetic or geometric means), becomes empirically relevant only if it allows a better evaluation of multidimensional wellbeing. To test this hypothesis, we compare the MSI and the MPI measures with a self-reported indicator of life evaluation.

Self-reported life evaluation is obtained from the question "*How do you rate your life at present?*" (recorded in CHNS as item u420). It is a categorical variable, ranging between 1 (worst life evaluation, "*very bad*") and 5 ("*very good*").

Table 11 shows the correlation between this indicator and seven different measures of wellbeing: IMSI and MMSI as MSI indexes, M_0 and H as MPI indexes, Geometric and Arithmetic Means of the indicators at the basis of the MSI, the per capita income (in logarithmic form[86]), which is the most widespread interest variables considered by the literature. We recall that the MPI measures were computed over a different sample[87]; Table 11, and following comparisons, consider the "common support" (i.e. the individuals for which both MPI and MSI are available).

Table 11: Correlation between life self-evaluation and wellbeing indicators, China, 2011

	M_0 (MPI)	H (MPI)	IMSI	MMSI	Arithmetic Mean	Geometric Mean	Income
Life Self-Evaluation	-0.083***	-0.086***	0.245***	0.228***	0.230***	0.172***	0.188***

Source: Author's elaboration based on CHNS, 2011. Significance levels 0.01, 0.05 and 0.10 are indicated respectively by ***, **, *.

All the indexes are significantly correlated with the self-reported Life Evaluation. As expected, the correlation is negative for the index measuring poverty (MPI and H), and positive for the others. This result confirms that all these measures catch important elements for the personal wellbeing: the indexes not only respond to objective value judgements, but also to subjective self-reported perceptions.

Stronger correlations (higher absolute values, which can be compared irrespectively of the sign), indicate a higher capacity of describing life self-evaluation. MSI indexes are more strongly correlated with Life Self-Evaluation. Indeed, while the MPI is more suitable for immediate interpretations and comparison with different datasets, the (I)MSI is more suited to account for several dimensions of wellbeing, and his description of life satisfaction is therefore more complete. Among the traditional aggregation techniques, the geometric means is less correlated with Life Self-Evaluation (note that it frequently reports zero-values), while the arithmetic mean is similar to the MMSI. The correlation of the IMSI is significantly[88] stronger. To sum-up, there is a trade-off in the choice about the empirical measurement of multidimensional wellbeing: less straightforward aggregation techniques like the MMSI and IMSI result more efficient in predicting the self-reported wellbeing.

[86] A lower bound was fixed at zero, to assign a real value to individuals whose income was negative.

[87] We recall that, dealing with the MSI, our sample is restricted to adult individuals in year 2011 who answered to at least three of the five subsections of the questionnaire utilized in the computation.

[88] The difference between Pearson's correlation coefficients is computed through the test of equality between two correlation coefficients, not shown for space concerns.

Interestingly, M_0 does not correlate with Life Self-Evaluation better than H. Comparing these multidimensional poverty indicators, the more elaborated one (M_0) has a weaker correlation with Life Self-Evaluation. This fact means that separating the individuals considered multidimensionally poor from the remaining of the sample is informative in terms of self-reported wellbeing, but the MPI tools could be not suited to further elaborate within the poor group[89]. However, we recall that the question about self-reported wellbeing is not designed to investigate poverty: the capacity of MPI to measure properly life conditions within the poor group (not in the purpose of this work) could require an *ad hoc* analysis.

Similarly, we compute the correlation between Life Self-Evaluation and the eight variables underlying the MSI. All these correlations are negative and significant at 1%, with the only exception of Nutrition (negative but non-significant correlation)[90].

For simplicity, in the remaining of this section, we compare MPI only with IMSI (which resulted the index more suited to catch self-reported life quality), excluding the other indexes.

Beside the correlation with the self-evaluated quality of life, the MPI and the IMSI are strongly correlated with each other. This was expected, not only because the two indexes measure two very related phenomena (respectively multidimensional poverty and deprivation), but because some of their underlying indicators are in common (although they are measured with different metrics). The Pearson's correlation between M_0 and IMSI is -0.155, statistically significant at 1% level. The correlation of IMSI with the *H* index is slightly lower (in absolute value). The correlation is therefore robust, but far from being perfect. Similarly, the eight indicators underlying the IMSI and indexes based on other aggregation methods are generally correlated with M_0 and *H*[91].

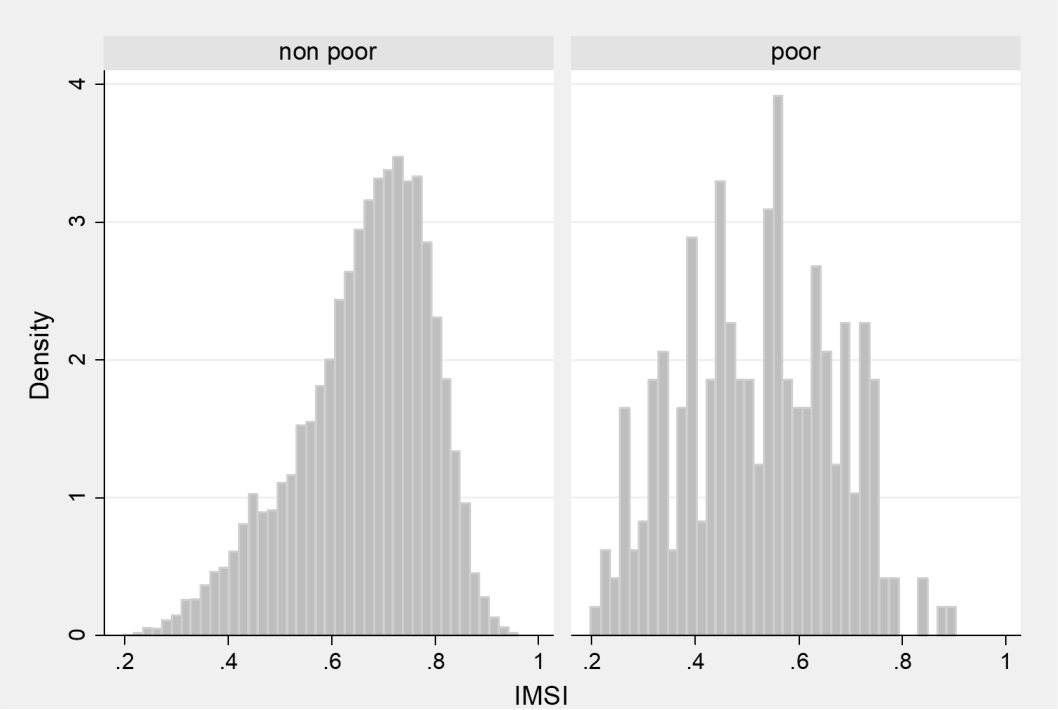
Among the individuals classified as multidimensionally poor according to the MPI criteria ($c_i > 1/3$), the IMSI scores vary markedly. As expected, the average IMSI of these individuals is significantly lower with respect to non-poor (MPI and MSI share many of their underlying indicators, as years of schooling or access to water), but the two groups are largely overlapping. Figure 2 describes the distribution of the IMSI in the two groups, non-poor (on the left) and poor (on the right).

[89] The analysis of the correlation between self-reported wellbeing and A (not reported here for space constraint) confirms this incapacity.

[90] Among these variables, Nutrition has the weaker correlation, while Assets has the highest correlation (also higher than the correlation with income mentioned above). Correlations are not shown here for space concerns.

[91] MMSI and geometric mean are the indexes with respectively the strongest (-0.165) and the weakest (-0.129) negative correlation with M_0. Amongst the 8 unidimensional indicators, Assets (a variable considered by the MPI) has the highest correlation with M_0 (-0.198), all the other indicators have correlations weaker than -0.15 (the M0-IMSI correlation). The correlations of Education, Sanitation, Nutrition and Work are also significant at 1% level. Health and Leisure also have negative correlations, but their significance is lower than 1%. Finally, the correlation between M_0 and Housing is positive (we recall that M_0 measures poverty, and therefore negative correlations are expected). Similar results apply considering *H* rather than M_0.

Figure 2: IMSI among multidimensionally poor and poor individuals, China, 2011



Source: Author's elaboration based on CHNS, 2011. The "non-poor" and "poor" groups are defined according to the MPI.

Another advantage of IMSI is its capacity to observe wellbeing differences not only *between* but also *within* families[92]. Indeed, the indicators included in the IMSI computation are largely individual variables enhancing the opportunity to investigate elements such as age and gender. These elements, which are mostly overlooked by household-based indicators (as those used by the MPI) result crucial in the comprehension of Chinese inequalities. Note that adopting the adult individuals as unit of analysis also has negative drawbacks, as the need of excluding children from the sample[93].

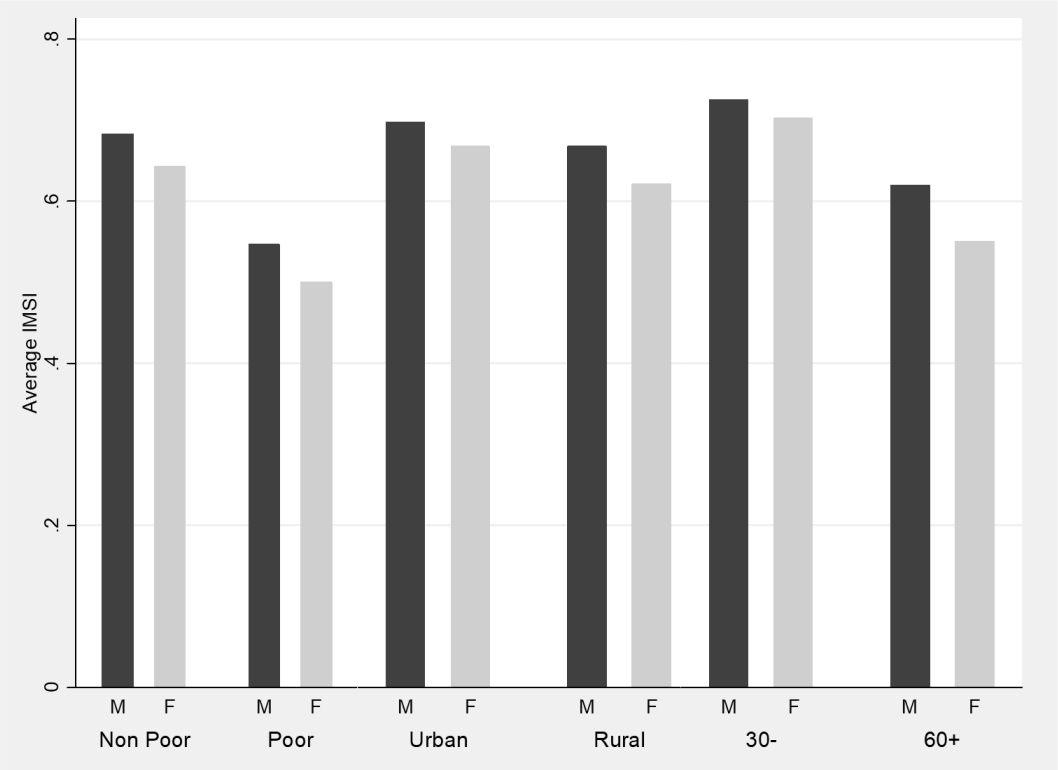
The wellbeing of males is significantly higher than that of females (see Table 10 in the previous subsection). This advantage, calculated in the overall sample, emerges clearly also focusing on subgroups, and especially on the most deprived subsamples. Figure 3 shows the average IMSI outcome in advantaged and disadvantaged groups, differentiating the average performances of males (dark bars) and females (light bars). Advantaged and discriminated groups are defined according to three different variables: multidimensional poverty (defined according to the MPI technique); rural-urban residence; age (in this case we point out the

[92] The average standard deviation of IMSI within all households is 0.060, while it is even higher if we include only the multidimensionally poor households (MPI classification).

[93] Children performances cannot indeed be compared with those of the adults. An MSI-based analysis would then require the selection of different samples and wellbeing indicators. On the contrary household level indexes, the global MPI is informative about the whole family including children. Yet, the idea that a household-level measure is informative about the totality of its components has been criticized because of intra-household differences, which can particularly affect women and children. For a literature review about multidimensional poverty and children, see Biggeri and Mehrotra (2011) and the literature review of Alkire and Santos (2013).

performances of young people, i.e. those below 30 years old, considered more advantaged, and the performances of old people, i.e. those above 60 years old, considered disadvantaged).

Figure 3: IMSI among advantaged and disadvantaged subgroups, males and females, China, 2011



Source: Author's elaboration based on CHNS, 2011.

In all the six subgroups, males have higher performances than females. We define here the "gender-gap" as the absolute difference between the average IMSI among analogue subgroups of male and female individuals. Figure 3 shows that the gender gap is always higher in the discriminated subgroup: it is higher among poor individuals, among rural households and (especially) among old cohorts. A similar result applies also to inner (poorer) provinces, disadvantaged with respect to eastern (richer) provinces[94].

These findings seem to confirm and generalize the existence of a "sticky floor" affecting Chinese women, as denounced first by Chi and Li (2008). This concept refers to a gender gap that is wider for the lowest quintiles of the population, discriminating poor women more than their better-off counterparts. Chi and Li considered earnings as interest variable and as variable underlying the population distribution. The results represented in Figure 3 suggest a generalization of the Chinese "sticky floor" in two directions. Firstly, we considered as interest variable an index of multidimensional wellbeing rather than a unidimensional variable; secondly, multidimensional poverty, rural-urban differences and age are all feasible criteria to distinguish the top and the bottom of the population distribution.

[94] E.g., in Beijing the MSI is 0.733 among men and 0.717 among women; in Guizhou it is respectively 0.651 and 0.594.

All in all, besides the theoretical foundation (described in section 3), the empirical evidence provided by the IMSI is original and not innovative with respect to the conclusions drawn from previous researches about monetary and multidimensional poverty[95]. The IMSI reports a higher correlation with the self-reported quality of life (the correlation is higher also with respect to other MSI-based indexes) and allows to compare the level of multidimensional wellbeing (or deprivation) between adult individuals, between and within households, allowing thus to observe inequalities based on gender and age. Note that this allowed to draw original policy implication in terms of multidimensional gender gap. On the other hand, being widely adopted by several investigations, the MPI results more useful for comparisons with different case-study. Moreover, the MPI provides a measure of wellbeing that applies to all the members of the household (assuming a fair within household redistribution[96]), while we had to exclude individuals below 18 years old from the sample in the MSI analyses. Finally, the MPI and the MSI adopt two radically different standpoint, respectively framing deprivation as a fuzzy or sharp phenomenon (Burchi, Rippin and Montenegro, 2015).

5. Conclusions

In this chapter, we analyzed the multidimensional wellbeing in China adopting two alternative indicators: the MPI and the MSI.

The MPI focuses on the issue of poverty, identifying deprivations defined at dimension level, and distinguishes individuals belonging to poor and non-poor households (who in turn are differentiated according to the number of deprivations they experience). In the selection of the relevant dimensions and their relative thresholds, we adopted the specifications provided by the OPHI. The analysis of this index allows to represent Chinese trajectory in terms of multidimensional poverty reduction on a time span of more than 20 years. It is important to underline that, after an increase in poverty between 1989 and 1991, during all the Nineties and the first decade of the new millennium, poverty in China strongly reduced, a reduction that has been particularly strong in the Nineties, while in the new millennium it continued with a slower pace.

The properties of the MPI allow a decomposition of the index in comparable subgroups. Therefore, we computed the level and the trend of poverty in specific geographic areas and for individuals with specific characteristics. At the geographical level, the rural/urban and the inner/coastal gaps both influence the MPI:

[95] We also compared the IMSI results with monetary poverty, as defined by Chinese government. This analysis, not reported here for space concerns, also showed the higher descriptive capacity of the IMSI in terms of interpersonal inequalities and life satisfaction.

[96] The literature does not provide agreement on this assumption, and specific indexes that target at capturing children basic needs can provide a more correct measure of children well-being, at the cost of renouncing to compare adult and children conditions (Biggeri and Mehrotra, 2011; Alkire and Santos, 2013).

coastal and urban areas register a significantly lower level of multidimensional poverty. These differences do not seem to reduce over time. On the contrary, the rural gap is increasing. At individual level, people belonging to the Han ethnicity (the ethnic majority) and members of the Chinese Communist Party have lower poverty rates. The existence of a gender gap is instead hardly caught by this index, based on household-level indicators.

The MSI is adopted to provide a more punctual representation of multidimensional wellbeing, able to measure not only the (extreme) deprivations but the whole range of satisfaction in various dimensions. Two main differences exist with the MPI: the selection of the relevant dimensions (based on a wider and individual-based set of indicators) and the aggregation technique (which instead of summing deprivation, takes into account the individual capacity of substituting wellbeing in a dimension with wellbeing from a different one). The second difference is methodological, while the first one is related to the selection of dimensions operated by the OPHI. However, the OPHI selection seems consistent with the MPI technique, individuating extremely serious deprivations that, when occur, affect the whole household. The set of dimensions included in the MSI does not allow a calculation of the index in the whole period, and we limit our MSI analysis to the year 2011.

Another original contribution of this work is the computation of a new index based on the MSI methodology, obtained relating the parameter g_i to the income of the individual *i*. Indeed, income has a peculiar role in determining the wellbeing: our index, named IMSI, considers income as a mean, rather than an end, and includes it as a tool that proxies the individual interdimensional arbitrage capacity. The correlation with self-reported life evaluation suggests that the MSI is on average more able than the MPI to catch self-reported wellbeing. Indeed, the IMSI is the aggregation technique with the highest correlation (with respect to arithmetic and geometric mean and the traditional MSI version).

The IMSI scores indicate significant differences based on geography (confirming the findings of the MPI analysis), highlighting also important differences based on gender and age: women and old people have on average a lower multidimensional wellbeing. Interestingly, the gender-bias is stronger in backward contexts. This result suggests that the "sticky floor" theory can be generalized beyond the boundaries of monetary wellbeing. This finding has important policy implications in terms of poverty alleviation. Individuals classified as multidimensionally poor with the MPI technique are indeed a very heterogeneous group, and women result, on average, more deprived according to the IMSI, especially in the backward contexts.

Dealing with the Chinese goal of building a 小康 society, the MSI -and the IMSI in particular- seems particularly relevant for its capacity to evaluate the individual wellbeing going beyond the strictly monetary aspect and the measurement of overt deprivations. Promoting the introduction of this tool in the economic debate is important under several perspectives. At the theoretical level, the IMSI provides a new and more sophisticated answer to the question whether to include or not income in the calculation of multidimensional

wellbeing. At the practical level, the IMSI proved to be more efficient than the MPI and other aggregation techniques in providing an objective calculation of multidimensional wellbeing that reflects the subjective evaluation. However, this result cannot be generalized across time and countries without further investigations. Finally, dealing with the policy implications, individual-level measuring is important to improve the targeting of the poor in the design of social policies, which however remains crucially related to the conception of poverty adopted by the policy-makers.

References

Aiguo, L. (2006). Transition, inequality, stress and health status in China. *project 'Heath amnd Social Upheavals' sponsored by the John D and Catherine T MacArthur Foundation, Institute of World Economics and Politics, Chinese Academy of Social Sciences, Beijing*.

Alkire, S. (2007). Choosing dimensions: The capability approach and multidimensional poverty. *The many dimensions of poverty*. Palgrave Macmillan, London, 89-119.

Alkire, S., & Foster, J. (2011). Counting and multidimensional poverty measurement. *Journal of public economics*, *95*(7), 476-487.

Alkire, S., & Santos, M. E. (2013). A multidimensional approach: poverty measurement & beyond. *Social indicators research*, *112*(2), 239-257.

Alkire, S., Meinzen-Dick, R., Peterman, A., Quisumbing, A., Seymour, G., & Vaz, A. (2013). The women's empowerment in agriculture index. *World Development*, *52*, 71-91.

Alkire, S., & Shen, Y. (2015). Exploring multidimensional poverty in China. *OPHI Working Paper*, l-4.Anand, S., & Sen, A. (1997). Concepts or Human Development and Poverty! A Multidimensional Perspective. *United Nations Development Programme, Poverty and human development: Human development papers*, 1-20.

Alkire, S., & Robles, G. (2017). Multidimensional poverty index summer 2017: Brief methodological note and results. *OPHI Methodological Notes*, *45*.

Bandyopadhyay, S. (Ed.). (2017). *Research on Economic Inequality: Poverty, Inequality and Welfare*. Emerald Publishing Limited.

Biggeri, M. and Mehrotra, S. (2011). Child poverty as capability deprivation: How to choose domains of child well-being and poverty. *Children and the capability approach*. Palgrave Macmillan, London, 46-75.

Biggeri M., Mauro, V. (2018, Forthcoming), "Measuring Sustainable Human Development Across Countries: the Multidimensional Human Development Index", Cambridge Capability Conference proceedings, CUP.

Biggeri, M., & Mauro, V. (2018). Towards a more 'Sustainable' Human Development Index: Integrating the environment and freedom. Ecological Indicators, 91, 220-231.

Boarini, R., & d'Ercole, M. M. (2013). Going beyond GDP: An OECD perspective. *Fiscal Studies*, *34*(3), 289-314.

Bourguignon, F., & Chakravarty, S. R. (2003). The measurement of multidimensional poverty. *Journal of Economic inequality*, *1*(1), 25-49.

Burchi, F., Rippin, N., & Montenegro, C. (2015). From income poverty to multidimensional poverty: An international comparison. In *international conference of the human development and capability association, Georgetown University, Washington, September*.

Chakravarty, S. R., & D'Ambrosio, C. (2006). The measurement of social exclusion. *Review of Income and wealth*, *52*(3), 377-398.

Chi, W., & Li, B. (2008). Glass ceiling or sticky floor? Examining the gender earnings differential across the earnings distribution in urban China, 1987–2004. *Journal of Comparative Economics*, *36*(2), 243-263.

China, U. N. (2013). China's progress towards the Millennium Development Goals. *United Nations System in China*. Accessed online at: http://www.cn.undp.org/content/dam/china/docs/Publications/UNDP-CH-MDGs2013_english.pdf

Chyi, H., & Zhou, B. (2014). The effects of tuition reforms on school enrollment in rural China. *Economics of Education Review*, *38*, 104-123.

Clark, D. A. (2003). Concepts and perceptions of human well-being: Some evidence from South Africa. *Oxford Development Studies* 31.2: 173-196.

Cruz, M., Foster, J. E., Quillin, B., & Schellekens, P. (2015). Ending Extreme Poverty and Sharing Prosperity.

Feng, D., Chu, X., & Chen, W. (2016). Study of Comprehensive Evaluation of Poverty Reduction Effect for Chinese Poverty-Stricken Areas-Based on the Data of Chinese 14 Contiguous Poor Areas. *Applied Economics and Finance*, *3*(3), 37-44.

Gustafsson, B. A., & Quheng, D. (2011). Di Bao receipt and its importance for combating poverty in urban China. *Poverty & Public Policy*, *3*(1), 1-32.

Klugman, J., Rodríguez, F., & Choi, H. J. (2011). The HDI 2010: new controversies, old critiques. *Journal of Economic Inequality*, *9*(2), 249-288.

Labar, K., & Bresson, F. (2011). A multidimensional analysis of poverty in China from 1991 to 2006. *China Economic Review*, *22*(4), 646-668.

Mauro, V., Biggeri, M., & Maggino, F. (2018). Measuring and monitoring poverty and well-being: A new approach for the synthesis of multidimensionality. *Social Indicators Research*, *135*(1), 75-89.

Mazziotta, M., & Pareto, A. (2016). On a generalized non-compensatory composite index for measuring socio-economic phenomena. *Social indicators research*, *127*(3), 983-1003.

Meng, Q., Fang, H., Liu, X., Yuan, B., & Xu, J. (2015). Consolidating the social health insurance schemes in China: towards an equitable and efficient health system. *The Lancet*, *386*(10002), 1484-1492.

Montalvo, J. G., & Ravallion, M. (2010). The pattern of growth and poverty reduction in China. *Journal of Comparative Economics*, *38*(1), 2-16.

Nicholas, A., Ray, R., & Sinha, K. (2013). *A dynamic multidimensional measure of poverty* (No. 25-13). Monash University, Department of Economics.

Nussbaum, M. C. (2011). *Creating capabilities*. Harvard University Press.

Pun, N., Gambino, F., & Sacchetto, D. (2012). *Cina, la società armoniosa: sfruttamento e resistenza degli operai migranti*. Jaca Book.

Qi, D., & Wu, Y. (2015). A multidimensional child poverty index in China. *Children and Youth Services Review*, *57*, 159-170.

Ravallion, M. (2010). *Mashup indexes of development*. The World Bank.

Ravallion, M., & Chen, S. (2007). China's (uneven) progress against poverty. *Journal of development economics*, *82*(1), 1-42.

Sen Amartya, K. (1999). Development as freedom.

Seth, S., & Alkire, S. (2014). Measuring and decomposing inequality among the multidimensionally poor using ordinal data: A counting approach.

United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. *Resolution adopted by the General Assembly*.

Wang, Y., & Wang, B. (2016). Multidimensional poverty measure and analysis: a case study from Hechi City, China. *SpringerPlus*, *5*(1), 642.

Wei, S. J., & Zhang, X. (2011). The competitive saving motive: Evidence from rising sex ratios and savings rates in China. *Journal of political Economy*, *119*(3), 511-564.

Yang, J., & Mukhopadhaya, P. (2017). Disparities in the level of poverty in China: evidence from China family panel studies 2010. *Social Indicators Research*, *132*(1), 411-450.

Yu, J. (2013). Multidimensional poverty in China: Findings based on the CHNS. *Social indicators research*, *112*(2), 315-336.

Annex 1: MSI sample and imputation

The main individual information we adopt are from "education", "physical exams", "health", "physical activity" and "jobs" subsections of the CHNS data. Only individuals that answered to at least three of these five subsections were considered, the others were dropped from our dataset. 6,681 individuals (33.88% of the sample) were dropped from the sample for this reason, all of whom did not answer to any of the five individual questionnaires. The remaining sample consists of 13,041 individuals, of which 13,031 answered to all five questionnaires (independently from data having missing information or not), 9 answered to four questionnaires, and 1 to three questionnaires.

Missing information are those from non-answered questionnaires (the ten individuals mentioned above), those not reported or recorded as "Unknown" and those inconsistent with the questionnaire options. The amount of missing information is quite low, usually below 1%. Table 7 indicates the amount (absolute and relative) of missing information for each indicator adopted to calculate the wellbeing in our eight dimensions (plus income, used to build the IMSI formula).

We imputed missing values separately in 6 different areas (the rural/urban combination of East/Center/West provinces). Along with the variables needed for the indicators (reported in Table 7), we included controls related to height, weight, age, gender, household head, the interaction between gender and being household head, satisfaction (self-reported), medical insurance, electricity, adequate cooking fuel, household size, house dimension per capita, income per capita.

A similar imputation applies to the subsample of non-working individuals to obtain a binary variable (built on item b2a) that distinguishes retired and students from housewives, disables and individuals seeking work[97]. Only one imputation is carried out in this case (rather than 6), including the controls mentioned above plus a dummy variable distinguishing rural and urban areas, and a variable ranging from 1 to 3 describing the development of the province (1 for the East, 2 for the Center, 3 for the West).

[97] 1,001 missing observations over 5522 non-working individuals in 2011, corresponding to 18.13%.

Table 7: Missing data in MSI indicators, China, 2011

Dimension	Variable	Missing	Total	Percent Missing
///	ln(income/c)	165	13,041	1.27
Education	Years of Education	25	13,041	0.19
Health	Sick/Injured	1	13,041	0.01
Health	Severity	15	13,041	0.12
Health	Illness Days	402	13,041	3.08
Health	Disease History	1	13,041	0.01
Health	Smoking	7	13,041	0.05
Nutrition	Body Mass Index	165	13,041	1.27
Housing	Rooms/c	171	13,041	1.31
Housing	House Ownership	10	13,041	0.08
Sanitation	Surrounding Cleaning	12	13,041	0.09
Sanitation	Flush Toilet	15	13,041	0.12
Sanitation	Tap Water	6	13,041	0.05
Assets	Assets	0	13,041	0
Work	Employment	1	13,041	0.01
Leisure	Time for Sedentary Activities	0	13,041	0
Leisure	Time for Non-Sedentary Activities	2	13,041	0.02
Leisure	Time for Sleeping	59	13,041	0.45

Source: Author's elaboration based on CHNS, 2011.

Annex 2: MSI variable construction

Education. This dimension is built over one variable: Years of Education. This variable, recorded in the questionnaire (item a11), has been substituted by the variable highest degree achieved (item a12) in case of missing information, considering the total amount of years necessary to reach the degree indicated (therefore implicitly assuming the individual did not undertake further classes). The Years of Education, ranging from 0 to 18, were normalized dividing by 18.

Health. This dimension is built over five variables: Sick/Injured, Severity, Illness Days, Disease History and Smoking. Sick/Injured is a binary variable signaling whether the respondent has been sick or injured in the 4 weeks before the interview (item m23). Severity is a self-reported evaluation of the severity of the illness/injury, running from 1, not severe, to 3, quite severe (item m25); we considered the value 0 for the non-ill people. Illness Days tells how many days in the 4 weeks before the interview the respondent was unable to carry out normal activities due to this illness (m26a). The maximum to this variable is set at 28, values larger than 31 were considered as missing. Disease History records how many of the following diseases

were ever diagnosed to the individual: goiter, angular stomatitis, blindness in 1 eye, blindness in both eyes, loss of 1 arm or the use of 1 arm, loss of both arms or the use of both arms, loss of 1 leg or the use of both legs, high blood pressure, diabetes, myocardial infarction, apoplexy, bone fracture, asthma, whistling/wheezing in chest, stroke, cancer. The resulting variable runs from 0 to 8. Smoking is a binary variable reporting whether individuals currently smoke cigarettes or pipe (items u25 u32 u27).

We divide Severity and Illness Days by their maximum (respectively 3 and 28), then multiply these two variables and subtract their product from one. In this way we obtain a variable ranging from 0 (a quite severe disease affected at least 28 days) to 1 (no disease). In case of permanent diseases, the previous measure of health is downsized by the factor $\frac{1}{1+n}$, where n represents the number of diseases in Disease History. This procedure reduces the wellbeing according to the number of permanent diseases recorded (with a decreasing marginal penalization). Finally, we reduce this Health score of 10% for smoking individuals.

Nutrition. This dimension is built over one variable: Body Mass Index (BMI). In turn, the BMI is obtained from the ratio between weight and squared height. Because of some inconsistency in these latter data, we compare height and weight of the individuals with $BMI \leq 15$ kg/m^2 or $BMI \geq 40$ kg/m^2, eventually replacing height and/or weight with the individual median value. Because of the inverted U relation between health and BMI, we distinguish individuals with BMI higher and lower than 22 kg/m^2. We assign a Nutrition value equal to 0 to individuals with $BMI \leq 13$ kg/m^2 or $BMI \geq 40$ kg/m^2, and value equal to 1 to individuals with $BMI = 22$ kg/m^2. Intermediate values are proportionally calculated in the interval (0; 1).

Housing. This dimension is built over two variables: Rooms/c and House Ownership. The first variable divides the number of rooms in the house, excluding bathroom/toilet (item l17), by the household size. We set an upper limit at four rooms per capita, considering this threshold as fully satisfying (larger houses do not trigger an increase in wellbeing). Furthermore, we divide this value by four to have an index ranging from 0 to 1. House Ownership is a binary variable that has value 1 when the household owns the house where they live, and zero otherwise (item l200). In case of house ownership, we lift the aforementioned index, so that it ranges between 0.2 and 1 (irrespectively of how small is the house, individuals owning their house cannot have a Household index below 0.2).

Sanitation. This dimension is built over three variables: Tap Water, Flush Toilet and Surrounding Cleaning. These are three categorical, ordinal, variables ranging in the interval [0; 3], where 0 correspond to the worst situation and 3 to the best. The *Sanitation* index sums these variables and divides by 9, to obtain an index ranging between 0 and 1. Tap Water, Flush Toilet and Surrounding Cleaning were in turn based on the information available respectively in item l1, l5 and l6.

Assets. This dimension is calculated thanks to the information about the ownership of color TVs, Refrigerators, Bicycles, Motorcycle, Cars, Tractors, Telephones and Cellphones (items l105, l115, l23, l27, l31,

l37, l140f and l140h), which are the durables considered by the OPHI in the computation of the MPI. We divide this summation by 8 to obtain an index ranging in the interval [0; 1].

Work. This dimension is mainly built over one binary variable: Employment. This variable is equal to one when the individual is working and zero otherwise (according to information in item b2). We assigned the value $^2/_3$ to the students and retirees who are not working (item b2a), and zero to housewives, disables and individuals seeking work. We then computed the average of this variable amongst each household. The overall *Work* index is a weighted average between the employment condition of the individual itself (weight=$^2/_3$) and the average employment condition of his family (weight=$^1/_3$). This allows to simultaneously account for the individual and household condition.

Leisure. This dimension is built over three variables: Time for Sleeping, Time for Sedentary Activities and Time for Non-Sedentary Activities. Time for Sleeping measures the hour of sleep per day (item u324). We consider fully satisfied all individuals with at least 8 hours of sleep per day, reducing to eight all values above this threshold. Similarly, we consider fully deprived all individuals with less than 3 hours, lifting to three all values below this threshold. The resulting variable ranging in the interval [3; 8] is proportionally spread over the interval [0; 1]. Finally, we downsize this variable for individuals doing on average less than half an hour per day of physical activity and for individuals doing on average less than one hour per day of sedentary activities. These reductions are inversely proportional to the minutes per day spent in these activities: each of them subtracted at most (i.e. with 0 minutes per day spent in physical/sedentary activities) 20% of the total wellbeing calculated based on the sleeping time.

Income. As mentioned in the discussion about the MSI formula, income is not included in the IMSI underlying dimensions, but it has a role in the computation of function g. The values of g must range between 0 and 1. After calculating the natural logarithm of the income per capita, we assign value zero to natural logarithm equal to 5 or less (i.e. income per capita equal or lower than 148.41¥ per capita). We assign value 1 to natural logarithm equal to 12 or more (i.e. income per capita equal or higher than 162754.79¥ per capita). Intermediate values are proportionally assigned to natural logarithm ranging between 5 and 12.

Moreover, we adopt as the reference point to individuate monetary poverty the rural poverty line introduced in 2011, when the government fixed the poverty line at 2300 yuan per year. According to 2011 inflation, a threshold of 2536 yuan applies to 2011 (Bandyopadhyay, p.221; 2017).

Chapter III

The Development Patterns of Chinese Provinces

Social and Economic Convergence, 1993-2016

Luca Bortolotti

Abstract:

Measuring and monitoring multidimensional development is a key feature in the agenda of the international community (Agenda 2030) and the Chinese Government (targeting the building of a "harmonious society"). This chapter analyzes the patterns of economic and social progress across Chinese provinces in the aftermath of Deng Xiaoping travel in South China in 1992. Aggregating social and economic outcomes into multidimensional indicators, we provide synthetic measures of wellbeing, alternative to the traditional variables investigated, relative to different spheres of wellbeing. These measures allow studying under a new and comprehensive perspective the synergy between different types of development. Moreover, the chapter investigates the convergence amongst provinces and discusses which factors and policies fostered the Chinese development.

The methodology for the aggregation is based on the new Multidimensional Synthesis Indicator, introduced by Mauro, Biggeri and Maggino (2018) while convergence is explored using β- and σ-convergence methods. The data on the 31 Chinese provinces are obtained by official Chinese statistics and the variables are grouped in 10 unidimensional indicators and three-levels multidimensional indicators.

Every Chinese province records an improvement in economic development and, to a lower extent, in social development, with notable differences across provinces. The effects of the "harmonious society" strategy, launched in 2005, in terms of multidimensional provincial development are also discussed by this chapter.

Since 2005 the capacity to integrate synergistically different developmental dimensions has strengthened, while the achievements of Chinese provinces have gradually converged (according to both β- and σ-convergence methods) toward a more homogeneous level of multidimensional wellbeing.

Keywords: China; Multidimensional Development; Convergence; Provincial Development.

JEL classification: I31 O18 O53 R11

1. Introduction

Measuring multidimensional outcomes and their progress is vital for the international community (following Agenda 2030) as well as the Chinese government. In 2005 China officially adopted the goal of pursuing a "harmonious society" (HS), which become an important feature of the Chinese development strategy re-orienting its trajectory toward sustainable development achievements (Li, Cheng, Beeton and Halog, 2016).

Since the beginning of reforms in 1978, the emergence of China is a major event in global economy, a well-acknowledged fact in the literature[98]. The most striking effects of the Chinese reforms are undoubtedly the high GDP growth rates and the underlying increases in productivity (Lin, 2011). The strength of these achievements has partially obscured other outcomes, as well as differences across Chinese provinces. Chinese development to date has very much been an uneven and multifaceted phenomenon, which cannot be reduced to economic growth recorded at the national level (Saphiro, 2001; Goodman and Segal, 2002; Nolan, 2004; Shue and Wong, 2007; Lemoine, Poncet and Ünal, 2015). On the contrary, the Chinese reforms, especially after Deng Xiaoping's travel to South China in 1992, caused a deep transformation of Chinese society involving institutions, health, the natural environment, and many other aspects of progress including diverse territorial development patterns.

So far, most of the literature has concentrated on Chinese economic and non-economic outcomes separately. However, this separation of the 'economic' from the 'social' discourse entails several shortcomings, as it often underplays the complexity of sustainable human development conceived by a multidimensional framework (Mehrotra and Delamonica, 2007; Ranis, Stewart and Samman, 2006; Biggeri and Mauro, 2010).

The aim of this chapter is twofold. The first aim is to provide multidimensional measurements of Chinese development trajectory achieved at provincial level from 1993 to nowadays. The Deng Xiaoping travel to South China in 1992 led to the 'definitive' transformation of the Chinese economy and society with different consequences from societal and spatial points of views, which are overlooked by traditional interest variables as income per capita. The second aim of the chapter is to adopt these new measures of development in the analysis to explore the synergies among different goals, the causes of development and, especially, the convergence amongst provinces between 1993 and 2016.

The analysis, conducted in the framework of Sustainable Human Development, is thus based on a new method of computing multidimensional wellbeing: the Multidimensional Synthesis Indicator (MSI) introduced by Mauro, Biggeri and Maggino (2018). The MSI is adopted here for the first time at the subnational level. The data, obtained from official Chinese statistics, consists of 34 variables measured at the provincial level covering all the 31 provinces for the period 1993-2016. These variables are grouped into 10

[98] Among the exterminate literature about Chinese economic growth and its background, we limit here to quote the books by Nolan, Arrighi (2007), Lin (2011).

unidimensional indicators and three-levels multidimensional indexes[99]. Disaggregation by province and by dimension of development allows to examine the effects of the adoption of the "harmonious society" strategy and to explore convergence issues.

The chapter is structured into seven sections and proceeds as follows. The second section reviews the literature about the measurement of multidimensional development and the economic convergence, with a preferential selection of China-based studies. The third section introduces the separation of the 'economic' and 'social' discourses, presenting the framework to explore multidimensional development in China. The fourth section explains the methodology adopted; this section is divided into three subsections, devoted respectively to the building of the unidimensional indicators through normalization, the building of multidimensional indexes through MSI aggregation, and the convergence analysis. The fifth section presents the data. The sixth section describes and discusses separately the results about the measurement and the engines of multidimensional wellbeing (6.1), the relation between different components of development (6.2), and the extent of convergence (6.3). The final section contains conclusions and policy implications.

2. Literature Review: Multidimensional Wellbeing and Convergence in China

This section involves and combines elements typical of two streams of literature: indexes of multidimensional wellbeing and convergence analysis. We review the literature about these two topics separately, respectively in section 2.1 and 2.2, because the contamination between these fields has been narrow so far. Before entering in the details of these two topics, we want to briefly introduce two broader areas of investigations that encompass the cases of multidimensional wellbeing and convergence analysis: inadequacy of economic variables to describe Chinese wellbeing and inequality between Chinese provinces.

In the literature, the awareness about the shortcomings of the Chinese development model has brought to singling out its weak points, particularly in fields as environmental protection and labour conditions[100]. Beside these "unidimensional critiques", we want to mention the discourse about happiness, that has inevitably led to a radical critique to income as unique interest variable. The book *Happiness and economic growth*, curated by Clark and Senik (2014), collects three investigations based in China, underlying the weakness in the level

[99] The first-level multidimensional indexes are those based on a relatively homogeneous set of unidimensional indicators, the second-level indicators are more comprehensive, and the third-level index includes all the available variables. The subsection 3.1 explains more in detail the construction of these indexes.

[100] The literature about Environment, Labour Conditions and Security is very broad, and a literature review about these topics is not in the purpose of this study. We want to quote however the works by Saphiro (2001) and Ngai (2005).

of subjective wellbeing in contrast to the fast economic growth triggered by reforms. This result is explained by several factors, not last the worsening of employment and social safety conditions[101].

The difference in trajectories of coastal and inner areas is a major problem of Chinese development since the opening-up of the country to trade and investments with neighboring countries in 1978 (Shue and Wong, 2007, Lemoine, Poncet and Ünal, 2015). The book *China Deconstructs*, by Goodman and Segal (2002) describes the peak of this issue with its economic and political consequences. At the end of the Nineties, the Chinese central government launched a "Go-West strategy" (西部大开发) campaign aimed to reverse this divergence across China. Fang, Dewen and Yue (2009) suggest that, beside the policy measures, also a "flying gees" process is now opposing to the provincial divide. Indeed, backward regions can benefit from transfers of capitals and technologies from the advanced ones, becoming particularly competitive in the labour-intensive industry, while the advanced regions specialize in R&D industry and in services. This phenomenon allows inner provinces to "exploit the backwardness advantages".

2.1 Multidimensional Wellbeing

Considering simultaneously the trend of different measures of wellbeing is a way of extending the economic analysis beyond its traditional boundaries (Noll, 2004). Important contributions in this direction came thanks to the Basic Need approach (Hicks and Streeten, 1979) and the Capability Approach (Sen, 1999; Nussbaum, 2011) that have been channeled in the Sustainable Human Development paradigm (UNDP, 1990; Ul-Haq 1995; Ranis, Stewart and Samman, 2006). Another relevant stream of literature about a broader conception of development was launched by the Brundthland Report *Our Common Future* accounting for environmental/ecological sustainability dimensions (1987).

Based on these considerations, various practical perspectives were carried out internationally as the Agenda 2030 and several multidimensional indexes were built to measure multidimensional development. This debate was enriched by the global initiatives carried on by the OECD, the Human Development Reports and the International Panel on Social Progress (IPSP)[102]. Some individual countries[103] took remarkable steps

[101] Easterlin (2014), writes: "*The fact that life satisfaction in China failed to increase noticeably along with income and output and has a U-shape similar to that found in the European transition countries is indicative of the fundamental importance of employment and the social safety net in determining the course of life satisfaction*".

[102] The OECD promoted the Better Life Index, including eleven dimension (Housing; Income; Jobs; Community; Education; Environment; Civic Engagement; Health; Life Satisfaction; Safety; Work-Life Balance), available online at: http://www.oecdbetterlifeindex.org/. The Human Development Report discusses which dimensions (and how) should be surveilled to obtain an inclusive index of human development (see, among the others, Fukuda-Parr, 2001). The IPSP put together the efforts of scholars from different social sciences with the aim of tackling the "most pressing challenges of our time" in a multi-disciplinary perspective. More information are available online at: https://www.ipsp.org/.

[103] In 2008, the French government commissioned an investigation about economy and the society, which resulted in a report (Stiglitz, Sen, Fitoussi, 2009) that methodologically investigates separately the classical GDP issues, the quality of life and the sustainability. The Italian project about "Equitable and sustainable well-being" (Benessere Equo e Sostenibile

forward too, including China that in 2005 challenged the traditional perspective of the policymakers and the monolithic vision of development thanks to Hu Jintao's project of building a "harmonious society" (Joshi, 2012; Li, Cheng, Beeton and Halog, 2016).

Thereafter, we review some of the most important indexes and methodologies suggested to measure multidimensional wellbeing at macro level which have been applied to study the Chinese development[104]. These studies, along with the harmonious society concept (described more in depth in the next section), provide solid ground for the identification of the aspects of well-being that deserve to be accounted by a comprehensive multidimensional index.

The Human Development Index (HDI) is a remarkable example of multidimensional index, promoted by the United Nations Development Programme. This index is founded on three dimensions: Health, Education and Living Standard. The Human Development Report 2016 measures the worldwide achievements in human development through the HDI and testifies that China has grown in all the three dimensions considered. This allowed China to reach the average level of HDI recorded in the East Asia and Pacific area[105]. However, the HDI is not the only composite index adopted to measure multidimensional development at macro-level, nor there is agreement among scholars on its completeness. Ranis, Stewart and Samman (2006) criticize the narrow scope of the HDI, suggesting that other variables should be added to the HDI pillars[106] to obtain a more complete measurement of human development. About the capacity of the HDI to synthetize human development and on the other relevant dimension not caught by the HDI, see also Fukuda-Parr (2001). Hirai (2017) provides an updated literature review about the criticisms (and defenses) of the HDI scope.

The 2030 Agenda set by the United Nations has broadened the number of spheres of well-being under surveillance, identifying the priorities of world development in 17 goals (associated to 169 targets), named Sustainable Development Goals (SDGs). Each of these goals is related to a single dimension: Poverty; Hunger; Health; Education; Gender Equality; Water and Sanitation; Energy; Work and Economy; Infrastructure; Inequality; Sustainable Cities; Sustainable consumption; Climate Change; Water Environment; Earth Environment; Peace and Justice; International Partnership. Except for the last two goals (related respectively

- BES) includes 12 dimensions: Health; Education and training; Work and life balance; Economic well-being; Social relationships; Politics and Institutions; Security; Subjective well-being; Landscape and cultural heritage; Environment; Research and innovation; Quality of services. The 2017 BES report is available online at: https://www.istat.it/it/files//2017/12/Bes_2017.pdf

[104] For a review of the literature that includes multidimensional indexes measured at micro level, see the previous chapter.

[105] See the Human Development Report 2016, Human Development for Everyone - Briefing note for countries on the 2016 Human Development Report: China, available online at: http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/CHN.pdf

[106] Alongside these three pillars, which remains fundamental in every sustainable development discourse, the dimensions added by Ranis, Stewart and Samman (2006) are: mental well-being; empowerment; political freedom; social relations; community well-being; Inequalities; work conditions; leisure conditions; political security; economic security; environmental conditions.

to policies implemented by the central governments and to a technical issue), all the other goals were considered in our definition of the measurement of multidimensional wellbeing in Chinese provinces.

The Multidimensional Poverty Index (MPI) proposed by Alkire and Foster (2011) is probably the multidimensional index more frequently applied to the Chinese context. The MPI detaches from the HDI and similar indexes (and from the purpose of this study too) because it is focused on poverty and its thresholds (the so-called "Strong-Focus" property, pointed out also in Bourguignon and Chakravarty, 2003). The MPI considers ten indicators in turn grouped into three dimensions that recall the HDI: Living Standards, Health and Education. Alkire and Shen (2015) measure the incidence of poverty in China in 2010 and in 1014 through the MPI. Other scholars calculate indexes of multidimensional poverty in China similar, but not identical, to the MPI[107]. These studies, beside the 3 pillars of the MPI, broad their set of variables, including new dimensions (as Nutrition, Social Security, Information, Housing etc) which will be considered in the analysis of this chapter.

The indexes analyzed above, group all the dimensions considered in a single index. This way of proceeding does not allow distinguishing dimensions which are closely related to each other from dimensions which are different (or almost antithetical). This limit is tackled by Biggeri and Mauro (2010), that investigate the 'synergies' within sustainable human development looking at the relation between social and economic outcomes in 50 countries. To do this, they build two separate multidimensional indexes, one for the Social Dimensions (SD) and another for the Economic Dimensions (ED). The SD includes social, political and civil outcomes, namely: Education, Life Expectancy and Freedom Index. The ED includes economic, inequality and environmental outcomes, namely: GDP, Employment and CO_2 Emissions. The main contribution of Biggeri and Mauro (2010) is the theoretical and applied investigation of the different combinations of economic and social development. These combinations determine a variety of 'patterns of HD progress'[108]. China for example results to be characterized by a strong ED (hampered by the environmental degradation), and a weaker SD.

Despite the growing worldwide interest about multidimensional measures, the literature about multidimensional wellbeing in the Chinese context is quite narrow. With few exceptions[109], this literature either focuses on the poverty issue (Yu, 2013; Alkire and Shen, 2015; Qi and Wu, 2015; Wang and Wang, 2016; Yang and Mukhopadhaya, 2017; Nicholas, Ray and Sinha, 2017), or involves China only in an international comparison (Biggeri and Mauro, 2010), without investigating the subnational levels, or involves

[107] See, among the others Yu, 2013; Qi and Wu, 2015; Wang and Wang, 2016; Yang and Mukhopadhaya, 2017; Nicholas, Ray and Sinha, 2017. Another investigation on multidimensional poverty in China, Labar and Bresson (2011), adopts the concept of stochastic dominance, opposed to the MPI,

[108] The most striking cases, reported by the authors, are: jobless growth; ruthless growth; futureless growth; peace-less growth. Such types of growth hamper respectively employment, equity, sustainability, safety.

[109] See Bin (2016), who adopts a multidimensional index based on the Principal Component Analysis (discussed later), and Bortolotti (2018), who adopts a version of the MSI based at micro-level.

only a limited number of dimensions (as in the *China National Human Development Reports* published by UNDP China and Development Research Center of the State Council of China). Therefore, the issue of measuring the effects of Chinese reforms in a multidimensional framework is largely unexplored. This chapter tries to give a small contribution in the direction of filling this gap, by adapting the methodologies proposed by Mauro, Biggeri and Maggino (2018) to the case of Chinese provinces, and by analyzing separately the trend of social and economic dimensions.

2.2 Convergence analysis between Chinese provinces

Convergence studies developed thanks to the precious contributions of Barro and Sala-i-Martin (1992) and Quah (1993). Section 4.3 is devoted to the main contributions introduced by these authors: β- and σ-convergence. In the literature, convergence analysis usually focuses on variables as per capita GDP, factors productivity or Consumer Price Index. China is no exception, and since the Nineties the trajectory of Chinese provinces has been analyses with the lens of convergence analysis.

Chen and Fleisher (1996) are among the firsts to study convergence in the aftermath of the reforms launched in 1978[110]. They observe that convergence in per capita production during 1978-1993 is conditional on investment, human capital and proximity to the coastline. However, the inner-coastal gap did increase slightly, causing a major divide across China. Similarly, Young (2000) concludes that the reforms adopted between 1978 and 1997 caused fragmentation and divergence in prices.

Several economists have then updated the research about inequality trend within Chinese provinces, obtaining different results according to the period and methodology adopted[111]. Tian, Zhang, Zhou and Yu (2016) provide a comprehensive literature review covering these investigations and their results. Moreover, their work finds the existence of two diverging clubs between 1978 and 2013, one with high-income and another with low-income, which are internally converging. This conclusion seems to confirm and extend Chen and Fleisher (1996) findings.

Lemoine, Poncet and Ünal (2015) focus on the convergence of labor productivity in the manufacturing sector, considering also the spatial distribution of production at sectoral level. Their findings confirm a converging trend in the period 1999-2009. Indeed, in the new millennium (and particularly since the mid-2000s) backward provinces located in inner China were able to turn their weaknesses into strengths, triggering a "flying gees" process and eventually reducing the gap with the coastal provinces.

In addition to income-centered convergence studies of China, some recent works investigated the energetic and environmental issues. Most of the studies about convergence in carbon emission have found a

[110] Previous studies have focused on long-run inequality among Chinese regions and include the Maoist period.
[111] Lemoine, Poncet and Ünal (2015) underline that an important difference in the methodologies is whether provinces are considered separately or grouped in three (East, Center and West) or in two (inner and coastal) categories.

converging trend among Chinese provinces. A detailed literature review about these studies is provided by Wu, Wu, Guo and Cheong (2016), along with their own investigation, based on a continuous dynamic distribution approach, which also finds convergence of carbon emissions among 286 Chinese cities between 2002 and 2011. Boussemart, Leleu and Shen (2015) incorporate CO_2 in the computation of Chinese growth, obtaining the "environmental growth"; their results show a convergence between 1997 and 2010 in carbon shadow prices among 30 Chinese provinces. Cheong, Li and Shi (2018) analyze the electricity consumption between 2000 and 2015, highlighting a divergence trend across provinces. Démurger (2001) emphasizes the role of infrastructure (both transportation facilities and telecommunications) in driving the differences across provinces during the period 1985-1998.

To the best of our knowledge, Bin (2016) is the only study that tests convergence among Chinese provinces with reference to an index of multidimensional wellbeing being, the "Composite Index of Regional Development" (CIRD). This index aggregates through principal component analysis five dimensions: macroeconomic; science and innovation; environmental sustainability; human capital Index; public facility. The distribution of the CIRD density function amongst 30 provinces in 1998-2010 points to the existence of three provincial groups with weaker provinces left behind.

Considering the blooming of interest around multidimensional poverty and spatial inequality, the narrowness of literature regarding multidimensional wellbeing convergence is quite striking, especially in a country, China, where the balancing and inclusiveness of the development strategy is a particularly sensitive topic. Our analysis tries to fill this gap, adopting an innovative method to synthetize different dimensions of wellbeing: the MSI. This technique, alternative to the traditional approaches based on the principal component analysis or the simple mean, is consistent with the hypothesis of convex preferences among dimensions, aggregated through a flexible function (see the methodology section 4.2).

3. Multidimensional analysis and Chinese Development

When the Chinese Communist Party launched the reforms, its aim was to build a "Xiaokang" (小康) society, i.e. a "moderately-prosperous" society that is not exclusively concerned with economic well-being. However, during the first stages of the reforms, monetary achievements – particularly along coastal, richer, provinces – have been the main target of policymakers (Shue and Wong, 2007). However, the diverging trend of provincial value added that emerged in the Eighties and Nineties has been partially opposed both by policy measures -the "Go-West" strategy launched at the end of the 1990s- and by market dynamics -the "Flying Gees" process described by Fai, Dewen and Yue (2009). More recently, also the issue of non-monetary development has been tackled. Indeed, under the leadership of Hu Jintao (2002-2012), the concern about a

broader conception of development resurged, with the rhetoric about a "harmonious" (和谐) growth. The leadership of Xi Jinping keep embracing an inclusive and widespread concept of development, which is part of Xi's project, named "Chinese Dream" (中国梦), or "Great Rejuvenation of the Chinese Nation". The latest targets of the reforms, announced in the 13th Five-Years Plan (valid for the 2016-2020 period), officially refer to "Xiaokang" and "harmonious" society (Joshua, 2017). Along with the concern about the sustainability of the Chinese development model, Chinese leadership attempted to include a broader set of targets. In terms of policy, the period of the harmonious society has been characterised by important reforms in the environmental and social fields, as the targets of universal health coverage and green economic growth[112].

The critical monitoring of the macroeconomic achievements across Chinese territory has therefore become essential in the perspective of harmonious society (Joshi, 2012; Li, Cheng, Beeton and Halog, 2016; Xue, Weng, Yu, 2018), despite the narrowness of the existing literature[113]. Two aspects deserve attention: the inclusion in the development process of the actors who did not "get rich first" (i.e. the provinces located in inner China) and the capacity of economic growth to trigger improvements in multidimensional wellbeing. This chapter shed lights on these topics by analysing whether economic growth and non-monetary wellbeing are coupling at the provincial level. In doing this, we also want to check how different provinces achieved different outcomes, whether they are developing toward similar or heterogeneous patterns, and whether they will eventually reach a similar level of wellbeing (convergence analysis).

Dealing with the differences among provinces, traditionally scholars analyse this heterogeneity through the division between East, Centre and West China. Another way of grouping provinces widely adopted in the literature is the division between inner and coastal provinces or, respectively, "Yellow China" and "Blue China" (Lemoine, Poncet, and Ünal, 2015), with the last economically advantaged over the second. These are not the only possible divisions, especially to explain differences in development broader than simple GDP growth. The convergence analysis wants to investigate if all the provinces will eventually reach a similar level of development (absolute convergence). The case of club convergence applies the concept of convergence to smaller groups sharing similar characteristics. Indeed, in a multidimensional perspective the issue of convergence is more complex, implying different criteria to observe convergence, which could lead to the coexistence of different clubs.

Dealing with the relation between different aspects of wellbeing, we propose a conceptual frame to examine Chinese provincial multidimensional progress, referring to the paradigms of Sustainable Human Development (SHD), Sustainable Development Goals (SDGs) and Harmonious Society (HS). These paradigms not only provide insights about how to select dimensions and variables but can also suggest how these

[112] For more insights on these green environmental development and health reforms, see respectively Su, Heshmati, Geng, and Yu (2013) and Yip and Hsiao (2009).
[113] See above, section 2.1.

dimensions dialogue with each other. The next subsection describes more in detail our approach toward multidimensional development, providing the framework of our measurement.

3.1 Conceptual frame for exploring multidimensional patterns in China

Our investigation of wellbeing follows an inclusive approach based on 'consensus' among different conceptions of multidimensional wellbeing (SHD, SDGs, HS), rather than an exclusionary approach (Qizilbash, 2018) typical of the conception of development uniquely in terms of economic growth or an empirical strategy based on data (e.g. using principal component analysis[114]).

Since the late 1980s, discontent about global development patterns and outcomes in terms of poverty, inequality and environmental issues has gathered pace, leading to several prominent critiques of reducing development to economic growth (Seers, 1969; Streeten et al. 1981; UNDP, 1996). Indeed, income growth had, in various contexts, failed to translate into poverty reduction and better quality of life and happiness for people.

The resulting debate has recently moved toward a constructive dialogue, leading to a consensus in the international arena on sustainable development. Thanks to the SDGs (Agenda 2030), social progress has become definitely both multidimensional and universal. The UNDP SHD paradigm already moved in the same direction, considering the quality of people's lives the core concern in the evaluation of development strategies and plans (UNDP, 1990). At the same time, according to the SHD paradigm the type of economic growth matters for social progress (UNDP, 1996). This has political implications: any development process that increases the severity of poverty, unemployment, environmental degradation or human conflict needs to be counted negatively in SHD processes.

The links between the SDGs and the SHD paradigm, hence, are strong. As pointed out by Qizilbaqsh (2018), the 'four pillars' of SHD (productivity; sustainability; empowerment; equity) are motivated by happiness

[114] The Principal Components Analysis (PCA) is a fascinating tool to reduce multidimensionality (Decancq and Lugo, 2013), because it exploits the correlations between the dimensions in the computation of their weights and prevents the "double counting" of strongly correlated variables. However, the selection of the relevant variables was done to include relevant aspects independently of their correlations. For example, Classic Economic Variables and Infrastructure Endowments are strongly correlated; nevertheless, they are both intrinsically relevant, and considering them separately would not imply double counting, but rather accounting for two different aspects. On the other hand, dimensions as Labor Conditions, that are negatively correlated with most of the other elements, should not be considered with a negative weight, because they were included exactly with the purpose of accounting for negative spillovers of the other aspects of wellbeing. In other words, the dimension considered are not interchangeable: they are involved in a formative, rather than reflective, relation (Maggino, 2017), which must allow for heterogeneity.
Note also that the adoption of the weights suggested by PCA does not tackle the issue of substitutability between dimensions, because the assignment of the weights is independent from the relative scarcity or abundance of the wellbeing in each dimension.

considerations and are very close to World Happiness Report (Helliwell, Layard, Sachs, 2012: 7), which considers the prospect of the SDGs.

The Chinese notion of HS emerged in parallel to the SHD paradigm and SDGs agenda, combining elements firmly embedded in a Confucianist understanding of the world and the universe. Although the Chinese government has not presented the HS strategy as a point of political discontinuity (Joshi, 2012), it has shifted its priorities following new guidelines for policy-making that explicitly target sustainable forms of social and economic development. The HS officially entered in the Chinese strategy in 2005[115] and has 2020 as time horizon.

With an inclusive and holistic approach, Joshi (2012) summarizes the HS in nine points that cover: (1) a democratic legal system; (2) the protection of human rights; (3) narrowing the wealth gap; (4) increasing employment; (5) the provision of government and public services; (6) attention to people's moral standards; (7) public order; (8) protection of the environment; and (9) the growth of rural incomes. According to Li, Cheng, Beeton and Halog (2016: p.689) "*In the context of Chinese culture, sustainable development and harmonious development have many points in common*"; however, it is noteworthy that, with respect to the SDGs, the HS is not easily measurable quantitatively, and is therefore harder to include in an indicator.

In the SHD paradigm, the attention is centered on what people get from development, not only what they put into it (Anand and Sen, 2000). From the SHD point of view, in our analysis the attention should be focused on the different opportunities that a human being may face in Chinese provinces. We include in the computation of multidimensional wellbeing some concepts related to the HS strategy through the selection of dimensions (such as environment, labour, equality, security) that correct the traditional conceptions of economic and social development, in order to obtain a more "harmonious" version of these achievements.

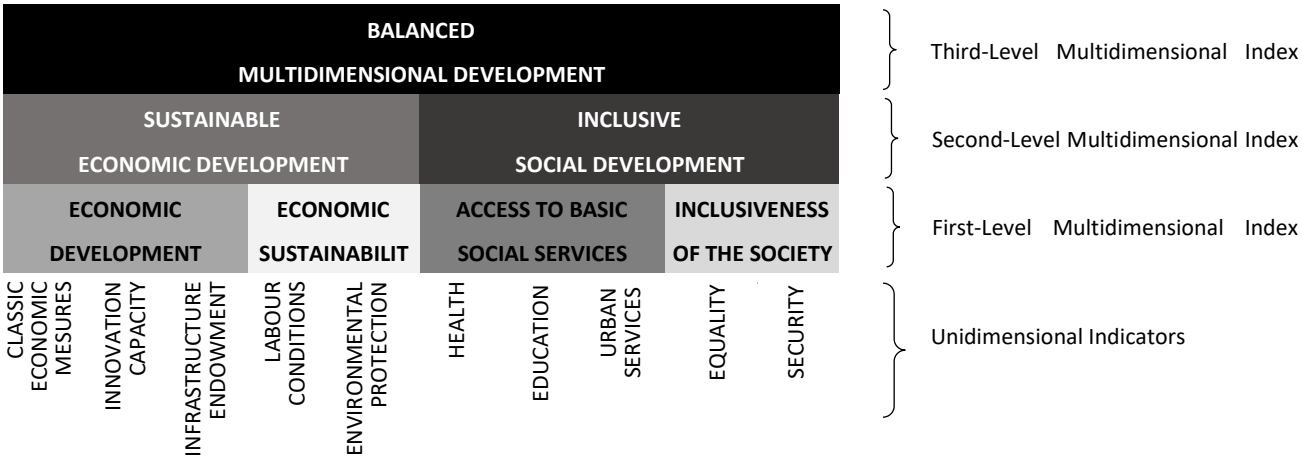
These considerations have motivated our choice of selecting ten unidimensional indicators: Classic Economic Measures, Innovation, Infrastructure Endowment, Labour Conditions, Environment Protection, Health, Education, Urban Services, Equality, Security. This list does not include other fundamental aspects often considered in the literature (as peace, justice, and corruption), while other dimensions particularly relevant for the Chinese case (as demography and family stability) are treated in a following analysis, as described in the appendix[116]. Section 5 (data) explains which variables allowed to build these ten unidimensional indicators.

[115] When the Sixth Plenum of the 16th CPC Central Committee approved the "Resolutions of the CPC Central Committee on Major Issues Regarding the Building of a Harmonious Socialist Society". See the China Daily article available at: http://www.chinadaily.com.cn/china/2006-10/12/content_706359.htm.

[116] These dimensions were excluded for the specific nature of our research, which is based on official data collected at provincial level. Indeed, most of the variation in peace and justice only emerges at national level, because of the highly centralized system Chinese political system. Dealing with corruption, its nature is intrinsically difficult to be caught, and empirical analysis can offer highly contradictory data according to the angle adopted to observe this phenomenon (Li, 2016).

The first three unidimensional indicatos are the pillars of Economic Development in a broad conception (the first-level multidimensional index), while labour conditions and environmental protection are two other fundamental points to preserve the harmony and the sustainability of such development (the second-level multidimensional index). Health, Education and Urban Services are the pillars of the basic social services, while equality and security are added to check the harmony and inclusiveness of social development. Considering all the ten dimensions jointly allow us to compute a third-level multidimensional index, the Balanced Multidimensional Development. Figure 1 describes all these variables in a scheme.

Figure 1: Unidimensional and Multidimensional Indicators



Source: Author's elaboration.

In the SHD perspective there are relevant synergies among monetary and non-monetary development. According to the literature, a strong two-way connection operates between economic growth and HD (Ranis and Stewart, 2000; Ranis, Stewart, Samman, 2006; UNDP, 1996): economic growth can provide the resources to permit sustained improvements in HD that, in turn, can influence feedback loops into production. According to Ranis and Stewart (2000), an economy may be on a mutually reinforcing upward spiral, with high levels of HD leading to high growth which in turn further promotes HD. Conversely, weak HD may result in low growth and consequently poor progress toward HD improvement. The strength of the links in the two chains influences the extent of mutual reinforcement between HD and economic growth and is therefore a

Demography and Family Stability are two main dimensions not included in this research, which accounts for the litigations and security issues within the household (note that labour disputes are instead accounted in the Labour Condition Indicator). These aspects are recognized as crucial sources of concern for the well-being of families, especially in the Chinese context, where the one child policy and the increase in internal mobility resulted in a growing concern for the well-being of the elderly (Giles and Mu, 2007; Islam and Smyth, 2015), while the rising number of divorces represents another problem of nowadays China (Zheng et al., 2019). Despite the relevance of these topics in the Chinese debate, demography and family structure were initially not included in our index of multidimensional development. Indeed, differently from topics as health or education, there is no agreement on the desired household structure neither from an economic nor from a well-being perspective (as an example, we can note that the Sustainable Development Goals do not directly address these issues). Annex 2 provides preliminary results about family stability and composition and about the effects of including these indicators in the measurement of multidimensional provincial well-being.

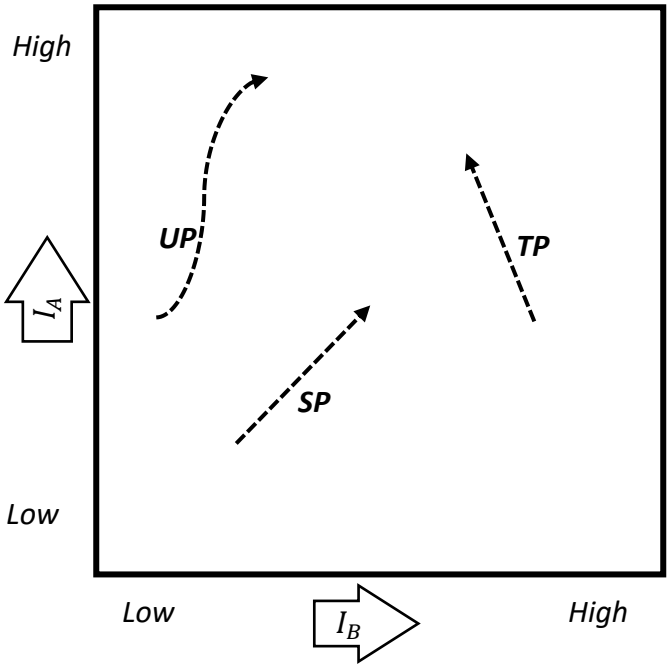
valuable feature. This mutual relation determines synergies also in policy implementation, between social and economic interventions (Mehrotra and Delamonica, 2007).

Following Biggeri and Mauro (2010), this chapter does not assume the achievement of a synergic relation as a trivial feature of development. On the contrary, we investigate the relation between different multidimensional indicators, trying to identify under which conditions economic and social outcomes expand jointly (synergic patterns) or when some indicators expand at the expense of others (trade-offs). We are particularly interested in analysing the relationship between three couples of indexes: Economic Development and Sustainable Development; Access to Basic Social Services and Inclusiveness of the Society; Sustainable Economic Development and Inclusive Social Development. The first two cases involve first-level multidimensional indexes, and measures respectively if (when and where) the economic and the social development were harmonious. The last case involves the relation between the two second-level multidimensional indexes and aims to shed light on the overall development of each province.

The approach and graphical representation by Biggeri and Mauro (2010) is an intuitive strategy to investigate synergies. Given two different (multidimensional) indexes, I_A and I_B, that characterize a province, we measure them in two orthogonal axes; then we track the development pattern for all years, and consider whether its movement conforms with one of the following patterns, represented in Figure 2:

- A "Synergic" or "Balanced" pattern: the values of I_A or I_B and their growth rates are similar, moving closely to the 45-degree bisector;
- An "Unbalanced" pattern: the increase in I_A is higher or lower than the increase in I_B, and either corresponds to an I_A-oriented pattern and to an I_B-oriented pattern;
- A "Trade-off" pattern: the value of I_A increases over time while that of I_B decreases (or vice versa).

Figure 2: Patterns of Human Development



Source: Author's elaboration. SP represents a Synergic Pattern; UP an Unbalanced Pattern (I_A-oriented); TP a Trade-off Pattern.

4. Methodology

To identify the relations between social and economic development of Chinese provinces, we resume the available information of specific social and economic outcomes in two comprehensive measures: Sustainable Economic Development (hereafter SED) and Inclusive Social Development (ISD). These measures, as well as the Balanced Multidimensional Development (BMD), require a technique that synthetizes different information, representative of different spheres of wellbeing -comprising both monetary and non-monetary aspects- into a single index.

The most intuitive way of aggregating different dimensions of development is through the computation of the arithmetic mean. This methodology implicitly assumes that the dimensions in question are perfect substitutes, i.e. success in a single dimension can compensate for failure in another. This assumption seems quite fetched, especially in case of overt poverty, where the success in a single outcome cannot compensate the deprivations recorded elsewhere.

The issue of aggregating different dimensions of well-being has been addressed in several ways. The investigations on multidimensional poverty (see Bourguignon and Chakravarty, 2003; Alkire and Foster, 2011) face a similar problem, but they have always maintained a focus over specific thresholds of wellbeing (the poverty cut-off), reducing the complexity of this issue. This problem is instead at the core of the HDI. The HDI abandoned the assumption of perfect substitution, rejecting the arithmetic mean in favour of the geometric mean (Klugman et al., 2011). The MSI adopt a similar but more elaborated perspective, allowing to deal with many indicators without incurring in the problems of collapsing to zero and allowing a flexible aggregation function (differently from the HDI).

The imperfect substitutability of one element with another is particularly important when we deal with a formative synthesis (Maggino, 2017). In a formative synthesis, the aggregate indicator is constructed over several variables relative to different domains that are not necessarily correlated with each other. At the opposite extreme, in a reflective synthesis, the aggregate indicator is built over several variables relative to the same phenomenon that are strongly correlated with each other and are therefore interchangeable.

Therefore, a substantial difference exists between the multidimensional indexes (BMD, second- and first-level indexes) and the 10 unidimensional indicators (in turn built over 34 variables). The construction of the

unidimensional indicators implies reflective relations[117], therefore a simple mean is sufficient to synthetize their values. The construction of the multidimensional indexes on the contrary implies formative relations, therefore we synthetize these indexes through the MSI method.

The following section, 4.1, describes the normalization applied to the original 34 variables in order to obtain "building blocks" suited for the aggregation, irrespectively of their scale. Section 4.2 enters in the details of the MSI, presenting the function that synthetizes the unidimensional indicators into multidimensional indicators. Finally, section 4.3 is devoted to the convergence analysis, providing a summary of β- and σ-convergence and a description of the expedients adopted to apply these tools to our MSI index.

4.1 From the recorded variables to the unidimensional indicators

An application of the MSI aggregation technique is possible only when, its underlying unidimensional indicators are expressed in a comparable way, and their values are included in the interval [0; 1], where 0 indicates the worst possible condition and 1 the highest possible condition. Note that an identical problem is tackled by the HDI, whose four underlying indicators[118], are all variables obtained through a normalization.

In our case, the unidimensional indicators at the basis of the MSI are in turn depending on the 34 variables collected. The computation of the 10 indicators represented at the bottom of Figure 1 is the result of two processes: the normalization of the 34 variables and the computation of the arithmetic mean of the normalised values related to each indicator. Note that once the 34 variables are transformed in variables that range in the interval [0; 1], also the arithmetic mean between them will range in the interval [0; 1]. For this reason, the unidimensional indicators computed in this way are suitable for the application of the MSI technique. A preliminary step implies redirecting the original variables toward a positive direction, inverting for example the sign of the pollution variable, so that higher values correspond to higher levels of wellbeing. A common normalization formula - also at the basis of the previous computation of the MSI (Biggeri and Mauro, 2018)- is as follows:

$$z_i = \frac{x_i - a}{b - a} \qquad (1)$$

[117] Through a correlation matrix – not reported here for space constraints- we observed the correlation among pooled variables included in each unidimensional indicator. All the variables in the Strictly Economic, Innovation, Infrastructure, Environmental, Health, Education and Services indicators are significantly (5% level) correlated to each other. In the Labor, Equality and Security indicators, all the variables are significantly correlated but to each other with one exception (these are respectively: unemployment, non-significant; gender bias in education, negatively correlated; deaths in traffic accidents, negatively correlated).

[118] The HDI Indicators currently are: Life expectancy at birth; Mean years of schooling; Expected years of schooling; GNI per capita (PPP $).

Where z_i is the normalized score relatively to province i, and x_i is its original score, a is the lowest value achievable (the "zero"), and b is the highest value achievable (the "one"). These two parameters, a and b, are often identified with, respectively, the minimum and the maximum value recorded in the sample. Several exceptions exist to this technique, including establishing *a priori* (i.e. before observing the data of the sample) the thresholds of the maximum and minimum score theoretically achievable. The HDI uses a mix of both the traditional and the *a priori* techniques[119].

Consistently with the nature of our data, we refined the normalization technique according to two criteria: the exclusion of "outlier provinces" in the setting of relevant parameters; the adoption of Chinese average outcomes as a reference point for the single provinces.

Because of the numerosity, variety and peculiarity of the indicators included, an *a priori* identification would have been highly arbitrary. Assuming that the minimum and the maximum values ever recorded in *any* province are consistent thresholds, would be misleading too. For example, the structure of Beijing and Shanghai municipalities is completely different from other provinces, which lead them to achieve -for better or for worse- outcomes out of the reach of the traditional provinces. Therefore, we identified the minimum and the maximum outcomes ever achieved from a group of 26 provinces, excluding Tibet and the municipalities[120]. These values are used to winsorize the data: in the five outlier provinces, minimum and maximum scores replaced respectively the values below the minimum and above the maximum thresholds. In formula, this winsorization corresponds to:

$$\begin{cases} x'_{itj} = x_{itj} & \forall i \neq Beijing, Tianjin, Shanghai, Chongqing, Tibet \\ x'_{itj} = min\left(b_j; max\left(a_j;\ x_{itj}\right)\right) & \forall i = Beijing, Tianjin, Shanghai, Chongqing, Tibet \end{cases} \quad (2)$$

Where x_{it} is the outcome of province i at time t with respect to the variable j. x'_{itj} is the same value after winsorization; b_j is the maximum value of j observed in any year among the 26 selected provinces; a_j is the minimum value of j observed in any year among the 26 selected provinces. Note that the minimum and maximum are not year-specific. Indeed, a_j and b_j must be time invariant, to make the achievements realized in different years comparable over time. This also means such values could be inconsistent for a comparison between preceding or following years.

[119] In the HDI, a and b are calculated asymmetrically: the value b is the actual highest value recorded over a certain time span; a is instead "can be appropriately conceived of as subsistence values".

[120] Tibet is excluded in the identification of a and b, because its data reports high volatility and several outliers, because of a small population sample. Similarly, we exclude the four municipalities: Beijing, Tianjin, Shanghai and Chongqing.

The traditional normalization technique overlooks how the values are distributed across the interval $[a; b]$. This fact can give rise to problems of implicit weighting during the multidimensional aggregation, especially in the case of non-symmetric distributions. For example, by aggregating a variable whose probability density function is lower at low levels and a variable whose probability density function is higher at low levels, we would obtain an index that implicitly gives more importance to the first variable and less importance to the second one. To tackle this undesired feature, we decided to split the normalization in two parts. The values laying below the Chinese (intertemporal) average outcome, will be normalized within the range [0; 1); those above the Chinese (intertemporal) average outcome, will be normalized within the range (0.5; 1]. The value 0.5 is assigned to the variables equal to the Chinese (intertemporal) average outcome. The fact that the value 0.5 has a specific meaning in the comparison of the result constitutes a positive feature of this normalization, because it favours the interpretability of the results.

$$\begin{cases} z_{itj} = \dfrac{x'_{itj} - a_j}{2 \times (c_j - a_j)} & if\ x'_{itj} \leq c_j \\ z_{itj} = 0.5 + \dfrac{x'_{itj} - c_j}{2 \times (b_j - c_j)} & if\ x'_{itj} > c_j \end{cases} \quad (3)$$

Where x'_{itj}, a_j and b_j are defined as above; z_{itj} is the normalized score of province i at time t relatively to the carriable j; c_j is the average x_j recorded across years for China as a whole[121] in the variable j.

After transforming our 34 variables x_{itj} into the normalized variables z_{itj}, we computed the 10 unidimensional indicators through a simple mean. In this way we obtain the unidimensional indicator w_{itk}, where i represents the province we are observing, t represents the year and k represents the dimension. Analogously to their "underlying building" blocks, the unidimensional indicators range in the interval [0;1]. Different selections of unidimensional indicators can give rise to different types of multidimensional indicators. Once the unidimensional indicators w_{itk} are computed, we can proceed in their aggregation to obtain a multidimensional index. The adopted procedure, the MSI, is described in the following section.

4.2 Measuring multidimensional Wellbeing through MSI analysis

[121] Despite c_j is calculated including also the performances of Beijing, Shanghai, Tianjin, Chongqing and Tibet, $\forall j$ empirically it is true that $a_j \leq c_j \leq b_j$.

The MSI formula, already described in the previous chapter[122], is as follows:

$$I_{it} = 1 - \left[\frac{1}{K}\sum_{k=1}^{K}(1 - w_{itk})^{g(w_{it})}\right]^{\frac{1}{g(w_{it})}} \quad (4)$$

Where w_{itk} is defined as above. K is the number of dimensions included ($k = 1 \dots K$). Depending on how many and which dimensions k we include in the multidimensional index I_{it}, we can obtain different levels of multidimensional indexes[123]. The formula $g(w_{it})$ represents a parameter that determines how far heterogeneity is penalized (i.e. to what extent a scarce dimension of well-being can be substituted for an abundant dimension of well-being). This formula plays a crucial role, related to the properties of the MSI.

The MPI satisfies three important properties, described in Mauro, Biggeri and Maggino (2018): Strict Monotonicity; Continuity; Heterogeneity Penalization. Strict Monotonicity guarantees that any increase in the value of any dimension considered led to an increase of the MSI index. Continuity guarantees that an infinitesimal increase in any index results in an infinitesimal increase in the MSI. Heterogeneity Penalization guarantees that if the same amount of wellbeing is added to a relatively abundant dimension of wellbeing and subtracted to a relatively scarce dimension of wellbeing, the net effect on the MSI is a reduction of wellbeing. Moreover, we do not impose this penalization to be equal for all the provinces of our sample, but we calibrate it based on their characteristics, according to the function $g(w_{it})$.

The highest the function $g(w_{it})$, the highest the penalization of the heterogeneity, to the extreme case $g(w_{it}) \to \infty$, that leads to a Leontiev function, which identifies the multidimensional wellbeing to the minimum wellbeing recorded in any dimension. On the contrary, lower $g(w_{it})$ allows a lower penalization of heterogeneity, until the extreme case $g(w_{it}) = 1$, implying no penalization, corresponding therefore to the simple mean. Following Mauro, Biggeri and Maggino (2018), we adopt as $g(w_{it})$ the inverse of the simple mean among different dimensions. In formula:

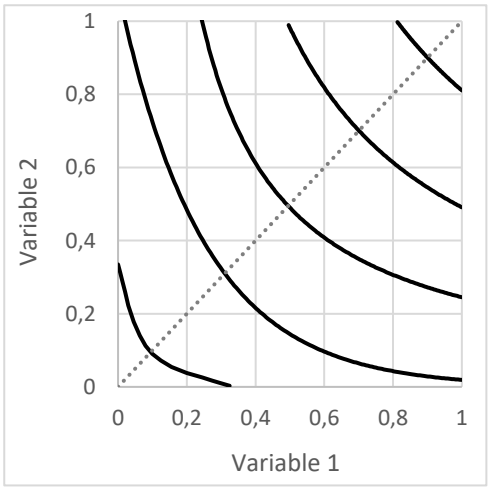
$$g(w_{it}) = \bar{w}_{it.}^{-1} \quad (5)$$

[122] The previous chapter introduced the traditional MSI along with an original method, the IMSI. In this analysis we stick to the traditional MSI formulation.

[123] We recall that our analysis adopts different multidimensional indices, as shown in Figure 1. Indeed, there are four first-level multidimensional indexes, synthetizing only 2 o 3 dimensions; there are two second-level multidimensional indexes, with $K = 5$; there is one third-level multidimensional indices, the BMD, with $K = 10$.

In this way we want to penalize more the heterogeneity of (on average) more backward provinces. Indeed, while a richer province has more tools to tackle the scarcity of wellbeing in a single dimension, the same condition is afforded with more difficulties by a poor province, resulting in a bigger loss of multidimensional wellbeing. Figure 3 represents an example of MSI based on two variables (on the axes), where the curves represent each combination of the two variables such that the total MSI value is the same.

Figure 3: Two-Dimensional MSI



Source: Author's elaboration. The 5 curves represent respectively MSI=0.1, MSI=0.3, MSI=0.5, MSI=0.7; MSI=0.9.

Any increase in an indicator x_{it} has therefore two positive effects: a direct one, implying the higher wellbeing derived from that dimensions, and an indirect one, through $g(w_{it})$, implying the province's improved capacity of substituting wellbeing in scarce dimensions.

This method allows to obtain the measure of BMD (and first- and second-level multidimensional indexes). Through these indexes, we can explore the trend and the distribution of the multidimensional development in several ways.

Firstly, we compare the MSI values obtained in different years and in different provinces to measure the strength of development over time and across provinces. Note that the parameters a_j, b_j and c_j (described in section 4.1) are time- and province-invariant, allowing such comparisons. Secondly, we analyse the provinces' capacity of achieving synergic patterns among multidimensional indexes (as described in section 3.1 and Figure 2). Finally, to tackle the issue of convergence, we will apply the β-convergence and σ-convergence. The traditional formulations of these concepts cannot be applied to the MSI, because this index has an upper-bounded range and should not be considered in its logarithmic form (as the tradition object of convergence analysis, the GDP per capita). The following subsection discusses therefore β- and σ-convergence, in general terms and relatively to our case.

4.3 Convergence

Analysing convergence for multidimensional development entails investigating whether different provinces have become more – or less - equal between 1993 and 2016, and whether they will eventually reach the same levels of well-being. The lack of convergence would instead imply that the unbalances recorded at the beginning of the investigation have maintained or improved (the case of divergence).

Borrowing from convergence analysis the concepts of β-convergence and σ-convergence, we want to check if the efforts of the Chinese government to tackle the growing inequality within provinces had notable results in the 24 years analysed.

The hypothesis of β-convergence[124] identifies convergence with a negative relation between the initial level and the growth rate of the variable in question (usually the log of income per capita). In formula:

$$\frac{1}{T} g_i = \alpha + \beta I_{i0} + u_i \qquad (6)$$

Where I_{i0} is the relevant variable recorded by individual i in the first year observed, $t = 0$; T measures the length of the time passed between the first and the last year observed; g_i is a measure of the growth of I_i between the first and the last year observed; and u_i has a mean equal to zero and a finite variance. The negative relation typical of convergence is therefore $\beta < 0$, and can be estimated through a cross-section regression. Convergence is absolute (or unconditional) if the correlation is significantly negative without controlling for other covariates. On the contrary, convergence is conditional if the negative correlation appears only after controlling for some variables (usually investments).

The interest variable of our analysis is the Balanced Multidimensional Development BMD_i obtained with the formula (4). We firstly test absolute convergence, not including covariates. The growth is measured by $g_i = BMD_{it_{24}} - BMD_{it_1}$, where t_1 and t_{24} are respectively the first and the last year. Our specification differs from the traditional interest variable[125] and hence the measurement of its growth also changed[126]. To reflect the nature of the variable BMD_i, bounded in [0;1] and calculated symmetrically around 0.5, we measured the absolute growth. In formula:

[124] See, among the others, Barro and Sala-i-Martin (1992)

[125] Dealing with income, the ln(GDP/c) is traditional interest variable. We recall that ln(GDP/c) is included in variables upon which the BMD is built

[126] Other measures of growth, applied to unbounded variables, are $g_i = \frac{x_1 - x_0}{x_0}$ and $ln\left(\frac{x_1}{x_0}\right)$.

$$BMD_{it_{24}} - BMD_{it_1} = \alpha + \beta BMD_{it_1} + u_{it_{24}} \quad (7)$$

This equation can be easily transformed in the following:

$$BMD_{it_{24}} = \alpha + \gamma BMD_{it_1} + u_{it_{24}} \quad (8)$$

Where $\gamma = \beta + 1$. The condition $\beta < 0$ implies $\gamma < 1$, corresponding to the case of convergence: the multidimensional growth is stronger in "richer" provinces.

Quah's (1993) arguments (based on Galton's fallacy) contributes to the emergence of σ-convergence as another method to identify convergence. Convergence is here described as the case in which "*Each country eventually becomes as rich as all the others - the cross-section dispersion diminishes over time*" (Quah, 1993, p.428). Further models were elaborated to encompass issues as spatial autocorrelation and non-stationarity (Tian et al., 2016). This methodology observes the dispersion over the years, investigating whether it constantly decreases. The measures of dispersion traditionally adopted in σ-convergence analysis are the standard deviation (σ_t) and the coefficient of variation (σ_t/μ_t, where μ_t is the average value of our interest variable in the year t).

Our interest variable is bounded in [0;1], similarly to the beta distribution. For this reason, σ_t does not linearly increase with μ_t. Therefore, tσ_t/μ_t is a misleading measure of dispersion. Moreover, σ_t is likely to increase when $\mu \cong 0.5$ and must be $\sigma_t = 0$ when $\mu = 0$ or $\mu = 1$. Because of these distortions, the σ_t is discarded as measure of dispersion too. A proper measure of the dispersion among provinces is the variance (${\sigma_t}^2$) corrected by the product of the average and its complementary number for 1, both ranging in [0;1]. In formula: $\frac{{\sigma_t}^2}{\mu_t \times (1-\mu_t)}$.

We remind that our BMD index is bounded in the interval [0;1], even if by construction these limits are never binding for the "comparable" 26 provinces[127] between 1993 and 2016. For this reason, our convergence analysis can only refer to this period. Extensions to a longer time-span could require an updating of the

[127] Five provinces are excluded from the calculation of the normalization parameters, and their values are therefore more likely to concentrate at the extreme tails. The [0;1] bound is binding at the level of 34 variables, but it is less binding in the unidimensional indicators (Tibet is the only province whose indicators ever reach value 0, in Innovation Capacity, and value 1, in Environment Protection). Multidimensional indexes are never bounded in our sample. In addition to the methodological issue, the outlier provinces have peculiar characteristics that make it difficult to imagine convergence between them and the 26 "comparable" provinces.

parameters described in section 4.1. Convergence within provinces is tested amongst the "comparable" provinces, while the inclusion of the entire sample of 31 provinces is used as a robustness check.

5. Data

This investigation is based on 34 variables, collected at the provincial level in each year of the 1993-2016 period. The variables are standardized and aggregated in 10 unidimensional indicators with the methodology discussed above (section 4.1). These are the only variables upon which we evaluate the multidimensional wellbeing. This selection includes available information in almost all most relevant spheres of wellbeing according to the literature about SDGs, Human Development and Harmonious Society. Some exceptions, anticipated in section 3, involve those important dimensions that are not caught by any available provincial-level data; other unidimensional indicators are founded only on an incomplete set of variables for the same reason[128]. A list of the 10 unidimensional indicators follows, indicating in parenthesis their underlying variables (34 in total).

- Classic Economic Measures (income[129] per capita; household consumption in PPP[130]; investments per capita);
- Innovation Capacity (patents accepted per capita; R&D Expenditure per capita[131]; technical market/GDP);
- Infrastructure[132] Endowment (highways/km^2; paved roads per capita; power generation per capita; popularization rate of telephone);
- Labour Conditions (unemployment rate; labour share of GDP; labour disputes per capita[133]);
- Environment Protection (tons of sulphur emission per capita; tons of solid waste per capita; tons of waste water per capita);

[128] Political freedom and human rights constitute the most notable missing aspect in our analysis. However, such data are mostly related with policies implemented by the central government (especially in the Chinese context), since any political discrimination applies between different provinces. A different type of omission involves those variables that were not available (or were highly incomplete across time and space of our analysis), but that we would have wanted to add in the formation of the ten unidimensional indicators. These variables are: free time and work satisfaction (Labour Conditions); homicide rate (Security).

[129] Income, as well as the following variables expressed in yuan (i.e. expenditures, consumption, investments) are inflated to 2000¥ according to the official CPI (calculated at national level) and calculated as natural logarithm.

[130] The Purchasing Power Parity is obtained according to Brandt and Holz (2006) data (see after).

[131] Before 2000 the data is calculated only based on the funds and expenditures by "State-owned Research and Development Institutions and Information and Literature Institutions". These data were then increased proportionally.

[132] We attach to infrastructure a wide meaning, including transportation facilities, telecommunications, and energy. This is consistent with Démurger (2001), who emphasize the role of infrastructure in causing economic convergence.

[133] This data from the China Labour Statistical Yearbook, refers to the cases accepted by courts, except for 1996-1997, when only the data of mediated cases is available. Such data was increased proportionally to ensure comparability. The interpretation of this data is controversial (Cai and Wang, 2012), because it reflects both the roughness of working conditions and the political and economic freedom of pursuing an institutional conflict resolution. However, an unescapable point is that "*the growing divergence of interests between employers, employees and the state has been expressed in a dramatic increase in the number of formally registered individual and collective labour disputes*" (Clarke, Lee and Li, 2004, p.235). More on this topic in Cooke, 2008.

- Health (hospital beds per capita; medical personnel per capita; budget expenditure in health per capita[134]);
- Education (share of people with primary education; share of people with college or higher education; students/teacher ratio in primary schools; budget expenditure in education per capita);
- Urban Services (floor space[135]; access to water; access to gas; public buses per capita; green areas per capita);
- Equality (urban household consumption over rural household consumption; rate of male population with college or higher education over rate of female population with college or higher education; average wage of workers in banking and insurance sector over average wage[136]);
- Security; (environmental emergencies per capita; inflation of food prices above the CPI[137]; deaths in traffic accidents per capita).

These ten unidimensional indicators are calculated as simple mean of their underlying variables[138], which were normalized according to the procedure described in section 4.1. The multidimensional indexes synthesize these indicators in a single value. According to the number and type of indicators included, there are several possible multidimensional indexes, organized in three levels. The third-level multidimensional index, the "Balanced Multidimensional Development", includes all the ten indicators. "Sustainable Economic Development" (SED) and "Inclusive Social Development" (ISD) are second-level multidimensional indexes and contain respectively the first five (related to the economic sphere) and the last five (social sphere) indicators listed. We can further distinguish within SED "Economic Development" (considering the pillars of economic activities: Classic Economic Measures, Innovation and Infrastructure Endowments) and "Economic Sustainability" (Labour Conditions and Environmental Protection). Note that the two pillars of Economic Sustainability are two aspects initially neglected by the Chinese reformers, which became relevant in the discourse around the harmonious society. We also distinguish within ISD "Access to Basic Social Services" (Health, Education and Urban Services) and "Inclusiveness of the Society" (Equality and Security). Again, the second index, "Inclusiveness of the Society", corrects a narrow concept of development thanks to aspects stressed by the harmonious society discourse. The relation between the unidimensional indicators and the multidimensional indexes follows the description provided in Figure 1, section 3.1.

To collect the 34 variables at the basis of the 10 unidimensional indicators, we draw on several official sources of Chinese statistics. The first source we looked is the National Bureau of Statistics of China (NBS), that provides an online database about annual data by province. Not all the data are available from this source, and in several cases the variables are available only for the latest years. In these cases, we then resorted to the 24 "China Statistical Yearbooks" released between 1994 and 2017 (usually these sources report the data

[134] Between 1993 and 1996 the data of health and education budget expenditure were collected jointly. In these years we divided proportionally the total amount of such expenditure.
[135] In 2009-2016 this data was obtained by adding to the previous "Per Capita Floor Space of Residential Building in Urban Areas" the amount of "Floor Space of Residential Buildings Sold" per capita.
[136] Considering that wages in the banking and insurance sector are among the highest ones, this measure was included to consider the inequality among workers.
[137] We considered 2000 as base year to calculate the difference between the overall and the food inflation.
[138] Consistently with the "formative" (rather than "reflective") nature of their relation (Maggino, 2017) discussed above.

relatively to the previous year). If neither of these sources released a complete time span of the interest variable, we further resorted to the "China Labour Statistical Yearbooks" released between 1994 and 2016 and to the "China Compendium of Statistics" (containing provincial data only up to 2008).

Beside these official data, we borrowed from Brandt and Holz (2006) the measure of spatial price differences among Chinese provinces to calculate the household consumption in purchasing power parity, which is based on the price difference in 2000 estimated by Brandt and Holz and the official Consumer Price Index (CPI) recorded at the provincial level by the NBS in the period 1994-2016. The other inflated variables are obtained applying the official inflation rate, calculated at the national level through the CPI.

The official data in the 34 dimensions considered were almost completely available from official statistics: only the 5.06% of the data are missing. A major reason behind such missing data is the fact that Chongqing became an independent municipality only in 1997. Indeed, in the first years of our investigation Chongqing data are merged with Sichuan province (that used to include Chongqing territory). We tackled this issue by splitting the Sichuan data recorded before independence in two parts, according to the proportion of Sichuan/Chongqing performances recorded afterward. In other words, we are implicitly assuming that the relation between Sichuan and Chongqing outcomes was not affected by the independence of the municipality established in 1997.

Other missing data came from some years when a specific data was not collected; in these cases, we interpolated the missing data assuming a linear trend. The variable "Gender bias in education" in Tibet, 1997 is considered an outlier[139] and replaced based on a linear interpolation of 1996 and 1998 values.

6. Results and Discussion

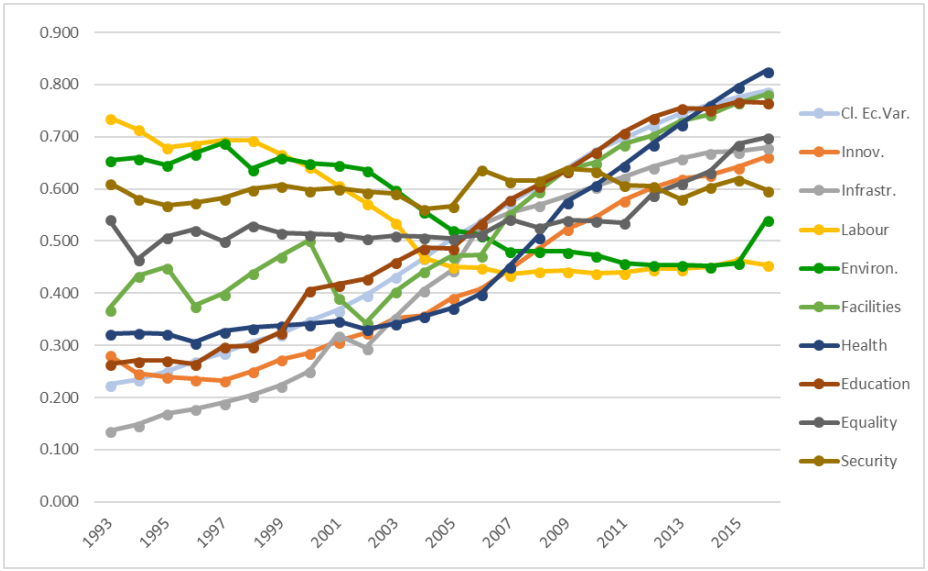
Consistently with our research questions, we divided our results into three subsections. The first analyses trend of multidimensional indexes over time and across provinces, investigating their engines. The second part looks at the relation between different types of development (focusing on economic development/economic sustainability; provision of social services/social inclusiveness; sustainable economic development/inclusive social development). The last subsection investigates convergence across provinces.

[139] In that year and province, the sample of people with college education or above amounted to only 7 units (in a sample of 2193 units), five males, 1 woman and one whose gender is not recorded. Such gender bias seems however driven by the small sample and was corrected with an average of the proportion recorded in the preceding and following years.

6.1 Chinese multidimensional development

Considering overall China, a positive trend generally appears in the 10 unidimensional variables. Between 1993 and 2016, a remarkable growth involves particularly 4 dimensions: Classic Economic Measures, Innovation Capacity, Infrastructure Endowments and Education. Other three indicators, Health, Urban Facilities and Equality are instead stable (or show a contrasted trend) in the first decade surveyed, while effective improvements are evident in the second period. Finally, three indicators, Labour Conditions, Environment Protection and Security deteriorate over time. Figure 4 compares the trend over time of the 10 unidimensional indicators in overall China. It is important to underline that the three decreasing lines correspond to the major weaknesses pointed out by the literature about Chinese development strategy (Saphiro, 2001; Ngai, 2005). However, in the last years these indicators did not drop considerably. Annex 2 includes an analysis of the family stability issue, another weak point of Chinese development.

Figure 4: Wellbeing trend in 10 Dimensions, China, 1993-2016

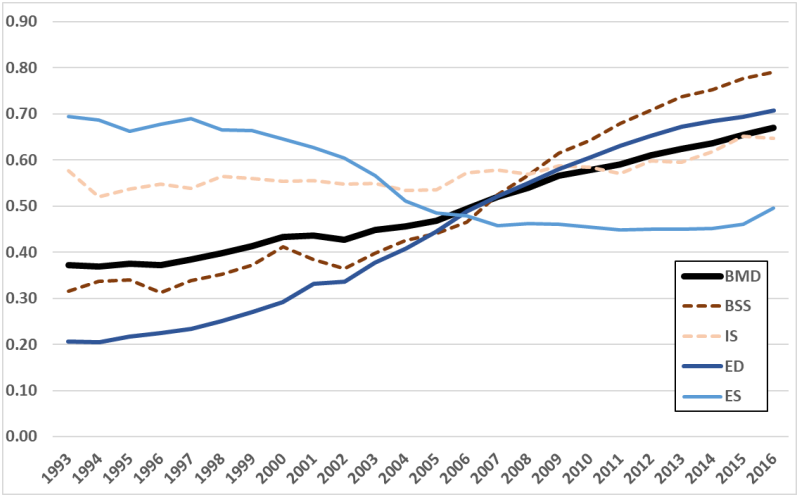


Source: Author's calculation.

Grouping the three strictly economic indicators, we obtain a measure of Economic Development, which increased constantly, even if at slightly decreasing pace. Economic Sustainability decreased in the first half of the period observed (approximately until 2005), to remain stable thereafter. The Access to Basic Social Services improved, showing a mild increase in the Nineties characterised by booms and busts, followed by a steadier growth in the new millennium. The Inclusiveness of the Society has instead remained quite stable for most of the years considered.

Figure 5 compares the trend over time of these 5 multidimensional indicators in overall China.

Figure 5: Wellbeing trend according to Multidimensional Indicators, China, 1993-2016



Source: Author's calculation. BMD=Balanced Multidimensional Development; BSS=Access to Basic Social Services; IS=Inclusiveness of the Society; ED=Economic Development; ES=Economic Sustainability.

The multidimensional development of China expanded over time, sustained both by the economic development and the (consequent) provision of social services. Among the remaining critical points, the environmental degradation, yet far from being recovered, and the scarce attention to inclusiveness emerge. The net evaluation of Chinese development in these 24 years therefore depends on the weights assigned to the different aspects of wellbeing[140]. Exclusively focusing on the monetary aspects (or on the provision of services based on such economic development) led to overestimate Chinese achievements.

The indicators just analysed deal with the development of China as a whole, but these aggregate achievements have been unequally distributed among provinces. Adopting the traditional division of Chinese provinces in the East, Centre and West regions, we observe that the eastern provinces are on average[141] the strongest performers in terms of Balanced Multidimensional Development (and in Economic Development too). Central and Western provinces, on the other hand, lag behind the national average: Western provinces always rank in the lowest positions. The inner-coastal gap thus remains far from being closed, particularly in the "Economic Development" sphere.

To obtain a more detailed analysis of the factors underlying income and multidimensional growth, we run a random effect regression considering the causes usually pointed out by the literature (Goodman and Segal, 2002; Biggeri, 2003; Nolan, 2004; Lin, 2011; Lo, 2018). These are:

- Geographic location: central and eastern provinces are advantaged by their strategic position closer to Taiwan and other maritime trade routes;

[140] The BMD weights equally the 10 unidimensional indicators. The net development can become negative if the three dimensions that decrease over time (Labour Conditions, Environmental Protection, Security) are weighting more.
[141] The averages of East, Center and West China, as well as the National average, are weighted proportionally to the resident population.

- Access to capital: domestic investments and international trade were fundamental drivers of the economic development;
- Structure of the economy: the agricultural sector and the maintenance of the State-Owned Enterprises (SOEs) are indeed traditionally seen as a burden for the Chinese development.

Therefore, we estimate the impact of these factors (adding a linear effect of the passing of the time) on development, through the following equation[142]:

$$Dev_{pt} = \alpha + \beta_1 T_t + \beta_2 E_p + \beta_3 C_p + \beta_4 I_{pt} + \beta_5 T_{pt} + \beta_6 S_{pt} + \beta_7 A_{pt} + u_i + v_{it} \qquad (9)$$

Where Dev_{pt} is a measure of the development of province *p* at time *t*, and can be alternatively the normalized income per capita, the SED, the ISD or the BMD. Note that all these variables are continuous and bounded in [0; 1]. T_t accounts for the passing of time, assuming a linear effect (T_t=0 in 1993; T_t=1 in 1994 etc.). E_p and C_p are dummy variables associated respectively to East and Centre China. I_{pt}, T_{pt}, S_{pt}, and A_{pt} are respectively the investments over the GDP, the total trade (exports + imports) over the GDP, the share of total investments originated by SOEs, the share of GDP originated by the agricultural sector. u_i and v_{it} are respectively the random effect and the pure residual.

Table 1 reports the results of the four estimates. Looking at the signs, magnitude and significance of the coefficients allow comparing what is the role of these factors in determining income, economic, social and multidimensional development.

The factors promoting (or hampering) income growth have different effects in terms of multidimensional development. The most striking difference is the role of SOEs, with a negative impact on income growth but positively on the BMD. Other differences are:

- The growth over time of SED, ISD and BMD is lower than income growth (consistently with Figure 5);
- The differences between West, Centre and East China are lower in a multidimensional conception of development;
- The agriculture sector is less detrimental in a multidimensional perspective (and is not significantly negative for the ISD).

[142] We run regressions based on similar models with the Ordinary Least Squares methodology and replace the regional dummies with a measure of the air distance between the regional capital and the nearest port. The results of these two regressions (not reported for space concerns) are similar and confirm the robustness of our findings.

Table 1: Economic Development vs Economic Sustainability in selected provinces, 1993-2016

	Income	SED	ISD	BMD
Year	0.02***	0.01***	0.01***	0.01***
East	0.20***	0.08***	0.11***	0.09***
Centre	0.07***	0.04***	0.08***	0.06***
Investments	0.11***	0.09***	0.18***	0.13***
Foreign Trade	0.05***	0.12***	0.16***	0.14***
SOEs	-0.06***	0.03**	0.06***	0.04***
Agriculture	-0.45***	-0.20***	-0.03	-0.12***

Source: Author's calculation. Income is a normalized variable of income per capita; SED, ISD and BMD are defined as above. The number of observations is 744 (24 years, 31 provinces) in every regression.

6.2 The balancing of different types of development

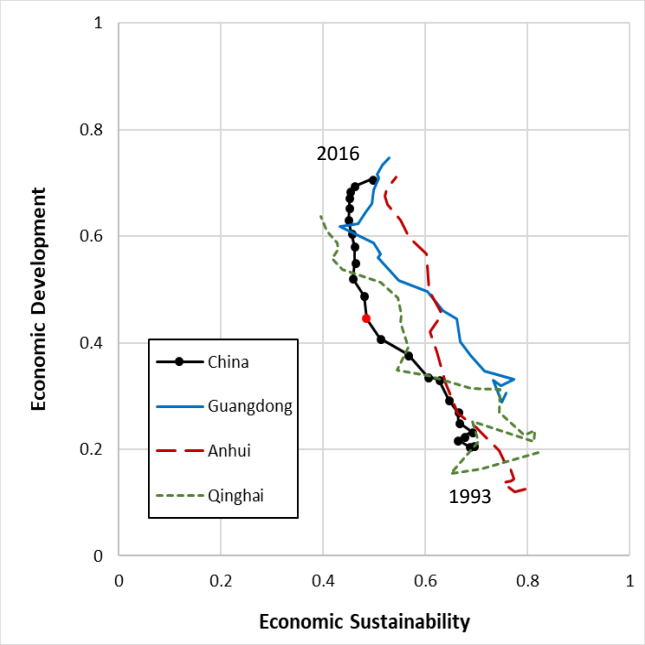
Relatively to the economic sphere, we have 5 unidimensional indicators divided into two separate groups: those related to the strict notion of economic development (Classic Economic Measures, Innovation and Infrastructure Endowments) and those related to the sustainability of the development (Labour Conditions and Environment Protection). The first ones grew steady, while the second ones dropped in a first period, with an uptick in the latest years (Figure 4). Therefore, for large part of the reform era, the economic growth presented a trade-off with its sustainability. This caused a serious worsening in the sustainability index, which in 2016 is still below the average 1993 level. This trade-off lasted approximately until 2005, when the "harmonious society" became a preeminent target. Afterwards, the index of economic sustainability (on aggregate) stopped worsening, while the index of economic development kept improving. The shift in the political agenda of Chinese leadership is not the only possible explanation of this discontinuity: a parabolic relation between pollution and income is well documented in economic development[143].

The relation between economic development and sustainability changes in different provinces. Eastern provinces have higher levels of economic development, but also an initially harsher worsening in the sustainability; however, the reverse in this trade-off relation occurred earlier and more definitely. Inner

[143] Grossman and Krueger (1991) were the first to introduce this concept, which is known as the "Environmental Kuznets Curve". A comprehensive discussion about the Environmental Kuznets Curve is not in the purpose of this thesis, and we limit to suggest this theory as a possible contributing factor.

provinces started from a weaker economic development and postponed the recovery in sustainability to strengthen the strictly economic outcomes. In some of these provinces, especially in the West, the effects of sustainability recovery did not show up yet. Figure 6 shows the pattern of economic development in overall China and in three selected, paradigmatic, provinces[144].

Figure 6: Economic Development vs Economic Sustainability in selected provinces, 1993-2016



Source: Author's calculation. The red dot in the "China" line refers to the year 2005.

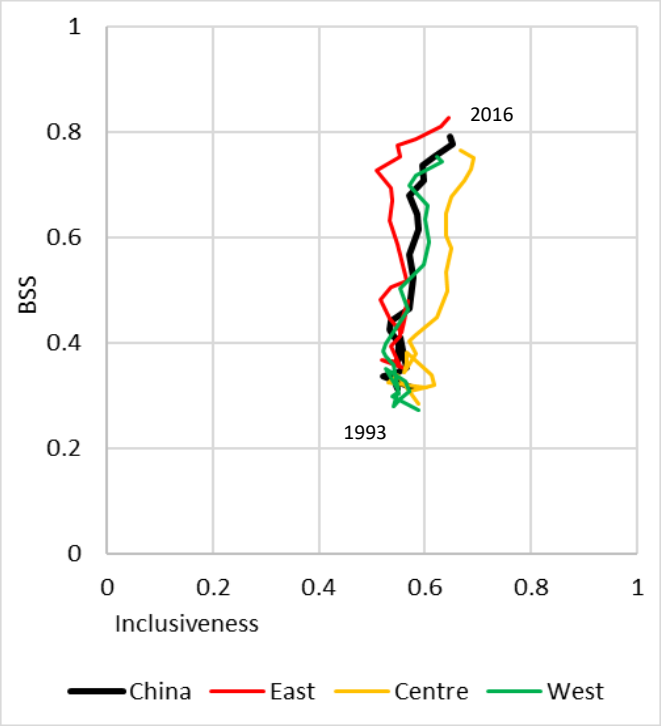
Dealing with the social dimensions, the improvements in the "Access to Basic Social Services" were not accompanied by improvements in the "Inclusiveness of the Society". This unbalanced trajectory is shared by all provinces and involves all the periods observed without major discontinuities.

In Eastern China we observe a lower degree of social inclusiveness (including Guangdong, Beijing and Shanghai, where for many years a major decline in inclusiveness occurred). Indeed, social exclusion in this region was accompanied by a higher capacity of providing social services. Since 2011 the issue of inclusiveness seems to have been tackled more seriously, resulting in a more balanced trajectory. In the central provinces the inclusiveness was stronger, and the provision of basic social services increased rapidly but not enough to catch up with the national average yet. Some positive exceptions are centre-north

[144] Guangdong (East) show a high economic development, associated firstly with strong decrease in sustainability, then with its rapid recovery. Anhui (center) is a case of rapid economic development and moderate worsening in sustainability (until the very latest years). Qinghai (west) is a case of lower economic development, not yet accompanied by sustainability improvements. For clarity reasons only the cases of three provinces with emblematic trends were reported. However, these cases are not sufficient to describe the heterogeneity across Chinese provinces. Two other important cases not reported here are some Manchurian provinces (Heilongjiang, Jilin), where the switch from trade-off to unbalanced patter is accompanied by a loss in economic competitiveness; coastal municipalities (Shanghai, Beijing, Tianjin), where the economic development is much higher than the Chinese average, and a balanced trajectory appears in the latest years.

provinces (Heilongjiang, Jilin, Inner Mongolia), where basic social services are now above the average. Western provinces have an average level of inclusiveness and a low level of social services. Figure 7 shows the pattern of social development in overall China and in its three regions.

Figure 7: Provision of Basic Social Services vs Social Inclusiveness in Chinese regions, 1993-2016



Source: Author's calculation

The SED and the ISD both present a positive pattern, driven by the "Economic Development" and "Access to Basic Social Services" components. Apart from Beijing and Shanghai[145], whose trend is more contrasted, most of the provinces show an increasing trend in SED and ISD.

Each province can be compared with overall China in terms of development levels and development trajectory. Most Western provinces perform worse than the national average – both socially and economically. Remote provinces such as Tibet, Qinghai and Xingjian are generally more disadvantaged in economic terms, and struggle to catch up with China as a whole, although some other western provinces have become less disadvantages since the 1990s. Central and eastern provinces are inhomogeneous groups, containing below-the-average and above-the-average, as well as socially-oriented and economically-oriented provinces. However, in the new millennium the variety of economic achievements between provinces has reduced.

The divide between inner China (backward) and coastal China (advanced) is well documented in the literature about Chinese economic development (Lemoine, Poncet, and Ünal, 2015). Our analysis finds that a similar

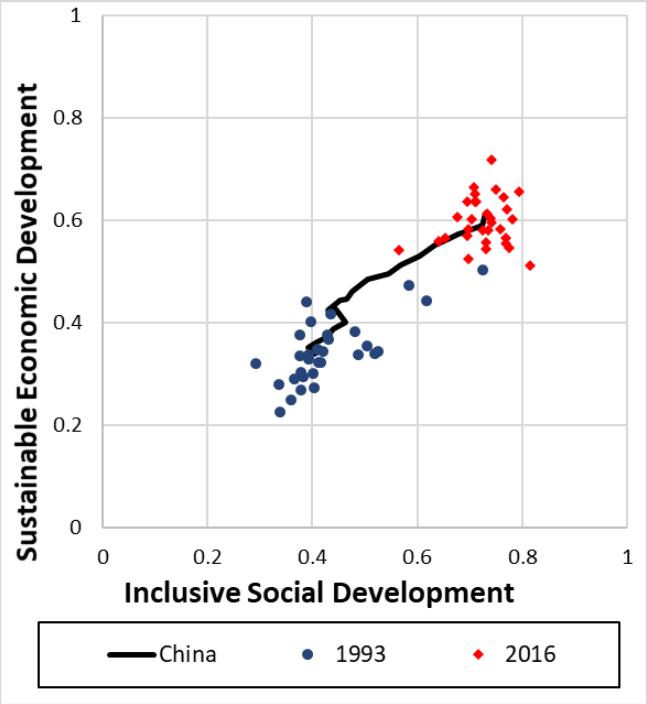
[145] We recall that these two provinces are excluded in the computation of a_j and b_j, making their estimates less accurate.

divide applies to a multidimensional conception of development too. This result is not (only) driven by the classic economic measures. Interestingly, besides the longitude (inner/eastern China), the latitude (northern/southern China) seems to matter too. Focusing on the cases of higher multidimensional development (on average over time BMD higher than national average), we observe that the development of north-east provinces is largely driven by social outcomes, while south-east provinces are more economically oriented. From a political economy perspective, the difference between the Chinese northern and the southern coasts can be explained with reference to the different economic strategies adopted in these areas. The "Guangdong model" (Lo, 2003), applied in the southern coast, is a strategy more adherent to Deng's policy, based on international trade and foreign investments. In the north, and particularly in the Manchurian area, there is a stronger presence of state-owned enterprises, which is a legacy of the cold war (Goodman and Segal, 2002). The differences between these two areas are therefore consistent with their history and economic structure.

Figure 8 shows the pattern of multidimensional development in overall China and the (synergic) shift of the 31 provinces from low to high levels of both SED and ISD. Looking at the dispersion between the blue dots (provinces in 1993) and red rhombus (provinces in 2016), we observe the variation across provinces of economic and social achievements. Such variation has decreased in the observed period in both indexes. Figure 9 divides Chinese provinces into three groups: multidimensionally backward provinces (provincial BMD lower than the national average); social oriented provinces (BMD higher and more ISD-oriented than average); economic oriented provinces (BMD higher and more SED-oriented than average) provinces. The map on the left Figure 9 suggests a net division between these three groups, even if some provinces are closer to intermediate situations, as we can observe in the graph on the right[146]. Annex 1 contains more detailed pictures about the expansion over time of ISD and SED.

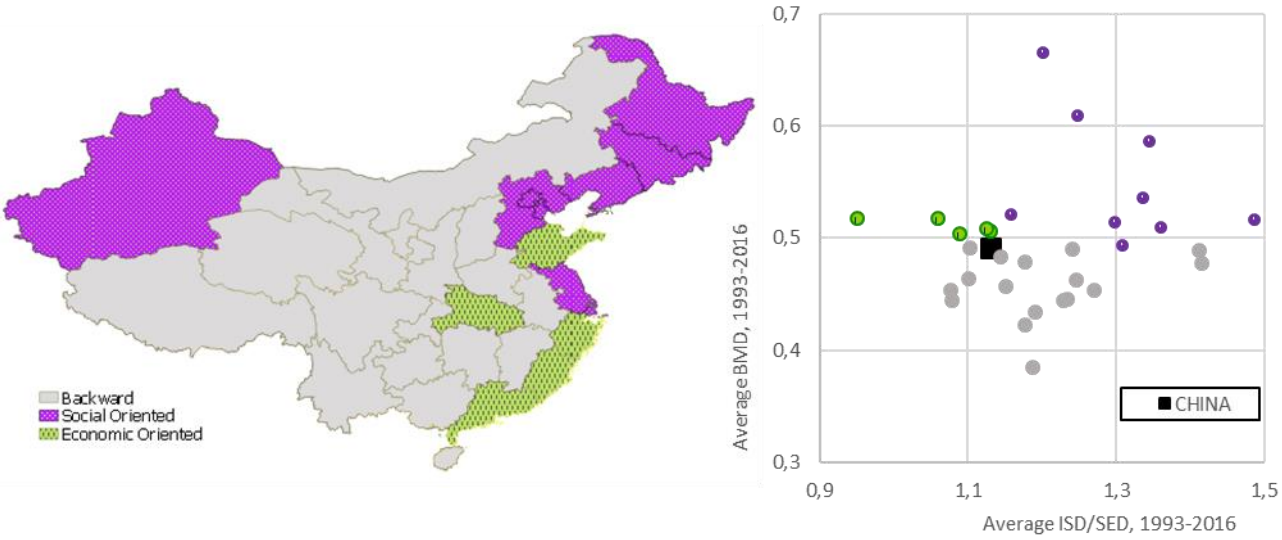
[146] Hainan (south-east China) has a BMD score just below the national average: it is not far away from the group of Economic Oriented provinces. Qinghai and Shanxi (central China) also have an average BMD score slightly below the national average. Hebei (central China) has a BMD score just above the national average. Hubei (central-east China) and Shandong (central China) have a ratio between ISD and SED close to the national average.

Figure 8: SED and ISD in China and 31 provinces, 1993-2016



Source: Author's calculation

Figure 9: Average Achievements of Chinese Provinces over Time, 1993-2016



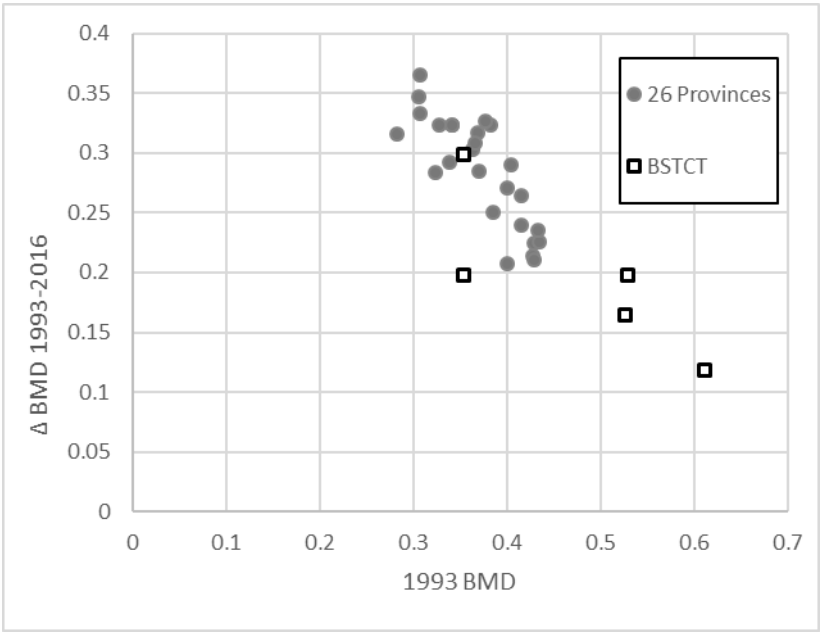
Source: Author's calculations.

6.3 Convergence

A first step in the empirical analysis of convergence is based on the β-convergence hypothesis. Figure 10 shows graphically that poorer provinces (in terms of BMD score in 1993) are also those with the higher BMD

growth. This statement holds both for the "normal" 26 provinces as well as for Tibet and the four direct-controlled municipalities.

Figure 10: relation between BMD in 1993 and the growth of BMD 1993-2016



Source: Author's calculation. BSTCT are the following five "non-comparable" provinces: Beijing, Shanghai, Tianjin, Chongqing, Tibet.

We proceed to test the significance of this convergence with an econometric approach. Selecting the MSI observed in 26 provinces in 1993 and in 2016, we estimate the coefficient γ in the formula (8): a coefficient significantly lower than 1, allows to reject the null hypothesis (the growth of the provincial MSI is unrelated to their initial multidimensional development) and confirm a converging trend.

The convergence among 26 provinces results significant: the coefficient γ is 0.17, significantly below 1[147]. This means that given two provinces, if one of them had a BMD higher of 0.01 in 1993, on average, its advantage will be only 0.0017 in 2016.

This result is robust if we add the remaining five provinces, with an estimated γ equal to 0.29. Moreover, a Chow test[148] shows the results of the two sample (comparable and outlier provinces) can be considered jointly.

Splitting the time interval into two periods, 1993-2005 and 2005-2016, it emerges that the value of γ is not significantly lower than 1 in the second period, but not in the first one. Therefore, according to the β-

[147] The 95% Confidence interval ranges between -0.0763488 and 0.4089421.

[148] The Chow Test compare the results of a regression applied to a sample and to its subgroups through an analysis of their residual sum of squares. It is based on the distribution: $\frac{(RSS_1 - RSS_2)}{(DF_1 - DF_2)} / \frac{RSS_2}{DF_2} \sim F_{DF_1 - DF_2, DF_2}$, where RSS are the residual sums of squares, DF are the degrees of freedom and the subscripts 1 and 2 refers respectively to the regression containing the whole sample (31 provinces in our case) and to the two separate regression of the subsamples (26 and 5 provinces separately in our case). Running this test, we obtain a chow value close to 3, with a p-value equal to 0.066, that does not allow to reject Chow's null hypothesis (i.e. the two samples behave in the same way).

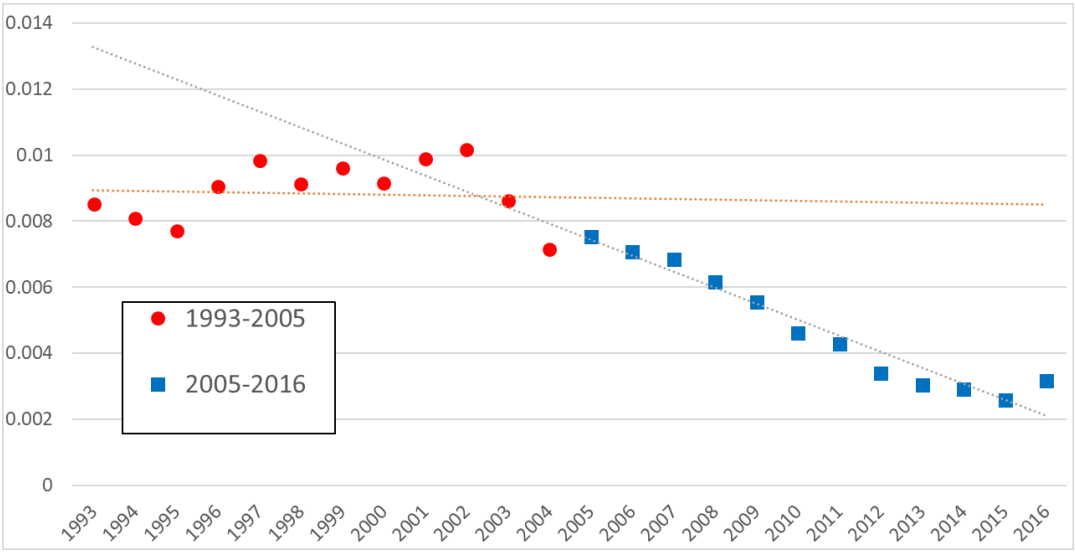
convergence criteria, convergence has occurred in 1993-2016, but in the first half of this period, before the blossoming of the "harmonious society" idea, such convergence was not statistically significant.

Through σ-convergence analysis, we observe that the dispersion between provincial levels of the BMD decreased between 1993 and 2016. This decrease has not been constant nor has occurred in all years. As Figure 11 shows, the dispersion of BMD decreases constantly between 2005 and 2016 (the final year notwithstanding). The trend is more scattered between 1993 and 2005 (a decrease is witnessed for 6 years, and increases take place in the remaining 6 years), although the net result is decreasing dispersion.

To measure the intensity and significance of the reduction of dispersion, we run a regression that explains dispersion over the passing of time. For the whole period, the reduction of dispersion is 0.0003 per year, significant at 5% level. Between 1993 and 2005, the reduction is weaker and no longer statistically significant; whereas between 2005 and 2016 the reduction is stronger (0.0004) and significant.

Considering all the Chinese provinces instead of the subsample of 26 "comparable" provinces, the level of dispersion is always higher; this confirms that the performance of outlier and comparable provinces is different. In terms of σ-convergence, however, the reduction of dispersion is again statistically significant between 1993 and 2016 (with a stronger pace), but is not significant between 1993 and 2005.

Figure 11: Dispersion in BMD achievements across 26 provinces, 1993-2016

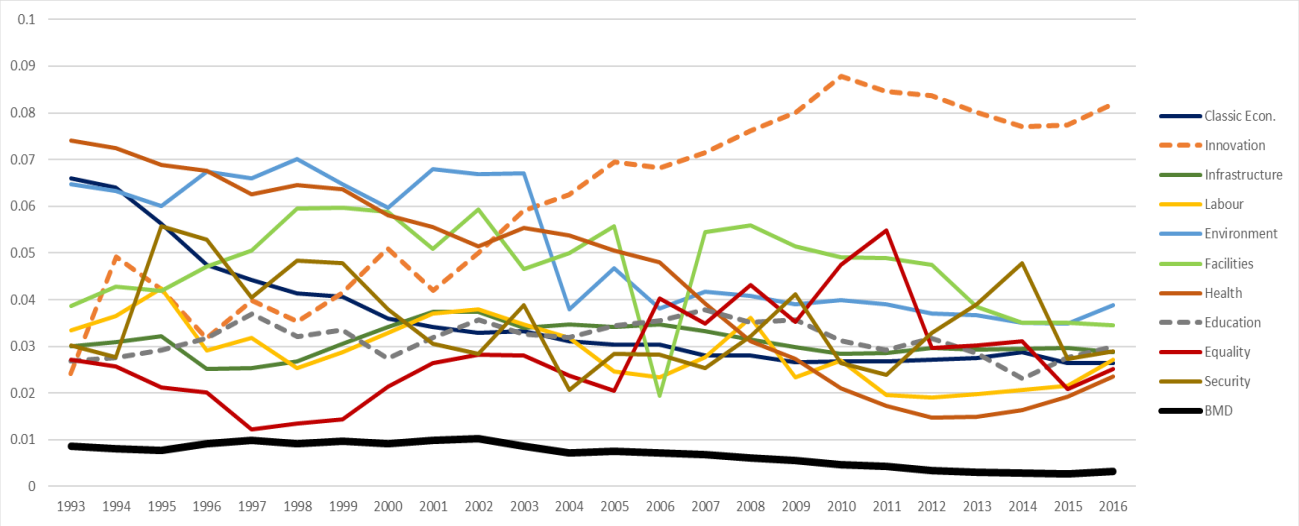


Source: Author's calculation. The dispersion is measured by $\frac{{\sigma_t}^2}{\mu_t \times (1-\mu_t)}$. σ_t is the standard deviation and μ_t is the average in time t.

To investigate what caused this σ-convergence trend, we compute the dispersion for each of the 10 unidimensional indicators across 26 provinces. Most of these dispersions decrease over time. Innovation Capacity and Education are the only dimensions in which the dispersion in 2016 is higher than the dispersion in 1993. A regression that explains these dispersions with the passing of time finds significantly negative

relations (convergence) for Classic Economic Variables, Labour Condition, Environmental Protection and Health. A non-significant trend characterizes Infrastructure Endowment, Urban Services and Security. In contrast, innovation Capacity[149] and Equity both show a significant increase in dispersion over time. Figure 12 reports the dispersion in 26 provinces of all the unidimensional indexes and the Balanced Multidimensional Development Index. It is important to recall that the trends in dispersion only deals with the distribution of the differences recorded over time between provinces, and are not informative whether the development of the dimension is strong, mild or negative[150].

Figure 12: Dispersion in BMD and unidimensional indicators across 26 provinces, 1993-2016



Source: Author's calculation. The dotted lines (innovation and education) represent the indicators that record an increase in dispersion in 1993-2016. The black bold line is the third-level multidimensional indicator (Balanced Multidimensional Development).

In summation, both to the β-convergence and σ-convergence methods points to the existence of convergence. This trend is significant in the aftermath of the promulgation of the harmonious society concept, while in the previous period convergence is not statistically significant. This conclusion is robust independently from the inclusion in the sample of Beijing, Tianjin, Shanghai, Chongqing and Tibet (characterised by more "extreme" behaviours). Moreover, convergence is observed in most of the unidimensional indexes, with the notable exceptions of equality and Innovation.

[149] The divergence of Innovation Capacity is striking and involves all the three variables adopted to calculate this unidimensional index. This fact is particularly worrying because of the crucial role of innovation in triggering overall development (Lin, 2011). Also for Education, another strategical dimension, the level of dispersion in 2016 is higher than in 1993, and the same is true for popularization rate of telephone and highway density, two variables at the basis of the Infrastructure Endowment dimension, which is also crucial for long term development (Démurger, 2001).

[150] As an example, the Environmental Protection indicator is characterized both by a decreasing trend (on average, see Figure 4) and by a converging trend (between provinces). This means there is a convergence toward the bottom, which is clearly not a desired outcome.

7. Conclusions

This study tracks the evolution of Chinese provinces in terms of multidimensional development between 1993 and 2016. Adopting a framework is based on the SHD, SDGs and HS paradigms allowed to construct an index, the Balanced Multidimensional Development Index – BMD, which includes measures of economic and social development. Indeed, this index is based on 34 variables, grouped into ten unidimensional indicators that are in turn aggregated through an MSI-methodology, under the implicit hypothesis of convex preferences. This hypothesis is consistent with the idea that "averages are better than the extremes", especially in the poorer contexts.

The multidimensional approach offers a different picture with respect to the income per capita, traditionally considered as the only relevant interest variables. This novel approach is particularly suited to the Chinese context. Indeed, in the recent decades Chinese central government has prioritized different areas of wellbeing. Economic development has been almost the only target of reformers in a first period, while a more comprehensive development strategy was promoted thereafter, with policies oriented toward equity, environmental protection, and social security.

This chapter points out three main results. First, the BMD exhibits a positive trend, although the growth of this index remains weaker than the rise in GDP per capita. Environmental protection and labor conditions were neglected by the Chinese government before the implementation of the HS, resulting in a major break on multidimensional development. Indeed, the policies supporting economic growth can have weaker and unexpected results in the perspective of multidimensional development.

Second, in terms of synergies, Chinese development has been characterized both by economic and social development. However, trade-offs occurred between economic development and economic sustainability prior to HS. Social development and social inclusiveness are also characterized by an unbalanced trajectory, (in favor of the first index). Moreover, the wellbeing is not equally distributed across provinces: the east is more advanced, especially in economic terms. The capacity to achieve synergic development varies across provinces and regions.

Third, an unequivocally convergence trend amongst Chinese provinces can be observed after 2005 for many wellbeing variables and the BMD index. Prior to this (between 1993 and 2005) the provinces did not converge significantly. β-convergence and σ-convergence analyses both confirm this trend. Focusing on specific dimensions of development, however, does indicate that some aspects of well-being have converged while others have diverged. Some key dimensions - infrastructure, education and innovation – are amongst those

whose convergence has been weakest. In the framework of the Go-West strategy, the Chinese government should thus consolidate the overall converging trend through specific policies in these fields.

These results show that the complexity of Chinese development is not fully captured by focusing on average per capita income across provinces. Indeed, major differences and trends across dimensions emerge for particular provinces. In terms of policy, different priorities can be identified for different territories, as inclusiveness for coastal provinces and sustainable economic development for western provinces. In fact, the heterogeneity of development patterns actively discourages the adoption of "a one size fits all" policy approach.

The change of dominant philosophy (from Deng's "*let some people get rich first*" approach to the HS 'convergence' rhetoric) seems to have affected Chinese multidimensional achievements promoting a more synergic and egalitarian development pattern, consistent with the targets of the central government. Indeed, 2005 is a breaking point in the relation between ED and SE and in the β- and σ-convergence (that reflects when the "harmonious society" first entered China's five-years plan).

However, much remains to be done in terms of harmonious society. On one hand, the development trajectory of China, especially in poorer areas, needs to pay more attention to the economic sustainability issue, in terms of labor and environmental conditions. On the other hand, a redistribution of resources across Chinese provinces with respect to innovation capacity, education and infrastructure is suggested in order to achieve more equal outcomes (and opportunities of further development).

This chapter sheds light on Chinese development using a different perspective from the standard economic literature. Future researches should continue to monitor the multidimensional development of China. Indeed, whether the effects of five-year plans and the One-Belt-One-Road initiative will reinforce convergence and multidimensional poverty reduction across provinces is an open question. Moreover, additional dimensions (for which statistics are not currently available at provincial level), could be included at later dates to create broader and more rounded measures of well-being.

References

Alkire, S., & Foster, J. (2011). Counting and multidimensional poverty measurement. *Journal of public economics*, *95*(7), 476-487.

Alkire, S., & Shen, Y. (2015). Exploring multidimensional poverty in China. *OPHI Working Paper*, l-4.

Arrighi, G. (2007). *Adam Smith in Beijing: Lineages of the twenty-first century*. Verso books.

Barro, R. J., & Sala-i-Martin, X. (1992). Convergence. *Journal of political Economy*, *100*(2), 223-251.

Biggeri, M. (2003). Key factors of recent Chinese provincial economic growth. *Journal of Chinese Economic and Business Studies*, *1*(2), 159-183.

Biggeri, M., & Mauro, V. (2010). Comparing human development patterns across countries: Is it possible to reconcile multidimensional measures and intuitive appeal?. *Dipartimento di Scienze Economiche Working Paper*, (15).

Biggeri, M., & Mauro, V. (2018). Towards a more 'Sustainable'Human Development Index: Integrating the environment and freedom. *Ecological Indicators*, *91*, 220-231.

Biggeri, M., Maggino, F., & Mauro, V. (2018). Analisi del benessere e della povertà multidimensionale nello sviluppo umano sostenibile, Pisa: Pacini editore

Bin, P. (2016). Dynamic Development of Regional Disparity in Mainland China: An Experimental Study Based on a Multidimensional Index. *Sustainability*, *8*(12), 1287.

Bortolotti, L. (2018). La riduzione della povertà multidimensionale in Cina: calcolo dell'MPI nel ventennio 1991-2011. *Analisi del benessere e della povertà multidimensionale nello sviluppo umano sostenibile*, 81-99.

Bourguignon, F., & Chakravarty, S. R. (2003). The measurement of multidimensional poverty. *The Journal of Economic Inequality*, *1*(1), 25-49.

Boussemart, J. P., Leleu, H., & Shen, Z. (2015). Environmental growth convergence among Chinese regions. *China Economic Review*, *34*, 1-18.

Brandt, L., & Holz, C. A. (2006). Spatial price differences in China: Estimates and implications. *Economic development and cultural change*, *55*(1), 43-86.

Brundtland, G. (1987). Our common future: Report of the 1987 World Commission on Environment and Development. *United Nations, Oslo*, *1*, 59.

Cai, F., & Wang, M. (2012). Labour market changes, labour disputes and social cohesion in China.

Chen, J., & Fleisher, B. M. (1996). Regional income inequality and economic growth in China. *Journal of comparative economics*, *22*(2), 141-164.

Cheong, T. S., Li, V. J., & Shi, X. (2018). Regional disparity and convergence of electricity consumption in China: A distribution dynamics approach. *China Economic Review*.

Clark, A. E., & Senik, C. (Eds.). (2014). *Happiness and economic growth: Lessons from developing countries*. Studies of Policy Reform.

Clarke, S., Lee, C. H., & Li, Q. (2004). Collective consultation and industrial relations in China. *British journal of industrial relations*, *42*(2), 235-254.

Cooke, F. L. (2008). The changing dynamics of employment relations in China: An evaluation of the rising level of labour disputes. *Journal of Industrial Relations*, *50*(1), 111-138.

Decancq, K., & Lugo, M. A. (2013). Weights in multidimensional indexes of wellbeing: An overview. *Econometric Reviews*, *32*(1), 7-34.

Démurger, S. (2001). Infrastructure development and economic growth: an explanation for regional disparities in China?. *Journal of Comparative economics*, *29*(1), 95-117.

Easterlin, R. A. (2014). Life Satisfaction in the Transition from Socialism to Capitalism: Europe and China. *Happiness and Economic Growth: Lessons from Developing Countries*, 6-31.

Fang, C., Dewen, W., & Yue, Q. (2009). Flying Geese within Borders: How China Sustains Its Labor-intensive Industries?[J]. *Economic Research Journal*, *9*, 4-14.

Fukuda-Parr, S. (2001). Indicators of human development and human rights--overlaps, differences... and what about the human development index?. *Statistical Journal of the United Nations Economic Commission for Europe*, *18*(2, 3), 239-248.

Giles, J., & Mu, R. (2007). Elderly parent health and the migration decisions of adult children: Evidence from rural China. *Demography*, *44*(2), 265-288.

Goodman, D. S., & Segal, G. (2002). *China deconstructs: Politics, trade and regionalism*. Routledge.

Grossman, G. M., & Krueger, A. B. (1991). *Environmental impacts of a North American free trade agreement* (No. w3914). National Bureau of Economic Research.

Helliwell, J., Layard, R., & Sachs, J. (2012). World Happiness Report. The Earth Institute, Columbia University. *Canadian Institute for Advanced Research*.

Herrerías, M. J., & Monfort, J. O. (2015). Testing stochastic convergence across Chinese provinces, 1952–2008. *Regional Studies*, *49*(4), 485-501.

Hirai, T. (2017). The Human Development Index and Its Evolution. In *The Creation of the Human Development Approach* (pp. 73-121). Palgrave Macmillan, Cham.

Islam, A., & Smyth, R. (2015). Do Fertility Control Policies Affect Health in Old Age? Evidence from China's One-Child Experiment. *Health economics*, *24*(5), 601-616.

Joshi, D. (2012). Does China's recent 'harmonious society' discourse reflect a shift towards human development?. *Journal of Political Ideologies*, *17*(2), 169-187.

Joshua, J. (2017). Economic Policies of Economic Growth and Development. In *China's Economic Growth: Towards Sustainable Economic Development and Social Justice* (pp. 45-80). Palgrave Macmillan, London.

Klugman, J., Rodríguez, F., & Choi, H. J. (2011). The HDI 2010: new controversies, old critiques. *The Journal of Economic Inequality*, *9*(2), 249-288.

Labar, K., & Bresson, F. (2011). A multidimensional analysis of poverty in China from 1991 to 2006. *China Economic Review*, *22*(4), 646-668.

Lemoine, F., Poncet, S., & Ünal, D. (2015). Spatial rebalancing and industrial convergence in China. *China Economic Review*, *34*, 39-63.

Lin, J. Y. (2011). *Demystifying the Chinese economy*. Cambridge University Press.

Li, X. (2016). Measuring Local Corruption in China: a Cautionary Tale. *Journal of Chinese Political Science*, *21*(1), 21-38.

Li, Y., Cheng, H., Beeton, R. J., Sigler, T., & Halog, A. (2016). Sustainability from a Chinese cultural perspective: the implications of harmonious development in environmental management. *Environment, development and sustainability*, *18*(3), 679-696.

Lo, D. (2003). Assessing the Role of Foreign Direct Investment in China's Economic Development: Insights from Sectoral-regional Analyses. Economic Research Journal, 9(004).

Lo, D. (2018). Consideration on China's New Normal Economic Growth. *Journal of China and International Relations*, *6*(1), 73-94.

Maggino, F. (2017). Dealing with Syntheses in a System of Indicators. In *Complexity in Society: From Indicators Construction to their Synthesis* (pp. 115-137). Springer, Cham.

Mauro, V., Biggeri, M., & Maggino, F. (2018). Measuring and monitoring poverty and well-being: A new approach for the synthesis of multidimensionality. *Social Indicators Research*, *135*(1), 75-89.

Mehrotra, S., & Delamonica, E. (2007). *Eliminating human poverty: macroeconomic and social policies for equitable growth* (Vol. 1, No. 84277-84774). Zed Books.

Nicholas, A., Ray, R., & Sinha, K. (2013). *A dynamic multidimensional measure of poverty* (No. 25-13). Monash University, Department of Economics.

Nolan, P. (2004). *China at the Crossroads*. Polity Press.

Noll, H. H. (2004). Social indicators and Quality of Life research: Background, achievements and current trends. In *Advances in sociological knowledge* (pp. 151-181). VS Verlag für Sozialwissenschaften, Wiesbaden.

Nussbaum, M. C. (2011). *Creating capabilities*. Harvard University Press.

Qizilbash M. (2018). "In Defence of Inclusiveness: On Sustainable Human Development, Capability and Indicators of Progress." Cambridge Capability Conference.

Qi, D., & Wu, Y. (2015). A multidimensional child poverty index in China. *Children and Youth Services Review*, *57*, 159-170.

Ngai, P. (2005). *Made in China: Women factory workers in a global workplace*. Duke University Press.

Quah, D. (1993). Galton's fallacy and tests of the convergence hypothesis. *The Scandinavian Journal of Economics*, 427-443.

Ranis, G., & Stewart, F. (2000). Strategies for success in human development. *Journal of human development*, *1*(1), 49-69.

Ranis, G., Stewart, F., & Samman, E. (2006). Human development: Beyond the human development index. *Journal of Human Development*, *7*(3), 323-358.

Seers, D. (1969). The meaning of development. *New Delhi*, *3*.

Sen, A. (1999). Development as freedom.

Shapiro, J. (2001). *Mao's war against nature: Politics and the environment in revolutionary China*. Cambridge University Press.

Shue, V., & Wong, C. (Eds.). (2007). *Paying for progress in China: Public finance, human welfare and changing patterns of inequality*. Routledge.

Stiglitz, J. E., Sen, A., & Fitoussi, J. P. (2009). Measurement of economic performance and social progress. *Online document http://bit. ly/JTwmG. Accessed June*, *26*, 2012.

Streeten, P., Burki, S. J., Haq, U., Hicks, N., & Stewart, F. (1981). First things first: meeting basic human needs in the developing countries.

Su, B., Heshmati, A., Geng, Y., & Yu, X. (2013). A review of the circular economy in China: moving from rhetoric to implementation. *Journal of Cleaner Production*, *42*, 215-227.

Tian, X., Zhang, X., Zhou, Y., & Yu, X. (2016). Regional income inequality in China revisited: A perspective from club convergence. *Economic Modelling*, *56*, 50-58.

Ul Haq, M. (1995). *Reflections on Human Development*. Oxford University Press, New York

UNDP (1990). *Human Development Report 1990*. *Concept and Measurement of Human Development.* Oxford University Press, New York.

UNDP (1996). *Human Development Report 1996*. Oxford University Press, New York.

Wang, Y., & Wang, B. (2016). Multidimensional poverty measure and analysis: a case study from Hechi City, China. *SpringerPlus*, *5*(1), 642.

Wu, J., Wu, Y., Guo, X., & Cheong, T. S. (2016). Convergence of carbon dioxide emissions in Chinese cities: A continuous dynamic distribution approach. *Energy Policy*, *91*, 207-219.

Xue, L., Weng, L., & Yu, H. (2018). Addressing policy challenges in implementing Sustainable Development Goals through an adaptive governance approach: A view from transitional China. *Sustainable Development*, *26*(2), 150-158.

Yang, J., & Mukhopadhaya, P. (2017). Disparities in the level of poverty in China: evidence from China family panel studies 2010. *Social Indicators Research*, *132*(1), 411-450.

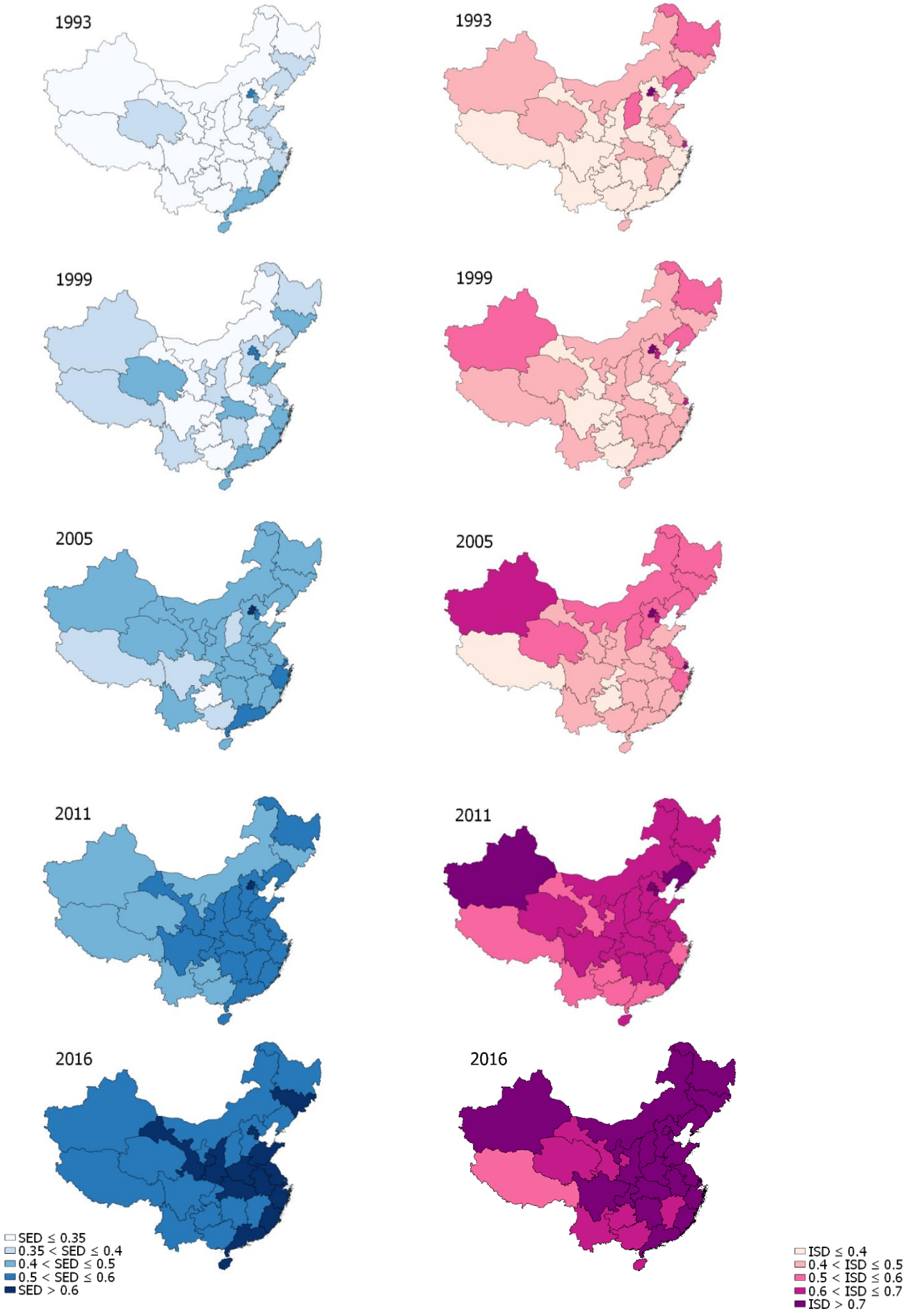
Yip, W., & Hsiao, W. (2009). China's health care reform: A tentative assessment. *China economic review*, *20*(4), 613-619.

Young, A. (2000). The razor's edge: Distortions and incremental reform in the People's Republic of China. *The Quarterly Journal of Economics*, *115*(4), 1091-1135

Yu, J. (2013). Multidimensional poverty in China: Findings based on the CHNS. *Social indicators research*, *112*(2), 315-336.

Zheng, S., Duan, Y., & Ward, M. R. (2019). The effect of broadband internet on divorce in China. *Technological Forecasting and Social Change*, *139*, 99-114.

Annex 1: SED (left) and ISD (right)



Annex 2: Households Structure and Stability

This section briefly describes the achievements of Chinese province in terms of an eleventh unidimensional indicator: Household Composition. This indicator is based on two variables, both of whom are considered negatively related to well-being: the number of divorces per 10000 couples and the number of one-person households over the total sample of the NBS[151].

Along with Environmental Protection, Labor Conditions and Security, the national average level of this indicator decreases over time. With respect to the other indicators, Household Composition is the sphere of well-being that records the most impressive drop. Indeed, in 1993 its level (national average) measures 0.80, while in 2016 it records 0.39. With few exceptions, year after year the indicator always decrease, indicating a constant trend. These values and the trend of this, represented in Figure 13 can be compared with those represented in Figure 4 (p.107).

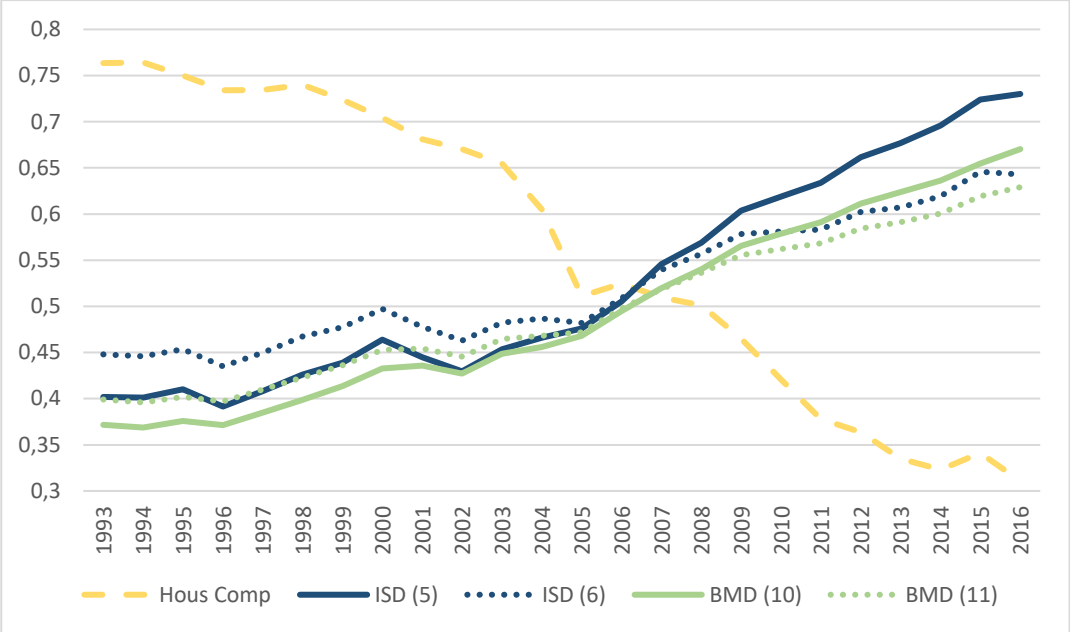
Differently from most of the other indicators, the well-being in the Household Composition dimension is generally lower in the advanced coastal provinces, while it remains higher in the inner part of China. The weakening of family ties, because of growing divorces and growing share of one-person households, seems therefore a price China had to pay for its modernization: wealthier provinces are suffering disproportionately more because of this issue, which is worsening over time.

After integrating the Household Composition dimension in our multidimensional indexes, we can therefore note a worsening in the growth of the average level of well-being, and a reduction in the dispersion across provinces. Figure 13 reports also the trend of the Inclusive Social Development (ISD) and the Balanced Multidimensional Development (BMD) when their underlying indicators are increased to comprehend Household Composition.

In terms of convergence, the Household Composition indicator is not converging toward a similar level of well-being. Its inclusion in the computation of the BMD, however, does not modify significantly the conclusion previously drawn from the analysis of ten indicators. Indeed, the convergence remains significant both through β- and σ-methodologies. Moreover, the study of σ-convergence, confirms that there is an important difference between the period 1993-2005 (the convergence is not statistically significant) and 2005-2016 (the convergence is significant at 1% level). Figure 14 reports graphically the σ-convergence results, and can be compared with Figure 11 (p.116).

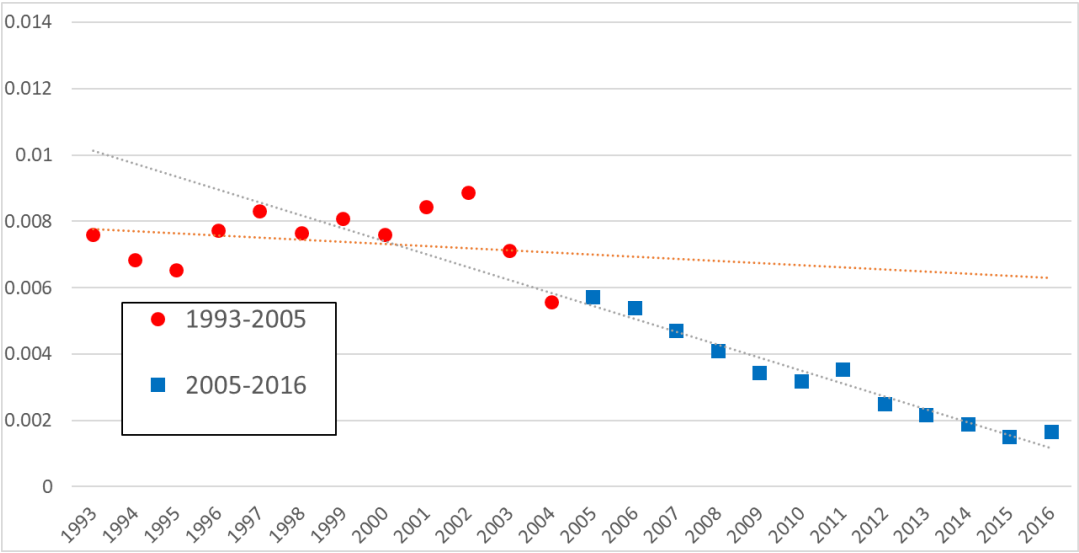
[151] The number of divorces was available for the entire panel (with the exception of Chongqing data in the years 1993-96. The number of One-Person households over the total sample of households was instead available only for the years 1993-94, 1996, 1998-99, 2002-2009, 2010-16; in the remaining years this variable was linearly interpolated.

Figure 13: Correction of the ISD and BMD for Household Composition



Source: Author's elaboration. The line "Hous Comp" represent the trend of the new indicator. The solid lines ISD and BMD are the multidimensional indicators which do not include this dimension (corresponding respectively to Inclusive Social Development with 5 indicators and Balanced Multidimensional Development with ten indicators). The dotted lines correspond to the indicators corrected for Household Composition.

Figure 14: Dispersion in BMD achievements across 26 provinces, 1993-201



Source: Author's calculation. The levels of dispersion and the trend over time can be compared with those in Figure 11 (p.116).

Conclusions

This thesis investigates the development of China since the end of the 20th century. Differently from most of the existing literature, we do not focus on the expansion of income (or considering individually any other variable affected by the Chinese reforms); rather we adopt a multidimensional perspective in an analysis that owes much to the recent debate about composite indexes to measure the well-being. Indeed, the aim of the thesis is to provide a comprehensive picture of the inequalities, the deprivations and the development strategies that characterize China.

The first chapter provides an original contribution in the literature about inequality in China by computing the trend of income, education and nutrition inequality in the period 1989-2011 and decomposing these measures to point out the factors underlying inequalities. Income, education and nutrition inequalities exhibit different trends: while income reports the typical inverted-U trend (with a relatively high level of inequality), education inequality decreases, and health inequality improves. The chapter highlights also the misallocation of government resources in the different spheres of public welfare. Finally, the chapter applies to the outcomes in these three (separated) spheres the distinction between inequality of effort and inequality of opportunity. Indeed, the role of circumstances (i.e. those elements beyond people's control) in creating income, education and nutrition inequality is analyzed over time through a regression-based decomposition of inequality. Inequality of effort results increasingly important in causing income inequality; this fact emphasizes the importance of relaunching the debate about the trade-off between growth and redistribution of income. Dealing with education, the positive results in terms of increasing average schooling and inequality reduction advanced together, while the rural-urban gap remains a nerve of the Chinese education system that policy maker should urgently address. The relation between income, education and nutrition suggests that an integrated approach is likely to be the most effective strategy to tackle inequality in these fields and sustain the development of China.

The second chapter analyzes the multidimensional deprivations. Two techniques are adopted and compared to measure multidimensional poverty and wellbeing: the Multidimensional Poverty Index (MPI) and the Multidimensional Synthesis Indicator (MSI). The chapter enriches theoretically and empirically the literature about the multidimensional measurement of well-being in a twofold way. Firstly, through the computation of the Chinese MPI in the long-run (between 1989 and 2011) and secondly through the introduction of new indexes that summarize the individual satisfaction of fundamental needs on a continuous scale. The analysis of MPI in this time interval shows that multidimensional poverty reduction did occurred but has been weaker than income poverty reduction. Moreover, significant differences exist in the poverty rates across different

geographical areas and social groups, indicating which categories were more affected by deprivation (and consequently should be the priority targets of anti-poverty measures). However, the traditional technique adopted to compute the MPI does not allow to obtain a clear interpersonal comparisons within a household. This issue is addressed with the introduction of several MSI indexes, computed at the individual level, which catch the discrimination of women in China. In this sense, our results suggest the existence of a "sticky floor": the women living in disadvantaged contexts are those reporting the highest gap in multidimensional wellbeing. The policy maker should therefore consider these areas as the main battleground in the fight against gender discrimination. Along with the methodologies traditionally adopted in the literature, we develop here for the first time the Income-Adjusted MSI (IMSI), adopting the theoretical concept of income as a mean to achieve wellbeing rather than an end. The IMSI provides thus an original contribution in the debate about the role of income in multidimensional wellbeing and results a better predictor of subjective wellbeing than the other indexes analyzed. Empirically the IMSI proved to be more precise than MPI and previous MSI specification in catching the self-reported life satisfaction. However, the MPI remains more useful to define sharply a group of multidimensionally poor individuals.

The last chapter applies the MSI indexes at the provincial level for the first time in the economic literature. We build various measures of wellbeing for the Chinese provinces between 1993 and 2016, considering several aspects of development (consistently with the Harmonious Society strategy specifically related to China and with the Sustainable Human Development worldwide recognized). Among these indexes, the "Balanced Multidimensional Development" (BMD) measures development in the more comprehensive way (including ten dimensions) and is therefore adopted to test empirically the effectiveness of the Harmonious Society strategy. Indeed, until now this topic has remained largely unexplored in the empirical economic literature. Various indexes based on different spheres of wellbeing are compared to investigate the capacity of Chinese provinces to achieve a balanced and synergic development. These development trajectories result not homogeneous across provinces and over time. However, government's project of pursuing a "Harmonious Society" seems to have trigger positive outcomes. Indeed, since 2005, the BMD scores points to a converging trend amongst provinces, while the relation between different spheres of wellbeing becomes more synergic. These two positive results should not however overshadow the allometry in the development of specific dimensions (especially in innovation capacity) that emerges in our results. The importance of adopting multidimensional indexes of development is remarked by the fact that the ranking of Chinese provinces changes according to the measure of development adopted, and the factors underlying development change too.

Despite the three chapters adopt different dataset and methods, they share the same purpose of investigating the topic of multidimensional deprivation and inequality in China. The results are consistent in highlighting the different effects of Chinese reforms in the income and in the multidimensional sphere. The thesis generally points to a bettering of Chinese conditions (despite multidimensional indexes grew with a

pace lower than income improvements) that has been achieved also thanks to the efforts of the Chinese central government in pursuing a more balanced and harmonious development strategy.

This thesis also indicates which dimensions and which regions remain more fragile and backward in a multidimensional perspective, providing a possible framework to address anti-poverty policy interventions. Among the main sources of concern, we want to emphasize three issues: the increase in nutrition inequality, the deterioration of the environment and labor conditions, the inequalities across genders and provinces.

The increase in nutrition inequality, described in the first chapter, shows that new challenges are emerging in nowadays China. Indeed, the policy-makers have to start addressing problems typical of the rich societies along with completing the development process started in 1978.

The deterioration of the environment and labor conditions, described in the third chapter, stands out as the main weakness in the development strategy of Chinese provinces. The efforts of policy makers in the creation of a harmonious and prosperous society seem to have contributed in "rebalancing" the Chinese development, but these spheres of wellbeing still deserve special attention.

The inequalities across genders and provinces are a transversal theme in all the chapters and constitute another major weakness of the Chinese development. Rural and western dwellers and women have been disproportionally excluded from the benefits triggered by the reforms (moreover, these characteristics seem to interact and mutually reinforce the disadvantages).

The methodologies and indicators traditionally adopted to evaluate the development of China may have contribute in underestimating the importance of these three issues. As the second chapter shows, multidimensional indexes should be adapted according to the research question and the context of the investigation. Indeed, such adaptation can improve the multidimensional analysis, providing more accurate measures of wellbeing.

This thesis and the tools adopted do not exhaust the research about the multidimensional development of China. On the contrary, new aspects assume relevance in the discourse about Chinese Development and make room for further investigations about the development of emerging economies (and China in particular) in a multidimensional framework.

Moreover, the changes that the Chinese strategy is going to experience in its "New Normal" and the recent measures implemented, as the "One Belt One Road", will affect the development of China in the next years from monetary and non-monetary perspectives. Therefore, the diffusion of multidimensional analyses and the formulation of multidimensional targets could be important to evaluate the trajectory of Chinese development and to address its policies, preventing the repetition of unbalanced development strategies.