Towards a ‘harmonious society’? Multidimensional development and the convergence of Chinese provinces

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Abstract

The paper analyses multidimensional patterns of development across Chinese provinces over the last two decades (1993–2016) from a balanced or 'harmonious society' perspective. The harmonious multidimensional index and other indexes are introduced to explore different development patterns among Chinese provinces. In order to analyse multidimensional convergence amongst the provinces, β- and σ-convergence methods are applied. The results indicate that recent efforts to move towards a "harmonious society" are paying-off, although notable differences across provinces remain and specific domains deserve special consideration.

Keywords: Chinese Provinces; Provincial Multidimensional Development; Convergence; Harmonious society.

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INTRODUCTION

The rise of China is one of the defining events of recent global economic history. China's remarkable economic growth rates have triggered progress in social domains such as health and education. To date, however, this progress has also been characterised by unsustainable features and strong regional disparities.[i]

The great reforms of the 1980's, relaunched by Chinese leader Deng Xiaoping in 1992 during his travel to South-China, paved the way for a gradual economic transition to a market socialist economy enhancing impressive GDP growth (Nolan, 2004; Lin, 2011). However, the undeniable success of these economic reforms was accompanied by increasing pollution, internal migration and greater inequality across households and provinces – amongst other things (Yao and Liu, 1998; Zhao and Tong, 2000; Biggeri, 2003; Biggeri 2007; Herrerías and Monfort, 2015; Chen et al., 2018). In 2005, the new leadership –aware of these economic and social imbalances – officially adopted the goal of pursuing the "Harmonious Society" (HS) (Hu Jintao 2004-2012), which became a core components of Chinese development strategy (Li et al., 2016). Following the HS vision, the Chinese government pursued policies in support of the environment, health, education, energy, demography and other aspects of development. The overall strategy gave priority to balanced regional development with redistribution to sustain the poorest provinces.[ii] Xi Jinping's leadership continues to embrace an inclusive and broad notion of development which is reflected in his "Chinese Dream" project. The latest targets of the reforms, announced in the 13th Five-Year Plan (2016–2020), cover "moderately prosperous" (*Xiaokang*) and "harmonious society" principles (Joshua, 2017; see Appendix 1 for details). Whether provincial disparities are temporary or deeply rooted in the rise of China remains to be seen; nevertheless, caution is surely required in describing Chinese provincial development as "harmonious" – especially from a multidimensional perspective.[iii]

This paper analyses progress towards a "harmonious society" in China from a multidimensional perspective exploring development and convergence across provinces between 1993 and 2016 by introducing the Harmonious Multidimensional Index (HMI) and other sub-indexes.

The existing literature on Chinese provincial multidimensional development and convergence is limited – despite growing and widespread interest in multidimensional poverty and spatial inequality (e.g., Chen & Fleisher, 1996; Yao & Liu, 1998; Herrerías & Monfort, 2015; United Nations Development Programme (UNDP) China, 2016). Chen and Fleisher (1996) were among the first to study the economic convergence of Chinese provinces in the aftermath of the reforms (1978-1993). They observe that convergence in per capita production is conditional on investment, human capital and region (coastal versus interior). Disparities in the inner-coastal gap increased following the reforms, causing a major divide within China. Similarly, Young (2000) concludes that the reforms adopted between 1978 and 1997 caused fragmentation and divergence in prices. Several economists have contributed to this stream of literature, obtaining mixed results depending on the period studied and the methodology adopted (see, for example, Fan and Sun, 2008; Sakamoto and Islam, 2008; Feng et al., 2016; Tian et al., 2016).[iv] Most of these studies are based on either β-convergence or σ-convergence. Besides income, productivity, and prices, convergence studies have investigated carbon emissions (Boussemart et al., 2015; Wu et al., 2016), electricity consumption (Cheong et al., 2018), and infrastructure (Démurger, 2001). These studies reveal that provincial inequality is a multidimensional phenomenon: environmental and infrastructural divides coexist with – and in some cases reinforce – the income divide. Other contributions in the analysis of multidimensional regional inequalities are provided by Fan et al. (2011), who investigates regional disparities in terms of infrastructure, social investment and protection, and governance reform; and Schütz et al. (2017), who investigate the convergence of production factors, technical change, productivity, and distribution. Both these studies show that different types of inequality overlap across provinces. To the best of our knowledge, Bin (2016) is the only study that explores convergence (1998–2010) with respect to a multidimensional index of well-being: the "Composite Index of Regional Development", which aggregates five domains (Macroeconomics; Innovation; Environment; Human

Capital; and Facilities) through principal component analysis pointing to the existence of three provincial groups with weaker provinces lagging behind. None of these studies systematically investigate Chinese provincial development in terms of the HS vision. Indeed, the available literature either adopt a purely theoretical approach (Joshi, 2012; Li et al., 2016), covers a limited group of provinces (Labar and Bresson, 2011; Yu, 2013; Qi and Wu, 2015; Feng et al., 2016; Yang and Mukhopadhaya, 2017) or only includes a limited set of domains (Fan et al., 2011; UNDP China, 2016; Schütz et al., 2017).

This paper contributes to the existing literature on Chinese convergence by: (1) developing the HMI and related indices to track provincial development; (2) formulating procedures to analyse pathways towards the HS; and (3) tracking convergence prior to, and during, the adoption of the HS strategy from a multidimensional perspective.

The HMI and the related sub-indexes are based on the new Multidimensional Synthesis of Indicators (MSI) approach developed by Mauro et al. (2018) which is employed at the regional level for the first time in this paper. A relevant feature of this method of aggregation is that it takes better account of heterogeneity among different components of development than existing aggregation methods based on arithmetic or geometric means (Biggeri and Mauro, 2018). This property, in turn, is essential for adequately capturing patterns harmonious development and disparities across regions and provinces. The multidimensional convergence among provinces is explored, via the HMI, using β- and σ- convergence methods (Quah, 1993).

From a theoretical perspective, the 10 domains chosen to compose the HMI are based on a combination of the main pillars of the HS development strategy, of the Sustainable Human Development (SHD) paradigms and of the Sustainable Development Goals (SDGs) (Agenda 2030). These 10 domains are computed from 36 variables covering all 31 provinces for the period 1993–2016 using official statistics from the Chinese Statistical Bureau.

Development towards the HS is deemed to take place if the following conditions are met:

i. the HMI index increases over time;

ii. the economic and social development indexes and the HS sub-indexes increase in a synergic pattern; and

iii. the HMI of different provinces converge toward similar levels of development.

This third condition constitutes *per se* a contribution to the literature on convergence in China.

The paper is structured as follows. The following section introduces a conceptual framework that underpins the exploration of multidimensional development in China. It considers the selection of relevant domains, present the available data and discusses the construction of unidimensional indicators. Section three introduces the methodology applied. Section four reports provincial multidimensional development and convergence results. Section five presents the main policy implications and concludes. The on-line appendices enrich the results with correlations, regressions and maps.

CONCEPTUALIZING THE HMI

In this section we develop a conceptual framework to define the HMI and select the corresponding domains and variables.[v]

Conceptual Framework

The conceptual framework combines the main pillars of the HS development strategy with the two most prominent approaches to multidimensionality, i.e. the Sustainable Human Development (SHD) paradigm and the Sustainable Development Goals (SDGs) (Agenda 2030) (see Table 1).

From the late 1980s the literature on poverty, inequality and environmental issues began to challenge the economist's exclusive focused on GDP growth as the only or primary "objective of development" (Seers, 1969; Streeten et al. 1981; Brundtland et al., 1987; UNDP, 1990). The United Nations Development Programme (UNDP) showed that the type of growth as well as the extent of growth matters for Human Development (UNDP, 1996). Any development process that increases the severity of poverty, inequality, unemployment, environmental degradation or human conflict needs to be weighed negatively in SHD processes. The UNDP developed a well-known tool – the Human Development Index (HDI) – based on three core domains of development: Health, Education and Living Standard (UNDP, 1990). However, many authors conscious of the limits of the HDI vis-à-vis the broader SHD paradigm (most notably, Sen, 2006), argued for the need to include other domains in a more comprehensive index – including the natural environment and working conditions (Ranis et al., 2006; Hirai, 2017; Biggeri and Mauro, 2018)[vi]. This multidimensional vision of development was reflected in the Millennium Development Goals and later the 2030 Agenda for Sustainable Development and the 17 SDGs which have begun to cover sub-national aspects of development[vii].

In China, the notion of the HS emerged in parallel with the SHD paradigm and the SDGs; the concept itself is firmly embedded in the Confucian tradition (Joshi, 2012). HS was officially introduced in the eleventh five-years plan in 2005 with 2020 as the target date. It represents a departure from previous development strategies on "sustained growth" as it embraces an inclusive and holistic approach to development[viii] that explicitly targets sustainable forms of social and economic development as well as balanced progress across provinces.

The SHD, SDGs, and HS paradigms are theoretically interconnected (e.g. Li et al., 2016: p.689; Qizilbash, 2018). To the best of our knowledge, such theoretical proximity has not resulted in an index that combines the HS concept with the other two paradigms.

The selection of HMI index domains summarised in table 1 take account of the SHD and SDG domains and draw on the HS literature to identify harmonious aspects of development (Joshi, 2012; Li et al 2016; Joshua, 2017, Xi, 2017). The 10 domains selected are the Economy, Innovation, Infrastructure Endowment, Labour Conditions, Environment Protection, Health, Education, Urban Services, Equality, and Household Stability (see Figure 1). Four of these domains (the environment, labour conditions, equality and household stability) are introduced to adjust standard conceptions of economic and social development to produce a more "harmonious" vision of economic and social development. The HMI is constructed through a formal aggregation procedure that attaches equal weight to each domain. The complementarity among domains is captured via a new methodology applied while each domain is computed using different proxies based on reflective aggregation procedure (see next section).

Table 1: The HMI 10 dimensions and their relevance in Chinese and SHD literature

	HS Dimensions selected in this paper	HDI standard	Ranis et al. (2006) HDI enhanced	SDGs	HS Joshi (2012)	Xi Jinping Chinese Dream
1	Economy	X	X	X	X	X
2	Innovation Capacity			X		X
3	Infrastructure Endowment			X	X	X
4	Labour Conditions		X	X	X	X
5	Environmental Protection		X	X	X	X
6	Health	X	X	X		X
7	Education	X	X	X		X
8	Urban Services			X	X	X
9	Equity		X	X	X	X
10	Household Stability		X		X	X

Source: Authors' elaboration. Note that some SDGs (and related targets) only apply to the central government budget/policies and cannot be measured at provincial level. This analysis is therefore not comprehensive of all the aspects touched in the SDGs.

To deepen our understanding of provincial HS evolution, further sub-indexes are introduced. Notice that the 10 domains summarised in table 1 relate to two spheres of the development process: Economic development (ED) and Social development (SD). According to the SHD literature, there are synergies between these two spheres (UNDP, 1996). The ED can provide the resources to permit improvements in SD that, in turn, can generate feedback loops for production (Ranis et al., 2006). The two standard indexes of ED and SD are composed of the Economy, Innovation, and Infrastructure Endowment (ED); and Health, Education and Urban Services (SD) (Biggeri and Mauro, 2010). In addition, two corrected indexes that incorporate 'harmonious adjustments' are considered: the Economic Sustainability (ES) index featuring labour conditions and environmental protection; and the Inclusive Society (IS) index consisting of equity and household stability. To disentangle the economic and social spheres from a HS perspective, the Harmonious Economic Development (HED) and the Harmonious Social Development (HSD) indexes were computed. The HED is based on five of the ten domains listed above: Economy, Innovation, Infrastructure Endowment, Labour Conditions, and Environment Protection (i.e. ED plus ES) whereas the HSD is derived from the other five domains: Health, Education, Urban Services, Equality, and Household Stability (i.e. SD plus IS).

Figure 1

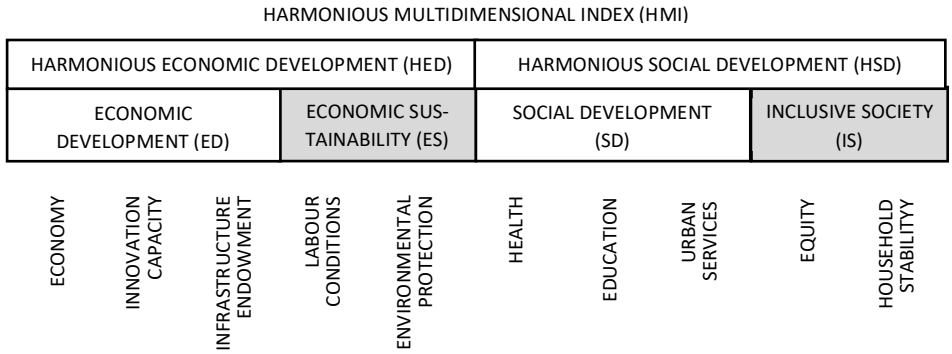

Figure 1. The Harmonious Multidimensional Index. Source: Authors.

Provincial data and unidimensional domains

The choice of variables to measure the 10 domains is based on the existing literature on this topic (Ranis et al., 2006; Biggeri and Mauro, 2010; Sachs et al., 2016; variables included in the SDGs targets, etc.)[ix] and the

availability of official data at provincial level. The data sources employed are the National Bureau of Statistics of China (NBS) online database, the China Statistical Yearbooks, the China Labour Statistical Yearbooks and the China Compendium of Statistics of the NBS.

In total 36 variables were selected to represent the 10 domains (see details in Table A1 at the end of online appendices):

- Economy – income per capita; household consumption in PPP; and investments per capita
- Innovation Capacity – patents accepted per capita; R&D Expenditure per capita; and share of technical market/GDP
- Infrastructure Endowment – highways/km^2; paved roads per capita; power generation per capita; and telephones/mobile phones per capita
- Labour Conditions – unemployment rate; labour share of GDP; and labour disputes per capita
- Environmental Protection – sulphur emission per capita; solid waste per capita; waste water per capita; and environmental emergencies per capita
- Health – hospital beds per capita; medical personnel per capita; and budget expenditure in health per capita
- Education – share of people with primary education; share of people with college or higher education; students/teacher ratio in primary schools; and budget expenditure in education per capita
- Urban Services – floor space; access to water; access to gas; public buses per capita; and green areas per capita
- Equity – 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; and average wage of workers in banking and insurance sector over average wage
- Household Stability – inflation of food prices above the Consumer Price Index[x]; deaths in traffic accidents per capita; divorces per couple; and share of families with a single adult component.

All variables are treated as positive opportunities (those that capture "negative" phenomena, such as emissions per capita, were reversed) and are normalized using the interval [0; 1], where "0" indicates the worst outcome and "1" the best outcome. The correlation matrix, and the trend and distribution of these proxies confirm the soundness of our selection (see Table A3 in the Appendix). Appendix 2 provides further details on standardisation and sources for the 36 variables as well as definitions and details. Any missing data[xi] (5.25 percent) was interpolated.[xii]

The variables are aggregated within the 10 unidimensional domains w_{pdt} (where p represents the province, t the year and d the domain) using an arithmetic mean[xiii] across their normalized values. By design, the indicators w_{pdt} are normalised scores varying in the interval [0; 1] and are thus comparable.

The unidimensional domains for China and the three macro-regions East, Centre and West reported in Table 2 for 1993 and 2016. These domains are generally improving if the 'harmonious adjustment' domains are excluded. The domains with the highest score in 2016 (such as Health), the highest positive difference 2016-1993 (such as Economy) and the highest negative difference 2016-1993 (such as Household Stability) are easily identifiable. A comparison across regions is also feasible. Tables A2 and A3 in the Appendix contain further results and their provincial disaggregation to facilitate a dashboard a7frpproach to policy-making.

Table 2: Unidimensional domains w_{pdt} in 1993 and 2016

Domains	1993				2016			
	China	East	Centre	West	**China**	East	Centre	West
Economy	**0.23**	0.31	0.17	0.17	**0.79**	0.82	0.77	0.76
Innovation Capacity	**0.28**	0.34	0.25	0.23	**0.66**	0.74	0.60	0.59
Infrastructure Endow.	**0.14**	0.21	0.10	0.07	**0.68**	0.73	0.65	0.62
Labour Conditions	**0.74**	0.73	0.78	0.68	**0.45**	0.42	0.48	0.48
Environmental Protection	**0.60**	0.53	0.64	0.66	**0.63**	0.61	0.67	0.61
Urban Services	**0.37**	0.44	0.37	0.30	**0.78**	0.85	0.74	0.70
Health	**0.32**	0.36	0.31	0.28	**0.83**	0.83	0.81	0.86
Education	**0.26**	0.27	0.27	0.24	**0.77**	0.80	0.75	0.71
Equity	**0.54**	0.55	0.55	0.53	**0.70**	0.72	0.69	0.68
Household Stability	**0.74**	0.71	0.78	0.74	**0.38**	0.33	0.43	0.40

Source: Authors' calculation. The Chinese values are calculated as mean between provinces weighted according to the population.

METHODOLOGY: THE HMI AND CONVERGENCE ANALYSIS

HMI

The methodology employed to aggregate the domains into multidimensional indexes is rooted in the MSI approach (Mauro et al, 2018). This methodology has three main properties: strict monotonicity (every increase in any dimension leads to an increase in the aggregate index); continuity (infinitesimal increases in a dimension have infinitesimal effects on the index) and heterogeneity penalization. The latter ensures that the net effect on an aggregate index will be negative if the same quantity is added to a relatively abundant component and subtracted from a relatively scarce component. The magnitude of this "loss" is not defined *a priori* but depends on the data itself: higher penalization is associated with lower and more heterogeneous scores.

The penalization of heterogeneity distinguishes the MSI from traditional aggregation methods. In fact, the arithmetic mean and the counting approach (both widely adopted in measuring multidimensional development and poverty) have been criticized for effectively assuming that different dimensions are perfect substitutes (Mazziota and Pareto, 2016), i.e. success in one domain can compensate for failure in another. The UNDP now prefers to use the geometric mean in computing the HDI to avoid perfect substitution between diverse dimensions. But in contrast to the MSI, the geometric mean tends to collapse to zero whenever the value of any component approaches zero (a risk that increases with the number of domains) (Klugman et al., 2011).

The HMI aggregates the 10 unidimensional domains w_{pdt} as follows:

$$HMI_{pt} = 1 - \left[\frac{1}{10}\sum_{d=1}^{10}\left(1 - w_{pdt}\right)^{1/\overline{w}_{pt}}\right]^{\overline{w}_{pt}} \qquad (1)$$

where $\overline{w}_{pt}$ is the arithmetic mean of the 10 domains d for province p at time t. The penalization of heterogeneity changes across provinces and over time, according to $\overline{w}_{pt}$: the lower $\overline{w}_{pt}$, the higher the

penalization of heterogeneity. Following the HS perspective, provinces with greater balance across components have higher HMI scores, *ceteris paribus*. In other words, provinces that achieve low and unbalanced results are penalised more heavily. Poorer provinces (a lower $\overline{w}_{pt}$) have less means to tackle deprivation in specific well-being domains; it follows that imbalances are more serious in cases where they hit poorer provinces and therefore result in greater loss of multidimensional development. This perspective is consistent with the logic of the HS and allows for a flexible aggregation function.

The indexes ED, ES, SD, IS, HED and HSD, defined in Figure 1, are obtained in the same way.[xiv]

The second condition underlying convergence – a synergic pattern across sub-indexes – indicates that development can only be harmonious if achieving progress in some domains does not occur at expense of other domains. For example, achievements in terms of economics and innovation should not endanger labour conditions and/or the protection of the environment. Potential synergies or trade-offs within and between harmonious economic (HED) and social domains (HSD) are analysed according to which of the following archetypes fits the development patterns tracked in each year:

- "Synergic" or "balanced" (positive or negative) patterns: the values of HED and HSD and their growth rates are similar, approaching the 45-degree bisector;
- "Unbalanced" patterns: the increase in HED is higher (lower) than the increase in HSD, corresponding to an economic-oriented (social-oriented) pattern;
- "Trade-off" patterns: the values of HED increase over time while those of HSD decrease (or vice versa).

Convergence analysis

Analysing convergence for the HMI and sub-indices involves investigating whether different provinces have become more equal between 1993 and 2016, and whether they will eventually reach the same levels of multidimensional development.

β-convergence analysis identifies convergence with a negative relation between the initial level of the variable in question and its growth (e.g. Barro and Sala-i-Martin, 1992; Herrerías and Monfort, 2015). The HMI form of β-convergence is described in the following equation:

$$HMI_{p\ 2016} - HMI_{p\ 1993} = \alpha + \beta HMI_{p\ 1993} + u_p \qquad (2)$$

where $HMI_{p\ 1993}$ ($HMI_{p\ 2016}$) is the relevant variable recorded by province p in the first (last) year observed; and u_p is the error term, with a mean equal to zero and a finite variance. The coefficient β, estimated through a cross-section regression, indicates convergence if $\beta < 0$. If $\beta > 0$ divergence occurs instead. Note that growth is conceived as the absolute difference in HMI levels, not as the growth rate.[xv] Equation (2) can be transformed as follows:

$$HMI_{p\ 2016} = \alpha + \gamma HMI_{p\ 1993} + u_p \qquad (3)$$

where $\gamma = \beta + 1$. The condition $\beta < 0$ implies $\gamma < 1$ and corresponds to convergence, meaning that the multidimensional growth of "richer" provinces is weaker than the multidimensional growth of "poorer" ones.

σ-convergence analysis follows the method of Quah (1993, p. 428): "*Each country eventually becomes as rich as all the others – the cross-section dispersion diminishes over time*". This procedure can adopt different measures of dispersion and can be applied at regional the level (Wu et al., 2016). Considering the bounded nature of the HMI, we apply the following formula to compute the dispersion trend [xvi]:

$$\frac{{\sigma_t}^2}{\mu_t\,(1-\mu_t)} \qquad (4)$$

where σ_t and μ_t are, respectively, the standard deviation and simple mean of the HMI across provinces at year t.

RESULTS AND DISCUSSION

Chinese provincial multidimensional development

HMI results reveal a continuous increase every year for each province between 1993-2016.

Comparing the HMI with the arithmetic mean, we find that the highest penalisation occurs in the early years; the development process then became more balanced, especially in the western and central provinces.[xvii]

Notice that several domains enjoy remarkable growth (economy, innovation capacity, infrastructure endowments, health, education, urban services) while others (labour conditions and environment protection) deteriorate before 2005 and then rally. In addition the equity domain did not improve while household stability deteriorated.

These differences confirm that no single domain (or proxy) can catch the complexity of Chinese development by itself. Moreover, the ED domain exhibits a growth much higher than other domains. The results confirm that HS domains represent major issues for China: Environmental Protection, Labour Conditions, Equity and Household Stability.

The average score (weighted according to provincial population) of the HMI, sub-indexes, and GDP per capita across China are reported in Figure 2. This graph shows that ED (and GDP per capita component), outperform other aspects of development (which is consistent with Deng's emphasis on income growth); ED and SD grow steadily, while ES and IS decline slightly before levelling out.

Figure 2

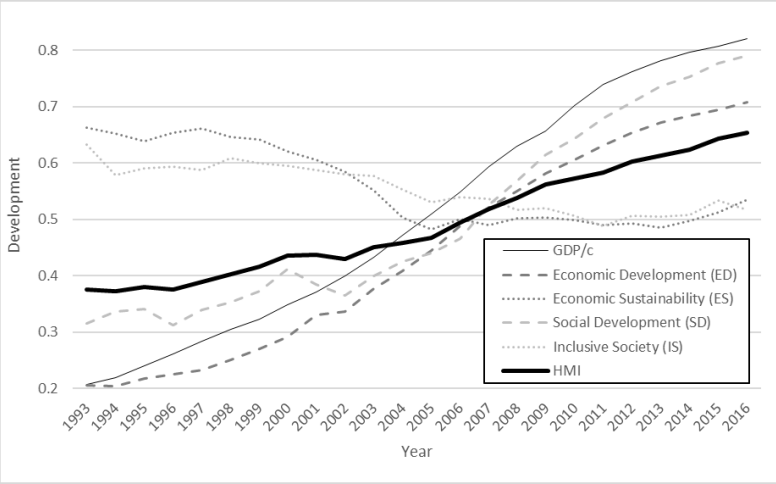

Figure 2. Chinese average Economic and Social Development, 1993-2016. Source: Authors' calculation.

These trends can be broken down by province to capture spatial inequalities. Adopting the traditional division between East, Centre and West regions indicates, as expected, significant differences in the level of the HMI and other sub-indexes (see Table A4 in the online appendix for detailed results). The Eastern region has the best performance in terms of the HMI and HED; it's HSD is also better than average. However, the ES and IS indexes (harmonious adjustments) perform poorly, typically recording scores below the central and western regions. The Western provinces rank in the lowest positions in terms of the HMI and achieve lower than average scores in HED and HSD (this is especially true of remote areas such as Tibet, Qinghai and Xingjian). The Central provinces have intermediate HMI scores and enjoy relatively rapid development in terms of HSD. As far as sustainability and inclusiveness are concerned, the central provinces record scores higher than both western and eastern provinces.

The inner-coastal gap remains prominent – particularly in the ED sphere. The economic literature extensively documents how China's development strategy generated a divide between inner backward regions and the more advanced coast (Yao and Liu, 1998; Zhao and Tong, 2000), and our analysis points to similar results, confirming the necessity of redistribution and place-based policies. In addition to this "longitudinal" inequality (between coastal and inner provinces), "latitudinal" disparities also emerge (Figure 3), distinguishing provinces that have mostly developed in terms of SD (the north) from provinces stronger in ED (the south).

The left panel of Figure 3 shows the economic and social development of all provinces (whose colour becomes darker between 1993 and 2016). The "harmonious adjustments" in the right panel indicate no improvement or some deterioration in terms of Economic Sustainability and Inclusive Society. The result is consistent with the analysis of synergies across sub-indexes (see the next section and Figure 4). Appendix 3 reports the results of an investigation into the relation between different kinds of development and provincial characteristics.

Figure 3

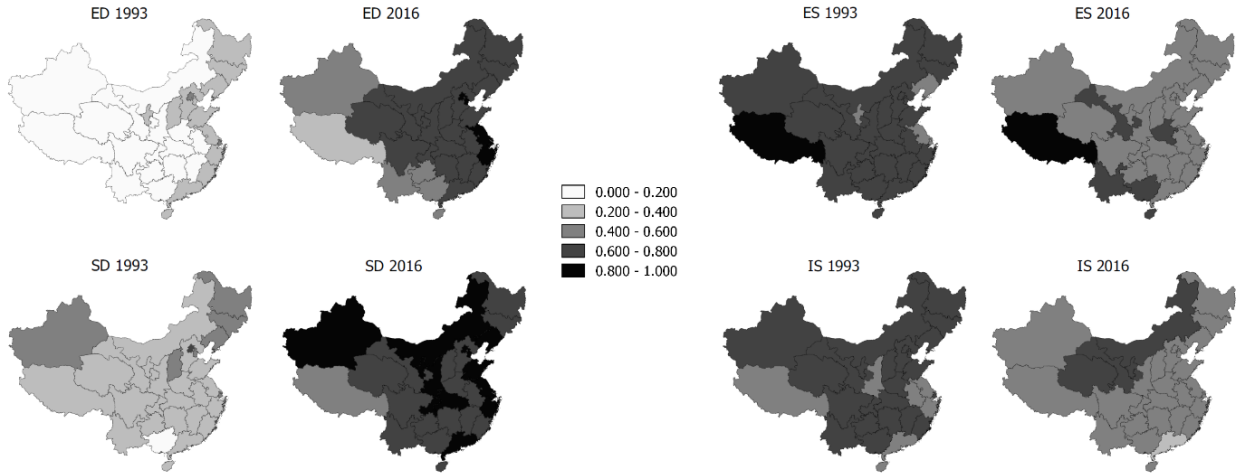

Figure 3. Economic Development, Social Development, Economic Sustainability and Inclusive Society indexes in 1993 and in 2016. Source: Authors' calculations.

Synergies and trade-offs of different provincial development patterns

All 31 provinces have progressed from lower to higher levels of HED and HSD (Figure 4). The relation between HED and HSD describe a synergic pattern: both indexes increase in parallel and this trend becomes particularly marked after 2005. This indicate that Chinese development has become more balanced between economic and social aspects. The variation across provinces indicates the unequal distribution of outcomes.[xviii]

Different patterns are recorded across China, confirming the heterogeneity of Chinese provinces. The north (Inner Mongolia, Xinjiang etc.) is more social-oriented with the HSD largely exceeding HED, while the south (Chongqing, Guangdong) shows a more economic-oriented pattern. These findings are consistent with the literature on Chinese regional development (Goodman and Segal, 2002) and seem to suggest that provinces that benefitted the most from reforms developed economically (south-east), while areas less privileged by the reforms were still able to enjoy some SD.

To investigate further the outcomes of Chinese provincial development and the role of the HS strategy, we can compare ED and SD with their 'harmonious adjustments' – ES and IS as shown in the two bottom panels of Figure 4 (see also the correlations in Table A5 at the end of the online Appendices).

A trade-off pattern emerges between ED and ES: ED in Chinese provinces occurred at the cost of ES, at least in the initial period of our analysis. After 2005 (once the HS became a prominent objective) a discontinuity appears in the economic trajectory involving a shift from a trade-off to an unbalanced pattern of development: ED remains stronger than ES but the latter stops deteriorating (Figure 4, bottom left panel).[xix]

The relation between ED and ES varies across provinces. Richer provinces (e.g., Guangdong, Beijing, Zhejiang) initially had worse results in terms of ES. However, they also managed to reverse this trade-off earlier and more drastically; and they have recently achieved significant labour and environmental outcomes. In contrast, some poor western provinces (e.g., Sichuan, Qinghai) have not shown any sign of recovery in the ES domain yet. This phenomenon could be related to the increase in demand and resources for sustainability triggered by ED.

SD improvements were not accompanied by IS (see Figure 4, bottom right panel). An unbalanced trajectory is typically shared by all provinces over the entire period of the analysis. Some eastern provinces (e.g. Beijing,

Shanghai, Guangdong) record lower and initially decreasing levels of SI. Since 2011 the issue of inclusiveness has been tackled more strongly, triggering a more balanced trajectory. Central provinces outperformed both eastern and western provinces in terms of IS (this suggests IS is not necessarily related to economic growth).

Figure 4

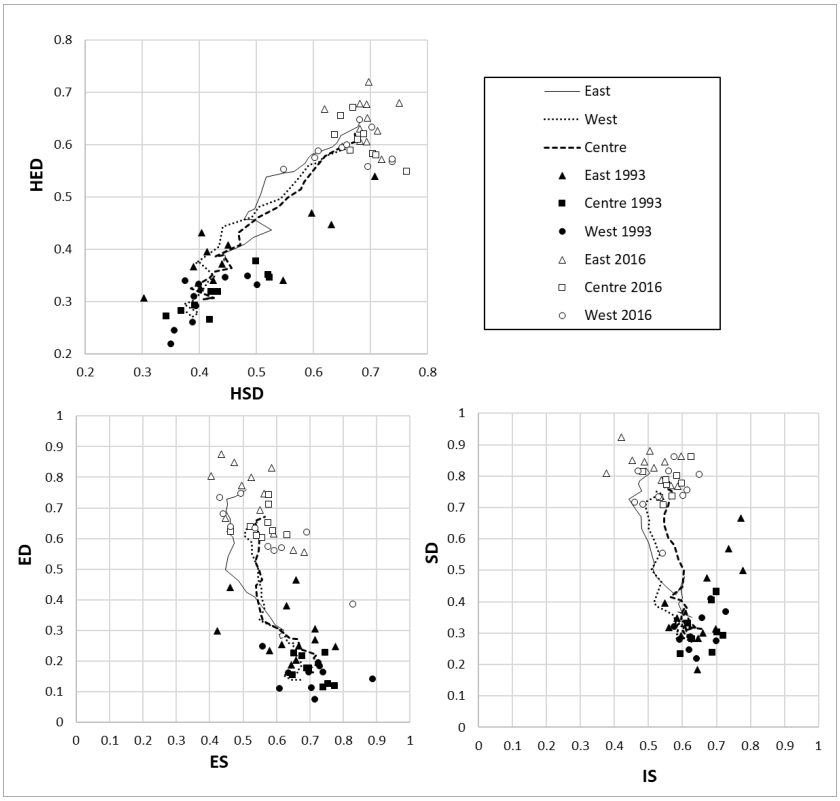

Figure 4. Harmonious Economic Development vs Harmonious Social Development (top left panel); Economic Development vs Economic Sustainability (bottom left); Social Development vs Inclusive Society (bottom right) in three regions.
Source: Author's calculation.

Convergence

The HMI β-convergence results point to a converging trend – especially after 2005 (Figure 5, left). Selecting the HMI observed for each of the 31 Chinese provinces in 1993 and 2016, we estimate the coefficient γ in equation (5). The result, $\gamma = 0.28$, corresponds to a value significantly below 1, so the null hypothesis (ΔHMI_p and $HMI_{p\ 1993}$ are unrelated) can be rejected in favour of convergence. To check the robustness of these findings, we tested and confirmed this result for 26 of the 31 provinces (excluding five "outlier" provinces, i.e., Tibet and the four directly-controlled municipalities).[xx]

Repeating the analysis before and after the adoption of the HS in 2005 shows that convergence was much weaker in the initial period ($\gamma = 0.84$, not significant; below 1 at the 1% level between 1993 and 2005) than the latter period ($\gamma = 0.37$, significant between 2005 and 2016).

Through σ-convergence analysis, we observe that dispersion between provincial levels of the HMI decreased between 1993 and 2016. This decrease has not been constant, nor has it occurred in all years. Figure 5 (right panel) shows the results of the HMI dispersion index over time. To measure the significance of this trend, we run a regression that explains dispersion over the passage of time. For the whole period, the reduction of dispersion is 0.0004 per year, which is significant at the 1% level. Between 1993 and 2005, the reduction is weaker and no longer statistically significant, whereas between 2005 and 2016 the reduction is stronger and

significant. Excluding the five outlier provinces, dispersion is lower (consistently with higher homogeneity across provinces), but its trend remains decreasing and significant between 1993 and 2016 (and between 2005 and 2016, although it is stable between 1995 and 2005).

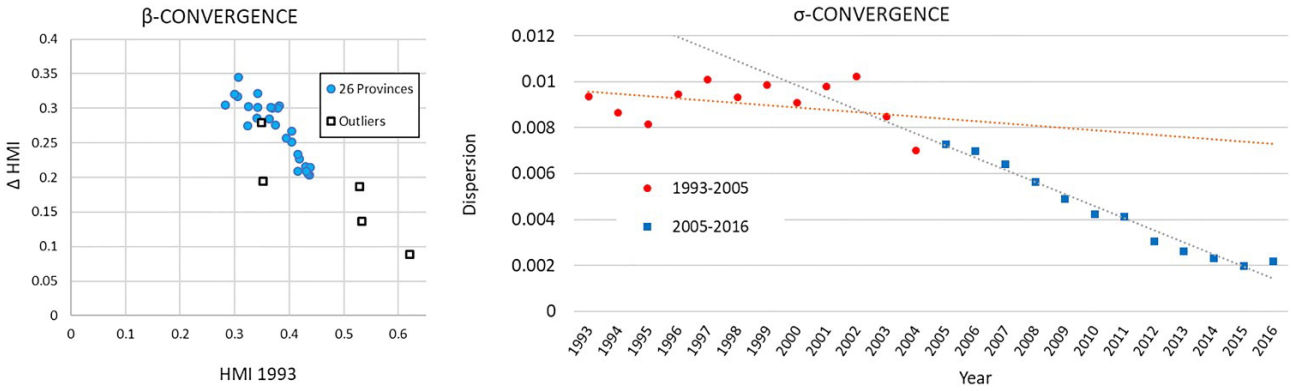

Figure 5. Harmonious multidimensional index (HMI) in 1993 and its absolute growth in 1993–2016 (left); and dispersion in HMI, 1993–2016 (right).

Source: Author's calculation

In order to further investigate σ-convergence, the dispersions for each of the ten unidimensional domains across province were analysed. Most of these dispersions decrease over time, although dispersions for Innovation Capacity, Education and Stability increase (the increase is significant for Innovation, and non-significant for the others). Education, Innovation, and Infrastructures are key engines for Chinese development (Lin, 2011; Démurger, 2001), therefore the lack of convergence in these domains is particularly worrying and may suggest that the government's effort to "Go-West" placate the symptoms of divergence rather than the roots of the problem. Table 3 reports the average level and dispersion of unidimensional indicators as well as HED, HSD, and HMI. This table points to the domains that need specific attention because of their deterioration (labour conditions, household stability) or because of their concentration (innovation, education, household stability).

Table 3. Level and dispersion in domains and multidimensional indexes for China, selected years

	China average[a]			Dispersion across 26 provinces		
	1993	**2005**	**2016**	**1993**	**2005**	**2016**
Economy	0.23	0.50	0.79	0.066	0.030	0.026
Innovation Capacity	0.28	0.39	0.66	0.024	0.070	0.082
Infrastructure Endowment	0.14	0.44	0.68	0.03	0.034	0.029
Labour Conditions	0.74	0.45	0.45	0.033	0.025	0.027
Environment Protection	0.60	0.52	0.63	0.044	0.034	0.029
HED	0.33	0.46	0.63	0.011	0.009	0.006
Urban Services	0.37	0.47	0.78	0.039	0.056	0.034
Health	0.32	0.37	0.83	0.074	0.050	0.024
Education	0.26	0.49	0.77	0.027	0.034	0.030
Equity	0.54	0.51	0.70	0.027	0.021	0.025
Household Stability	0.74	0.56	0.38	0.023	0.025	0.025
HSD	0.42	0.47	0.67	0.014	0.012	0.007
HMI	0.36	0.46	0.67	0.009	0.007	0.002

[a]China average is calculated as the mean between provinces weighted according to the population.

HED: harmonious economic development; HSD: harmonious social development; HMI: harmonious multidimensional index.

Source: Authors' calculation.

To check for robustness, after observing similar convergence across the sub-set of 26 provinces, we investigated evidence of club convergence, conditional convergence, and convergence of (unscaled) variables, obtaining results in line with the evidence considered above.[xxi]

CONCLUSIONS

This study analyses Chinese Provincial Development from a multidimensional perspective with respect to convergence and the concept of a HS over the period 1993–2016. The HMI – based on the MSI method – can adjust standard measures of ED and SD, capture the HS perspective (in conjunction with the other indexes), and account for balance (or lack thereof) across domains.

The results provide new insight into regional multidimensional development in China and its 'adherence' to the HS strategy. It is possible to identify three factors that would make Chinese development harmonious: (1) the growth of the HMI over time; (2) synergies between different sub-indexes of development; and (3) convergence across provinces.

In terms of the first factor, the HMI exhibits a steadily increasing trend between 1993 and 2016. This positive trend applies across provinces, although the results are not equally distributed. The coastal region is the most advanced, especially in terms of ED. However, despite strong ED and SD, the sustainability and inclusiveness of such progress has been weak until relatively recently. Environmental protection and labour conditions deteriorated between 1993 and 2005 (i.e. before HS).

In terms of synergies, the second point, Chinese provincial development has been characterized by both economic and social development. However, prior to HS policies trade-offs occurred between i) economic development and economic sustainability, and ii) social development and social inclusiveness (characterized by an unbalanced trajectory favouring ED and SD rather than ES and IS). Differences in the capacity to achieve synergic development emerge across provinces and the three macro-regions. Since 2005 China has shifted toward a more synergic development pattern.

Concerning the third point, a robust convergence trend of HMI between Chinese provinces can be observed from 2005. Prior to the HS strategy, provinces did not converge significantly (i.e. between 1993 and 2005). β-convergence and σ-convergence analyses both confirm this result. Focusing on specific domains, it is possible to examine which aspects of development have converged and which have diverged (innovation, for example, is concentrated in specific provinces).

The results show that the complexity of Chinese development can be better captured through multidimensional analysis. The change of dominant philosophy (from Deng's "*let some people get rich first*" approach to the HS strategy) seems to have re-orientated Chinese multidimensional development. Efforts towards a "harmonious society" are paying-off, especially in terms of stronger synergies across domains and convergence across provinces.

In terms of policy implications, however, the analysis indicates that the priorities of provinces differ across China, and territorial or place-based policies are needed to create a harmonious society. Three general

implications emerge for central government's policy-makers. First, the development trajectory of China, especially in poorer areas, should give priority to ES in terms of labour and environmental conditions. Second, a redistribution of resources with respect to innovation capacity, education and infrastructure is required to achieve equality across Chinese provinces. Third, in order to adjust the policies according to the HS strategy, Chinese policy-makers need monitor regional development from a multidimensional perspective.

The lack of availability of proxy indicators for the personal liberties domain is one limitation of the present study and indexes. Furthermore, considering the provinces as unit of analysis does not allow one to capture sub-provinces' dynamics.

Future researches could expand these analyses to Chinese county-level data, adapting the HMI to investigate local dynamics. Moreover, given the prominence multidimensional development is obtaining in academia and for practitioners (Frediani et al., 2019; Strohmaier et al., 2019), this methodology can be adapted to other contexts to investigate the (national and local) development of other countries or regions by refining some of the domains.

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NOTES

[i] These unsustainable features have characterized the economic, social and environmental spheres, i.e. all three pillars of sustainability. The provincial disparities are the result of regional natural endowments and institutional reforms that sparked a deep-seated and ongoing transformation of Chinese society while fostering diverse territorial development patterns (Zhao and Tong, 2000; Shue and Wong, 2007; Goodman and Segal, 2002).

[ii] The Chinese provinces are key political and economic actors (since the Tang dynasty, 618–690, 705–907) and increasingly became the core of policy implementation and regional identification (Goodman & Segal, 2002)

[iii] See, for instance, Chen and Fleisher (1996), Yao and Liu (1998), Herrerías and Monfort, (2015) and UNDP China (2016).

[iv] Tian et al. (2016) provides a more comprehensive literature review of income convergence across Chinese provinces.

[v] Different methods for selecting domains can be combined (Frediani et al., 2019).

[vi] Ranis et al. (2006) includes mental well-being, empowerment, political freedom, social relations, community well-being, inequalities, working conditions, leisure conditions, political security, economic security, and environmental conditions as potential additions for a human development index.

[vii] In particular, SDG 1 describe poverty as multidimensional and SDG10 explicitly focuses on within country inequality. A strong emphasis on 'SDGs localisation' emerged in the post-2015 development agenda (UNDG, 2014). These debates have recently been enriched by initiatives facilitated by international organizations such as the OECD, the International Panel on Social Progress, the UNDP ART program and the actions of individual countries. For instance, in 2008 the French government commissioned the 'Sarkosy Report" to investigate the relevance of indicators relating to growth, the quality of life and sustainability. Indeed, following this research the European Commission launched the Index on Social Progress (Stiglitz et al. 2009). A similar project on "Equitable and Sustainable Well-Being" was launched by the Italian government in 2010.

[viii] Joshi (2012) summarizes the HS strategy in terms of (1) a democratic legal system; (2) protection of human rights; (3) narrowing the wealth gap; (4) increasing employment; (5) provision of government and public services; (6) attention to moral standards; (7) public order; (8) environmental protection; and (9) growth of rural incomes.

[ix] The 2030 Agenda and the corresponding SDGs is particularly informative about relevant measures of development. Each of the 17 goals are decomposed into 169 targets and 232 indicators, resulting in a large variety of proxies. However, only few of these variables apply and are available at the Chinese provincial level.

[x] The spatial prices (used to calculate household consumption in purchasing power parity) are based on official provincial CPI data recorded by the NBS using Brandt and Holz's method (2006). These prices vary across provinces.

[xi] Including Chongqing prior to 1997.

[xii] Some data and proxy variables for some sub-domains are not available. These variables fall under the Labour condition (free time, work satisfaction) and human stability (domestic migration) domains. In addition, it was not possible to collect provincial level data for the personal liberties domain (including variables such as political freedom, human rights and homicide rate), which could not be included in our analysis.

[xiii] A reflective synthesis is built over variables relating to similar phenomena that are strongly correlated with each other and are therefore interchangeable (Maggino, 2017). Conversely, the MSI methodology is preferred for less correlated components (formative synthesis, as for HMI, HED and HSD).

[xiv] In HED and HSD $d = 5$; in ED and SD $d = 3$; in ES and IS $d = 2$. All these indexes, including the HMI, are directly calculated on the respective domains to avoid duplicate penalisation and allowing for comparability.

[xv] The growth rate would be inappropriate to capture the evolution of an index ranging [0; 1].

[xvi] The most notable measures of dispersion are the standard deviation (σ_t) and the coefficient of variation (σ_t/μ_t where μ_t is the average value in year t). Because of the bounded nature of the HMI and recalling the beta distribution, we chose a different measure of dispersion. As σ_t does not increase linearly with μ_t, relying on the coefficient of variation would be misleading. However, σ_t increases when $\mu \cong 0.5$, but must be $\sigma_t = 0$ when $\mu = 0$ or when $\mu = 1$.

[xvii] Average penalization relating to outcomes heterogeneity is 12% in 1993 and 3% in 2016.

[xviii] The 2016 dispersion is lower than 1993 dispersion, suggesting convergence in HMI.

[xix] The introduction of the HS approach as a political goal is not the only plausible explanation of the change in development pattern: the existence of an inverted-U relation between pollution and income could be an alternative – or additional – explanation. Grossman and Krueger (1991) were the first to introduce this concept, which is known as the "environmental Kuznets curve".

[xx] The four directly-controlled municipalities are: Beijing, Tianjin, Shanghai, and Chongqing (the latter became independent from Sichuan in 1997); their different characteristics in terms of population density, urbanization, and infrastructure hamper their comparability with the other provinces. The autonomous region of Tibet is also set aside for the purposes of comparisons because of its small population sample. In the literature on convergence, these provinces

have been excluded from analysis for similar reasons (e.g. Démurger, 2001; Boussemart et al., 2015; Herrerías and Monfort, 2015).

[xxi] β-convergence appears within the east and centre regions (but not in the west). Controlling for State Owned Enterprises, international trade and investments, β- (conditional) convergence remains significant. Most of the variables (24/36) significantly converge and the remaining ones (largely belonging to non-converging unidimensional domains) are either divergent (12 variables) or stable (1 variable). The results of these tests are available upon request.