the review of income and wealth

Review of Income and Wealth 2015
DOI: 10.1111/roiw.12214

MOBILITY IN CHINA

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The evidence on rank and income mobility in China reveals an important change around the year 2000. Using panel data from the China Health and Nutrition Survey we show that rank mobility fell markedly from the decade immediately preceding the millennium to the decade immediately following: in this respect China is becoming noticeably more rigid. By contrast income mobility has carried on increasing; so has income inequality. The simultaneous increase in rigidity and inequality presents China with a challenging policy problem.

JEL Codes: D63

Keywords: income distribution, mobility measurement

1. Introduction

The extent and nature of income mobility in China has been of considerable interest to economists. It is seen as an integral part of the remarkable period of transformation and growth experienced by China from the late twentieth century onwards; it is seen by some as a possible opposing force to the rapid increase in inequality that has accompanied the rapid growth in incomes. Here we look at the evidence on mobility over different time spans and present the results from a particularly valuable data source that allows us to contrast developments in the dynamics of income immediately before and after the millennium. The results—focusing on both rank mobility and income mobility—contain some surprises.

It is well known that income distribution in China has changed dramatically in recent times. During the period 1989–2011 real per-capita rural income grew to 3½ times its 1989 value; urban incomes grew fivefold; inequality increased

Note: The research reported here uses data from the China Health and Nutrition Survey (CHNS). We thank the National Institute of Nutrition and Food Safety, China Center for Disease Control and Prevention, Carolina Population Center, the University of North Carolina at Chapel Hill, the NIH (R01-HD30880, DK056350, and R01-HD38700) and the Fogarty International Center, NIH for financial support for the CHNS data collection and analysis files from 1989 to 2006 and both parties plus the China-Japan Friendship Hospital, Ministry of Health for support for CHNS 2009 and future surveys. We thank Dirk Van de gaer, Philippe Van Kerm, participants at the China Meeting of the Econometric Society, and the referees of this Review for helpful comments. Chen wishes to acknowledge partial financial support from the Social Science Foundation of Ministry of Education of China (Project No. 11YJC790023).

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enormously (Wu and Perloff, 2005; Ravallion and Chen, 2007, and Chen *et al*., 2010). However, analysing the dynamics of distribution presents a challenge because there is no nationally representative long-run annual panel dataset for incomes in China,[1] although work has been done on short-run mobility using data for specific subsets of the population.[2] Mobility is higher in rural areas of China, where income inequality is also higher (Sun *et al*., 2007), and general mobility appears high relative to other countries: for example Khor and Pencavel (2006) finds greater income mobility in urban China than in the USA—see also Nichols (2010). It has been argued that, because of the pattern of income mobility, the inequality of current income overstates long-run inequality—in some sense high income mobility "counteracts" rising income inequality (Wang, 2005). Although some authors claim that short-run income mobility in China has been increasing (Nichols, 2010), others claim that, after a sustained increase in the 1990s, mobility may have stabilised towards the end of the millennium (Yin *et al*., 2006; Sun *et al*., 2007; Ding and Wang, 2008) and that the rise in inequality may have been accompanied by a rise in inequality of opportunity (Zhang and Eriksson, 2010).

We throw new light on the relationship between mobility and inequality over the period 1989–2011 and highlight an important change that has occurred in China that has not previously been discussed. The paper is organised as follows: Section 2 introduces the data and Section 3 describes the analytical tools that we will use; Sections 4 and 5 present our mobility estimates using the tools from section 3, and Section 6 concludes.

2. The Data

This paper uses the China Health and Nutrition Survey (CHNS).[3] As its name suggests, this survey is designed to track the effects of the health, nutrition, and family planning policies and programs implemented by national and local governments. However, the survey also collects information on households' economic circumstances and this has been used in a number of studies to provide evidence on mobility in China (Wang, 2005; Ding and Wang, 2008).

Over two decades the CHNS has been carried out periodically in nine Chinese provinces: Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong. For the present study we had available the survey waves for 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. The basic unit of analysis here is the household: apart from immediate family a household may contain members of the extended family, including relations by marriage and others not related to the household head. From time to time, new households and communities are added.[4] For further details on the survey, sample statistics and an overview of attrition from the sample see sections A.1 to A.3 in the Appendix.

[1]For an overview of some of the issues of mobility in China see Fields and Zhang (2007).

[2]For example, mobility in rural China is examined in Shi, Nuetah, and Xin (2010), Shi, Liu, Nuetah, and Xin (2010) and in Zhang *et al*. (2007), while Khor and Pencavel (2006) and Yin *et al*. (2006) focus on urban China. Intergenerational mobility is discussed in Bian (2002), Guo and Min (2008) and Gong *et al*. (2012).

[3]http://www.cpc.unc.edu/projects/china

[4]Not all provinces are available in all waves and three additional provinces were added in the 2011 wave—see the Appendix for details.

Although the focus is principally on health and nutrition, data on income are routinely collected. The income concept used in this study is equivalised total household income valued in terms of 2011 Yuan. Total household income is the sum of all sources of income and revenue minus expenditures incurred in generating that income; nine sources of income are identified in the questionnaires: business, farming, fishing, gardening, livestock, non-retirement wages, retirement income, subsidies, and other income.[5] To equivalise incomes we use the widely accepted square-root form of the Buhmann *et al*. (1988) scale.

3. Mobility Measurement

3.1. *Approaches to Mobility*

Mobility can be interpreted in a variety of ways: as simple income variability, as an extension of familiar ordering principles for income distributions (Dardanoni, 1993) or as an aspect of multiperiod welfare (Gottschalk and Spolaore, 2002). Some approaches use explicit decomposition into mobility components such as exchange and structural mobility (Van Kerm, 2004; Tsui, 2009).

Here we adopt a unified approach that covers the principal economic interpretations of mobility. Let us assume that there is agreement on the concept of income and of the household (income receiver). Then we may distinguish two principal ways of capturing the mobility of households between points in time. Each can be thought of as a way of aggregating information about changes in household status from over time: they differ only in the interpretation of "status". *Income mobility* involves tracking the income-movements of households through time: here status is income. By contrast *rank mobility* involves tracking changes in households' position in the income distribution over the period or periods concerned: here status is ordinal rank. We will be concerned with both forms of mobility.

In our approach we focus only on single-period mobility although we do allow for periods of differing length.[6] Each period can be thought of as a time interval $[t_0, t_1]$. We use a variety of forms of summarizing the status movements over the period, as explained in the next two subsections.

3.2. *Transition Matrices*

First, we will describe our standard tool for presenting information about rank mobility. Let the set of all possible status values be S; if we define a household's *status* as its rank in the distribution then $S = [0, 1]$.[7] Let us define subsets S_1, . . . , $S_K \subset S$ such that $\cup_{k=1}^{K} S_k = S$ and $S_k \cap S_{k'} = \varnothing$. Let $n_{k\ell}$ be the number of households that are in S_k at time t_0 and in S_ℓ at time t_1. The transition matrix P is the $K \times K$ array with typical element

[5]Because expenditures are deducted some households' measured total income is negative. Where a component is missing, CHNS attempts to impute an appropriate value.

[6]Although multiple-period mobility indices are available they are difficult to interpret where the length of the periods varies (as in CHNS) and so we have not used them here.

[7]One can use a similar approach for the case of income mobility; in this case S would be some subset of the real line.

$$p_{k\ell} := \frac{n_{k\ell}}{\sum_{j=1}^{K} n_{kj}}.$$

A convenient summary statistic to capture mobility the mobility implied by P is:

$$m(P) := \frac{K - \sum_{k=1}^{k} p_{kk}}{K-1} \tag{1}$$

—see Prais (1955), Shorrocks (1978), Trede (1999), and Formby *et al.* (2004).

The transition matrix is a convenient way of providing a simple snapshot of rank-movements in the sample. But one has to admit that it is a crude aggregation in the same sort of way that a histogram provides a rather crude snapshot of an income distribution. For this reason it is useful to employ indices that take into account more of the information available in the income history of households.

3.3. *Mobility Indices*

Denote the status of household i at the beginning and at the end of a given period by u_i and v_i respectively, where $u_i, v_i \in S$ and $S = [0, 1]$ in the case of rank mobility, $S = \mathbb{R}_+$ for income mobility. In an n-household society all the information about mobility for a given definition of status is contained in the mobility profile $\{(u_i, v_i)_{i=1,\ldots,n}\}$. We need a set of tools that will aggregate the information in any such profile in a way that appropriately characterizes income mobility within an n-household society.

Using a set of basic axioms on mobility orderings[8] over the set of all possible profiles, Cowell and Flachaire (2011) derive the following class of mobility measures:

$$M_\alpha := \frac{1}{\alpha[\alpha-1]n} \sum_{i=1}^{n} \left[\left[\frac{u_i}{\mu_u} \right]^\alpha \left[\frac{v_i}{\mu_v} \right]^{1-\alpha} - 1 \right], \alpha \in \mathbb{R}, \alpha \neq 0, 1 \tag{2}$$

where μ_u, μ_v are the means of the u and v values respectively and α is a sensitivity parameter that characterizes any particular member of the class. A high positive α produces an index that is particularly sensitive to downward movements and a negative α produces an index that is sensitive to upward movements. We have the following limiting forms for the cases $\alpha = 0$ and $\alpha = 1$, respectively

$$M_0 = -\frac{1}{n} \sum_{i=1}^{n} \frac{v_i}{\mu_v} \log\left(\frac{u_i}{\mu_u} \Big/ \frac{v_i}{\mu_v} \right), \tag{3}$$

[8]The key assumptions here are that mobility rankings should have an independence property that ensures subgroup decomposability (this is particularly important if one needs to ensure consistency under disaggregation by provinces, for example) and that mobility rankings should be invariant under scale transformations of the mobility profile (so that, for example, mobility comparisons based on position do not depend on whether one uses absolute numbers below/above a given household or the proportion of the sample below/above a given household).

TABLE 1
Decade Rank Transition Matrices

		2000						2011				
		1	*2*	*3*	*4*	*5*		*1*	*2*	*3*	*4*	*5*
1989	*1*	**0.29**‡	0.23	0.21	0.15	0.12	**2000**	**0.34**‡	0.26	0.18	0.13	0.08
	2	0.25	**0.25**	0.21	0.17	0.12		0.24	**0.25**	0.23	0.16	0.13
	3	0.18	0.23	**0.21**	0.23	0.15		0.18	0.23	**0.22**	0.2	0.17
	4	0.14	0.15	0.21	**0.22**‡	0.27		0.13	0.14	0.22	**0.27**‡	0.24
	5	0.13	0.14	0.16	0.22	**0.34**		0.11	0.13	0.15	0.24	**0.37**
		$m(P) = 0.9225$ [0.9107, 0.9343]						$m(P) = 0.8875$ [0.8748, 0.9002]				

Notes: ‡: significant change in transition probability at 1% level. Numbers in [ ] are 99%-confidence interval of estimate.

$$M_1 = \frac{1}{n}\sum_{i=1}^{n}\frac{u_i}{\mu_u}\log\left(\frac{u_i}{\mu_u}\Big/\frac{v_i}{\mu_v}\right). \tag{4}$$

In fact equations (2)–(4) represent a class of classes—a "superclass"—of mobility indices, since each M_α is defined for an arbitrary definition of status and, for any given data set we can extract more than one status concept. In sections 4 and 5 we will apply M_α to the two principal status concepts that are of economic interest: rank and income.

4. Rank Mobility

We now use these tools to set about comparing the mobility history of the 1990s with that of the 2000s. We begin by concentrating only on rank mobility. Here household i's status at date t is given by its position in the distribution:

$$s_i = F_t(y_{it}), \tag{5}$$

where $F_t(\bullet)$ is the distribution function at date t and y_{it} is household i's income at t; we estimate F_t using the empirical distribution function.

4.1. *Mobility Pre/Post Millennium—A First Look*

Table 1 presents our "decade" transition matrices pre and post millennium (1989/2000 and 2000/2011). Groupings 1, . . . ,5 are equal-sized 20 percent slices of the distribution at the beginning and the end of each period.[9] The diagonal elements in Table 1 (highlighted in bold) tell a clear story: we can see that rank mobility appears to have fallen from the pre-millennium to the post-millennium decade. If a household were in the bottom 20 percent in 1989 then the probability that it would still be in the bottom 20 percent a decade later was 29 percent; but if

[9]Note that Table 1 excludes Heilongjiang which was only incorporated into the CHNS survey in 2000. See section 4.2 for a discussion of how the results are affected by including this province.

TABLE 2
MOBILITY PRE/POST MILLENNIUM: COASTAL PROVINCES

		2000					*Rural*		2011				
		1	*2*	*3*	*4*	*5*			*1*	*2*	*3*	*4*	*5*
	1	**0.31**	0.19	0.19	0.20	0.10		*1*	**0.32**	0.22	0.24	0.12	0.10
1989	*2*	0.29	**0.23**	0.20	0.19	0.09	**2000**	*2*	0.17	**0.28**	0.25	0.16	0.14
	3	0.17	0.21	**0.23**	0.20	0.18		*3*	0.26	0.19	**0.21**	0.17	0.17
	4	0.13	0.23	0.17	**0.19**	0.28		*4*	0.14	0.20	0.17	**0.26**	0.24
	5	0.10	0.13	0.19	0.23	**0.35**		*5*	0.11	0.12	0.14	0.28	**0.35**
		2000					*Urban*		**2011**				
		1	*2*	*3*	*4*	*5*			*1*	*2*	*3*	*4*	*5*
	1	**0.42**	0.19	0.22	0.06	0.08		*1*	**0.45**	0.25	0.15	0.08	0.08
1989	*2*	0.14	**0.16**	0.24	0.27	0.19	**2000**	*2*	0.20	**0.35**	0.18	0.20	0.08
	3	0.11	0.22	**0.22**	0.27	0.19		*3*	0.20	0.13	**0.28**	0.23	0.18
	4	0.22	0.19	0.22	**0.16**	0.22		*4*	0.10	0.15	0.23	**0.30**	0.23
	5	0.11	0.24	0.11	0.22	**0.32**		*5*	0.05	0.10	0.18	0.20	**0.45**

a household were in the bottom 20 percent in 2000 then the probability that it would still be in the same group a decade later had risen to more than one third. The summary statistic $m(P)$ also shows a reduction in mobility, significant at the one percent level.

Furthermore, these conclusions are supported if we look at a more detailed breakdown of the sample into rural and urban subsamples—see Table A.4 in the Appendix—which throw some further light on the detail of Table 1. First, there is greater mobility for rural households in comparison with urban households, both before and after the millennium. Second, the decline in mobility pre- to post-millennium is evident if we take rural households or urban households separately. Third the detailed change in mobility is different between rural and urban households (there is a significant fall in mobility for those in the fourth group of rural households and a significant fall in mobility for those in the third group of urban households); but they have one thing strikingly in common, the highly significant fall in mobility for the bottom group. This reduction in the mobility prospects of poor households after the millennium applies strongly to both sections of Chinese society.

It is also interesting to see *where* the change in mobility seems to have occurred. Let us divide the provinces up into two regions, Coastal (Liaoning, Shandong, and Jiangsu) and Inland region (Guangxi, Guizhou, Hubei, Hunan, and Henan). From Tables 2 and 3 it is clear that in both regions mobility for the bottom 20 percent group is lower for urban households than for rural households and that, for the inland provinces, mobility at the bottom of the distribution fell dramatically (i.e. p_{11} rose) from the pre-millennium period to the post-millennium period. If we compare the $m(P)$ statistic pre-millennium and post-millennium we find that overall mobility fell for rural and for urban households in each of the two regions; in each case this fall is significant at the 1 percent level with the exception of rural households in the coastal provinces, where the fall is significant at the 5 percent level.

TABLE 3

Mobility Pre/Post Millennium: Inland Provinces

		2000					*Rural*		2011				
		1	*2*	*3*	*4*	*5*			*1*	*2*	*3*	*4*	*5*
	1	**0.24**	0.20	0.24	0.17	0.15		*1*	**0.31**	0.24	0.18	0.15	0.12
1989	*2*	0.23	**0.23**	0.24	0.17	0.14	**2000**	*2*	0.16	**0.26**	0.25	0.17	0.16
	3	0.19	0.25	**0.18**	0.22	0.16		*3*	0.20	0.18	**0.22**	0.20	0.20
	4	0.16	0.20	0.19	**0.23**	0.23		*4*	0.19	0.15	0.21	**0.24**	0.21
	5	0.17	0.13	0.15	0.21	**0.33**		*5*	0.14	0.17	0.14	0.24	**0.31**
		2000					*Urban*		**2011**				
		1	*2*	*3*	*4*	*5*			*1*	*2*	*3*	*4*	*5*
	1	**0.34**	0.27	0.19	0.12	0.08		*1*	**0.49**	0.24	0.13	0.08	0.06
1989	*2*	0.21	**0.25**	0.25	0.21	0.08	**2000**	*2*	0.21	**0.28**	0.22	0.18	0.11
	3	0.17	0.18	**0.20**	0.22	0.24		*3*	0.17	0.20	**0.21**	0.27	0.13
	4	0.12	0.18	0.21	**0.24**	0.25		*4*	0.05	0.15	0.20	**0.25**	0.35
	5	0.15	0.13	0.15	0.22	**0.34**		*5*	0.08	0.13	0.23	0.23	**0.33**

4.2. *Rank Mobility—Robustness Checks*

Length of Period

We can also examine the change in short-run mobility in China over the two decades. The CHNS data permit us to look at two-year mobility at four points during the period: 1989/91, 1991/93, 2004/06, 2009/11. The upper part of Table 4 shows the short-run rank-mobility transition matrices at these four points. We may summarize the change in mobility by looking at three key statistics: p_{11}, the probability that someone starting in the lowest 20 percent group stays in the same group, p_{55}, the probability that someone starting in the highest 20 percent group stays in the same group and $m(P)$, defined in equation (1). The lower part of Table 4 shows, for each of these statistics, the significance level of the change in mobility as we go from any one of these four points to any other point. So, for example if we compare 1989/91 with 1991/93, the change in p_{11} and p_{55} is not significant but there is a rise in $m(P)$, significant at the 10 percent level. But if we compare 1989/91 with 2009/11 we find that p_{11} and p_{55} rise and $m(P)$ falls, all significant at the 1 percent level; the same is true if we compare 1991/93 with 2009/11. The overall message is clear: there is some evidence of a rise in short-run rank mobility a decade before the millennium, but there is overwhelming evidence of a reduction in mobility thereafter.

If we break this change in short-run mobility down into its components an interesting pattern emerges. At the bottom of the distribution the reduction in short-term mobility is particularly associated with rural households (Appendix Table A.5): the rise in p_{11} from 1989/91 to 2009/11 and the rise in p_{11} from 1991/93 to 2009/11 are each significant at the 1 percent level. By contrast, at the top of the distribution the change in short-term mobility is driven principally by the urban households (Appendix Table A.6): all the "long-distance" comparisons of two-year transitions (for example comparing 1991/93 with 2009/11) show a strongly significant increase in p_{55}.

TABLE 4

TWO-YEAR RANK TRANSITION MATRICES (TOTAL)

		1991							2006				
		1	*2*	*3*	*4*	*5*			*1*	*2*	*3*	*4*	*5*
	1	**0.41**	0.26	0.16	0.10	0.07		*1*	**0.44**	0.26	0.14	0.09	0.07
1989	*2*	0.25	**0.29**	0.19	0.15	0.11	**2004**	*2*	0.23	**0.30**	0.25	0.15	0.08
	3	0.16	0.23	**0.27**	0.21	0.13		*3*	0.17	0.22	**0.28**	0.22	0.12
	4	0.10	0.13	0.23	**0.32**	0.22		*4*	0.10	0.14	0.22	**0.31**	0.23
	5	0.07	0.09	0.15	0.23	**0.46**		*5*	0.06	0.09	0.11	0.24	**0.50**
				$m(P) = 0.8135$							$m(P) = 0.7923$		
		1993							**2011**				
		1	*2*	*3*	*4*	*5*			*1*	*2*	*3*	*4*	*5*
	1	**0.41**	0.26	0.15	0.11	0.06		*1*	**0.46**	0.23	0.16	0.10	0.06
1991	*2*	0.26	**0.28**	0.21	0.16	0.09	**2009**	*2*	0.24	**0.32**	0.23	0.13	0.08
	3	0.16	0.23	**0.25**	0.20	0.16		*3*	0.15	0.24	**0.28**	0.21	0.12
	4	0.10	0.14	0.23	**0.30**	0.22		*4*	0.07	0.13	0.23	**0.33**	0.24
	5	0.07	0.10	0.14	0.23	**0.46**		*5*	0.08	0.08	0.10	0.23	**0.51**
				$m(P) = 0.8223$							$m(P) = 0.7756$		

	Significance levels of mobility statistics								
	p_{11}			p_{55}			$m(P)$		
	1991/93	2004/06	2009/11	1991/93	2004/06	2009/11	1991/93	2004/06	2009/11
1989/91	[ ]	10%	1%	[ ]	5%	1%	<u>10%</u>	1%	1%
1991/93		10%	1%		5%	1%		1%	1%
2004/06			[ ]			[ ]			1%

Note: [ ] means change in statistic is not significant. Underline indicates mobility *increase*; all others indicate mobility decrease.

Inclusion of Missing Province

As a further check we examine the effect of including the missing province referred to in footnote 4.19. Heilongjiang was unavailable before 2000; the effect of including this province in the computations of 2000–2011 is shown in Tables A.7–A.9 in the Appendix. It is clear that the conclusion that rank mobility fell after the millennium remains unaffected by the inclusion of Heilongjiang and, furthermore, that this conclusion about the reduction in mobility is also confirmed for the the breakdown into rural and urban households.

Also, as Appendix Table A.1 shows, province 21 (Liaoning) was not available in 1997; however the exclusion of this province does not affect any of our conclusions.

Age Correction

When comparing long periods such as 1989–2000 and 2000–2011 it is clear that through attrition (discussed below), addition of replacement households to the sample and the passage of time, the age composition of the sample may have changed and that this may affect the mobility estimates.[10] We can tackle this by reweighting the data to take account of the changing age structure. Let n_{akl} be the number of households of age a that are in S_k at time t_0 and in S_ℓ at time t_1. Let A be the set of all types (for example all the different age groups). For a household of type a let the probability of inclusion in the sample be proportional to w_a. The estimate of the probability that a household in S_k at time t_0 will be in S_ℓ at time t_1 is

$$p_{k\ell} := \frac{\sum_{a\in A} w_a n_{ak\ell}}{\sum_{a\in A}\sum_{j=1}^{K} w_a n_{akj}}. \tag{6}$$

The transition matrix P is the $K \times K$ array with typical element $p_{k\ell}$. Notice that (6) becomes $p_{k\ell} := \frac{n_{k\ell}}{\sum_{j=1}^{K} n_{kj}}$ if w_a is the same for all $a \in A$.

Accordingly we recomputed the 2000–2011 transition matrices using the age-weights from 1989. As we can see in Table A.10 (in the Appendix) this reweighting does not change the conclusion that rank mobility reduced when comparing 2000–2011 with 1989–2000.

4.3. *Attrition Issues*

One of the drawbacks of the CHNS is that not all provinces in China are covered by the sample. This means that we do not have direct evidence of income mobility within the omitted provinces and that there is attrition from the sample because of migration out of the nine provinces included in CHNS. However, we can use the detail of the attrition data to confirm the picture of a reduction in mobility.

[10]For additions to the sample see section A.1 in the Appendix; Tables A.2 and A.3 show the sample characteristics at the beginning and end of periods.

We can characterize households who leave the sample as broadly consisting of two contrasting types. We may imagine that in any given year n_1 people leave the sample for economic reasons, for example to get a job in a part of China not covered by the sample; this process clearly represents potential income mobility. Also in the same year n_2 people leave the sample for other reasons—they die, retire, go to live with their family elsewhere; of course this does not represent income mobility. The problem is that we do not know the values of n_1 and n_2 and there is no direct way of estimating them.

However, at any age τ, we can observe the sum $n(\tau) := n_1(\tau) + n_2(\tau)$, the number of those aged τ or less who leave the sample. Those whose heads are aged 35 or below are not interesting since very few leave the sample. Those whose age is greater than 55 are also not likely to be relevant: it is unlikely that many in this upper age group will migrate out of the sample for economic reasons. Furthermore, it is likely that $n_1(\tau)/n(\tau)$ decreases with τ: you are more likely to move for economic reasons if you are young.

It is clear from Table 5 that, with the trivial exception of the over-55 urban households, $n(\tau)$ decreases between the 1990s and the 2000s for both rural and urban subsamples. If we make the reasonable assumption that n_2 (the non-mobility component of attrition) remains fairly stable over time this must mean that n_1 has fallen: "mobility" from inside to outside the sample must have decreased.

Now consider the "ratio" columns in Table 5. This ratio is smaller for the lower ages—the reduction in $n(\tau)$ is much greater among younger people. This is consistent with the points that $n_1(\tau)/n(\tau)$ decreases with τ and with the claim that reduction in movement is due to n_1 rather than n_2.

In China there is substantial internal migration that is driven by economic incentives. If geographical mobility is indeed associated with rank (positional) mobility then it is clear that the change in the attrition pre/post millennium reinforces the conclusions of a reduction in rank mobility that we drew from the first pass at the data in section 4.1.

4.4. *Mobility Indices*

To examine the detail of the change in rank mobility pre/post millennium we use the M_α family of indices in equations (2)–(4) with status determined as in (5). The evidence for the periods 1989–2000 and 2000–2011 is presented in Figure 1 which

TABLE 5

Households Leaving the Sample by Age

	Rural			Urban		
Age, τ	$n(\tau)$ 1989–2000	$n(\tau)$ 2000–2011	ratio	$n(\tau)$ 1989–2000	$n(\tau)$ 2000–2011	ratio
≤40	71	22	0.31	29	8	0.28
≤45	133	61	0.46	79	35	0.44
≤50	180	156	0.87	136	104	0.76
≤55	215	218	1.01	181	162	0.89

Note: Number in each cell gives the number of households with heads at or below the given age who leave the sample during each period.

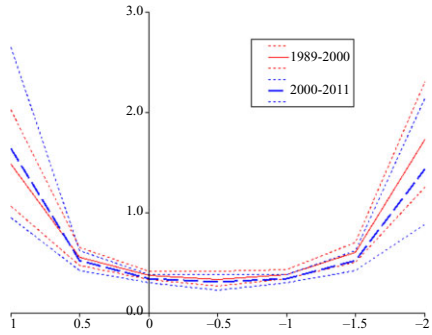

Figure 1. Rank mobility M_α before and after the millennium

plots M_α for $\alpha \in [-1, 2]$ along with 95 percent confidence bands.[11] The conclusions drawn from the transition-matrix analysis in section 4.1 are broadly confirmed: with the exception of the extreme case $\alpha = -1$ the point estimates of 2000–2011 are less than those for 1989–2000; for $\alpha \geq 1$ this decrease in mobility is significant. Rank mobility remains unchanged or falls from the first decade to the second decade.

5. Income Mobility

Now, instead of rank mobility, we focus on income variability over the same periods. Each panel in Figure 2 (adapted from the suggestion by Trede 1998) provides information similar to that in the transition matrix.[12] It shows where people in the distribution move to at the end of a period conditional on a particular starting point at the beginning of the period. The horizontal axis is beginning-of-period income relative to the median; the vertical axis is relative income at the end of the period. The six panels cover the periods 1989–2000 and 2000–2011 for the whole sample, for the rural subsample and the urban subsample. In each panel we plot the 0.1, 0.3, 0.5, 0.7, and 0.9 quantiles of the end-of-the period distribution conditioned on relative income at the beginning of the period. The flatter are these profiles, the greater is mobility—if they were completely flat then there would be

[11]Table A.11 in the Appendix provides the detail underlying Figure 1.

[12]Consider any row h of the transition matrix as a vector. This vector $(\hat{f}_{h1}, \hat{f}_{h2}, \ldots, \hat{f}_{hK})$ gives the empirical frequency distribution over the sets $S_1, \ldots, S_K$ at time 1 *conditional* on the individuals being in set S_h at time 0. Let $\hat{F}_{h1} := \hat{f}_{h1}$, $\hat{F}_{h\ell} := \hat{F}_{h\ell-1} + \hat{f}_{h\ell}$, $\ell = 2, \ldots, K$. Then $(\hat{F}_{h1}, \hat{F}_{h2}, \ldots, \hat{F}_{hK})$ gives a simple estimate of the distribution function for time 1, conditional on being in set S_h at time 0. If we know F_0 and F_1 the (unconditional) distribution function of income for the whole population at time 0 and at time 1 we can convert from proportions of the population to quantiles. For example if $S_1 = [0, 0.1]$, the bottom 10 percent, then $x_{0.1} = F_0^{-1}(0.1)$. is the 10 percent quantile where F_0^{-1} denotes the inverse of the time-0 distribution function F_0. In general

$$x_p = F_0^{-1}(p),\ p \in [0, 1].$$

We do the same thing at time 1:

$$y_q = F_1^{-1}(q),\ q \in [0, 1].$$

In this way we can convert from $S_k = [q_{k-1}, q_k)$ to income intervals $[y_{k-1}, y_k)$.

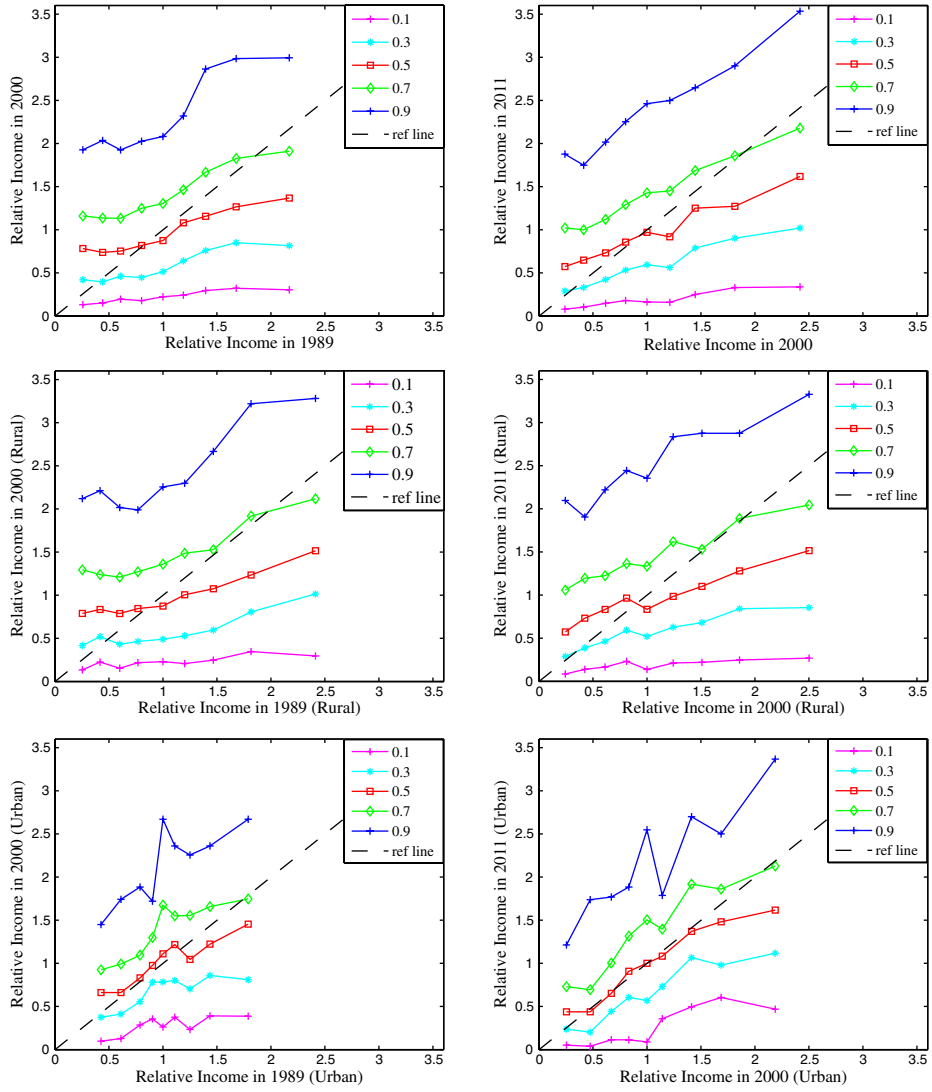

Figure 2. Conditional quantiles

perfect mobility because the end-of period distribution would be independent of income at the beginning of the period; roughly speaking, the further apart are the profiles then the greater is end-of-period inequality. By contrast if all the profiles were 45-degree lines then clearly relative income at the beginning of the period would predict the same relative position at the end of the period. If $y_{t'} = \phi(y_t)$, where ϕ monotonic increasing, then we may have increasing or decreasing inequality, according as the function ϕ causes the profiles to fan out or cluster; whether that inequality change should be considered as "mobility" is a moot point.

Compare each pair of panels in Figure 2 to get a picture of pre/post-millennium mobility for the whole sample (top), for rural households and for

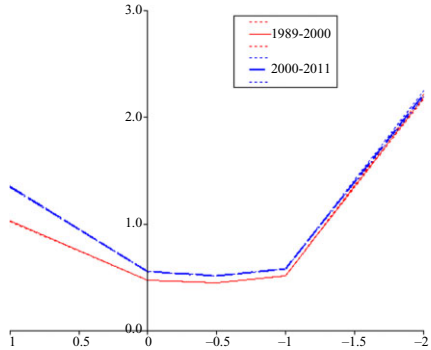

Figure 3. Income mobility M_α before and after the millennium

urban households (bottom). This graphical presentation suggests an ambiguous picture of the change in income mobility pre-millennium to post-millennium. For example, for those with incomes between the median and 1.5 times the median the 0.9 profile is flatter in 2000–2011 than in 1989–2000, but above 1.5 times the median the 0.9 profile is steeper in 2000–2011. However inequality appears to have increased as one moves to the right-hand panels. Furthermore, for the whole sample and for the rural subsample the profiles become more "fanned out" in the 2000–2011 period; this means that the higher is one's income in rural households, the more uncertain have become one's future prospects after the year 2000.

To obtain a clearer answer on how income mobility may have changed let us again make use of the mobility indices introduced in section 3. But now household's status at date t is given simply by income:

$$s_i = y_{it}. \tag{7}$$

Apply the M_α index once again but this time with status defined by (7) rather than (4)—in effect we extract another class of mobility indices from the superclass. However, there is a problem. As noted in footnote 5 there is a small proportion of the sample negative and zero incomes in the sample[13] and M_α is not defined for negative incomes and is not defined everywhere for zero incomes. For this reason we removed the zero and negative observations from the sample.

Figure 3 plots M_α for $\alpha \in [-1, 2]$ along with 95 percent confidence bands—it is the income-mobility counterpart to Figure 1. As we can see income mobility in the whole sample has *increased* throughout the parameter range:[14] comparing Figures 1 and 3 it is clear that there is a remarkable contrast between the behavior of income mobility and rank mobility as China moved into the new millennium. This is largely attributable to the very high values for M_α for positive values of α

[13]Among rural households 3.1 percent had negative or zero incomes during 1989–2000, 2.58 percent during 2000–2011. The corresponding proportions of urban households with zero or negative incomes were 0.98 percent (1989–2000) and 1.44 percent (2000–2011).

[14]Table A.12 in the Appendix presents the results underlying Figure 3. Note that the pattern of increased income mobility in the whole sample is confirmed in the rural and urban subsamples taken separately with just two exceptions ($\alpha = 1$ for rural households and $\alpha = 2$ for urban households).

and demonstrates the importance of careful choice of the status variable in interpreting mobility patterns.

We might wonder why income mobility goes the opposite way from rank mobility. It is not hard to see if we consider for a moment an artificial example. Again, if all that happens to incomes from time t to t' can be characterized as $y_{t'} = \phi(y_t)$, where ϕ is non-stochastic, then there is obviously no rank mobility (no household changes places in the distribution with any other) but the income growth will generate positive income mobility and possibly—depending on the nature of ϕ—an increase in income inequality too.[15] One can have a reduction in rank mobility coexisting with an increase in income mobility—this is what happened in China. This also mirrors a phenomenon noted in other economies: distributions with higher inequality tend to show lower rank mobility.[16]

6. Conclusion

Our study has some things in common with previous research on China: for example, as with other studies, we find that rural mobility is higher than urban. However, we have shown something new: around the turn of the century the process generating income distribution in China appears to have turned a corner.

Rank mobility decreased as China moved into the new millennium. It has now become more difficult for those on the bottom rungs of the economic ladder to move upwards and it has become easier for those on the top rungs to stay there. However, while there was a big slow-down in rank mobility around the time of the millennium, at the same time income variability kept on growing. This increase in income mobility occurred in both rural and urban areas and carried on right through our 20-year period of study. The reason for these opposite movements in rank mobility and income mobility is that the rich have continued to become richer relative to the poor: old-fashioned inequality has increased and society may have become more polarized. Clearly a detailed study of proximate economic causes for the reduction in rank mobility is required. However, restrictions on labor mobility are likely to have contributed to the problem and it is not hard to find reasons for this in the changing conditions in the housing market[17] and the development of a kind of administrative monopoly in key large-scale industries.[18]

This change in rank mobility that has taken place is important for two reasons. First, a reduction in long-term mobility suggests that, along with the rise in income inequality, there has been a rise in inequality of opportunity which contributes to a perception of unfairness in the outcome of the economic system.[19] Second, it may be evidence of a policy failure in the management of the country's

[15]Cf the discussion on the components of mobility in Van Kerm (2004).

[16]See, for example, the comparison of Germany and the USA in Maasoumi and Trede (2001), in terms of short-term (intragenerational) mobility; the similar phenomenon of higher inequality being associated with higher *inter*generational mobility has been widely observed and dubbed the "Great Gatsby curve" (Krueger, 2012).

[17]These include the limitations imposed by the *hukou* system and a housing reform in the late 1990s that involved the abolition of "welfare housing"; *The Economist* (2014) commented on a class of "losers" for whom "property prices [have been] climbing well beyond their reach".

[18]The State-owned Assets Management Committee was established in 2003.

[19]For the connection with inequality of opportunity see, for example, Stokey (1998, p. 161).

development process. China's leaders realised from the outset that the rapid growth in income around the turn of the century would be accompanied by a growth in income inequality: but it was envisaged that the inequality growth would eventually be reversed.[20] Here economic mobility can be seen to play an important role, as an effective mechanism for offsetting the effects of growing inequality; in a sense it substitutes for comprehensive redistribution program and may forestall the public demand for state intervention.[21]

As she has moved into the new millennium China has seen income inequality continue on its path of rapid increase; but there is also evidence that the underlying dynamic has changed. China has become more rigid, presenting its policy makers with a potentially serious challenge.

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[20]"Our policy is to let some areas and some people get rich first and then have them stimulate and help other regions, other people, and so gradually achieve common prosperity" (Deng Xiaoping, 1985).

[21]On this "substitution" role of mobility see for example Field and Ok's (1999) characterization of the argument in Friedman (1962). This type of argument is clearly present in policy makers' minds: "A just society allows the public to share the fruits of reform and development. Recently, I often read Adam Smith's Theory of Moral Sentiments. He actually talks about two invisible hands: one refers to the market, one is ethical. If, in the long run, only a few are wealthy and most are in poverty, this is unfair and such a society is doomed to instability. Therefore, I am concerned about solving the problem of the gap between rich and poor. We need to foster economic and social development, while also gradually narrowing the gap between rich and poor. This is our goal" (Wen Jiabao, 2009).

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

A.1: Sample: details
A.2: Summary statistics
Table A.1: Provinces in the sample
Table A.2: Sample summary statistics. For years 2000 onwards, includes Liaoning but excludes Heilongjiang
Table A.3: Sample summary statistics. Includes both Liaoning and Heilongjiang
A.3: Attrition
A.4: Supplementary analytical tables
Table A.4: Decade rank transition matrices: Rural and Urban breakdown
Table A.5: Two-year rank transition matrices (rural)
Table A.6: Two-year rank transition matrices (urban)
Table A.7: Transition Matrix 2000–2011 (Heilongjiang included)
Table A.8: 2000–2011 Transition Matrix, Rural (Heilongjiang included)
Table A.9: 2000–2011 Transition Matrix, Urban (Heilongjiang included)
Table A.10: Transition matrices: age-weighted data
Table A.11: The M_α index: rank mobility
Table A.12: The M_α index: income mobility
Figure A.1: CHNS: Income distribution: summary statistics
Figure A.2: CHNS: Income distribution 1989, 2000, 2011
Figure A.3: Attrition from the sample