Understanding income volatility in urban China

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A B S T R A C T

Higher income volatility is associated with a higher risk and a reduction in well-being. Income volatility is widely studied in many advanced economies, yet little is known about income volatility in China. In this paper we document trends in earnings volatility and household income volatility in urban China and examine what are the driving forces. Using the China Urban Household Survey, we find that male earnings volatility increased by 89% between 1992 and 2009. Earnings volatility is higher for older, less educated, and those who work in private service sector and non-SOEs. Decomposition analysis suggests that couple's earnings shocks are positively correlated, while transfer income and other income help smooth out head earnings shocks. In addition, transfer income and other non-transfer income plays a larger role in smoothing out head earnings shocks for poorer households.

1. Introduction

The well-being of a household is not only related to the level of income, but also related to how income fluctuates over time. Income volatility, generally defined as the degree of change in income from one period to the next, measures a household's economic security and instability. Volatility increases the risk of living in poverty, experiencing food insecurity, utility disruptions, or housing instability. For low-income households who do not have sufficient savings to smooth their consumption, rising income volatility is usually associated with an increase in risk and a reduction in welfare.

It is well documented that income volatility has been increased in the U.S. and several other developed countries over the past several decades (Moffitt & Gottschalk, 2002, among others). Little is known about income volatility in Asian countries. In this paper we focus on income volatility in urban China and examine the following questions: How has earnings volatility and household income volatility in urban China changed over time? How earnings volatility differs by age, gender, education, and industry? What accounts for the changes in household income volatility?

Our study is by far the first paper that examines trends in household income volatility in China and its driving forces. We decompose household income into four income sources: head earnings, spouse earnings, transfer income, and non-transfer other income. We examine not only the volatility of each income source, but also the covariance between each pair of income source. The decomposition analysis also allows us to quantify the relative contribution of each component in household income volatility. Understanding the trends and underlying driving forces of household income volatility has important policy implications. It helps understand whether couples can insure against each other's earnings shocks, and whether public transfer programs are effective in smoothing out household consumption.

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In addition, we provide detailed subgroup analysis on earnings volatility in urban China, which is also new to the literature. Our analysis shed light on which groups of individuals face higher income uncertainty. If these individuals also have lower assets to weather negative earnings shocks, government policies could consider targeted transfer to help them smooth consumption.

Unlike measures of income inequality in which only repeated cross-sectional data are needed, measurement of income volatility requires longitudinal data so that we can calculate income changes for the same individual or the same household over time. Almost all existing studies on income uncertainty or income shocks use China Household Nutrition Survey (CHNS), which has a wide and unequal time gap between two surveys.[1] We construct two-year panel based on the rotating feature of the Urban Household Survey (UHS) to examine short run income fluctuations.

Using the UHS 1992–2009, we find that earnings volatility in urban China has increased over time. Male earnings volatility increased by 89.2% and female earnings volatility increased by 19.6%. Earnings volatility is higher for older, less educated, and those who work in private service sector and non-SOEs. Earnings volatility is also correlated with unemployment. Household income volatility increased for poorer households (income below median), while volatility decreased for richer households (income above median), between 2002 and 2009. Decomposition analysis suggests that couple's earnings shocks are positively correlated, while transfer income and other income help smooth out head earnings shocks. In addition, transfer income and other non-transfer income plays a larger role in smoothing out head earnings shocks for poorer households.

The rest of the paper is organized as follows. Section 2 reviews existing literature. Section 3 describe how we measure income volatility and how we decompose total household income volatility into different components. Section 4 describes the data and summary statistics. Section 5 presents the results on earnings volatility and household income volatility. Section 6 provides volatility decomposition analysis and Section 7 concludes.

2. Literature review

There is a large literature on earnings or income volatility in the U. S. and other developed countries (Gottschalk & Moffitt, 1994; Haider, 2001; Shin & Solon, 2011; Moffitt & Zhang, 2022). Most studies focus on male earnings volatility and find that volatility have been increased over the past several decades. Moffit and Zhang (Moffitt & Zhang, 2018a, 2018b) provide an overview of the studies on male earnings volatility in the U.S. Studies using survey data or administrative data mostly find that male earnings volatility has been increased in the 1980 s, become flat in 1990 s, and started to increase again in 2000 s, although studies do not agree on the exact turning point.

Earnings volatility is measured either by transitory variance in the error components model (e.g., Moffitt & Gottschalk, 2002), or variance in one- or two-year difference in earnings (e.g., Shin & Solon, 2011). The identification of the first method relies on longitudinal data with panel year sufficiently long, so that the model can estimate autocorrelation process such as AR (1) or ARMA (1,1). The second method only requires panel data with earnings observations of one or two years apart. Moffitt and Zhang (2018a) show that the two methods are empirically very close to each other.

Studies have examined household income volatility extensively, but the driving force of changes in household income volatility is not widely studied. Hardy and Ziliak (2014) apply the decomposition technique in Bohrnstedt and Goldberger (1969) to decompose the arc percent change in household income into five components parts: head's earnings, spousal earnings, transfer income, other non-transfer income, less net tax payments. They construct a series of two-year panels from the Current Population Survey (CPS) for empirical analysis. We mainly follow Hardy and Ziliak (2014) for decomposition. Another way to examine the driving forces of household income volatility is to apply formal error components model and decompose total variance in household income volatility into permanent and transitory components of each income source and correlation between income sources (Hyslop, 2001; Zhang, Shiu, & Gottschalk, 2022). This method requires long time horizon panel data. Neither method has been applied to examine the driving forces of household income volatility in Asian countries.

Although several studies have examined income inequality or mobility in China (e.g., Zhan, Ma, & Li, 2021; Zeng & Zhu, 2022), little is known about how income fluctuates over time, and how difference income sources affect total household income fluctuations. Empirical studies in China measure income fluctuation in various ways: income uncertainty, stochastic income shocks, or income instability. Some of these studies focuses on the relative importance of income instability in the total variance in earnings or income. Zhao (2007) is the first one that examines earnings instability in urban China, using China Household Nutrition Survey (CHNS) 1989–2006. He decomposes the variance of log earnings into transitory and permanent parts and find that around 70% of the total variance comes from the transitory component. He also finds that earnings instability decreased from early 1990–2004 and started to increase between 2004 and 2006. This trend holds for both male and female. Nichols (2010) provides a unified framework to estimate income inequality, volatility and mobility risk in China and U.S. Using CHNS 1989–2006, he finds that China has higher and more rapidly increasing income volatility than U.S. Also use CHNS, Xu and Zhu (2011) find that transitory income shocks, measured as variance in residual income from Mincer wage regressions, explain more than 60% of the income inequality. Chamon, Liu, and Prasad (2013) find that a sharp increase in income uncertainty is mainly driven by transitory idiosyncratic shocks, using the CHNS 1989–2009.

As urban and rural areas in China are distinctly different in terms of both economic development and institutions, studies either focus on urban China or rural China. The above studies examine income volatility in urban China. There are two studies in Chinese

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[1] The CHNS surveys were conducted in 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009 and 2011.

examine income volatility in rural areas. Kou and Hou (2015) use Rural Fixed Point panel data 2002–2006 to examine the consumption insurance against transitory income shocks and permanent income shocks. They find that consumption smoothing can offset part of the transitory income shocks but not permanent income shocks. Using CHNS 1989–2011, Jin and Wang (2018) find that transitory variance in income for rural residents has been increasing since the late 1990 s and reaches peak in 2005 and then decline.

Most of the above studies on income volatility using the CHNS data, which are collected in 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. Income volatility is not accurately measured if we only observe income changes 3–4 years apart, as it could mask the fluctuations within shorter period. For example, if someone's earnings in year 2000–2004 are 20,000RMB, 25,000RMB, 30,000RMB, 15,000 RMB, and 20,000RMB respectively, what we observe in the CHNS 2000 and 2004 data is that he has zero earnings volatility, but his earnings are actually highly volatile if we observe year to year income fluctuations. More importantly, these studies only look at the volatility of a single income source (either individual earnings or total household income) and did not look at how volatility of different income sources and correlation between income sources affect total household income volatility. Our study fills in this research gap. We decompose household income into head earnings, spouse earnings, transfer income, and non-transfer other income. Household income volatility depends on the volatility of each income source as well as the covariance between each pair of income source. Our decomposition analysis provides a better understanding of the driving forces of household income volatility.

3. Measuring volatility

In this section we first describe how we measure earnings volatility and household income volatility, then we illustrate how we decompose household income volatility into different components. Volatility is defined as the rate of fluctuation over time for some income variable. Following Shin and Solon (2011) and Moffitt and Zhang (2018a) (2022), we define income as the variance of the change in log earnings or log income between two survey years for the same individual or the same household.

$$v_{it} = Var\left(\ln y_{i,t} - \ln y_{i,t-1}\right) \tag{1}$$

This is a commonly used measure in earnings volatility literature. An alternative measure is the variance of the transitory component in the error components model. The two measures usually show consistent trend in earnings volatility, as discussed in Moffitt and Zhang (2018a).

Studies on male earnings usually use log earnings as earnings measure. As the majority of male are employed, this measure does not exclude many observations. When we examine volatility of other income sources, such as female earnings or transfer income, there are more zeros than male earnings. In order to accommodate zero incomes, we use the variance of arc percent change to measure earnings and income volatility :

$$v_{i,t} = Var\left(\frac{y_{i,t} - y_{i,t-1}}{\overline{y}_i}\right), \text{where} \overline{y}_i = \frac{y_{i,t} + y_{i,t-1}}{2} \tag{2}$$

For household income volatility decomposition, we mainly follow Hardy and Ziliak (2014). In our analysis, we decompose total household income into four different income sources: wage income of the male, wage income of the spouse, transfer income, and non-transfer other income, as shown in the following equation:

$$y_{i,t} = y_{i,t}^h + y_{i,t}^s + y_{i,t}^t + y_{i,t}^o \tag{3}$$

By combing Eqs. (2) and (3), we derive Eq. (4) to quantify the relative contribution of each income sources, and the covariance between income sources:

$$\frac{y_{i,t} - y_{i,t-1}}{\overline{y}_i} = \sum_{j=1}^4 \frac{\overline{y}_i^j}{\overline{y}_i}\left(\frac{y_{i,t}^j - y_{i,t-1}^j}{\overline{y}_i^j}\right) = \sum_{j=1}^4 Var\left[\frac{\overline{y}_i^j}{\overline{y}_i}\left(\frac{y_{i,t}^j - y_{i,t-1}^j}{\overline{y}_i^j}\right)\right] + \sum_{k=1}^4\sum_{j=1}^4 Cov\left[\frac{\overline{y}_i^j}{\overline{y}_i}\left(\frac{y_{i,t}^j - y_{i,t-1}^j}{\overline{y}_i^j}\right), \frac{\overline{y}_i^k}{\overline{y}_i}\left(\frac{y_{i,t}^k - y_{i,t-1}^k}{\overline{y}_i^k}\right)\right] \tag{4}$$

Where j and k represent each of the four income components. For each j, k and $j \neq k$, $\frac{\overline{y}_i^j}{\overline{y}_i}$ is the share of income component j to total household income, and $\frac{y_{i,t}^j - y_{i,t-1}^j}{\overline{y}_i^j}$ is the arc percent change for income component j. In addition, we conduct subgroup analysis by education, industry, age, whether work in state-owned enterprises, and so on.

The above decomposition suggests that total changes in household income volatility can arise from changes in volatility of each income source, or from the covariances between two income sources. For example, if husband's earnings shocks and wife's earnings shocks become more negatively correlated, we would observe household income volatility to decline.

4. Data and summary statistics

4.1. Data

The main data used in this study are the Urban Household Survey 1992–2009, collected by China's National Bureau of Statistics. The UHS contains detailed information on various income sources of each household member, demographic information, employment, occupation, and industry. Its survey design is like that of the Current Population Survey (CPS) in the U.S., which is widely used in income and employment studies. Several studies have used UHS to study wage structure in China (e.g., Ge & Yang, 2014).

Table 1
Summary Statistics.

Variable	Observations	Mean	Std. Dev.	Min	Max
Household level 2002–2009					
Household income	73,590	31,621	19,036	2969	166,120
Head wage	73,590	15,163	12,241	0	88,372
Spouse wage	73,590	8754	9406	0	62,979
Transfer income	73,590	3773	6800	0	48,640
Other income	73,590	3932	8893	0	81,277
Head age	73,590	45.39	8.00	22	60
Head education					
Junior HS or below	73,590	0.31	0.46	0	1
High school	73,590	0.35	0.48	0	1
College and above	73,590	0.34	0.47	0	1
Head industry					
Industrial	66,839	0.35	0.48	0	1
Service-private	66,839	0.39	0.49	0	1
Service-public	66,839	0.24	0.43	0	1
Head works in SOE	63,636	0.68	0.47	0	1
Head is self-employed	68,696	0.07	0.26	0	1
Head region					
East	73,590	0.48	0.50	0	1
Central	73,590	0.37	0.48	0	1
West	73,590	0.15	0.35	0	1
Individual level 1992–2009					
Gender	228,653	0.51	0.50	0	1
Male wage	111,382	12,930	11,792	0	84,163
Female wage	105,865	8312	8950	0	60,492

Source: Urban Housing Survey 1992–2009

Notes: Household level sample includes married couples with head age 20–60 in 2002–2009. Individual level sample includes males age 20–60 and females 20–55 in 1992–2009.

Although UHS is mainly a repeated cross-section dataset, it maintains a rotating feature, which is also similar to the CPS. The UHS randomly retains about two thirds of the households each year from the previous wave. This allows us to construct income volatility measure of variance in one-year difference in earnings or income for about two thirds of the sample each year.[2] We match individuals by household code, person code (which also defines the relation to head), gender, and age.[3] The merge rate is reported in Appendix Table A1.[4]

The main measure of earnings we use is annual wage income, which consists of basic wage, bonuses, subsidies, and other labor income from employment. For individual earnings volatility analysis we use data from 1992 to 2009.

The measure of household income is the sum of all income from all household members, including head, spouse, and other individuals live in the same household who are economically connected.[5] For household income decomposition analysis, we first keep only married couples and then construct four income variables: (1) head earnings; (2) spouse's earnings; (3) transfer income, which includes both public transfers from central or local government, as well as private transfers from friends and relatives; (4) other income. We construct this variable by subtracting (1)-(3) from total household income, and it could include capital income of heads and spouses, earnings from household members other than heads and spouses, and some miscellaneous income.

For household income volatility and decomposition analysis we only use data from 2002 to 2009. We are not able to construct consistent measures over longer time horizon as we do for earnings for three reasons. First, the data structure is different for 1992–2001 and 2002–2009 survey. In 1992–2001 survey household income is a sum of income of each household member plus an extra component which is "not assignable to any household member", while the 2002–2009 survey does not have this extra component. Second, the definition of transfer income differs. Income received from selling properties is included in transfer income in 1992–2001 but not in 2002–2009. Therefore, in decomposition analysis we do not have a consistent measure of transfer income. Third,

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[2] Longitudinal data with high quality income information for each household member is rarely available in China. Several studies on income inequality use the Chinese Household Income Project (e.g., Zhan et al., 2021), which contain high quality income measures, but it does not contain a panel feature to study volatility. The China Family Panel Studies is a longitudinal dataset that surveys biennially since 2010. However, the questionnaire for individual earnings changed over time and we cannot construct consistent measure for wife's earnings. In addition, household income in 2016 was not asked in the survey for those who were in the sample in the prior year, thus income was imputed in 2016 for those sample.

[3] The panel feature of the UHS is also used in other studies such as Painter, Yang, & Zhong (2022).

[4] Due to changes in survey structure or low merge rates in some years, we exclude the 1993–94, 1996–97, 1999–2000, 2001–2002, 2006–07 and 2007–08 from the two-year panel construction. There are major changes in survey design in 2002 thus the 2002 survey does not retain any households from the 2001 survey. The low merge rate in some other years is a result of changes in survey design or sampling method, so that a larger proportion of "old sample" are removed from the rotation group.

[5] We define head as "head" in *Hukou* system if he is male, or spouse if the head in Hukou system is female. In this way we ensure all heads in our sample are male. Therefore, we essentially look at male earnings and female earnings separately.
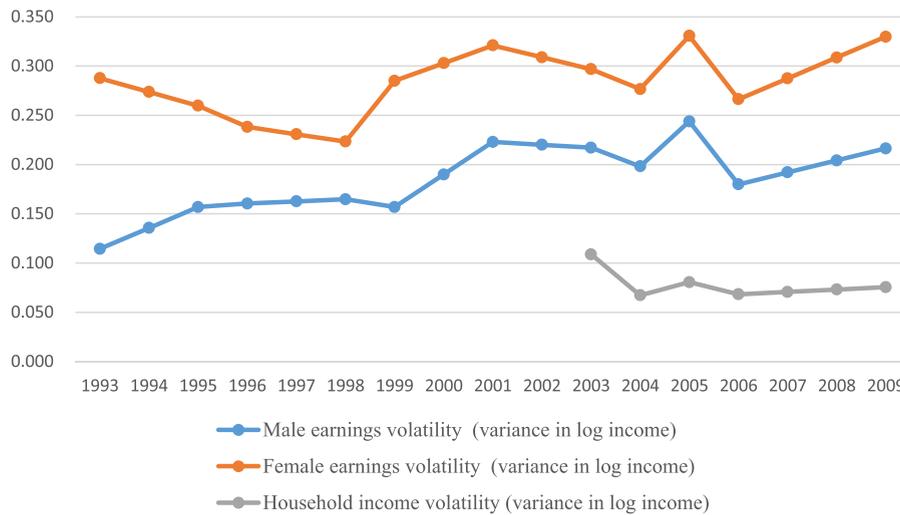
Fig. 1. Earnings Volatility and Household Income Volatility. *Notes*: Year 1994, 1997, 2000, 2002, 2007, and 2008 are interpolated.

there are many missing values in income from other household members who are not heads or wives in the 1992–2001 data. As household income is calculated as the sum of individual income for each household member, missing values in individual income imply missing values in household income.

The UHS is not publicly available, and the version that we have access to cover 16 provinces and cities: Beijing, Shanxi, Liaoning, Heilongjiang, Shanghai, Jiangsu, Anhui, Jiangxi, Shandong, Henan, Hubei, Guangdong, Chongqing, Sichuan, Yunnan and Gansu. We use China's urban household consumption price index as the deflator. All incomes are in 2002 RMB.

We trim top one percent and bottom one percent of earnings and income to reduce measurement error. We start with individual earnings volatility analysis, which include males age 20–60 and females age 20–55. This gives us 111,382 person-year observations of male and 105,865 person-year observations for female. For household income volatility decomposition, we only use married couples with head's age 20–60, which includes 73,590 person-year observations.

4.2. Summary statistics

Table 1 reports summary statistics on key variables such as income, education, age, and industry. Average annual household income is 31,621 RMB. Average male wage income is 12,930 RMB, which contributes nearly half of the total household income. Average female wage income is 8312 RMB, much lower than male wage income, which partly due to a lower female labor force participation rate. Most heads work in state-owned enterprises, and seven percent are self-employed.

Appendix Table A2 presents proportion of individuals or households with zero income. The average proportions of zero values of head earnings, spouse earnings, transfer income, and other income, are 12.8%, 28.9%, 26.5% and 64.8%, respectively. Existing studies on income volatility either use variance of log values or arc percent change. Due to a large proportion of zero income for some income sources, we use arc percent change which allows zero income in one of the two years.

5. Volatility analysis

5.1. Patterns in earnings volatility and household income volatility

Fig. 1 presents trends in individual earnings volatility 1993–2009 and household income volatility over 2003–2009, measured by the variance of difference in log earnings between current year and previous year. We find three patterns: First, both male and female earnings volatility has been increased over time and male earnings volatility increased more than that of female. Specifically, male earnings volatility increased by 89.2% between 1993 and 2009, while female earnings volatility only increased by 19.6%. The trend after 1999 are very similar for male and female earnings, while in earlier years female earnings volatility declined and male earnings volatility increased. Second, household income volatility is relatively flat in 2004–2009, and declined between 2003 and 2004. Third, in terms of the magnitude, female earnings are more volatile than male, and household income volatility is much lower than male or female individual earnings volatility. These patterns are also found in volatility studies in other countries (e.g., Zhang 2009).

5.2. Volatility in subgroups

Table 2 and Table 3 present earnings volatility by age, education, industry, sector, and region for males and females respectively. When we look at age differentials, we find that the middle-aged have a more stable earnings profile than those who are in their early

Table 2
Male Earnings Volatility, Overall and Subgroup Analysis.

Year	1993	1995	1996	1998	1999	2001	2003	2004	2005	2006	2009
All	0.114	0.157	0.160	0.165	0.157	0.223	0.217	0.198	0.244	0.180	0.216
By age											
Age 20–39	0.106	0.150	0.185	0.167	0.162	0.276	0.240	0.211	0.279	0.201	0.247
Age 40–49	0.085	0.085	0.096	0.116	0.101	0.153	0.168	0.159	0.187	0.139	0.156
Age 50–60	0.167	0.302	0.224	0.259	0.238	0.229	0.258	0.235	0.269	0.201	0.251
By education											
Junior HS or below	0.170	0.228	0.193	0.192	0.213	0.312	0.315	0.255	0.258	0.207	0.275
High school	0.088	0.110	0.151	0.170	0.154	0.197	0.230	0.201	0.259	0.187	0.201
College and above	0.073	0.141	0.131	0.117	0.095	0.165	0.135	0.152	0.219	0.154	0.193
By industry											
Manufacture	0.088	0.138	0.160	0.142	0.147	0.186	0.151	0.130	0.177	0.128	0.167
Business Service	0.133	0.182	0.221	0.202	0.139	0.247	0.280	0.211	0.223	0.174	0.204
Social Service	0.052	0.067	0.065	0.078	0.076	0.163	0.105	0.087	0.145	0.106	0.137
By sector											
SOE	0.082	0.113	0.121	0.109	0.102	0.135	0.121	0.102	0.145	0.102	0.124
Non-SOE	0.298	0.374	0.384	0.372	0.401	0.418	0.428	0.386	0.433	0.285	0.300
By region											
East	0.110	0.143	0.157	0.154	0.126	0.188	0.225	0.177	0.208	0.186	0.209
Central	0.114	0.180	0.189	0.176	0.189	0.238	0.211	0.203	0.313	0.175	0.203
West	0.110	0.123	0.111	0.156	0.129	0.262	0.213	0.264	0.221	0.163	0.266

Source: Urban Housing Survey 1992–2009
Notes: Sample includes males aged 20–60.

Table 3
Female Earnings Volatility, Overall and Subgroup Analysis.

Year	1993	1995	1996	1998	1999	2001	2003	2004	2005	2006	2009
All	0.260	0.233	0.215	0.215	0.262	0.310	0.286	0.269	0.322	0.256	0.311
By age											
Age 20–34	0.198	0.263	0.203	0.243	0.322	0.314	0.285	0.294	0.342	0.285	0.330
Age 35–44	0.200	0.123	0.132	0.179	0.197	0.254	0.221	0.219	0.261	0.195	0.229
Age 45–55	0.490	0.393	0.390	0.247	0.300	0.381	0.374	0.312	0.375	0.313	0.402
By education											
Junior HS or below	0.356	0.323	0.311	0.272	0.370	0.410	0.417	0.374	0.474	0.387	0.400
High school	0.188	0.167	0.154	0.194	0.206	0.290	0.291	0.266	0.326	0.240	0.338
College and above	0.159	0.189	0.109	0.129	0.191	0.197	0.163	0.178	0.210	0.182	0.231
By industry											
Manufacture	0.167	0.169	0.143	0.208	0.230	0.211	0.176	0.162	0.200	0.159	0.165
Business Service	0.289	0.251	0.194	0.200	0.256	0.326	0.301	0.242	0.291	0.216	0.258
Social Service	0.103	0.085	0.159	0.115	0.145	0.190	0.106	0.118	0.137	0.131	0.165
By sector											
SOE	0.143	0.130	0.122	0.143	0.180	0.195	0.138	0.133	0.172	0.121	0.149
Non-SOE	0.456	0.511	0.431	0.386	0.434	0.528	0.514	0.435	0.482	0.386	0.425
By region											
East	0.180	0.223	0.224	0.202	0.235	0.307	0.307	0.251	0.285	0.280	0.314
Central	0.330	0.212	0.167	0.229	0.242	0.295	0.277	0.285	0.385	0.231	0.308
West	0.217	0.304	0.287	0.209	0.362	0.342	0.262	0.288	0.313	0.226	0.305

Source: Urban Housing Survey 1992–2009
Notes: Sample includes females aged 20–55.

stage of the career or close to retirement, both for males and females. Earnings volatility increased more for the youngest group (males aged 20–39 and females aged 20–34) from 1993 to 2009.

Tables 2 and 3 also shows that earnings volatility decreases in education for both males and females. Among different education groups, we find that individuals without a high school degree face the highest earnings volatility, and those with a college degree or above have a more stable earnings profile. This pattern persists throughout the entire sample period. This is consistent with Xu and Zhu (2011) and Chamon et al. (2013), who also find lower educated individuals have higher earnings volatility.

There is a significant difference in earnings volatility by industry. Earnings volatility is much higher in business service industry, including trade, financial, insurance, real estate, and business services. Earnings are more stable in social service industry, including education, research, community, and social services. When we divide workers into workers in state-owned enterprise (SOE) and non-

Table 4

Household Income Volatility, Overall and Subgroup Analysis.

Year	2003	2004	2005	2006	2009
All	0.082	0.061	0.069	0.061	0.068
By age					
Age 20–39	0.060	0.062	0.064	0.063	0.069
Age 40–49	0.075	0.057	0.068	0.059	0.067
Age 50–60	0.108	0.064	0.074	0.061	0.067
By education					
Junior HS or below	0.096	0.071	0.079	0.063	0.076
High school	0.079	0.057	0.067	0.061	0.070
College and above	0.071	0.055	0.063	0.058	0.059
By region					
East	0.121	0.057	0.079	0.062	0.063
Central	0.056	0.059	0.060	0.061	0.068
West	0.056	0.078	0.061	0.053	0.079
By income quartile					
Below 25 pct	0.079	0.094	0.099	0.086	0.082
25–50 pct	0.055	0.052	0.063	0.051	0.058
50–75 pct	0.050	0.044	0.055	0.044	0.055
Above 75 pct	0.132	0.047	0.061	0.048	0.058

Source: Urban Housing Survey 2002–2009
Notes: Sample includes married couples with head age 20–60.
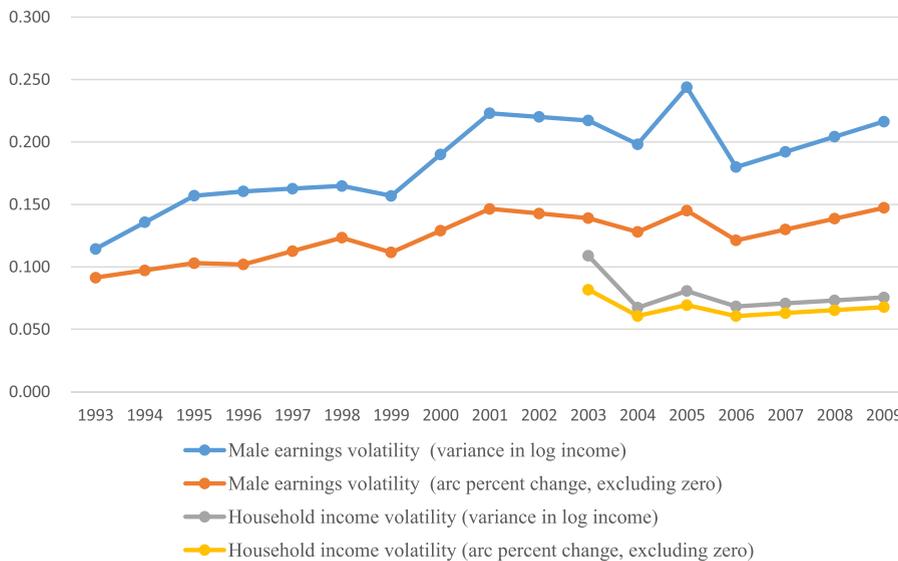
Fig. 2. Trends in Male Earnings and Household Income Volatility, Log Income vs. Arc Percent Change.

SOE, we find non-SOE workers face a higher earnings volatility. This is as expected as SOE jobs are usually more stable with small unemployment risks.

Finally, we examine regional differences in earnings volatility. We divide the full sample into east, central, and west region.[6] we find that earnings volatility is generally lower in east regions than central regions. Male workers in all regions experience an increasing earnings volatility, with the volatility grows the fastest in west regions. The sharp increase in earnings volatility in west region in 2001–2009 coincides with the China's Western Expansion since 1999. Trends are slightly different for female workers. We find an increasing in earnings volatility in east and west regions but not in central region.

Table 4 shows household income volatility by head's age, education, residence region, and income quartiles. Like individual earnings volatility, we find less educated households also face higher household income volatility. When we look at income volatility by quartile, the poorest households exhibit the highest volatility. Hardy and Ziliak (2014) also find similar results using the U.S. data. We do not find significant pattern by age or by region.

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[6] Among the provinces covered in the UHS data, east region includes Beijing, Liaoning, Shanghai, Jiangsu, Shandong, and Guangdong; central region includes Shanxi, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and west region includes Chongqing, Sichuan, Yunnan and Gansu.
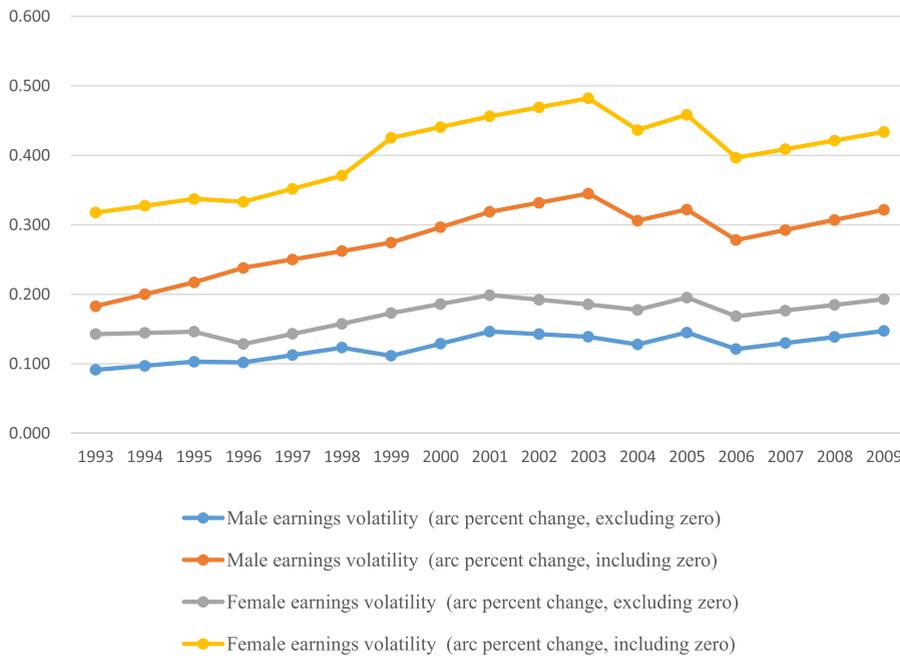
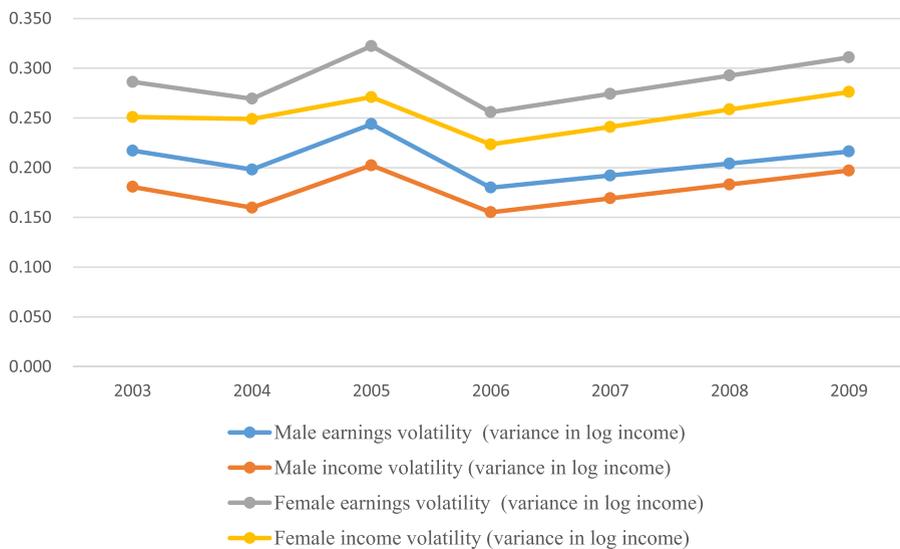**Fig. 3.** Earnings Volatility Including or Excluding Zeros.

Fig. 4. Male and Female Earnings Volatility versus Income Volatility.

5.3. Alternative measures

We examine the sensitivity of volatility by (1) compare results of variance in one year difference in log income versus arc percent change; (2) arc percent change including and excluding zero income; (3) individual earnings versus individual income. Overall, we find results are robust to different measures of volatility or difference measures of income.

Fig. 2 shows that trends in volatility are similar when we switch from variance in one year difference in log income to arc percent change in income. Fig. 3 shows male and female earnings volatility with and without zeros, measured by arc percent change. We still find male earnings volatility increased more than female in 1993–2009. When we include zero earnings, female earnings volatility no longer displays a declining trend in earlier years. The gap between volatility including and excluding zeros is larger for females than that of males, as female labor force participation rate is lower than male.

Our main analysis at the individual level only considers income from employment. Some individuals also earn rents, stock returns, or receive transfers from government. Fig. 4 compares individual earnings volatility with individual income volatility in 2003–2009
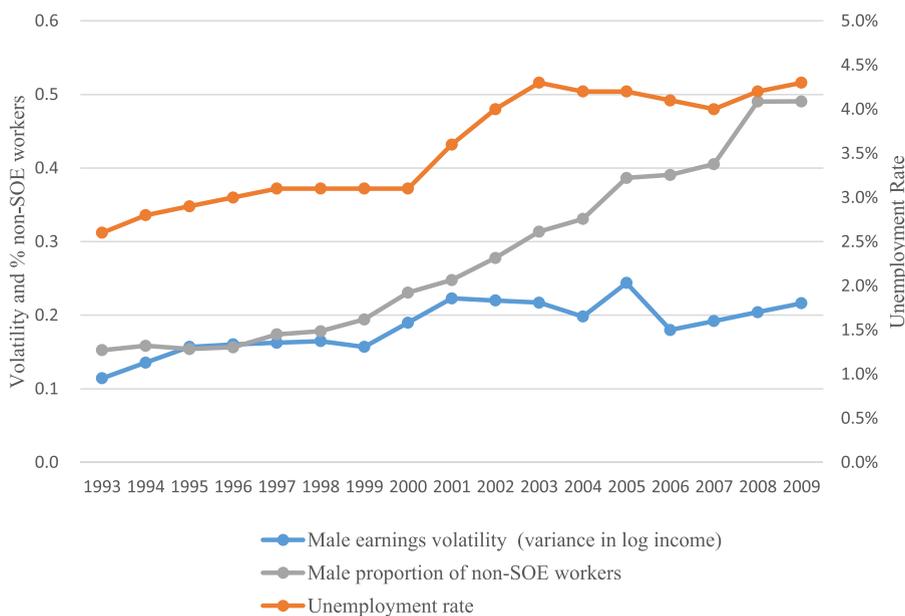
Fig. 5. Male Earnings Volatility and Macroeconomic Conditions.

Table 5
Weighted Variances and Covariances of Household Income Volatility.

Year	2003	2004	2005	2006	2009	Change 2003–2009	Relative Contribution in 2009
Household Income Volatility	0.082	0.061	0.069	0.061	0.068	-0.014	100%
Weighted Variance							
Head's wage	0.035	0.029	0.032	0.026	0.030	-0.005	44%
Wife's wage	0.019	0.016	0.018	0.014	0.017	-0.002	24%
Transfer income	0.020	0.018	0.016	0.015	0.016	-0.004	23%
Other income	0.017	0.016	0.020	0.017	0.021	0.004	31%
Weighted Covariance							
Head and wife	0.009	0.004	0.006	0.004	0.006	-0.003	9%
Head and transfer	-0.005	-0.007	-0.005	-0.005	-0.005	0.000	-7%
Head and other	-0.005	-0.006	-0.010	-0.004	-0.007	-0.002	-11%
Wife and transfer	-0.006	-0.006	-0.005	-0.004	-0.005	0.001	-8%
Wife and other	-0.002	-0.003	-0.005	-0.002	-0.003	-0.001	-4%
Transfer and other	0.001	-0.001	0.001	0.000	-0.001	-0.002	-1%

Source: Urban Housing Survey 2002–2009
Notes: Sample includes married couples with head age 20–60.

and we find the trends are very similar. In addition, volatility in total individual income is lower than earnings, which suggests that non-earned income such as capital income or transfer income smooths out earnings shocks. We do not show results over longer time periods, as the measure of individual income has the same problems as household income in early years 1992–2001: there are many missing values in unearned income for those who are not heads or wives, and there are some miscellaneous incomes that are not assigned to a specific individual in the household. Therefore, in the main analysis we focus on earnings volatility instead of income volatility.

5.4. Volatility and macroeconomic conditions

Earnings volatility could reflect changes in macroeconomic conditions. In the earnings volatility analysis by region in Table 2 and Table 3, we find that the substantial increase in earnings volatility in west region coincides with the China's Western Expansion since 1999. In Fig. 5 we plot male earnings volatility along with the unemployment rate and the proportion of non-SOE workers, to understand if earnings volatility is correlated with labor market conditions or major economic reforms.[7]

Fig. 5 shows that earnings volatility is correlated with unemployment rate. As unemployment rate increases in the late 1990 s,

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[7] Unemployment rate is adapted from the National Bureau of Statistics of China.

Table 6
Weighted Variances and Covariances of Income Sources, Income above Median.

Year	2003	2004	2005	2006	2009	Change 2003–2009	Relative Contribution in 2009
Household Income Volatility	0.091	0.046	0.059	0.046	0.057	-0.033	100%
Weighted Variance							
Head's wage	0.032	0.021	0.026	0.020	0.022	-0.010	39%
Wife's wage	0.018	0.011	0.015	0.011	0.013	-0.005	23%
Transfer income	0.017	0.013	0.012	0.011	0.011	-0.006	18%
Other income	0.013	0.011	0.016	0.014	0.017	0.004	30%
Weighted Covariance							
Head and wife	0.014	0.003	0.007	0.003	0.005	-0.009	9%
Head and transfer	-0.001	-0.005	-0.004	-0.003	-0.002	-0.002	-4%
Head and other	0.001	-0.003	-0.005	-0.004	-0.003	-0.004	-6%
Wife and transfer	-0.005	-0.005	-0.003	-0.004	-0.003	0.002	-6%
Wife and other	0.000	-0.001	-0.004	-0.002	-0.002	-0.001	-3%
Transfer and other	0.003	0.000	0.001	0.001	0.000	-0.003	0%

Source: Urban Housing Survey 2002–2009.
Notes: Sample includes married couples with head age 20–60.

Table 7
Weighted Variances and Covariances of Income Sources, Income below Median.

Year	2003	2004	2005	2006	2009	Change 2003–2009	Relative Contribution in 2009
Household Income Volatility	0.067	0.074	0.080	0.071	0.072	0.005	100%
Weighted Variance							
Head's wage	0.037	0.036	0.039	0.031	0.036	-0.001	50%
Wife's wage	0.020	0.020	0.022	0.017	0.020	0.000	27%
Transfer income	0.022	0.024	0.020	0.019	0.020	-0.002	28%
Other income	0.021	0.022	0.026	0.020	0.024	0.004	34%
Weighted Covariance							
Head and wife	0.003	0.005	0.006	0.005	0.006	0.003	8%
Head and transfer	-0.011	-0.010	-0.007	-0.008	-0.008	0.002	-12%
Head and other	-0.012	-0.010	-0.015	-0.005	-0.012	0.000	-16%
Wife and transfer	-0.008	-0.007	-0.006	-0.006	-0.008	0.000	-11%
Wife and other	-0.005	-0.004	-0.005	-0.003	-0.005	0.000	-6%
Transfer and other	-0.001	-0.001	0.001	-0.001	-0.001	-0.001	-2%

Source: Urban Housing Survey 2002–2009.
Notes: Sample includes married couples with head age 20–60.

earnings volatility also increases. Both unemployment rate and earnings volatility declined in 2002–2006. The decline could be related to the college expansion or China joined WTO.

During our sample period the proportion of non-SOE workers also increased over time. Following the state-owned enterprise reform and housing reform that relaxes the bundle between housing with SOE jobs in the late 1990 s, there are more and more workers switch from SOE jobs to non-SOE jobs. As non-SOE jobs are generally more unstable than SOE jobs, it is as expected that earnings volatility has been increasing.

6. Volatility decomposition

In this set of empirical exercises, we quantify the relative contribution of each piece in total household income volatility by using decomposition method based on Eqs. (3) and (4), following Hardy and Ziliak (2014). During the period of 2003–2009, the overall household income volatility declines by 17% and we examine what drives this change. We document weighted variances in each income sources, $Var\left[\frac{\bar{y}_i^j}{\bar{y}_i}\left(\frac{y_{i,t}^j - y_{i,t-1}^j}{\bar{y}_i^j}\right)\right]$, and weighted covariances between each pair of income sources, $Cov\left[\frac{\bar{y}_i^j}{\bar{y}_i}\left(\frac{y_{i,t}^j - y_{i,t-1}^j}{\bar{y}_i^j}\right), \frac{\bar{y}_i^k}{\bar{y}_i}\left(\frac{y_{i,t}^k - y_{i,t-1}^k}{\bar{y}_i^k}\right)\right]$. Table 5 shows the results for the full sample, and Tables 6 and 7 shows the decomposition results for income above median, and income below median, respectively.

6.1. Trends in household income volatility and its driving forces

We first examine changes in volatility between 2003 and 2009 and what drives the changes. Although overall household income volatility declined from 0.082 to 0.067, a 17.2% decline, household income volatility increased by 7.2% for poorer households whose income below the median (Table 7), and the decline is only found in richer households.

In terms of the relative contribution of each component, the main driving forces are four weighted variance terms rather than

Table A1

Number and Rate of Mergers in UHS 2-year Panel.

	No. of Obs. Merged	Total Obs.	Merge Rate
2-year panel	**Male individuals**		
1992–1993	1810	9252	19.56%
1994–1995	2351	9083	25.88%
1995–1996	2520	8964	28.11%
1997–1998	2962	8988	32.96%
1998–1999	3106	8995	34.53%
2000–2001	3305	8904	37.12%
2002–2003	15,723	25,851	60.82%
2003–2004	20,892	29,546	70.71%
2004–2005	9960	31,300	31.82%
2005–2006	22,397	32,530	68.85%
2008–2009	26,356	36,385	72.44%
Total 1992–2009	111,382	209,798	53.09%
2-year panel	**Households**		
2002–2003	12,724	19,661	64.72%
2003–2004	16,163	22,305	72.46%
2004–2005	7673	23,563	32.56%
2005–2006	17,035	24,358	69.94%
2008–2009	19,995	27,031	73.97%
Total 2002–2009	73,590	116,918	62.94%

covariance terms. The volatility of head's wage contributes to most of the total household income volatility, for example, 44% in 2009 for the full sample, 39% for households with income above the median, and 50% for households with income below the median. This finding is consistent with Hardy and Ziliak (2014) who find similar pattern using data in the U.S.

The decrease of the covariance of head's wage and wife's wage played an important role in reducing the total income volatility of the full sample, as it declined by 36% between 2003 and 2009. The second largest contribution of covariance component comes from the enhanced negative relationship between head's wage and transfer income, as this covariance decreased 39% during 2003–2009.

The reduction of variances of head's wage, wife's wage, transfer income and covariance of head's wage and wife's wage contributes the most to the drop of total income volatility among wealthier families. In contrast, although variances of head's wage and transfer income decreased among poorer families, the magnitudes are too small to offset the increasing covariances between head's and wife's wage income and between head's wage income and transfer income.

6.2. Marital sorting and household smoothing

Decomposition analysis suggests some evidence of marital sorting and household smoothing. First, head's wage and wife's wage shocks are positively correlated for all years, and for both full sample and subgroup analysis. This is consistent with the story of positive marital sorting. Studies have shown that in recent years higher educated women tend to marry higher educated men, or high-income women tend to marry high-income men. Those studies mainly tell a story on couples' permanent income. Our decomposition analysis shows that married couples' income volatility is also positively correlated. This could due to that they tend to work in similar industry, e.g, both work in financial industry thus both have high income volatility, or both works as teachers or professors and have stable jobs.

Second, transfer income, or non-transfer other income, on the other hand, are negatively correlated with head's wage or wife's wage, almost for all the years we observe in Tables 5–7. Table 5 suggests that the weighted covariance between head's wage income and transfer income is − 0.005 on average between 2003 and 2009, and the average weighted covariance between head's wage income and other income is − 0.005 in 2003–2009.

Third, transfer income and other income plays a larger role in smoothing out head's earnings shocks for poorer households. On average, the weighted covariance is − 0.007 between head's wage and transfer income for households with income below median (Table 7), versus − 0.003 for households with income above median (Table 6). For other income, the weighted covariance is − 0.009 for households below income median, versus − 0.003 for households above income median.

7. Conclusion

Understanding the dynamics of income volatility is important for research that aim to investigate insurance against income shocks, and important for policies that intend to help households smooth their consumption. Our paper is the first one that provides a comprehensive picture of trends in household income volatility and its driving forces in urban China. Using China Urban Household Survey 1992–2009, we find that male earnings volatility increased by 89.2% and female earnings volatility increased by 19.6%. Earnings volatility is higher for older, less educated, and those who work in private service sector and non-SOEs. Earnings volatility is also correlated with unemployment. Household income volatility increased for poorer households (income below median), while volatility decreased for richer households (income above median), between 2002 and 2009. Decomposition analysis suggests that couple's earnings shocks are positively correlated, while transfer income and other income help in smoothing out head's earnings shocks. In addition, transfer income and other non-transfer income plays a larger role in smoothing out head's earnings shocks for

Table A2
Proportion with Zero Income.

Year	Head Earnings	Spouse Earnings	Transfer income	Other income
2003	10.85%	25.69%	25.27%	67.49%
2004	12.58%	27.99%	26.02%	67.88%
2005	10.84%	25.78%	23.50%	66.34%
2006	13.54%	30.53%	26.69%	65.15%
2009	14.51%	31.43%	28.65%	59.76%
Average	12.84%	28.88%	26.49%	64.82%

poorer households.

We only examine household income volatility within a decade due to data limitation. We do not find a significant increase in household income volatility, and this maybe just the trend within this specific period in the 2000 s. It is important to understand long term trend on income volatility, as many studies have done so using data in the U.S. and some other developed countries. Longitudinal data sets with high quality of income data and long-time horizon are crucial for such analysis. Going forward, more work on income volatility in China or other countries in Asia, as well as the underlying causes of the changes in income volatility would be warranted.

Data Availability

The data that has been used is confidential.

Acknowledgements

Appendix

See in Tables A1,A2.

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