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Determinants of residential satisfaction in urban China: A multi-group structural equation analysis

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Abstract

Based on the 2006 wave of the China General Social Survey, this paper analyses interregional disparities in residential satisfaction in urban China. It also explores whether the determinants vary across the coastal, central and inland regions by means of a multi-group structural equation model (SEM). We find that residential satisfaction in the coastal region is lower than in the central and inland regions. Housing quality, home ownership, community type, socioeconomic status and *Hukou* in all three regions have positive impacts on residential satisfaction, while the presence of children has a negative effect. The magnitude of each variable's impact on residential satisfaction varies across regions due to the disparities in economic, social and physical conditions. Housing quality is the most important determinant of residential satisfaction in the coastal region, whereas community type and *Hukou* are the most important in the central and inland regions.

Keywords

interregional disparities, latent variable, multi-group structural equation model, residential satisfaction, urban China

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Introduction

Over the last 30 years, economic development and housing reform have brought substantial improvements to quality of life in China, particularly to residential conditions. Before the housing reforms in 1998, the 'welfare housing supply' system dominated housing policy. A distinguishing feature of this policy was that state-owned companies

and institutions were in charge of housing financing, construction, maintenance and allocation. Houses were allocated to urban households¹ according to the social status of

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the head of the household (Zhao and Bourassa, 2003). As rent was extremely low, state-owned institutions could not adequately finance the construction of new housing and the maintenance of existing housing (Wang and Murie, 1999; Wu, 1996). As a result, overcrowding and lack of facilities were typical of urban living conditions. To improve living conditions, the national government launched a housing reform programme which substituted the welfare system for a market system. Private real estate enterprises were allowed to construct housing and new houses were permitted for trade (Wang and Murie, 1999). The housing reform has substantially improved the living conditions of urban residents. For instance, per capita living space increased from 6.7 m² in 1978 to 32.9 m² in 2012.

While the reform has greatly improved average urban living conditions such as living space, interregional disparities have widened because of differences in economic, social and physical conditions (Demurger, 2001; Li and Fang, 2014; Yu, 2006). Urban residents in the less densely populated central and inland regions have, on average, larger houses than those in the economically more developed coastal region who, on the other hand, enjoy better local amenities and housing facilities (Yu, 2006).² Meanwhile, home ownership in the coastal region is lower than in the central and inland regions (Yi and Huang, 2014). These interregional disparities may have resulted in disparities in residential satisfaction (Mohan and Twigg, 2007).

Chinese housing satisfaction studies are limited in time and space. Most studies are cross-sectional analyses which focus on a population in a particular city. For instance, He and Yang (2011) analysed residential satisfaction in Wuhan, Chen et al. (2013) in Dalian, Fang (2006) in a redeveloped neighbourhood in Beijing and Yang et al. (2013) in Beijing. Few researchers have systematically analysed variation in residential satisfaction across regions, with the exception of

Hu (2013) and Li and Wu (2013). However, differences among the coastal, central and inland regions have not yet been analysed.

Previous studies suffer from two methodological shortcomings. One is multicollinearity. For instance, housing size and the number of bedrooms are highly correlated, which affects their standard errors and the significance levels of their estimated coefficients. Secondly, it has been common practice for cross-region comparisons to estimate different models for different cities or for different groups of cities, as in Li and Wu (2013). Consequently, any differences found may be attributable to differences in satisfaction, their determinants, the models applied or to all of these. To reduce this kind of ambiguity, the same model needs to be used; in other words, multi-group analysis should be applied (Koufteros and Marcoulides, 2006; Schumacker and Marcoulides, 1998).

This paper assesses disparities in residential satisfaction and identifies their determinants across the coastal, central and inland regions in China. Multi-group structural equation modelling (multi-group SEM) is applied to reduce the problem of multicollinearity and to estimate and test differences among the three regions on the basis of a common model. The research is based on the 2006 Chinese General Social Survey (CGSS) which provides detailed, nationwide information on residential conditions and household and personal characteristics.³

The remainder of the paper is organised as follows. The next section describes the conceptual model. The multi-group SEM is then discussed, followed by the data and the estimated models. Conclusions and policy implications are presented in the final section.

Conceptual model

In this section, we develop the conceptual model based on a literature review and ad hoc considerations. The model, presented in

Figure 1. The conceptual residential satisfaction model.*

Figure 1, consists of the endogenous variables *Residential satisfaction*, *Housing quality*, *Home ownership* and *Community type*, and the exogenous variables *Gender*, *Children*, and *Socioeconomic status*. Below, we first discuss the endogenous variables and their relationships, then the exogenous variables and their impacts.

The main endogenous variable is *Residential satisfaction*. It is a latent variable⁴ defined as a household's subjective assessment of their living environment (Galster, 1987; Lu, 1999). We take *Housing satisfaction* and *Community satisfaction* as the two observed indicators of *Residential satisfaction*. They represent related dimensions of *Residential satisfaction* (Lu, 1999). Both indicators are measured on a four-point scale ranging from very unsatisfied to very satisfied.

Housing quality is a determinant of *Residential satisfaction* with a positive impact. It is a latent variable measured by the following indicators. The first is *Living space*. Larger per capita living space not only meets basic physical but also psychological needs (Harris et al., 1996). Particularly, it reflects an individual's social status (Opoku and Abdul-Muhmin, 2010). Chen et al. (2013) and Fang (2006) showed that residential

satisfaction increases with per capita living space in Beijing and Dalian, respectively. The *Number of bedrooms*, *Number of bathrooms* and *Number of living rooms* are the other *Housing quality* indicators. James (2008a, 2008b) showed that the presence of separate bedrooms for parents and children contributes to more private space. In a similar vein, bathrooms provide privacy and convenience whereas living rooms offer space for common household activities.

The next endogenous explanatory variable of *Residential satisfaction* is *Home ownership*. Homeowners tend to be more satisfied with their housing and community characteristics than tenants (Deurloo et al., 1994; Diaz-Serrano, 2009; Parkes et al., 2002) because they generally have fewer incentives to move out of their current community (Dietz and Haurin, 2003; Helderma et al., 2004; Lu, 1998). They are therefore more likely to participate in community activities and management and to construct social bonds with their neighbours (Diaz-Serrano and Stoyanova, 2010; DiPasquale and Glaeser, 1999). In addition, home owners are at less risk than renters of being involuntarily moved from their homes. Chen et al. (2013) showed that the impact of home ownership on residential satisfaction is significant and positive in the Chinese city of Dalian. Thus, we hypothesise that *Home ownership* has a positive impact on *Residential satisfaction*.

*Measurement errors, coefficients and correlations in Equations (1) to (3) are not included in Figure 1. Latent variables in ellipses; observed variables in boxes; a one-way arrow between two variables indicates a postulated direct impact.

The final endogenous explanatory variable of *Residential satisfaction* is *Community type*. Residents highly appreciate safe communities with good leisure facilities; local shops; public facilities such as transportation, schools and healthcare; and good environmental quality (Dekker et al., 2011; Hipp, 2010; Lu, 1999). The dataset does not include information on the above community facilities. However, information is captured from each respondent on the type of community they live in, which corresponds to the presence of the above characteristics. Therefore, we consider community type as a proxy for community facilities. There are four categories: (i) shanty communities; (ii) affordable housing communities (state-developed communities for low-income urban households), resettled housing communities (state-developed communities for households whose houses have been demolished because of a public project) and old communities; (iii) commodity housing communities (communities constructed by private real estate development companies) and state-built communities; and (iv) upscale communities (single-family detached house communities). A shanty community is crowded and has poor public transportation and insufficient sanitary and leisure facilities. An affordable, old or resettled housing community is better than a shanty community in terms of sanitary facilities, but lacks adequate public transportation and leisure facilities. A commodity housing or state-built community has good public transportation and sanitary and leisure facilities. An upscale community has green space, in addition to good sanitary, transportation and leisure facilities.

We take *Housing quality* as an endogenous variable which is positively affected by the endogenous variables *Home ownership* and *Community type*. The rationale for the former relationship is that homeowners tend to take more actions to improve the quality

of their housing (Davidson and Leather, 2000; Dekker et al., 2011). Henderson (1985) showed that *Community type* positively impacts on *Housing quality*. The implications of these hypothesised relationships are that *Home ownership* and *Community type*, in addition to their direct impacts, have indirect impacts on *Residential satisfaction* (via *Housing quality*).

We now turn to the exogenous variables. An important positive determinant of *Residential satisfaction* is *Gender*. The rationale is that women generally spend more time in their communities than men and thus have more friends and acquaintances in their neighbourhoods (Reid and Comas-Diaz, 1990). Women also spend more time at home than men and thus adapt their homes more to suit their needs. Several studies support the hypothesis that women tend to be more satisfied with their houses and communities than men, for example Lu (1999) and Ibem and Aduwo (2013).

Although there is no consensus about its impact in the literature, we consider *Children* as a determinant of *Residential satisfaction*. Brodsky et al. (1999) and Dekker et al. (2011) found that parents with children are less satisfied with their residential conditions than those without children because of their additional demands for amenities such as playgrounds, a safe and healthy environment and extra rooms. However, Guest and Wierzbicki (1999) and Parkes et al. (2002) argue that children are an important intermediary in generating social bonding, which in turn results in higher *Residential satisfaction*.

We also hypothesise that *Children* have an impact on *Housing quality* and *Community type* since most families in urban China have only one child. Therefore, families pay a lot of attention to their child's wellbeing, inter alia by providing decent housing and community conditions for them. Parents with children are therefore generally more critical about the size of their

house, and the facilities and conditions of their house and community (Brodsky et al., 1999). Therefore, *ceteris paribus*, we expect households with children to be less satisfied with their houses and communities than those without.

We assume the latent variable *Socioeconomic status* – measured by *Income* and *Education* – to indirectly impact on *Residential satisfaction* via *Housing quality*, *Community type* and *Home ownership*. Since the introduction of the market-based housing supply system, urban residents have been allowed to purchase houses (Wang and Murie, 1996, 1999), which has rendered income an important determinant of *Home ownership* (Li and Chen, 2011; Logan et al., 2010). Moreover, households with higher incomes could more easily relocate from one community to another to meet their demand for particular community characteristics (Teck-Hong, 2012). High-income households also have more financial means to furnish and decorate their houses, which positively impacts *Housing quality*. Finally, residents with higher education are better able to find better housing and communities than their less well-educated peers (Fredrickson et al., 1980). On the basis of the above considerations, we expect *Socioeconomic status* to have positive impacts on *Housing quality*, *Community type* and *Home ownership*.

The final exogenous variable is *Hukou* which, like *Socioeconomic status*, indirectly impacts on *Residential satisfaction* via *Home ownership*. Without a permanent *Hukou*, individuals are excluded from the urban welfare system and have no access to public housing or government-subsidised housing (Wu, 2002). Furthermore, individuals without a permanent *Hukou* are generally poorer than local urban residents and their income is unstable, which hinders them from obtaining mortgages for commercial housing. Therefore, individuals without a permanent *Hukou* are less likely to be homeowners.

The magnitudes of the impacts of the determinants of *Residential satisfaction* are likely to differ across the three regions because of socioeconomic disparities. Firstly, because of the higher population density and higher housing prices, the impacts of house size and *Home ownership* in the coastal region are likely to be larger than in the central and inland regions (see Demurger, 2001; Zhuo et al., 2009). Particularly, urban residents in the coastal region are more likely to live in smaller houses and are less likely to be homeowners. Therefore, because of more severe scarcity, *Home ownership* and house size will be more appreciated in the coastal region. The opposite holds for the impact of *Community type*. The relatively favourable economic conditions in the central and especially the coastal region allow more investments in public goods such as public transport, green space (such as parks) and sport facilities (Li and Fang, 2014). Communities in these regions are therefore likely to be in better shape than those in the inland regions. Thirdly, because of approximately equal labour force participation rates, the difference in *Residential satisfaction* between females and males in the coastal and central regions is likely to be marginal. In the inland region, however, female labour market participation is relatively low (Yao and Xu, 2013). Accordingly, women spend more time at home than men and thus are likely to be more satisfied with their home than men are.

In a similar vein, we expect variation with respect to the determinants of the other endogenous variables across the three regions.

Multi-group SEM

We applied a multi-group SEM to estimate the same satisfaction model simultaneously (presented in Figure 1) for each group and to test the equality of parameters across groups (Deng et al., 2005). As an SEM, a multi-group SEM can handle latent and observed

variables and their relationships within an integrated framework (Jöreskog and Sörbom, 1996). A multi-group SEM is a system-of-equations model composed of two measurement models and a structural model.

The measurement models present the relationship between the latent endogenous and latent exogenous variables and their indicators. Measurement model (1) relates to the endogenous variables and model (2) to the exogenous variables:⁵

$$\mathbf{y}^g = \mathbf{A}_y^g \boldsymbol{\eta}^g + \boldsymbol{\varepsilon}^g \text{ with } \text{cov}(\boldsymbol{\varepsilon}^g) = \boldsymbol{\Theta}_\varepsilon^g \quad (1)$$

$$\mathbf{x}^g = \mathbf{A}_x^g \boldsymbol{\xi}^g + \boldsymbol{\delta}^g \text{ with } \text{cov}(\boldsymbol{\delta}^g) = \boldsymbol{\Theta}_\delta^g \quad (2)$$

where $\mathbf{y}$ denotes a $p \times 1$ vector of endogenous observed variables, $\mathbf{x}$ a $q \times 1$ vector of exogenous observed variables, $\boldsymbol{\eta}$ an $m \times 1$ vector of latent endogenous variables and $\boldsymbol{\xi}$ an $n \times 1$ vector of latent exogenous variables. $\mathbf{A}_y$ and $\mathbf{A}_x$ are $p \times m$ and $q \times n$ matrices of coefficients (loadings), respectively. $\boldsymbol{\varepsilon}$ and $\boldsymbol{\delta}$ stand for $p \times 1$ and $q \times 1$ vectors of measurement errors of $\mathbf{y}$ and $\mathbf{x}$, respectively. $\boldsymbol{\Theta}_\varepsilon$ ($p \times p$) and $\boldsymbol{\Theta}_\delta$ ($q \times q$) are the covariance matrices of $\boldsymbol{\varepsilon}$ and $\boldsymbol{\delta}$, respectively. The superscript g refers to the g th group, $g = 1, \dots, G$.

The structural model presents the relationships between the latent exogenous and latent endogenous variables as well as the relationships among the latent endogenous variables mutually. It reads:

$$\begin{aligned} \boldsymbol{\eta}^g &= \mathbf{B}^g \boldsymbol{\eta}^g + \mathbf{F}^g \boldsymbol{\xi}^g + \boldsymbol{\zeta}^g \text{ with } \text{cov}(\boldsymbol{\xi}^g) \\ &= \boldsymbol{\Phi}^g \text{cov}(\boldsymbol{\zeta}^g) = \boldsymbol{\Psi}^g \end{aligned} \quad (3)$$

where $\mathbf{B}$ is an $m \times m$ matrix of the structural relationships among the latent endogenous variables mutually, $\mathbf{F}$ an $m \times n$ matrix of the coefficients of the impacts of the exogenous latent variables on the endogenous latent variables and $\boldsymbol{\zeta}$ a random $m \times 1$ vector of errors. $\boldsymbol{\Phi}$ ($n \times n$) and $\boldsymbol{\Psi}$ ($m \times m$) are the covariance matrices of $\boldsymbol{\xi}$ and $\boldsymbol{\zeta}$, respectively.

Equations (4) to (6) present the conceptual model as an SEM derived from equations (1) to (3).⁶

$$\begin{aligned} & \begin{bmatrix} \text{Housing satisfaction} \\ \text{Community satisfaction} \\ \text{Living space} \\ \text{Number of bedrooms} \\ \text{Number of bathrooms} \\ \text{Number of living rooms} \\ \text{Tenure} \\ \text{Community type} \end{bmatrix}^g \\ &= \begin{bmatrix} \lambda_{1,1} & 0 & 0 & 0 \\ \lambda_{2,1} & 0 & 0 & 0 \\ 0 & \lambda_{3,2} & 0 & 0 \\ 0 & \lambda_{4,2} & 0 & 0 \\ 0 & \lambda_{5,2} & 0 & 0 \\ 0 & \lambda_{6,2} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^g \\ &\times \begin{bmatrix} \text{Residential satisfaction} \\ \text{Housing quality} \\ \text{Tenure} \\ \text{Community type} \end{bmatrix}^g + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ 0 \\ 0 \end{bmatrix}^g \\ &\begin{bmatrix} \text{Gender} \\ \text{Children} \\ \text{Income} \\ \text{Education} \\ \text{Hukou} \end{bmatrix}^g = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \lambda_{3,3} & 0 \\ 0 & 0 & \lambda_{4,3} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^g \\ &\times \begin{bmatrix} \text{Gender} \\ \text{Children} \\ \text{Socioeconomic status} \\ \text{Hukou} \end{bmatrix}^g + \begin{bmatrix} 0 \\ 0 \\ \delta_3 \\ \delta_4 \\ 0 \end{bmatrix}^g \end{aligned} \quad (4)$$

$$\begin{aligned} & \begin{bmatrix} \text{Gender} \\ \text{Children} \\ \text{Income} \\ \text{Education} \\ \text{Hukou} \end{bmatrix}^g = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \lambda_{3,3} & 0 \\ 0 & 0 & \lambda_{4,3} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^g \\ &\times \begin{bmatrix} \text{Gender} \\ \text{Children} \\ \text{Socioeconomic status} \\ \text{Hukou} \end{bmatrix}^g + \begin{bmatrix} 0 \\ 0 \\ \delta_3 \\ \delta_4 \\ 0 \end{bmatrix}^g \end{aligned} \quad (5)$$

$$\begin{aligned}
& \begin{bmatrix} \text{Residential satisfaction} \\ \text{Housing quality} \\ \text{Tenure} \\ \text{Community type} \end{bmatrix}^g \\
&= \begin{bmatrix} 0 & \beta_{1,2} & \beta_{1,3} & \beta_{1,4} \\ 0 & 0 & \beta_{2,3} & \beta_{2,4} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}^g \\
&\times \begin{bmatrix} \text{Residential satisfaction} \\ \text{Housing quality} \\ \text{Tenure} \\ \text{Community type} \end{bmatrix}^g \\
&+ \begin{bmatrix} \gamma_{1,1} & \gamma_{1,2} & 0 & 0 \\ 0 & \gamma_{2,2} & \gamma_{2,3} & 0 \\ 0 & 0 & \gamma_{3,3} & \gamma_{3,4} \\ 0 & \gamma_{4,2} & \gamma_{4,3} & 0 \end{bmatrix}^g \\
&\times \begin{bmatrix} \text{Gender} \\ \text{Children} \\ \text{Socioeconomic status} \\ \text{Hukou} \end{bmatrix}^g + \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \end{bmatrix}^g
\end{aligned} \quad (6)$$

Note that for each latent variable the variance is fixed at 1 to assign it a measurement scale and render the model identified (see Jöreskog and Sörbom (1996) for details).

The indicators of *Housing satisfaction*, and the variables *Community satisfaction*, *Home ownership*, *Gender*, *Children* and *Hukou*, are ordinal or dichotomous. Therefore, we shall apply the Weighted Least Squares (WLS) estimator based on the matrix of polychoric correlations (see Flora and Curran (2004) and Jöreskog and Sörbom (1996) for details). The LISREL 8 software package was used (Jöreskog and Sörbom, 1996).

LISREL 8 provides a variety of statistical tools to evaluate the goodness-of-fit of a (multi-group) SEM, including the χ^2 statistic and the Root Mean Square Error of Approximation (RMSEA), the Goodness-of-Fit Index (GFI), the Adjusted Goodness-

of-Fit Index (AGFI) and the Comparative Fit Index (CFI). The χ^2 is inappropriate for assessing the goodness-of-fit of the SEM in this study as the number of observations for each group is larger than 1000 and because of the presence of ordinal and dichotomous observed variables (Bollen, 1989; Jöreskog and Sörbom, 1996). Therefore, the model fit will be evaluated by means of the RMSEA, GFI, AGFI and CFI.

However, the χ^2 can be used to test nested constraints, particularly whether or not the same model holds for all three regions. In that case the test statistic is:

$$\Delta\chi^2 = \chi_0^2 - \chi_1^2 \quad (7)$$

where χ_0^2 and χ_1^2 are the overall model fit of the χ^2 values under the null (the same model holds for all three regions) and the alternative hypothesis, respectively, and df_0 and df_1 are the corresponding degrees of freedom. The null is rejected at significant level α if $P(\chi_{df_0-df_1}^2 \geq \Delta\chi^2) < \alpha$, with $\chi_{df_0-df_1}^2$ being the critical chi-square value with $df_0 - df_1$ degrees of freedom.

Data and empirical results

Data

The dataset analysed comes from the national Chinese General Social Survey (CGSS), which was conducted in 2003, 2004, 2005, 2006, 2008 and 2010 (Bian and Li, 2012). The CGSS contains detailed information on personal characteristics and household and housing conditions. However, information on residential satisfaction was only collected in 2006. In the 2006 wave, 6013 urban residents in 28 provinces in mainland China were interviewed.⁷ Eight hundred and eighty observations (14.63%) were excluded because of incomplete information, leaving a total of 5133 observations for empirical analysis.

To account for disparities in residential conditions and local physical and socioeconomic conditions across the coastal, central and inland regions, we divided the 5133 observations into three groups according to region: 2383 observations (46.43%) in the coastal region, 1519 (29.59%) in the central region and 1231 (23.98%) in the inland region.⁸

Descriptive statistics on housing and community satisfaction, housing characteristics and household characteristics are presented in Table 1. The table shows that residents in the coastal region have higher education and income levels than their counterparts in the central and inland regions but enjoy smaller housing. In addition, home ownership is lower in the coastal region, which is consistent with Yi and Huang (2014). This is most likely due to substantially higher housing prices in the coastal region.

The table shows furthermore that housing satisfaction and community satisfaction in the coastal region are lower than in the central and inland regions. A nonparametric Kruskal-Wallis One-way ANOVA led to the rejection of the hypotheses that there are no differences among the three regions in housing satisfaction and community satisfaction: $\chi^2 = 14.20$, $df = 2$, $p\text{-value} = 0.00$ and $\chi^2 = 9.43$, $df = 2$, $p\text{-value} = 0.01$, respectively.⁹

Invariance tests

As a first step, we shall test invariance of the determinants of *Residential satisfaction* across the three regions. In other words, we shall test the hypothesis:

H1 *The same model holds for all three regions.*

If H1 is rejected, we will test whether the same model holds for two regions (H2: coastal and central; H3: coastal and inland; and H4: central and inland).

The results of the χ^2 difference tests are presented in Table 2. The table shows that all four hypotheses are rejected at the 0.01 level, implying that the impacts of the determinants on residential satisfaction vary between the three regions. Interpretations are provided below.

The region-specific SEMs

Before going into detail, we observe that the estimated coefficients are standardised or beta coefficients.¹⁰ As a consequence, the scales of the explanatory variables are irrelevant and the estimated coefficients are directly comparable.

The overall goodness-of-fit indices of the SEM models for the three regions, specifically RMSEA = 0.07, GFI = 0.99, AGFI = 0.97 and CFI = 1.00 for the coastal region; RMSEA = 0.07, GFI = 0.99, AGFI = 0.97 and CFI = 1.00 for the central region; RMSEA = 0.07, GFI = 0.98, AGFI = 0.97 and CFI = 1.00 for the inland region, meet their critical values: < 0.08 for the RMSEA, > 0.95 for the GFI, > 0.95 for the AGFI and > 0.95 for the CFI, indicating that the empirical models have good overall fit (see e.g. Hooper et al. (2008) for details).

The measurement equations of the endogenous and exogenous latent variables – consisting of factor loadings, standard errors and R^2 s – are presented in Table 3. The loadings are significant at the 0.01 level for all three regions and exceed the recommended minimum magnitude of 0.20 (Jöreskog and Sörbom, 1996). The table furthermore shows that while the loadings of *Housing satisfaction*, *Living space*, *Number of bedrooms* and *Education* only vary slightly across the three models, the loading of *Income* varies from 0.27 in the coastal region to 0.82 in the central region. The reliabilities or R^2 s (i.e. the proportion of the variance of an indicator explained by its latent variable) of the

Table 1. Descriptive statistics for the observed variables.

Variable	Coastal region				Central Region				Inland region			
	Mean	S. D.	Min	Max	Mean	S. D.	Min	Max	Mean	S. D.	Min	Max
Housing satisfaction ^a	2.47	0.75	1	4	2.57	0.77	1	4	2.54	0.79	1	4
Community satisfaction ^a	2.61	0.63	1	4	2.68	0.64	1	4	2.66	0.66	1	4
Living space (m ²)	27.91	20.18	4	250	30.47	22.37	4	255	28.75	17.74	4	160
Number of bedrooms	2.10	1.05	1	9	2.26	1.16	1	9	2.32	1.12	1	9
Number of bathrooms	0.90	0.44	0	4	0.79	0.53	0	4	0.93	0.42	0	5
Number of living rooms	0.87	0.55	0	4	0.94	0.62	0	3	1.04	0.47	0	3
Community type ^b	2.47	0.52	1	4	2.30	0.50	1	4	2.39	0.49	2	4
Home ownership (0 = rent, 1 = own)	0.70	0.46	0	1	0.85	0.36	0	1	0.72	0.45	0	1
Gender (0 = male, 1 = female)	0.55	0.50	0	1	0.55	0.50	0	1	0.54	0.50	0	1
Children ^c	0.36	0.48	0	1	0.47	0.50	0	1	0.52	0.50	0	1
Income (1000 RMB/year)	44.28	229.23	2	8000	21.22	25.40	2	500	23.30	73.34	1	2500
Education ^d	4.07	1.57	1	8	3.55	1.39	1	7	3.65	1.53	1	8
Hukou ^e	0.84	0.37	0	1	0.86	0.34	0	1	0.80	0.40	0	1

Notes: ^a 1 = very unsatisfied; 2 = unsatisfied; 3 = satisfied; 4 = very satisfied. ^b 1 = shanty community; 2 = affordable, old and resettled community; 3 = commodity housing and state-constructed community; 4 = upscale community. ^c 0 = no children under 16 years old in the family; 1 = at least one child under 16 years old in the family. ^d 1 = illiterate; 2 = primary school; 3 = junior high school; 4 = senior high school; 5 = polytechnic school; 6 = junior college; 7 = bachelor's; 8 = master's or above. ^e 1 = with a permanent Hukou in the city; 0 = without a permanent Hukou in the city.

Table 2. Invariance tests of residential satisfaction across regions.

No.	Hypothesis	χ^2	Df	$\Delta\chi^2$	Δdf	Sign. Level	Decision
H1	Null hypothesis: <i>The same model holds for all three regions.</i>	1869.25	155	312.81	26	0.00	Rejected
	Alternative hypothesis	1556.44	129				
H2	Null hypothesis: <i>The same model holds for the coastal and central regions.</i>	1255.08	99	112.22	13	0.00	Rejected
	Alternative hypothesis	1142.86	86				
H3	Null hypothesis: <i>The same model holds for the coastal and inland regions.</i>	1155.47	99	161.52	13	0.00	Rejected
	Alternative hypothesis	993.95	86				
H4	Null hypothesis: <i>The same model holds for the central and inland regions.</i>	975.62	99	126.78	13	0.00	Rejected
	Alternative hypothesis	848.84	86				

indicators *Housing satisfaction*, *Living space* and *Number of bedrooms* are quite stable across the models. For *Community satisfaction*, *Number of bathrooms* and *Number of living rooms*, there is quite some variation. The indicators *Income* and *Education* have relatively low reliabilities (*Income* in the central region is an exception). We therefore substituted the latent variable *Socioeconomic status* for its directly observed indicators. The substitution only marginally changed the structural model and the other equations of the measurement models. Therefore, we retained the model with *Socioeconomic status*.¹¹

The main results in Table 3 are the estimated loadings of *Housing satisfaction* and *Community satisfaction*. The estimated loadings of the former are uniformly larger than those of the latter, indicating that *Residential satisfaction* manifests itself more strongly via *Housing satisfaction* than via *Community satisfaction*. The R^2 s of *Housing satisfaction* are also uniformly larger. The rankings of the loadings and R^2 s of the other indicators vary across the regional models

unsystematically. Nevertheless, the results show that *Living space* is the indicator of *Housing quality* with the highest loading and reliability in all three models. *Income* is the indicator of *Socioeconomic status* with the largest loading and highest reliability, except in the inland region model where *Education* has the highest reliability.

We now turn to the structural models presented in Table 4, the residential satisfaction equation in particular. The first feature to note is that the R^2 s indicate that 16%, 21% and 13% of the variation in *Residential satisfaction* is explained by the explanatory variables in the three structural models. This outcome is higher than in Chen et al. (2013) and Hu (2013), indicating that SEM may have more explanatory power than conventional approaches. A second feature is that the magnitudes and significance levels of the impacts of the determinants of *Residential satisfaction* vary across regions.

Consistent with the existing literature (including Dekker et al., 2011), *Housing quality* positively and significantly impacts *Residential satisfaction* in all three models,

Table 3. Standardised coefficients of the measurement models.

Latent variable	Indicator	Coastal region			Central region			Inland region		
		Coefficient	S.E.	R ²	Coefficient	S.E.	R ²	Coefficient	S.E.	R ²
Residential satisfaction	Housing satisfaction	0.91***	0.03	0.83	0.96***	0.04	0.93	0.97***	0.06	0.95
	Community satisfaction	0.73***	0.02	0.53	0.61***	0.02	0.37	0.54***	0.03	0.30
	Living space	0.98***	0.06	0.87	0.94***	0.08	0.89	0.97***	0.07	0.94
	Housing quality	0.50***	0.03	0.25	0.44***	0.03	0.20	0.49***	0.04	0.24
Socioeconomic status	Number of bedrooms	0.60***	0.03	0.36	0.96***	0.04	0.93	0.60***	0.04	0.36
	Number of living rooms	0.63***	0.03	0.40	0.87***	0.04	0.75	0.44***	0.03	0.19
	Income	0.27***	0.04	0.07	0.82***	0.02	0.68	0.37***	0.03	0.08
	Education	0.21***	0.03	0.04	0.26***	0.03	0.07	0.28***	0.04	0.13

Notes: ***p < 0.01. S.E.: standard error.

Table 4. Standardised coefficients of the structural models.

Explanatory variables	Coastal region			Central region			Inland region		
	Residential satisfaction	Housing quality	Home ownership	Community ownership	Housing quality	Residential satisfaction	Community ownership	Housing quality	Home ownership
Housing quality	0.44*** (0.06)					0.08*** (0.04)		0.12*** (0.04)	
Home ownership	0.32*** (0.04)	0.15*** (0.02)			0.11*** (0.02)	0.27*** (0.04)		0.34*** (0.06)	0.11*** (0.03)
Community type	0.16*** (0.04)	0.34*** (0.06)			0.25*** (0.05)	0.48*** (0.06)		0.27*** (0.06)	0.41*** (0.14)
Gender	−0.04 (0.04)				0.03 (0.04)			0.06** (0.03)	
Children	−0.10** (0.05)	−0.29*** (0.03)		0.01 (0.03)	−0.16*** (0.04)		0.04 (0.04)	−0.50*** (0.11)	0.08 (0.04)
Socioeconomic status		0.16*** (0.03)	0.58*** (0.22)	0.25*** (0.04)	0.15*** (0.03)		0.48*** (0.23)	0.30*** (0.07)	1.56*** (0.80)
Hukou			0.83*** (0.23)		0.72*** (0.24)		0.24 (0.85)	1.99*** (0.70)	0.03
R ²	0.16	0.19	0.40	0.06	0.38	0.21	0.06	0.40	0.03

Notes: Standard errors in parenthesis. **p < 0.05, ***p < 0.01.

indicating that more living space, bedrooms, bathrooms and living rooms result in more residential satisfaction. The impact in the coastal region is much greater than in the central and inland regions. A possible explanation is that on average, *Housing quality* in the coastal region is poorer than in the other two regions (see Table 1) and is thus more appreciated.

Home ownership also has a positive and significant impact on *Residential satisfaction* in all three models, which confirms the hypothesis in the conceptual model that homeowners are more satisfied than renters. The results also show that the impact in the coastal and inland region models is somewhat larger than in the central region model. This could be because the home ownership rate in the former regions is lower than in the central region (see Table 1).

Community type has a significant and positive impact in all three models, as hypothesised. Its impact in the coastal and central region models is lower than in the inland region model. This could be because compared to the inland region, more public goods (such as public transport, schools and hospitals) are provided in the coastal and central regions to improve community facilities, notably in the shanty, old and resettled housing communities (Zhang and Kanbur, 2005), which reduces the differences between communities.

In the inland region model, *Gender* is significant as expected. In the coastal and central regions, however, the difference between women and men is insignificant, which is probably related to the fact that female labour force participation in these regions is high, meaning that females spend approximately as much time in their residential communities as males.

The presence of *Children* has a negative and significant impact on *Residential satisfaction* in the coastal and central regions, which is in line with the hypothesis

postulated above and also with Brodsky et al. (1999) and Dekker et al. (2011). In the inland region, however, it has an insignificant impact. A possible explanation for the latter result is that parents with young children are less critical about their surroundings as mothers spend more time with their children (Yao and Xu, 2013) because of lower female labour force participation.

Home ownership, *Community type* and *Socioeconomic status* have significant and positive impacts on *Housing quality* in all three models, while the presence of *Children* has a negative, significant impact.¹² The main determinants of *Home ownership* are *Socioeconomic status* and *Hukou* all three models, with significant, positive effects, while the only significant determinant of *Community type* is *Socioeconomic status*.¹³

Table 5 presents the standardised indirect and total impacts¹⁴ of the explanatory variables on *Residential satisfaction* and on its indicators *Housing satisfaction* and *Community satisfaction*.¹⁵ Below we discuss only the total effects.

In descending order of magnitude, *Housing quality*, *Home ownership*, *Socioeconomic status*, *Hukou* and *Community type* have positive, significant total impacts on *Residential satisfaction* in the coastal region. Furthermore, the presence of *Children* has a negative, significant impact and *Gender* an insignificant effect. Similar observations apply to the indicators *Housing satisfaction* and *Community satisfaction*. The impacts on the latter are somewhat lower (in absolute values for *Children*) because of its smaller loading. In the central region, *Community type* has the greatest impact on *Residential satisfaction*, followed by *Home ownership*, *Socioeconomic status*, *Hukou* and *Housing quality*. Again, *Children* has a negative total impact and *Gender* an insignificant one. The same order holds for the indicators. In the inland region model *Hukou* has the largest impact on *Residential*

Table 5. Standardised indirect and total impacts.

Explanatory variables	Coastal region				Central region				Inland region			
	Indirect impacts		Total impacts		Indirect impacts		Total impacts		Indirect impacts		Total impacts	
	Residential satisfaction	Housing satisfaction	Community satisfaction		Residential satisfaction	Housing satisfaction	Community satisfaction		Residential satisfaction	Housing satisfaction	Community satisfaction	
Housing quality		0.44*** (0.06)	0.40*** 0.03	0.32*** 0.03		0.08** (0.04)	0.07** 0.03	0.05** 0.02		0.12*** (0.04)	0.12*** 0.04	0.07*** 0.02
Home ownership	0.07*** (0.01)	0.39*** (0.04)	0.35*** 0.03	0.28*** 0.02	0.01 (0.01)	0.28*** (0.04)	0.27*** 0.03	0.17*** 0.02	0.01 (0.01)	0.36*** (0.06)	0.35*** 0.05	0.19*** 0.03
Community type	0.15*** (0.04)	0.31*** (0.04)	0.28*** 0.02	0.23*** 0.02	0.04** (0.02)	0.29*** (0.04)	0.28*** 0.03	0.18*** 0.02	0.05*** (0.02)	0.32*** (0.05)	0.31*** 0.04	0.15*** 0.03
Gender		-0.04 (0.04)	-0.03 0.02	-0.03 0.02		0.03 (0.04)	0.03 0.03	0.02 0.02		0.06** (0.03)	0.06** 0.04	0.03 0.02
Children	-0.11*** (0.03)	-0.20*** (0.04)	-0.18*** 0.03	-0.14*** 0.02	-0.01 (0.02)	-0.17*** (0.04)	-0.16*** 0.03	-0.10*** 0.02	-0.04*** (0.04)	-0.08 (0.05)	-0.07 0.04	-0.04 0.02
Socioeconomic status	0.37*** (0.07)	0.37*** (0.07)	0.34*** 0.04	0.27*** 0.04	0.21*** (0.05)	0.21*** (0.05)	0.21*** 0.04	0.13*** 0.03	0.38*** (0.11)	0.38*** (0.11)	0.37*** 0.08	0.21*** 0.05
Hukou	0.32*** (0.08)	0.32*** (0.08)	0.29*** 0.05	0.23*** 0.04	0.20*** (0.06)	0.20*** (0.06)	0.20*** 0.05	0.12*** 0.03	0.39*** (0.11)	0.39*** (0.11)	0.38*** 0.09	0.21*** 0.05

Notes: Standard errors in parenthesis. ** $p < 0.05$, *** $p < 0.01$. Since no endogenous variables impact on Home ownership and Community type, there are no indirect impacts on these variables. The standardised total impacts for these two variables therefore equal the standardised coefficients presented in Table 4. Since they impact on the indicators Housing Satisfaction and Community Satisfaction via the latent variable Residential satisfaction, there are no direct effects of the explanatory variables on these indicators. Hence, their indirect effects are their total effects.

satisfaction, followed by *Socioeconomic status*, *Home ownership*, *Community type* and *Housing quality*. Furthermore, *Gender* has a significant, positive impact and *Children* a negative, though insignificant impact.

The magnitude of the total impacts on *Residential satisfaction* and its indicators varies across the three models. It is nevertheless clear that *Home ownership* and *Community type* are major determinants with substantial positive direct impacts and smaller indirect effects in all three models. *Socioeconomic status* has substantial positive effects on *Residential satisfaction* via *Housing quality*, *Home ownership* and *Community type* and *Hukou* via *Home ownership*. The results indicate that the market factor *Socioeconomic status* and the institutional factor *Hukou* play an important role in shaping residential satisfaction in transitional China, which is consistent with Market Transition Theory (see Nee, 1996). The total impact of *Housing quality* on *Residential satisfaction* varies from 0.44 in the coastal region model to 0.08 in the central region model. This difference is due to the fact that on average, housing quality in the coastal region is less than in the other two regions (see Table 1) and is thus more appreciated. Meanwhile, the total *Gender* impact is only significant in the inland region model due to low female labour market participation. Consequently, the time females spend in their residential communities is significantly more than for males. In the coastal and central regions females have full-time jobs, like males, and spend the same amount of time in their communities as males. Finally, the total impact of *Children* is significant and negative in the coastal and central regions and insignificant in the inland region. This variation is due to the fact that mothers in the inland region are less likely have full-time jobs and thus spend more time on caring for their

children, which compensates for poor living conditions.

Conclusions and policy implications

This paper analyses interregional disparities in urban residential satisfaction in the coastal, central and inland regions in China, based on the 2006 wave of the China General Social Survey. It applies structural equation modelling (SEM) to reduce the problem of multicollinearity, and multi-group analysis to reduce the risk that disparities in residential satisfaction are wrongly ascribed to differences in model specification.

The paper's main finding is that *Housing quality*, *Home ownership*, *Community type*, *Socioeconomic status* and *Hukou* in all three regions have positive impacts on *Residential satisfaction*, while the presence of *Children* has a negative effect. The results furthermore indicate that the sizes of the impacts of the determinants of *Residential satisfaction* strongly differ across the regions. *Housing quality* is the most important determinant of *Residential satisfaction* in the coastal region, and *Community type* and *Hukou* in the central and inland regions, respectively. Meanwhile, *Home ownership* has a larger total impact in the coastal and inland regions than in the central region, which is related to the fact that home ownership is lower in the former two regions. *Community type* has a larger impact in the inland region than in the coastal and central regions, where investments in public goods have improved community facilities, notably in shanty, old and resettled housing communities, such that the differences between communities have been reduced. The impact of *Gender* on *Residential satisfaction* in the coastal and central regions is insignificant and smaller than in the inland region because female

labour market participation is high in the former regions. Consequently, the time females spend in their residential communities is not significantly more than that of males. The presence of *Children* has a smaller impact on *Residential satisfaction* in the inland region than in the coastal and central regions because females in the inland region spend more time with their children, which compensates for housing and community disamenities.

The paper confirms the findings in Yu (2006) that residents in coastal regions have smaller housing, and fewer bathrooms and living rooms. It furthermore shows that housing satisfaction and community satisfaction in the coastal region are lower than in the central and inland regions.

The findings in this paper have some important policy implications. Firstly, to increase residential satisfaction, policy-makers should pay more attention to increasing community satisfaction, as it has lower loading on residential satisfaction than housing satisfaction in all three regions. Secondly, differentiation of policy across the regions is needed as the impacts of the determinants of residential satisfaction vary. Particularly, in the central region and especially in the coastal region, the focus should be on housing quality improvement. In contrast, community improvement is needed in the inland region. Furthermore, in the coastal and central regions, property speculation should be dealt with to increase housing affordability and to increase the living space available to urban residents. In the inland regions, investment in public goods should be encouraged to improve community satisfaction. Thirdly, housing subsidies and social housing policies should be implemented to help immigrants without a *Hukou* obtain decent accommodation.

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Notes

1. Because of substantial disparities in China between rural and urban areas in housing, community characteristics and socioeconomic conditions, this paper focuses on urban areas. For an overview of the rural-urban disparity, see amongst others Knight and Song (1999) and Park (2008).
2. See Appendix A for the classification of regions.
3. Although there have been several CGSS waves, the 2006 wave is the only one so far which permits analysis of residential satisfaction. Since the differences in the economic and social environment among the three regions have increased rather than decreased (Fleisher et al., 2010), the relationships identified in this paper are likely to still hold.
4. A latent variable (or theoretical construct) denotes a variable which is supposed to exist but can be only indirectly observed through observable indicators (Oud and Folmer, 2008). A well-known example is welfare, which is measured by indicators such as per capita income, income inequality, the unemployment rate and environmental quality. For details, see Jöreskog and Sörbom (1996) and the references therein.
5. It is possible to include intercepts in the measurement models and the structural model. However, the empirical analysis is presented in terms of standardised variables and beta coefficients. Therefore, intercepts are not included here.

6. *Home ownership*, *Gender*, *Children*, *Community type* and *Hukou* are single-indicator latent variables with loadings equal to 1 (before estimation) and measurement errors fixed at 0.
7. There are 31 provinces, major metropolitan municipalities and autonomous regions in mainland China. Qinghai, Ningxia and Tibet were not covered in the 2006 wave. As the populations in these three provinces only account for a very small proportion of the national population, their absence will not seriously affect the national representativeness of the survey (Bian and Li, 2012).
8. This distribution is in line with the regional distribution of China's urban population in 2006: 48.36%, 29.26% and 22.38% in the coastal, central and inland regions, respectively (China Statistics Yearbook, 2007).
9. As *Housing satisfaction* and *Community satisfaction* are ordinal variables, we applied the nonparametric Kruskal-Wallis test.
10. A standardised coefficient represents the standard deviation change in the dependent variable caused by a standard deviation change in an independent variable. For instance, from the coastal region model (Table 3) it follows that a standard deviation increase in *Residential satisfaction* leads to a 0.91 standard deviation increase in *Housing satisfaction* and a 0.73 standard deviation increase in *Community satisfaction*.
11. The model, with *Education* and *Income* substituted for the latent variable *Socioeconomic status*, is available from the first author upon request.
12. *Residential satisfaction* is the core topic of the paper. Therefore, we only briefly discuss the *Housing quality*, *Home ownership* and *Community type* equations.
13. We also considered the impact of *Children* on *Home ownership*. However, as it turned out to be insignificant at the 5% significance level in all three regions, we deleted it. Note that the impact of *Children* on *Home ownership* is ambiguous in the Chinese context for the following reasons. Firstly, in the short run, the presence of children hampers home ownership because of the implied financial burden. In the long run, however, it could

contribute to the children's wealth via inheritance. Secondly, improving children's well-being via housing is a matter of housing quality rather than ownership. These ambiguities may have contributed to the insignificance of the variable.

14. The total impact of an endogenous or exogenous explanatory variable on an endogenous variable is the sum of its direct and indirect impacts. An indirect impact materialises via an intermediate endogenous variable. Direct effects are given by the measurement and structural models (the coefficients in Tables 3 and 4).
15. Since they impact on the indicators *Housing satisfaction* and *Community satisfaction* via the latent variable *Residential satisfaction*, there are no direct effects of the explanatory variables on these indicators. Hence, their indirect effects are their total effects.

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Appendix A. The classification of regions.

Source: Liu (2006), modified by the authors.