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Gentrification effects of China's urban village renewals

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Abstract

China is known in the post-cold war era for its rapid urban regeneration. Urban villages that emit negative social externalities are a unique and salient disamenity, and are central to the urban regeneration policy and planning. This paper uses micro-geographical data to explore how the extent and configuration of recently renewed urban villages in Beijing have influenced nearby housing values. Compared with locations having similar demographic characteristics, locations near urban village renewal sites experienced increases in housing values. Additional results quantify evidence in support of the heterogeneous effects from urban village renewals in affected areas versus unaffected areas.

Keywords
China, housing markets, urban regeneration

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Introduction

Decades of rapid urbanisation and infrastructure investment have dramatically changed urban forms in China. In a modern Chinese city, urban villages that emit negative social externalities are a unique and salient disamenity, and are central to regeneration policy and planning (Song and Zenou, 2012; Song et al., 2008; Wang, 2000; Wu, 2007). Since the 2000s, China has embarked on an ambitious initiative to regenerate depressed urban villages through regenerating plans under the umbrella of various City Strategic Development Acts. Despite widespread public and policy interests, we lack a rigorous assessment of whether changes in urban village disamenities are capitalised in the housing markets in terms of a prominent public policy.

This paper provides evidence on evaluating the gentrification effects of China's urban regeneration programme in terms of people's willingness to pay for avoiding local disamenities. Our research design is based on a renewal policy in local amenities that

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result from more than 100 urban village renewals instituted by the Beijing municipal government as a key part of the city regeneration programme in preparation for the 2008 Olympics. If households value these amenities, urban village renewals should lead to a rise in the price of housing in the immediate vicinity of sites, relative to locations further away. To conduct our investigation, we have assembled geo-coded data sets on the housing markets in Beijing. We link location information on urban villages with data that provide detailed geographical information on the transacted condominium units in the metropolitan area.

Our paper contributes to several strands of literature. First, it contributes to a growing body of urban studies in valuing public infrastructure investment. The conventional wisdom, argued vigorously by planners and economists, is about the unbiased information of local amenities and disamenities. This assumption is critical because it has allowed for the development of optimal policy by deriving estimates of people's willingness to pay (WTP) for local amenities and disamenities (e.g. Chay and Greenstone, 2005; Cheshire and Sheppard, 2004; Gibbons and Machin, 2008; Greenstone and Gallagher, 2008; Wu and Dong, 2014). But for emerging economies such as China, there is little evidence on whether housing market participants are aware of differences in local amenities induced by urban village renewal policies.

There is a substantial literature that investigates various aspects of urban villages in China (see recent reviews in Wang, 2000; Zhang and Song, 2003). Much of it is concerned with institutional and residential characteristics of urban villages, issues not directly related to our work. Indeed, existing evidence on spillover effects of urban villages is particularly sparse, despite the fact that urban villages are widely believed to cause intensified congestion, social disorder and deteriorated living environment. Song and Zenou (2012) use a cross-sectional approach to examine the relationship between housing prices and proximity to urban villages. They find that proximity to urban villages is associated with a decrease in the housing price gradient within a large Chinese city, but do not address the likely reverse causality problem. In what is probably the most closely related paper to our own, Zhang et al. (2015) look at the effects of urban village removals on nearby housing values. On the surface, our research design resembles the investigation in Zhang et al. (2015). We make a similar difference-in-difference approach, but note that more careful consideration reveals differences between our research and that of Zhang et al. (2015). For example, we used night light intensity scores as a proxy for village area characteristics, rather than using pre-selected village surveys. We focused on locations both in the immediate vicinity of urban villages and slightly further away, allowing for comparisons across housing units locating at different distances from the urban villages. While existing studies have been mostly concerned with the average effects of urban village renewals on home values, we look at the distributional effects of housing market consequences over space – an important complementary inquiry. Our econometric approach for mitigating omitted variables concerns is not a panacea but it yields reasonable results across a range of empirical specifications and sensitivity tests.

Context and data

Urban village renewals

The urban village is a special outcome resulting from the rapid urbanisation 'enclosure' movements over the past two decades. Figure 1 summarises the unique social-economic structure of urban villages in China. As cities sprawl, villagers lose their farmlands but can maintain collective-

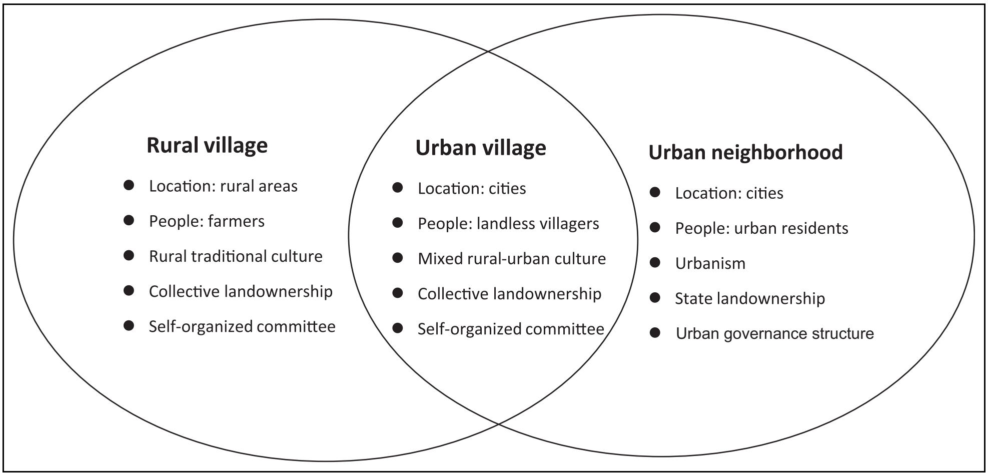

Figure 1. Socioeconomic structure of urban villages in China.

ownership rights of their housing plots (*zhai-jidi*) within the 'village-settlement' lands (often loosely termed 'urban villages'). With limited human capital and skills, landless villagers are marginalised in the urban labour market, and their livelihoods have transformed from 'growing grains' to 'renting apartments'. Without explicit planning controls, housing structures in urban villages are mostly characterised by 'face-to-face' buildings with poor ventilation and lighting, leading to slum-like building environments. In addition, urban villages receive almost no public services from city governments and function as self-organised administration units, taking care of their own community interests. Owing to the lack of public investments and planning interventions, urban villages become as a poorly maintained, overcrowded and depressed area, and even become as a springboard for illegal transactions and crimes.

The distribution of urban villages in Beijing is closely linked to the urban form. Beijing is a largely monocentric city (Zheng and Kahn, 2008). There are five 'ring roads' circled around the central business district (CBD) from the inner city to the outer city. For this study, we have focused on the metropolitan area mostly within the No.6 ring road.

As cities grow at their peripheries, local governments convert the agricultural lands in the urban peripheries into non-agricultural land uses. City mayors and planners increasingly weigh the trade-offs between land development and preservation of villagers' settlements. Owing to the high compensation fees for villagers' housing relocation, a small piece of farmland parcel is usually left for villagers' settlements, leading to the so-called 'urban villages'. As such, 357 urban villages have been created and scattered across the Beijing metropolitan area. Over the past two decades, urban villages in Beijing were widely considered underdeveloped. The year 2000 China 5th population census revealed that per-resident educational attainment level was below the city average. Capital spending in public infrastructure was particularly stingy, well below the city average. Urban villages in Beijing became notorious for their overcrowding and poor built environment and are widely condemned by policymakers and real estate developers as a salient disamenity.

The Beijing municipal government launched a concerted urban village removal programme. The programme was implemented as a part of preparation work for the 2008 Beijing Olympic Games. This programme emphasised the improvement of local living environment through housing reconstruction, street-market removals (*ma lu shi chang*), and environment protection activities. However, as detailed information on the implementation of individual projects is unavailable, we do not know the capital spending for each renewal project, and to what extent the renewal project would change the ownership structure and local demographics inside urban villages. We have to assume that the renewal programme intensity is the same for every urban village. As a complementary analysis, we have endeavoured to test for heterogeneity based on key observable village characteristics.

We obtain the data about urban village renewals from the Beijing Municipal Commission of Development and Reform (BMCDR). Our study focuses on 213 urban village sites within the metropolitan area. For each village's renewal project, our data include the urban village's name, location, and related information. One potential source of bias might come from changes in boundaries of urban villages over time. Indeed, it is possible that village-level administrative organisations may have incentives to justify larger government subsidies by over-measuring the boundary of their houses and the entire village areas before the policy placement period. Given the lack of data information, we cannot directly test this issue, but we propose an alternative check of using the night light intensity score (LIS) data from the DMSP/OLS satellite night-time light image data. These data integrate satellite image data of night light intensity scores (Henderson et al., 2012) as a proxy demographic measure for local areas. The left panel of Figure 2 illustrates the spatial distribution of night light intensity scores for the Beijing urbanised area in 2005. The right panel of Figure 2 shows lights at night for the same area in 2009. There are substantial variations in the intensities of night lights over space. We follow Ma et al. (2015) to inter-calibrate DMSP/OLS night-time light images in order to eliminate inter-annual variations and response differences among sensors. In spite of the fact that light increases enormously over the intervening five years, we can still use the same technique to identify renewed and existing urban village areas in 2009. After excluding urban villages with incomplete information, we obtain 103 renewed urban villages in the metropolitan area. We merged renewed and non-renewed urban villages' location information and geo-coded them in Beijing's geographic information system (GIS) map. Figure 3 shows the spatial distribution of urban villages in Beijing. With future work we could, in principle, go further and examine the renewal effect on each village individually. Nevertheless, we simplify the analysis by treating them as a single policy agenda since it occurred in the same time period.

Data

The data sets describe transacted condominium units (housing units, thereafter) from 2005 to 2009 compiled from released information by the Beijing Municipal Commission of Housing and Rural-Urban Development. We use the Rgstat package (Pebesma, 2004) to assign housing unit information to grid-unit groups based on the spatial interpolation methods,[1] and there is clear evidence that changes in housing values vary widely over space (Figure 3). If the types of housing units that transact changes over time (for example, one might expect sales of houses that can accommodate families with school-age children to react differently to urban village disamenities than do small flats for young professionals), this will bias housing price measures relative to the

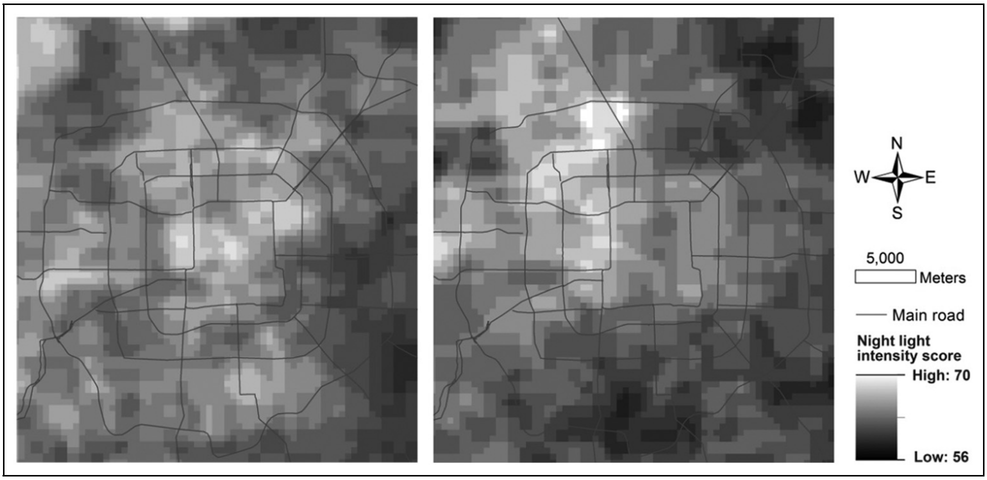

Figure 2. Night light intensity score in Beijing. The left panel shows the average night light intensity score in 2005; the right panel shows the average night light intensity score in 2009.

outcome of interest – the average spatially interpolated market value of houses in the grid-unit. Three steps can be used to mitigate this concern when more detailed data are available at the local area level. First, when interpolating prices of house sales to the grid-unit level, one can weight them by their year-2000 population or by the number of transactions at the local area level. Second, one can include in controls for the floor-to-area ratio of housing units to absorb any remaining selection issues. Third, demographic data can be used to control for key pre-treatment location characteristics near urban villages. We obtain the local demographic characteristics from the recent population census and employment census, though we are unable to exclude intra-grid-unit movers from the calculation. Geographical information on other local public goods is taken from a variety of sources for the use of controllable variables (see Table 1).

Theoretical framework

To motivate our empirical strategy, we sketch a simple theoretical model of housing market in the context of urban village externalities.[2] In a spatial economy, there is a continuum of individuals (denoted C) that can choose to live in one of two residential locations $j \in (V, M)$. While some choose to live near the urban village ($j = V$) and others choose to live further away from the urban village ($j = M$), but in the same labour market. Residents in each location enjoy localised amenities net of housing costs, A_j, associated with their location. Each household i has some idiosyncratic preference for both residential locations, q_{ij}, representing heterogeneity in the valuation of local amenities. The q_{ij} is independently and identically distributed across households and assumed to possess a continuous multivariate distribution with mean zero.

An individual seeks to maximise utility by choosing across locations:

$$U_{ij} = \max\{p_V + q_{iV}, p_M + q_{iM}\} \quad (1)$$

where p_j represents mean utility in location j. Individuals will choose the community that yields the highest utility. Based on this, we can write the welfare of individuals in location V and M as:

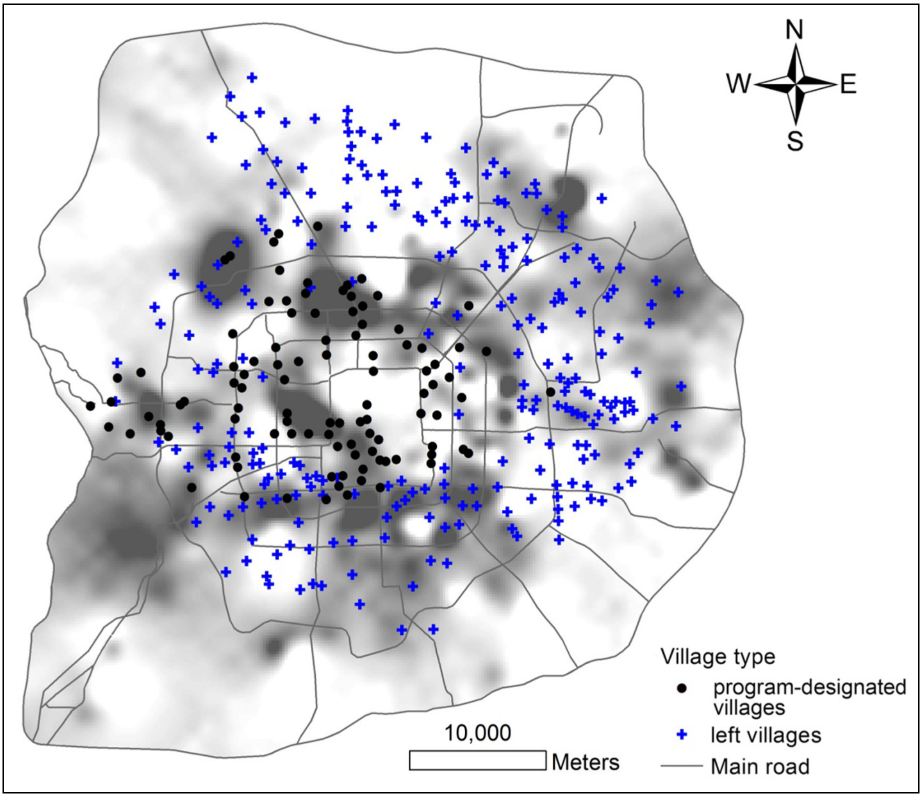

Figure 3. Spatial distribution of urban villages in Beijing. Bold black dots indicate the renewed urban villages from 2005 to 2008. Blue crosses are the remaining urban villages. Smooth white-grey areas represent variations of housing price changes.

Table 1. Location characteristics variables name and definitions.

Variable name	Definition	Mean	Std. dev.
CBD distance	Distance to the central business district (*Guomao*) (km)	8.43	3.51
School distance	Distance to the nearest education facilities (km)	2.68	3.42
Bus access	Distance to the nearest bus station (km)	1.87	1.73
Rail access	Distance to the nearest subway station (km)	4.24	2.97
Employment density	Total employment density in each neighbourhood (employees/km^2)	1240	430
Population density	Total population density in each neighbourhood (persons/km^2)	9883	22,463

$$W = E[\max(p_N + q_{iV}, p_F + q_{iM})] \qquad (2)$$

And consider a policy shock stemming from the urban village renewal programme without increasing the living cost of workers in the urban villages. We assume this policy shock as a marginal improvement in urban productivity through increasing residents' quality of life. If this is the case, this will help to increase wages in both the near and far village locations. The completion of the urban village renewal programme thus creates a strong externality for residents living near the village through, for example, better living environment.

Taking the derivative of individuals welfare with respect to the urban village renewal programme the marginal willingness to pay (MWTP) equation can be written as:

$$MWTP = \frac{dW}{d\theta} = C_M \cdot \frac{\partial I}{\partial \theta} + C_V \cdot \left[\frac{\partial I}{\partial \theta} + \frac{\partial A_V}{\partial \theta}\right] = C_M \cdot \frac{\partial I}{\partial \theta} + C_V \cdot \frac{\partial A_V}{\partial \theta} \quad (3)$$

where $d\theta$ represents the marginal effect of the urban village renewal program and the total productivity (I) effect associated with the urban village renewal programme. Productivity effect is assumed to be similar for both nearby residents and those a little further from a village. This is not the key focus of this paper. This study focuses on the differences in amenities due to the completion of urban village renewals for residents near the villages. Since positive village externalities in the form of improved social and residential environment are highly localised, these benefits will only accrue to the residents living near villages.

After the completion of the urban village renewal programme, some 'marginal' residents who initially lived further away from a village may move into residences near the village. The completion of the urban village renewal programme may be approximated simply by changes in prices experienced by the immobile population. In the case of non-marginal changes in local amenities, the preference-based sorting will need to be taken into consideration. For simplicity, recent studies (e.g. Palmquist, 1992) suggest that the slope of the regression specification is an approximate measure of the willingness to pay (WTP) for a non-marginal change.

Empirical methods

Baseline model specification

The underlying empirical model for our analysis is:

$$Log\Delta Y_{ijd} = \beta_0 + \beta_1 \cdot Village_{ij} + \beta_2 \cdot Near_{ijd} + \beta_3 \cdot Village_{ij} \times Near_{ijd} + \omega_j + \beta_4 Z_{jd} + \varepsilon_{jd}, \quad (4)$$

where $Log\Delta Y_{ijd}$ is the change in the outcome variable (i.e. housing values) for unit i near urban village site j in distance group d before and after the village renewal programme. Our intention is to construct a spatial difference-in-difference-style estimator. So, for each urban village j, there are two observations. One observation consists of outcome variables 'near' an urban village (i.e. within a 1 km radius of the urban village site). The second observation per urban village consists of outcome variables within a 2–4 km distance range of the urban village; this second group provides a counterfactual for outcome variables near urban villages. The choice of a 2 km threshold is based on what we consider to be a feasible walking distance to a village. As robustness checks, we have investigated the linearity of the price-distance with kernel regressions using the residuals from a linear housing price model. An example is shown in Figure 4. There is a clear break in the price–distance trend at 2–3 km, suggesting that 2 km is an appropriate cut-off point.

The '$Village_{ij}$' is an indicator variable that is equal to one if a urban village exists and zero otherwise. It is equal to 1 for both distance groups associated with a village. In Equation (4), we define '*Near*' as being within 0–2 km, and the indicator '*Near*' is equal to one if the observation is within 2 km distance band in which a village existed throughout the study period.

The parameter of interest in Equation (4) is β_3, the coefficient on the interaction term, $Village_{ij} \times Near_{ijd}$. It captures the differential impact of the existence of urban villages on outcome variables within 2 km, relative to those 2–4 km away from the location of the urban village site. Alternatively, we estimate a different model specification to test the localised effect of urban village renewals. In this specification, the variable '$Village_{ij}$' is replaced by another indicator variable '*Renewal* $Village_{ij}$'. This '*Renewal* $Village_{ij}$' variable is equal to one after the urban village has been renewed. Again, the parameter associated with the interaction of '*Renewal* $Village_{ij} \times Near_{ijd}$' allows to estimate the localised impacts of urban village renewals. Equation (4) further includes area-specific (e.g. urban village, neighbourhood) fixed effect ω_j to control for general spatial patterns near a village, though this would be collinear with the '*Near*' indicator. Additional controls include key pre-treatment socio-demographic characteristics Z_{jd} such as population density, employment density, distance to the CBD, distance to bus stop, distance to subway stations and proximity to education facilities.

Endogeneity

It is important to note that urban village renewal programmes may not be selected randomly. Urban villages' renewal projects might be more likely to happen for villages located in premium locations, where the land price is higher and thus the local governments can obtain higher land revenue. It is also likely that there are unobservables that can simultaneously affect the selection

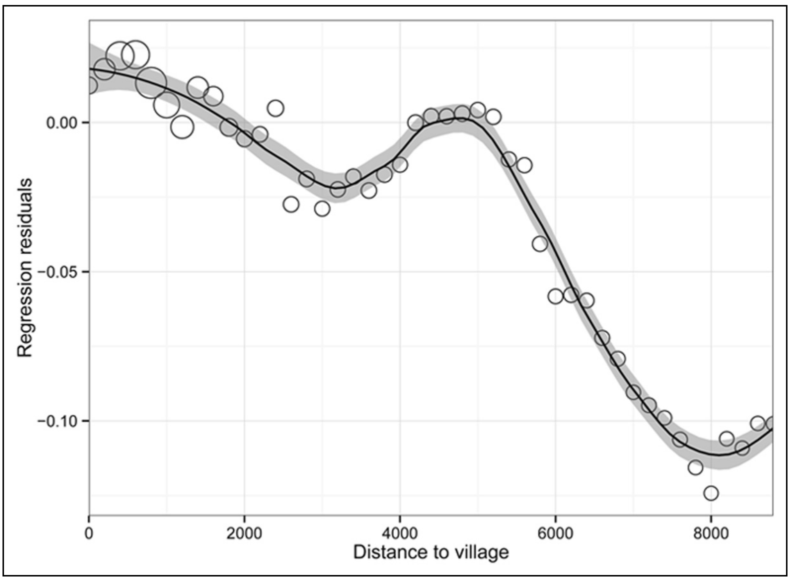

Figure 4. Housing price gradient, with distance to villages. The kernel regression of residual prices on distance to urban villages in metres (grid points) is shown. Residual prices are estimated as the residuals from the OLS regression of log-prices on the controls using local demographic data. The grey areas around the dark line represent 95% confidence intervals, where standard errors are computed using cluster-robust standard errors. The circle points are weighted by the number of urban villages.

criteria of urban village renewals and the real estate value premiums. This is a typical endogeneity concern.

Recent research has constructed reliable comparison groups in ways that try to address the non-randomness of the programme placement problem when public interventions are targeted places instead of people. The availability of institutional details, such as spatial boundary discontinuity, policy implementation stages and comparisons of policy recipients within the narrow margins, has stimulated a number of economic studies on evaluating the place-based policy impacts (Busso et al., 2013; Gibbons et al., 2013; Neumark and Kolko, 2010). In our context, limited information is publicly released on how the city government selected urban villages. Importantly, we do not know how many potential villages were initially selected and the final villages were chosen based on what kinds of selection criteria. The lack of institutional details hinders the possibility of using advanced estimation strategies to address the likely selection bias. In our approach the focus is to identify housing units both in the immediate vicinity of urban villages and slightly further away, allowing for comparisons across housing units locating at different distances from the sites. Owing to the data limitations, we are restricted to assume that the intensity level of urban village renewals is similar across villages. We acknowledge the potential bias source from the preference-based sorting mechanisms.

As an additional robustness check, we have used the propensity score matching method to reconstruct comparable groups so as to capture more reliable average treatment effects on the treated (Abadie and Imbens, 2011). Following Zhang et al. (2015), our intention is that urban village areas that have similar characteristics have similar propensity scores, which can be achieved by estimating the probit model as follows:

$$\begin{aligned} &\textit{Probability of Renewal} \\ &= f(\alpha_0 + \beta_j * \textit{Village}_j + \delta_j * \textit{Location}_j + \varepsilon_i) \end{aligned} \tag{5}$$

where $Village_j$ is a vector of key observable housing market characteristics in urban village areas such as floor-to-area ratio; $Location_j$ is a vector of the village's location characteristics such as the distance to the CBD, and the distance to the nearest subway station. By estimating Equation (5), each village will get the propensity score of the probability of renewal. We classify the villages into subgroups with similar propensity scores. We then match villages by minimising the difference in propensity scores between the treatment and control groups so as to treat the renewal programme selection within a subgroup as a plausibly exogenous decision. Finally, it is worth noting that while not uniformly superior to other methods, our approach provides a useful way for estimating aggregated effects at the local area level without hard-to-measure assumptions involved.

Results

Estimated impact on housing values

Table 2 reports main results for estimated impacts on housing values from two panels. Panel (A) reports the estimated coefficients and standard errors associated with the effects of urban village existence and Panel (B) reports the effects of the urban village renewals. The comparison group is housing units located between 2 and 4 km of the urban village, whereas the distance-bin indicator '*Near*' changes across model specifications, as indicated by column headings.

Column (1) reports estimated results from a specification that provides the unadjusted correlation between the dependent variable and the presence of urban villages. For example, the specification in column (1) controls for the change in log average housing values from 2005 to 2009 within 0–1 km of the urban village. In this specification the presence of the urban village within the 1 km spatial range is associated with a substantial fall in housing values, whereas the urban village renewals lead to a significant rise in nearby housing values.

Column (2) adds the complete set of pretreatment demographic characteristics as well as village fixed effects. After adjusting for covariates, the magnitude of the estimated effects decreases slightly but remains statistically significant. Columns (3) and (4) present the specifications by using the sample within 1–2 km of urban villages. The point estimates in columns (3) and (4) are of a smaller magnitude, suggesting that the effects of urban villages on housing values decay over space. For example, we find that the presence of urban villages leads to slightly lower decrease in housing values within a 1–2 km distance ring. In columns (5) and (6), we compare the entire 0–2 km area with the 2–4 km control ring, and the overall impacts on housing value remain stable regarding the presence of urban villages and renewed urban village within a 2 km radius. The last four columns of Table 2 use the alternative comparison group (housing units located between 2 and 3 km of the urban village) to examine the sensitivity of the main results. This modification in columns (7) and (8) slightly changed the point estimates, but these results are the consistent with our baseline results in columns (5) and (6). Regression results using the propensity score method are shown in columns (9) and (10). The estimated effects are less significant but are of a larger magnitude. This result suggests that some unobservables may be correlated with local housing price growth trend. This is supported by empirical evidence since Chinese city governments have often selected to regenerate urban villages in depressed areas or areas with high development potentials. If households were aware of local disamenities such as congestion and crime in these depressed areas and they were valued significantly by households, one would have expected to see this reflected in housing price differentials and the danger of underestimating or overestimating the effect of urban village renewals. Given the lack of detailed policy decision-making criteria and micro data, future works with more detailed data on households' residential mobility are needed to verify the robustness of our results, and test the real estate market dynamics caused by differential residential mobility with an inflow of those most benefiting in monetary terms from urban village renewals.

Note that under our imposed assumption that the benefits of urban village renewals would accrue similarly to housing units within 1 km and those within 1–2 km from the village. This estimate may reflect an upper bound on the net benefits associated with the urban village renewals. Thus, it is very useful to address concerns about the fact that changes in urban village amenities may lead to a rise in housing demand in nearby (i.e. 0–1 km) locations and a corresponding fall in housing demand in locations farther away. This type of preference-based sorting would overestimate the housing price response of the urban village renewals in the closing distance range. A further concern comes from potential spatial autocorrelation issues since we are using data on closely spaced grid units in the estimation. We explicitly investigate these concerns by estimating alternative specifications for changes in housing prices within mutually exclusive concentric rings (separate distance groups) of urban villages.

Table 3 presents the results based on the following model, restricting the sample to different distance bandwidths (0–1 km, 1–2 km and 2–4 km):

Table 2. The impact of urban villages on local housing values: Baseline results

	0–1 km		1–2 km		0–2 km		0–2 km		0–2 km	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Estimated effect on urban village existence										
Village by near	−0.057***	−0.047***	−0.024***	−0.020**	−0.045***	−0.036**	−0.043***	−0.044	−0.062**	−0.054
	(0.006)	(0.009)	(0.008)	(0.010)	(0.014)	(0.017)	(0.015)	(0.026)	(0.024)	(0.052)
Panel B: Estimated effect on urban village renewals										
Renewal village by near	0.041**	0.031**	0.033**	0.034**	0.033***	0.042***	0.038***	0.044**	0.054	0.059
	(0.015)	(0.016)	(0.016)	(0.013)	(0.011)	(0.012)	(0.014)	(0.019)	(0.030)	(0.057)
Controls for all panels										
fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y	N	Y

Notes: Panel A reports estimates of the effect of urban village existence on local housing values. Panel B reports estimates of the effect of urban village renewals on housing values. ‘Village’ is the indicator variable equal to one for urban villages that have existed in our study period. ‘Renewal’ is the indicator variable equal to one for urban villages that have been renewed. The indicator variable ‘Near’ changes as one moves across the columns, indicated by the column headings. The comparison group in columns (1)–(6) is areas between 2 and 4 km from urban villages, whereas the comparison group in columns (7)–(10) is areas between 2 and 3 km from urban villages. The last two columns report the propensity score reweighting estimators, as an additional robustness check. Controls include distance to CBD, subway stations, and others as noted in Table 1. Standard errors are in parentheses. ** denotes statistical significance at the 5% level, and *** at the 1% level.

Table 3. The impact of urban villages on local housing values: Robustness specifications.

	(1)	(2)	(3)	(4)
Renewal village 0–1 km	−0.048***	−0.060***	−0.076***	−0.078***
	(0.012)	(0.012)	(0.009)	(0.008)
Renewal village 1–2 km	−0.029**	−0.028**	−0.033***	−0.029***
	(0.013)	(0.014)	(0.011)	(0.010)
Renewal village 2–4 km	−0.012	−0.018	−0.017	−0.012
	(0.015)	(0.016)	(0.012)	(0.011)
Controls	Yes	Yes	Yes	Yes

Notes: Each row and column report the estimates of the effect of urban villages on a separate distance-group regression. The specifications from column (1) to column (4) are estimated by using simultaneous autoregressive model, conditional autoregressive model, spatial lag model and spatial error model, respectively. The regression specification changes as one moves across the columns, indicated by the row headings. Standard errors are in parentheses. **denotes statistical significance at the 5% level, and *** at the 1% level.

$$\Delta LogY_{ij} = \beta_0 + \beta_1 \cdot Renewal\_Village_{ij} + \beta_2 Z_j + \varepsilon_j \tag{6}$$

The coefficient of interest is β_1, which shows the relationship between urban village renewal status ($Renewal\_Village_{ij}$) and changes in housing values. In these specifications, the comparison group consists of housing units within the same distance group from a given urban village that did not experience urban village renewals. To account for potential spatial autocorrelation effects, results from Table 3 are estimated by using spatial regression methods:[3] simultaneous autoregressive model (column 1), conditional autoregressive model (column 2), spatial lag model (column 3) and spatial error model (column 4). The headline finding is that the point estimate remains large, the magnitude increases and significance improves relative to our main results. Again, we find that effects of urban village treatment status are highly localised, and there seems to be little effect of urban village renewals at further distances. In the results that are not reported, Moran's I statistics suggest some evidence of spatial autocorrelations in the residuals.

Additional robustness results: Heterogeneous parameters and channels at work

So far we have concentrated on the average effect of a village renewal without considering a tremendous amount of heterogeneity across villages. Table 4 explores the heterogeneity in estimates reported in Table 2 by stratifying villages across key observable characteristics. Panel (A) reports the heterogeneous effects of urban village existence, and Panel (B) reports the heterogeneous effects of the urban village renewals. We group villages into whether their value of a particular characteristic of interest is above or below the median level. The characteristic we consider is the night light intensity score indicator. The key finding from Table 4 is that urban villages with dimmer light intensities have a more positive effect on housing price premiums after their renewals than those with stronger light intensities, though not all coefficients are statistically significant.

In addition to the results reported in this section, additional robustness checks are needed to address potential concerns about: (1) controlling for village-neighbourhood-year trends. Since Beijing is such a fast-growing city with a large heterogeneity, controlling for the village-neighbourhood fixed effects is not enough since the identified effects may come from the variation from differential development of different village-neighbourhood areas; (2) controlling for housing price gradient patterns. Suppose that there is a positive association between distance to the urban village centre and housing price. When the government started the renewal project, the gradient started to diminish and even became opposite. Thus there is a danger that the empirical results might be consistent with this 'gradient' story and nothing to do with externalities. Aside from changes in the distance to urban villages, it is also important to consider the estimates' robustness to changes in the housing price gradients induced by urban village amenity improvements. In this study, we directly measure effects of urban village renewals on housing prices in the closing distance range relative to areas slightly further away, and more evidence is needed to adjust for the influence of housing price gradient patterns. (3) To enrich our findings, it is important to show that the driven force of the prices at treated areas should not come from the supply side. Future work in this line of research might replace the dependent variable by quantity of the transactions and test if the increased prices go together with increased quantity.

Before concluding, it is noteworthy that the measured 'renewal effect' only captured the localised external effects on housing values outside of urban villages, rather than urban villages themselves. Indeed, it is highly possible that urban village renewals may drive up housing rents inside urban villages, leading to socioeconomic changes in residents inside the villages. If this finding holds generally for residents in our study who live outside urban villages, we may expect a bias in the correlation between changes in house prices outside urban

Table 4. The impact of urban villages on housing values: Heterogeneity based on median village characteristics.

	0–1 km		1–2 km		0–2 km	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	LIS < median	LIS >= median	LIS < median	LIS >= median	LIS < median	LIS >= median
Panel A: Estimated effect on urban village existence						
Village by near	−0.134***	−0.061	−0.037**	−0.034	−0.081**	−0.022
	(0.048)	(0.047)	(0.018)	(0.039)	(0.037)	(0.047)
Panel B: Estimated effect on urban village renewals						
Renewal village by near	0.064***	0.044*	0.043***	0.038***	0.044**	0.033
	(0.019)	(0.026)	(0.015)	(0.014)	(0.019)	(0.029)

villages and changes in socioeconomic characteristics inside urban villages. It is likely the case that residents may subconsciously attempt to justify housing values by overstating or understating the quality of local amenities such as urban villages in the neighbourhood. To the extent that these results hold more broadly, our results provide implications for local governments to consider social contributions of urban villages when launching regeneration programmes. Empirically, it is expected that changes in housing prices can be reflected in changes in residential sorting so in some way can affect dense and mixed land uses, neighbourhood gentrification and local public goods capitalisation (Zheng and Kahn, 2008; Wu et al., 2013, 2015). Insofar as this occurred then there would be policy implications for mixed land use configurations and also for the long-term impact on social welfare. Thus policymakers should take effective steps to help maximise welfare, for example by offering sufficient affordable housing with reasonable distances to local amenities, and by making mixed land use plans and appropriate government interventions that could help to gentrify the depressed areas.

Conclusion

Urban village is a salient local amenity resulting from the fast urbanisation in China. Mayors and planners face difficult, often politically contentious decisions about if it is worthwhile to gentrify urban village areas. A common policy view is to combine planning efficiency objectives with local objectives of public policies under the presumption that the external costs of urban villages affect people's WTP to avoid local disamenities.

This paper assesses the spatially localised impact of urban village renewals on local housing markets in a mega city in China. The presented findings provide evidence that the presence of urban villages can lead to a significant reduction in housing values in affected areas relative to locations further away. The results are roughly symmetric with improvements in housing prices within 2 km when urban villages are renewed. These results also suggest that urban village renewal programme effects on housing prices are highly localised and tend to fade with distance.

These findings relate to existing theoretically motivated policy discussions in the literature, and serve to emphasise the importance of gentrification consequences of urban regeneration policies. There may be competing explanations for our results arising from urban village renewals because of heterogeneity in government policy implementations. If the programme intensity distributions were made uniform across space, improving urban villages' conditions would then gentrify adjacent local area economic status in response. While there is a clear gentrification trend in urban village areas, it is important to know if ownership structure and demographics inside urban villages are expected to change and how such changes will affect long-term neighbourhood dynamics. Thus a better understanding about long-term gentrification trends induced by regeneration policies and how these trends interact with people's income and WTP in the context of real estate markets is a critical area for future works.

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Notes

1. Kriging-based interpolations were implemented using the R-gstat package (Pebesma, 2004). Recent literature suggests that Kriging-based methods can provide a precise and localised way for spatial data interpolations (Anselin and Lozano-Gracia, 2008).
2. Note that the results from this partial equilibrium analytical framework could generalise into a general equilibrium sorting model found in Bayer and Timmins (2005, 2007).
3. See Schabenberger and Gotway (2005) for details about the spatial autocorrelation problem and justifications made in these spatial methods.

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