HOUSING ALLOCATIONS AND INEQUALITY IN EARLY AND MID-REFORM URBAN CHINA

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Abstract

This paper demonstrates that subsidized housing substantially increased inequality among urban Chinese residents in 1988 and 1995. Regressions for 1995 rental units impute estimated market rents in 1988 and 1995 for all dwelling units. In both years, these imputed values exceed actual rents by a factor of more than ten. Estimated true household income, the sum of imputed net estimated market rent and total reported income, exceeds total reported income by approximately 23% in 1995. The Gini coefficient for true household income in 1988 is probably in the vicinity of .250, more than 20 % greater than the coefficient of .206 for total reported income. The Gini coefficient for 1995 is probably around .310, 11.1% greater than the reported value of .279.

J.E.L. codes: D31, O15, O18, P36, R21

In 1988, virtually all urban Chinese housing was allocated administratively at nugatory rents. By 1995, many urban dwellings were the object of explicit exchanges. However, few were actually traded at market prices (Zax, 2004). Therefore, the nominal prices of urban Chinese dwelling units during the mid-reform period understate the consumption value of those units. Consequently, measured household incomes understate welfare.

This paper attempts to estimate the contribution of allocated urban housing to the average level of welfare for urban Chinese residents and to inequality among them in 1988 and 1995. Section I describes the data sources for this endeavor. Section II provides descriptive evidence of inequality in housing consumption.

Despite the absence of true market rents in either year, 1995 survey respondents in rental dwelling units provided plausible estimates of expected market rents. Section III presents hedonic regressions that relate these rents to their determinants. Section IV compares the effects of imputed expected rents from these regressions to those of actual expected rents on inequality among renter households. Section V imputes net rents for all dwelling units in 1995 and calculates the effect of this imputation on inequality. Section VI performs the same exercise for 1988. Section VII concludes.

I. Data

The analysis in this paper is drawn from the urban waves of the 1988 and 1995 Chinese Household Income Project (CHIP) surveys. The original sample for the 1988 survey consists of

Table 1

Provincial distribution, 1988 and 1995

	1988	1995
Beijing	5.60%	8.46%
Shanxi	10.6%	11.0%
Liaoning	10.2%	12.1%
Jiangsu	13.6%	12.1%
Anhui	8.69%	8.55%
Henan	11.5%	10.4%
Hubei	11.2%	11.2%
Guangdong	11.4%	8.87%
Yunnan	10.6%	10.6%
Gansu	6.57%	6.71%
Observations	8,645	5,615

8,996 urban households across ten enumerated provinces.[1] The first column of table 1 presents the provincial distribution of 1988 households with complete data for the purposes of the analysis in this paper. The original sample for the 1995 survey consists of 6,080 households. The second column presents the provincial distribution of the 1995 sample employed here.[2]

II. Variations in housing consumption

Housing conditions varied substantially among urban Chinese households in both 1988 and

[1] This sample also contains 13 households from unidentified provinces. This survey is described in Griffin and Zhao (1992). It and the rural companion survey are available from the Inter-University Consortium for Political and Social Research as data set 9836.

[2] The 1995 CHIP survey was also administered to 848 households in Sichuan province. The analysis here omits these households in order to maintain comparability with the 1988 CHIP survey. This survey and the rural companion survey are available from the Inter-University Consortium for Political and Social Research as data set 3012.

Table 2

Variation in dwelling unit size, 1988 and 1995

	1988	1995
Number of rooms:		
Average	2.49	2.70
Standard deviation	1.08	2.20
Coefficient of variation	43.6	81.2
90th percentile	4.	4.
10th percentile	1.	1.
Total living area, in square meters:		
Average	41.1	48.4
Standard deviation	23.1	29.1
Coefficient of variation	56.2	60.1
90th percentile	64.	77.
10th percentile	19.	24.

Note: Sample for 1988 contains 8,645 observations. Sample for 1995 contains 5,615 observations.

1995. Table 2 reports that the average urban dwelling unit in 1988 had 2.49 rooms. The standard deviation of rooms per dwelling unit was slightly less than half that amount, at 1.08. Variations in living area per dwelling unit were slightly larger: The standard deviation of 23.1m^2 was somewhat more than half of the average of 41.1 m^2.

Urban housing conditions in 1995 were both better and more variable than in 1988. The average dwelling unit had more rooms, at 2.70, and more space, at 48.4m^2, then in 1988. However, the coefficient of variation for rooms per dwelling unit nearly doubled, from 43.7 to 81.2, between the two years. The coefficient of variation for living area increased, though by much less, from 56.2 to 60.1.

Table 3 demonstrates that, in both years, structural characteristics of urban dwelling units

Table 3

Variation in dwelling unit characteristics, 1988 and 1995

	1988	1995
Household has own tap water	80.5%	84.0%
Household has own kitchen	82.0%	83.9%
Household has bath and toilet	8.20%	32.7%
Household has central heating	16.8%	32.4%
Household has piped gas	16.3%	31.3%
Household located in city center	39.5%	35.7%

Note: Sample for 1988 contains 8,645 observations. Sample for 1995 contains 5,615 observations.

also varied substantially across households. In 1988, nearly 20% of urban households did not have tap water. Almost as many did not have a kitchen of their own. Fewer than 10% had both a bath and a toilet. Fewer than 20% had central heating or piped gas. Approximately 40% lived in the center of their city.

Desirable structural characteristics became much more widespread in parallel with the increase in average dwelling unit size from 1988 to 1995. By the latter year, nearly one-third of all urban households had own baths and toilets, central heating and piped gas. The proportions enjoying tap water and their own kitchen had also increased.

However, these characteristics were certainly not universal. Variations in the sizes and attributes of urban dwelling units suggest that flows of housing services varied across units, as well. Consequently, different dwelling units made different contributions to household welfare.

Table 4

Measured rents and incomes, 1988 and 1995

	1988:			1995:		
	Total reported income	Reported rent	Reported rent as % of reported income	Total reported income	Reported rent	Reported rent as % of reported income
Average	509.	3.33	.654%	1,192.	22.8	1.92%
10th percentile	307.	0.	0.%	576.	0.	0.%
90th percentile	747.	6.20	.830%	1,928.	32.0	1.66%
Difference, 90th percentile and 10th percentile	440.	6.20	-	1,341.	32.0	-
Standard deviation	215.	8.46	-	699.	217.	-
Coefficient of Variation	42.1	254.	-	74.4	58.2	-

Note: Sample in 1988 consists of 8,686 households. Sample in 1995 consists of 5,615 households. Actual rent calculated as zero if not reported. Household incomes are not adjusted for numbers of household members. All monetary values in nominal yuan per month.

These differences were almost surely not reflected in different rent payments. In 1988, average monthly rent payments were 3.33 yuan. In the distribution of rents, the 90th percentile was only 6.20 yuan per month. In effect, almost all urban housing in 1988 was in the form of an in-kind transfer, either from state-run enterprises or other organs of the state (Zax, 1997).

Rents were higher in 1995 than in 1988. Average rents in 1995 were 22.8 yuan per

month. The 90th percentile rent was 32.0 yuan per month. While both figures are roughly five times their 1988 equivalents, even the latter was equivalent to fewer than four U.S. dollars. They must still have been well below any reasonable estimates of the values of urban Chinese housing services in 1995.

III. Hedonic estimation of 1995 expected market rents

In the absence of market rents, the value of services from urban Chinese dwelling units can only be imputed. The 1995 urban CHIP survey asks "(i)f you could rent out your house on the market, please estimate the per month rent" (question 613, "Urban Household Income Survey", 1995). Of the 5,615 households identified in table 1, 4,513 provided valid responses.

The average expected market rent in these responses is 421 yuan per month. This is approximately twenty times as great as average actual rents, and above the 99th percentile in the distribution of actual 1995 rents. This raises the question as to whether these expectations, formed with regard to a market of which few had any real experience, were at all realistic.

If they were, then the average value of the flow of housing services would exceed average actual rents by 399 yuan per month. Therefore, the potential value of total consumption would exceed total reported income by the same amount. Consequently, the true value of potential household consumption, or "total estimated income" would be the sum of this excess and average total reported income, or, on average, 1,591 yuan per month.[3]

Descriptively, this suggests that survey reports of expected market rents may be plausible.

[3] This procedure for the calculation of total estimated income is the foundation for the estimates of inequality in sections IV, V and VI below.

Average expected market rents would be 26.5% of average potential household consumption. This is relatively consistent, though somewhat lower than typical income shares of rental expenditures in economies with income levels similar to those in China where housing allocations are completely monetized (Zax, 2003). Given the abundant descriptive evidence suggesting that urban Chinese housing regulations require construction to adhere to quality standards that are excessive in comparison to income levels (Zax, 2003), this average is perhaps somewhat low.

Table 5 provides an analytical check on the plausibility of reported expectations regarding market rents. It presents hedonic regressions of expected market rents on dwelling unit structural, locational and provincial characteristics. If expected rents are plausibly related to these characteristics, they may serve as acceptable indicators of the value of housing services produced by these dwelling units.

The first regression of table 5 is based on the sample of all households reporting expected market rents. Some results are intuitive. F-tests demonstrate that dwelling unit structural and locational characteristics are jointly significant at better than .01%. Expected rents are higher, with significance of better than 5%, for dwelling units with larger area, with air conditioners and located in inner suburbs. They are higher, with significance of 10%, for dwelling units with central heating.

At the same time, other structural characteristics do not have statistically significant effects. Moreover, expected market rents are significantly and implausibly lower in most provinces, including Beijing, then in the reference province of Gansu. Lastly, the regression as a whole has low explanatory power, with an R^2 value of barely 5%. These results imply that the

Table 5

Regressions for estimated market rent

	All dwelling units	Owner-occupied dwelling units	Rental dwelling units
R^2	.0507	.0547	.311
Adjusted R^2	.0449	.0409	.304
F-statistic	8.87	3.97	41.04
p-value	<.0001	<.0001	<.0001
Coefficients for dummy variables representing dwelling unit characteristics:			
Number of rooms	−4.02	−1.17	−.691
	(.33)	(.03)	(.16)
Area	2.83	2.51	2.20
	(2.64)	(1.07)	(4.52)
Own tap water	84.9	49.7	44.2
	(.80)	(.20)	(1.18)
Shares tap water	66.5	69.8	10.1
	(.46)	(.17)	(.21)
Bath and toilet	19.7	.0110	67.5
	(.25)	(.00)	(2.22)
Toilet, no bath	106.	145.	52.4
	(1.27)	(.75)	(1.75)
Shares bathroom facilities	−146.	−294.	−31.4
	(1.27)	(.88)	(.86)
Air conditioner	344.	394.	214.
	(2.69)	(1.38)	(4.68)
Central heating	289.	516.	119.
	(1.95)	(1.41)	(2.37)
Other heating equipment	85.9	228.	10.3
	(.61)	(.65)	(.22)
Own kitchen	−50.8	−136.	39.4
	(.54)	(.59)	(1.24)
Shared kitchen	−78.8	−102.	−38.6
	(.41)	(.14)	(.69)

Table 5 (continued)

Located in city center	146.	264.	100.
	(.69)	(.49)	(1.45)
Located in city periphery	117.	179.	88.3
	(.56)	(.33)	(1.28)
Located in inner suburbs	458.	830.	179.
	(2.05)	(1.48)	(2.43)
Fuel is piped gas	133.	39.6	144.
	(.91)	(.14)	(2.00)
Fuel is bottled gas	63.7	134.	-3.04
	(.46)	(.54)	(.04)
Fuel is coal	−89.8	−208.	17.2
	(.60)	(.75)	(.24)
Coefficients for dummy variables representing provinces:			
Beijing	−238.	−914.	587.
	(1.66)	(2.17)	12.38)
Shanxi	−874.	−1,599.	−94.8
	(6.43)	(4.99)	(1.98)
Liaoning	−794.	−1,544.	14.7
	(5.92)	(4.23)	(.32)
Jiangsu	−546.	−1,077.	118.
	(2.92)	(2.35)	(1.86)
Anhui	−617.	−1,077.	-2.95
	(3.25)	(2.37)	(.05)
Henan	−761.	−1,334.	-92.6
	(5.22)	(3.88)	(1.83)
Hubei	−612.	−1,222.	84.3
	(3.19)	(2.68)	(1.26)
Guangdong	1.62	−346.	460.
	(.01)	(.73)	(6.69)
Yunnan	−649.	−1,224.	-6.13
	(3.11)	(2.59)	(.07)
Intercept	450.	1,009.	-151.
	(1.42)	(1.32)	(1.29)
Observations	4,513	1,883	2,478
p-value	<.0001	.130	<.0001

Table 5 (continued)

Observations	4,513	1,883	2,478
Test for joint significance of structural and locational variables:			
F-statistic	3.47	1.38	14.7
p-value	<.0001	.130	<.0001
Test for joint significance of provincial dummies:			
F-statistic	11.5	4.84	66.6
p-value	<.0001	<.0001	<.0001

Note: Parentheses contain t-statistics. Gansu is the omitted province.

formation of expected market rents in this sample is not informative with regard to plausible market forces.

The second column of table 5 presents the same regression, applied only to the subsample of dwelling units that were owner-occupied. The explanatory power of this regression is similar to that of the first. However, the structural and locational characteristics are jointly and individually insignificant. Only the provincial dummy variables have statistically significant effects.

The results of this regression indicate that the expectations regarding market rents among 1995 owner-occupants in Chinese urban dwellings were essentially unrelated to the structural and locational characteristics of their dwelling units. This suggests that their expectations do not provide trustworthy estimates of the values of the housing services that they consumed. It suggests, further, that the expectations of these households may be responsible for the weak performance of the first regression.

The third regression of table 5 confirms this suggestion. It again reproduces the specification of the first, but applied only to the sample of all rented dwelling units with positive actual rents.[4] The performance of this regression is dramatically superior to the performance of its two predecessors. It explains nearly one-third of the variation in expected market rents for these dwelling units. The structural and locational characteristics are jointly significant at better than .01%.

Many of these characteristics are individually and plausibly significant, as well. Expected market rents increase with better than 5% significance with greater living area, the presence of a private bath and toilet, the presence of an air conditioner or central heating, piped gas and locations in the inner suburbs. They increase with better than 10% significance for units with a private toilet.

Lastly, provincial variations in expectations are consistent with casual observations of the Chinese housing market. Expected monthly market rents in Beijing exceed those in Gansu by 587 yuan. Expected rents in Guangdong exceed those in Gansu by 460 yuan. Both differences are huge, relative to average expected market rents. Both are also statistically significant at better than .01%.

The comparisons across the three regressions of table 5 suggest that only households already in rental units had plausible expectations of competitive market rents. While, almost universally, they were not paying these rents themselves, they were more aware of what competitive market conditions might be than were households that did not participate in the

[4] This sample omits 152 dwelling units included in the sample for the first regression that are identified as rented, but with zero reported monthly rents.

restricted rental markets of that time. Consequently, the rest of this paper relies on the relationship between expectations of market rents and other observable characteristics among these households to impute expected market rents for all households.

The regressions of table 5 restrict these observable characteristics to those describing the dwelling unit and its location. This is the conventional specification for hedonic rent regressions. It is motivated by the presumption that, when housing is traded in markets that are relatively complete, the value of a dwelling unit should be fully characterized by its physical attributes. Under this presumption, this value should be unrelated to occupant characteristics, at equilibrium.

In contrast, the evidence of table 4 demonstrates that actual rents did not reflect the true market value of urban Chinese housing in 1995. Therefore, housing allocations must have been dictated, at least in part, by administrative matching. It is likely that characteristics of the household as well as of the dwelling unit may have been important in this matching process. For example, households with workers earning larger salaries may also have been allocated more desirable housing.

Table 6 presents a hedonic rent regression that augments the third regression of table 5 with financial and demographic characteristics of the household. All of the results of the original regression reappear in the new specification, with only two exceptions. The significant positive effects of piped gas and Jiangsu province on estimated market rents in the third regression of table 5 become insignificant in the regression of table 6.

This regression reveals that some household characteristics also make significant contributions to the explanation of expected market rents. The eight variables identifying

Table 6

Regression for estimated market rent
with financial and household characteristics

R^2	.322	F-statistic	29.0
Adjusted R^2	.311	p-value	<.0001

Explanatory variable	Coefficient	Explanatory variable	Coefficient
Structural characteristics:			
Number of rooms	−1.56	Other heating	.0763
	(.37)	equipment	(.00)
Area	2.18	Own kitchen	34.9
	(4.32)		(1.10)
Own tap water	43.8	Shared kitchen	−48.1
	(1.18)		(.86)
Shares tap water	14.7	Located in city center	111.
	(.31)		(1.61)
Bath and toilet	62.7	Located in city	98.9
	(2.06)	periphery	(1.43)
Toilet, no bath	49.8	Located in inner	187.
	(1.67)	suburbs	(2.55)
Shares bathroom	−30.4	Fuel is piped gas	117.
facilities	(.84)		(1.62)
Air conditioner	205.	Fuel is bottled gas	−22.1
	(4.47)		(.31)
Central heating	101.	Fuel is coal	1.73
	(2.01)		(.02)
Financial characteristics:			
Private rented	−132.	Labor income	.0689
house	(1.42)		(3.28)
Property income	−.102	In-kind income	.2584
	(.80)		(1.14)
Transfer income	.237	Pension income	.0739
	(2.40)		(1.96)
Other income	.536	Entrepreneurial	−.130
and sales	(2.88)	income	(1.13)

Table 6 (continued)

Household characteristics:			
Number of children	−16.3	Number of workers	13.9
	(.97)		(.96)
Number of Communist Party members	−7.42	Average education of workers	−1.10
	(.56)		(.38)
Number of iron rice bowl workers	−19.6		
	(1.67)		
Provincial dummy variables:			
Beijing	533.	Henan	−88.6
	(1.93)		(1.76)
Shanxi	−86.8	Hubei	58.2
	(1.81)		(.87)
Liaoning	1.75	Guangdong	369.
	(.04)		(5.13)
Jiangsu	69.4	Yunnan	−43.2
	(1.09)		(.52)
Anhui	−32.5	Intercept	−151.
	(.50)		(1.26)

Tests for joint significance of	F-statistic	p-value
Structural and locational variables	11.6	<.0001
Household financial characteristics	4.50	<.0001
Household demographic characteristics	.915	.470
Provincial dummies	44.4	<.0001

Note: Sample consists of 2,478 households. Gansu is the omitted province. Parentheses contain t-statistics.

ownership type of the dwelling and household income components are jointly significant at better than .01%. In particular, households with more income from labor, transfers and sales or other income appear to be allocated more desirable dwelling units. These characteristics are associated with significantly higher expected market rents.

In contrast, household demographic characteristics appear, in general, to be unrelated to

the quality of allocated housing. The five demographic variables are jointly insignificant in the regression of table 6. Only the number of iron rice bowl workers in the household attains individual significance, and that barely, at the 10% level. Its coefficient suggests that workers in state-owned enterprises were allocated dwelling units with slightly lower expected market values than those of workers with other employers.

In sum, the regression of table 6 provides an improved explanation of expected market rents, relative to that of the third regression of table 5. The appropriate F-test rejects the hypothesis that the two are statistically indistinguishable with a value of 6.40, significant at better than .01%. Although the inclusion of household characteristics is unconventional, it would still be preferable for typical inferential purposes.

The available data permit six additional elaborations of the third regression in table 5.[5] Table 7 characterizes each specification and summarizes statistical performance. The first two rows of this table, in the first panel, reproduce the degrees of freedom, R^2 and adjusted R^2 values for, respectively, the third regression of table 5 and the regression of table 6.

The third and fourth rows present these statistics for the third regression of table 5 and the regression of table 6, each stratified by province. F-tests demonstrate that each of these regressions is statistically superior, at better than 1% significance, to the corresponding pooled model in tables 5 and 6. Moreover, the regression summarized in the fourth row is superior to that in the third row, with the same level of significance.

The second panel of this table summarizes the performance of regressions which are analogous to those of the first panel, but which replace provincial dummy variables with dummy

[5] The author can provide details of all regressions upon request.

Table 7

Goodness of fit for estimating equations

Estimating equation	Degrees of freedom	R^2	Adjusted R^2
Pooled across provinces with provincial dummies:			
Structural characteristics	2,450	.311	.304
Structural and household characteristics	2,437	.322	.311
Stratified by province:			
Structural characteristics	2,304	.382	.336
Structural and household characteristics	2,179	.418	.338
Pooled across provinces with county dummies:			
Structural characteristics	2,402	.354	.334
Structural and household characteristics	2,389	.359	.335
Stratified by province with county dummies:			
Structural characteristics	2,256	.421	.364
Structural and household characteristics	2,131	.453	.364

Note: Sample consists of 2,478 households.

variables for the sampled counties within these provinces. Some of the unexplained variance in expected market prices from the regressions of tables 5 and 6 undoubtedly arises from variations in building techniques, amenities and public services that are local rather than provincial in scope. County dummies should capture at least some of this variation. The comparison between the first and second panels of table 7 demonstrates that all four regressions with county dummies are superior to the corresponding regressions without these dummies at better than 1%

significance.[6]

The comparisons between regressions within the second panel replicate almost all of the comparisons within the first panel. The pooled regression with household characteristics is superior to that without, again with better than 1% significance. The two stratified regressions are superior to the corresponding pooled regression at the same level of significance. The only comparison that is not consistent is that between the two stratified equations. With county dummies, the stratified regression with household characteristics is statistically indistinguishable from that without.

The objective of the next three sections is to estimate or impute net estimated market rent to all households and calculate the inequality that results. For this purpose, the specific effects of individual explanatory variables in any of the regressions of table 7 are not important. The following sections compare the relevant implications of these regressions through comparisons of their implied distributions for expected market rents.

IV. Actual and imputed inequality for rental units in 1995

As discussed in the previous section, reported estimated market rents for the subsample of rental units addressed by the regressions summarized in table 7 are plausible. The first row of table 8 presents summary statistics for the distribution of these estimates, as reported in the original data by the households in this subsample.

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[6] The households in the subsample of rental dwelling units with positive rents were drawn from 62 counties in the ten provinces: one in Beijing, seven in Shanxi, five in Liaoning, nine in Jiangsu, six in Anhui, eight in Henan, seven in Hubei, eight in Guangdong, eight in Yunnan and three in Gansu.

Table 8

Descriptive statistics for reported and imputed estimated market rents, renter households in 1995

Estimated market rents	Standard deviation	Coefficient of variation	90th percentile	10th percentile	Difference, 90th and 10th percentile
Reported	508.	130.	999.	60.0	936.
Imputations					
Pooled across provinces with provincial dummies:					
Structural characteristics	283.	72.7	854.	81.8	772.
Structural and household characteristics	288.	74.0	865.	75.7	789.
Stratified by province:					
Structural characteristics	314.	80.6	839.	91.7	747.
Structural and household characteristics	328.	84.2	881.	81.5	800.
Pooled across provinces with county dummies:					
Structural characteristics	302.	77.5	915.	54.9	860.
Structural and household characteristics	304.	78.1	912.	58.1	854.
Stratified by province with county dummies:					
Structural characteristics	329.	84.5	916.	79.2	837.
Structural and household characteristics	342.	87.7	914.	68.3	846.

Note: Sample consists of 2,478 households. The average value for reported estimated market rents and for all imputed values for estimated market rents is 389 yuan. These averages are identical because regression guarantees that the average for the actual and predicted dependent variable must be the same within a fixed sample.

The imputation strategy employed in sections V and VI uses the regressions summarized in table 7 to impute estimated market rents for all households. This imputation is necessary to

estimate the value of housing for the 3,137 households in the 1995 survey which were either owner-occupied or did not report estimated market rents. It is also necessary for the entire 1988 sample, which was not asked to estimate market rents.

However, for the 2,478 households that form the subsample for the regressions summarized in table 7, both valid reports of estimated market rents and regression-based imputations are available. The comparison between the two allows for an assessment of whether the imputation procedure introduces any biases in the ultimate measurements of inequality.

For this purpose, the remainder of table 8 presents summary statistics for the distributions of imputed estimated market rents in the subsample of rented dwelling units with positive actual rents, based on each of the regressions summarized in table 7. These imputations are simply the predicted values from each of the regressions, using the coefficients for each regression and the reported values for each of the explanatory variables.

Table 8 demonstrates that distributions of imputed values from all of the regressions fail to reproduce the full variation of estimated market rents. This, of course, is guaranteed for any regression whose R^2 value is less than one. Similarly, those with higher R^2 values must yield more dispersed distributions of predicted values, again as in table 8.

Table 9 demonstrates the consequences of these variations in dispersion for standard measures of inequality. The first entry in the first row of this table presents the Gini coefficient for total reported income within this subsample.[7] This value, .265, measures inequality across

[7] All Gini coefficients in are calculated using household data. Van Ourti and Clarke (2011) document the biases that arise from Gini calculations based on grouped data. The biases that they identify are markedly smaller than those estimated below. Van Ourti and Clarke (2011, 990) assert that Gini coefficients based on group data always inderestimate the coefficients from individual data, because of the convexity in the distribution of individual incomes.

Table 9

Gini coefficients for renter households in 1995

	Total reported income	Estimated market rent	Estimated net market rent	Estimated total income
Reported	.265	.520	.579	.299
Imputations				
Pooled across provinces with provincial dummies:				
Structural characteristics	.265	.397	.446	.275
Structural and household characteristics	.265	.403	.453	.281
Stratified by province:				
Structural characteristics	.265	.411	.459	.278
Structural and household characteristics	.265	.430	.479	.283
Pooled across provinces with county dummies:				
Structural characteristics	.265	.422	.473	.281
Structural and household characteristics	.265	.425	.476	.283
Stratified by province with county dummies:				
Structural characteristics	.265	.436	.487	.283
Structural and household characteristics	.265	.453	.505	.286

Note: Sample consists of 2,478 households.

urban Chinese renter households, ignoring the contribution of net estimated market rents to household income.

The next two entries in the first row of table 9 report the Gini coefficients for measures of the value of housing. The first, .520, is the Gini coefficient for estimated market rent, as

reported in the original data. This indicates that the value of housing services was distributed much less equitably than was measured income.

"Net estimated market rents" are the difference between estimated market rents, summarized in table 8, and actual rents, summarized in table 4. The third column of the first row of table 9 reports that the Gini coefficient for net estimated market rents is .579. This demonstrates that the addition to total income represented by housing services consumed but not purchased was distributed even more unequally than were estimated market rents, themselves.

True household income is the sum of reported income and these net estimated market rents. The final column of the first row of table 9 reports the inequality in this sum, "estimated total income". The Gini coefficient for estimated total income is .299. This coefficient is more than .03 points, or almost 13% higher, than the Gini coefficient for total reported income.

In other words, the inequality in total reported income is markedly increased by the substantial inequality in net estimated market rents. Consequently, total reported income understates true inequality in the subsample of rented dwelling units with positive actual rents.

The remaining eight rows of table 9 report estimated inequality based on the imputations described in table 8. These rows demonstrate that, first, Gini coefficients for imputed estimated market rent and imputed net estimated market rent invariably underestimate the true inequality in the corresponding reported values. This restates the comparison between the dispersions in reported and imputed distributions presented in table 8.

Second, as a consequence, all imputations of estimated total income indicate less inequality than is present in reported values of estimated total income. This suggests that the imputation strategy employed by the next two sections will similarly understate actual inequality

in estimated total income.

Lastly, the extent of understatement is inversely correlated with the explanatory power of each regression, as given in table 7. Imputed values for estimated total income based on the third regression of table 5, that which employs the most parsimonious specification, have a Gini coefficient of only .275. This understates the true value of .299 by nearly nine percent. In contrast, the richest specification, the stratification by provinces with county dummy variables, yields a Gini coefficient of .286. This understates the true value by only 4.5%.

This comparison between Gini coefficients based on reported and imputed data is possible only in the subsample examined here, because households within this subsample provided valid reports of estimated market rents. The next two sections extend the imputation strategy to, first, the entire 1995 sample of households, and then to the 1988 sample of households. The comparisons in table 9 assist in the interpretation of Gini coefficients for imputed data in the complete 1995 and 1988 samples.

V. Imputed inequality in 1995

Table 10 reports summary statistics for the distributions of imputed values for all households in 1995. The first column of table 10 presents the average values of imputed estimated market rents for each of the imputing regressions. As given in table 8, these averages must be the same for the sample of 2,478 households upon which these regressions are based. However, regression does not place any constraints on the predicted values for the remaining 3,137 households in the 1995

Table 10

Descriptive statistics for imputed
estimated market rents, all households in 1995

Imputed estimated market rents	Average	Standard deviation	Coefficient of variation	Percentiles: 90th	10th	Difference, 90th and 10th
Pooled across provinces with provincial dummies:						
Structural characteristics	358.	266.	74.4	759.	83.2	676.
Structural and household characteristics	358.	276.	77.2	785.	73.8	711.
Stratified by province:						
Structural characteristics	345.	294.	85.2	729.	84.0	645.
Structural and household characteristics	341.	341.	100.	781.	68.5	713.
Pooled across provinces with county dummies:						
Structural characteristics	375.	311.	82.9	906.	53.2	853.
Structural and household characteristics	375.	313.	83.4	895.	52.5	843.
Stratified by province with county dummies:						
Structural characteristics	346.	331.	95.7	811.	52.1	759.
Structural and household characteristics	342.	371.	109.	830.	41.0	789.

Note: Sample consists of 5,615 households. Averages differ across imputations because this sample includes observations not in the sample upon which the regressions are based.

sample. Therefore, the average values in this column can differ from each other.[8]

All of the average values for imputed estimated market rents lie in the range from 341 to

[8] They also differ from the average expected market rent of 421 yuan per month because that average ignores the 1,102 households which did not report expected market rents.

375 yuan per month. As in the calculation at the beginning of section III, these averages, in conjunction with average total reported income of 1,192 yuan per month and average actual rents of 22.8 yuan per month, estimate that the average value of imputed expected total income, the total potential value of consumption, was between 1,510 and 1,544 yuan per month.

Imputations of estimated average expected market rents therefore represent between 22.6% and 24.3% of the corresponding values for the average of imputed total estimated incomes. Again, these shares are plausible, although somewhat low in comparison to those for countries at comparable levels of economic development with competitive housing markets.

As in table 8, the dispersion in distributions of imputed estimated market rents increases monotonically with the explanatory power of the imputing regression. The standard deviation of imputed estimated market rents from the stratified regression with county dummies and household characteristics is 371. This is almost 40% larger than that for imputations from the sparsest specification, the third regression of table 5.

However, according to table 11, all imputations indicate that inequality in urban Chinese housing in 1995 greatly exceeded the apparent inequality in total reported income. Gini coefficients for imputed estimated market rents range from .399 to .512. Those for imputed net estimated market rents are once again higher, ranging from .442 to .566.

Furthermore, all imputations indicate that actual urban Chinese inequality in 1995 was greater than the apparent inequality in total reported income. Coefficients for imputed total estimated income range from .285 to .304. Gini coefficients at the low end of this range suggest that inequality in total measured income was only a modest understatement of true inequality. However, the highest values suggest that inequality was as much as nine percent higher than

Table 11

Gini coefficients for all households in 1995

	Total reported income	Estimated market rent	Estimated net market rent	Total estimated income
Reported	.279	-	-	-
Imputations				
Pooled across provinces with provincial dummies:				
Structural characteristics	.279	.399	.443	.285
Structural and household characteristics	.279	.410	.457	.293
Stratified by province:				
Structural characteristics	.279	.425	.473	.290
Structural and household characteristics	.279	.464	.515	.298
Pooled across provinces with county dummies:				
Structural characteristics	.279	.445	.492	.290
Structural and household characteristics	.279	.446	.493	.292
Stratified by province with county dummies:				
Structural characteristics	.279	.479	.529	.298
Structural and household characteristics	.279	.512	.566	.304

Note: Sample consists of 5,615 households.

indicated by the Gini coefficient for total measured income.

Moreover, the evidence in table 9 indicates that even the largest of these values understates true inequality in total estimated income. If the understatement is as great as in table 9, the Gini coefficient for estimated total income would be approximately 4.5% higher than the

value of .304 given by imputations from the stratified model with county dummies and household characteristics. This suggests that the Gini coefficient for estimated total income would be approximately .318. This value is almost 14% greater than the Gini coefficient for total reported income.

VI. Imputed inequality in 1988

The 1988 urban CHIP survey contains all of the dwelling unit and household variables used in the regressions of table 7. Therefore, in principle, the regressions of table 7, applied to the 1988 dwelling unit and household characteristics, impute the estimated 1995 market rents for those dwelling units. However, this imputation encounters three challenges.

The first challenge is that the 1988 household sample was drawn from the all of the provinces of table 1, but from a different sample of counties within those provinces than was the 1995 household sample. For this reason, regressions based on the 1995 sample cannot estimate county effects for 1988 observations. Consequently, only the 1995 regressions that omit incorporate county dummies, those represented in the first panels of tables 7 through 11, can impute estimated market rents for the 1988 sample. As demonstrated in tables 8 and 9, those regressions will probably underestimate the true inequality in the consumption value of 1988 dwelling units.

The second challenge is the assumption, embodied in the imputation procedure, that the latent prices of dwelling unit attributes in 1988 were the same as the analogous prices in 1995. This assumption is unavoidable and untestable, but may not be entirely compelling. As demonstrated in tables 2 and 3, many dwelling unit attributes were more scarce in 1988 than in

Table 12

Gini coefficients for all households in 1988

	Total reported income	Estimated market rent	Estimated net market rent
Reported	.206	-	-
Imputations			
Pooled across provinces with provincial dummies:			
Structural characteristics	.206	.467	.471
Structural and household characteristics	.206	.484	.490
Stratified by province:			
Structural characteristics	.206	.455	.460
Structural and household characteristics	.206	.666	.677

Note: Sample consists of 8,645 households.

1995. It is possible that their implicit values may have therefore been greater, as well. This would probably imply greater inequality in the true consumption value of 1988 dwelling units than would be estimated by the 1995 latent prices. In the absence of observable, credible 1988 values, this possibility can only be acknowledged.

The third challenge is the conversion of 1995 values, as predicted by the regressions of table 7, into 1988 values for comparison with 1988 measured incomes. This challenge is confronted below. Consequently, table 12 replicates most, but not all of table 11 for the 1988 sample. It presents only the Gini coefficients for total reported income, estimated market rent and estimated net market rent in 1988.[9]

[9] The Gini coefficient is independent of price level because it is invariant to multiplicative transformations. Therefore, the Gini coefficients for estimated market rent and net estimated

Table 12 demonstrates that inequality in 1988 housing consumption exceeded that in 1988 measured income and in 1995 housing consumption. All Gini coefficients for imputed estimated market rents and for imputed net estimated market rents exceed the Gini coefficient for total reported income by at least a factor of two. Moreover, they all exceed the corresponding Gini coefficients in table 11 for 1995.

In particular, imputations based on the regression that is stratified by province and includes household characteristics yield Gini coefficients for imputed estimated market rents and imputed net estimated market rents that are both approximately equal to .67. On the evidence of table 8, the imputations from this equation are likely to be the most accurate. On the evidence of that table and with the biases discussed at the beginning of this section, they are likely to be underestimates. This suggests that the inequality in 1988 housing consumption was startling.

In order to estimate inequality in 1988 total estimated income, the estimated 1995 consumption value of 1988 housing must be restated in values that are commensurable with 1988 measured income. Official statistics suggest that substantial deflation is necessary. The first row of table 13 reports that the "Urban" component of the "General Consumer Price Index" in 1995 was 2.279 times its level in 1988.[10] This deflation is empirically suspect, at least in the present context. The second and third rows of table 13 apply it to average monthly nominal incomes in the 1988 and 1995 surveys, as reported in table 4. Alarmingly, it estimates that real average total

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market rent do not change if these estimates are restated in terms of the 1988 price level.

[10] These values are from Table 9-2, "General Price Indices", of the China Statistical Yearbook 2001. This Yearbook is the most recent to publish price indices for both 1988 and 1995. It is available at http://www.stats.gov.cn/english/statisticaldata/yearlydata/YB2001e/ml/indexE.htm.

Table 13

Urban Chinese inflation and real income growth between 1988 and 1995

	1988	1995	% Change
General retail price index, urban	188.5	429.6	227.9%
Average monthly household income, CHIPS:			
Nominal	509.	1,192.	234.2%
Real	270.	277.	102.8%
Annual per capita disposable income, urban residents:			
Nominal	1,181	4,283	362.7%
Real	626.5	997.0	159.1%

Note: First, fourth and fifth rows are from the China Statistical Yearbook 2001.

reported incomes grew by only 2.8% between 1988 and 1995, implying annual growth of much less than one percent.

This seems implausibly low. The fourth and fifth rows demonstrate that it is also inconsistent with other official Chinese statistics. The same deflator, applied to nominal per capita disposable income of urban residents, implies real growth between 1988 and 1995 of 59.1%.

Table 14 demonstrates that the implied growth rate of real household income in the CHIPS surveys is also inconsistent with statistics published by the World Bank. They estimate that real Chinese GDP per capita grew by 66.9% between 1988 and 1995. Real Chinese GNI per capita, evaluated at purchasing-power parity (PPP), grew by 64.1%. Real GDP per person employed, again evaluated at PPP, grew by 55.3%.

Table 14

Chinese income growth between 1988 and 1995

	1988	1995	% Change
US CPI deflator	1.000	1.288	22.8%
Chinese GDP per capita, $:			
Nominal	281.	604.	214.9%
Real	281.	469.	166.9%
Chinese PPP GNI per capita, $:			
Nominal	700.	1,480.	211.4%
Real	700.	1,149	164.1%
Constant (1990) PPP GDP per person employed	2,538.	3,941.	155.3%

Note: First, second, fourth and sixth rows are from the data.worldbank.org, downloaded 12/12/11. Third and fifth rows are author's calculations.

Tables 13 and 14 suggest that Chinese real incomes experienced growth of approximately 60% between 1988 and 1995. If this were also true of the average real household incomes in the 1988 and 1995 CHIPS surveys, then the implicit deflator for 1995 value of 1,192, relative to the 1988 value of 509, would be 1.460. This "real income deflator" is an alternative to the official deflator in tables 15 and 16.

Moreover, there are substantial reasons to suspect that official inflation measures understate actual inflation for this period. They are based on prices that were set administratively with only modest regard for the equality between demand and supply. Consequently, inflationary pressures could express themselves as excess demand, rather than price increases (Chen and Hou, 1986; Imai, 1994, as examples). Moreover, Wu (2007) provides evidence that official deflators

may have, on occasion, been deliberately manipulated to achieve political goals.

While Yi (1990), Brandt and Zhu (2000), Gerlach and Peng (2006) and Guerineau and Guillamont-Jeanneney (2005), as examples, employ official Chinese inflation series uncritically, Yu (1997) and Funke (2006) express reservations. Chen and Hou (1986), Feltenstein and Farhadian (1987), Feltenstein, Lebow and van Wijnbergen (1990), Yi (1991), Imai (1994), Moosa (1997) and Wang and Meng (2001) attempt to construct more accurate measures of Chinese inflation. They all conclude that official Chinese inflation measures understate true inflation in the 1980s.[11]

The alternative inflation series estimated by Feltenstein and Ha (1991) appears to have the greatest credibility. It is the foundatino for Huang (1994) and Li and Leung (1994). Hasan (1999) is based on the Li and Leung (1994) extension. Feltenstein and Ha (1991, 292) conclude "that by the end of 1988 the 'true' price index was 114 percent higher than the official index, based on the assumption that the two were equal at the beginning of 1979."

This would imply that the true urban general retail price index in 1988 was 403.4 rather than the 188.5 given in the first row of table 13. If the official price level for 1995 was correct, this would imply that the urban cost of living rose by only 6.5% between 1988 and 1995, or that the deflator for 1995 should be 1.065. Given the possibility of error in the official 1995 price level, This "Feltenstein and Ha (1991) deflator" serves as a lower bound on inflation in tables 15 and 16.

The official deflator is inconsistent with expectations regarding housing consumption as

[11] Portes and Santorum (1987) present the Feltenstein and Farhadian (1987) and the Feltenstein, Lebow and van Wijnbergen (1990) inflation revisions along with an official price index without offering an opinion as to which is more accurate.

Table 15

Descriptive statistics for imputed estimated market rents using structural and household characteristics, all households in 1988

Imputed estimated market rents	Average	Standard deviation	Coefficient of variation	Percentiles: 90th	10th	Difference 90th and 10th
Official deflator, 2.279:						
Pooled with provincial dummies	108.	96.5	89.6	253.	5.3	247.
Stratified by province:	86.9	136.	157.	219.	−19.5	239.
Budget share deflator, 1.667:						
Pooled with provincial dummies	148.	132.	89.6	346.	7.2	338.
Stratified by province:	119.	187.	157.	299.	−26.7	326.
Real income deflator, 1.460:						
Pooled with provincial dummies	168.	151.	89.6	395.	8.2	386.
Stratified by province:	136.	213.	157.	342.	−30.5	373.
Feltenstein and Ha (1991) deflator, 1.065:						
Pooled with provincial dummies	231.	207.	89.6	541.	11.3	552.
Stratified by province:	187.	292.	157.	468	−41.7	510.

Note: Sample consists of 8,645 households. Averages differ across imputations because the imputing regressions are based on a different sample. Values are deflated from original estimates in 1995 yuan. Official deflator is .439. Budget share deflator is .600. Real income deflator is .685.

well as with real income growth in the CHIP surveys. Using the pooled equation with provincial dummies, the official deflator estimates that the average imputed estimated market rent in 1988 was 108. With an average monthly household income of 509., this implies that the share of

housing in imputed total estimated income was no greater than 17.5%. This is implausibly low by international standards. The "budget share deflator" that would equate the share of housing in imputed total estimated income in 1988 to approximately that of 1995, 23%, would be equal to 1.667.[12]

Table 15 presents descriptive statistics for 1988 imputed estimated market rents using each of these deflators. For brevity, this table includes imputations only from the two regressions without county dummies that include household characteristics. Consistent with table 12, it demonstrates that imputed estimated market rents varied substantially.

The standard deviation of imputed estimated market rents is, at minimum, only slightly less than the average. Depending on equation and deflator the differences between the imputed estimated market rents at the 10^{th} and 90^{th} percentiles of its distribution vary between a little less than half of average monthly incomes to slightly more than average incomes. Regardless of regression or deflator, these statistics suggest that inequality in 1988 total estimated income is likely to exceed inequality in 1988 reported income.

Table 16 confirms this suggestion. It presents Gini coefficients for total estimated income, using both of the equations and all four deflators represented in table 15. All eight Gini coefficients are at least 10% larger than the Gini coefficient for total reported income, .206. At the same time, the eight Gini coefficients vary substantially among themselves, from .224 to .271.

This variation derives from two concurrent patterns. First, regardless of deflator, Gini

[12] Implicitly, the real income and Feltenstein and Ha (1991) deflators increase this share to values closer to international standards, though at the cost of greater inconsistency with the official deflator.

Table 16

Gini coefficients for total estimated income using
structural and household characteristics, all households in 1988

	Specification:	
	Pooled across provinces with provincial dummies	Stratified by province
Official deflator:	.224	.228
Budget share deflator:	.233	.242
Real income deflator:	.238	.249
Feltenstein and Ha (1991) deflator:	.254	.271

Note: Gini coefficient for total reported income is .206. Sample consists of 8,645 households.

coefficients are larger for the regression with the higher explanatory power, that stratified by province. This replicates the pattern displayed in tables 9 and 11 for 1995. Presumably, as in those tables, if county effects were estimable for the 1988 sample, the implied Gini coefficients would be greater.

Second, regardless of regression, Gini coefficients are larger for smaller deflators. With lower rates of inflation between 1988 and 1995, 1995 estimates of 1988 net imputed rents are larger in 1988 terms and form a greater proportion of estimated total income. They therefore make a larger contribution to inequality in estimated total income. As the distribution of estimated net imputed rents is much more inequitable than that of total reported income, lower inflation rates increase the inequality in estimated total income.

All of the Gini coefficients in table 16 presumably embody the negative bias demonstrated in table 9. In addition, the biases discussed at the beginning of this section are negative. Consequently, even the smallest estimates of table 16 imply a true Gini coefficient in excess of .23, or an increase of at least 11.7% above the Gini coefficient for total reported income. Any reasonable adjustment to the official inflation rate would then imply a true Gini coefficient in excess of .25, or an increase of at least 21.4%.

VII. Conclusion

This paper imputes rents for urban Chinese housing in 1988 and 1995, based on expected market rents reported in 1995. Although these expectations were based on little experience of competitive rental markets, their magnitudes and associations with dwelling unit structural, locational and provincial characteristics suggest that they were reasonably realistic.

The difference between imputed and actual rents measures the implicit subsidy accruing to urban Chinese households through the provision of housing at non-market prices. The imputations in this paper suggest that, on average, these subsidies were large. They amounted to nearly one-quarter of total imputed income in 1995.

The distribution of these subsidies was much more inequitable than was the distribution of reported income. Consequently, inequality in imputed total income was substantially higher, in both years, than inequality in reported income. In 1995, the Gini coefficient for imputed total income was almost certainly above .3, even though that for reported income was only .279. In 1988, the Gini coefficient for imputed total income was probably above .250, while that for reported income was only .206. Non-market allocations of urban Chines housing during the

period under study allowed the urban economy to sustain levels of inequality far in excess of those apparent from the monetized portion of household income.

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