Job-Housing Separation and Income Level

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Abstract: The commuting time of residents in Chinese major cities continues to increase with significant differences in job-housing separation across various city types and demographic groups. Using job search theory and efficiency wage theory, this study examines the relationship between job-housing separation and income levels in Chinese large cities. As the degree of job-housing separation increases, workers' income levels continue to rise. Second, regardless of wage levels, job-housing separation can lead to wage compensation, with workers at the lower end of the wage distribution being in a disadvantaged position. Third, the long-term effect of job-housing separation on income is more pronounced than the short-term effect. Fourth, Using the difference-in-differences model to overcome the model to reveal the causal relationship between residential-job separation and income level, the results show that change in wages between any two periods is mainly caused by the change in commuting time, and the long-term effect is greater than the short-term effect. The conclusion provides important insights for promoting a shift toward balanced job-housing distribution in urban areas.

Keywords: Urban Residents; Difference-in-Differences Model; Commuting Time; Income Level; Job-housing Separation

1. Preface

Against the backdrop of rapid urban expansion and the continuous enrichment and optimization of transportation modes, what is the long-term relationship between job–housing separation and wage levels among urban residents in China? Does this relationship exhibit heterogeneity? Can the commuting costs born by workers be compensated through wages? Addressing these questions can not only deepen the understanding of current urban transportation management but also provide references for future urban transportation planning. Although commuting behavior is an important issue of considerable academic interest [1, 2], research on the impact of job–housing separation on wage levels remains to be further expanded.

The job search theory model posits that regardless of whether the labor and housing markets meet the conditions of perfect competition, workers themselves cannot make decisions that minimize commuting costs. High commuting costs are the ultimate outcome of job searches aimed at obtaining higher wage levels. Employers as the demand side of labor tend to pay higher wages in the long run to employees with high commuting costs. When certain factors cause changes in commuting costs, employees will engage in new bargaining and negotiation with employers, demanding wage increases to offset the rising commuting costs. If the increase is insufficient to cover the additional commuting costs, employees will leave the company and enter a new round of job search (Rouwendal, 2004) [3]. The relationship between commuting costs and individual wages may be either positive or negative. This implies that wages may fully compensate for commuting costs, or there may be no compensation, in which case compensation may be provided through residential choices or locational characteristics. Ommeren and Fosgerau using labor supply data released by Statistics Netherlands [4], confirmed that wage compensation for commuting costs does exist and is fully realized through wage rates. The study also found that full-time workers do not receive full compensation, with a wage compensation rate of 77%. Additionally the marginal level of compensation varies by gender, with men receiving a higher proportion of compensation than women.

Based on job search theory and compensating wage differential theory, this article uses panel data of urban residents from 2011 to 2017, along with fixed-effects models and difference models to examine the long-term relationship between commuting costs and wages.

2. Theoretical Analysis and Hypotheses

2.1 Theoretical Analytical Foundation

2.1.1 Job-housing separation and workers reservation wage

Job seekers typically assess and form expectations about future salary levels based on their own resource endowments and the wage information they gather from the labor market. This psychologically anticipated minimum acceptable wage which is referred to as the "reservation wage." According to reservation wage theory if the observed wage level falls below an individual expected reservation wage, such individuals may choose to withdraw from the labor market, refusing to accept jobs that pay less than this threshold, and instead "reserve" their labor for personal or domestic use. In other words, given multiple job opportunities these individuals will only accept positions that exceed their reservation wage, otherwise they remain inactive with waiting for better opportunities. Job–housing separation reduces rest and leisure time from job seekers, increases their work-related costs and consequently leads directly to an increase in the reservation wage level.

2.1.2 Corporate decision-making mechanism

Upon learning about job-housing separation from employees, employers may consider offering compensation to such employees to incentivize them to remain with the company, avoid the opportunity and search costs associated with position vacancies and ensure smooth business operations[5]. Companies typically weigh these additional costs against potential wage increasement. When the wage increment attributable to job-housing separation remains below the additional costs and falls within an acceptable range for the company, employers may choose to raise wages for employees with long commutes, ensuring that the actual wage level does not fall below the "reservation wage." It is benefical to retain experienced staff. At this point a better match is formed between the company and the employee. The resulting wage becomes the "reservation wage" that incorporates the cost of job-housing separation.

2.2 Proposing Theoretical Hypotheses

2.2.1 Theoretical analysis

With the continuous expansion of Chinese major cities and the increasing degree of job-housing separation, not only workers' "reservation wages" rise accordingly, but the search costs for both firms and individuals also increase simultaneously. In such a context, workers aiming to maximize their own interests will engage in new bargaining and negotiation with their current employers, demanding wage increases to compensate for rising commuting costs. If employees do not receive the raise and if the wage increase is insufficient to offset the additional commuting costs, they will leave their current employer and enter a new round of job search [6]. The lack of pricing power in wage bargaining puts firms in a passive position during labor negotiations, forcing them to become price-takers in the labor market. Under these circumstances, firms ultimately bear the burden of rising commuting costs.

The job search theory model posits that regardless of whether labor and housing markets meet the conditions of perfect competition, workers themselves cannot make decisions that minimize commuting costs. High commuting costs are the ultimate outcome of job searches aimed at securing higher wage levels. Over a longer time horizon, such costs incurred by workers can ultimately be shifted to firms, leading to a stable equilibrium in wage levels. From a long run equilibrium perspective, wage levels depend more on the productivity at the workplace, labor costs and production efficiency of worker. In pursuit of higher excess economic profits, employers not only strive to enhance employee productivity but also provide wage compensation based on the degree of job–housing separation, resulting in differentiated commuting compensation wages for employees with different commuting times. Workers with longer commutes receive higher wages [7].

2.2.2 Hypothesis formulation

Based on the above analysis, this paper proposes the following two hypotheses.

Hypothesis 1: Over a relatively long period, as the large city expands in size, the increasing degree of job–housing separation among residents gradually raises the overall “reservation wage”in the city. To avoid the opportunity costs and search costs caused by job vacancies and to ensure the smooth operation of production and business activities, firms tend to offer a certain wage premium to employees with long commutes. Employees thereby receive compensation for the additional commuting

costs, which in turn continuously pushes up the reservation wage level as commuting time increases.

Hypothesis 2: In the long run, there is an inverse relationship between urban residents expected commuting time and leisure time， increasement in commuting time implies the reduction in leisure time. Meanwhile there is a positive relationship between expected commuting time and wage levels.

3. Construction of the Test Model

3.1 Model Design

3.1.1 Commuting time and leisure

From the perspective of labor supply, this section primarily analyzes the relationship between commuting time and leisure, aiming to test Hypothesis 2. Hypothesis 2 posits an inverse relationship between expected commuting time and leisure time, where longer commuting hours imply a reduction in leisure time. Accordingly the following econometric model is specified:

$$\ln lei_{it} = \beta_0 + \beta_1 \ln com_{it} + \beta_2 ind_{it} + \beta_3 res_{it} + \beta_t + \mu_{it} \quad (1)$$

In Equation 1， lei_{it}、com_{it} represent the leisure time and commuting time on workdays for all individual samples i in year t respectively, Variable ind_{it} represents the individual characteristics of the sample, including age, gender, years of education, marital status, children status, and commuting mode. res_{it} refers to the residential characteristics of a sample, including living area and property ownership attributes. μ_{it} is the random error term. β_0 denotes the time-invariant intercept term, while βt represents the fixed effects.

3.1.2 Commuting time and wage level

According to Hypothesis 2, it is expected that there is a positive relationship between commuting time and wage level as commuting time increases, the wage level also rises. To test this hypothesis, this section primarily examines the relationship between commuting time and hourly wages of employees.

Drawing on the research of Ross & Zenou [8] and others, this paper establishes the following model:

$$\ln w_{it} = \beta_0 + \beta_1 \ln com_{it} + \beta_2 ind_{it} + \beta_3 res_{it} + \beta_t + \mu_{it} \quad (2)$$

In Equation 2 , W_{it} represents the hourly wage level of sample individual i in year t, $\ln W_{it}$ and $\ln com_{it}$ denotes the logarithm of the hourly wage level and commuting time for sample individual i in year t. Similar to Equation 1, ind_{it} denotes the individual characteristics of the sample, including age, gender, years of education, marital status, children status and commuting mode, res_{it} refers to the residential characteristics of the sample, including living area and property ownership characteristics. μ_{it} is the random error term, β_0 represents the time-invariant intercept term and β_t indicates the industry fixed effects.

It should be noted that since this paper focuses on the impact of commuting time on wage levels, changing residential address may interfere with the interrelationship between commuting time and wage levels[9] .We exclude workers who changed their residential addresses. This paper focuses on samples whose residential addresses remained unchanged during the tracking period to study the relationship between commuting time and income level. Meanwhile starting from the implicit assumption that workers do not receive price or rent compensation from the housing market during the survey period, we exclude the possibility that residents commuting behavior may be compensated in the housing market. Our aim is to examine whether workers' commuting time can be compensated in the form of wages in the labor market [10].

At this point the change in commuting time is achieved through altering either the workplace or the commuting mode, which implies that commuting time is not influenced by the income level within the model. When considering how commuting time affects income level, it is necessary to satisfy the premise that commuting time is an exogenous variable, thereby allowing the use of the ordinary least squares method to obtain estimation results. This model clearly cannot be estimated using cross-sectional data, because in cross-sectional data the relationship between commuting time and wage levels across individuals arises from differences in workplace and residential locations, making it impossible to discuss situations where residential location does not change over time. However, we can utilize panel data to observe information on individual income characteristics, commuting behavior and other relevant features that vary over time, as well as information on whether and when they change their residential address. This paper employs such data to examine the impact of commuting time on income levels for employees

who did not change their residential address during the observation period [11].

3.2 Data Sources and Sample Selection

3.2.1 Data sources and sample selection

This study primarily utilizes data on urban residents' commuting behavior from waves of the China Family Panel Studies. The survey covers employment, housing, consumption and income, encompassing aspects such as living and working conditions, residential arrangements, household decision-making and income and expenditures of workers. The statistical description of the variables is presented in Table 1. Among them commuting time refers to the total daily travel time required on average for the round trip between home and work. The hourly wage variable is derived by dividing the monthly net income by (weekly working hours * 4.4). In addition to the above variables, this paper includes the following control variables: individual characteristics, residential characteristics, workplace characteristics, means of transportation and leisure time. Individual characteristics include variables such as household registration status, gender, education level, age, work experience, marital status and number of children aged 16 and below. Residential characteristics consist of two variables: property ownership type and floor area. Workplace characteristics encompass factors such as company size, nature of the employing unit, job skill requirements and managerial authority. In this study, years of education are represented by the values 0, 1, 2, 3, 4, and 5, corresponding to illiteracy, primary school, junior high school, senior high school (or vocational secondary school), junior college and bachelor's degree or above respectively. Work experience is represented by subtracting years of education and 6 from the worker's age, gender is coded as 1 for male and 0 for female, household registration is coded as 1 for agricultural and 0 for non-agricultural. Enterprise ownership is coded as 1, 2, and 3 for private, state-owned (collective), and foreign-funded enterprises respectively, company size is coded as 1, 2, and 3 for small, medium, and large scale, respectively. Occupational skill level is coded as 1, 2, and 3 for mental work, semi-skilled/semi-manual work and manual work respectively.

The descriptive analysis results of each variable are presented in Table 1 below:

3.2.2 Descriptive analysis

The means and standard deviations of the main variables are presented in Table 1.

Table 1. Mean and Standard Deviation of Main Variables

Variable Name	Obs	Mean Standard	Mean Standard	Min	Max
hwage	3488	22.96	33.61	0.41	399
comtime	3488	29.35	26.24	0	120
edu	3482	2.03	1.17	0	5
hukou	3478	0.74	0.44	0	1
gender	3476	0.72	0.45	0	1
workyear	3488	27.92	21.05	0	70
job	3266	1.49	0.88	1	4
weekhour	3488	48.66	16.12	7	100
workfeature	2710	1.42	0.56	1	3
housework	3474	10.56	9.35	0	84
manage	3478	1.80	0.40	1	2
lei	3474	7.05	2.69	8.14	14.61
scale	2710	1.42	0.56	1	3
area	3478	10.77	9.81	10	105
right	2710	1.42	0.56	1	3
child	3476	3.25	0.87	0	4
married	3478	0.74	0.44	0	1
jiao	2496	2.11	0.49	1	3

4. Empirical Results and Analysis

4.1 The Correlation between Commuting Time, Leisure Time, and Income Level

To examine the relationship between commuting time and leisure time as well as wage level, this study first plotted scatter plots in Figure 1 and Figure 2. Preliminary observations suggest an inverse relationship between commuting time and leisure time—as commuting time increases, leisure time decreases.

4.2 The Impact of Job-Housing Separation on Income Levels: Based on the Labor Supply Entity

4.2.1 Job-housing separation and leisure time

In Table 2, the estimation results of models (1)–(4) indicate a significant inverse relationship between commuting time and leisure time of workers confirming Hypothesis 2 proposed earlier. The extension of commuting time significantly reduces leisure time. Model (1) represents the regression using the random effects model. The estimation results indicate that for every 1% increase in commuting time workers' leisure time decreases by 3.98% which is statistically significant at the 1% level.

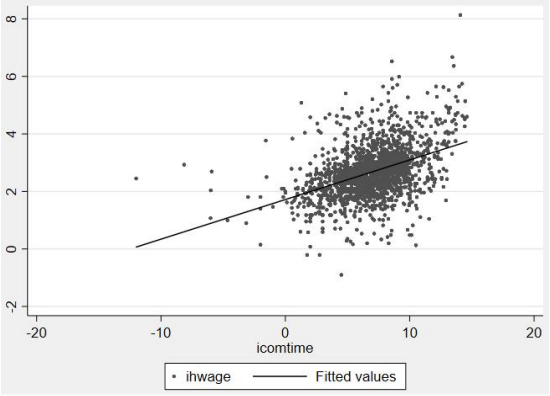

Figure 1. Scatter Plot of Commute Time and Wage Level

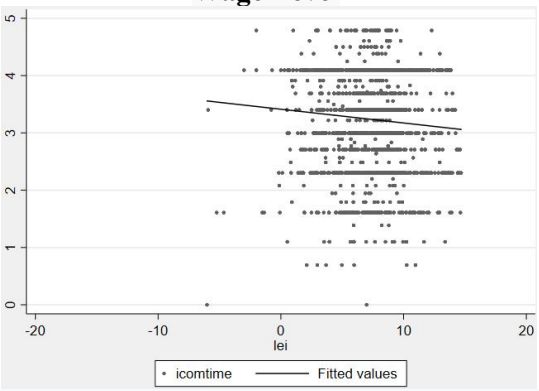

Figure 2. Scatter Plot of Commuting Time vs. Leisure Time

Model (2) employs a fixed-effects model for regression. The estimation results indicate that a 1% increase in commuting time leads to a 6.30% reduction in leisure time of workers. To eliminate the influence of temporal trends and city specific variations, models (3) and (4) respectively utilize time fixed effects and city fixed effects to estimate the relationship between commuting time and leisure time.The results indicate that for every 1% increase in commuting time while workers' leisure time decreases by 6.1%. The estimation results from fixed-effects models (2)–(4) show that the 1% increase in commuting time reduces workers leisure time by 6.0%, 6.3% and 4.29%, respectively all statistically significant at the 1% level. It can be observed that long commutes substantially encroach upon workers' leisure time, exerting a profound impact on their daily life and work.

Additionally control variables related to individual worker characteristics such as age and gender also significantly influence leisure time. Age has a significant negative effect on wage levels, meaning that older individuals tend to have more leisure time. Compared to women, men spend more time on leisure activities, one possible reason being that men generally devote less time to household chores[12]. Among education levels, having a junior high school education shows a relatively higher significance and coefficient in relation to leisure time.

Table 2. Regression Results of Commuting Time and Leisure Time

v1	Random effects	Fixed effects	Time fixed effects	Region fixed effects
	1	2	3	4
variable	lei	lei	lei	lei
icomtime	-3.984 ***	-6.295 ***	-6.094 ***	-4.295 ***
	-0.541	-0.789	-0.789	-0.918
age	-0.0278 ***	-0.0432***	-0.0500***	-0.0232***
	-0.00868	-0.0118	-0.0118	-0.0108
1.gender	9.539***	22.50 ***	23.10 ***	9.50 ***
	-1.157	-4.107	-4.086	-4.145
1.hukou	-1.326	0.948	1.781	1.92
	-1.291	-2.418	-2.41	-2.433
1.edu	3.388*	4.255	3.64	3.567
	-1.943	-2.711	-2.698	-2.234
2.edu	6.146***	5.618*	5.604*	5.290*
	-1.919	-2.981	-2.964	-2.081
3.edu	5.751***	-1.922	-2.389	-1.022
	-2.151	-3.495	-3.476	-3.095
4.edu	10.88***	2.431	1.773	2.456
	-2.99	-5.095	-5.068	-5.215
5.edu	8.676 **	-2.144	-3.156	-1.144
	-3.478	-7.04	-7.003	-6.04
2.right	-1.749	-5.544 **	-4.686 *	-5.230 **

	-1.736	-2.534	-2.526	-2.518
3.right	3.626*	2.053	1.854	2.012
	-1.976	-2.804	-2.793	-2.104
1marry	9.709 ***	6.652 ***	6.239 ***	4.652 ***
	-1.355	-2.394	-2.383	-1.344
child	1.924	6.944	6.136	5.038
	-4.138	-6.189	-6.155	-5.089
2.year			0.891	
			-1.008	
3.year			-3.777 ***	
			-1.006	
2o.num				0.235
				-0.15
3o.num				-0.122
				0.208
Constant	112.9 ***	115.0 ***	114.6 ***	105.0 ***
	-3.441	-5.66	-5.651	-4.086
Observations	3,430	3,430	3,430	3,430
R-squared		0.072	0.084	0.097

4.2.2 Job-housing separation and income level

In Table 3, the estimation results of models (1)–(4) indicate that workers' commuting time and wage levels exhibit a significant positive correlation with confirming the earlier Theory 1 and Hypothesis 2. The extension of commuting time significantly increases workers' wage levels. Among them, model (1) represents the regression using the random effects model. The estimation results show that for every 1% increase in commuting time, workers' wage levels rise by 0.08%, and this result is significant at the 1% level.

Model (2) employs a fixed-effects model for regression. The estimation results indicate that for every 1% increase in commuting time, the wage level of workers rises by 0.08%. To eliminate the influence of temporal trends and city-specific changes, (1) and (2) employed time-fixed effects and city-fixed effects models, respectively to estimate the relationship between commuting time and wage levels. The results indicate that a 1% increase in commuting time raises workers' wage levels by 6.1%.Estimates from the fixed effects models (2)–(4) show that a 1% increase in commuting time increases workers' wage levels by 0.1% and 0.09% respectively and these results are statistically significant at the 1% level.

This suggests that workers receive wage compensation for commuting time, with wage levels rising as commuting time increases. Furthermore, control variables related to individual characteristics of workers, such as age, gender, household registration status, education level, number of children and housing area, also significantly affect wage levels, exhibiting a positive correlation. Higher age, higher education level, greater number of children and larger housing area are all associated with higher corresponding wage levels.

Table 3. Regression Results of Commuting Time and Wage Level

v1	(1)	(2)	(3)	(4)
VAR	ihwage	ihwage	ihwage	ihwage
icomtime	0.0848***	0.0823***	0.109***	0.0909***
	-0.0187	-0.0295	-0.0278	-0.0288
age	0.000195	0.000766**	0.00129***	0.02129***
	-0.000242	-0.000333	-0.000316	-0.000216
1.gender	0.224***	0.639***	0.804***	0.704***
	-0.0393	-0.165	-0.156	-02356
1.hukou	-0.0392	0.153*	0.180**	0.180**
	-0.0438	-0.0905	-0.0851	-0.0851
1.edu	0.152**	0.192*	0.0896	0.1896
	-0.0676	-0.113	-0.106	-0.116

2.edu	0.387***	0.388***	0.343***	0.378***
	-0.0664	-0.13	-0.122	-0.148
3.edu	0.451***	0.235	0.208	0.378
	-0.0737	-0.15	-0.141	-0.238
4.edu	0.553***	0.256	0.206	0.263
	-0.0999	-0.199	-0.187	-0.197
5.edu	0.812***	0.418*	0.304	0.378
	-0.112	-0.243	-0.229	-0.289
2.jiao	-0.249***	-0.309***	-0.199**	-0.219**
	-0.0598	-0.0963	-0.0908	-0.0817
3.jiao	0.317***	0.206**	0.195**	0.105**
	-0.0678	-0.105	-0.0986	-0.0978
2.right	3.794	0.973	3.327	3.479
	-5.04	-6.714	-6.693	-6.704
area	-0.001***	-0.001***	-0.001***	-0.001
	(-6.10)	(-5.39)	(-4.51)	(-1.56)
child				
marry				
2.year			0.157***	0.287***
			-0.0346	-0.0369
3.year			-0.270***	-0.175***
			-0.0381	-0.0323
2o.num				1.207
				-1.148
3o.num				2.539
				-1.576
Constant	2.359***	1.889***	1.701***	1.701***
	-0.117	-0.227	-0.214	-0.214
Observations	2,288	2,288	2,288	2,288
R-squared		0.095	0.206	0.078
Number of id	1,364	1,364	1,364	1,364

4.2.3 Heterogeneity in job-housing separation and income levels

To examine the differential impact of commuting time on wage levels across different quantiles, this section further employs the panel quantile regression method to estimate the numerical relationship between the explained variable and the explanatory variables. Advantage lies in extending the ordinary OLS regression approach by investigating the conditional probability distribution of the explained variable. By fitting the weighted average that minimizes the absolute residuals at various quantiles, we obtain regression results for the conditional quantiles of commuting time and workers' wage levels. This approach fully accounts for the influence of sample outliers on the regression outcomes of the model, to make the estimation results more accurate and reasonable. We specify the quantile regression model as follows:

$$Q_{jt}(\ln W_{ft} | X_{jt}) = X_{jt}\beta_{jf} + U_{jt} \quad (3)$$

X represents variables such as the worker's commuting time and individual characteristics, β denotes the variable coefficients and U is the random error term.

$Q_{jt}(\ln W_{ft} | X_{jt})$ represents the corresponding wage level of workers at different quantiles under given conditions. This paper selects five quantile points: 0.1, 0.25, 0.5, 0.75, and 0.9 and estimates the corresponding variable coefficients using Equation (4).

$$\min\left\{\sum_{j:\ln W_j \geq X_j\beta(\theta)} \theta\left|\ln W_j - X_j\beta(\theta)\right| + \sum_{j:\ln W_j < X_j\beta(\theta)} (1-\theta)\left|\ln W_j - X_j\beta(\theta)\right|\right\} \quad (4)$$

The estimation results are presented in Table 4. The 0.1, 0.25, 0.5, 0.75, and 0.9 quantiles, each additional minute of commuting time increases the hourly wage by 3.7, 3.9, 5.9, 9.9 and 183.7 cents, Respectively which represents a significant expense for employers. In summary as commuting time lengthens, wage levels rise correspondingly and the impact of commuting time on wages becomes particularly pronounced at higher wage quantiles.

Table 4. Quantile Regression Results of Commuting Time and Wage Level

v1	1	2	3	4	5
icomtime	0.0377***	0.0391***	0.0595**	0.0990**	1.837 ***
	-0.00478	-0.00966	-0.0234	-0.0458	-0.265
hukou	0.052	-0.030	-0.027	-0.006	0.037
	(0.67)	(-0.64)	(-0.63)	(-0.14)	(0.41)
gender	2.360***	3.744***	2.889***	7.308***	141.9 ***
	-0.375	-1.283	-1.11	-2.441	-23.74
edu	1.574***	1.295***	2.659***	3.153***	-19.42
	-0.243	-0.368	-0.58	-0.715	-14.09
workyear	0.00171	0.0362 ***	0.0502 ***	0.115 ***	0.915 ***
	-0.00299	-0.00587	-0.0027	-0.019	-0.0942
weekhour	-0.158 ***	-0.313 ***	-0.360***	-0.820 ***	-4.969 ***
	-0.0117	-0.0356	-0.04	-0.0749	-0.572
hukou	-1.649 ***	1.568	-1.023	-1.864	-21.53
	-0.631	-1.012	-0.962	-1.394	-18.97
manage	-0.337	-0.238	-3.430 ***	0.829	21.90 **
	-0.388	-0.306	-0.583	-1.539	-9.403
jiao	2.409 ***	1.939 ***	4.051 ***	5.025 ***	40.12 **
	-0.24	-0.408	-1.24	-1.776	-17.09
right	2.537 ***	3.463 ***	2.028 ***	1.963 ***	2.715 ***
	(3.30)	(7.45)	(4.93)	(4.35)	(3.06)
area	0.001 ***	0.001 ***	0.001 ***	0.000 ***	0.001 ***
	(-3.29)	(-7.42)	(-4.92)	(-4.34)	(-3.07)
Observations	2,530	2,530	2,530	2,530	2,530
Number of groups	1,460	1,460	1,460	1,460	1,460

5. Conclusion

First,as the degree of job-housing separation increases, workers' income levels continue to rise. Second, regardless of wage levels, job-housing separation can lead to wage compensation, with workers at the lower end of the wage distribution being in a disadvantaged position. Third, the long-term effect of job-housing separation on income is more pronounced than the short-term effect. In the long run, wage levels can be further adjusted based on commute duration, including wage compensation for commuting costs. Fourth, the focus of future urban management should be on establishing a sustainable transportation system to ensure the normal and efficient operation of urban traffic, thereby reducing the commute time for labor market participants.

Acknowledgments

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