Original Article

ELRR

Commuting time and sickness absence in China: Rural/urban variations and Hukou impacts

The Economic and Labour Relations Review
2020, Vol. 31(1) 76–95

DOI: 10.1177/1035304619899770
journals.sagepub.com/home/elra
SAGE

Murong Guo and Kuang Tang
Renmin University, China

Zicheng Wang
Jinan University, China

Abstract

This article addresses three main issues: the relationship between commute time and sickness absence, the heterogeneity of the commuting–absenteeism effect between rural migrants and urban citizens, and the effect of China's Hukou system on the commuting–absenteeism effect. It applies a unique set of employer–employee matched data in China and a zero-inflated negative binomial model. We find clear evidence that a longer commuting time contributes to an increase in sickness absence. The heterogeneity of the commuting–absenteeism effect can also be confirmed: longer commuting leads to higher absence rates for urban citizens but not for rural migrants. Furthermore, we explore the effect of commuting on a set of health-related outcomes. The estimations demonstrate that commuting time has a significant impact on health-related outcomes for both migrants and urban citizens, but unequal access to housing provision and to social health insurance in the Hukou system may mean that rural migrants resort to more informal medical services and thus lack access to the official sickness certificate required to seek legal sickness absence. We recommend accelerated reform of the Hukou system to encourage rural workers to seek appropriate and timely medical services, thereby reducing public health risks.

JEL Codes: I12, I14, J83, N35, N75

Keywords

Commuting, Hukou, public health, rural disadvantage, sickness absence, zero-inflated negative binomial model

Corresponding author:
Zicheng Wang, School of Public Management, Jinan University, 601 West Huangpu Blvd, Guangzhou 510632, China.
Email: wangzicheng976@126.com

Introduction

For millions of employees, commuting is a routine but important component of daily life. With China's rapid urbanisation and popularisation of private vehicles, working places and residences are becoming increasingly distant, and commuting is increasing accordingly (Lin et al., 2015; Yang and Gakenheimer, 2007). Most employees in China have experienced a heavy commuting burden (Nie and Sousa-Poza, 2018), which is portrayed as 'a plague that affects modern [humanity]' (Koslowsky et al., 2013). Long commute times have become more common in the larger cities and average commuting time for residents in Beijing and Shanghai amounts to 52 and 51 minutes (Baidu, 2014). The commuting burden has become one of the most serious components of 'urban disease' in China, which is not only bad for employees and their families, but also linked to high rates of worker absenteeism.

Various studies have turned to discussing the effect of commuting on subjective well-being (SWB) in China (Nie and Sousa-Poza, 2018; Zhu et al., 2019). However, little attention has been paid to the effects of commuting on employee's absenteeism in China. There are general claims that commuting may be linked to health and well-being (Taylor and Pocock, 1972), and that it also may be related to employees' absenteeism (Goerke and Lorenz, 2017). But whether longer commute time leads to more absence or not has not achieved a consensus in empirical studies. Some previous studies have found no clear nexus between commuting and sickness absence (Buzzard and Liddell, 1963; Jones, 1971; Liepmann, 1944; Norman, 1959), whereas clear evidence confirming a relationship has been confirmed in America, Australia, Germany and the UK (Giménez-Nadal et al., 2018a; Kluger, 1998; Magee et al., 2011; Van Ommeren and Gutiérrez-i-Puigarnau, 2011). Most previous studies conducted in developed countries have neglected the possibility of a heterogeneous commuting–absenteeism effect, reflecting the socio-economic traits of different employee groups. In China, such heterogeneous effects, induced by the Hukou system, seem likely to be particularly important. This is because rural migrants and urban citizens may experience different health insurance constraints, which will produce different commute-absence effects.

The present study tries to fill this empirical gap by addressing three main questions. First, is there a positive relationship between commute time and sickness absence, in the sense that sickness absence increases with commute time? Second, does the effect of commuting on sickness absence vary by Hukou? And third, if so, what is the mechanism leading to the difference in the commuting–absenteeism effect between rural migrants and urban citizens?

This study contributes to the literature in two distinct ways.

First, using a unique dataset named China's Matched Employer-Employee Survey (CMEES, 2013), this study applies the zero-inflated negative binomial (ZINB) model to explore the nexus between commuting time and sickness absence in China. In doing so, it provides a new perspective from which to understand the impact of work–life balance on the productivity of employees in China.

Second, the study discusses the heterogeneous effects induced by the Hukou system and explores the potential mechanism of these effects in the China context, by estimating the effect of commuting time on health-related outcomes. Importantly, it establishes the blocking role of unequal social health insurance in the transmission effect linking commuting and absenteeism.

The remainder of the article is organised as follows. Section 'Literature review' provides a literature review on which the conceptualisation of the commuting–absenteeism relationship is based. Section 'Background and conceptual framework' provides an institutional background and sets out the conceptual framework and econometric method, and then section 'Data and descriptive statistics' describes the data sampled and provides distributions of the main variables. In section 'Econometric method and empirical results', the empirical results of baseline estimations, robust checks and mechanism analysis will be presented. Section 'Conclusion' concludes with three recommendations: gradual relaxation of the Hukou system, improved urban public transport and rural welfare measures such as commuting subsidies and flexible work schedules.

Literature review

Commuting is viewed as an indispensable part of day-to-day life for millions of workers worldwide (Holland, 2016; Novaco et al., 1990). With urban expansion and traffic congestion growing, commute time has been steadily increasing, reflecting challenges of work–life balance for employees. In addition, its link to health and well-being (Sandow et al., 2014), commuting has also been linked to labour costs and productivity (Allen, 1983; Grinza and Rycx, 2018; Van Ommeren and Gutiérrez-i-Puigarnau, 2011). An array of studies has afforded some concern to the nexus between commuting and worker absenteeism (Goerke and Lorenz, 2017; Taylor and Pocock, 1972; Van Ommeren and Gutiérrez-i-Puigarnau, 2011).

The theories argued through new welfare economics and the efficiency wage model predict different directions of the commuting–absenteeism link. First, discussions from new welfare economics state a positive effect of commuting on illness absence. Long commuting is seen as harmful to the commuter's physical and mental health (Nie and Sousa-Poza, 2018; Roberts et al., 2011; Stutzer and Frey, 2008). By reducing leisure time for health-promoting behaviours, such as physical activity, relaxation and social participation (Hansson et al., 2011), long commuting is posited as increasing the risk of health-related illness and thus leading to an involuntary or unavoidable absenteeism. Meanwhile, long commuters are predicted to have a high level of shirking behaviour to gain additional benefits from absence (Goerke and Lorenz, 2015; Ross and Zenou, 2008), which will increase the likelihood of involuntary absenteeism. On the other hand, efficiency wage theory claims that commuting time may be negatively related to sickness absence days. Individuals who choose to take a long commute to work must have been well compensated (Goerke and Lorenz, 2015; Stutzer and Frey, 2008). Long commuters are posited as more likely to be undertaken by people with high work morale, and this may effectively reduce the incidence of voluntary absenteeism (Hassink and Fernandez, 2018).

The relationship between commuting and sickness absence is thus theoretically ambiguous. Resolution of the debate has also gained no consensus in empirical studies. An early contribution by Liepmann (1944) found that while commuting may increase sickness absence, there was no clear evidence of such an impact in London. Similar conclusions were confirmed by Norman (1959) and Jones (1971), who after asserting that absenteeism increases with commute time, provided no supportive evidence. A more elaborate study conducted by Buzzard and Liddell (1963) indicated only a tiny positive association between commuting time and sickness absence, with conclusions from subgroups being differentiated and inconsistent.

A few researches also obtained evidence of a clear positive effect. Using the survey of 1994 office workers in Central London, Taylor and Pocock (1972) demonstrated that the number of commute stages was related to both certified and uncertified sickness absence. Subsequently, Kluger (1998) and Magee et al. (2011) also found a positive relationship between commuting time and absence in America and Australia, respectively . Van Ommeren and Gutiérrez-i-Puigarnau (2011) discussed the nexus between commuting distance and absenteeism using seven waves of the 1999 to 2007 German Socio-Economic Panel (GSOEP) survey, also finding clear evidence that commuting distance has a strong positive effect on absenteeism, with an elasticity of about 0.07. More recently, a study conducted by Giménez-Nadal et al. (2018a: 9, 11) established that commuting increases worker's illness-related absence. Using data from the US Panel Study of Income Dynamics (2011, 2013, 2015), they found that a 1% increase in the daily commute of male workers is associated with an increase of around 0.018% in sick-day absences per year, while there is no significant evidence for women. In addition, Goerke and Lorenz (2017) also found a significant positive relationship from the GSOEP, but the significant effect was only for the long distance commuter, with no evidence that the commuting distances induce to higher sickness absence in general.

Such studies neglected the fact that sickness absence is a multi-factorial phenomenon, determined by various circumstances at different structural levels, that might also interact and/or modify with the effects of commuting (Alexanderson, 1998). In addition, the effect seems to be driven by variations in different employee groups depended upon demographic traits and socio-economics status. As urbanisation accelerates, the commuting burden has become a thorny problem for commuters not only in first-tier cities but also in some second- and third-tier cities.[1] Some researchers have thus turned to discussing the effect of commuting on SWB, including life satisfaction and emotional reactions. In these studies, the confirmed evidence is that a longer commute time is associated with lower levels of SWB (Nie and Sousa-Poza, 2018; Zhu et al., 2019).

In particular, the impact of commuting on sickness absence remains under-studied in the China context, especially the differences among employee groups with different Hukou status. Urban citizens are defined as employees with local urban Hukou, and rural migrants are defined as employees with non-local agricultural Hukou. To address this gap, our article uses a unique representative dataset of CMEES, conducted in 2013, to explore the nexus between commuting and sickness absence, and further discusses the heterogeneity of the commuting–absenteeism relationship generated by the Hukou system and the potential transmission channels of these different effects.

Background and conceptual framework

The Hukou system and institutional background

Hukou is a system of household registration in China. Similar to an internal passport, it is used by the government to regulate population mobility between rural and urban areas

(Zhao and Howden -Chapman, 2010). Hukou is closely connected to access to most of the public services offered by the local city. Without a local Hukou, rural migrants are less likely to gain urban welfare benefits and need to pay more for social services (Wu, 2002).

Accordingly, to reduce restrictions on Hukou, many cities have already relaxed residency requirements to attract domestic migrants – especially young graduates (Wu and Zhang, 2018; Zhang and Tao, 2012). These incentives, however, tend to favour young and educated workers rather than the rural migrants without higher education qualifications. Many of these rural migrants are unable to reach those criteria and have less likelihood to obtain access to urban welfare benefits.[2] The Hukou system still acts as the main institutional barrier that restricts access the basic urban welfare and social service programmes to the disadvantage of rural migrants in modern China (Fang and Zhang, 2016).

The segregated health insurance in the Hukou system may induce different commuting influences on sickness absence among rural migrants and urban citizens. The health insurance system in urban is mainly consisted of Urban Employee Basic Medical Insurance (UEBMI), which was established in 1988 and fully implemented nationwide in 1998. UEBMI is a compulsory medical insurance which is jointly financed by employers (6%) and employees (2%). However, rural migrants have lower UEBMI coverage than their urban counterparts. According to Meng (2017), only 29% of rural migrant workers participated in UEBMI, whereas, nearly 92% of urban citizens enrolled in it.

The Hukou system exposes rural migrants to a disadvantaged position, giving them an unfairly restricted share of public health insurance and compelling them to pay high out-of-pocket expenses for health services (Peng et al., 2010). When these workers get sick, they may be involved in a series of ineffective health-seeking behaviours, such as unsupervised self-medication, obtaining medical advice from unlicensed private clinics or 'just holding on' without enjoying health services for minor illnesses (Hong et al., 2006; Liang et al., 2010; Peng et al., 2010).

Conceptual framework

In line with previous studies of Van Ommeren and Gutiérrez-i-Puigarnau (2011) and Giménez-Nadal et al. (2018a, 2018b), the present study addresses the positive effect between commuting time and sickness absence, and the nature of the transmission mechanism. The effect of commuting time on sick leave may be transmitted by health status. A number of studies have shown that long commuting was accompanied by lower subjective/psychological well-being and increased stress (Novaco and Gonzales, 2009; Stutzer and Frey, 2008; Van Ommeren and Gutiérrez-i-Puigarnau, 2011), and that such stress impairs the employee's health and thereby induces absenteeism.

However, unique institutional arrangements, especially the Hukou system, may be another transmission mechanism that has a different influence on worker's commuting and health-seeking activities. With insufficient health insurance for the reasons outlined above, rural migrants may have to give up the right to sick leave or to seek professional hospital services once they experience health problems (Peng et al., 2010). The impact of commuting on sickness absence may therefore vary by Hukou status, that is, commuting time induces absenteeism for urban citizens, while it has no significant effect on

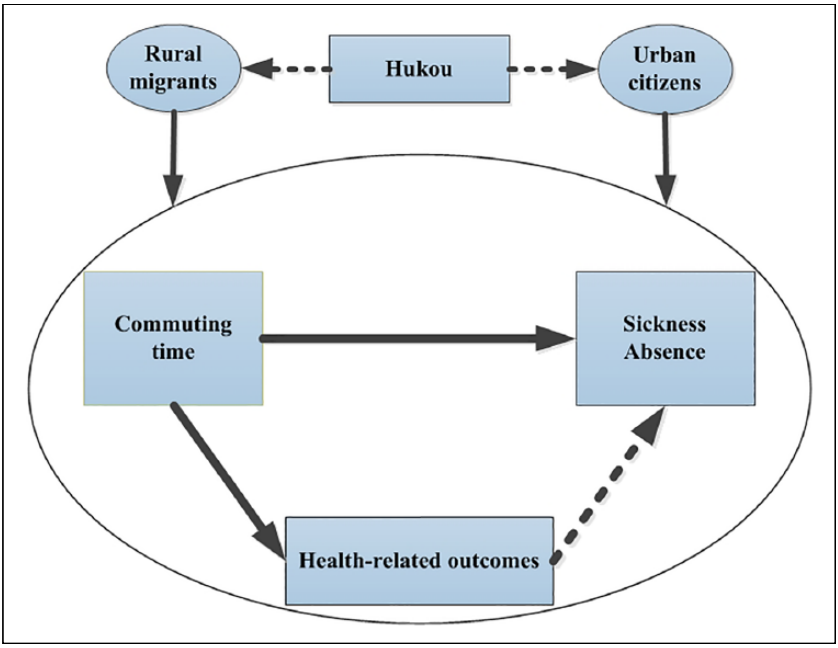

Figure 1. Research framework of this study.

rural migrants. The potential mechanism channel we claim is still the health status. Commuting time has both significant effect on the health status of urban citizens and rural migrants. But with insufficient health insurance, rural migrants who suffer health-related illness have less access to ask for formal absence permission, whereas urban citizens with illness find it relatively easier to get an official certificate to ask for legal sickness absence. Thus, unequal and discriminatory health insurance may block the transmission channel linking commuting time and sickness absence, which may lead to a commuting–absenteeism effect that varies according to Hukou status (Figure 1).

Data and descriptive statistics

Sample introduction

This study uses data from CMEES, which is conducted by the School of Labour and Human Resources, Renmin University of China. The samples were selected from an enterprise listing according to 2008 national economic census data, which were drawn using the two-stage stratified random sampling method. The enterprises in the private and public sectors must have 20 employees or above, and if one enterprise refused to be interviewed, it will be replaced by another with the same size in the same industry and regions.

Unfortunately, the CMEES conducted a commute times survey only in 2013, and so our study could not use more recent data. CMEES 2013 includes 4532 employees in 444 companies and covers 12 cities across the country. CMEES 2013 collects rich information on the demography, employment traits and company characteristics, while it also provides detailed information about both sickness absence days and commuting time. Thus, it provides useful data for analysing the effect of commuting on sickness absence.

Descriptive statistics

The distributions of the main variables are shown in Table 1. Rural migrants occupied 21.74% of the full sample, while urban citizens amounted to 78.26%. The dependent variable ‘sickness absence’ was defined from the question ‘In the past year, how many days have you asked for leave due to illness?’, which was defined to include sickness absence with and without official sickness certificate. The average sickness absence days in the full sample were nearly 2.46, with a standard deviation of 7.42. In addition, 60.26% of employees had not been absent for illness during the past year. Moreover, the duration of sickness absence of rural migrants was slightly lower than that for urban citizens. Figure 2 portrays the full distribution of sickness absence days.

Commuting time is the focal variable in this study, which is defined as minutes spent in one-way daily. The average one-way commuting time was approximately 26 minutes in the full sample, whereas rural migrants’ commute time was less than urban citizens, with a gap of 6.2 minutes. The probable explanation is that most rural migrants have less chance to be homeowners. Many have to live in employer-provided dormitories or ‘Urban Villages’ with a short commute distance from the workplace (Li and Duda, 2010). Figure 3 portrays the full distribution of commuting times.

The control variables included individual-level variables (personal characteristics and job-related traits), company-level variables (company types and sectors) and city-level variables. Rural migrants were younger (a mean age of 29 years) than urban citizens (a mean age of 34 years), and only 47% of rural migrants were married, whereas 72% of their urban counterparts were married. Although rural migrants had lower educational levels than urban citizens, most of them had completed the 9-year compulsory education.

Most of the rural migrants seemed to be in a weaker position than urban citizens. As shown in Table 1, 80% of employees worked in domestic private enterprise and about 40% of them were employed in the manufacturing sector. A majority of the samples came from second-tier cities, with only 19.70% and 18.56% chosen at the level of first- and third-tier cities. As indicated in endnote 2, over 849 of the samples were thus from most developed areas in China; 2661 of them were collected in well-developed cities, and 800 of the samples were from other prefecture-level cities excluding the first- and second-tier cities in China.

Econometric method and empirical results

Econometric method

Sickness absence days are a count variable (0, 1, 2, 3, etc.). When modelling a count variable, there are several count model options. As shown in Figure 3, the distribution of

Table 1. Descriptive statistics.

Variable	Full sample (N = 4324)		Rural migrants (N = 940)		Urban citizens (N = 3384)	
	Mean	SD	Mean	SD	Mean	SD
Dependent variable						
Sickness absence	2.4556	7.4155	2.1827	5.4877	2.5318	7.8692
Focal variables						
Commuting time (CT)	26.1978	20.133	21.3538	18.3642	27.5338	20.3952
1. Individual level						
Personal variables						
Age	33.2241	9.8471	29.0202	8.9004	34.3918	9.7799
Male	0.4545	0.498	0.5064	0.5002	0.4401	0.4965
Married	0.6652	0.472	0.4739	0.4996	0.7183	0.4499
Education year	13.2367	2.8078	12.4096	2.9063	13.4668	2.7361
Job-related traits						
Occupation categories						
Manager	0.1771	0.3818	0.1466	0.3539	0.1855	0.3888
Skilled worker	0.205	0.4037	0.2280	0.4198	0.1986	0.3990
Ordinary worker	0.6179	0.486	0.6254	0.4843	0.6159	0.4865
Job condition						
Job strain	2.9101	1.1178	3.0021	1.0766	2.8846	1.1279
Overtime (hours/per week)	3.3669	5.3424	3.8826	5.9184	3.2242	5.1635
Training time (days/per year)	6.8506	15.0699	6.2089	13.3385	7.0288	15.5136
Job tenure (years)	5.3188	6.4301	2.8269	3.0517	6.0102	6.9309
Job security	3.618	0.7765	3.5606	0.7622	3.6339	0.7798
Injury	0.0234	0.1512	0.0351	0.1842	0.0201	0.1404
Wage (year)	35,634	25,390	34,698	21,772	35,883	26,265
Sector						
Manufacture	0.3913	0.4881	0.3479	0.4765	0.3050	0.4605
2. Company level						
State-owned enterprise (SOE)	0.1470	0.3541	0.0628	0.2428	0.1704	0.3760
Foreign-owned enterprise (FOE)	0.0584	0.2346	0.0554	0.2288	0.0593	0.2361
Domestic private enterprise (DPE)	0.7946	0.404	0.8818	0.3230	0.7704	0.4207
3. City level						
First-tier city	0.1970	0.3978	0.2753	0.4469	0.1752	0.3802
Second-tier city	0.6174	0.4861	0.7012	0.4580	0.5941	0.4911
Third-tier city	0.1856	0.3888	0.0235	0.1515	0.2307	0.4213

SD: standard deviation.

sickness absence days in our sample was heavily skewed to the right and contained a large proportion of zeroes. The number of zeroes might seem excessive given the processes that could lead to a response variable value of zero. In this case, an employee might be absent zero days during the last year if he never got sick and requested sick

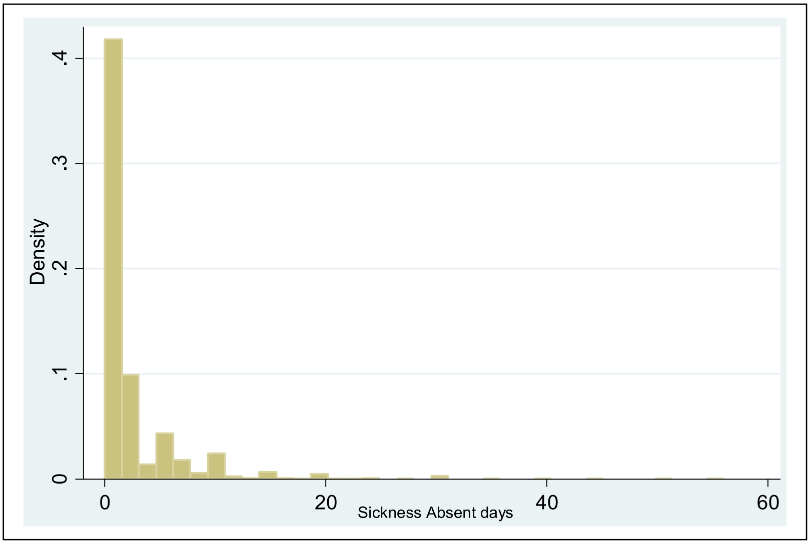

Figure 2. Frequency distribution of absent days.

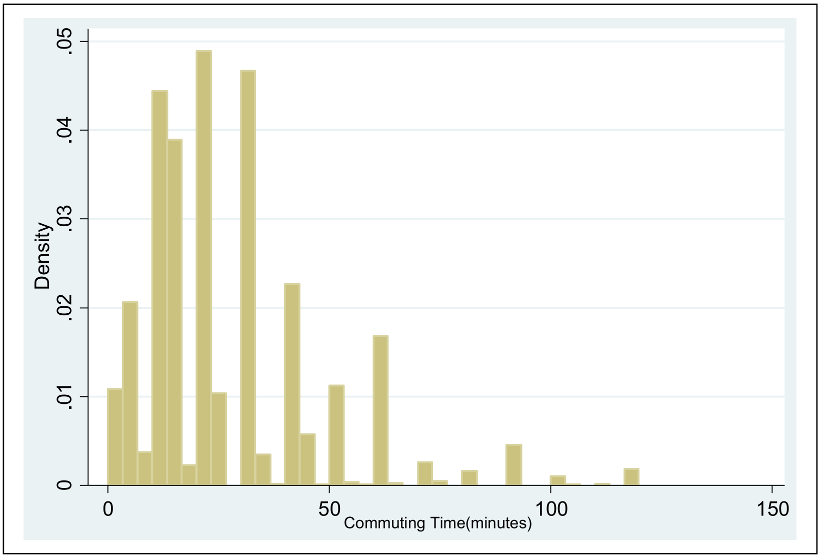

Figure 3. Frequency distribution of commuting time.

leave. Another employee might be absent 0 days because their supervisor disagreed with their request for sick leave as well as because they insisted on going to work every day regardless of illness. These two employees will look identical in the response variable, but they have arrived at the same outcome for different reasons. The first employee potentially could have been absent during the last year, but in actuality was not. The

Table 2. Tests and fit statistics for count-data model.

PRM		BIC = 826.744	AIC = 8.436	Prefer	Over	Evidence
vs	NBRM	BIC = –17,948.376	dif = 18,775.120	NBRM	PRM	Very strong
		AIC = 3.557	dif = 4.880	NBRM	PRM	$p = 0.000$
		LRX2 = 18,783.376	prob = 0.000	NBRM	PRM	
vs	ZIP	BIC = –11,326.390	dif = 12,153.133	ZIP	PRM	Very strong
		AIC = 5.242	dif = 3.194	ZIP	PRM	$p = 0.000$
		Vuong = 20.008	prob = 0.000	ZIP	PRM	
vs	ZINB	BIC = –17,984.950	dif = 18,811.694	ZINB	PRM	Very strong
		AIC = 3.509	dif = 4.928	ZINB	PRM	
NBRM		BIC = –17,948.376	AIC = 3.557	Prefer	Over	Evidence
vs	ZIP	BIC = –11,326.390	dif = –6621.987	NBRM	ZIP	Very strong
		AIC = 5.242	dif = –1.685	NBRM	ZIP	
vs	ZINB	BIC = –17,984.950	dif = 36.574	ZINB	NBRM	Very strong
		AIC = 3.509	dif = 0.048	ZINB	NBRM	$p = 0.000$
		Vuong = 8.831	prob = 0.000	ZINB	NBRM	
ZIP		BIC = –11,326.390	AIC = 5.242	Prefer	Over	Evidence
vs	ZINB	BIC = –17,984.950	dif = 6658.561	ZINB	ZIP	Very strong
		AIC = 3.509	dif = 1.733	ZINB	ZIP	$p = 0.000$
		LRX2 = 6666.815	prob = 0.000	ZINB	ZIP	

BIC: Bayesian information criterion; AIC: Akaike's information criterion; ZINB: zero-inflated negative binomial. PRM: Poisson Regression Model(PRM) ; NBRM:The Negative Binomial Regression Model (NBRM) ZIP: Zero-Inflated Poisson(ZIP); LRX2:likelihood-ratio X^2 statistic(LRX2)

second employee was certain to be absent 0 days, and will be referred to from this point forward as a 'certain zero'. Thus, the number of zeroes may be inflated and the number of sickness but absent for 0 days cannot be explained in the same manner as the number of employees that were absent for more than zero days. The standard negative binomial (NB) and Poisson regression (PR) models will not distinguish and deal with this problem, but a zero-inflated model allows for and accommodates this complication.

The count-fit function in Stata software was used to explore the goodness of fit for all four count models. Both the results of the residuals and a set of fit statistics from the tested models, including AIC, BIC and Vuong tests, indicate that ZINB model is better than others. The results are depicted in Table 2 and Figure 4.

The ZINB regression model generates two separate models and then combines them. First, a logit model is generated for the 'certain zero' cases (described above) to predict whether or not a worker would be in this group. Then, an NB model is generated that predicts the counts for those workers who are not certain zeroes. Finally, the two models are combined. For more information about the specific introduction of ZINB regression model, see Hilbe (2007).

Empirical results: Baseline model

Three ZINB regressions were applied to explore the relationships among commuting, illness and absence. The first estimation was conducted using the full sample to confirm the positive nexus between commuting time and the number of sickness absence days, while

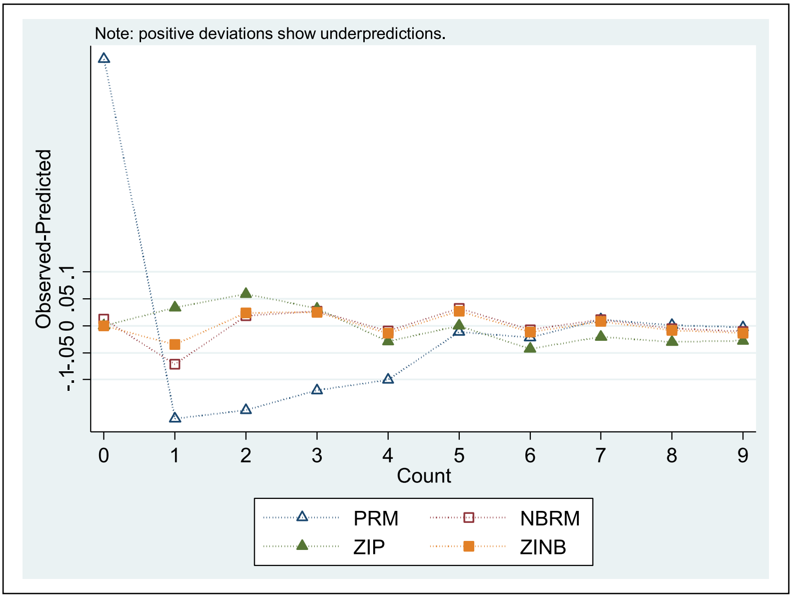

Figure 4. Observed–predicted deviations for count-data models.
PRM: Poisson Regression Model; NBRM:Negative Binomial Regression Model;ZIP: Zero-Inflated Poisson(ZIP);ZINB:Zero-Inflated Negative Binomial Rural migrants accessing

the subgroups of rural migrants and urban citizens were estimated separately to identify the heterogeneity effects. The results are shown in Table 3. The Vuong test in the bottom of Table 3 also proved that a ZINB model was a better fit for the data than standard NB.

The estimation in the full sample reveals that commuting time is significantly positively related to the number of sickness absence days. It is consistent with the conclusion of Van Ommeren and Gutiérrez-i-Puigarnau (2011) and Giménez et al. (2018a), who found evidence of a positive relationship between commuting time and sickness absence in Germany and America. Furthermore, the estimation coefficients demonstrate that the longer an employee's commuting time is, the more predicted days absent for employee. When the commute time increases by 1 minute, the expected number of days absent will increase by a factor of 1.003807 (exp(0.0038)) while holding all other variables in the model constant.

When we divided the samples into two subgroups by Hukou status (rural migrants and urban citizens), the separate estimations in Table 3 indicate that the commuting–absenteeism effect varies across different employee groups. Commuting time exerts a positive effect on absenteeism for urban citizens, but a very different picture emerges for rural migrants, for whom sickness absence do not seem to be significantly associated with commuting time. The result is also analogous with Giménez-Nadal et al. (2018a), who found the evidence of another heterogeneity effect. Giménez-Nadal et al. (2018a) concluded that the link between commuting and sick-day absences varies by gender. In other words, the commute is associated with male worker's sick-day absences, but in the case of women, its relationship is not significant.

Table 3. Estimation results of commuting time and sickness absence.

	Full sample	Rural migrants	Urban citizens
Focal variable			
Commuting time (CT)	0.0038**	0.0004	0.0046**
	(0.0019)	(0.0036)	(0.0021)
Individual level			
Age	0.0674**	0.0176	0.1104***
	(0.0321)	(0.0582)	(0.0358)
Age square	0.0007*	0.0000	0.0012***
	(0.0004)	(0.0008)	(0.0004)
Male	0.0572	0.1233	0.0913
	(0.0813)	(0.1597)	(0.0900)
Married	0.2215*	0.0538	0.3488***
	(0.1196)	(0.1850)	(0.1261)
Education year	0.0530	0.6152**	0.0493
	(0.1284)	(0.2616)	(0.1339)
Education year square	0.0041	0.0260**	0.0049
	(0.0052)	(0.0108)	(0.0054)
Migrant	0.2767**		
	(0.1335)		
Manager	0.1128	0.2045	0.1201
	(0.1015)	(0.1986)	(0.1117)
Skilled worker	0.2987**	0.3991**	0.2838*
	(0.1324)	(0.1835)	(0.1499)
Job strain	0.0132	0.0198	0.0134
	(0.0406)	(0.0672)	(0.0432)
Overtime	0.0033	0.0247**	0.0017
	(0.0085)	(0.0107)	(0.0092)
Training time	0.0069**	0.0082	0.0058*
	(0.0031)	(0.0052)	(0.0034)
Job tenure	0.0044	0.0182	0.0091
	(0.0072)	(0.0234)	(0.0076)
Job security	0.0116	0.0315	0.0348
	(0.0462)	(0.0816)	(0.0526)
Injury	0.6272**	0.3021	0.7969**
	(0.3014)	(0.2644)	(0.3903)
Wage (log)	0.3055***	0.3489*	0.2504**
	(0.1104)	(0.2020)	(0.1128)
Manufacture	0.0831	0.0338	0.0857
	(0.0856)	(0.1337)	(0.0922)
Company level			
State-owned enterprise (SOE)	0.1850	0.0557	0.1824
	(0.1210)	(0.3004)	(0.1278)
Foreign-owned enterprise (FOE)	0.0898	0.1445	0.0993
	(0.1336)	(0.2175)	(0.1593)
City level			
First-tier city	0.2359	0.6578	0.3633
	(0.2028)	(0.4624)	(0.2274)
Second-tier city	0.0290	0.5357	0.0582
	(0.1101)	(0.4490)	(0.1049)

(Continued)

https://doi.org/10.1177/1035304619899770 Published online by Cambridge University Press

Table 3. (Continued)

	Full sample	Rural migrants	Urban citizens
Constant	5.7611***	8.4989***	6.3050***
	(1.3048)	(2.6496)	(1.3987)
Vuong test	8.75***	4.62***	8.41***
Log pseudo likelihood	6679.99	1307.96	5330.88
N	3840	797	3043

The selection of variables is almost consistent with the NB (negative binomial) regression model.
Robust standard errors in parentheses: $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$.

The estimations of control variables in the full-sample model are consistent as expected. Migrants have less likelihood to be absent due to sickness: the expected number of days absent in a year for migrants is exp(–0.2767) = 0.7583 times the expected number of days for urban residents while holding all other variables in the model constant. This finding reveals that rural migrants may suffer more discrimination in labour right protections, exposing them in a vulnerable position. When they suffer sickness, they may have less access to absence permission.

Higher wages will weaken the likelihood of being absent when sick. With a 1% increase in the wage, the expected number of days absent in a year will decrease 0.7368% (exp(–0.3055)) while holding all other variables in the model constant. This result is consistent with the proposition that an increase in sick leave costs will reduce the demand for sick leave. Moreover, the results also indicate that socio-economic status, such as age, marital status, occupational class and health status are important determinants of sickness absence.

Robustness checks

We now develop additional analyses to check the robustness of our results. The robustness checks involve omitting variables, possible measurement error and other additional variables, which are estimated through three employees groups: full samples, rural migrants and urban citizens.

Robustness model I explores the effect of extreme values. An extreme value of commute time may result from potential self-reporting error, which will induce a bias estimation. Thus, robustness model I drops the samples whose absenteeism was more than 180 days during the past year from the estimation.

Furthermore, to correct the measurement error of sickness absence, we also define sickness absence as a dummy variable (it equals 1, if the individual took sick leave during the past year) to make regression (robustness model II). To identify the effect difference between long and short commuters, we also divide the commuters into three groups, short-time commuters, middle-time commuters and long-time commuters. The employees whose time spent on one-way daily travel is less than 10 minutes (i.e. $0 \leqslant CT \leqslant 10$ minutes) are defined as short-time commuters, those who travel to work over 10 minutes and less than 26 minutes are middle-time commuters (i.e. $10 < CT \leqslant 26$ minutes), while the rest of the employees who travel over 26 minutes are long-time commuters (i.e. CT > 26 minutes).

Robustness model IV is re-estimated for those individuals who have not been injured during work because injury can affect both the probability of becoming a commuter and of being absent from work. One can imagine that an injured employee may receive a large number of days absent for recuperation and unwillingness to experience a longer commute. In this case, it may bring a few outliers. Hence, robustness model IV excludes observations for those who have been injured at work during the past year.

In a further robustness check, robustness model V excludes observation of workers who reported that their medical expenditure in the past year was more than 10,000 Yuan. The mean of medical expenditure for the full sample is 1083 Yuan. An employee whose medical expenditure is nearly 10 times greater than the mean value could suffer a serious illness and poor health, which may cause estimation bias. In a further robustness check, model VI, the modes of transportation such as active and passive modes were added to the estimation. The former refers to those who walk or cycle to work, while the latter includes those who drive cars or use public transportation.

The estimations from robustness checks are shown in Table 4. It is clear that commuting time has a significant positive effect on sickness absence in all six robustness estimations, which indicate that a higher commute burden may induce more sickness absenteeism. More importantly, the conclusion that the effect of commute time on sickness absence is varied by Hukou status is still robust. In all six estimations, the significant positive effect only emerges in the group of urban citizens, whereas there is no significant evidence for rural migrants.

Transmission mechanism analysis

Given the previous findings for the baseline model and robustness checks, the conclusion can be stated that longer commuting leads to higher absence for urban citizens but not for rural migrants. It is a surprising outcome, calling for an explanation of why rural migrants and urban citizens suffer this different commuting–absenteeism effect. The potential mechanism we claim is health status, which implies that commuting time affects absence by impairing the worker's subjective and objective health status, leading to additional health-related absence, which is recognised as involuntary absenteeism.

To explore the transmission channel that links the commute to sickness absence, we estimate the effects of commuting on a set of health-related outcomes, such as self-rated health status, degree of depression, whether obese or not. Table 5 presents the results from three groups. The results reported in Columns 1 and 2 show that commuting time has a significant positive influence on health outcomes for both the migrants and urban citizens. Longer commute times for both the migrants and urban citizens will induce lower self-related health status and higher depression. Meanwhile, migrants and urban citizens with longer commute time are both more likely to be obese.

We also explore the differentiated commuting–health effect through adding an interaction term between rural migrants and commuting time into the estimation. In Table 5, the results are shown in Column 3. The interaction term in the full-sampled

Table 4. Robustness checks.

	Full sample	Rural migrants	Urban citizens
Robust (1): excluding sickness leave > 180			
Commuting time (CT)	0.0033*	0.0004	0.0042**
	(0.0019)	(0.0036)	(0.002)
Individual level	Yes	Yes	Yes
Company level	Yes	Yes	Yes
City level	Yes	Yes	Yes
N	3839	797	3042
Robust (2): sickness leave as dummy variable			
Commuting time (CT)	0.0040**	0.0004	0.0045**
	(0.0018)	(0.0041)	(0.0020)
Individual level	Yes	Yes	Yes
Company level	Yes	Yes	Yes
City level	Yes	Yes	Yes
N	3849	797	3052
Robust (3): commuting as categorical variable			
Mid commuter	0.0987	0.0169	0.1515
	(0.1008)	(0.1658)	(0.1093)
Long commuter	0.2475**	0.0938	0.2966**
	(0.1136)	(0.1803)	(0.1208)
Individual level	Yes	Yes	Yes
Company level	Yes	Yes	Yes
City level	Yes	Yes	Yes
N	3840	797	3043
Robust (4): excluding injury = 1			
Commuting time (CT)	0.0040**	0.0005	0.0044**
	(0.0019)	(0.0038)	(0.002)
Individual level	Yes	Yes	Yes
Company level	Yes	Yes	Yes
City level	Yes	Yes	Yes
N	3747	769	2978
Robust (5): excluding medical cost > 10,000			
Commuting time (CT)	0.0040**	-0.0002	0.0046**
	(0.0019)	(0.0034)	(0.0021)
Individual level	Yes	Yes	Yes
Company level	Yes	Yes	Yes
City level	Yes	Yes	Yes
N	3742	787	2955
Robust (6): add transport modes variables			
Commuting time (CT)	0.0039**	0.0015	0.0041*
	(0.002)	(0.0039)	(0.0021)
Individual level	Yes	Yes	Yes
Company level	Yes	Yes	Yes
City level	Yes	Yes	Yes
N	3840	979	3043

Model: Zero inflated negative binomial regressions (ZINB) regressions are used in all models except for robust (2) (logit). Only the coefficients for the commuting time (CT) variables are reported in NB model. Robust standard errors in parentheses: $*p < 0.1$, $**p < 0.05$, $***p < 0.01$.

Table 5. Mechanism analysis: health-related outcomes.

	Rural migrants	Urban citizens	Full sample
Mechanism (1): self-rated health			
Commuting time (CT)	−0.0023*	−0.0018***	−0.0020***
	(0.0012)	(0.0006)	(0.0006)
Migrant			−0.0066
			(0.0393)
Commuting time (CT) × migrant			0.0009
			(0.0013)
Individual level	YES	YES	YES
N	799	3064	3861
Mechanism (2): depression			
Commuting time (CT)	0.0030*	0.0023***	0.0024***
	(0.0018)	(0.0008)	(0.0008)
Migrant			0.0687
			(0.0530)
Commuting time (CT) × migrant			0.00003
			(0.0018)
Individual level	YES	YES	YES
N	800	3061	3861
Mechanism (3): obesity (0–1)			
Commuting time (CT)	0.0077*	0.0065***	0.0068***
	(0.0045)	(0.0020)	(0.0021)
Migrant			0.0137
			(0.1477)
Commuting time (CT) × migrant			−0.0015
			(0.0046)
Individual level	YES	YES	YES
N	800	3064	3864

Only the coefficients for commuting time (CT), interaction of commuting time and migrants and migrants variables are reported. Individual-level variables are included: age, male, married, education year, manager, skilled worker, job strain, Overtime, training time, job tenure, job security, injury, wage (log), manufacture. Robust standard errors in parentheses: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

model presents positive effect but these are not significant. Those findings suggest that commuting has a negative effect on the health of both rural migrants and urban citizens, while there is also no obvious commuting–health effect difference between these two groups.

There is a consensus that health status is related to involuntary sickness absence. Poorer health status will induce higher sickness absence (Kyrolainen et al., 2008; Paringer, 1983). In this case, commuting time may be significantly related to the sickness absence of both rural migrants and urban citizens, as we have confirmed that commuting has a significant effect on the health-related outcomes for both groups. But the previous findings from the baseline model and robustness checks have demonstrated that longer commuting induces higher absence only for urban citizens but not for rural migrants.

Why was the transmission channel blocked? It may be the unequal social health insurance induced by the Hukou system. The Hukou system remains a fundamental institutional constraint in the process of migrant integration in China. Without a local urban Hukou, rural migrants can move to a new place but cannot obtain the same public services and welfare as local urban citizens. They are less likely to participate in the UEBMI and have less access to share the formal public health care as local urban citizens. Therefore, the informal and insufficient medical service such as unsupervised self-medication, obtaining medical advice from unlicensed private clinics, or 'just holding on' without any health services for minor illnesses has become a common choice for rural migrants. Rural migrants accessing informal medical services will obtain no official certificate from the doctor. Consequently, it is difficult for rural migrants to ask employers for legitimate sickness absence without an official sickness certificate. If absent without permission, they will be punished for large economic losses. That is, why the commute induces the same health problems for migrants and urban citizens, but has no significant effect on the sickness absence for migrants.

Conclusion

In this study, we have enriched the research on the nexus between commuting time and sickness absence using a unique employer–employee matched data in China. We find clear evidence that commuting time has a significant positive effect on sickness absence. When commute time increases 1 minute, the expected absence time is predicted to increase by 1.0038, that is by nearly 1 day.

The heterogeneity of the commuting–absenteeism relationship is also confirmed in the case of urban citizens and rural migrants. We have posited that the Hukou system introduces this heterogeneity, and that the mechanism is differential access to health care and sick leave. Unequal social health insurance in the Hukou system may block the transmission channel between commute time and sickness absence, making rural migrants inclined to seek alternative informal medical services and restricting their ability to obtain the official sickness certificate that would allow them to ask for legal sick leave.

Our findings have several implications. First, we advocate a gradual relaxation of Hukou system restrictions to ensure that rural migrants share basic public services on an equal footing with urban citizens and to accelerate migration integration. Importantly, reducing restrictions based on Hukou is the fundamental requirement for rural migrants to completely enrol in the urban social health insurance system, which can guarantee access to basic medical services and weaken the harmful effects of long commutes for rural migrants.

Second, urban governments, especially from the larger cities, should improve public transport to alleviate the traffic congestion. The orientation and reform of the new urbanisation programme should give high priority to the people's demand for enjoying a faster and shorter commute.

Third, it should be recognised that employees with longer commutes are less productive. Commuting subsidies may reduce or compensate for the adverse health effects of long travel-to-work time. Flexible and autonomous working schedules are another important and effective way to improve job satisfaction and mental health, and thereby enhance both well-being and productivity.

Acknowledgements

The authors are grateful to the School of Labor and Human Resources at Renmin University of China for the data supplied. They would also like to thank the three anonymous referees for their helpful feedback.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship and/or publication of this article. This study was funded by the National Social Science Fund of China (grant numbers 17BJY044 and 18ZDA081).

Notes

1. First-tier cities represent the most developed areas in China. Only four large cities Shanghai, Shenzhen, Guangzhou and Beijing are regarded as first-tier. Second-tier cities are well-developed cities with large and dense populations. They make a huge economic contribution in China. The list of second-tier cities includes Chengdu, Hangzhou, Chongqing, Wuhan, Xian, Suzhou, Tianjing, Nangjing, Changsha, Zhengzhou, Dongguan, Qingdao, Shenyang, Ningbo, Kunming and another 30 prefecture-level cities. The 337 prefecture-level cities excluding the first- and second-tier cities are categorised as third-tier cities.
2. The eligibility criteria include local income tax payment certificates or social insurance participation records in destination cities. For example, without Beijing local Hukou, migrant buyers must provide at least 5 years of social insurance records or local income tax payment certificates to become qualified to purchase house or receive free compulsory education for their children in public schools.

References

Alexanderson K (1998) Sickness absence: a review of performed studies with focused on levels of exposures and theories utilized. *Scandinavian Journal of Social Medicine* 26(4): 241–249.

Allen SG (1983) How much does absenteeism cost? *Journal of Human Resources* 18(3): 379–393.

Baidu (2014) My 2014 work commute survey. Available at: http://www.chinanews.com/tp/hd2011/chart/2015/01-26/31.shtml (accessed 15 December 2019).

Buzzard RB and Liddell FDK (1963) *Coalminers' Attendance at Work* (Medical Research Memorandum 3). London: National Coal Board Medical Service.

Fang Y and Zhang Z (2016) Migrant household homeownership outcomes in large Chinese cities – the sustained impact of Hukou. *Eurasian Geography and Economics* 57(2): 203–227.

Giménez-Nadal J, Molina JA and Velilla J (2018a) *Commuting time and sick-day absence of US Workers*. IZA Discussion papers no. 11700. Available at: http://ftp.iza.org/dp11700.pdf (accessed 13 December 2019).

Giménez-Nadal J, Molina JA and Velilla J (2018b) Spatial distribution of US employment in an urban efficiency wage setting. *Journal of Regional Science* 58(1): 141–158.

Goerke L and Lorenz O (2015) Commuting and sickness absence. In: *Economic development – theory and policy conference*, p. 113173. Verein für Socialpolitik/ German Economic Association. Available at: https://www.econstor.eu/bitstream/10419/113173/1/VfS_2015_pid_711.pdf (accessed 13 December 2019).

Goerke L and Lorenz O (2017) *Commuting and sickness absence*. SOEP (German Socioeconomic Panel) Discussion paper no. 946. Available at: http://dx.doi.org/10.2139/ssrn.3099438 (accessed 13 December 2019).

Grinza E and Rycx F (2018) *The impact of sickness absenteeism on productivity: new evidence from Belgian matched panel data*. IZA Discussion paper 11543. Available at: http://ftp.iza.org/dp11543.pdf (accessed 13 December 2019).

Hansson E, Mattisson K, Björk J, et al. (2011) Relationship between commuting and health outcomes in a cross-sectional population survey in southern Sweden. *BMC Public Health* 11(1): 834.

Hassink WH and Fernandez RM (2018) Worker morale and effort: is the relationship causal? *The Manchester School* 86(6): 816–839.

Hilbe JM (2007) *Negative Binomial Regression*. Cambridge: Cambridge University Press.

Holland DM (2016) *Cost of commuting: a review of determinants, outcomes, and theories of commuting-related stress*. University Honors Theses. Paper 299. Available at: https://pdxscholar.library.pdx.edu/honorstheses/299/ (accessed 13 December 2019).

Hong Y, Li XM, Stanton B, et al. (2006) Too costly to be ill: health care access and health seeking behaviors among rural-to-urban migrants in China. *World Health and Population* 8(2): 22–34.

Jones RM (1971) *Absenteeism* (Department of Employment, Manpower Papers No. 4) London: HMSO.

Kluger AN (1998) Commute variability and strain. *Journal of Organizational Behavior* 19(2): 147–165.

Koslowsky M, Kluger AN and Reich M (2013) *Commuting Stress: Causes, Effects, and Methods of Coping*. New York: Springer Science and Business Media.

Kyrolainen H, Hakkinen K, Kautiainen H, et al. (2008) Physical fitness, BMI and sickness absence in male military personnel. *Occupational Medicine* 58(4): 251–256.

Li B and Duda M (2010) Employers as landlords for rural-to-urban migrants in Chinese cities. *Environment and Urbanization* 22(1): 13–31.

Liang WP, Zheng JZ, He L, et al. (2010) Research of health service demands and utilization of migrant workers in Taiyuan. *China Health Resources* 2 (In Chinese).

Liepmann KK (1944) *The Journey to Work: Its Significance for Industrial and Community Life*. New York: Oxford University Press.

Lin D, Allan A and Cui J (2015) The impact of polycentric urban development on commuting behaviour in urban China: evidence from four sub-centres of Beijing. *Habitat International* 50: 195–205.

Magee C, Stefanic N, Caputi P, et al. (2011) Occupational factors and sick leave in Australian employees. *Journal of Occupational and Environmental Medicine* 53(6): 627–632.

Meng X (2017) The labor contract law, macro conditions, self-selection, and labor market outcomes for migrants in China. *Asian Economic Policy Review* 12(1): 66–67.

Nie P and Sousa-Poza A (2018) Commute time and subjective well-being in China. *China Economic Review* 48: 188–204.

Norman LG (1959) The health of London's travelling public. *Journal (Royal Society of Health)* 79(3): 229–241.

Novaco RW and Gonzales O (2009) Commuting and well-being. In: Amichai-Hamburger Y (ed.) *Technology and Psychological Well-Being*. New York: Cambridge University Press, pp. 174–205.

Novaco RW, Stokols D and Milanesi L (1990) Objective and subjective dimensions of travel impedance as determinants of commuting stress. *American Journal of Community Psychology* 18(2): 231–257.

Paringer L (1983) Women and absenteeism: health or economics? *American Economic Review* 73(2): 123–127.

Peng Y, Chang W, Zhou H, et al. (2010) Factors associated with health-seeking behavior among migrant workers in Beijing, China. *BMC Health Services Research* 10(1): 69.

Roberts J, Hodgson R and Dolan P (2011) 'It's driving her mad': gender differences in the effects of commuting on psychological health. *Journal of Health Economics* 30(5): 1064–1076.

Ross SL and Zenou Y (2008) Are shirking and leisure substitutable? An empirical test of efficiency wages based on urban economics theory. *Regional Science and Urban Economics* 38(5): 498–517.

Sandow E, Westerlund O and Lindgren U (2014) Is your commute killing you? On the mortality risks of long-distance commuting. *Environment and Planning A* 46(6): 1496–1516.

Stutzer A and Frey BS (2008) Stress that doesn't pay: the commuting paradox. *The Scandinavian Journal of Economics* 110(2): 339–366.

Taylor PJ and Pocock SJ (1972) Commuter travel and sickness absence of London office workers. *British Journal of Preventive and Social Medicine* 26(3): 165.

Van Ommeren JN and Gutiérrez-i-Puigarnau E (2011) Are workers with a long commute less productive? An empirical analysis of absenteeism. *Regional Science and Urban Economics* 41(1): 1–8.

Wu L and Zhang W (2018) Rural migrants' homeownership in Chinese urban destinations: do institutional arrangements still matter after hukou reform? *Cities* 79: 151–158.

Wu W (2002) Migrant housing in urban China: choices and constraints. *Urban Affairs Review* 38(1): 90–119.

Yang J and Gakenheimer R (2007) Assessing the transportation consequences of land use transformation in urban China. *Habitat International* 31(3–4): 345–353.

Zhang L and Tao L (2012) Barriers to the acquisition of urban Hukou in Chinese cities. *Environment and Planning A* 44(12): 2883–2900.

Zhao P and Howden -Chapman P (2010) Social inequalities in mobility: the impact of the hukou system on migrants' job accessibility and commuting costs in Beijing. *International Development Planning Review* 32(3–4): 363–384.

Zhu Z, Li Z, Chen H, Liu Y, et al. (2019) Subjective well-being in China: how much does commuting matter? *Transportation* 46(4): 1505–1524.

Author biographies

Murong Guo is a PhD candidate in the School of Labour and Human Recourses at Renmin University of China, Beijing, China. Her research interests include labour relations and labour migration.

Kuang Tang is a professor in the School of Labour and Human Resources at Renmin University of China. His interested research fields are labour relations, collective bargaining and collective dispute resolution.

Zicheng Wang is an associate professor in School of Public Administration at Jinan University. His major research interests focus on labour migration, labour relations and social security.