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# The disutility of commuting? The effect of gender and local labor markets

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## Abstract

Standard economic theory postulates that commuting is a choice behavior undertaken when compensated through either lower rents or greater amenities in the housing market or through higher wages in the labor market. By exploiting exogenous shocks to commuting time, this paper investigates the impact on well-being of increased commuting. *Ceteris paribus*, exogenous increases in commuting time are expected to lower well-being. We find this holds for women but not men. This phenomenon can be explained, in part, by the different labor markets in which women operate. Where local labor markets are thin, women report significantly lower well-being when faced with an increased commute. This does not hold for tight local labor markets. Further our findings reveal that it is full-time working women in the managerial and professional tier of the occupational hierarchy who are most affected. These results suggest that the policy solution for reducing the adverse effects of commuting may require changes to labor market institutions rather than changes to transport policy.

*JEL classification:* C1; I1

*Keywords:* commuting; exogenous shocks; well-being; panel data econometrics

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# 1 Introduction

Commuting is an important modern phenomenon, which can be characterized as the spatial interaction between the housing and labor markets. While it has been a focus of research in both urban and labor economics, these two branches of the discipline tend to view commuting from within their individual silos, with only a small number of studies providing a more integrated approach. Urban economics tends to make the assumption that the labor market is in equilibrium and analyses housing decisions, whereas conversely labor economics largely assumes that the housing location is given and analyses labor supply decisions. Standard economic theory postulates that commuting is a choice behavior, where rational individuals should only be prepared to undertake longer commutes if they are compensated for doing so. This compensation can take the form of better housing and/or better job characteristics.

Despite the dominance of this assumption in the literature a number of empirical studies, based on three distinct theoretical approaches, have provided evidence that contradicts this prediction. The influential work of Hamilton (1982) on excess commuting, and its later extensions, are framed within the standard urban economics model, which assumes a frictionless economy, and thus full compensation for commuting via wages and housing. Extensions have relaxed the monocentric cities assumptions of earlier work and also accounted for the heterogeneity of workers and residential location (see for example Mills and Hamilton (1984); Cropper and Gordon (1991)); but these models still tend to find that the predicted commuting pattern is not one that minimizes the total commuting distance traveled by workers. In contrast, more recent work in labor economics, such as Manning (2003), introduces job search frictions, and explicitly recognizes the importance of commuting to matching workers and spatially distributed jobs. Mannings model is particularly relevant to our work since the thinness of local labor markets in his model leads to the prediction that workers do not receive full wage compensation for longer commutes. Finally, the work of Stutzer and Frey (2008) and Frey and Stutzer (2014) assumes that individuals are affected by systematic behavioral mistakes in their commuting decision making, which leads them to commute for longer than that required to maximize their utility.

A further pertinent feature of the commuting literature is the observation that there are important gender differences in travel behaviors, and average commute times for men are substantially higher than for women (White, 1986; Gordon et al., 1989; Deding et al., 2009). In the UK on average over the period 1999 to 2014 men commute for 28 minutes each way, and women only 16 minutes (Organisation for Economic Co-operation and Development, 2014). There are a number of possible explanations for this difference, arising largely from the differential domestic and labor market positions of men and women (Hanson and Pratt, 1995). Further, Roberts et al. (2011) provide evidence that

women are adversely affected by higher commute times, whereas men are not.

In this paper, we combine direct estimation of a utility function with an account of local labor market conditions in order to provide a more comprehensive understanding of commuting choices, and test the prediction that rational commuters are compensated for their travel time. To abstract from the possible effects of compensating variables and to cope with the simultaneity of housing and job location choices, we adopt a novel identification strategy, recently used by Gutiérrez-i Puigarnau and van Ommeren (2015) to explore the relationship between commuting time and weekly working hours. Taking this idea from a related (but separate) literature, we hold both an individual's household location and their job characteristics constant, and then assert that any noticeable changes in commuting time are brought about by factors that are exogenous to individual choice; these could include firm relocations and/or changes in transport infrastructure. We explore the relationship between commuting and utility for men and women separately, and we take account of how men and women might be differentially affected by local labor circumstances, as this has been largely neglected in the existing literature <sup>1</sup>.

Using data from the UK Household Longitudinal Study (UKHLS) we show that longer commutes brought about by exogenous shocks lead to lower levels of utility for women, but not for men. We investigate further this phenomenon by considering caring responsibilities, working hours, occupational hierarchies and characteristics of local labor markets; in particular, following Manning (2003), whether individuals face thin or tight labor markets. Our findings suggest that it is married (or cohabiting) women, working full-time in managerial or professional roles, who report decreases in utility for increasing commutes. Moreover, we find these effects for women faced with thin local labor markets where the ratio of vacancies to unemployment counts is low, meaning that individuals are required to commute further for suitable employment opportunities.

In the following section we review some of the related literature, in Section 3 we provide a methodological framework. Section 4 introduces the data we use and Section 5 the empirical strategy. We report the results in Section 6 as well as exploring the robustness of these results and exploring potential mechanisms that could explain them. Finally, Section 7 concludes.

## 2 Related literature

The role of commuting has featured prominently in models in both labor and urban economics. Both literatures position commuting as a compensating differential when considering job characteristics or household location. Labor economics has been concerned predominantly with the relationship between commuting and wage rates, and to

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<sup>1</sup>Roberts and Taylor (2017) is a recent exception.

a lesser extent hours worked. In urban economics, the primary trade-off is between the amenity of residential location and commuting distance.<sup>2</sup> We briefly set out some of the key arguments from these literatures below.

In urban economics, the standard monocentric model assumes a frictionless economy. Workers want to reside close to their place of employment (located within a central business district: CBD hereafter) but also demand space for residential purposes (Alonso, 1964; Mills, 1967; Muth, 1969). Since space is limited close to the CBD, workers must accept residential locations at a distance from their place of employment. As one moves further away from the CBD, housing rents decrease, so individuals are fully compensated for longer commutes via the residential housing market. In equilibrium, homogeneous individuals are equally well-off even though they reside at different distances from their employment, hence workers are assumed to be indifferent to their commute. Empirically Hamilton (1982) showed that actual commutes in the US were longer than those predicted by this model. His solution was to extend it to include other determinants of location choice, like local amenities. In our empirical work below, household location (and hence amenities) are held constant. Cropper and Gordon (1991) extended the model further to relax the monocentricity assumption and to take account of dual earner households. Their predicted commutes are still longer than those required to maximize utility, but are substantially less than those estimated by Hamilton (1982). Cropper and Gordon (1991) also find that the marginal value of moving closer to work is higher for the secondary wage earner in a household (usually the woman), but unlike our analysis below, they do not differentiate any further between types of female worker. In another extension to the standard model, Wheaton (1977) states that it is unable to explain why the rich live further from the city center (assumed to be main location of employment) than the poor. He argues that this is because the income elasticity of housing demand and elasticity of the cost of travel time are approximately equal, whereas the former would need to be larger than the latter to explain why the rich choose to commute further than the poor. In a more recent study, Glaeser et al. (2008), revisit this point and argue that one reason for the distance-income gradient is that the poor have a stronger preference for public transport, which is generally better closer to the city center.<sup>3</sup> In our analysis below, we carry out sub-sample analysis by mode of transport, as well as by occupational status and by household income level in order to shed light on these issues.

In labor economics Manning (2003) develops a model with job search frictions that is informative for our empirical work. In this model, jobs are characterized by wages and location, both of which are valued by workers. The labor market is ‘thin’, char-

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<sup>2</sup>Time is a more appropriate measure of the opportunity cost of commuting than distance in the context of a utility function. The main cost of travel is due to time losses rather than monetary expense, and this has been demonstrated empirically for the UK, see van Ommeren and Dargay (2006).

<sup>3</sup>This argument is echoed by LeRoy and Sonstelie (1983) and Gin and Sonstelie (1992).

acterized by vacancies occurring only occasionally, and distributed geographically; this provides employers with some monopsony power over workers. Workers are assumed to derive utility from wages and disutility from commutes. While workers receive many job offers, only those above their chosen reservation wage are acceptable. The threshold at which jobs are acceptable (the reservation wage) increases with commuting costs, thus the distribution of accepted wages is expected to rise with increasing commuting time. The model further predicts that workers fail to receive full compensation, via wages, for longer commutes, such that workers' marginal utility with respect to commuting distance decreases. Given that the distribution of wage offers are constant across locations (since they are determined by employers), utility falls with increasing commutes; and a higher proportion of job offers is rejected since reservation utility remains constant. The model therefore assumes an implicit trade-off between wages and commutes, but that this trade-off is incomplete with workers observed to be traveling longer distances tending, on average, to be worse-off.<sup>4</sup> Manning (2003) provides empirical support for this model using data from the British Household Panel Survey (BHPS) and the Labor Force Survey. He shows, for example, that the wage differential between two workers in the same household with a one hours difference in (two-way) commuting time is around 7%. Using a similar theoretical framework and data from the Netherlands Rouwendal (1999) finds that women accept lower wages for a reduction in commuting time and that children in the household increase the wage premium for commuting distance. We will explore both gender effects and the effect of children in our empirical work.

Adopting a different approach, empirical studies by Stutzer and Frey (2008) and Frey and Stutzer (2014) depart from the rational economic agent assumptions of neoclassical economics, and instead accept that individuals can make systematic behavioral errors in their commuting decision making, which leads them to commute for longer than that required to maximize their utility. The empirical work in these studies is similar to ours in that it adopts an approach, that is increasingly accepted in economics, of approximating utility by subjective well-being (SWB).<sup>5</sup> While standard economic theory views the measurement of utility through revealed preferences via the choices individuals make, this has been challenged on both theoretical and practical grounds (see for example, Dolan and Kahneman (2008) and Kahneman et al. (1997)). In the absence of choice-based preferences, SWB aims to evaluate experienced utility capturing elements of emotion and cognition (Dolan and Kahneman, 2008).<sup>6</sup> Stutzer and Frey (2008) analyzed data

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<sup>4</sup>This is a similar approach to Rouwendal (2004) who argues that a searcher looks for a job from a given residential location. This model can be used to derive critical acceptable commuting distances from which isochrones that describe boundaries of spatial labor markets can be derived.

<sup>5</sup>See, for example, Stutzer and Frey (2002), van Praag and Ferrer-i Carbonell (2003), Ferrer-i Carbonell and Frijters (2004).

<sup>6</sup>Note that while we proxy utility with SWB like Stutzer and Frey (2008) our work does not rest on the assumption that households do not make rational choices.

from 19 years of the German Socioeconomic Panel Study to investigate the relationship between commuting distances and overall life satisfaction. Employing fixed-effects techniques, they find evidence of a negative and statistically significant relationship between commuting time and well-being. They label this a ‘commuting paradox’ claiming that rational individuals should not partake in these longer commutes if they negatively affect their well-being. In a later study, Frey and Stutzer (2014) look for an explanation for their earlier result and argue that one possible causal pathway is that people do not adapt to increases in commuting, but only to increases in income, which is an alternative explanation for why individuals are not fully compensated for commuting.<sup>7</sup>

Using thirteen waves of the BHPS, Roberts et al. (2011) test whether the relationship found by Stutzer and Frey (2008) is consistent with UK data. Their measure of SWB was the General Health Questionnaire (GHQ - see description in our Data section ) as opposed to overall life satisfaction. Their main result is that commuting time is detrimental to the well-being of women, but not men. This result is consistent to a number of robustness checks (such as controlling for the interaction of mode and distance, excluding London and the South East, and controlling for differential time use via household chores and childcare). Dickerson et al. (2014) used data from the BHPS (1996-2008) to try and replicate the results of Stutzer and Frey (2008). They used a life satisfaction question to see if the findings of Roberts et al. (2011) were sensitive to the well-being proxy. Applying a new method of estimating fixed-effects logit models (the Blow-Up and Cluster of Baetschmann et al. (2015)) the authors failed to replicate the result of Stutzer and Frey (2008) using life satisfaction as an outcome; that is they find no significant relationship between commuting time and SWB. Further, Dickerson et al. (2014) could only replicate the results of Roberts et al. (2011) if they used the same outcome (GHQ) and the same time period. They did not find evidence of gender differences when life satisfaction was the outcome of choice.

While the conventional approach to commuting behavior assumes that it is a source of disutility (hence individuals will seek to minimize travel times and associated costs, subject to constraints), it has also been suggested that commuting can be a source of positive utility. For example, Mokhtarian and Salomon (2001) argue that utility can be derived from the activity to be undertaken at the destination, from activities undertaken during travel, and from the act of travel itself. By eliciting preferences over both ideal and relative desired commute time (i.e. much less” to much more” than currently) Redmond and Mokhtarian (2001) find that most individuals have a non-zero optimum commute duration, which may be violated in either direction (although only 7% reported an actual commute less than their optimum). While a majority of respondents (52%) reported

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<sup>7</sup>In contrast Stopher (2004) has argued that people do adapt to their commute over time becoming more accepting of the time cost.

a commute longer than their optimum, a large proportion (42%) reported an actual commute within 5 minutes of their optimum. Similarly, Ory et al. (2004) present results of a survey of commuters in San Francisco which suggest that commuting might not be the burden it is widely believed to be - half of the sample were satisfied with their commute, and a small proportion stated a desire to increase their commute. In an early contribution Getis (1969) suggested the existence of maximum acceptable commuting distances; and the excess commuting predictions of Hamilton (1982) and Cropper and Gordon (1991) can also be interpreted as suggesting that there is non-linearity in the relationship between commuting duration and utility around some optimal level of commute. In our empirical work we explore this prediction using spline models (see Greene (2008, Ch. 6)) which allow, for example, individuals with shorter commutes to be affected differently to people with longer commutes.

### 3 Methodological framework

As explained in our Introduction, standard economic theory assumes that individuals who commute are compensated for the disutility of commuting through the labor and/or housing markets. Accordingly, individuals trade-off wages (and other job characteristics) and housing costs (and other housing characteristics) with commutes, to the point at which their utility is equalized over the set of all possible choices. Assuming that individuals have homogeneous preferences, utility ( $U$ ) is gained from income from work  $w$ , job characteristics  $j$ , housing characteristics  $h$ , and disutility is obtained from commuting  $c$ :

$$U_i = u(w_i, j_i, h_i, c_i) \quad \forall i \quad (1)$$

Utility is maximized for all  $i$ , such that:

$$U_i^* = U_i^0 = u(w_i^0, j_i^0, h_i^0, c_i^0) \quad \forall i \quad (2)$$

To examine how utility responds to an exogenous shock in commuting time (at some point  $t > 0$ ), we take the total derivative of Equation 2 with respect to commuting time  $c$ . Ignoring sub- and super-scripts, this can be written:

$$\frac{dU}{dc} = \frac{\partial U}{\partial w} \frac{dw}{dc} + \frac{\partial U}{\partial j} \frac{dj}{dc} + \frac{\partial U}{\partial h} \frac{dh}{dc} + \frac{\partial U}{\partial c} \quad (3)$$

Accordingly, an exogenous increase (decrease) in commuting time will lead to a decrease (increase) in overall utility, all else held constant. Our empirical approach aims to test directly the assumptions embedded in equation (3). Since housing, labor supply



and commuting times are choice variables, individuals with heterogeneous preferences are able to select the optimal combination for their particular preference set. Our concern lies with the assumption that increases in commuting, observed through increased commuting time, are associated at the margin with a decrease in utility as proxied by SWB.<sup>8</sup> We test this assumption by observing exogenous shocks to commuting time while holding constant the three other arguments of the utility function (1); that is by holding constant wages, other job characteristics and housing rents. If increased commuting time confers disutility (that is,  $\frac{\partial U}{\partial c} < 0$ ) which would otherwise be available for compensation, then this disutility should be observed by decreases in SWB where commuting time is subject to change but labor and housing market returns are held constant, that is when  $\frac{\partial U}{\partial w} \frac{dw}{dc} = 0$  and  $\frac{\partial U}{\partial h} \frac{dh}{dc} = 0$ .

### 3.1 Identification strategy

Our identification strategy relies on observing exogenous shocks to commuting time, holding all other determinants of utility constant. This is achieved by exploiting data on the location of residence of an individual together with information on their employment and job characteristics. Accordingly, we only consider individuals with a constant household location across the waves of data in our sample. This ensures that the individual has not moved and has not, therefore, sought out compensation in the housing market for a change in commuting time. Accordingly,  $\Delta h = \frac{\partial U}{\partial h} = 0$  ( $\frac{dh}{dc} = 0$ ) in Equation 3.

Additionally, we only consider individuals who do not change the nature of the job, nor their employer, such that job characteristics do not change:  $\Delta j = \frac{\partial U}{\partial j} = 0$  in Equation 3. It is not unrealistic to assume that labor income  $w$  is a function of job characteristics, such that  $w = w(j)$ . Given that  $\Delta j = 0$ , then it follows that  $\Delta w = dw = 0$ .<sup>9</sup> Hence the total derivative of utility with respect to changes in commuting time is simply the partial derivative:

$$\frac{dU}{dc} = \frac{\partial U}{\partial c} \tag{4}$$

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<sup>8</sup>Commuting distance may also increase. However, the effect on utility of an increase in commuting distance is ambiguous. If an individual travels by car and an increased commuting distance is associated with faster traffic flow due to a dominant use of a freeway/motorway as opposed to secondary roads, then travel time may not change substantively. For this reason we prefer to measure the impact of commuting on well-being via travel time. Furthermore, time is more appropriate in an economic choice framework since there is a fixed amount of time (24 hours) in a day.

<sup>9</sup>This assumption is testable in our data - see section 6.2.2.

Gutiérrez-i Puigarnau and van Ommeren (2015) use a very similar identification strategy in a related but separate literature, which estimates the effect of commuting time on labor supply.<sup>10</sup>

If an individual,  $i$ , meets the above two criteria,  $\Delta j = \Delta h = 0$ , but they do report a non-trivial change in their commuting duration, defined as a change of 5 minutes or more for a one-way commute to work ( $|\Delta c| \geq 5$ )<sup>11</sup>, then we assert that the individual has experienced an exogenous shock to their commuting time. This ensures that the individual has not moved, nor changed job, and has not, therefore, sought out compensation in the housing or labor market for a change in commuting time.<sup>12</sup> We assume that the sample of individuals defined above experience a shock to commuting duration between waves due to a change in mode of transport, or due to a change in either transport infrastructure and/or a change in workplace location. Since a change of transport mode may well be endogenous to the commuting time and SWB, we also undertake analyses on the sub-sample of individuals who report no change in mode of travel.<sup>13</sup> Accordingly, the group of individuals assumed to either experience a change of travel infrastructure or a change in workplace location (but not job) is the focus of our analysis. Identification relies on the assumption that such individuals experience an exogenous shock to their commuting behavior, as they cannot directly affect either firm/job relocation or transport networks (and have not moved the location of residence). To ensure the assumption of no compensation in the labor market, in addition, we perform analyses where wages are held constant (adjusted for inflation) across adjacent waves.

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<sup>10</sup>Mulalic et al. (2014) and Gutiérrez-i Puigarnau and van Ommeren (2010) use firm relocation directly as their identifying strategy when exploring the relationship between commuting and wages/labor supply, but the UKHLS data that we use does not contain information on employment location.

<sup>11</sup>The definition of a non-trivial change in commuting duration is clearly subjective. Accordingly, we further consider alternative definitions of changes in one-way commuting times of 10 and 15 minutes or over. These lead to quantitatively and qualitatively similar results.

<sup>12</sup>Since we only consider individuals who experience a shock to commuting times but do not change household location or job, it is possible that we identify a local treatment effect. However, generalizing the sample to include individuals who move house or change job threatens the identification of causal effects due to compensatory factors as described in the main text.

<sup>13</sup>If we were interested in the overall association between commuting duration and SWB then individuals who change mode of travel would be of interest. However, we are interested in the direct causal effect of commuting on well-being disentangling any potential reverse effects of well-being impacting on travel durations.

## 4 Data

### 4.1 UK Household Longitudinal Study (UKHLS)

Our primary dataset is the UKHLS. This is a nationally representative sample of UK households designed as the follow up survey to the BHPS, which contains repeated information on around 80,000 individuals in 30,000 households. We use six waves of data from 2009 to 2014. UKHLS contains a rich set of information on socio-economic characteristics, health and well-being, and labor market characteristics relating to both individuals and households.

Our outcome of interest is SWB as a proxy for utility. This is measured using the GHQ; a set of 12 questions designed to identify minor psychiatric disorders and also to investigate psychological health or SWB more generally (Goldberg and Williams, 1988). It has been used as a proxy for SWB in a number of economic analyses (e.g. Gardner and Oswald (2007); Roberts et al. (2011)). Each of the 12 questions is answered on a 0-3 scale, thus giving a 37 point Likert scale. For ease of interpretation, we recode GHQ such that higher scores correspond to a better level of SWB.

Identification of the effects of commuting on SWB is observed via exogenous shocks to commuting duration. This is achieved by observing individuals for whom their job and their place of residence have not changed across waves, but for whom commuting duration has changed. To observe individuals who have not changed jobs we rely on the question “*do you have the same job for the same employer?*”. This is combined with knowledge that household location has remained constant (UKHLS asks respondents the date they moved to their current residential address).<sup>14</sup> We also exploit data on wages and Standard Occupational Classification (SOC) (Office for National Statistics, 2008) to ensure changes to commuting times are not driven by compensatory characteristics. We explore the no change of job assumption by undertaking robustness checks on a subsample of individuals who have a constant SOC code, based on 2000 definitions.

Our measure of commuting duration is taken from the response to the question “*about how much time does it usually take for you to get to work each day, door to door (in minutes)?*” which is asked only to people who state they are in employment. To control for individual preferences we condition on characteristics typically used in the literature concerned with well-being (e.g. Dolan and Kahneman (2008)), including age (and its square),

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<sup>14</sup>We explore non-mover status in two ways. Firstly by using the survey response to place of residence and secondly, by checking this response is consistent with no change in Lower Layer Super Output Area (a small level geographical area with a mean population size of 1500) location of residence.

educational attainment, the number of children in a household, a married/cohabiting identifier, and log equivalized monthly household income (deflated to 2005 prices, and equivalized using the OECD modified scale, detailed in Foster (2009)).

Table 1: Information on inclusion criteria and sample size

Criteria	Number		Percent	
	Observations	Individuals	Observations	Individuals
	$NT$	$N$	$NT$	$N$
Full UKHLS Sample	291,871	81,102	100%	100%
In at least two waves	271,410	60,641	93%	75%
Employed in all waves	127,444	35,439	44%	44%
No change of house	96,492	27,253	33%	34%
Same Job as last year	84,990	21,964	29%	27%
Change in commuting time $\neq 0$	59,928	16,876	21%	21%
Change in commuting time $\geq \pm 5$ mins.	56,828	15,855	19%	20%
Non-missing H&WB information	56,635	15,846	19%	20%

Table 1 presents information on inclusion criteria for the sample of UKHLS individuals used to define the estimation sample. The six waves of the UKHLS sample contains information on  $N = 81,102$  individuals who are observed across waves to provide  $NT = 291,871$  total observations. We remove individuals who are observed in only a single wave (we are concerned with identifying the effect of *changes* in commuting times on SWB); individuals not employed and individuals who change place of residence or change job. Since identification is informed by respondents who undergo a change in commuting times we further remove individuals who do not report such a change together with those who report a small change ( $< 5$  minutes). Accordingly, our working sample consists of 15,846 individuals for whom there are 56,635 observations. Descriptive statistics for the estimation sample are provided in Table 2. The mean GHQ score is 25.22.<sup>15</sup> There are slightly more observations on females than males; mean age is 44 years; 45% have a university level qualification, average usual weekly hours of work is 34; and average log monthly equivalized household income is £7.56.

Table 3 breaks down the descriptive statistics into gender and mode of transport. Males, in general, experience longer commutes (27.68 minutes for a one-way commute compared to 23.29 for women), and this remains the case irrespective of the mode of transport, with the differential being largest for commutes via public transport. Public transport is associated with the longest commuting times (an average one-way commute

<sup>15</sup>For the GHQ measured on the Likert scale Piccinelli et al. (1993) cite a threshold score of 13/14 to determine caseness (probable non-psychotic psychiatric disturbance (Martin and Newell, 2005)). Politi et al. (1994) suggest a lower level of 8/9. These translate into thresholds scores of 22/23 or 27/28 respectively when transformed such that higher values of GHQ are associated with better psychiatric well-being.

Table 2: Summary statistics for estimation sample

	Mean	Std. Dev.	Min	Max.
GHQ score	25.22	4.91	0	36
Male	0.44	0.5	0	1
Age	43.71	10.63	16	65
University level qualification	0.45	0.5	0	1
College level qualification	0.22	0.41	0	1
School level qualification	0.22	0.41	0	1
Household size	3.04	1.31	1	16
Number of children	0.71	0.98	0	8
Usual hours worked	33.55	9.82	0.1	97.7
Married/Cohabiting	0.6	0.49	0	1
Divorced	0.09	0.29	0	1
Log household income	7.56	0.51	1.55	9.9

The sample size is  $NT = 56,635$ , based on an unbalanced sample of  $N = 15,846$  individuals.

of 48.31 minutes) and cycling the shortest commuting times (15.88 minutes). These differentials across mode are clearly important when considering changes in commuting times and we provide results on the well-being effects of commuting times where mode is held constant.

## 5 Empirical approach

Typically, amongst the literature which employs longitudinal data, fixed effects has been used to control for possible endogeneity in the commuting and well-being relationship. We adopt a different approach by identifying exogenous shocks to commuting behavior brought about by firm relocation and/or changes in transport infrastructure. Fixed effects models are not adequate on their own as they cannot deal with the simultaneity of decisions on home and job location. However, we employ fixed effects models to our sample who have experienced these exogenous shocks to further allow us to control for individual unobserved time-invariant preferences.

We define our sub-sample of interest to be those individuals who experience at least one exogenous shock to their commuting duration between two consecutive waves of the UKHLS. These shocks are defined as set out in section (3.1) using information on the location of household residence, reported commuting time and responses to the question on whether an individual has the *same job* for the same employer as the previous wave. For such individuals we retain all waves of data in which they appear in UKHLS. We estimate the following:

Table 3: Sample commuting times by gender and mode

	<i>NT</i>	Mean	Std. Dev.	Median
<i>All modes</i>				
Commuting time <sup>a</sup> - full sample	56635	25.22	20.18	20
Male	24927	27.68	21.99	20
Female	31708	23.29	18.41	20
<i>By mode<sup>b</sup></i>				
Car - all	40429	23.10	17.54	20
Male	17848	25.27	19.46	20
Female	22581	21.38	15.64	20
Public transport - all	7072	48.31	24.53	45
Male	3190	51.94	25.27	50
Female	3882	45.33	23.49	45
Walk or Cycle - all	8225	15.88	12.64	12
Male	3305	17.75	14.23	15
Female	4920	14.63	11.29	10

<sup>a</sup>We winsorize the commuting data, such that any observations above the 99th centile are recoded to be equal to the value at the 99th centile. Without doing this gave us a maximum CT of 740 minutes, which we think unrealistic. This winsorization does not affect our conclusions, and results without this recoding are available on request.

<sup>b</sup> Car is defined as any commuter who uses either a car or van (either as a driver or a passenger) as their main mode of travel to work. Public transport is defined as those who use either a bus, train, or underground/tram, and those who either walk or cycle the whole way are the Walk or Cycle commuters. We present the median here, as we make use of this in our spline models (see Section 5). Note that the sum of Car + Public Transport + Walk or Cycle is not equal to the overall sample size as we do not include people who use a motorcycle or moped.

$$SW_{it} = \beta C_{it} + X'_{it}\gamma + \alpha_i + \varepsilon_{it}, \quad \text{for } i = 1, \dots, N; t = 1, \dots, T_i, \quad (5)$$

where  $SW_{it}$  is our measure of SWB,  $C_{it}$  is commuting time, and  $X_{it}$  is a vector of observable confounding characteristics known to be correlated with SWB and potentially  $C_{it}$ .  $i$  indexes individuals and  $t$  time (max  $T_i = 5$ ). Individual specific and time-invariant heterogeneity is captured by  $\alpha_i$  with  $\varepsilon_{it}$  representing an idiosyncratic error term. Due to the (quasi-)cardinal nature of our outcomes, we estimate (5) using OLS with fixed effects.

## 6 Results

### 6.1 Overall

Table 4 presents the main regression results using the sample of individuals experiencing an exogenous shock to their commuting time of 5 minutes or greater and estimating model (5); results are presented separately by gender.

Table 4: The effect of exogenous shocks to commuting on different health and well-being outcomes

		GHQ		
		Overall	Women	Men
Overall	Commuting time (hours)	-0.198** (0.097)	-0.466*** (0.155)	0.012 (0.119)
	Other controls <sup>a</sup>	Yes	Yes	Yes
<i>NT</i>		56635	31653	24900
<i>N</i>		15841	8759	7082

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ .

<sup>a</sup>: additional controls include age (and its square), number of children in the household, usual number of hours worked, a married indicator, the log of equivalized household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

Overall SWB appears to decrease with increased commuting time. On closer inspection this result is driven by a gender effect; women report a decrease in SWB of 0.466 points on the Likert scale for an additional one hour increase in their commute. While this might appear a small reduction in well-being, it is comparable to that observed for women commuters in Roberts et al. (2011). In contrast we do not observe a negative impact of longer commutes for men, and instead obtain a coefficient close to zero. These results are consistent with those of Roberts et al. (2011).<sup>16</sup>

To account for possible non-linearities in the relationship between commuting time and well-being we explored the use of piecewise linear splines (PLS: Greene (2008)), which allow for differing slopes in different parts of the distribution of commuting duration. Results suggest that there is no strong evidence of a major non-linearity in the effects of commuting on SWB.

## 6.2 Robustness checks

### 6.2.1 The trade-off between residential location, wages and commuting

The modeling framework assumes that individuals are compensated for their commutes through wages or residential amenities or both. In order to examine the robustness of our results to this equilibrium assumption, we repeat our analysis on a subsample of individuals who report that they have lived in the same house and had the same job for

<sup>16</sup>If we split the sample by commuting mode, we find qualitatively similar results. Women who commute by car and active travel modes are adversely affected by increasing commutes. We fail to find any effects for males by mode.

at least five years prior to experiencing the exogenous shock to their commute<sup>17</sup>. Such individuals might be assumed to be in a stable equilibrium. In the short-run individuals may not achieve their optimal portfolio, that is they may gain rents from commuting, or suffer costs that are not compensated through housing or wages. In the longer run, however, on average, it is expected that people are compensated for costs thus predicting that there is no systematic relationship between commuting and utility level. Assuming individuals who have remained in the same household location and job for the previous five years are in a stable equilibrium, the impact of an exogenous shock to commuting might be expected to be greater than for the full sample, due to a move away from a position where they were happy with the trade-off between location, wages and commuting time. The results from this subsample are reported in Table A1. The effects for women are larger in magnitude when compared to the main results reported in Table 4; however, for men again we do not see significant effects on well-being.

### 6.2.2 Income

Identification of the impact of commuting on well-being is based on the assumption that there is no change in job characteristics and hence no change in income. However given the role of income in determining well-being, in the main analysis presented above, we condition on household income. Since a key compensating factor for a change in workplace location maybe an increase in wages (own personal labor income) we perform a robustness check on a subsample of individuals whose income has not changed more than 5% during their time in the survey.<sup>18</sup> We use a derived UKHLS variable which reports the total personal monthly gross income from labor income (top-coded at £15,000). This robustness check ensures that observed changes in commuting time are not compensated through changes to personal income. While the choice of 5% is arbitrary it allows for general wage inflation and minor increments that may be awarded on pay scales irrespective of a change in job characteristics. Over the period from January 2009 to December 2014 nominal wages grew by about 8%,<sup>19</sup> but the majority of our sample are observed

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<sup>17</sup>UKHLS asks individuals the date they moved into their current address and the date they started their current job. Together with the date of interview, we use these pieces of information to construct duration in both house and job. These move-in and job start dates are not available for all individuals, and for those with missing dates, we exclude from this robustness check. Of the 56,635 observations, 27,339 [9,141 individuals] meet the criteria, 14,348 do not, and we have missing dates for the other 14,948 observations.

<sup>18</sup>Timothy and Wheaton (2001) argue that on average employers who are based where there is a difficulty commuting will have to compensate their workers accordingly with higher wages, but as we hold job characteristics and household location constant we effectively rule this out. We are concerned more here with the possibility that an employer move may involve a specific worker compensation for the inconvenience of that move.

<sup>19</sup>ONS, Analysis of Real Earnings, <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandwages> Accessed 1 November 2017.



for less than the full 6 waves of data available.

The results of this robustness check are reported in panel (a) of Table A2. The coefficients for the pooled sample and for females are similar in terms of sign and significance, although slightly larger in magnitude, to the main results reported in Table 4. For males, the coefficient is now negative, but remains insignificant.

As we have discussed above the urban economics literature predicts different location choices for the rich and the poor, resulting from different preferences for space, and also possibly for transport modes. In further analysis not reported here we have split our samples of men and women to those above and below median household income (for the sample as a whole). We find that it is women in the group with below median household income who are adversely affected by increases in commuting time. Men are not affected and nor are women if their household has above median income. We also split our sample into occupational groups (as well as by median income). Here we find that the effect is largely for women in the lowest ranking occupational category (routine/semi-routine tasks) with household income below the median.

### 6.2.3 Shift workers

It is possible that a change in commuting time is due to a change in working patterns, for example, working a day shift instead of a night shift. Such a change is likely to impact on travel times; for example, due to differential availability of public transport or different levels of traffic congestion at different times of the day. To investigate if we are capturing any possible effect of changing times of work when identifying changes in commuting durations, we run a robustness check on a subsample of employees whose time of work (or shift) does not vary throughout the study period<sup>20</sup>. 11,388 out of the total 15,843 individuals (72%) have constant shift patterns, corresponding to 42,372 out of 56,635 observations (75%). The results of this robustness check are reported in panel (b) of Table A2. Consistent with the main set of results, we again observe a decrease in well-being for increases in commuting time for women only.

### 6.2.4 Vary definition of shock

The results presented above define an exogenous shock to commuting time as any change greater than five minutes. However, this definition maybe thought of as somewhat arbitrary, and as such we also consider a threshold of 10 minutes. The results are presented

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<sup>20</sup>UKHLS asks workers to report the time of day they usually work. Responses are reported on a 10-point scale, with options including ‘mornings only’, ‘during the day’, ‘evenings only’, ‘rotating shifts’.

in Table A3. For a shock of 10 minutes or more, the magnitude of the effect of commuting time on utility/well-being is larger than for 5 minutes and the statistical significance remains the same.

It maybe the case that our five minute definition of a shock may be susceptible to misreporting due to rounding. For example, a 12 minute commute could be recorded as 10 minutes in wave 1, 15 minutes in wave 2, and 10 minutes in wave 3. To deal potential measurement error we perform robustness checks based on the shock being an absorbent shock. That is, once the change in commuting time happens we stipulate this new, post-shock, commuting time must be maintained for at least two or three waves.

In total 38,722 (68%) observations corresponding to 9,166 individuals (57%) experience a shock which then sustained for at least two years. The results for this subsample are presented in panel (a) of Table A4. The effects on GHQ are typically smaller than the main results, and less significant. 15,903 (28%) observations corresponding to 3,329 individuals (21%) experience a shock and then maintain the new post-shock duration for at least three years. The results for this subsample are presented in panel (b) of Table A4. The results for GHQ lose significance, with the effect for women only being significant at  $p < 0.1$ .

### 6.3 Why do women but not men experience disutility from commuting?

The literature in urban economics, has often found that women place a greater valuation on time use than would be expected from their incomes (Rouwendal and Nijkamp, 2004).<sup>21</sup> Why should this be the case for women but not men? One reason, is that women are often placed in a situation of being the primary care giver for children and secondary income earners in a household. The constraint on time this imposes results in a willingness to accept jobs with low wages within reasonable distance from the location of residence. Accordingly, women's willingness or ability to trade-off longer commutes against other aspects of job characteristics is more restricted.

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<sup>21</sup>The standard assumption is that the wage rate affects commuting costs through the value of time. For example, that commuting costs increase with distance at a decreasing rate. The opportunity cost of commuting in terms of foregone leisure can be captured by earned income; see for example, DeSalvo and Huq (1996).

### 6.3.1 Do household commitments explain the gender gap?

If women are the primary care providers for children within households, then the presence of children might explain the negative well-being effect of an increase in commuting time, should this impact on the perceived ability to provide adequate care. That is, women with children face a greater opportunity cost of commuting time. Given that younger children require greater time inputs than older, more independent children, then one might expect increases in commuting time to impact mothers of younger children (pre-school, primary school) more than mothers of older children (adolescents).

Table 5 reports the results from four different subsamples of individuals: (Panel a) those who do not have children of their own in the household.<sup>22</sup>; (Panel b) those who have children aged between 0 and 15 years old; (Panel c) those with children aged between 0 and 4 years old and (Panel d) those with children aged 5-15 years. As we have seen previously the only significant effects are observed for women. These are always negative with the largest effect observed for women of pre-school age (0 to 4 years). This is more than three times the size of effect observed for women with children in the age group 5 to 15 years. The latter effect is only marginally greater than the effect of commuting observed for women with no children. Unsurprisingly, having children of a very young (pre-school) age increases the opportunity cost of commuting for women, lowering their well-being. However, having children of school age does not reduce well-being from commuting compared to women with no children. The presence of children in the household therefore only partially explains the observed decrease in well-being from commuting that women experience compared to men.

### 6.3.2 Does part-time work explain the gender gap?

An interesting implication of Manning's search model (Manning, 2003) is that it predicts a stronger relationship between wages and commutes where travel costs of commuting are high; this is likely to be the case for part-time workers. The implication here is that part-time workers exhibit higher returns to commuting costs, the latter measured as commuting time divided by hours worked. However, where compensation does not take place, as is the case for the exogenous shocks to commuting observed in our data, then the expectation is that increased commuting times will lead to greater disutility for part-time workers compared to full-time workers. In our sample, a greater proportion of women (35.3%) report working part-time ( $\leq 30$  hours per week) than men (6%). Could

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<sup>22</sup>UKHLS asks respondents how many children of their own live in the household. Accordingly, the report of no children will include households that never had children together with households for which children have left home.

Table 5: Number of children in household, and by age of children

		GHQ		
		Overall	Women	Men
Panel (a) No children	Commuting time (hours)	-0.238* (0.137)	-0.435** (0.211)	-0.053 (0.170)
	Other controls	Yes	Yes	Yes
	Observations:			
	NT	27,556	15,619	11,937
	N	7,318	4,063	3,255
Panel (b) Children (0-15 yrs)	Commuting time (hours)	-0.186 (0.221)	-0.514 (0.361)	0.042 (0.271)
	Other controls	Yes	Yes	Yes
	Observations:			
	NT	11,783	6,798	4,985
	N	3,276	1,886	1,390
Panel (c) Children 0-4 yrs	Commuting time (hours)	-0.462 (0.426)	-1.476** (0.733)	0.216 (0.505)
	Other controls	Yes	Yes	Yes
	Observations:			
	NT	3,720	1,897	1,823
	N	1,631	850	781
Panel (d) Children 5 -15 yrs	Commuting time (hours)	-0.147 (0.243)	-0.485 (0.404)	0.083 (0.295)
	Other controls	Yes	Yes	Yes
	Observations:			
	NT	10,111	5,905	4,206
	N	3,023	1,757	1,266

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ .

Table shows results for individuals with children in household of specific age consistently over observation period.

Other controls include age (and its square), number of children in the household, usual number of hours worked, a married indicator, the log of equivalized household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

this be an explanation for the finding that shocks to commuting negatively affect women but not men? Panel (a) of Table 6 reports results for the sample broken down by full-time and part-time workers (these are individuals who report full-time or part-time working consistently throughout the observation period in the sample). Contrary to predictions, women working full-time report an effect on well-being from increased commuting, but part-time workers do not. This suggests that time constraints, perhaps operating through childcare and other domestic commitments may offer a better explanation of the impact on well-being where time is constrained for full-time workers. If time constraints are important then it might be expected that single women faced greater costs of commuting than married or cohabiting women who can share household tasks. Panel (b) of Table 6 reports the impact on well-being for a sample broken down by marital status. Negative and significant effects are observed for both married/cohabiting and single women. The effect, however, is far greater for single compared to married women. As with part-time versus full-time workers, effects for men are not statistically significant.

Table 6: Results by Work and Marital status

		GHQ					
		Overall	Women	Men	Overall	Women	Men
		Always Full-Time			Always Part-Time		
Panel (a) Work status	Commuting time (hours)	-0.136 (0.109)	-0.458** (0.203)	0.0389 (0.125)	-0.189 (0.322)	-0.0618 (0.358)	-0.940 (0.698)
	Other controls	Yes	Yes	Yes	Yes	Yes	Yes
	Observations:						
	NT	38,402	16,474	21,928	8,190	7,456	734
	N	10,125	4,320	5,805	2,212	1,985	227
		Overall	Women	Men	Overall	Women	Men
		Always Married			Always Single		
Panel (b) Marital status	Commuting time (hours)	-0.101 (0.109)	-0.387** (0.183)	0.0779 (0.131)	-0.300 (0.236)	-0.628** (0.320)	0.187 (0.337)
	Other controls	Yes	Yes	Yes	Yes	Yes	Yes
	Observations:						
	NT	39,136	20,839	18,297	11,913	7,545	4,368
	N	10,137	5,356	4,781	3,285	2,031	1,254

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

Other controls include age (and its square), number of children in the household, usual number of hours worked, a married indicator, the log of equivalized household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

Table 7 disaggregates the sample into women with and without children in the house-

hold working full-time or part-time and married/cohabiting or single. Sample sizes become small for some of the combinations. However, the only significant effect for changes in commuting times is for married/cohabiting women working full-time who do not have children.

Table 7: By number of children, marital status and work status, Women only

		GHQ			
		Always Married		Always Single	
		Always FT	Always PT	Always FT	Always PT
Panel (a) No Children	Commuting time(hours)	-0.721** (0.340)	0.122 (0.609)	-0.330 (0.421)	0.288 (1.553)
	Other controls	Yes	Yes	Yes	Yes
	Observations				
	NT	5,646	2,130	3,451	476
	N	1,460	548	929	145
		GHQ			
		Always Married		Always Single	
		Always FT	Always PT	Always FT	Always PT
Panel (b) Children	Commuting time(hours)	-0.145 (0.587)	-0.409 (0.666)	0.806 (1.445)	-2.379 (2.141)
	Other controls	Yes	Yes	Yes	Yes
	Observations				
	NT	1,862	2,028	480	414
	N	529	569	139	130

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ .

Other controls include age (and its square), number of children in the household, usual number of hours worked, a married indicator, the log of equivalized household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

### 6.3.3 Thinness of local labor market

Manning's job search model (Manning, 2003) is characterized by a thin labor market where vacancies occur occasionally and are distributed geographically. In such markets employers have monopsony power over workers and workers fail to receive full compensation for longer commutes to secure employment. The approach can be applied to job search behaviors of either gender. Gender segregation theories of labor markets, however, suggest that men and women effectively operate in different labor markets (Anker, 1997). It might be possible, therefore, for women to be facing a thin local labor market situation, while men in the same local area do not, and vice versa. It may also be possible that for a given level of labor market thinness, men and women react differently to increased

Table 8: Using measure of labor market tightness = Vacancy count/ Unemployment count

	GHQ					
	Thin labor markets <25th percentile			Tight labor markets >75th percentile		
	Overall	Women	Men	Overall	Women	Men
Commuting time(hours)	-0.452** (0.197)	-0.653** (0.303)	-0.283 (0.250)	-0.012 (0.185)	-0.291 (0.297)	0.217 (0.225)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations						
NT	14,073	7,865	6,208	14,053	7,941	6,112
N	3,857	2,137	1,720	3,637	2,036	1,601

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ .

Other controls include age (and its square), number of children in the household, usual number of hours worked, a married indicator, the log of equivalized household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

<25th percentile and >75th percentile are the bottom and top quartiles of the labor market tightness indicator, computed as number of vacancies/ unemployment count in the local authority districts.

commutes. This section explores whether the thinness of labor markets can explain the differential gender effect of commuting on well-being.

One potential reason for women to be more influenced than men by the thinness of labor markets is if they are viewed as secondary income earners in a household and look towards local labor markets as a source of employment. When local markets are thin, employment opportunities may only be found at a greater geographical distance from residential location. While the extra commute that this entails may not be fully compensated by the wage rate offered, the time cost of commuting may also impinge on the well-being of women who, for example, have responsibilities for children or other caring duties, or who work part-time. An alternative refinement to Manning's approach is that workers commanding high wages are often more educated and specialized and as such generally face a thin labor market necessitating greater commuting distances. If educated and specialized women workers face fewer job opportunities than male counterparts, then this could create a greater disutility for women than men, particularly if women are not fully compensated through, for example, comparative wage discrimination.

In order to assess whether this framework can explain the difference in results we find for men and women, we classify the local labor market (defined at the Local Authority level) according to its tightness defined as  $\theta = \frac{v}{u}$  where  $v$  is the vacancy count and  $u$  is the unemployment count. Labor markets with a low value of  $\theta$  are defined as thin and

Table 9: Women only - interactions with labor market thinness

	GHQ					
	Thin labor markets <25th percentile					
	Always Married	Always Single	Always FT	Always PT	Always No kids	Always Kids
Women						
Commuting time(hours)	-0.968** (0.360)	-0.140 (0.619)	-0.672* (0.381)	-0.384 (0.699)	-0.690* (0.417)	-0.498 (0.651)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations						
NT	5,035	1,960	4,155	1,759	3,875	1,598
N	1,264	506	1,064	452	984	423

  

	GHQ					
	Tight labor markets >75th percentile					
	Always Married	Always Single	Always FT	Always PT	Always No kids	Always Kids
Women						
Commuting time(hours)	-0.668* (0.350)	0.026 (0.628)	-0.089 (0.410)	-0.513 (0.676)	0.033 (0.411)	-0.337 (0.761)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations						
NT	5,390	1,799	4,170	1,880	4,059	1,696
N	1,332	452	1,039	471	1,007	441

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ .

Other controls include age (and its square), number of children in the household, usual number of hours worked, a married indicator, the log of equivalized household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

<25th percentile and >75th percentile are the bottom and top quartiles of the labor market tightness indicator, computed as number of vacancies/ unemployment count in the local authority districts.

those with a high value, tight (Patacchini and Zenou, 2006). In general it should be easier to secure a job locally in a tight labor market than a thin market. Vacancy data at the LAD level are only available to 2012 (our data span 2009 to 2014). We create a measure of labor market thinness by computing  $\theta$  for the years 2009 to 2012. We then categorize LADs as thin if they are within the bottom 25th percentile of the distribution of  $\bar{\theta}$ , and tight if they are within the top 25th percentile. This categorization is applied to all years of data (2009 to 2014).<sup>23</sup>

Table 8 reports the effect of commuting time on well-being in thin and tight labor markets. The results support Mannings hypothesis for women but not men. Women re-

<sup>23</sup> $\bar{\theta} = 0.155$ ; sd = 0.071; min = 0.040; max = 0.598. On average, women residing in thin local labor markets report an average one-way commuting time of 25.12 minutes; those in tight local labor markets report an average of 23.63 minutes.



port a statistically significant decrease in well-being for an increased commute in thin but not tight labor markets.<sup>24</sup> The effect for women is nearly one and a half the magnitude of the main result reported in Table 4. The corresponding effect for men is smaller in magnitude and not statistically significant at conventional levels.

Further exploration reported in Table 9 reveals that in thin labor markets married women’s GHQ suffers from increased commuting times. There are also negative (and significant effects at 10% level) for full-time workers and women with no children. We do not observe these results in tight labor markets. In general the results accord with those found in Table 7 even if they have children and whether or not they are single or in a couple. This suggests that this effect is not primarily due to domestic responsibilities or women holding a secondary labor market position within the household.

Analysis by type of occupation in Table 10 shows support for the assertion that more educated and specialized women workers are required to travel further when faced with thin local labor markets and suffer a fall in well-being as a consequence. The table shows that women working in managerial and professional occupations report lower well-being scores with increasing commuting time.<sup>25</sup> We do not observe a similar effect for men. Women in this occupational group face an average one-way commute of 30.4 minutes in thin labor markets and 33.0 minutes in tight labor markets. The corresponding times for men are 33.0 and 32.0 minutes respectively. These are longer commuting times than the average across all occupational groups in these labor markets. While we observe a decrease in well-being for women in other occupational groups, these are imprecisely estimated and do not attain statistical significance.

## 7 Conclusions

This paper considers the disutility of commuting, proxied by a measure of well-being. While much of the economics literature assumes increased commutes are compensated by increased wages, this has been questioned, particularly where local labor markets are thin (Manning, 2003). In contrast urban economists assume the disutility of commutes is offset by lower rents and/or greater amenities in housing markets. We combine these two literatures and estimate the impact of exogenous shocks to commuting holding place of

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<sup>24</sup>Note when we restrict the analysis to the year for which vacancy data exit (2009 to 2012) we get a qualitatively similar result but the magnitude of the effect of commuting time on well-being is greater at -1.314 (s.e. 0.537).

<sup>25</sup>The grouping is based on the Job SOC 2000 classification codes provided in the UKHLS data, where by job SOC codes from 111-123 and 211-311 are classified as Management/professionals.

Table 10: By Occupation type

	GHQ					
	<25th percentile			>75th percentile		
	Overall	Women	Men	Overall	Women	Men
Management&Professional						
Commuting time (hours)	-0.685** (0.322)	-1.168** (0.576)	-0.406 (0.379)	0.016 (0.298)	-0.503 (0.586)	0.267 (0.321)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations:						
NT	4,346	1,968	2,378	4,541	2,149	2,392
N	1,313	594	719	1,291	616	675
Associate professionals						
Commuting time (hours)	-0.458 (0.534)	-0.566 (0.742)	-0.306 (0.732)	-0.385 (0.485)	-0.676 (0.648)	0.108 (0.728)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations:						
NT	2,385	1,518	867	2,376	1,451	925
N	750	464	286	713	439	274
Admin&Services						
Commuting time (hours)	-0.234 (0.454)	-0.188 (0.502)	-0.280 (1.078)	-0.371 (0.427)	-0.0396 (0.479)	-1.630* (0.973)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations:						
NT	4,412	3,516	896	4,262	3,543	719
N	1,351	1,048	303	1,220	990	230
Skilled trades						
Commuting time (hours)	-0.309 (0.566)	-1.904 (2.557)	-0.177 (0.579)	0.881 (0.575)	0.534 (2.868)	0.797 (0.583)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations:						
NT	803	103	700	816	130	686
N	250	35	215	249	41	208
Routine/semi-routine						
Commuting time (hours)	-0.856 (0.610)	0.141 (1.423)	-1.254* (0.646)	-0.436 (0.506)	-0.928 (1.174)	-0.281 (0.541)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations:						
NT	2,050	715	1,335	1,995	640	1,355
N	651	240	411	595	204	391

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ .

Other controls include age (and its square), number of children in the household, usual number of hours worked, a married indicator, the log of equivalized household income, and year dummies. Married includes those legally married, living as a couple and same sex unions. Grouping based on the Job SOC 2000 classification codes provided in the UKHLS data, where by job SOC codes from 111-123 and 211-311 are classified as Management/professionals; 312-356=Associate professionals; 411-421 and 611-721=Admin/services; 511-549=Skilled trade; 811-822 and 911-925=Routine/semi-routine which includes Operatives/elementary occupations.

<25th percentile and >75th percentile are the bottom and top quartiles of the labor market tightness indicator, computed as number of vacancies/ unemployment count in the local authority districts

residence and job characteristics (and wages) constant. Our findings reveal that women, but not men, are adversely affected by increased commutes and investigate the mechanisms behind this finding. Our results suggest that it is married or cohabiting women working full-time in managerial or professional roles who report decreases in utility for increasing commutes. Moreover, we find these effects for women when faced with thin local labor markets where the ratio of vacancies to unemployment counts is low. It would appear that women undertaking such job roles are required to commute further from their location of residence to secure relevant employment opportunities. This does not appear to be compensated through wages or job amenities resulting in disutility from the increased commuting time imposed.

Further our findings provide support for Manning's model but only for women. This may be a result of gendered segregation of jobs whereby men and women are effectively operating in separate labor markets. Manning's predictions assume homogeneous labor, but we argue that gender is an obvious form of heterogeneity that warrants further investigation.

Our results also suggest that the policy solution for reducing the adverse effects of commuting, will require changes to labor market institutions rather than changes to transport policy.

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# A Appendix

Supplementary tables



Table A1: Robustness check: constant workplace and home for at least five years

	GHQ		
	(1) Overall	(2) Women	(3) Men
Commuting time (hours)	-0.338** (0.147)	-0.614*** (0.231)	-0.116 (0.185)
Other controls <sup>a</sup>	Yes	Yes	Yes
Observations:			
$N \times T$	27300	15639	11661
$N$	9139	5151	3989

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

<sup>a</sup>: additional controls include age (and its square), number of children in the household, usual number of hours worked, a married/cohabiting indicator, the log of equivalized household income, and year dummies.

Table A2: Robustness checks: holding constant wages and shifts

	GHQ		
	Overall	Women	Men
<b>Panel a:</b> Constant wages (Last wage = first wage $\pm$ 5%)			
	(1a)	(2a)	(3a)
Commuting time (hours)	-0.244** (0.107)	-0.503*** (0.174)	-0.051 (0.130)
Other controls <sup>a</sup>	Yes	Yes	Yes
Observations:			
$N \times T$	45897	25140	20757
$N$	12052	6546	5506
<b>Panel b:</b> Constant shift patterns			
	(1b)	(2b)	(3b)
Commuting time (hours)	-0.125 (0.112)	-0.390** (0.177)	0.092 (0.139)
Other controls <sup>a</sup>	Yes	Yes	Yes
Observations:			
$N \times T$	42449	23512	18937
$N$	11414	6261	5153

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

<sup>a</sup>: additional controls include age (and its square), number of children in the household, usual number of hours worked, a married/cohabiting indicator, the log of equivalized household income, and year dummies.

Table A3: Varying the definition of an exogenous shock

	GHQ		
	Overall	Women	Men
<b>Panel a:</b> $\Delta CT \geq 10$ minutes			
	(1a)	(2a)	(3a)
Commuting time (hours)	-0.302* (0.164)	-0.666** (0.274)	-0.0436 (0.193)
Other controls <sup>a</sup>	Yes	Yes	Yes
Observations:			
$N \times T$	16851	9073	7778
$N$	10530	5748	4782

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ .

<sup>a</sup>: additional controls include age (and its square), number of children in the household, usual number of hours worked, a married/cohabiting indicator, the log of equivalized household income, and year dummies.

Table A4: Absorbent shocks

	GHQ		
	Overall	Women	Men
<b>Panel a:</b> No change two years after shock			
	(1a)	(2a)	(3a)
Commuting time (hours)	-0.158* (0.089)	-0.424** (0.202)	0.0602 (0.162)
Other controls <sup>a</sup>	Yes	Yes	Yes
Observations:			
$N \times T$	38722	22167	16555
$N$	9166	5217	3949
<b>Panel b:</b> No change three years after shock			
	(1b)	(2b)	(3b)
Commuting time (hours)	-0.355 (0.236)	-0.425* (0.227)	0.305 (0.292)
Other controls <sup>a</sup>	Yes	Yes	Yes
Observations:			
$N \times T$	15903	9299	6604
$N$	3329	1937	1392

Standard errors in parentheses. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ .

<sup>a</sup>: additional controls include age (and its square), number of children in the household, usual number of hours worked, a married/cohabiting indicator, the log of equivalized household income, and year dummies.