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The disutility of commuting? The effect of gender and local labour markets

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Abstract

Commuting is an extremely important modern phenomenon characterised by the spatial interaction of housing and labour markets. The average commuter in the UK spends nearly an hour a day travelling to and from employment. Standard economic theory postulates that commuting is a choice behaviour undertaken when compensated through either lower rents or greater amenities in the housing market or through greater wages in the labour market. By exploiting exogenous shocks to commuting time, this paper investigates the impact on wellbeing of increased commuting. Ceteris paribus, exogenous increases in commuting time are expected to lower wellbeing. We find this holds for women but not men. This phenomenon can be explained, in part, by the different labour markets in which women operate. Where local labour markets are thin, women report significantly lower wellbeing when faced with an increased commute. This does not hold for tight local labour 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.

JEL classification: C1; I1

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

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1 Introduction

In order to partake in paid employment at a location other than at their place of residence, an individual must travel between home and workplace locations. This (often daily) journey is referred to as a *commute*. This time spent commuting places a non-trivial constraint on the time use of employed individuals, and has an opportunity cost in terms of forgone time that cannot be used for work or leisure. Commuting is an extremely important modern phenomenon; it has helped to shape the world by allowing the separation of our professional and private lives, and it is a key theme in urban growth development. The average commuter in the UK spends nearly an hour a day travelling, and this is increasing gradually over time (Department for Transport, 2017).

Commuting can also be characterised as the spatial interaction between the housing and labour markets. However, while it has been a focus of research in both urban and labour 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 labour market is in equilibrium and analyses housing decisions, whereas conversely labour economics assumes that the housing market is in equilibrium and analyses labour supply decisions. Standard economic theory postulates that commuting is a choice behaviour, where rational individuals should only be prepared to undertake longer commutes if they were 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 have provided evidence that contradicts this prediction (see for example, Manning (2003), Stutzer and Frey (2008), and Roberts et al. (2011). These studies differ in their methodological approaches and in particular, while local labour market conditions are a key feature in the job search model of Manning (2003), they are completely neglected in the utility function estimation of both Stutzer and Frey (2008) and Roberts et al. (2011).

In this paper we combine direct estimation of a utility function with an account of local labour 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 apply a novel identification strategy (recently used by Mulalic et al., 2014) where we hold both an individual's household location and their job characteristics constant. We then assert that any noticeable changes in commuting time are brought about by factors which are exogenous to individual choice. These could include firm relocations and/or changes in transport infrastructure. We argue that the individual has no control over either, and hence the variations brought about in commuting time are exogenous.

A further pertinent feature of the commuting literature, is the observation that there are important gender differences in travel behaviours. It is well known that average commutes times for men are substantially higher than for women (White, 1986; Gordon et al., 1989). 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 labour 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 line with these previous studies 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 labour circumstances, as this has been neglected in the existing literature[1].

Using data from the UK Household Longitudinal Study (UKHLS; also known as '*Understanding Society*') and applying fixed-effect regression specifications to a subset of individuals who meet our inclusion criteria, we show that longer commutes brought about by exogenous shocks lead to lower levels of utility for women, but not for men. We investigate this phenomenon by considering caring responsibilities (for example, children in the household), working practices (full-time versus part-time) and characteristics of local labour markets, in particular, following Manning (2003) whether individuals face thin or tight labour markets, together with occupation hierarchies. 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 labour markets where the ratio of vacancies to unemployment counts is low and hence individuals are required to commute further for 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.

[1]Roberts and Taylor (2017) is a recent exception.

2 Related literature

2.1 The disutility of commuting

The role of commuting has featured prominently in models in both labour and urban economics. Both literatures position commuting as a compensating differential when considering job characteristics or household location. Labour economics has been concerned predominantly with the relationship between commuting and wage rates, and to a lesser extent hours worked and job search. In urban economics the primary trade-off is between the amenity of residential location and commuting distance. We briefly set out some of the key arguments from these literatures below.

In an important contribution, Manning (2003) develops a job search model in which jobs are characterised by wages and location, both of which are valued by workers. This occurs within a 'thin' labour market characterised 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, w, and disutility from commutes, such that utility, u, is defined as $u = w - \alpha t$, where α represents a measure of the costs to the worker of the commute t. Each individual faces a reservation utility, d, below which the job at distance t and wage w will not be accepted ($u < d$). Since the reservation utility is constant then as commutes increase, the reservation wage rate for an individual will also increase to offset the greater costs of commuting. The distribution of accepted wages is therefore 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. The expected impact of this is a higher proportion of job offers 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 travelling longer distances tending, on average, to be worse-off. These results come about due to the assumed monopsony power of employers in 'thin' labour markets. An individual is realistically only able to consider a finite number of job offers - those available at a reasonable commuting distance. [2] Empirical support for the predictions from the model is presented

[2] 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 labour markets can be derived.

in Manning (2003) using data from the British Household Panel Survey (BHPS) and the Labour Force Survey.

Other studies find similar evidence for compensation between commuting distance[3] and wages but interpret the results differently. For example, Madden (1985) hypothesizes that more able individuals (higher labour quality) choose longer commutes simply because they can command higher wages which makes longer commutes worthwhile. Mulalic et al. (2014) use firm relocation in an attempt to tease out the causal impact of commuting on wages. Using data from Denmark, they show that a 1km increase in commuting distance is compensated by a 0.15% increase in wages (3 years after relocation). Hazans (2004) considers the role of commuting on spatial wage disparities between urban and rural areas in Baltic countries. Results suggest that the wage gap (both between capital cities and rural areas and between capital cities and other cities) is reduced by commuting in certain areas but unchanged in others. These differences appear to be explained by country-specific spatial patterns of commuting flows, preferences over housing, educational and occupational composition of commuters, and wage discrimination against rural residents in urban labour markets. Cogan (1981) considers the relationship between commuting and labour supply. Assuming workers optimally choose their daily labour supply but with a fixed number of workdays in a week, models predict that daily hours and hence total labour supply declines with increasing commuting times, but that an increase in the monetary cost of commuting results in an increase in daily hours and total labour supply. Exploiting the same firm relocation identification strategy used by Mulalic et al. (2014), Gutiérrez-i Puigarnau and van Ommeren (2010) examine the relationship between commuting and labour supply in Germany. They find that increases in commuting, brought about by firm relocation, increases daily and weekly labour supply (in hours), but have no effect on the number of days an individual attends work.

Models of household location in urban economics have also focused on the role of commuting. The standard monocentric model assumes that 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, hence individuals are compensated for longer commutes in the residential housing market. For homogeneous individuals the model provides an equilibrium solution where everyone is equally well-off even though they reside at different

[3]Time is a more appropriate measure of the opportunity cost of commuting than distance in the context of the 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).

distances from the CBD. Accordingly in equilibrium, workers are assumed to be indifferent to their commute, since they are fully compensated through lower house prices (see for example, Rouwendal and Nijkamp (2004)). As with labour economics, while it is assumed in equilibrium that workers are indifferent to their commute, commuting plays a central role in formulating the model.

While the conventional approach to commuting behaviour assumes that it is a source of disutility (hence individuals will seek to minimize travel times and associated costs, subject to constraints), it has been suggested that commuting can be a source of utility. For example, Mokhtarian and Salomon (2001) argue that utility can be derived from three components of travel: 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 commute time and relative desired commute (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 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 addition to the potential perceived benefits of travel reducing the disutility of commuting, others have argued that people adapt to their commute over time becoming more accepting of the time cost Stopher (2004). In contrast Frey and Stutzer (2014) argue 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.

In our analysis we adopt an approach, that is increasingly accepted in economics, of approximating utility by subjective well-being (SWB).[4] 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), (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).

[4]See, for example, Stutzer and Frey (2002), van Praag and Ferrer-i Carbonell (2003), Ferrer-i Carbonell and Frijters (2004).

In recognition that the burden of commuting is potentially detrimental to well-being, in recent years there has emerged a strand of literature that attempts to quantify this relationship. Stutzer and Frey (2008) analysed data from 19 years of the German Socio-economic Panel Study to investigate the relationship between commuting distances and overall SWB measured by responses to the question "How satisfied are you with your life, all things considered?", which is answered on a 0 "completely dissatisfied" to 10 "completely satisfied" scale. Employing fixed-effects techniques, they find evidence of a negative and statistically significant relationship between commuting time and well-being. They do not control for income in their models as they argue that this is a potentially compensating factor for longer commutes. The authors label their findings as a commuting paradox as they claim that rational individuals should not partake in these longer commutes if they negatively affect their well-being.

Using thirteen waves of the BHPS, Roberts et al. (2011) test whether the relationship found by Stutzer and Frey 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. Additionally, Roberts et al. control for other confounding factors, such as income and quality of housing. 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. 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., 2014) the authors failed to replicate the result of Stutzer and Frey using life satisfaction as an outcome; that is they find no significant relationship between commuting time and SWB. However, Dickerson et al. do control for household income, unlike Stutzer and Frey. Further, Dickerson et al. could only replicate the results of Roberts et al. 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.

Few researchers have explored the effects of travel mode on wellbeing, but Martin et al. (2014) use UK longitudinal data from the BHPS to show that individuals who commute by walking or cycling (active commuters) and those who use public transport report higher levels of SWB (as proxied by GHQ) than individuals who travel to work by car.

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 labour 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 equalised 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:

$$U_i = u\left(w_i, j_i, h_i, c_i\right) \qquad \forall\ i \tag{1}$$

Following Stutzer and Frey (2008), we assume that, on average, individuals are in equilibrium. That is, the trade-offs between the various inputs to the utility function have been made and utility is maximised for all i, such that:

$$U_i^* = U_i^0 = u\left(w_i^0, j_i^0, h_i^0, c_i^0\right) \quad \forall\ i \tag{2}$$

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:

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

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, labour 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.[5] We test this assumption by observing exogenous shocks to commuting time while

[5]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

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 labour 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. This ensures that $\Delta h = \frac{\partial U}{\partial h} = 0 \left(\frac{dh}{dc} = 0\right)$ 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 labour income w is a function of job characteristics, such that $w = w(j)$. Given that $\Delta j = 0$, then it follows that $\Delta w = dw = 0$.[6] Hence the total derivative of utility with respect to changes in commuting time is simply the partial derivative:

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

A similar identification strategy to define exogenous shocks to commuting has been used in the literature. For example, Mulalic et al. (2014) use firm relocation in an attempt to tease out the causal impact of commuting on wages. The authors argue that firm relocation is often only announced very close to the actual relocation to minimise disruption, and hence relocations can be assumed to be an exogenous shock. Gutiérrez-i Puigarnau and van Ommeren (2010) exploit the same place of work relocation identification strategy to examine the relationship between commuting and labour supply in

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.

[6]This assumption is testable in our data - see section 6.2.2.

Germany. Munford (2014) exploited a similar approach using UK data from the Annual Survey of Hours and Earnings which contains a precise indicator of firm relocation (firm postcodes), but with an approximation to commuting burden based on the Euclidean distance between the location of residence and workplace.

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 ($|\Delta c| \geq 5$)[7], 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 labour market for a change in commuting time. 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 subsample of individuals who report no change in mode of travel.[8] 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 behaviour, 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 labour market, in addition, we perform analyses where wages are held constant (adjusted for inflation) across adjacent waves.

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 characteris-

[7]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.

[8]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.

tics, health and well-being, and labour 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 list 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).[9] 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 sub-sample 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), educational attainment, the number of children in a household, a married/cohabiting identifier, and a log equivalised monthly household income (deflated to 2005 prices, and equivalised using the OECD modified scale, detailed in Foster (2009)).

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 sin-

[9] 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.

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 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.

gle 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%). 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.[10]. 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 equivalised household income is £7.56.

[10]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 3: Sample commuting times by gender and mode

	NT	Mean	Std. Dev.	Median
All modes				
Commuting time[a] - full sample	56635	25.22	20.18	20
Male	24927	27.68	21.99	20
Female	31708	23.29	18.41	20
By mode[b]				
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

[a]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.
[b] 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 use people who use a motorcycle or moped.

Table 3 breaks down the descriptive statistics into gender and mode of transport effects. 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 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 behaviour 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:

$$SW_{it} = \beta C_{it} + X_{it}'\gamma + \alpha_i + \varepsilon_{it}, \qquad \text{for } i = 1, \ldots, N; t = 1, \ldots, T_i, \tag{5}$$

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 α_i with ε_{it} representing an idiosyncratic error term. Due to the (quasi-)cardinal nature of our outcomes, we estimate (5) using OLS with fixed effects.

The study by Redmond and Mokhtarian (2001) appears to support the notion that commuting is not unequivocally a disutility to be minimized, but instead that their is an optimum commuting time, for which individuals state a preference. Violations then lead to disutility. Their results suggest that for many people actual commutes are longer than desired. In the model of job search, Manning (2003) also predicts that workers do not receive full compensation via wages for longer commutes such that marginal utility falls with duration of commute. It has also been noted that average commuting distances vary less over time and space, than might be expected on the basis of random matching of jobs to workers over a sizeable area (Rouwendal and Nijkamp, 2004), which again has led to the notion of a maximum commute that individuals are willing to accept (see, for example, Getis (1969)). Taken as a whole, this suggest that there exists non-linearity in the relationship between commuting duration and SWB around some optimal level of commute. To model this effect we allow for piecewise linear splines (PLS: Greene (2008), ch. 6). This approach allows for differing slopes in different parts of the distribution of commuting duration; for example, individuals with shorter commutes are likely to be affected differently than people with longer commutes.

In order to implement these PLS, we split the commuting time data in segments, where each segment is separated from the next by a knot. To illustrate, assume that there is a single knot (and hence two segments of the data), and this knot is located at the median of the distribution of commuting time (refer to Table 3). Let C^m be the median commuting time, and define $D_i = 1$ if $C_{it} \geq C^m$ and 0 otherwise; that is $D_i = 1$ if, and only if, the commuting time of individual i is greater than the median. We then run the following regression:

$$SW_{it} = b_1 C_{it} + b_2 D_1 \left(C_{it} - C^m\right) + X'_{it}\gamma + \alpha_i + \varepsilon_{it}, \qquad \text{for } i = 1, \ldots, N; t = 1, \ldots, T_i, \tag{6}$$

The coefficient, b_1 represents the relationship between commuting time and SWB for individuals who face a commute of less than or equal to the median. $b_1 + b_2$ represents the marginal effect of commuting time for individuals with a commute above the median duration. A test for differential affects above and below the median requires a test of the hypothesis $H_0 : b_2 = 0$.

6 Results

6.1 Overall

Panel (a) of 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.

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).[11]

Panel (b) of the table considers non-linearity in the effects of commuting on SWB

[11] If we split the sample by commuting mode, we find qualitatively similar results. Women who by car and active travel modes are adversely affected by increasing commutes. We fail to find any effects for males by mode.

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

		GHQ		
		Overall	Women	Men
Panel (a) Overall	Commuting time (hours)	-0.198**	-0.466***	0.012
		(0.097)	(0.155)	(0.119)
	Other controls [a]	Yes	Yes	Yes
Panel (b) Splines	Commuting time < median	-0.011**	-0.009	-0.014*
		(0.005)	(0.007)	(0.007)
	Commuting time ≥ median	-0.001	-0.007**	0.003
		(0.002)	(0.003)	(0.003)
	Other controls [a]	Yes	Yes	Yes
	NT	56635	31653	24900
	N	15841	8759	7082

Standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; ***$p < 0.01$.
[a]: additional controls include age (and its square), number of children in the household, usual number of hours worked, a married indicator, the log of equivalised household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

via the fitting of splines. The negative effect of increased commuting time on women remains and is broadly of a similar magnitude below and above the median point. This would 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 modelling framework assumes that individuals are compensated for their commutes through wages or residential amenities or both. That is, individuals are in equilibrium such that they are indifferent to the commutes they face. 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 at least five years prior to experiencing the exogenous shock to their commute[12]. Such

[12]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.

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 wellbeing.

6.2.2 Income

Identification of the impact of commuting on wellbeing 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 wellbeing, 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 labour 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. We use a derived UKHLS variable which reports the total personal monthly gross income from labour 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%,[13] but the majority of our sample are observed 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.

[13]ONS, Analysis of Real Earnings, https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandwo
Accessed 1 November 2017.

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[14]. 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 wellbeing 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 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.

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

[14] 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'.

$p < 0.1$.

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).[15] 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.

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 wellbeing 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.[16]; (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

[15]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).

[16]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*	-0.435**	-0.053
		(0.137)	(0.211)	(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	-0.514	0.042
		(0.221)	(0.361)	(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	-1.476**	0.216
		(0.426)	(0.733)	(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	-0.485	0.083
		(0.243)	(0.404)	(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 equivalised household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

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 wellbeing. However, having children of school age does not reduce wellbeing from commuting compared to women with no children. The presence of children in the household therefore only partially explains the observed decrease in wellbeing 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 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 wellbeing 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 wellbeing 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 wellbeing 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 7 disaggregates the sample into women with and without children in the household 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

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	-0.458**	0.0389	-0.189	-0.0618	-0.940
		(0.109)	(0.203)	(0.125)	(0.322)	(0.358)	(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	-0.387**	0.0779	-0.300	-0.628**	0.187
		(0.109)	(0.183)	(0.131)	(0.236)	(0.320)	(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 equivalised household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

children.[17]

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**	0.122	-0.330	0.288
		(0.340)	(0.609)	(0.421)	(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	-0.409	0.806	-2.379
		(0.587)	(0.666)	(1.445)	(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 equivalised household income, and year dummies. Married includes those legally married, living as a couple and same sex unions.

6.3.3 Thinness of local labour market

Manning's job search model (Manning, 2003) is characterised by a thin labour 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 behaviours of either gender. Gender segregation theories of labour markets, however, suggest that men and women effectively operate in different labour markets (Anker, 1997). It might be possible, therefore, for women to be facing a thin local labour 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 labour market thinness, men and women react differently to

[17] If we break down further women with pre-school aged children and women with children aged 5 to 15 years, we observe a very large and significant effect (-30.04 ($s.e.$13.13)) for single part-time mothers with children of pre-school age. This is however, based on a very small sample of 43 women.

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

	GHQ					
	Thin labour markets <25th percentile			Tight labour markets >75th percentile		
	Overall	Women	Men	Overall	Women	Men
Commuting time(hours)	-0.452**	-0.653**	-0.283	-0.012	-0.291	0.217
	(0.197)	(0.303)	(0.250)	(0.185)	(0.297)	(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 equivalised 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 labour market tightness indicator, computed as number of vacancies/ unemployment count in the local authority districts.

increased commutes. This section explores whether the thinness of labour markets can explain the differential gender effect of commuting on wellbeing.

One potential reason for women to be more influenced than men by the thinness of labour markets is if they are viewed as secondary income earners in a household and look towards local labour 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 wellbeing 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 labour market necessitating greater commuting distances. If educated and specialised 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 labour 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. Labour markets with a low value of θ are defined as thin

Table 9: Women only - interactions with labour market thinness

	GHQ					
	Thin labour markets <25th percentile					
Women	Always Married	Always Single	Always FT	Always PT	Always No kids	Always Kids
Commuting time(hours)	-0.968**	-0.140	-0.672*	-0.384	-0.690*	-0.498
	(0.360)	(0.619)	(0.381)	(0.699)	(0.417)	(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 labour markets >75th percentile					
Women	Always Married	Always Single	Always FT	Always PT	Always No kids	Always Kids
Commuting time(hours)	-0.668*	0.026	-0.089	-0.513	0.033	-0.337
	(0.350)	(0.628)	(0.410)	(0.676)	(0.411)	(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 equivalised 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 labour market tightness indicator, computed as number of vacancies/ unemployment count in the local authority districts.

and those with a high value, tight (Patacchini and Zenou, 2006). In general it should be easier to secure a job locally in a tight labour 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 labour market thinness by computing θ for the years 2009 to 2012. We then categorise 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 categorisation is applied to all years of data (2009 to 2014).[18]

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

[18] $\bar{\theta} = 0.155$; sd = 0.071; min = 0.040; max = 0.598. On average, women residing in thin local labour markets report an average one-way commuting time of 25.12 minutes; those in tight local labour markets report an average of 23.63 minutes.

port a statistically significant decrease in wellbeing for an increased commute in thin but not tight labour markets.[19] 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 labour 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 labour 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 labour market position within the household.

Analysis by type of occupation in Table 10 shows support for the assertion that more educated and specialised women workers are required to travel further when faced with thin local labour markets and suffer a fall in wellbeing as a consequence. The table shows that women working in managerial and professional occupations report lower wellbeing scores with increasing commuting time.[20] 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 labour markets and 33.0 minutes in tight labour 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 labour markets. While we observe a decrease in wellbeing 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 wellbeing. While much of the economics literature assumes increased commutes are compensated by increased wages, this has been questioned, particularly where local labour 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

[19] 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 wellbeing is greater at -1.314 (s.e. 0.537).

[20] 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**	-1.168**	-0.406	0.016	-0.503	0.267
	(0.322)	(0.576)	(0.379)	(0.298)	(0.586)	(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	-0.566	-0.306	-0.385	-0.676	0.108
	(0.534)	(0.742)	(0.732)	(0.485)	(0.648)	(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	-0.188	-0.280	-0.371	-0.0396	-1.630*
	(0.454)	(0.502)	(1.078)	(0.427)	(0.479)	(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	-1.904	-0.177	0.881	0.534	0.797
	(0.566)	(2.557)	(0.579)	(0.575)	(2.868)	(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	0.141	-1.254*	-0.436	-0.928	-0.281
	(0.610)	(1.423)	(0.646)	(0.506)	(1.174)	(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 equivalised 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 labour 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 labour 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 of result of gendered segregation of jobs whereby men and women are effectively operating in separate labour markets. Manning's predictions assume homogeneous labour, 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 labour 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)	(2)	(3)
	Overall	Women	Men
Commuting time (hours)	-0.338**	-0.614***	-0.116
	(0.147)	(0.231)	(0.185)
Other controls [a]	Yes	Yes	Yes
Observations:			
$N \times T$	27300	15639	11661
N	9139	5151	3989

Standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; ***$p < 0.01$.
[a]: 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 equivalised household income, and year dummies.

Table A2: Robustness checks: holding constant wages and shifts

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

Standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; ***$p < 0.01$.
[a]: 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 equivalised household income, and year dummies.

Table A3: Varying the definition of an exogenous shock

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

Standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; ***$p < 0.01$.
[a]: 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 equivalised household income, and year dummies.

Table A4: Absorbent shocks

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

Standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; ***$p < 0.01$.
[a]: 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 equivalised household income, and year dummies.