How commuting influences personal wellbeing over time

Ben Clark, Kiron Chatterjee, Adrian Davis, Adam Martin
Panel data

• Numerous UK panel datasets
  • e.g. BHPS and Understanding Society
• Other international examples
  • e.g. German Socio-Economic Panel
  • U.S. Panel Study of Income Dynamics
• Key features of the data
  • Large sample sizes
  • The same individuals followed for long time periods
  • Individuals are nested in households
  • Wide ranging variables on multiple aspects of life
  • Nationally representative
  • Geographic identifiers for linkage to other data
Research opportunities

• Many existing studies have used primary data
  • Secondary data appears to be an underutilised resource
• Can support more advanced analytical techniques which are necessary for dealing with endogeneity or confounding
  • Fixed effects models (assuming that unobserved heterogeneity is constant over time)
  • Exogenous shocks
• Large samples of individuals who used relatively underused travel modes, e.g. bus and bike
• Of course, there are also limitations and disadvantages!
Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey

Adam Martin, Yevgeniy Goryakin, Marc Subirca

Abstract
Objective: The aim of this study is to explore the relationship between active travel and psychological wellbeing.

Method: This study used data on 17,985 adult commuters in eighteen waves of the British Household Panel Survey (1991/2–2008/9). Fixed effects regression models were used to investigate how (i) travel mode choice, (ii) commuting time, and (iii) switching to active travel impacted on overall psychological wellbeing and how (iv) travel mode choice impacted on specific psychological symptoms included in the General Health Questionnaire.

Results: After accounting for changes in individual-level socio-demographic characteristics and potential confounding variables relating to work, residence and health, significant associations were observed between overall psychological wellbeing (on a 36-point Likert scale) and (i) active travel (0.185, 95% CI: 0.148 to 0.221) and public transport (0.195, 95% CI: 0.051 to 0.339) when compared to car travel, (ii) time spent (per 10 minute change) walking (0.045, 95% CI: 0.003 to 0.163) and driving (−0.033, 95% CI: −0.064 to −0.001), and (iii) switching from car travel to active travel (0.079, 95% CI: 0.199 to 0.796). Active travel was also associated with reductions in the odds of experiencing two specific psychological symptoms when compared to car travel.

Conclusion: The positive psychological wellbeing effects identified in this study should be considered in cost-benefit assessment of interventions seeking to promote active travel.

Introduction
Regular, moderate-intensity physical activity can contribute to reductions in the risk of over twenty chronic health conditions (Biddle and Mutrie, 2007; Humphreys et al., 2014; WHO, 2010). Whilst frequent physical activity is predictive of higher psychological wellbeing (Anokye et al., 2012; Bize et al., 2007; Cerin et al., 2009; Hamer et al., 2009; Tekelenburg et al., 2008), an increasingly important indicator used by Governments at the national level (Fitzharris and Oswald, 2010) and in activity-based travel demand models (Ettema et al., 2010). These models focus not only on individual trips, where time savings alone are important, but seek to better understand how time is allocated across all trips and activities, allowing the impact on wellbeing of various interrelated factors such as travel patterns, urban form, and time use to be examined concurrently (Abou-Zeid and Ben-Akiva, 2012; Eltah and Koppelman, 1999; Bowman and Ben-Akiva, 2001; McFadden et al., 1977; Pejari et al., 2011; Sallis et al., 2004).

Studies that examine the impact on wellbeing of active travel for re-
Martin et al. 2014

- Impact of commuting behaviour on wellbeing (mental distress) using individual-level fixed effects analyses
  - 18,000 commuters
  - 18 years of data since 1990/1
- Compared to driving, wellbeing was higher when using active travel or public transport
- Wellbeing increased with travel time for walkers, but decreased for drivers
  - Travel mode choice was more important than travel time
- Use of active travel reduced the likelihood of two specific psychological symptoms
  - Being unable to concentrate and constantly under strain
Outline

1. Data set and measures
2. Cross-sectional associations between commuting and wellbeing
3. Frequency of changes to commuting mode and duration
4. Effects of changing commute mode / duration on personal wellbeing
   i. Short run
   ii. Long run
5. Take home messages
Data set

• Understanding Society
  • 6-wave sample of English workers 2009-2015 (n~26,000)

• Analysis methods
  • Cross-sectional analysis (path models)
  • Longitudinal analysis (panel models)
# Measures

## Commuting

**Commuting duration**

> About how much time does it usually take for you to get to work each day, door to door (in minutes)?

**Commuting mode**

> And how do you usually get to your place of work?

## Personal wellbeing

**Life satisfaction**

> How dissatisfied or satisfied are you with your life overall?

**Strain**

> Have you recently felt constantly under strain?

**Sat with leisure time availability**

> How dissatisfied or satisfied are you with the amount of leisure time you have?

**Job satisfaction**

> How satisfied or dissatisfied you are with your present job overall?

**Self reported health**

> In general would you say your health is [good to poor]?
Theorised Relationships

commute state

- physical health
- feeling strained
  - satisfaction with leisure time
  - satisfaction with job

life satisfaction
Cross-sectional associations
Sample characteristics (wave 2)

<table>
<thead>
<tr>
<th>Commute mode</th>
<th>Freq</th>
<th>%</th>
<th>Mean 1-way commute time (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car driver</td>
<td>10,460</td>
<td>62</td>
<td>24</td>
</tr>
<tr>
<td>Bus</td>
<td>1,136</td>
<td>7</td>
<td>40</td>
</tr>
<tr>
<td>Rail / metro</td>
<td>1,288</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td>Cycle</td>
<td>578</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>Walk</td>
<td>2,121</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>Other</td>
<td>1,258</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16,841</strong></td>
<td><strong>100</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>
Cross-sectional associations

Do people with longer duration commutes report different personal wellbeing scores compared to people with shorter duration commutes?

Yes

Do people that commute by different modes report different personal wellbeing scores?

Yes
Commute time

Life satisfaction scores indexed on 1 to 15 mins

- 1 to 15 mins: n=7056
- 16 to 30 mins: n=5271
- 31 to 45 mins: n=2101
- 46 to 60 mins: n=1316
- 61 to 90 mins: n=666
- 91 to 179 mins: n=202
Life satisfaction score indexed on driving commute mode

- Drivers
- Bus/Coach
- Rail/Metro
- Cycle
- Walk
Commute mode [ref drive]

Personal Wellbeing

Commute duration [ref 1-15mins]

Life satisfaction

-ve

>46mins

Strain

+ve

46-60mins

Leisure time avail.

-ve

>46mins

Job satisfaction

-ve

>15mins

Self-reported health

+ve

rail, cycle

bus, walk

-ve
6-wave panel analysis

Benefits

• Examine variation in wellbeing scores *within individuals* over 6 observations
  – Eliminates spurious *between individual* associations with commuting arising from unobserved personal characteristics

• Identify what happens to personal wellbeing when the commuting situation *changes over time*
  – Short run: from one wave to the next (12 months)
  – Long run: Over a period of up to 6 years
Questions – Part 1

1. How frequent are changes to the origin / destination of the commute from one observation to the next?
### Change in OD of the commute

<table>
<thead>
<tr>
<th>Change in OD of the commute</th>
<th>Freq</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changed employer / workplace</td>
<td>9,803</td>
<td>14</td>
</tr>
<tr>
<td>Moved to a new local area</td>
<td>5,571</td>
<td>8</td>
</tr>
<tr>
<td>Changed origin or destination</td>
<td>14,231</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total observations</strong></td>
<td>70,249</td>
<td>100</td>
</tr>
</tbody>
</table>


Questions – Part 1

1. How frequent are changes to the origin / destination of the commute from one observation to the next?

2. How frequent are changes to commute mode from one observation to the next?
Change in commute mode

- 18% of observations involved a change in commute mode
- 12,443 out of 70,249 observations

<table>
<thead>
<tr>
<th>Following obs mode</th>
<th>drive</th>
<th>bus</th>
<th>rail</th>
<th>cycle</th>
<th>walk</th>
<th>other</th>
<th>wfh</th>
<th>Total</th>
<th>Changed to</th>
</tr>
</thead>
<tbody>
<tr>
<td>drive</td>
<td>35,956</td>
<td>459</td>
<td>420</td>
<td>305</td>
<td>901</td>
<td>1,124</td>
<td>1,036</td>
<td>40,201</td>
<td>4,245</td>
</tr>
<tr>
<td>bus</td>
<td>254</td>
<td>2,889</td>
<td>310</td>
<td>58</td>
<td>348</td>
<td>270</td>
<td>36</td>
<td>4,165</td>
<td>1,276</td>
</tr>
<tr>
<td>rail</td>
<td>481</td>
<td>299</td>
<td>4,053</td>
<td>68</td>
<td>148</td>
<td>137</td>
<td>151</td>
<td>5,337</td>
<td>1,284</td>
</tr>
<tr>
<td>cycle</td>
<td>258</td>
<td>71</td>
<td>59</td>
<td>1,504</td>
<td>184</td>
<td>80</td>
<td>24</td>
<td>2,180</td>
<td>676</td>
</tr>
<tr>
<td>walk</td>
<td>726</td>
<td>318</td>
<td>128</td>
<td>169</td>
<td>5,402</td>
<td>320</td>
<td>142</td>
<td>7,205</td>
<td>1,803</td>
</tr>
<tr>
<td>other</td>
<td>821</td>
<td>269</td>
<td>115</td>
<td>87</td>
<td>308</td>
<td>2,258</td>
<td>94</td>
<td>3,952</td>
<td>1,694</td>
</tr>
<tr>
<td>wfh</td>
<td>1,003</td>
<td>47</td>
<td>147</td>
<td>33</td>
<td>138</td>
<td>97</td>
<td>3,380</td>
<td>4,845</td>
<td>1,465</td>
</tr>
<tr>
<td>Prev year miss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,364</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39,499</td>
<td>4,352</td>
<td>5,232</td>
<td>2,224</td>
<td>7,429</td>
<td>4,286</td>
<td>4,863</td>
<td>70,249</td>
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<tr>
<td>Changed from</td>
<td>3,543</td>
<td>1,463</td>
<td>1,179</td>
<td>720</td>
<td>2,027</td>
<td>2,028</td>
<td>1,483</td>
<td></td>
<td>12,443</td>
</tr>
</tbody>
</table>
Change in commute mode

Driving is:
• the most stable (unchanging) commute mode
• the most commonly preferred alternative commute mode

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<th>rail</th>
<th>cycle</th>
<th>walk</th>
<th>other</th>
<th>wfh</th>
</tr>
</thead>
<tbody>
<tr>
<td>drive</td>
<td>91.0%</td>
<td>10.5%</td>
<td>8.0%</td>
<td>13.7%</td>
<td>12.1%</td>
<td>26.2%</td>
<td>21.3%</td>
</tr>
<tr>
<td>bus</td>
<td>0.6%</td>
<td>66.4%</td>
<td>5.9%</td>
<td>2.6%</td>
<td>4.7%</td>
<td>6.3%</td>
<td>0.7%</td>
</tr>
<tr>
<td>rail</td>
<td>1.2%</td>
<td>6.9%</td>
<td>77.5%</td>
<td>3.1%</td>
<td>2.0%</td>
<td>3.2%</td>
<td>3.1%</td>
</tr>
<tr>
<td>cycle</td>
<td>0.7%</td>
<td>1.6%</td>
<td>1.1%</td>
<td>67.6%</td>
<td>2.5%</td>
<td>1.9%</td>
<td>0.5%</td>
</tr>
<tr>
<td>walk</td>
<td>1.8%</td>
<td>7.3%</td>
<td>2.4%</td>
<td>7.6%</td>
<td>72.7%</td>
<td>7.5%</td>
<td>2.9%</td>
</tr>
<tr>
<td>other</td>
<td>2.1%</td>
<td>6.2%</td>
<td>2.2%</td>
<td>3.9%</td>
<td>4.1%</td>
<td>52.7%</td>
<td>1.9%</td>
</tr>
<tr>
<td>wfh</td>
<td>2.5%</td>
<td>1.1%</td>
<td>2.8%</td>
<td>1.5%</td>
<td>1.9%</td>
<td>2.3%</td>
<td>69.5%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Changing from</td>
<td>9.0%</td>
<td>33.6%</td>
<td>22.5%</td>
<td>32.4%</td>
<td>27.3%</td>
<td>47.3%</td>
<td>30.5%</td>
</tr>
</tbody>
</table>
Questions – Part 1

1. How frequent are changes to the **origin / destination** of the commute from one observation to the next?

2. How frequent are changes to **commute mode** from one observation to the next?

3. To what extent do **one-way commute durations** change from one observation to the next?
## Change in commute duration

<table>
<thead>
<tr>
<th>Change in commute duration for:</th>
<th>Mean wave to wave change (mins)</th>
<th>SD (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full sample</td>
<td>8.8</td>
<td>18.6</td>
</tr>
<tr>
<td>Those that changed OD</td>
<td>16.3</td>
<td>23.4</td>
</tr>
<tr>
<td>Those that changed mode &amp; OD</td>
<td>22.6</td>
<td>30.1</td>
</tr>
<tr>
<td>Those with no change to OD / mode</td>
<td>6.0</td>
<td>15.6</td>
</tr>
</tbody>
</table>
Questions – Part 2

4. What is the effect of changing commute mode on personal wellbeing?

5. What is the effect of changing commute duration on personal wellbeing?
Panel modelling approach

Conditional change score models

- designed to indicate how wellbeing changes when individuals change commute mode or duration from one wave to the next

Short Run Effects

(within a 12 month period)
Change score models (wave i to wave i+1)

- Base Year Commute Duration
- Change in Commute Duration
- Following Year Commute Mode
- Change in SWB score

Base year conditions
SWB score
Demographic
Settlement type

Base year modal subgroup
Control variables

- **Income**
- **Management job** compensators for commuting
- Age
- Gender
- Ethnicity
- Education level
- Live with a partner
- Live with children
- Working hours
- Temporary job
- Belong to a religion
- Long standing health condition
Change score models (wave i to wave i+1)

- Base Year Commute Duration
- Change in Commute Duration
- Following Year Commute Mode

Change in SWB score

Base year conditions
- SWB score
- Demographic
- Settlement type

Life event variables
- Move home
- Change job
- Gain / lose partner
- Gain / lose child
- Gain degree
- Gain / lose management job
- Gain / lose PT empl
- Gain / lose temporary empl

Base year modal subgroup
What is the effect of changing commute mode on personal wellbeing?
What is the effect of *changing commute mode* on personal wellbeing?

<table>
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<tr>
<td>Life satisfaction</td>
<td>rail –ve</td>
</tr>
<tr>
<td>Sat with leisure time</td>
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<tr>
<td>Strain</td>
<td>cycle –ve</td>
</tr>
<tr>
<td></td>
<td>walk –ve</td>
</tr>
<tr>
<td>SR health</td>
<td>cycle +ve</td>
</tr>
</tbody>
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What is the effect of *changing commute mode* on personal wellbeing?

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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Commute mode: Summary

What is the effect of changing commute mode on personal wellbeing?

Key observations:

- Switches from driving to walking / cycling are linked to:
  - An uplift in satisfaction with leisure time availability
  - An uplift in job satisfaction
  - A reduction in strain
  - An uplift in SR-health for cycling

- The modal switches are not symmetrical e.g.
  - Switching from walking to driving is also linked to an uplift in job satisfaction
What are the effects of longer / lengthening commute durations on personal wellbeing?
What are the effects of *longer / lengthening commute durations* on personal wellbeing?

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**Commute duration:**

**Key observations**

**For drivers**
Lengthening commutes / longer duration base year commutes are linked to:
- Reduced satisfaction with leisure time availability
- Reduced job satisfaction
- Increased strain (base year effect)

**For users of motorised mode (drive, bus, rail)**
Lengthening commutes / longer duration base year commutes are linked to:
- Reduced satisfaction with leisure time availability
Outline

1. Data set and measures
2. Cross-sectional associations between commuting and wellbeing
3. Frequency of changes to commuting state
4. Effects of changing commuting state on personal wellbeing
   i. Short run
   ii. Long run
5. Take home messages
How does **starting a long duration commute** affect wellbeing over the longer term?
How does **starting a long duration commute** affect wellbeing over the longer term?

- State: Commute Duration > 45 mins
  - Ref: Commute Duration <=15 min
  - \(-0.20^{***}\)

- Switch: Short to long duration commute
  - T1: 0 - 12 months ago
  - \(+0.13^{*}\)

- Switch: Short to long duration commute
  - T2: 12-24 months ago
  - \(-0.06\)

- Switch: Short to long duration commute
  - T3: 24-36 months ago
  - \(+0.08\)

- **Leisure time avail.**

Sig level: 99%***, 95%**, 90%*
How does starting a long duration commute affect wellbeing over the longer term?

Implications

• Long duration commutes are linked to lower satisfaction with leisure time availability (in any period)

Dynamics

• The full negative effect of starting a long duration commute takes over 12 months to kick in
• It then stays the same…

![Graph showing the effect of long commute on satisfaction with leisure over time.](https://example.com/graph.png)
Take home messages

- commute state
  - satisfaction with leisure time
  - satisfaction with job
  - feeling strained
  - physical health

- life satisfaction
Take home messages: Findings

- Changing commute mode / duration does not (strongly) influence overall life satisfaction

- But there are influences on the sub-domains of wellbeing, e.g.:
  - Switches from driving to walking / cycling are linked to:
    - Increased sat. with leisure time availability
    - Reduced strain
    - Increased job satisfaction
    - Increased SR-health for cycling
  - Longer / lengthening commute durations are linked to:
    - Reduced satisfaction with leisure time availability (drive, bus, rail)
    - Increased strain (drive)
    - Reduced job satisfaction (drive)
  - Emerging evidence that the size of effect alters over the long run
Panel models offer valuable insights into how wellbeing alters in response to changing commute mode / time.

Informative to build understanding using a range of analytical approaches (cross-sectional, panel models).

There are limitations in how quantitative panel models can
  - represent complex long run effects
  - explain mechanisms

Further work

Do the commute duration / mode relationships vary by e.g. gender, age group, income distribution?

Feedback loops - Do people with low life satisfaction move home / job to improve their wellbeing?