Impacts of home-based telecommuting on vehicle-miles traveled: a nationwide time series analysis

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IMPACTS OF HOME-BASED TELECOMMUTING ON VEHICLE-MILES TRAVELED: A NATIONWIDE TIME SERIES ANALYSIS

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by Sangho Choo, Patricia L. Mokhtarian, and Ilan Salomon

EXECUTIVE SUMMARY

Study Background and Purpose

Teleworking is defined for this report as worki

Data Used in the Study

Ground VMT per capita: The first stage model has an adjusted R

Although conventional wisdom holds that vehicles themselves tend to induce vehicle travel, the number of vehicles variable was not found to be significant in our results. Similar to the lane-miles variable, the absence of this variable does not appear to be due to overly high correlations with included variables, but there could still be a subtle network of connections through correlations among number of vehicles per capita, employment, disposable income, and GDP. Based on the present results, it seems that if employment and disposable income are indirectly accounted for through the presence of GDP in the model, there is no residual effect of number of vehicles on VMT. However, here is a case where a more elaborate system of structural equations may be able to identify an effect that is not apparent in our single-equation model.

Recommendations

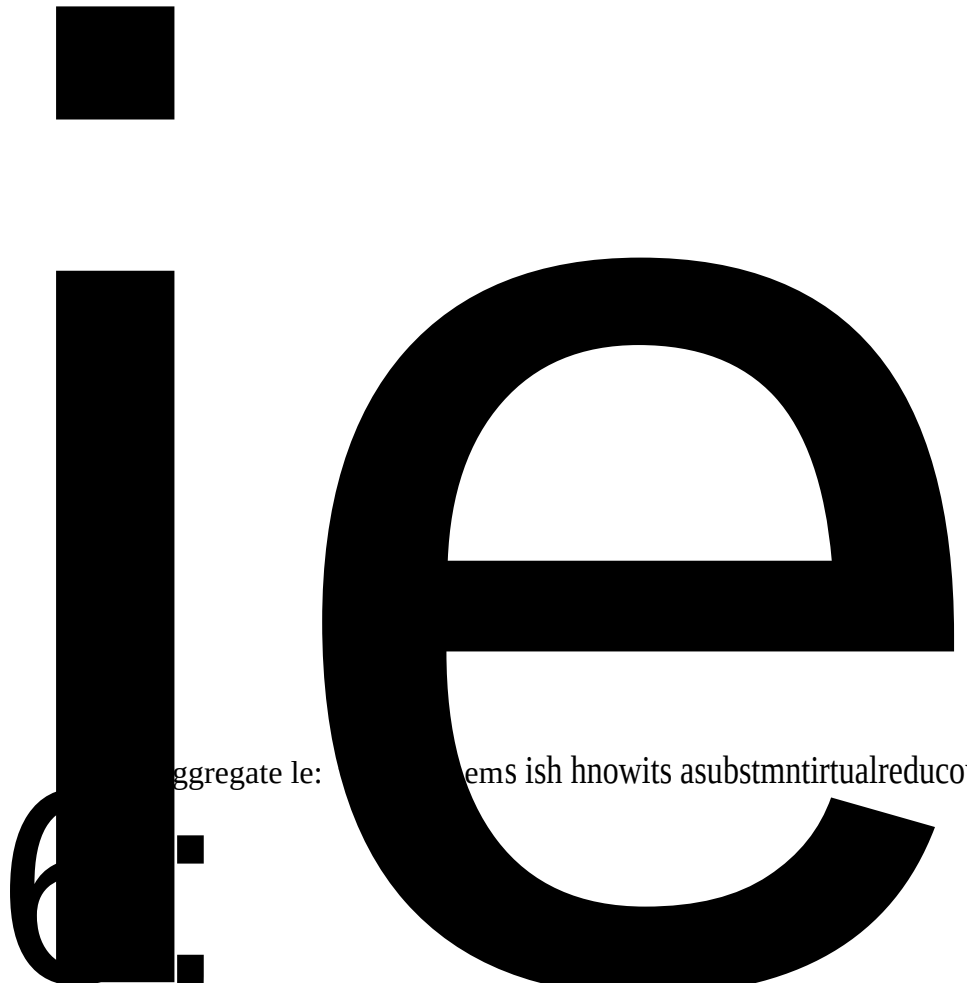
Given that telecommuting appears to have a statistically significant – albeit modest in magnitude – effect on reducing travel, several public policy recommendations suggest themselves.

2: Summary of Estimated Impact of Telecommuting on Miles Traveled in 1998 (using the 95% and 90% confidence for the estimated coefficient of telecommuting)

	Change in annual distance per capita (miles)	% change in annual distance per capita	Change in annual distance per telecom-muter (miles)	Change in distance per occasion (miles)

Center and Pentagon, or a major fire or flood) or the transportation system (weather emergencies, earthquakes, major construction projects).

All of these benefits are largely specu0ative; while anecdotal evidence for each of them is available, to our knowledge there has been virtually no rigorous empirical study of their extent at an aggregate level. This is true even for the putative transportation benefits, which have been the major (although not the exclusive) focus of public policy with respectis a537hcommuting. A number of small-scale empirical studies (Hamer *et al.*, 1991, 1992; Henderson *et al.*, 1996; Henderson and Mokhtarian, 1996; Koenig *et al.*, 1996; Mokhtarian, 1991, 1997, 1998; Mokhtarian and Varma, 1998, Mokhtarian *et al.*, 1995; Nilles, 1988; Pendyala *et al.*, 1991; RTA, istachot tshns



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is to provide some

immigration) and new ***licensed drivers***

and (2) as much more of the variance as possible is explai0ed using causal variables X

Table 1: Summary of Data Sources for Variables

Variable a	Source

Specifically, total VMT is annually reported by each state to the Federal Highway Administration. It is calculated by mu

Household Size

The Census Bureau publishes annual data on the num

4.3.1.1 Who is a Telecommuter?

The lack of a concise and universally-accepted definition of telecommuting has confounded research and policy-making since the 1970s. The use of inconsistent, unclear, or unsatisfactory definitions by different studies has resulted in a fundamental ambiguity with respect to the importance of the phenomenon. Very narrow definitions suggest that telecommuting may be of marginal value as a travel demand managem

- **What other criteria are applied?** Some surveys try to screen out inappropriate respondents (e.g., hom4makers or uncom

count of telecommu

One im

(Table 2 continued)

Data Source	Year	Count of Home Workers (millions)	Sample Size	Who Measured	Frequency Threshold	Nature of Arrange-ment	Form of Employment
FIND/SVP	1994	9.1	2,000 total households		at least one day/month		corporate (6.6M) and contract workers (2.6M)
FIND/SVP	1995	8.5	1,200 total households		at least one day/month		conventional employees (5.4M) and contract workers (3.1M)
FIND/SVP	1996	9.7					conventional employees (6.5M) and contract workers (3.2M)

FIND/SVP

Notes for Table 2

There are several concerns with the ma

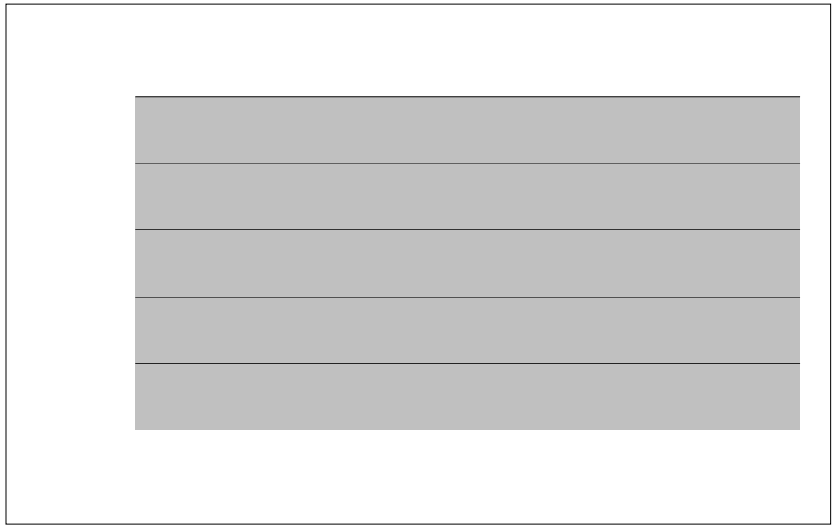
The estimated number of telecomm

To be included in the count for the marketing research studies, telecommu

4.4 Plots and Correlations of the Basic Data

Figure 1 plots the time series for each of the dependent and explanatory variables used in this study. It can be seen that, in their raw form, the variables under study have vastly different scales. For example, the percent of population living in suburban areas ranges only from 53 to 63%, whereas VMT ranges between 869 and 2,481 billVMT range/Ptween 8643 Tw 12 0 0 1259.882401 639.9

(Figure 1 continued)



(Figure 1 continued)

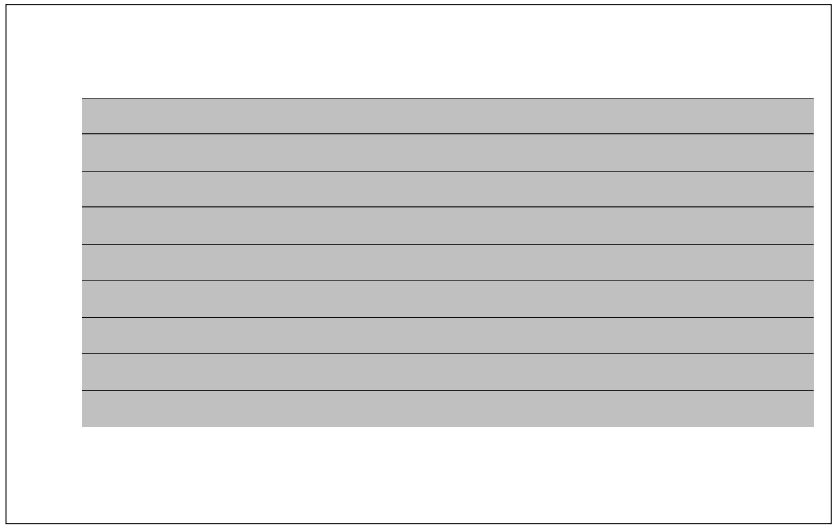


Table 3: Pairwise Correlation Coefficients (Raw Data)

Variables	VMT	Airline PMT	Total miles traveled

Table 4: Pairwise Correlation Coefficients (Differenced or Transformed Data)

Variables	VMT	Airline PMT	Total miles traveled	GDP per capita	Disposable income per capita	Employment per capita	Unemployment rate	Federal Interest Rate	Gasoline price	Miles per gallon	CPI (all)	CPI (transportation)	Population	Household size	Licensed drivers per capita	Number of pers

4.5 Factor Analysis

Table 4 makes it clear that the explanatory variables may be strongly correlated, not only with the dependent variables, but with each other. This was somewhat by design, in that several alternate indic

The four factors identified in Table 5 are quite ic

enced telecommuting series were not as strongly indicative of stationarity as they were for the log transform. Further, differencing the telecommuting series would have reduced the already small number of observations available for estimation from 11 to 10. We considered it preferable to preserve the additional degree of freedom, while maintaining a stronger basis for stationarity.

In m any cases the differenced series im mediately qualified as white noise, meaning that no further univariate modeling was necessary. In most of the remaining cases, modeling the differenced series as AR(1) achieved white noise, while in a few cases an AR(2) model was necessary. Table 8 lists each variable studied and the outcome of the univariate analyses.

Table 8: Univariate Time Series M12 40.9 12.27514.70 0 128 -0.0006 Tw 12 Uthe tel

Table 9: Multivariate Time Series Models for Vehicle Miles Traveled (VMT) (N = 33)

Model	Adjusted R	Explanatory variables			
		Constant	GDP per capita	Disposable income per capita	

Five models are presented with *VMT per capita* as the dependent variable. Alternative 1 is the counterpart td Alternative 1 for VMT only, but its goodness of fit is inferior. Alternatives 2 and

impacts of telecommu

average income

Table 11: Estimated [redacted]ecommuting on VMT in 1998 (using the 95% confidence interval for the estimated coefficient of telecomm[redacted]

Model	[redacted]ge in annual VMT [redacted]llions of miles)	% change in annual VMT	Change in annual VMT per telecommuter (miles)	Change in VMT per occasion (miles)

5.4.2 Second Stage Total Miles Traveled Models: The Impact of Telecommuting

Tabii49 presents the best stage 2 m odels for the two total miles traveled variabiis. In the f irst model, telecommuting is compii 12155.8405 667..n-m(6ificant (p-value = 0 186) aal 0 0 adjust. RP <</MCID

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Overview of Results

This study estimates the impact of home-based telecommuting on personal transportation through a multivariate time series analysis of

general, the worse the first-stage model is (i.e. the less variation in VMT that is explained by variables other than telecommuting), the m4271712 0 0 12 281.7944 re powexplained2by

The second explanatory variable that is intrigui

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