Labour supply and commuting

Eva Gutiérrez-i-Puigarnau *, Jos N. van Ommeren

VU University, FEWEB, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands

A B S T R A C T

We examine the effect of commuting distance on workers' labour supply patterns, distinguishing between weekly labour supply, number of workdays per week and daily labour supply. We account for endogeneity of distance by using employer-induced changes in distance. In Germany, distance has a slight positive effect on daily and weekly labour supply, but no effect on the number of workdays. The effect of distance on labour supply patterns is stronger for female workers, but it is still small.

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1. Introduction

This paper examines the effect of commuting distance on labour supply patterns, distinguishing between weekly labour supply, number of workdays per week and daily labour supply defined as the number of workhours per day. This distinction is essential in the context of commuting, because commuting distance travelled is a fixed cost for daily supply, but a variable cost for weekly supply through the chosen number of workdays. This issue has been mentioned in numerous theoretical papers (e.g. Cogan, 1981; Parry and Bento, 2001; Calthrop, 2001; Black et al., 2008).

One of the main issues we are concerned with is that distance may be endogenous with respect to labour supply. We employ an innovative approach where changes in distance are employer-induced, and therefore exogenous.[1] This is relevant because the literature emphasizes that it is not an easy task to find valid instruments for commuting distance, as it is related to labour and residence locations behaviour (Manning, 2003; Gubits, 2004).[2] As

emphasised in the literature study by Gibbons and Machin (2006), there is essentially no direct empirical evidence of the causal effect of commuting costs on labour supply. Most information we have about this relationship is indirect: most studies find that the commuters' value of travel time is rather low (about 50% of their wage), suggesting that the effect of the length of the commute on labour supply may be rather weak.

There are a number of reasons why the effect of (monetary and time) commuting costs on labour market behaviour and more specifically labour supply is of interest to economists (for a review see Gibbons and Machin, 2006). One reason is that policy makers aim to know whether congestion as well as (publicly-provided) transport infrastructure affects the decision of individuals with regard to how much time they spend on work (Hymel, 2009). A second reason is that it may help us to understand long-run developments in working patterns and commuting (Gin and Sonstelie, 1992; Van Ommeren and Rietveld, 2005). For example, an interesting question is whether century-long increases in (female) labour supply are due to the reduction in commuting costs, as a result of improvements in transportation technology and changes in residential location patterns (as suggested by Black et al., 2008).

A third reason is that there are divergent theoretical views on how to model the relationship between commuting costs and labour supply. These theoretical differences are in particular relevant because it appears that the optimal taxation of labour and commuting in the economy depends on the view taken. Some studies assume that the number of workdays is fixed and the number of workhours per day is freely chosen (e.g. Cogan, 1981), whereas in other studies, the opposite assumption is made (e.g. Parry and Bento, 2001; Calthrop, 2001). Given the latter assumption, revenues of

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* Corresponding author.
  E-mail addresses: egutierrez@feweb.vu.nl (E. Gutiérrez-i-Puigarnau), jommeren @feweb.vu.nl (J.N. van Ommeren).

[1] In our approach, we do not use information about whether firms move. By controlling for residence and job moves, we capture the effect of commuting distance changes induced by workplace relocations. This approach is also useful in other applications (e.g. job and residential mobility, Zax, 1991; wages, Manning, 2003). Van Ommeren and Gutiérrez-i-Puigarnau (2009) use the approach developed in the current paper in an absenteeism study.

[2] For example, due to the lack of instruments, Black et al. (2008) interpret their estimated relationship between female labour market participation and commuting as equilibrium correlations and stated that finding good instruments is a useful goal for future research.

road pricing must be used to reduce distortionary income taxes in order to increase welfare (Parry and Bento, 2001), but this is not necessary given the former assumption.

We believe it is fair to say that most economists think that higher commuting costs decrease labour supply (e.g. Bovenberg and Goulder, 1996; Mayeres and Proost, 2001; Parry and Bento, 2001), although most models allow for the possibility that commuting time has a positive effect on labour supply (Cogan, 1981; Parry and Bento, 2001; Black et al., 2008). For example, Black et al. (2008) argue that it is negative using a static labour supply model, but ambiguous using a dynamic one. In the context of the current paper, it is emphasised that increases in labour supply are a possible outcome when workers have the option to vary both the number of hours worked *per day* and the number of workdays. A positive effect is also possible when travel time costs vary over the day due to congestion and workers have the flexibility to choose their work start hour (see e.g. Vickrey, 1969; Arnott et al., 2005, p. 135). If workers with higher commuting costs arrive earlier at work and leave later from work in order to avoid congestion (or congestion charges), they simultaneously increase the number of hours worked (Arnott et al., 1993).

The next section discusses the theoretical setting of the paper. Section 3 introduces the identification strategy and the specification of the model; Section 4 provides information on the data employed and presents the empirical results; Section 5 concludes.

2. Theoretical setting

Our empirical study on the relationship between commuting behaviour and labour supply is closely related to the theoretical literature. Theoretical urban models essentially assume that the residence location is endogenous (e.g. Wales, 1978; White, 1988), whereas labour models assume that it is given (e.g. Gubits, 2004; Black et al., 2008). We will keep residence location constant in our empirical study, so we focus on the static labour supply literature (and also ignore transport mode choices).

One important issue is the choice of the period of time over which labour supply is measured. Cogan (1981) establishes that when fixed costs of employment are present (the main example is commuting), the period of time over which the fixed costs are incurred determines the ideal modelling choice of the period of time of labour supply. That is, if fixed costs are *per day*, such as commuting costs, and these daily costs are important, then the appropriate measure of labour supply is *daily* labour supply.[3] From this point of view, it is useful to assume that labour supply is optimally chosen *per day* (e.g. 7.7 h per day).[4] Given the additional assumption that workdays is fixed, labour supply models imply then, in general, that both daily and total labour supply decline with an increase in commuting *time*, but increase with an increase in *monetary* commuting costs (see e.g. Manning, 2003; Gubits, 2004).

This view is not undisputed though. Studies such as Parry and Bento (2001) and Calthrop (2001) make the opposite assumption that workers choose the *number of workdays per week* (e.g. 5 days), whereas daily hours are assumed to be fixed, so the commuting distance travelled per week is a variable cost. There is even a strict complementarity between the distance travelled per week and labour supply: workers may only adapt their commuting costs by adapting labour supply. It can then be shown that monetary and time commuting costs *decrease* number of workdays and therefore labour supply.

A priori, both views have some merit. In a working version of the current paper (Gutiérrez-i-Puigarnau and van Ommeren, 2009), we have combined both views in a labour supply model that allows workers to choose both *daily labour supply* and *number of workdays per week,* which determine total (weekly) labour supply (e.g. 40 h per week). Workers face time and monetary commuting costs that are both proportional to distance.[5] Non-labour income is given. Workers maximise utility derived from net income and leisure time, which are normal goods. The *daily* wage is increasing and concave in number of hours worked per day.[6] First-order conditions imply then that workers choose labour supply such that net income of working one additional day equals the wage of working one hour more per day times the loss of leisure time per day. Furthermore, they imply that non-labour income does *not directly* affect daily supply. This is a valuable result for the empirical analysis because it implies that non-labour income can be used as an instrument of weekly labour supply when one controls for weekly supply in a daily labour supply analysis.

We then obtain three conclusions on the labour supply effects of commuting distance.[7] First, *commuting distance increases daily supply*. This result is intuitive because workers have an incentive to reduce the number of workdays to avoid additional commuting costs, and then to increase daily supply to avoid a reduction in weekly income. Second, *the effect of distance on number of workdays as well as total labour supply is ambiguous*. The ambiguity arises because an increase in monetary costs has both an income and a substitution effect. Third, *conditional on total labour supply, commuting distance increases daily labour supply and decreases number of workdays*. The last conclusion is useful because it allows us to interpret behaviour of workers who may freely choose daily labour supply and number of workdays, but are not able to freely choose *total* labour supply. This is relevant because constraints on total labour supply set by employers, collective bargaining agreements, as well as by European Union labour laws, are quite common. One view may be that these constraints are only short-run restrictions for workers, but it is equally possible that many workers see these constraints as permanent, for example, because their occupation restricts them to work within certain collective bargaining agreements.

3. Identification strategy and specification of model

Our empirical study aims to investigate the causal effect of distance on labour supply, measured by weekly workhours, number of workdays and daily workhours. The worker's commuting distance is defined by the residence and the workplace location that are usually self chosen by the worker. However, quite regularly, the workplace location is changed by the employer so the distance change is employer-induced and therefore involuntary from the perspective of the worker. It has been estimated that about 7–8% of establishments relocate each year (Weltevreden et al., 2007). *We identify the effect of distance employing changes in commuting distance that are employer-induced through a change of workplace location.* In essence, we use within-workers' variation in distance and further control for all residence and job moves using fixed effects. Importantly, by controlling for job moves, we control for worker's *voluntary* workplace location changes, because it seems

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[3] There is little known about daily labour supply. The few studies known to us ignore commuting (Hamermesh, 1996; Costa, 2000).

[4] In most of the labour supply literature, it is not discussed explicitly whether labour supply is per day or per week, but since commuting costs are assumed to be *fixed*, labour supply must be per day, otherwise commuting cost would be a variable cost. We ignore issues such as teleworking.

[5] This assumption can be relaxed by assuming that commuting time and monetary costs increase with commuting distance, see for example, van Ommeren and Fosgerau (2009).

[6] This assumption is plausible when the worker becomes less productive the more hours she works.

[7] It is also possible to model the effects of commuting time and monetary costs as independent exogenous variables. Comparative static analysis entails then that an increase in commuting *time* increases daily labour supply, decreases the number of workdays, whereas it has an ambiguous effect on total labour supply. The effect of *monetary costs* on daily labour supply is positive, whereas it is ambiguous on number of workdays and total labour supply.