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Telecommuting, traffic congestion, and agglomeration: a general equilibrium model

Elena Safirova

Resources for the Future, 1616 P St. NW, Washington, DC 20036, USA

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Abstract

We develop a fully closed general equilibrium model of a monocentric city in which land is allocated to production, housing, and roads. CBD workers and telecommuters are imperfectly substitutable in production. CBD workers contribute to the CBD's agglomeration economies but cause traffic congestion in commuting. Telecommuters do not cause congestion and do not contribute to agglomeration. The effects of telecommuting on the urban economy and land use pattern are studied. The first-best optimal policy in the presence of agglomeration economies, congestion, and telecommuting is derived and its impacts are compared with the effects of different second-best policies.

JEL classification: C68; H23; O18; R13; R41

Keywords: Telecommuting; General equilibrium; Agglomeration economies; Congestion externality

1. Introduction

The idea of using telecommuting as a travel-reduction measure was introduced in the 70s by Nilles et al. [1]. The proponents of this innovative way of working have developed an extensive list of prospective benefits for economic agents and for the society as a whole.

E-mail address: safirova@rff.org.

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It has been forecast that telecommuters would save time as well as pecuniary costs of commuting and would improve family relations, while for the firms the arrangement of hiring telecommuters would increase productivity, decrease real estate costs and lower the turnover of the workforce. For the whole society, the new remote working arrangement was supposed to reduce traffic congestion and air pollution. Thus, apart from the social loneliness of the employees, which could probably be overcome by higher involvement in local community life, telecommuting looked like a win-win game for the workers, employers, and society (see Toffler [2]). Then, the speed of its adoption was expected to be restricted only by the cost of telecommunications and by the rate of employment growth in occupations compatible with telecommuting.

Since then telecommuting has taken off. According to different estimates, the number of employees who telecommute in the US is anywhere between 5 and 28.8 million people.[1] However, the level estimated by Nilles has never been reached [6,7]. Researchers from different fields contributed to the investigation of the hurdles that could have possibly slowed down the adoption process (see, e.g., Bernardino [8], Christensen [9], Bolin [10], and Westfall [11]). For instance, it has been suggested that for the workers the decision to telecommute could bring about lower chances of promotion compared to their commuting peers (Christensen [9] and Lewis [12]). In certain cases, workers experience worsening of family climate due to interference of work and family responsibilities (Hill et al. [13]). For the employers, telecommuting leads to agency problems and additional costs associated with telecommunication, while the increase in productivity is not documented well enough (Bolin [10] and Westfall [11]). Moreover, employers and employees often have diametrically different goals with respect to telecommuting. For example, managers prefer to employ as telecommuters workers with a longer tenure with the company, while those workers themselves often want to continue commuting. Agency problems arising from the necessity to monitor the remote work leads to the shift in the risk structure (Clark [14] and Westfall [15]).

At the same time, the benefits of remote work for society as a whole have never been considered in more detail, and the initial claims are taken for granted and even sometimes used by policymakers (see, e.g., Sampath et al. [16], Koenig et al. [17], and Oregon Department of Energy [18]). While the investigation of the effects that telecommuting can exert on society as a whole would require spatial analysis, only few attempts have been made to model the spatial impacts of telecommuting.

Lund and Mokhtarian [19] have developed a very simple partial equilibrium model which suggests that although telecommuting reduces the number of work trips, the long-term effects would probably include changes in residential location

[1] See, e.g., Handy and Mokhtarian [3], Korzeniowski [4], and ITAC [5]. The dispersion results from fragmentary data and discrepancies in the definitions of "telecommuting."