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Indirect benefits of infrastructure improvement in the case of an imperfect labor market

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ABSTRACT

We perform a welfare analysis of transport infrastructure improvements in the presence of an imperfect labor market, allowing for endogenous wages and involuntary unemployment. Efficiency wage setting is incorporated in a spatial two-region general equilibrium model, written as a welfare program. In our model, firms set wages above the market clearing level to create an inducement for employees not to shirk. The economy-wide effect (i.e. social welfare or total welfare) consists of the direct effect in transport market and the indirect effect in other markets. We conduct welfare analyses different from the conventional cost–benefit analysis, in which we distinguish between the direct welfare effect based on consumer surplus in the transport market and the indirect welfare effect through changes in regional unemployment, which is captured in the economy-wide effect. In our model, infrastructure improvement may increase unemployment in one region, but overall unemployment levels fall. The indirect welfare effects through decreases in overall unemployment are about 10–20% of the direct welfare effects for most plausible labor market parameters. The indirect welfare effects are larger, the poorer the initial transport infrastructure and the larger the labor market imperfections.

1. Introduction

Cost–benefit analysis (CBA) is a standard tool for the evaluation of infrastructure projects. The analysis usually starts with the effects of such projects on generalized costs in transport markets. These changes in costs lead to changes in transport demand. The pertaining welfare effects are measured by changes in consumer surplus based on the demand for transport. An important question is whether such an approach does not overlook effects of changes in transport costs on other markets. A starting point to this discussion has been given by Jara-Diaz (1986) who demonstrated that in the absence of market imperfections on all relevant markets, the change in consumer surplus on the transport market gives an adequate measurement of the change in total welfare.[1]

In recent years, there has been a growing interest in the question on the extent to which changes in consumer surplus measured in the transport market would underestimate (or overestimate) the actual welfare changes in the case of

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[1] This result does not mean that by focusing on demand for transport the other markets may be ignored. An appropriate analysis of demand for transport implies that adjustments in the other markets due to changes in transport costs are taken into account in the derivation of transport demand. Naive methods for the analysis of transport demand would lead to misleading results. Hence, the result that indirect effects in other markets may be ignored in welfare analysis only applies when the demand function has been appropriately derived.

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market imperfections. This is called the surplus equivalence problem by Jara-Diaz (1986). For example, the SACTRA (1999) report compares total welfare increases of infrastructure improvements with changes in consumer surplus and finds that the former is about 30% higher than the latter; this analysis is based on a monopolistic competition model dealing with regional trade. Newbery (1998) finds indirect welfare effects of 3–8% in the context of oligopolistic competition in a spatial price equilibrium model. Davies (1999) obtains an indirect welfare effect of about 12% in a partial oligopolistic model. Bröcker and Schneider (2002) arrive at indirect welfare effects of about 20% by a Computable General Equilibrium (CGE) model for European regions. Oosterhaven and Elhorst (2003) obtain indirect welfare effects ranging from 20% to 80% in a CGE model for Dutch regions. In a monopolistic competition model with localization economies, Venables (2007) finds increases ranging between 60% and 150%. Pilegaard and Fosgerau (2008) find the welfare gains from transport improvements in the case of labor market search imperfection typically exceed those computed by the standard CBA by 30–50%, where the magnitude depends on different assumptions and parameters. These figures indicate that there are substantial differences between the various studies depending on the nature of the imperfection and the type of model used.

The policy relevance of these studies is obvious. When market imperfections prevail, conventional CBA might underestimate total welfare change, this would lead to biases in decision-making on infrastructure projects or on infrastructure pricing. More in particular, when the gap between the two welfare measures would remain smaller than (say) 10% there would not be so much reason to worry, but for larger gaps there is a real risk that promising infrastructure plans would not be executed.

The studies presented thus far show that there are 'external benefits' from an infrastructure improvement, that is, the social benefits are different from the transport benefits due to the monopoly power on product markets and agglomeration economies. However, imperfections on labor markets have not received much attention in dealing with the surplus equivalence problem. One exception is the study by Pilegaard and Fosgerau (2008), which focuses on commuting behavior.

In this paper, we focus on transport infrastructure improvements that affect the transport costs of firms combined with labor market imperfections. In this context, transport infrastructure improvement affects the firms' demand for labor and therefore regional (un)employment levels. It is important here to distinguish between the effects on voluntarily and involuntary unemployment. Indirect welfare effects of infrastructure improvements may only arise through changes in *involuntary* unemployment, whereas these effects through changes in *voluntary* unemployment are absent.

Consider an economy where unemployment is involuntary and firms set wages and employment levels. In this case, firms will ignore the effect of their decisions on involuntary unemployment levels, so, at least according to theory, they set wages too high and employment levels too low. In other words, some workers are willing to work for a wage below the wage prevailing in the market. This is relevant for welfare analysis because it implies that transport projects might bring external benefits due to reductions in the *involuntary* unemployment level that are not captured in the demand function for transport.[2] We find that this is the case under several numerical examples and also under simplifying assumptions considered in the following section. The reason is that transport improves productivity of firms overall, which tends to increase employment levels in our model.

To understand the indirect welfare effects of transport improvements through changes in labor demand and therefore involuntary unemployment, it is important to realize that unemployment cannot be studied independently from wages. A large number of empirical studies have shown that there is a negative relationship between the (regional) real wage and the unemployment rate, usually called the wage curve (Blanchflower and Oswald, 1994). In the labor economics literature, there are nowadays two important groups of models for studying wage setting mechanism or deriving wage functions given the presence of unemployment (see, e.g. Pissarides, 1998). The first group is the efficiency wage or 'incentive wage' or shirking models, where the firms set the wage to induce workers not to shirk.[3] The second group is the wage bargaining models (Pissarides, 1985), where the wage is determined by bargaining between firms and employees (or unions). Both models have been widely used for studying unemployment issues in different contexts in the literature.[4] For example, Blanchflower and Oswald (1994) apply an efficiency wage model to explain the empirical regularity of a wage curve with an elasticity of around -0.1.

The main objective of this paper is to analyze and to distinguish between the direct and indirect welfare effects of a transport infrastructure improvement with labor market imperfections in a spatial (multi-regional) general equilibrium (SGE) model, because regional general equilibrium models provide a comprehensive framework for studying the regional effects of policies (see, e.g. Jones and Whalley, 1989). For this purpose, we develop a SGE model which includes an imperfect labor market with wage setting by firms and *involuntary* unemployment. To be specific, we employ a shirking model, introduced by Shapiro and Stiglitz (1984) in a general equilibrium framework, as the micro foundation of the efficiency wage model

[2] To be more precise, in the context of our model, infrastructure improvements will change regional levels of unemployment, as demand for labour will be affected. In fact, regional unemployment may go up, or down, but the *overall* level of unemployment will *decrease*. The latter statement is actually slightly stronger than we have been able to demonstrate formally. We are not able to show that this result holds in the two-region general equilibrium model (although it holds in all the numerical analyses). What is true is that in a more stylised model, we are able to show that overall unemployment will fall, see Section 2.

[3] The term efficiency wage can be best understood as implying that firms aim to compensate only labour input that is efficiently used to increase production.

[4] Wage bargaining models have been incorporated in general equilibrium models for studying labour taxation (see, e.g. Bovenberg et al., 2000). Efficiency wage models can be found in the literature for studying labour taxation, unemployment benefit and spatial agglomeration (see, e.g. Pisauro, 1991; Zenou, 2000).