What happens if we treat commuting as intermediate consumption?

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Introduction

Commuting is an important activity in the lives of many people. In the OECD countries, the average time spent commuting per workday ranges from 43 minutes (Australia) to 82 minutes (Japan). Most European countries are near the middle of this range, with average commuting times of 62 minutes in France, 65 minutes in Spain, and 66 minutes in Germany (OECD, n.d.). Commuting is also an important part of the economy – many jobs depend on the production of goods and services related to commuting, for example those of bus drivers and gas station employees. From an environmental point of view, however, the extent of commuting in modern economies is problematic. Commuting accounts for a significant share of total greenhouse gas emissions in all modern economies. For example, according Jackson et al. (2006), who study the carbon emissions associated with the consumption of private households in the United Kingdom, 7.9% of total emissions were related to commuting.

Our goal is to contribute to the study of commuting and the economic and ecological issues associated with it. We propose a modification to the official input-output table that allows us to identify the expenditure on commuting by product and by industry. The modified table can be used for many applications in the fields of ecological economics and regional studies. We present the current stage of work in progress. Since final results are not yet available, we outline a variety of results that can be expected.

GDP and welfare

Commuting expenditure is traditionally treated as final consumption by households. However, it is not quite clear if this is really a good approach. According to the official definition, GDP is calculated as follows:

$$Y = C + I + G + NX$$

GDP per capita is then often used as an indicator of economic welfare or well-being. This interpretation has been criticized by numerous authors for many reasons. One of them is the fact that C includes a variety of expenditures whose contribution to welfare is controversial. For example, it includes "defensive expenditure" which is spent for protection against crime, pollution, noise, and so on. To put it quite simple: If there is more crime, and people spend more money on guns and burglar alarms, GDP goes up.

Commuting expenditure, to some extent, is similar. Generally, workers do not spend money on gasoline because they enjoy driving. In fact, many of them probably hate driving to work and would strongly prefer to have workplaces closer to their homes. There is evidence that "people with long journeys to and from work are systematically worse off and report significantly lower subjective well-being" (Stutzer & Frey, 2008). National accounting, however, treats all consumption expenditure on gasoline and public transport as final consumption, similar to expenditure on recreational activities like theatre visits or restaurant dinners. Commuting time, however, is not necessarily leisure time. The European Court of Justice, for instance, has taken the view that, under certain conditions, "journeys made by workers […] between their homes and the first and last customer of the day constitute working time" (Court of Justice of the European Union, 2015). Therefore, one might call the current treatment of commuting expenditure into question.

Eisner (1988) discusses various instances of problems with the classification of certain expenditures as intermediate consumption or final consumption. With respect to commuting expenditures, he notes: "If these are paid directly by a business firm there will be intermediate product, included in the value of the "final" output of the firm. If firms pay their employees higher wages and let them pay their own travel cost, those expenditures will be counted as personal consumption and their value will enter independently into

gross national product in addition to the value of whatever output the firm is producing" (Eisner, 1988, p. 1614). He then proposes the construction of "extended accounts" (in addition to the established national accounts) to deal with such problems: "Extended accounts might move most expenses related to work from final product (generally consumption) to intermediate, regardless of who incurs them, and make corresponding reductions in national income" (Eisner, 1988, p. 1619).

Several attempts have been made to "adjust" GDP (or GNP) for the type of expenditure mentioned above. A well-known approach is the "Measure of Economic Welfare" (MEW) by Nordhaus and Tobin (1972). To construct the MEW, they "subtract output regarded as "regrettables and intermediate" […] These include costs of commuting to work […]" (Eisner, 1988, p. 1627). Zolotas (1981) also constructed a welfare index based on an adjustment of GNP. For 1977, he found that the private cost of commuting amounted to 7.2 percent of U.S. GNP. A more recent example is the work by Kubiszewski et al. (2013), who perform an adjustment of GDP based on a number of variables (Human Development Index, ecological footprint, biocapacity, Gini coefficient, life satisfaction, but not commuting)

The aforementioned literature shows there are good arguments for re-classifying commuting expenditure as intermediate consumption rather than final consumption. Conceptually, this is a rather simple operation. Empirically, all that is required is an estimate of total commuting expenditure. A simple subtraction then produces a sort of "GDP adjusted for commuting". However, in our view this approach does not do justice to the complex issues of commuting and its economic and ecological implications. One of these issues is the assignment of responsibility for emissions by industries and institutional agents, as outlined in the following.

Emissions and responsibility

Emissions are not (yet) recorded in the National Economic Accounts. However, many countries have set up satellite systems to measure the emissions of greenhouse gas emissions and other waste products. In these systems, emissions are generally assigned on the basis of producer responsibility. This means, for example, that carbon dioxide emissions resulting from the use of fossil fuels are assigned to the industry or sector that burns those fuels and the emissions that directly do the households for transport, heat, etc., are assigned to the families. Moreover, they are assigned to the country in which the fuels are burned.

Numerous authors have criticized this approach, arguing that those who burn the fuels should not be held responsible for the associated emissions. An alternative approach, based on consumer responsibility, has been developed (Munksgaard & Pedersen, 2001, Bastianoni et al., 2004, Peters, 2008, Peters & Hertwich, 2006, 2008). The idea is closely related to the "ecological footprint" of an economy (Minx et al., 2009, Turner et al., 2007). It is based on environmentally extended input-output models, which can be used to compute the carbon footprint that quantifies the total emissions, direct and indirect, associated with the final demand of different institutional agents (from a city, region or country to the tourists or different household types), and to simulate the effects of shifts in final demand on direct and indirect emissions (Kronenberg, 2009). For a country, the calculation of consumer responsibility relies on the development of multi-regional input-output (MRIO) models. With these models it is possible to include the emissions incorporated in the imports and exports of a country (Peters & Hertwich, 2008, Kanemoto et al., 2012).

The treatment of commuting as final consumption of intermediate consumption influences the assignment of the associated emissions, which are substantial. According to Druckman & Jackson (2009), approximately 37% of the emissions associated with private vehicle use and the consumption of transport services are

related to commuting. Therefore, the problem of assigning commuting expenditure must be discussed in order to interpret the results of consumption-based emission accounting. We would like to illustrate this with the following example.

On Monday, an economist takes his car to get from his home to the university and deliver a couple of lectures. The students enjoy the lecture (or maybe they don't) and pay their tuition fees. The economist gets his salary. Who is responsible for the emissions that the car driving has caused? The economist, because the laws of national economic accounting adopt the consumer responsibility view, and the gasoline consumption is treated as final consumption by households.

On Tuesday, the same economist calls the plumber to fix the heating in his home. The plumber takes his car to get from his home to the economist's house and fixes the problem. The economist enjoys a warm house, the plumber earns his income. Who is responsible for the emissions that the car driving has caused? From the consumer responsibility perspective, it is the economist again, because according to the laws of national economic accounting the gasoline consumption is treated as intermediate consumption by firms (the plumber) that serve the final demand of consumers. However, from a perspective of producer responsibility it would be the firm that supplies the plumbing service.

The adoption of a criterion for the assignment of responsibility permits the identification of the agents who are responsible for emissions and, moreover, the design of mitigation policies focusing, on the one hand, on the producers and, on the other hand, on consumers. An adequate emission accounting method would allow consumers to guide economic development and its impact on environment through their decisions, reducing their carbon footprint when they demand products (goods, services or energy) that are low in emissions (Muradian et al., 2002). Establishing a system of eco-labelling which enables consumers to identify goods and services with a lower carbon footprint might lead to more sustainable consumption decisions. (López et al., 2015).

An alternative approach

We propose to treat commuting as intermediate consumption. This has two advantages:

1. GDP is the sum of all final consumption expenditures. If we move commuting from final to intermediate consumption, GDP per capita becomes a better (or less bad) indicator of economic welfare.
2. If we treat commuting as intermediate consumption we get a better picture of the indirect emissions associated with the production of final goods. From a consumer responsibility view, the proposed changes imply that the environmental responsibility of households and workers who consume fossil fuels or transport services for commuting will be shifted to the households and workers who consume the goods and services produced by the workers who do the commuting.

We propose a three-step approach.

In the first step, we collect data to determine how much money households spend on commuting (gasoline, train tickets, etc.). The tricky part is to disentangle the amount spent on commuting from the amount spent on other purposes. For example, a household may spend 200 € per month on gasoline. Our job is then to determine how much of this amount was spent on commuting and how much on driving for other purposes.

Similar estimates have to be made for other transport-related expenditures (e.g. purchase and maintenance of vehicles).

In the second step, we extend the input-output table in order to show the commuting expenditure (estimated above) separately from the other expenditure. We divide final consumption by households into "commuting expenditure" and "other expenditure". This step already allows us the analysis of several interesting topics, for example the direct and indirect effects of commuting on employment, energy consumption, emissions and so on.

In the third step, we extend the interindustry transactions matrix with an additional row and an additional column. We move the commuting expenditure by final households from the final consumption quadrant into the new column labelled "commuting services". To maintain the accounting balances, we enter the "use of commuting services" into the corresponding row. In order to do this we need information on commuting by industry. In the environmental satellite account, this means that the emissions associated with commuting will be moved from the household sector to the new "commuting services" sector.

Expected results

At this point in time we are still in the early stages of the work. We expect that the analysis will produce interesting results with respect to the questions raised above. First, we will be able to say something about the direct and indirect greenhouse gas emissions associated with commuting as well as the number of jobs that depend on commuting expenditure. Second, when the modified IOT is finished, we will be able to study the emission intensity of different products and industries, taking into account that commuting patterns may differ across industries. Certain products that currently seem relatively "clean" may contain much higher embodied emissions if we consider the fact that workers who produce these products have consumed gasoline to get from their homes to their workplaces.

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