

# URBAN FREIGHT TRANSPORTATION AND THE QUANTIFIABLE CONSEQUENCES OF INEFFICIENT PLANNING ON URBAN SUSTAINABILITY

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## Contents

1. Introduction: Bringing Freight Transportation back into the Urban Sustainability Debate
  2. The Direct Impacts of Freight Transportation on Urban Settlements: The Focus on Externalities and Diseconomies
    - 2.1. Positive Externalities
    - 2.2. Negative Externalities
    - 2.3. The *Diseconomies* Related to Urban Freight Transportation
  3. Urban Freight Transportation and Urban Sustainability
  4. Case Study: Quantifying Diseconomies in the City of Petropolis, Brazil
    - 4.1. Fuel Consumption
    - 4.2. Emission of Pollutants
    - 4.3. Estimating Pollution Values
    - 4.4. Quantifying the Costs of Air Pollutant Emissions
  5. The “Monetarization of Externalities”: Policy Implications
  6. Conclusion
- Glossary  
Bibliography  
Biographical Sketches

## Summary

Through a study of externalities and diseconomies associated with urban freight transportation, this paper presents a first and rather limited economic evaluation of the importance of this kind of transport in the sustainability of urban settlements. We show here that despite its undeniable economic significance, urban freight transportation shows deleterious impacts in terms of pollution in cities. We conclude that closer attention needs to be given to the problem of improving the planning of freight transport

systems, since simply trying to reduce its presence contradicts the undeniable importance of delivery operations for urban commercial life.

## **1. Introduction: Bringing Freight Transportation Back into the Urban Sustainability Debate**

Challenges to economic development and urban well-being include allowing for an ever-increasing share of the population to commute in different directions, and be delivered the goods and services it needs on a daily basis, as well as promoting quality environmental living. Hence, the many patterns of transportation must be taken as a central concern of urban planning policies. They can be better understood as a piece in a coordinated mosaic of urban policies that reconcile both the practicalities of urban living with environmental policies, and, in this sense, direct us towards urban sustainability.

Studies have analyzed in detail the impacts of transportation on urban settlements. Yet seldom has the particular impacts of *urban freight transportation* been correlated to sustainability. Even rarer is the effort to quantify these impacts so as to describe a clear empirical picture. This paper intends to fill this gap by addressing the problems caused by urban freight transportation in a context of poor logistical and operational planning in urban settlements. We analyze them in economic terms—via a study of the externalities and diseconomies they engender. That is to say that both the deleterious effects generated by pollution (the externalities linked to freight transportation), and the economic losses associated with unnecessary and high fuel consumption (the diseconomies of this kind of transportation) will be evaluated more specifically in the model to be presented.

Hence, this study is concerned with measuring the impacts of urban freight transportation on the urban environment through a mathematical model that attributes values to pollution emission and fuel consumption. In order to do this, a careful study of the city of Petropolis, in Brazil, is used as the operational case study. Through the quantitative discussion of externalities and diseconomies we expose the relative importance of freight transportation in environmental outcomes. Since this correlation is shown as significant—albeit seldom discussed—the issue of planning urban freight transportation becomes central to the better functioning of life in cities. As modern life entails a significant increase in non-store purchases, it becomes clear that urban freight transportation will be intensified in the short to medium terms. Thus, we conclude that the management of the urban freight transportation issue is not merely one concerned with containment, but also requires effective planning, minding the difficulties already in place regarding traffic, and an emphasis on the absolute importance of efficient delivery of goods to the increasingly selective consumer in all sizes of cities.

The first section will deal with the general positive and negative impacts of freight transportation in urban settlements. The second section will explain the concepts of externalities and diseconomies as a key issue in analyzing, and mediating, the impacts of freight transportation on the urban environment. The third section will link the issues addressed to urban sustainability. In section four, the case study of the city of Petropolis will be described, along with the mathematical model created to guide this study.

Section five briefly links our approach to policy implications. Finally, we elaborate our conclusions in the last section.

## **2. The Direct Impacts of Freight Transportation on Urban Settlements: The Focus on Externalities and Diseconomies**

The transportation sector is among those that have kept a negative record in environmental degradation in large urban settlements, given the rapid growth in the number of cars and trucks in cities and the use of gasoline to operate them. Because of that, urban planning has been concerned with mediating the detrimental effects of transportation on urban living, primarily by trying to reduce transportation operations in cities. Here, we suggest that one way to understand in concrete terms the impact of transportation on the urban environment is to use the concept of externalities as a tool to qualify and quantify this impact, as well as to better plan mediating strategies to the problem.

In referring to transportation, we do not only mean the car, but especially the truck—often neglected in this kind of analysis. Together cars and trucks, shape the life of, and make for traffic patterns in, urban settlements. It is not only the flow of people driving their cars and riding on buses which create traffic jams and produce pollution, but overwhelmingly it is the flows of trucks making trips to and from distribution centers and warehouses, bringing to cities the goods people demand, and in this sense making life in cities both more attractive and more chaotic.

The term “externalities” refers either to costs or benefits generated outside the economic process which affect that process or to the costs and benefits generated inside the economic process which affect its environment (that are not actually paid for or enjoyed by people). More specifically, the externalities generated by freight transportation are related to the external feature of costs; when a given transportation mode is used, it incurs direct costs through its operation (such as fuel consumption, and trip time) that are called *internal costs* to be paid by those in charge of the operation. But there are also costs that are not paid by the user of the vehicle and that, hence, are not even normally taken into account when planning the delivery/pick up operation. Those are external costs, such as air pollution, and the impacts of vehicle utilization on urban traffic. These external costs are imposed on third parties or on the society as a whole. More generally these costs or externalities are unintended by-products of the transport activity itself and are costs that have to be met at some time in the future. By ignoring external costs the user of the transportation system tends to consume more transportation and roads, than what would be economically efficient. This leads to a reduction of the social efficiency of the transportation system as a whole. Given the importance of external costs, it becomes essential to describe the main positive and negative externalities linked to urban freight transportation. These are discussed below.

### **2.1. Positive Externalities**

Urban freight transportation is responsible for guaranteeing the dynamism of the urban economy with the delivery of supplies and services that are the backbone of commercial activity, especially international trade. An efficient freight transportation system, thus, is

crucial to ensure the competitiveness of a given region by its insertion not only in the national, but also in the international economy—an increasingly important feature in the current context of the economic interdependence known as globalization.

In addition, from a managerial perspective, urban freight transport plays an important role in every supply chain system. The viability of adopting industrial policies that foster international and local trade is determined, to a great extent, by urban freight distribution. Among the many technological, commercial, and industrial innovations that have been implemented in businesses in recent years *just in time systems* are of great significance. *Just in time* stands for small shipments to be made more frequently and to meet the precise time requirements of the customer. This new managerial tool of many efficient businesses can only be implemented if an efficient freight transportation system is in place.

## 2.2. Negative Externalities

Traffic jams are often worsened by the presence of heavy trucks on the roads. In addition, the problem of parking in busy streets is also exacerbated by freight vehicles, which can also make it more difficult for passenger vehicles to move. Along with that, common consequences of road traffic, especially concerning freight vehicles, are air and noise pollution, greater use of fuel (the lower the travel speed because of traffic congestion, the more the unnecessary consumption of fuel), and delays in the delivery of goods in and out of cities. These are not simple inconveniences of urban life, since air pollution is a threat to human health.

The most infamous pollutant, carbon monoxide (CO), is produced from the incomplete combustion of fuel. It impacts humans negatively by reducing the absorption of oxygen by hemoglobin, and impairing perception, thinking, and reflexes. Also, it induces angina, and causes drowsiness, which can lead to unconsciousness. Combined with other gases, it can also be fatal. CO inhalation is associated, furthermore, with lower worker productivity and general discomfort. Other pollutants such as nitrogen oxides (NO)—also a result of fuel combustion—are irritants to the lungs; likewise sulfur dioxide (SO<sub>2</sub>) which, once carried to the lungs, forms sulfuric acid. These negative externalities, in particular those associated with pollutant emissions and fuel consumption, are the central concern of this study.

## 2.3. The *Diseconomies* Related to Urban Freight Transportation

The term “diseconomies” can be defined as the economic principle that underlies the study of externalities and represents the generated costs of a given economic process, usually associated to public welfare, that are not covered or compensated for and may lead to the inefficient use of public goods. Such an approach can be used in a framework of urban development that aims at understanding patterns of land occupation, physical distribution of economic activities, and its relationship with the demand for transportation, while simultaneously considering that the transport system must include not only its effectiveness in meeting actual traffic demands, but also its impacts on the location of activities which gives rise to those demands. More specifically, the “diseconomies approach” can involve gathering and analyzing cost data

for periods of heavy traffic, traffic performance indicators, as well as consumption and emission of pollutants.

In this contribution we focus only on the issue of fuel consumption and the nature of pollutant emissions. It is worth noting that the values attributed to the coefficients for environmental impact used in this analysis refer solely to pollution produced. We associate monetary value to estimates of environmental degradation as an effort to ground an analysis of the latter in a concrete framework of diseconomies of scale that allow for a better definition of the problems at hand and a more effective tool for the design of effective solutions.

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