



Physical Infrastructure and Logistics from the Perspective of Transaction Cost Economics¹

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Abstract: In this article, the importance of physical infrastructure for reducing transaction costs and the use of transaction cost economics for analysing logistic chains is discussed. Transaction cost analysis facilitates the identification of frictions in the logistic chain, which is not only useful for improving its efficiency, but also to manage potential crises in these logistic chains.

Keywords: physical infrastructure, logistics, transaction costs, governance, supply chain

1. Introduction

Transaction cost theory has been applied to the question why firms exist (see Coase, 1937; Williamson, 1985). However, as companies tend to function more and more in networks (Castells, 1996), while logistic chains tend to lengthen and become more complex, a broader application of transaction cost theory may be required. While Information technology is an instrument in reducing transaction costs, the role of physical infrastructure itself should not be underestimated. The aim of the article is to show the importance of physical infrastructure for reducing transaction costs and the use of transaction cost economics for analysing logistic chains. First, the notion of transaction costs is elaborated. Then, the relation between physical

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infrastructure and the level of transaction costs is discussed. Finally, the usefulness of transaction costs is explained on the example of the logistic chain.

2. Transaction costs

Transaction costs theory, developed by economists such as Nobel Prize winners Ronald Coase (1937) and Oliver Williamson (1985), has been useful in explaining why the firm exists, something which was not possible using standard neo-classical economics assuming perfect frictionless markets (Furubotn and Richter, 1997). Transaction costs analysis facilitates the identification of the optimal organization structure, as well as decisions on “buy or make.”

Transaction cost economics is strictly related to the notion of governance, which is a broader concept than organisation. In the economic context, governance concerns different types of organisational structures (which range from markets to different forms of hierarchies and networks) involved in any kind of economic activity (see Platje, 2011). Governance structures are a way to support cooperation and reduce any kind of conflict (Williamson, 1985, 37), determined by the level of transaction costs. Transaction costs is a heuristic device analysing how easy or difficult it is to make any type of exchange, which basically exist due to the measurement and information problems appearing due to the heterogeneity of goods (Barzel, 1989) while people are fallible, have limited cognitive abilities and tend to behave opportunistically (they lie and cheat) (Furubotn and Richter, 1997; Molho, 1997).

For the question whether to produce within the company or contract via the market (i.e., decisions on “make or buy”, or which governance structure if most effective and efficient in achieving the desired goal), a distinction should be made between market and managerial transaction costs. The different types of transaction costs are presented in Table 1. Managerial transaction costs concern the information, negotiation and control costs (monitoring and enforcement costs) of organizing production within a company, while market transaction costs embrace this type of costs regarding contracting through the market. Often, transaction costs focus on the physical transfer of economic goods and services, as follows from Williamson’s (1985: 1) definition that transaction costs appear “when a good or service is transferred across a technologically separable interface. One stage of activity terminates, and another begins”.

However, a broader approach should be applied, as transactions include the transfer of many types of rights (Commons, 1934), while a property right itself consists of different characteristics (e.g., use rights, management rights, alienation rights (Honoré, 1961)) which may be transferred separately, and be owned, managed and used by different economic actors. This issue is relevant for the analysis of logistic chains and networks where many partners participate and tasks are outsourced and contracted to a wide range of organizational structures.

As is shown in Table 1, a distinction can be made between fixed and variable transaction costs. While the fixed transaction costs embrace the costs of creating, maintaining and changing structures of governance, variable transaction costs focus on the functioning and use of markets or hierarchical structures such as a company. It seems often to be assumed implicitly, in particular in neo-classical economic theory, that markets are a kind of free good, which functioning is accessible to anyone without a cost. The non-excludability and non-rivalry in use would make it a pure public good. However, as has been emphasized in literature (e.g., North, 1990; Castells, 1996; Cornes and Sandler, 1996; Sandler, 2001), institutions (formal rules of the game), institutions (formal rules of the game) and different forms of government administration, non-governmental mechanisms, but also social capital are elementary for the functioning of markets. A legal and administrative framework may be able only to deal with a certain number of transactions. However, as there are capacity problems and technological development leads to new types of goods accompanied with the need for different legal approaches and new transaction costs, existing market institutions may not only show rivalry in use (capacity problem), but may also depreciate (see Pejovich, 1995; Sandler, 2001; Platje, 2011). Therefore, maintenance of market institutions may be required, which is related to theories of institutional change, as otherwise long-term effects on economic performance may be negative. A similar line of reasoning applies to fixed managerial transaction costs, which is related to managerial and organizational theory.

Table 1. Different types of transaction costs – definitions and some examples

Type of transaction cost	Market transaction costs	Managerial transaction costs
Fixed transaction costs	“The costs of setting-up, maintaining or changing an organisational design” (Furubotn and Richter, 1997: 46). Related to the adaptive efficiency of governance structures, i.e., the ability to change when this is required by changing external circumstances, such as technology, competition and increased scarcity of resources.	
Variable transaction costs	Costs related to frictions in the functioning and use of the market mechanism.	Costs related to frictions in organising production within the company.
Information costs (search costs)	Searching for buyers and sellers. Information about culture, reliability, etc. of trade partners. Information on existence, interpretation and means of enforcement of laws and regulations. What is written in a contract and what is meant by it? Information on the quality of a product or service.	Collecting and processing information for decision-making on e.g. production plans and technologies.
Negotiation costs	Negotiation between and within organisations to establish contractual arrangements. Costs of red tape.	Bargaining between different departments on e.g. organisation of work, production plans, etc. Dealing with internal bureaucracy, paperwork, etc.
Control costs (monitoring and enforcement)	Check whether the contract partner fulfils the contractual requirements, e.g., quality of product / service produced, payment, etc. Protection against theft. Costs of obtaining damages for non-fulfilment of the contract (e.g. court, bailiff).	Costs of monitoring the execution of orders and motivating employees.

Source: adapted from Platje, 2011, 39-40, based on Furubotn and Richter, 1997 and Platje, 2004.

The existence of transaction costs creates opportunities for so-called opportunistic behaviour or rent-seeking, finding its expression in the problems of adverse selection (Akerlof, 1970) and moral hazard. High transaction costs create room for lying and cheating due to the possibility of unobserved behaviour (Molho, 1997). When the problem of lying and cheating becomes too large in a market (i.e., market transaction costs are high), this may be an argument for organizing production within a firm (Williamson, 1985). In particular so-called transaction-specific investments (asset specificity, specialized human capital, location, brand names, logistics processes, etc.) create the need for producing within a hierarchic structure (e.g., different forms of private companies, government bureaucracies, state enterprises, networks of enterprises) (Williamson, 1998, 36, 38). When a specific purpose technology is used for a certain logistic

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process, the dependency on this technology makes it often impossible to find a substitute on the market, providing incentives for a supplier to behave opportunistically (e.g., increasing prices and obtain monopoly rents). The moment that technology is generally applicable, and other suppliers can be easily found, outsourcing and subcontracting becomes an option. However, as Williamson (1985, 1998) emphasizes, a weak point of organization of production within a hierarchic structure is that there is no market competition, and indirect incentives for efficiency should be provided. On the other hand, when using a wide network of companies in a logistic chain with dispersed owners, it may become more difficult to establish responsibility for, for example, the quality of the final product, while external enforcement mechanisms (e.g., courts) have to be used more often.

Equation (1) (Platje, 2011) shows the basic idea behind transaction costs theory regarding the existence of the firm. When the sum of production costs and managerial transaction costs are smaller than the sum of the market price, the market transaction costs and transport costs, production within the company is more attractive (and the other way round). While this approach is very useful, it may be difficult to assess many types of transaction costs like expected loss related to lack of punctuality of supply.

$$(1) C_{\text{prod}} + TC_{\text{management}} < P_{\text{market}} + TC_{\text{market}} + C_{\text{transport}}$$

Where:

C_{prod} = production cost

$TC_{\text{management}}$ = managerial transaction costs

P_{market} = market price of the product

TC_{market} = market transaction costs

$C_{\text{transport}}$ = transport costs

3. Physical infrastructure, transport and logistics²

Transport (“carrying passengers or goods from one place to another (Longman, 1995, 1538)”) and infrastructure are important for the functioning of markets, and as such a determinant of economic development (Smith, 1998 (1776)). Developed transport infrastructure not only supports competition on markets, but also support the reduction of transaction costs (see Boehme et al., 1998; Aghion and Schankerman, 1999). With Telecommunication and ICT the effects are more directly visible, as they significantly reduce information costs, which not only facilitates the finding of new contract partners, but also the creation of new governance structures in the logistic chain. Logistics heavily relies on transport, production, distributional and informational infrastructure (roads, railroads, reloading stations, warehouses, information systems and telecommunication systems). In the context of the logistic chain, it is an important instrument on supporting the efficiency of production and flow of goods from the raw material producer, via producers of intermediate and final products to the final consumer. Logistics embraces “... the process of planning, co-ordination and control of flows of (raw) materials, activities connected with their storage, activities connected with the handling of goods, packaging, warehousing and the flow of final goods and the information connected with them from the point of production to the final consumer – with the aim of lowering total costs, while keeping a sufficient level of consumer service (Rydzkowski and Wojewódzka, 1997, 296, based on the definition of the Council of Logistic Management, Oakbrook, USA, 1985).”

An example of a logistic chain in the form of an industrial column is presented in Table 2. Traditionally, three flows are identified – goods, information and money. The use of transaction costs economics is most clear regarding the flows of information, as here the aim is to reduce the costs of access to, processing, use, etc., of information. This flow embraces pre-contractual information search as well as monitoring of the fulfilment of agreements. The flow of money is in two ways related to transaction costs. First of all, as is explained in standard economic theory (see Begg et al., 1994), the use of money is related to reduction of the transaction of barter trade (goods for goods). Furthermore, the accounting function of money makes it possible to compare prices (reducing market transaction costs) and develop, e.g., financial accounting which makes measurement and as a consequence management of the value of processes in the logistic chain

² This section is based on Platje, 2004.

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easier. On the other hand, post-contractual opportunistic behaviour (cheating) accompanies money as a mean of payment for goods and services. In particular when using different kinds of credits or when customers do not have to pay immediately, monitoring and enforcement costs related to late payment or lack of payment appear. Insurance and other instruments are in fact transaction costs of reducing the risk of non-fulfilment of the payment obligations. The development of logistics services in this field has the aim to reduce the transaction costs in the form of safeguards against potential opportunistic behaviour related with imperfect information as well as monetary flows.

Table 2 An industrial column

Supplier	Flow of goods	Flow of information	Flow of money
  (Raw materials and intermediate products)			
Producer			
 (Intermediate products)  (Final products)			
Central warehouse			
			
Wholesaler			
			
Retail trader			
 Consumer			

Source: van Goor et al., 1998: 7.

On first sight, the flow of goods only concerns transport costs. However, the information flows accompanying the process of transport create transaction costs. Furthermore, also

production costs are important in this flow, at least from the production of raw materials to the production of final goods. The logistic chain involves managerial transaction costs (related to production within a company) and market transaction costs when services and products are traded between companies. The problem of analysing transaction costs and finding opportunities for lowering these costs is, similar to other analyses of the logistic chain, that they should be dealt with from the point of view of the whole system. The basic idea is that logistics is an instrument lowering the marginal transaction costs (the transaction costs of undertaking extra activity) within the whole logistic chain. However, logistics is also a mean to improve the flow of goods and reduce transport and production costs. At this moment, it may be necessary to bear, for example, extra costs for improving the information flow. A similar relation may exist between factually incurred transaction costs and reduced costs in production processes. Such an investment is cost efficient as long as the (marginal) transaction costs incurred are smaller than the reduction in (marginal) transport or (marginal) production costs. A problem is that costs may be incurred in different companies than where the benefits may be obtained. For this reason, a developed market of logistics services with low negotiation and control costs is an important determinant of the opportunities for optimal use of logistics services.

The moment the final product leaves the central warehouse, the distribution to the final consumer concern to a large extent transaction costs. For example, wholesalers (towards the retail trader) and retail traders (towards consumers) have an intermediary function reducing the transaction costs for the buyers. This function is similar to a local market, where local suppliers present the goods from different producers to the consumers, who do not have to spend so much time and money on searching for different goods. An interesting example is competing firms, such as shoe retailers or clothing retailers, which can be found close to each other, as they sell products for which comparison of the product and finding the good that fits best (due to personal differences, tastes, fashion, etc.) may be important for many customers. This logic can also explain why large shopping malls contain a wide range of different stores, and many shops are concentrated in different areas or streets of towns and cities. However, storage of goods is required in order to display a wide range of products for the customer. Thus, storage or warehousing is to a certain extent a transaction cost which on the one hand reduces the information costs for the seller of predicting short-term changes in demand, while reducing the search costs for the buyer.

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The transformation as well as production of form, place and time provided by wholesalers and retail traders is, from the perspective of logistics, an instrument in creating value added (Van Goor et al., 1998: 8). The value added is created through transport (related to transport costs), production (related to production costs) and services facilitating transactions (related to transaction costs). While the distinction between the types of costs is irrelevant for the profitability of an economic unit, it is a useful instrument in cost accounting and analysis and management of costs. It is a helpful instrument identifying the type of potential problems appearing in different parts of the logistic chain, and with which type of product and / or services these problems are related. In general, place transformation creates transport costs. Time transformation is achieved by storage of goods. As was discussed above, this involves transaction costs related to uncertainties in delivery, uncertainties in consumer demand as well as storage of goods which are bought during certain periods (e.g., Christmas trees). However, storage of goods such as wine, cheese and certain types of meat until they are ready for consumption are costs of production.

The moment that logistic solutions lead to a decrease in transaction costs, this, other things equal, leads to more transactions (Platje, 2004). The increase in the number of transaction may in turn lead to higher marginal transaction costs, as the existing system is only able to deal with a certain number of transactions efficiently (see Pejovich, 1995). This capacity problem may be solved by introducing more advanced logistic solutions, such as Automatic Equipment Identification (AEI), Global Positioning Systems (GPS), Intelligent Transport Systems (ITS), Electronic Data Interchange (EDI) and telecommunication equipment. However, the use of new advanced logistics solutions may require a change in governance structure. Firms tend to become more interconnected through the use of logistic solution, which as a consequence may lead to more difficulties with the identification of particular owners. This, in turn, may create room for opportunistic behaviour, which is related to increased control costs (e.g., monitoring, safeguards).

Regarding the reduction of information costs, there are three different types of development (OECD, 1996: 10): lower costs of acquiring information and increase the quality of information, standardization of information collection and processing and the use of information technology in order to create new governance structures. Access to proper information is elementary for the management and operation of companies and their logistics processes. AEI, GPS and certain components of ITS for tracking and tracing are instrumental in this. The access

to good quality information is related to the second direction – the standardization of the collection and processing of data which are instrumental in reducing information asymmetries and mistakes. Systems such as EDI, “the inter-organisational, computer-to-computer exchange of business information through some standard machine-processable format (OECD, 1996, 93),” reduce storage costs and mistakes leading to unexpected lack of products for sales, in turn leading to dissatisfied customers. Direct access to information for management at different levels of a company reduces the opportunities for manipulation, which in turn reduce the need for control. The first two directions are strongly rely on the use of information technology. This creates the basis for the third direction of development – the creation of different types of logistic networks and expansion of the logistic chain (i.e., the development of new governance structures). Information technology by its transaction cost reducing function increases the opportunities for the use of market solutions as well as the reduction of the need for hierarchical organization company structures. As a consequence, the principle agent problem is reduced (OECD, 1996: 11; Furubotn and Richter, 1997). However, these advantages are reduced by the earlier mentioned increasing problems with identifying ownership in the increasing complex logistic networks.

4. Concluding remarks

The aim of this article was to show the importance of physical infrastructure for reducing transaction costs and the use of transaction cost economics for analysing logistic chains. While the notion of transaction costs is very useful in order to identify any types of frictions in a system, and to anticipate potential consequences, in reality they are difficult to measure (Furubotn and Richter, 1997). This measurement problem may easily lead to a neglect of certain types of transaction costs, as a profit oriented company may easily neglect potential threats which are difficult to measure, in particular when they are long-term. However, in times of a crisis the incentive to lie and cheat may increase, and in turn the related transaction costs are likely to increase, which may easily lead to a deepening of the crisis. When in times of prosperity transaction costs are identified, this may in fact become an important instrument in crisis management in the logistic chain.

Basically, reduced transaction costs in the logistic chain should lead to an increase in competitiveness and a better functioning of markets. For the individual company, a reduction in transaction cost may lead to a competitive advantage over other companies. In particular, when possessing specific human capital and knowledge as well as devices (related to Information Technology) and organizational structures, there may be economies of scale in information gathering and processing. However, this may lead to asymmetric improvement of access to information, and a comparative advantage for larger players. The effect on competition depends then on the number of players and their possibilities for collusion. Furthermore, network enterprises may develop, which create different barriers to entry for potential competitors, but also for potential new trade partners. Low transaction costs between partners in such a network may be a consequence of the development of process-based trust between trade partners interacting repeatedly with each other. Following Raiser (1997), this may not only to increased interconnectedness of companies, but also create a kind of group which may be resistant to new partners with innovative ideas. This implies that transaction cost reducing instruments, devices and policies should be considered in the context of incentives for development and innovation provided by the organizational structure, as otherwise the reduction in transaction costs may undermine its long-term sustainability.

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Infrastruktura fizyczna i logistyka z perspektywy ekonomii kosztów transakcyjnych

Streszczenie

W niniejszym artykule omówiono znaczenie infrastruktury fizycznej dla ograniczania kosztów transakcyjnych, a także rolę, jaką ekonomia kosztów transakcyjnych odgrywa z punktu widzenia analizy łańcucha logistycznego. Analiza kosztów transakcyjnych ułatwia identyfikację problemów w łańcuchu logistycznym, co jest użyteczne nie tylko dla poprawy jego efektywności, ale również zarządzania potencjalnymi kryzysami, które mogą w nim wystąpić.

Słowa kluczowe: infrastruktura fizyczna, logistyka, koszty transakcyjne, współrzędzenie, łańcuch logistyczny