Summary

Introduction

This thesis is concerned with the organization of transactions. A transaction occurs when a good or service is transferred across a technologically separable interface, which is when one stage of activity terminates and another begins. There are different structural forms that can be used for organizing transactions. For example, both stages of activity that a transaction connects can be brought together within a single firm, in which case the firm’s hierarchy is used to organize the transaction. Alternatively, the two stages can be distributed across different, specialized firms, in which case the market is used to organize the transaction. In more familiar terms, a firm has to decide between outsourcing and insourcing activities, i.e., between buying components on the market and producing them internally.

Chapter 1 describes the theoretical background for the research. Transaction cost economics (TCE) is often used to analyze the issue of make or buy, but many other questions of organizing as well. This theory originated in the paper The Nature of the Firm by Coase (1937) and was subsequently developed, among others, by Williamson (1975, 1985). Coase (1937, p. 390) wondered “why a firm emerges at all in a specialised exchange economy”, and “why co-ordination is the work of the price mechanism in one case and of the entrepreneur in another” (1937, p. 389). According to Coase and transaction cost economics in general, the firm should not be studied in isolation as a production function to
be optimized, but the transaction should be made the basic unit of analysis and the firm should be seen as one of several alternative ways to organize transactions. Costs are associated with transactions that vary with the characteristics of the transaction. Because organizational forms are differentially able to economize on those costs, different organizational forms are more suited for organizing transactions with particular characteristics than for others.

Transaction cost economics is about finding the most appropriate—i.e., the economic—organizational form given the characteristics of a transaction. The relevant characteristics are the frequency of the transaction, the uncertainty surrounding it and the transactionspecificity of the assets invested in it. In its search for optimal, economic organizational forms, TCE assumes that people are boundedly rational as well as potentially opportunistic. The first assumption means that people are unable to gather as well as process all the information required to make optimal decisions. The second means that people do not simply seek self-interest, but that they may do so with guile, including "calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse" (Williamson 1985, p. 47), and that differential trustworthiness is hard, if not impossible to predict.

**Motivation**

There are two main points on which we disagree with transaction cost economics. The first is that it hypothesizes that the optimal structural forms that result from its analysis are also the ones that are used for organizing transactions in reality, while the agents doing the organizing are explicitly assumed to be unable to perform the alignment of organizational forms with attributes of transactions. This issue is taken up in the second chapter. Our second point of disagreement with TCE is that the market is suggested as an alternative form to be used for organizing transactions, while in fact, a market has to be made before it can be used. The choice between make or buy is more appropriately framed as one among several alternative sources of supply, one of which is internal
to the firm and some of which are external. There will be more information available about some alternatives than about others. This connects to TCE's view on opportunism which is based on the assumption "that some individuals are opportunistic some of the time and that differential trustworthiness is rarely transparent \textit{ex ante}" (Williamson 1985, p. 64). In TCE, since it is hard to tell who will be opportunistic when, opportunism is always considered possible, and measures to counter its effects are always considered necessary.

The picture can be made clearer by introducing the distinction between room for and inclination towards opportunism (Nootenboom 1999b) and by considering that actual opportunism is a function of the two. TCE does not consider inclination towards opportunism, because “[i]nasmuch as a great deal of information about trustworthiness or its absence that is generated during the course of bilateral trading is essentially private information (…) knowledge about behavioral uncertainties is very uneven. The organization of economic activity is even more complicated as a result” (Williamson 1985, p. 59). In this thesis, however, the suggested increase in the complication of the organization of economic activity is not admitted as a justification for not addressing the relevant information about trustworthiness or its absence. Instead, individual agents are modeled, including their private information that they generate during the course of their bilateral exchanges with other individual agents.

\textbf{Chapter 2} takes up our other point of disagreement with transaction cost economics, that it hypothesizes outcomes consistent with a rational analysis that the agents involved are assumed to be unable to carry out. This is not to say that those outcomes can not occur, because the agents may stumble upon them by accident or luck, for example; objections are raised against the argument underlying the hypothesis of efficient outcomes. This argument is one often used in economics more generally, that behavior consistent with inefficient outcomes will not occur because it does not survive on markets. However, markets are not totally efficient in weeding out suboptimal behavior and in producing only optimal behavior. For optimal behavior to survive, it has to be present in the first place, or be introduced during the selection process, which may not hap-
pen because of barriers to entry. Even if the optimal behavior is present in the population, it has to be transferred from one agent to the next, which is not trivial and also not in the interest of the agent doing the transfer who may therefore try to sabotage this transfer.

Furthermore, the evolutionary natural selection argument is argued to be principally unsuited for described developments in economic systems. Drawing a parallel with an earlier critique (Klos 1999) of an application of a genetic algorithm, a computational model of an evolutionary processes, to the study of economic systems (Miller 1996), the appropriateness of the evolutionary metaphor is questioned. Agents typically only interact with other agents somehow close to them rather than with all other agents, and they are not given new behavior by an evolutionary process, but decide on changing their strategy themselves, based on a comparison with others close to them.

An Agent-based Approach

In order to cope with the two objections raised against (transaction cost) economics, an alternative, agent-based approach is proposed. This allows individual agents to trust and act upon their private knowledge and to make their own decisions about adapting their behavior in their search for better performance. The agents are allowed to adopt any possible form of behavior if they expect to benefit from it. They are also allowed to experiment and innovate and to make mistakes. In such a setting, it can be investigated whether—rather than assumed that—efficient outcomes arise. Because such systems of adaptive agents of any reasonable size are intractable analytically, we resort to computer simulations.

Chapter 3 describes the simulation model used. In each one of a sequence of timesteps, individual firms are confronted with the problem of organizing a transaction. On a final-goods market, they sell a product with a certain level of differentiation. They have to decide between making and buying a component required to produce their product. They do so in each of a number of timesteps, and base decisions in
certain timesteps on their experiences in previous timesteps, which are co-determined by the other agents' decisions.

Assets that a supplier invests in to produce the component for a buyer are specific to the transaction with the buyer to the extent that the buyer's product is differentiated. Suppliers may build up economies of scale in their accumulation of non-specific assets across the production for multiple buyers, and economies of learning in their continued, uninterrupted use of buyer-specific assets in their production for a particular buyer.

Buyers are assigned to a supplier (in which case they buy the component) or to themselves (in which case they make the component) on the basis of buyers' preferences for being matched to each one of a number of possible suppliers and to themselves and on the basis of suppliers' preferences for being matched to each one of the buyers. This is done by a so-called matching algorithm, i.e. Tesfatsion's (1997) Deferred Choice and Refusal (DCR) algorithm. Preferences are based on scores that agents assign to each other and on their loyalty for their current partner, if they have one. Loyalty means that the agents prefer their current partner over alternatives as long as the scores they assign to alternatives do not exceed the score they assign to their current partner by at least a certain threshold, $\tau$.

Scores are a function of profitability and trust: in essence, scores express expected profit—potential profit multiplied with the agent's trust in the other agent as an expression of the agent's subjective probability that the other agent will not behave opportunistically, but let him realize that potential profit. Because we want agents to be able to put differential weights on profitability versus trust, however, each agent raises other agents' profitability to the power of the value it uses for $\alpha$ and their trust to the power of $(1 - \alpha)$. Buyers contribute to profitability through the positive effect that the differentiation of their products has on the returns they generate, while suppliers contribute to profitability through the negative effect that their economies of scale and learning have on the costs of production. Buyers are not able to produce with efficiency higher than 0. Any profits made in a relation are shared among the two agents involved.

The agents' adaptation refers to the fact that they change their trust
in other agents on the basis of their experiences in mutual interactions as well as the values they use for \( \alpha \) and \( \tau \). There are different values possible for each and in each timestep, when they need them for establishing preferences, the agents choose one value for each.

Chapter 4 presents and discusses the results from experiments with the model. First of all, a parametersetting has been chosen that make the results sensitive, but not too sensitive to changes in experimental variables. Then, the plausibility of the model was tested. A result from TCE that is not disputed here is the relation between increasing transactionspecificity of assets and an increasing proportion of economic activity that is organized internally rather than on the market. This relation was found in the results of a series of experiments in which the differentiation of the buyers’ products on the final market was increased.

With some confidence in the model’s sensitivity and plausibility, the two points of criticism of transaction cost economics could be dealt with. Concerning the investigation rather than assumption of efficient outcomes, it was established that the optimum is often not reached in a complex system of boundedly rational, adaptive agents. Only rarely does the system, by coincidence, develop a situation that is optimal for all agents involved. As for the second point of criticism, a direct comparison between TCE and our model is much harder, because TCE does not mention trust. It appears from the results that the agents learn to put slightly stronger emphasis on profitability than on trust. A more general conclusion that can be drawn from the results is that individual agents need to be investigated in order to understand what happens in the system.